semester 4

Classroom Assessment

COURSE GUIDE

Associate Degree in Education/
B.Ed. (Hons) Elementary

2012

Higher Education Commission

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Technical Support: Education Development Center (EDC); Teachers College, Columbia University

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Foreword

Teacher education in Pakistan is leaping into the future. This updated Scheme of Studies is the latest milestone in a journey that began in earnest in 2006 with the development of a National Curriculum, which was later augmented by the 2008 National Professional Standards for Teachers in Pakistan and the 2010 Curriculum of Education Scheme of Studies. With these foundations in place, the Higher Education Commission (HEC) and the USAID Teacher Education Project engaged faculty across the nation to develop detailed syllabi and course guides for the four-year B.Ed. (Hons) Elementary and the two-year Associate Degree in Education (ADE).

The syllabi and course guides have been reviewed by the National Curriculum Review Committee (NCRC) and the syllabi are approved as the updated Scheme of Studies for the ADE and B.Ed. (Hons) Elementary programmes.

As an educator, I am especially inspired by the creativity and engagement of this updated Scheme of Studies. It offers the potential for a seismic change in how we educate our teachers and ultimately our country's youngsters. Colleges and universities that use programmes like these provide their students with the universally valuable tools of critical thinking, hands-on learning, and collaborative study.

I am grateful to all who have contributed to this exciting process; in particular the faculty and staff from universities, colleges, and provincial institutions who gave freely of their time and expertise for the purpose of preparing teachers with the knowledge, skills, and dispositions required for nurturing students in elementary grades. Their contributions to improving the quality of basic education in Pakistan are incalculable. I would also like to thank the distinguished NCRC members, who helped further enrich the curricula by their recommendations. The generous support received from the United States Agency for International Development (USAID) enabled HEC to draw on technical assistance and subject-matter expertise of the scholars at Education Development Center, Inc., and Teachers College, Columbia University. Together, this partnership has produced a vitally important resource for Pakistan.

PROF. DR SOHAIL NAQVI
Executive Director
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Islamabad

How this course guide was developed

As part of nationwide reforms to improve the quality of teacher education, the Higher Education Commission (HEC) with technical assistance from the USAID Teacher Education Project engaged faculty across the nation to develop detailed syllabi and course guides for the four-year B.Ed. (Hons) Elementary and two-year Associate Degree in Education (ADE).

The process of designing the syllabi and course guides began with a curriculum design workshop (one workshop for each subject) with faculty from universities and colleges and officials from provincial teacher education apex institutions. With guidance from national and international subject experts, they reviewed the HEC scheme of studies, organized course content across the semester, developed detailed unit descriptions and prepared the course syllabi. Although the course syllabi are designed primarily for Student Teachers, they are useful resource for teacher educators too.

In addition, participants in the workshops developed elements of a course guide. The course guide is designed for faculty teaching the B.Ed. (Hons) Elementary and the ADE. It provides suggestions for how to teach the content of each course and identifies potential resource materials. In designing both the syllabi and the course guides, faculty and subject experts were guided by the National Professional Standards for Teachers in Pakistan 2009 and the National Curriculum 2006. The subject experts for each course completed the initial drafts of syllabi and course guides. Faculty and Student Teachers started using drafts of syllabi and course guides and they provided their feedback and suggestions for improvement. Final drafts were reviewed and approved by the National Curriculum Review Committee (NCRC).

The following faculty were involved in designing this course guide: Syed Tariq Khurshid Gilani, GCET Muzaffarabad, AJK; Alia Ayub Siddiqui, Sardar Bahadur Khan Women University, Quetta; Muhammad Nawaz Khattak, GCE Gilgit; Muhammad Sharif, RITE (M) Kohat; Muahmmad Saeed Khan, University of Hazara, Mansehra; Muhammad Khalid Mahmood, University of Education, Lahore; Fizza Sabir, Fatima Jinnah Women University, Rawalpindi ; Nasir Mahmood, IER University of the Punjab University, Lahore; Ijaz Ahmad Shahid, GCET (M) Lalamusa; Muhammad Usman Ghani, GCET Faisalabad; Nida Mirza, University of Sindh, Hyderabad; Tanweer Ahmed Khan, BoC Sindh, Jamshoro; Muhammad Nawaz Shaikh, GECE (M) Larkana; Dr Javed Iqbal, Karakoram International University, Gilgit; Syed Abdul Majeed Shah, BoC Balochistan.

Subject expert guiding course design: Dr. Margaret Jo Shepherd, Teachers College, Columbia University

Date of NCRC review process: 3 March 2012

NCRC Reviewers: Dr Rehana Masroor, Dean Faculty of Education, Allama Iqbal Open University, Islamabad; Dr. Mussaret Sheikh, Chairperson Education Department , Fatima Jinnah Women University, Rawalpindi; Dr Rizwan Akram, Professor IER University of the Punjab, Lahore.

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Year/semester

Year 2, semester 4

Duration (hours)

48 hours (16 weeks)

Credit value

3 credits

Prerequisites

Successful completion of Semester 3 courses

Course description

It is natural for teachers to assume that students learn when the teacher teaches. It isn't sufficient, though, to assume that students are learning. Teachers need to *know* if students are learning. Yes, teachers give tests to find out if students are learning from the teacher's lessons. But often these tests occur at intervals of five or six weeks (or even longer periods). By the time the teacher learns that some students haven't been learning, those students are far behind others in the class. Without frequent assessment of their learning, it will be very hard for the students who have fallen behind to catch up with others in the class.

Classroom assessment, a set of educational practices taught in this course, enables a teacher to make instructional decisions with and for students based on information obtained from frequent evaluation of learning. There are many definitions of classroom assessment. Here is one:

> Classroom assessment is the process of collecting and interpreting information about learning and teaching as it occurs in a classroom for the purpose of making decisions that improve opportunities for learning.

Tests have a role in the evaluation of learning in school. However, there are notable differences between a test and an assessment. Any given test is a one-time event. Classroom assessment is a continuous process. Some tests, called *external tests*, are created by people who do not know the students who will take the test. In contrast, assessments are planned and conducted by teachers with their own students. Tests are part of the assessment process, but they are only one of many assessment tools. Assessment is a broad concept. A teacher conducting an assessment collects information about learning from several perspectives and uses more than one assessment tool.

This course is organized around two central classroom assessment activities. The first involves incorporating assessment activities into lessons. This means including assessment targets and criteria that represent success in achieving the targets—in addition to the lesson's learning objectives—in lesson plans. The second assessment activity is constructing an achievement test.

The goal of the first activity is to illustrate how assessment can improve learning and instruction. You have studied about learning goals, outcomes, and/or objectives in other courses, and you know how to use them in lesson plans. You'll use that knowledge now to distinguish between learning objectives and assessment targets. You will see how to write assessment targets and where they belong in a lesson plan. You will learn how to set the criteria that a student must meet in order to show that she or he has met the target and, therefore, achieved the lesson's learning objectives. You will see that you have to choose, from among several options, assessment tools that will give you the information you need to determine if students have achieved the lesson's objective.

The goal of the second activity is to show you that creating an appropriate achievement test for your students is more than just writing questions (though that is a central part of the process). You will see that good tests require a blueprint (usually called a Table of Specifications). The blueprint helps you decide the topics and learning objectives your test should include and how many questions you should write for each. You will learn what it means when a test is called *standardized* and also how to improve a test after you have given it once.

As you start this course, please understand that many teachers are already assessing student learning in their classrooms. They do it when they ask questions. They do it when they read and provide feedback on homework. They do it when they give a quiz or test. But most teachers aren't really aware of the importance of these assessment activities, and they don't assess student learning in a systematic way or with sufficient frequency.

Course outcomes

At the end of the course, you should be able to:

- write a lesson plan that includes assessment targets, criteria for demonstrating success achieving the targets, and appropriate assessment tools
- explain the purpose of a Table of Specifications for a test (test blueprint) to a colleague
- show a colleague how to construct a Table of Specifications for a test
- distinguish between good and weak short-answer, multiple-choice, true-false, and matching questions from an actual test and explain why each question is good or weak
- identify the characteristics of effective feedback and provide an example
- construct a rubric for a performance assessment task
- defend, with conviction, the claim that reliable information from assessments about students' learning status increases the effectiveness of instructional decisions

Teaching and learning framework

As the course description indicates, this course is organized around two complex assessment activities that teachers are expected to do in their classrooms: construct and use fair and reliable tests, and incorporate assessment into lessons. Student Teachers learn how to make a test by studying the steps in the process and then following them with the help of a coach or mentor and analysing the experience while it is under way.

One expects to improve with practice and good feedback from the coach or mentor. One also expects to learn from analysing students' performance on test questions and eliminating, adding, and/or rewriting questions based on that analysis.

After some experience planning and teaching lessons, Student Teachers learn to combine assessment and instruction by first acquiring some knowledge about assessment. They learn how to write assessment targets that match the lesson's learning objectives and figure out what constitutes credible evidence that the learning objectives have been achieved (success criteria). Then one must know the assessment tools that are available and choose tools that are valid measures of the assessment target and learning objective. When the necessary knowledge about assessment is at hand, teachers can study examples of lesson plans that include assessment and then write a plan and get feedback from a peer or a mentor. As with constructing an achievement test, one expects to improve with practice, good feedback from another interested person, and self-assessment of the experience.

This course teaches skills as well as knowledge and should include a practicum. Because it isn't certain that Student Teachers taking the course will have access to a practice site, it is unlikely that a test you construct or a lesson you plan can be tried with primary school students. As an alternative, practice materials have been created that can be used in college and university classrooms. The materials represent component parts of the larger tasks. The practice materials also serve as models for the tasks of constructing a test and writing assessment plans to use while teaching lessons.

The practice materials are intended for individual use (or work in pairs), after which Student Teachers form pairs (new pairs if the original work was in pairs) and exchange work for marking and feedback. When the pairs have shared their feedback with each other, the whole class can come together to discuss what they have learned from using a particular practice exercise. Two of these practice exercises may become assignments and graded. The rest should be marked but, in the spirit of formative assessment, should not be graded.

In sum, the dominant learning experience for this course involves practice exercises created from component parts of two complex assessment activities for which teachers are responsible. Individual (or pair) practice will be followed by interactions between peers working in pairs. They will mark each other's work and provide feed-back. Then the class can convene as a whole and, led by the faculty member, probe the experience they have just had to make generalizations about assessment that are worth recording in their notebooks.

Faculty may serve the role of coach throughout the course. They can guide and correct practice as represented in the skills exercises and then guide group reflection on that practice. This is essentially a skills-based course. Student Teachers need to acquire knowledge, too, but the knowledge serves learning a skill. For example, understanding a contemporary theory of motivation helps Student Teachers learn how to give feedback to students.

CONTENT OUTLINE

Unit 1: Classroom assessment—What are we talking about?

(3 weeks/9 hours)

For most of the recorded history of state-sponsored education, tests, in some form, have been the dominant means for determining what individual students learn from attending school. Tests are given to determine an individual's competence to participate in 'what comes next' in the educational trajectory from young child to adult: the next unit in the curriculum, the next class, secondary school, university, a job with specific credentials, etc. Over the course of the 20th century, tests became so important in school and in the world of work that it would be hard to find a literate person who hadn't taken several of them. The stakes in the score one receives on a test are often high: the score determines whether a person is accepted or rejected from a place in a university, for example.

As the 20th century became the 21st, methods for evaluating learning in school in addition to tests were introduced to teachers. (Teachers were already using some of the methods.) These ideas are described by the words *assess* and *assessment*. Attracted to a more comprehensive approach to evaluating learning in school, teachers in many parts of the world are in a slow transition from an entirely test-based culture for evaluating learning in school to an assessment-based culture. This unit is about that transition.

The unit begins with you. How was student learning measured when you were in school? Did the method or methods change as you progressed through school? Do you remember any time when a teacher gave you feedback about your score on a test that was intended to help you learn? What do you remember about the feedback from teachers that you received in primary and secondary school?

After probing your personal experience with others' judgments about an individual student's learning in school, you will study the meaning of the terms *evaluation*, *measurement*, *testing*, and *assessment* and study the difference between *summative* and *formative assessments*. Then you are introduced to the assessment standard (Standard 5) in the National Professional Standards for Teachers in Pakistan, Ministry of Education 2009. With your personal experience active in memory, some definitions in mind, and your country's assessment standard for teachers in view, you will study examples that illustrate assessment at home and in school. Then you will study the use of feedback to students, an essential component of assessment. As you can see, the use of effective feedback is one component of the assessment standard in Pakistan's National Professional Standards for Teachers.

Using your own experience in schools, the assessment examples, and concepts studied in this unit, the class will attempt to list characteristics of a test-based culture and an assessment-based culture for measuring learning in school. Finally, using this contrast chart and vocabulary chosen for the task, the class will write a definition for classroom assessment. The distinctions between evaluation cultures (test-based and assessment-based) and the definition of classroom assessment can be changed during the semester.

Unit outcomes

At the end of the unit, you should be able to:

- identify the features and provide an example of specific and constructive feedback
- explain the difference between measurement, evaluation, testing, and assessment
- explain the difference between summative and formative assessments
- contrast an assessment-based culture in schools with a test-based culture
- define *classroom assessment* and identify the most important words and ideas in your definition.

Week 1:	**Definitions, personal experience, professional standards, and examples**
Session #	Topics/themes
1	The purpose and content of the course Distinction between the meanings of *measurement*, *evaluation*, *testing*, and *assessment* Your experience of measurement, evaluation, testing and assessment The distinction between *summative* and *formative assessment*
2	The assessment standard in the National Professional Standards for Teachers in Pakistan
3	Examples of assessment • Asim, age 12, learns how to gain weight • The first lesson in a unit on the solar system • Ms Khan's grade 4 class

Week 2:	Feedback that moves learning forward
Session #	Topics/themes
1	The concept of feedback as it is used by biologists and engineers The concept of feedback as it is used by teachers Examples of conscious and unconscious feedback by teachers Summaries of research on teachers' feedback to students indicate that it has a powerful effect on learning The psychological effects for students of positive feedback and negative feedback
2	The theory of motivation that guides decisions about feedback: A growth mindset Types of feedback and their purposes Characteristics of effective feedback Feedback as encouragement versus feedback as praise Do oral and written feedback have identical effective features?
3	A practice exercise • Study and critique a teacher's first feedback to a student, age 11, on his answers to a test on the solar system • Study advice to that teacher about her feedback to the student • Study and critique the teacher's feedback to the same student on the same test in response to the advice she received • Reflection on what was learned about feedback

Week 3:	The context for classroom assessment in Pakistan
Session #	Topics/themes
1	Assessment policy and practice in government and private schools in Pakistan Presentation of information collected in interviews with teachers, peers, and parents about assessment
2	The concept of culture
3	Contrasting test-based culture in the classroom with an assessment-based culture Create a definition of classroom assessment that is appropriate to culture(s) in Pakistan

Unit 2: Assessment is a process that connects teaching and learning

(3 weeks/9 hours)

Classroom assessment is described as a process. English dictionaries contain more than one meaning for the word *process*. The distinguishing feature of all meanings is that more than one action is involved in an effort to achieve a specified result. These actions are continuous. Educators have chosen the term to describe actions undertaken to evaluate learning and improve achievement in school. Process is an important classroom assessment concept because it carries the message that evaluation of learning in school is not an event that occurs only at scheduled times during the school year. Assessment of learning is, or should be, a continuous practice throughout the school year.

The purpose of this unit is to present the decisions and actions that create the process of assessment in a classroom. You will have the opportunity to practice some of the actions. You will have the opportunity to study and discuss other decisions and actions that are inherent in the classroom assessment process. During the first week of the unit, you will learn the meaning of a *learning goal* as distinct from a *learning objective* and practice writing learning objectives. You will study the assessment components of a lesson plan: learning targets, success criteria, and appropriate assessment activities. You will practice writing these components into sample lesson plans.

In the second week of the unit, you will focus on procedures for recording data obtained from assessments. You will go back to the description of Ms Khan's classroom and discuss a teacher's monitoring notebook and students' subject matter journals as means for recording assessment data. You will examine a form created to record student participation in class discussions. You will see variations in the kinds of information a teacher might want to collect about students' participation in classroom discussions. You will talk about using information from the student participation records to make decisions about instruction. You will create a form for recording student's answers to a math quiz.

Assessment data have to be interpreted to be useful. Scores are guides to interpretation, but they don't tell how a student's performance compared with that of other students who took the test. Scores don't tell what a student knows and can do within the realm of knowledge covered by the test. Scores, alone, don't provide clues to important factors within the student or within the test that might have influenced a student's performance on the test. Before a test score can be interpreted, however, the teacher needs to have a sense that the interpretations she or he gives to the score are reliable and valid. Reliability and validity are logical concepts until they are measured for a particular test or assessment tool. Then they become psychometric (as well as logical) concepts. Interpretation of assessment data is the topic of the third week of the unit. You will learn the meaning of the word *psychometric*. Then you will learn that validity and reliability are not properties of tests. Validity and reliability have meaning when used to characterize the interpretations and conclusions that are made from test scores. You will learn that all assessments are subject to error. You will study three frames of reference for interpreting assessment data: a norm-referenced frame, a criterion-referenced frame, and a self-referenced frame.

Two 'big ideas' are the foundation for the unit. First, the title of the unit claims that assessment unites teaching and learning. Second, some people believe that assessment, particularly the use of a test, is an objective action. They mean that assessments used to evaluate human behaviour are less influenced by opinion and bias than teacher judgements alone. Yes, teachers use assessment data to make decisions about instruction and learning rather than relying on their opinions alone. But remember you, the teacher, make the decisions about what to assess and how to assess it. Assessments are designed to be fair and unbiased, but assessment is not a neutral enterprise. The same person who is going to use the assessment data to make decisions about teaching and learning made the decisions that created the assessment plan.

In the last session of the unit, you will have a chance to discuss these ideas. Where in the assessment process do you see direct connections with teaching? Do the connections extend directly to learning? Knowledgeable people claim that professional judgements is the most important element of assessment. What do these people mean? How does this relate to the point above that teachers make decisions about collecting data on students' learning that they then use to make decisions about teaching? You will share thoughts about objectivity in assessment and the role of professional judgements in assessment.

Unit outcomes

At the end of this unit, you should be able to:

- write a complete assessment plan into a lesson plan
- explain the necessity for recording assessment data and identify the challenges that necessity presents
- identify the places in the classroom assessment process where the teacher has to make a decision
- identify points in the classroom assessment process where assessment connects teaching and learning
- explain the concepts of *reliability*, *validity*, and *measurement error*.

Week 4:	**Learning objectives, learning targets, and success criteria**
Session #	Topics/themes
1	Definitions for *learning goals, learning objectives, learning targets, success criteria*, and *formative assessment* Difference between the terms *learning objectives*, *learning targets*, and *success criteria* Use of example lesson plans ('Sun, Earth, and the Moon') to discuss the process of creating assessment-embedded lesson plans
2	Using examples of assessment-embedded lesson plans to study the relationship between learning objectives, learning targets, success criteria, and formative assessment Working backward to write learning objectives, learning targets, success criteria, and formative assessments after studying the activities included in the lesson plans Practice providing peer feedback on language and clarity of learning objectives, learning targets, success criteria, and formative assessments
3	Working backward to write learning objectives, learning targets, success criteria, and formative assessments after studying the activities included in the lesson plans

Week 5:	**Recording assessment data**
Session #	Topics/themes
1	Recording assessment results Class discussions as opportunities to learn find out what students know and understand about a topic Recording student participation in discussion Drawing conclusions about student participation and student knowledge from records of participation in discussion
2	Student's participation in recording evidence of learning Methods for recording assessment data • Ms Khan's monitoring notebook • Students' science journals • Distinguishing between assessment procedures used by teachers and procedures used by students
3	Constructing a class record to document student achievement

Week 6:	Interpreting assessment data
Session #	Topics/themes
1	Test scores do not lead directly to educational decisions, though educational decisions are made and actions are taken on the basis of interpretations of test scores Interpretations and conclusions made from test scores should be valid and reliable Validity as a concept Validity as a psychometric construct Reliability as a concept Reliability as a psychometric construct Validity and reliability are not properties of the tests but of conclusions from test scores
2	Frames of reference for interpreting scores from assessment tasks • Norm-referenced frame of reference • Criterion-referenced frame of reference • Self-referenced frame of reference Other names for norm-referenced and criterion-referenced interpretations of students' scores on assessment tasks • Relative interpretations (comparable to norm-referenced interpretations) • Absolute interpretations (comparable to criterion-referenced interpretations) • Explanation for each of these interpretations of performance Illustrations of each of these interpretations of scores from assessment tasks
3	Create a diagram of the assessment process Identify places in the diagram where assessment connects learning with instruction Create one diagram, if possible, which everyone in the class can endorse

Unit 3: Assessment tools

(4 weeks/12 hours)

Assessment tools are activities and devices that elicit responses from students that are indicators of learning. Records are kept so the teacher has information to use when making decisions about what to teach to the class and to individual students.

Think for a few minutes about the assessment tools to which you have already been introduced in this course: a teacher's monitoring notebook, students' journals for specific school subjects, a teacher's questions designed to elicit the knowledge students already have about a new topic, and a monitoring record of students' participation in class discussions. These are called *informal* assessment tools. (You used some informal assessment tools in the student teaching practicum last semester, too.) The purpose of this unit is to increase your knowledge of the range, from simple to complex, of the tools you can create for assessing learning in your classroom.

The unit begins with the informal tools with which you are already familiar. You will also conduct an interview with a primary school teacher. The purpose is to learn which, if any, assessment practices she or he uses as well as their beliefs about and attitudes toward classroom assessment.

During the second week of the unit (week 8 of the course), you will learn about the use of essays as assessment tools. In week 3 (week 9 of the course), you will study performance-based assessments other than essays. You will construct a rubric with which to assess what students have learned through project work. In the final week of the unit, you will acquire some formal knowledge about portfolios intended to help you with the portfolio you will submit near the end of your next student teaching practicum.

Unit outcomes

At the end of this unit, you should be able to:

- construct, use, and analyze a simple interview tool
- know the forms and uses of essay questions
- construct short-answer essay questions that conform to guidelines recommended by assessment experts
- construct a rubric for a performance assessment task
- explain the different types of portfolio assessments
- describe the ways portfolio assessments are evaluated.

Week 7:	Interviewing teachers about assessment
Session #	Topics/themes
1	Interviews Constructing an interview tool to collect data about teacher practices, opinions, and beliefs about assessment
2	Conducting the interview
3	Discussion and analysis of data collected in the interview Critique of the interview tool

Week 8:	Essay questions: Measuring complex achievement
Session #	Topics/themes
1	Short-answer essays Longer-answer essays Learning goals that can be measured by short-answer essays Learning goals that can be measured by longer-answer essays Advantages and disadvantages of essay tests
2	Guidelines for writing essay questions Practice writing essay questions
3	Guidelines for scoring essay questions

Week 9:	Performance-based assessment (project-based assessment)
Session #	Topics/themes
1	Definition of *performance-based assessment* Use of an example of extended performance-based assessment (the green bean competition) to study different features of performance-based assessments Studying different features of a rubric and its relationship with the learning objectives and assessment tasks included in the performance-based assessment project
2	Understanding different characteristics of performance-based assessment tasks by conducting a short performance-based assessment task in class Using a rubric to grade a performance-based assessment task Understanding usefulness and challenges in using performance-based assessment tasks in class
3	Designing a performance-based assessment task

Week 10:	Portfolios: Summarizing student achievement
Session #	Topics/themes
1	What qualifies as a portfolio of student work? Types of portfolios • Project portfolios • Growth portfolios • Achievement portfolios • Competence portfolios • Celebration portfolios • Working folders Purposes of portfolios • Instruction • Assessment
2	Guidelines for portfolio entries Reflection and self-evaluation as part of the portfolio process Portfolio conferences
3	Assessing portfolios Advantages and disadvantages of portfolios

Unit 4: Teacher-made tests—How do teachers do it?

(4 weeks / 12 sessions)

This unit walks you through the process of test construction. Tests are one of the most commonly used assessment tools, so it is important to learn to write effective and fair tests. Effective and fair tests represent the instructional material (material the test is intended to cover) in its entirety and do not include anything that was not taught by the teacher. In order to achieve the goal of effectiveness and fairness, this unit familiarizes students with different features of standardized tests and the purpose of and difference between norm-referenced and criterion-referenced tests. You will also explore personal experiences and opinions about tests before delving into the steps for creating a test. You end this unit by creating a standardized mini (12-item) test and learning how to interpret test results.

Unit outcomes

At the end of this unit, you should be able to:

- come to personal conclusions about strengths and limitations of tests
- achieve a clear understanding of the features of a standardized test
- understand the difference between and purpose of norm-referenced and criterion-referenced tests
- understand the purpose of a Table of Specifications (test blueprint) and learn how to use it
- write effective test questions and put together a 12-item mini-test
- use an assessment tracker to judge the quality of a test and interpret test scores.

Week 11:	**Tests as assessment tools**
Session #	Topics/themes
1	Exploring personal experiences and feelings about tests Discussing the strengths and limitations of tests as assessment tools Understanding that tests are one of many assessment methods and like any other assessment tool have their own pros and cons
2	Exploring the definition of *achievement tests* and *standardized tests* Discussing different characteristics and examples of standardized tests
3	Studying two types of score interpretations for tests: Norm-referenced vs. criterion-referenced

Week 12:	**The test construction process**
Session #	Topics/themes
1	Start of the test construction process Learning to create a Table of Specifications -the first step in creating a test Drawing connections between learning objectives and a Table of Specifications
2	Creating a Table of Specifications to help write test questions Discussing the effectiveness of Table of Specifications in real-life classroom situations Connections between Bloom's Taxonomy and the Table of Specifications Classifying test questions according to Bloom's categories
3	Studying the differences between strong and weak test questions Exploring the characteristics of strong test questions Practicing writing short-answer, sentence completion, multiple-choice, and true-false questions

Week 13:	Writing test questions
Session #	Topics/themes
1	Continue to practice writing test questions
2	Putting the test together
3	Studying characteristics of clear test directions Practice writing test directions
Week 14:	**Practice interpreting test scores**
Session #	Topics/themes
1	Review of Student Teachers' current knowledge about the interpretation of test scores Introduction to assessment tracker (a tool for assessing the quality of the test and of student learning) Studying an example of an assessment tracker in detail to explore its main features
2	Learning to use an assessment tracker to interpret test scores
3	Using the assessment tracker to provide constructive feedback to students

Unit 5: Review through practice

(2 weeks/6 hours)

As mentioned, this course is organized around two assessment competencies that are central to effective teaching. The first of these is the teacher's motivation and know-how (meaning knowledge and skill) to include and use assessment plans in lessons. This enables continuous assessment that is corrective to the teacher regarding learning objectives and instruction and for the student regarding effort and learning strategies. The second competency is the motivation and know-how to write tests that produce valid, reliable, and fair evidence for interpretations about learning. This enables assessment that gives students and teachers summary statements about learning achieved over a particular period of time. Used together, these assessment competencies accomplish the reasons for evaluating learning in school: first, to facilitate learning, and then to measure it when the big decisions about 'what's next?' have to be made.

This unit provides the opportunity to practice each of these competencies with variations in the way you practiced the component skills during the course. During the course, you wrote learning objectives and assessment plans into sample lessons. During the first week of this unit, you will write a lesson/assessment plan on a topic and subject of your choice. During this course you constructed a test based on multiple-choice, true-false, matching, and short-answer questions. In the second week of the unit, you will write a final examination for this course based on essay questions. While the point hasn't been made yet in the course, there is evidence from research that writing a test is a particularly good way to study for taking a test.

NOTE: If your college or university gives final examinations composed of objective questions, it may be to your advantage when studying for the final exam to prepare a test based on essay questions.

To date, you have practiced component assessment skills in pairs. In this unit, you will work independently and then form a pair for feedback.

Unit outcomes

By the end of the unit, you should be able to:

- write a lesson plan that includes an assessment plan
- write a test based on essay questions that meet guidelines for questions that require reasoning
- determine when essay questions are more appropriate than objective test questions.

Week 15:	Writing an assessment-embedded lesson plan
Session #	Topics/themes
1	Review at least two of the sample science lessons into which you wrote learning objectives, learning targets, success criteria, and assessment tools Review definitions and differences between a learning objective and a learning target Selecting success criteria Listing assessment tools/methods used or studied in the course Designing a template for a lesson plans Choose a topic for your lesson/assessment plan
2	Write your lesson/assessment plan Select a partner with whom you will exchange feedback
3	Exchange feedback on the lesson plans Share feedback with the class Identify the main points about the assessment in lessons that were taught in this course

Week 16:	**Writing a test based on essay questions that could be used as a final examination for this course**
Session #	Topics/themes
1	Review the reason(s) for essay questions Review the two types of essay questions Review guidelines for writing essay questions Review the disadvantages of essay questions Identify course topics for essay questions
2	Identify the conditions under which final examinations are given in your college or university (for example, the length of the examination period) Identify the course topics you plan to include in your test Writing essay questions based on topics in this course Developing grading criteria for selected questions in the essay test
3	Exchange feedback on essay tests Answer a partner's question and return it to them for marking Marking essays based on grading criteria

Textbooks and resources

P. Black, C. Harrison, B. Marshall, and D. Wiliam, *Assessment for Learning: Putting It into Practice* (Berkshire, UK: Open University Press, 2010).

S. Clarke, *Active Learning through Formative Assessment* (London: Hodder Education, 2008).

J. H. MacMillan, *Classroom Assessment: Principles and Practices for Effective Standards-Based Instruction,* 5th ed. (Boston: Pearson, 2011).

M. D. Miller, R. L. Linn, and N. E. Gronlund, *Measurement and Assessment in Teaching*, 11th ed. (Upper Saddle River, NJ: Pearson, 2013).

R. Stiggins, J. Arter, J. Chappius, and S. Chappius, *Classroom Assessment for Student Learning: Doing It Right–Using It Well* (Boston: Pearson, 2006). This text has a DVD and a CD.

D. Wiliam, *Embedded Formative Assessment*. (Bloomington, IN: Solution Tree Press, 2011).

There are several website addresses to use for the course. These websites are listed on the handouts where they will be used.

Course assignments

Assignments are listed on a separate handout. The assignments will contribute to your grade.

Suggested assignments:

- A lesson plan with an embedded assessment plan
- A short test with the Table of Specifications and an answer key
- A performance-assessment project and its scoring rubric

Grading policy

The university and its affiliated colleges will determine the course grading policy. This should be shared with you (Student Teachers) at the beginning of the course. It is recommended that at least 50 per cent of the final grade be determined by course work undertaken during the semester. Course work may include assignments completed in schools.

Planning guide

Planning guide

In this planning guide, you will find ideas for teaching and learning this course.

For some sessions, detailed plans are provided. These session plans are examples, not prescriptions. The sessions were created in the belief that examples are helpful platforms for creative work and that faculty will adapt them to their local context.

The writers of the course aimed to respect copyright and have sought permission to use copyright material where necessary. Please contact EDC in case of questions or concerns about any of the materials used at www.edc.org.

UNIT 1

CLASSROOM ASSESSMENT—WHAT ARE WE TALKING ABOUT?

UNIT 1: CLASSROOM ASSESSMENT—WHAT ARE WE TALKING ABOUT?

(3 weeks/9 hours)

Teaching and learning resources for Unit 1

Handouts for Student Teachers

Week 1

'Unit 1, Week 1, Session 2: National Professional Standards for Teachers in Pakistan (NPSTP) Standard 5 Assessment'

'Unit 1, Week 1, Session 2: Assessment Helps Asim Gain Weight'

'Unit 1, Week 1, Session 2: Assessment in a Lesson about the Solar System'

'Unit 1, Week 1, Session 2: Assessment in Ms Khan's Grade 4 Class'

Week 2

'Unit 1, Week 2, Session 3: Teacher Feedback on the Solar System Unit Test: Before Receiving Advice'

'Unit 1, Week 2, Session 3: Teacher Feedback on the Solar System Unit Test: After Receiving Advice'

'Unit 1, Week 2, Session 3: Memo to Teacher about Feedback on the Solar System Unit Test'

Week 3

'Unit 1, Week 3, Session 2: List of Contrasts between a Test-based and an Assessment-based Culture in Schools'

Resources for faculty

From Week 1 throughout the course

➢ http://peoplelearn.homestead.com/BEduc/Chapter_10.pdf

This is a chapter on assessment from a book posted on Asia e University. Relevant definitions are presented on pages 255–257, and distinctions between summative and formative assessment are presented on pages 265–266.

Week 2

Grant Wiggins, 'Seven Keys to Effective Feedback', *Educational Leadership* (September 2012): Available at:

➢ http://www.ascd.org/publications/educational-leadership/sept12/vol70/num01/Seven-Keys-to-Effective-Feedback.aspx

Readings

Week 1

- Clarke, pp. 7–17 (history of formative assessment as well as distinctions between formative and summative assessment)
- McMillan, pp. 9–11
- Miller, Linn, and Gronlund, pp. 27–34 (definitions of assessment, evaluation, and measurement)
- Stiggins, Arter, Chappius, and Chappius, pp. 29–46 (especially pp. 42–47)

McMillan has a very informative table on page 63 that shows the range of assessment methods (in this course called tools). A transparency of this table will help make the point that assessment is a much broader practice than testing.

Week 2

- Black, Harrison, Lee, Marshall, and Wiliam, pp. 30–57
- Clarke, pp. 18–34 and 139–141
- McMillan, pp. 134–147
- Wiliam, pp. 107–131

Week 1: Definitions, personal experience, professional standards, and examples

This course is designed to persuade Student Teachers that evidence about learning collected in the classroom can be used to improve, as well as judge, student achievement. The course is also designed to teach Student Teachers that there are tools in addition to tests that, when used together, give detailed information to the teacher about adaptations to instruction that improve student achievement. Given these goals for the course and the influence of experience as a student on behaviour as a teacher, it is very important for Student Teachers to examine carefully their own ideas and feelings about assessment in the classroom. Student Teachers need to be aware of the beliefs and assumptions they bring to the study of assessment so that they are free to look carefully and critically at ideas and practices introduced in this course that may differ from those they experienced in school.

Session 1: Classroom assessment: Definitions and personal experience

Review the course syllabus (10 minutes)

Distribute the course syllabus. Rather than going through the entire syllabus in detail, provide a brief overview and ask Student Teachers to read it thoroughly for homework.

Presentation and discussion (20 minutes)

Provide definitions of *testing, measurement, evaluation,* and *assessment*. Give them a definition of *classroom assessment*. Finally, present the distinction between summative and formative assessment. Definitions that you provide can be created from those in the references listed above.

Student Teachers should take away the following from the presentation:

- Definitions of *measurement* and *testing* are standard, but definitions of *evaluation* and *assessment* vary from one assessment expert to another.
- Assessment is a process that is more comprehensive than testing.
- The concepts of *evaluation* and *interpretation* are often interchanged. Though not synonyms, each term refers to an analysis of students' performance that results in inferences about factors influencing academic achievement.
- Although assessment experts elaborate on the difference between formative and summative assessment, there is only one significant difference. That difference is the purpose for which the assessment is undertaken and the way the assessment data are used. Summative assessment scores are used to certify competence; formative assessment scores are used to improve instruction and learning. As Student Teachers will see during Week 2 of this unit, a summative test after the original purpose of the test has been satisfied can be turned into a formative assessment. The reverse is not true. A formative assessment in the original form cannot be turned into a summative test.

Small group leading to whole-class discussion (30 minutes)

Using small group discussions leading to full class discussions, give Student Teachers the opportunity to discuss their experiences with tests and other assessment tools in school. You could guide the discussion with questions in the unit outline.

Homework

In addition to reading the course syllabus, ask Student Teachers to interview a primary school teacher and principal about testing and assessment in school. They should also interview a parent and another college or university student about their experience with testing and/or assessment in school. Tell Student Teachers that they should be prepared to share the results from their interviews in class during Session 1 of Week 3.

Session 2: The assessment standard in the National Professional Standards for Teachers in Pakistan

This session is designed to: 1) help Student Teachers understand what the assessment standard in the NPSTP specifies they should know and be able to do in the domain of classroom assessment (Standard 5) and 2) identify the knowledge and skills they will learn in this course that are relevant to the standard.

Check what Student Teachers' know about the NPSTP (15 minutes)

First, ask them to define *standard* as educators use the word. Then ask them to explain why the Ministry of Education in Pakistan wanted professional standards for teachers.

Ask if they assessed themselves against the NPSTP during the practicum in Semester 3. If the answer is yes, ask for a few volunteers to share their self-assessment of the assessment standard with the class. If the answer is no, ask Student Teachers to look at the rubric for Standard 3 with a partner and then assess themselves. Invite a few to share their self-assessment.

Presentation on standards in education (20 minutes)

Prepare a presentation on standards, focusing on the National Professional Standards for Teachers in Pakistan. The content of this presentation obviously depends on the knowledge Student Teachers bring to the topic. Prior to your presentation, distribute the handout for this session ('National Professional Standards for Teachers in Pakistan Standard 5 Assessment'). Refer to this document during your presentation and allow time for Student Teachers to review relevant text and ask questions.

You may wish to include the following content in your presentation.

The English word *standard* can be used as a noun ('The department is creating standards for public transport providers') or as an adjective ('This book is the standard reference for Mughal history'). Among teachers and other educators, *standard* is used as a noun.

Teaching standards are created by achieving consensus among a group of people who know about and understand teaching. The group may include practicing teachers and academics. The standards they develop describe the characteristics of effective teaching. When the Policy and Planning Wing of the Ministry of Education in Islamabad endorsed the NPSTP, the standards became the model of effective teaching in Pakistan.

The NPSTP are general teaching standards for all teachers in all grades. It is also possible to develop teaching standards for specific subjects, such as standards for teaching science or Urdu. The standards in the NPSTP describe a teacher's work in three domains: knowledge and understanding, performance and skills, and dispositions.

The rubrics for the NPSTP provide a description of the standard at one of four levels. Level 1 describes the standard performed by an inexperienced teacher. Level 4 describes the standard performed by an experienced and very proficient teacher.

In the rubrics for the NPSTP, standards are further broken down into strands. The assessment standard is broken into four strands: assessment linked to learning objectives, formative assessment, summative assessment, and providing feedback.

A standard is a composite of knowledge, skill, and dispositions. Standards vary greatly; they may be general and inclusive descriptions, or they may be very specific. The NPSTP are general standards. They describe the work of an effective teacher, but they are not a description of what an observer would see a teacher do or hear a teacher say, and they do not describe the actual knowledge a teacher needs. Like most standards, the NPSTP have to be deconstructed, or broken down, to understand them better.

Deconstructing the assessment standard in the NPSTP (30 minutes)

Direct Student Teachers' attention to the rubric for Standard 5 about assessment. If needed, provide more time for them to read the descriptions at each level.

Explain that the rubric begins to break down the standard and to describe a teacher's work in more detail. However, it doesn't describe what an observer would see a teacher do or hear them say in a classroom or in a meeting with parents, for example.

Divide Student Teachers into small groups (three or four members). Direct all of the groups to the Level 4 description and ask them to list specific things they might see a teacher do or hear a teacher say that would provide evidence that they are at that level.

Share an example: the rubric says that a teacher at Level 4 'coaches children to engage in objective self-assessment'. So, an observer might see a teacher sitting with a child listening to the child explain how she solved a math problem and then asking if she thinks that solving such problems is easier now compared with the previous lesson.

Invite groups to share their evidence with each other. Invite volunteers to compile the evidence before the next session and display it in the classroom. Remind Student Teachers that this is not a complete list (it would never be complete). Consider returning to it later in the course.

Homework (5 minutes)

This homework assignment is intended to prepare Student Teachers for the next class session. Tell them to review their class notes from the first session this week to refresh them of the difference between formative and summative assessment and the particular characteristics of formative assessment. If sufficient copies of the book *Embedded Formative Assessment* by Dylan Wiliam are available, tell Student Teachers to read pages 27–50 before the next class. Distribute handouts for the next class ('Assessment Helps Asim Gain Weight', 'Assessment in a Lesson about the Solar System', and 'Assessment in Ms Khan's Grade 4 Class'). Tell Student Teachers to read these examples of assessment before the next class.

Session 3: Examples of assessment

The purpose of this session is to help Student Teachers make a clear distinction between the purpose of summative assessment and the purpose of formative assessment.

Presentation and class discussion (10 minutes)

This is a review session prior to discussing the three examples of assessment in the handouts Student Teachers received at the end of the last class session. The content should come from Student Teachers' class notes, the previously assigned readings, and the chapter by Wiliam assigned at the end of the last class session.

Case study and discussion (15 minutes)

Check that Student Teachers have the handout 'Assessment Helps Asim Gain Weight'. Allow the class 10 minutes to work in small groups and then bring them together to report to each other. There are questions to stimulate discussion on the handout. Remind Student Teachers that this assessment did not take place in a classroom, and the assessment target is a physical process rather than a mental process.

Discuss the following questions:

- What opportunities for learning does this assessment situation provide?
- Who is doing the assessment?

Class discussion: Assessment in a lesson on the solar system (15 minutes)

Follow the pattern established with the weight gain example. Check that Student Teachers have the handout 'Assessment in a Lesson about the Solar System'. This handout does not have questions attached, however. There are two important points to make with this example.

First, Student Teachers should see the relationship between the assessment target and the lesson's learning objectives. The second important point centres on the Student Teacher's ability to identify all the assessment activities in the lesson, including the guiding questions. Again, ask for reports of the small group discussion from two groups.

Class discussion: Assessment in Ms Khan's grade 4 class (15 minutes)

Check that Student Teachers have the handout 'Assessment in Ms Khan's Grade 4 Class'. There are questions attached to this handout that can guide the small group discussion. Ms Khan's monitoring log is an important feature of this example. Ask Student Teachers to discuss the practice of keeping such as log from the standpoint of utility and feasibility. Do they believe that they could keep a similar log? How would they use it? Would they organize it by date or create a separate page for each student? Again, ask two groups to summarize their discussion for the class.

Closing (5 minutes)

Tell class members that the following week is devoted to a study of feedback; they will begin to provide constructive written feedback to each other in the third class session. Remind them that the following week is devoted to a study of the cultural context, both in and out of school, in which assessment occurs. Remind them, also, that they are expected to come to the first class session in Week 3 prepared to report on interviews they have conducted with a teacher and principal currently working in a primary school. They should also interview a parent of a student currently enrolled in a primary school and another person (not preparing to teach), who is approximately their age. The purpose of these interviews is to find out these people's memories and opinions about the ways learning is evaluated in primary schools in Pakistan. The interviews can be built around the questions that the Student Teachers discussed during the first class session this week. Those questions are in the description of Unit 1 in the Course Syllabus.

Week 2: Feedback that moves learning forward

Session 1: Adding to Student Teachers' prior knowledge about feedback in school

In class today (5 minutes)

Feedback is an essential component of classroom assessment. Most advocates for a culture of assessment in schools believe that assessment is only complete when feedback that produces positive change in instruction and learning is an outcome of the assessment process. This week is devoted to the study of effective feedback to students. As discussed earlier, Student Teachers will practice written feedback with each other for the duration of the course.

Give Student Teachers an advance organizer (outline) for today's class:

- Presentation and discussion of their experience with and definition of feedback in school
- Oral presentation by you of definitions of feedback used by biologists, engineers, and teachers
- Class discussion of differences, if any, in these definitions
- Oral presentation by you about research on feedback on learning in school, highlighting studies by British educational psychologist Ruth Butler
- Volunteer 'significant point statements' about Butler's research
- Homework assignments

Invite a Student Teacher to repeat the outline for today's class.

Class discussion: Prior knowledge and experience with feedback in school (15 minutes)

Tell Student Teachers to choose a partner for a dialogue about experience with feedback from their teachers on tests, papers, homework, and class discussions. Ask them to spend 5 minutes thinking together about a definition of feedback as it is used in school. Reconvene the class to discuss their recollections and elicit some definitions. Ask a class volunteer to write two or three definitions on the board (or chart paper), assuming there are two or three different definitions.

Presentation: Conceptions of feedback from biology, engineering, and education (10 minutes)

Prepare your presentation to cover the following information.

Biology. The process by which a system (molecule, cell, or organism) is controlled or changed by the response it produces. The intent is to maintain balance within the system so it survives. Negative feedback is a signal sent back when a system needs to slow down or stop completely. Your stomach doesn't need to work when you aren't eating, for example. Positive feedback is the opposite. Rather than slowing or stopping a biological system, positive feedback is a signal that increases the action of the system.

Engineering. The process whereby some portion of the output signal of a system is fed back as input. The flush mechanism on a toilet is a good example of a mechanical feedback system. Inside the cistern (the part of the system that holds the water), there is a ball that floats on the water. The ball is connected by lever to a valve that can open and let in water. This float valve is often used to regulate the filling of a toilet cistern. When the toilet is flushed, the water level drops, and the float descends, levering the valve opening and allowing more water to enter. Once the float reaches the full position, the arm presses the valve shut again.

Education. Feedback is information about a student's progress toward reaching a goal or goals (Wiggins, 2012, p. 10). Feedback is information provided by an agent (teacher, parent, peer, book, self, experience) regarding aspects of one's performance or understanding (Hattie and Temperley, 2007, p. 81).

J. Hattie, and H. Temperley, 'The Power of Feedback', *Review of Educational Research* 77 (2007), 81–112. The article was retrieved from the Internet on 18 March, 2013.

G. Wiggins, 'Feedback for Learning', *Educational Leadership* 70 (2012), 10–16. The article was retrieved from the Internet on 21 February, 2013.

Class discussion: Differences in the meaning of feedback in biology, engineering, and education (10 minutes)

Explain that feedback seeks to maintain stability in biology and engineering; feedback seeks to promote change in education.

Feedback loops are internally controlled in biology and engineering; teachers are interested in promoting self-assessment and self-regulation of learning as students grow older, but the agents of feedback to students are more often external than internal.

Negative feedback is evaluative and maladaptive (not helpful) for learning; negative feedback is non-evaluative and adaptive in biology and engineering.

Note and discuss differences and similarities in Student Teachers' definitions of *feedback* and the definitions from Wiggins and Hattie and Temperley.

Presentation: Ruth Butler's research on feedback to school students (15 minutes)

The effects of feedback on student achievement is a thoroughly researched topic in the study of learning in school.

The research findings are strong: feedback has a powerful effect on achievement, but that effect can be negative (lowering achievement) as well as positive (increasing achievement).

Ruth Butler's research is the focus of this presentation because her findings are important and consistent.

NOTE: The content for this presentation is in one of the course textbooks, *Embedded Formative Assessment* (pages 108 through the first four lines of 111). This is a clear summary of Butler's research and identifies the primary references. Your presentation to the class can be created from this text.

There is a hypothesis about motivation in the Butler research that needs to be explained to the Student Teachers during your presentation. They should understand the distinction between intrinsic and extrinsic motivation as they have encountered those concepts in other courses. A more recent theory suggests that intrinsic motivation (internal to the person) may be expressed in two ways. Some students are motivated to learn because they want to become competent. They thrive on acquiring knowledge and new skills. These students are said to have *task-involved motivation*. Other students are motivated to work in school because they want to please and impress other people. They are less interested in the tasks and more interested in the impressions they make on other people. These students are said to have *ego-involved motivation*. This hypothesis about motivation is secondary to the reason for studying Dr Butler's research. The important information in her work is that written comments by the teacher on student's work had a greater influence on learning than grades alone or grades and comments. The purpose of this presentation is to understand what those findings say about feedback to students that moves learning forward.

Volunteers from the class make 'significant point' presentations about the Butler research (2 minutes)

Ask four Student Teachers to state a significant point about the Butler research. Tell them to give an original point (no repetition) and keep the pace fast.

Homework

Have Student Teachers write a one-page, single-spaced paper on the implications of the Butler research for written feedback to students. Ask them to bring their papers to the next class. The papers will be used in class before submitting them for your review.

Session 2: Interactions between students' beliefs about learning ability, motivation, and feedback

In the previous session, Student Teachers had the opportunity to see that the meaning of *feedback* as teachers use the term is not quite true to the meaning of feedback in biology and engineering, where the concept originated. Student Teachers also had the opportunity to learn that in carefully designed experiments that compared the effects of comments on elementary school students' work versus grades for their work versus comments and grades, the students learned more over a short period of time when they received comments only than they when they received grades or comments and grades. Student Teachers also heard you say that research on the effects of feedback to students is abundant but those effects are not consistently positive. The core description of feedback in biology and engineering is that the result of an action returns to the source of that action and influences that action in a constructive way. That core concept seems relevant to education.

Today in class (5 minutes)

Review the following: feedback to students is powerful, but the effect is not always positive; studies show that learning is more likely to occur from teachers' written feedback comments alone than from grades or grades and comments; the use of feedback in biology and engineering are not exact examples of the way feedback is used in the classroom; teachers need to go beyond the common core idea about feedback and develop guidelines for the use of feedback that are specific to learning in school.

Describe today's session. First, there will be a class discussion to elicit some general features of feedback. Then, Student Teachers will give each other written feedback practice with papers assigned for homework. There will be a second class discussion after practice to elicit specific features of feedback and then homework will be assigned.

Class discussion: General features of feedback (10 minutes)

Begin with a definition of feedback used in teaching and learning, preferably written on the board or chart paper. (If the class produced a definition in the last class session, use that. If not, use either the Wiggins or Hattie and Temperley definition presented in the last class.) The word *general* in the title for this discussion means features of feedback that people know from experience rather than studying. The features you are looking for are these: feedback can be written, spoken, or nonverbal; feedback can be given to an individual or a group; feedback can be encouraging or critical; feedback can be immediate or delayed; and feedback can elicit negative or positive feelings for the person who receives it. This short exercise is designed to prompt Student Teachers to think about feedback before they practice giving it. The exercise is predicated, in part, on the assumption that Student Teachers won't identify content features of feedback. If someone gives a content response (for example, provides correct responses to incorrect answers), tell the Student Teacher you recruited to write those responses on board/paper in a separate place, if there is room.

Feedback practice with homework papers (15 minutes)

Student Teachers form pairs to read and give written feedback to each other on the homework assignment. (Write about the implications of Ruth Butler's research for classroom practice.)

Approximately 10 minutes should be allocated for reading and writing feedback. Five minutes should be devoted to a discussion between the pairs about feedback given and received.

Class discussion of the feedback exercise (15 minutes)

Open the discussion by reminding students that in the first Butler study, learning was measured for three comparison groups: one that received feedback comments on their work; one that received grades; and one that received grades and feedback comments. In the second study, praise was an additional variable. In both studies, feedback comments on the first lesson was the only variable that produced evidence of learning on the second lesson. A grade alone, praise alone, and feedback comments plus a grade on the first lesson did not raise students' scores on the second lesson. These findings from research raise the question: What power to influence learning do teachers' feedback comments have that isn't shared by a grade or praise? (If Student Teachers raise their hands, get a few responses but don't expect to answer this question now.)

Turn to the Student Teachers' immediate experience with feedback. Ask: 'Did any of you receive praise on your paper?' (Record three or four responses on the board.) 'Did any of you receive direct criticism?' (Probably not, as they may not feel safe enough in a classroom to criticize each other.) Open the question-response interaction to any type of statement and take and record four or five responses. If you haven't received this kind of response, ask, 'Did any of you get a correction?' (Record responses, if so.) 'Were any of you asked a question on your homework papers that caused you to think about what you had written?'

If you didn't receive critical responses when you asked, write a few on the board (for example, 'this is wrong', 'this is a poor sentence', or 'I don't know what you mean').

Your next step is to help Student Teachers see that neither praise nor criticism gives information about why they were right or wrong. Neither type of feedback carries information that will be helpful at another time in a similar situation. Return to the big question: 'In these two studies, why did comments facilitate learning when grades and praise did not?' It is because comments–when they are directed to the content of the lesson and/or the strategies used to solve a problem–stimulate thinking and action. Comments can carry cues and probes that help students understand and correct their own mistakes. Praise alone doesn't tell you why your work was good, nor does criticism alone tell you why it was bad.

If you haven't received an explanation for the weak showing of comments and grades, probe a little more before explaining (students with high grades don't need to read comments and students with low grades don't want to read comments). Also probe to find out if any Student Teachers got the message from this research and discussion that grading every piece of work might not be a good idea. Students might benefit more from comments on some work and grades on other work.

Presentation on effective comments (10 minutes)

Give Student Teachers guidelines for feedback comments that facilitate learning. (Use the complete chapter on feedback in the Wiliam book [2011] as the content for this presentation.)

Guidelines for feedback comments that facilitate learning:

- Comments are related to the learning objectives of the lesson
- Comments that stimulate the student to think
- Comments that enable the student to take a constructive action
- Comments are focused on the main points of the lesson
- Comments are restricted in number so the student is not overwhelmed
- Students take time in class to respond to the feedback comments
- Comments are timely

Closing (5 minutes)

Call on four students to identify one main point from today's class (no repetition). Collect the homework papers and add your feedback to the Student Teachers' feedback before returning them. Tell them to read pages 138–141 in the Clarke book. These pages show feedback integrated into a writing lesson.

Session 3: Feedback that is consistently about the task rather than the person may increase motivation

As you think about and conduct this session, please remember that there are several practice exercises in the course, especially in Unit 4. If it fits your views about the purpose of the course, most of these practice exercises can go ungraded and be exchanged between pairs of Student Teachers for practice giving feedback in the form of task-oriented comments. Butler's research is important here. (If her findings can be generalized to students in Pakistan, when a grade is on the work, students are not inclined to read teachers' comments on the work). If you choose to have Student Teachers give each other task-oriented feedback throughout the course, you will have many opportunities after today to discuss feedback with them.

Today in class (5 minutes)

Explain what will happen in the session today:

- Review guidelines for feedback that facilitates learning
- Using the guidelines, critique feedback on a test about the solar system
- Role-play a belief about fixed learning ability versus a belief that learning ability can increase
- Discussion of interactions between feedback and beliefs about learning ability
- Summary of the week's lessons about feedback

Guidelines for feedback that facilitates learning (15 minutes)

- Feedback should be focused on the work the student did. If feedback is being given on work that was done during or after a lesson, the feedback should be related to the lesson's learning objective.
- Feedback isn't feedback unless it leads to thinking and action by the student.

Here is an example from a grade 6 class:

Learning objective: To learn how to create feelings of suspense in a story

Teacher's feedback to a student who has written about a mountain climbing expedition: 'Mountain climbing is a very exciting and often dangerous activity, but I don't feel that in your story. Choose one sentence from the story and create suspense with it'.

The student chose this sentence: 'Stuart and his climbing companions stopped on a ledge so their sherpas could catch up'.

The student wrote: 'Suddenly they heard cries from below but they couldn't see the sherpas. He sensed danger and struggled to control fear. After what seemed like hours, one of the sherpas came in view. He signaled that a sherpa had fallen but he wasn't seriously hurt'. (This is adapted from an example in *Enriching Feedback in the Primary Classroom*, p. 97.)

- Feedback should be focused on two or three of the most important ideas/concepts/knowledge/skills in the student's work.
- Feedback should be immediate (for verbal feedback) and within two days (for written feedback).
- Students should be given time in class to act upon the teacher's feedback.

NOTE: The five guidelines (but not necessarily the example) should be written on the board or chart paper.

Critique of feedback given to Fauzia's answers on a solar system unit test (40 minutes)

There are three documents for this exercise: a girl's answers to a solar system unit test with teacher's written feedback, a memo to the teacher from a member of the professional development staff in the school giving the teacher some advice about feedback, and the same test with the teacher's feedback after receiving the advice. (This handout is 'Teacher Feedback on the Solar System Unit Test: After Receiving Advice'. It has three parts that are to be given to Student Teachers sequentially. The directions for distributing each part are explained below.)

There is a striking difference between the two feedback examples. In the first one, the teacher gives the student all the correct answers. In the second one, the teacher leads the student to search for correct answers for herself. This very important concept is the second guideline (feedback isn't feedback unless it leads the student to think and act in ways that improve her or his performance). The teacher provides guidance but the student does the work.

The exercise was constructed with the following procedure in mind. Student Teachers will work in groups of four. If possible, each Student Teacher will receive a copy of the first feedback the teacher gave on the test.

Give the Student Teachers these questions:

- Does this feedback follow any of the guidelines you were given today?
- If so, which?
- If not, is there anything in common about the feedback comments?
- Who is doing the work to correct errors in this example, the student or the teacher?

Distribute the second set of feedback comments. After the Student Teachers have had a chance to read them, ask:

- Are these comments different from the first set of comments you read?
- If so, how?
- If not, is there anything in common about these feedback comments?
- Who is doing the work with these comments, the student or the teacher?
- Would you change these comments in any way?
- If so, how?

If the Student Teachers don't understand the main point (that is, in the first example the student isn't doing anything; by giving her the answers, the teacher is doing all of the work, and the chance is small that that the student is learning anything), give them the memo from the professional development specialist to read and ask the first two questions in the second set of questions again. If the Student Teachers understand the difference on their own, you can give them the professional development specialist's memo so they can see the secondary points in the memo (for example, grouping all questions with a similar error together).

Week 3: The context for classroom assessment in Pakistan

Thus far in this unit, Student Teachers have been introduced to the practice of classroom assessment by studying definitions, standards for practice, and examples. They have also been introduced to an idea that grades and praise alone may not be the best way to provide feedback to students about the work they do in school. Class sessions this week should give Student Teachers the opportunity to think beyond the technical aspects of classroom assessment.

Session 1: Existing practices for assessing learning in schools in Pakistan

The purpose of this session is to develop a sketch, at least, of the practice of assessing student learning in primary and secondary schools in Pakistan. If a person from an appropriate district or provincial office is available, this session can be planned around that person's presentation to the class. If a speaker is not available, the session can be built around a faculty presentation to the class.

Presentation: Overview of assessment in Pakistan (15 minutes)

Try to use information from a variety of sources for your presentation. There is a recent article about assessment in schools in Pakistan available on the Internet: S. Khattak, 'Assessment in Schools in Pakistan', *SA-eDUC JOURNAL,* at:

- http://www.nwu.ac.za/webfm_send/58399

The tone is negative, but it contains some useful information. You could also refer to reports by the National Education Assessment System (NAES) in Pakistan.

Discussion (30 minutes)

Provide approximately 15 minutes for Student Teachers to discuss the presentation in small groups. Ask them to summarize what they heard *and* the findings from their interviews (assigned in week 1). Then select a few groups to report to the rest of the class on the essential features of assessment policy and practice in schools.

Individual work (15 minutes)

Ask Student Teachers to create an outline for a 3- to 4-page paper about assessment policy and practice in schools in Pakistan. The paper should be a description of policy and practices in schools (it is not an opinion paper). The paper should address the broad question regarding assessment policy and practice: 'Who is responsible for what?'

Homework (5 minutes)

Ask Student Teachers to write a paper based on their outlines. The paper and the outline are due at the beginning of the next class.

Session 2: The practice of examining student learning in school is influenced by people's beliefs and values

As Professor Robin Alexander indicates, culture influences the education a society creates for its children (R. Alexander, *Essays on Pedagogy* [London: Routledge, 2008], p.181). Culture also influences particular practices within a system of education. The purpose of this session is to isolate some of the cultural influences on the practice of examining and evaluating the academic performance of individual students in school.

The outcome of this session is a table that contrasts a test-based culture in school from an assessment-based culture. References and the list of contrasts used in the session are in McMillan, on the charts on page 15 (which identify some of the features of an assessment-based culture) and page 19 (which identify some changes from a test-based culture to an assessment-based culture).

Presentation and class discussion (15 minutes)

Prepare a presentation on the concept of culture. The following is information to help you get started.

Culture is a concept created by anthropologists in the nineteenth century. The concept is used to describe or explain a variety of social ideas; consequently, the word has more than one definition. In this course the term *culture* refers to 'the collective ideas, values, customs, and relationships that shape a society's view of itself, the world, and education' (Alexander, p. 181). Professor Alexander's definition serves the purposes of this course well when extended to include these ideas: 1) the ideas, values, customs, and relationships that characterize a culture are transmitted from one generation to the next; 2) the ideas, values, customs, and relationships that characterize a culture form the basis for collective social action in a society; 3) culture influences human development through learning; and 4) one human being belongs to more than one culture, each culture identified in a different way (for example, by religion, ethnicity, language, work, and age).

Pause in the presentation and encourage Student Teachers to contribute to a discussion about the meaning of culture as a concept and word, and try to clarify misconceptions.

Small group work with prompts (30 minute)

Create small groups (with three to four members). Explain that the task is to create a table that contrasts a test-based culture in the classroom with an assessment-based culture. Each group should create a table with two columns. The heading in one column is 'People who favour a test-based culture in schools'. The heading in the other column is 'People who favour an assessment-based culture in schools'. Give a few examples from the completed table to help them get started. Monitor their work and provide guidance as needed.

Groups report to class (20 minutes)

Choose a few groups to share their tables with the class.

Closing (5 minutes)

Collect tables from each group. Ask three volunteers to work together to create one table from Student Teachers' tables and the example list and bring it to the next class session. Duplicate copies of the composite table and distribute at the beginning of the next session or ask the volunteers to create a large chart for display.

Homework (5 minutes)

Distribute the handout 'List of Contrasts between a Test-based and an Assessment-based Culture in Schools' and ask Student Teachers to read it before the next session.

Session 3: Imagining an assessment-based culture in schools in Pakistan

The difference between a test-based and an assessment-based culture in schools is a useful device for illustrating the influence of culture on educational practice. The purpose of including the list of contrasts in this course is to help Student Teachers assess the fit between beliefs and values regarding education in Pakistan and the beliefs and values that typically underlie a culture of assessment in schools.

Discussion (5 minutes)

Discuss the list of contrasts between a test-based and an assessment-based culture in schools. Respond to any questions Student Teachers may have about the table.

Small group leading to full-class discussion (20 minutes)

To the extent possible, this small to large group discussion should attempt to draw some conclusions about expectations for education among Pakistani citizens. If it helps, Student Teachers can put themselves in the role of a parent and ask what she or he wants education to do for their children.

Small group work (20 minutes)

Student Teachers can remain in the same groups they were in during the previous discussion of attitudes toward education in Pakistan. Ask each group to create a definition of classroom assessment suitable for schools in Pakistan.

Closing (10 minutes)

Ask groups to read their definitions to the class. Though time will be short, try to draw the main points for a definition from their reports. Collect the definitions from each group. Ask five volunteers to work together to create one definition, write it on chart paper, and post it at the beginning of the next class. It doesn't necessarily require discussion in the first session of the new unit.

UNIT 2

ASSESSMENT IS A PROCESS THAT CONNECTS TEACHING AND LEARNING

UNIT 2: ASSESSMENT IS A PROCESS THAT CONNECTS TEACHING AND LEARNING

(3 weeks/9 hours)

Teaching and learning resources for Unit 2

Handouts for Students Teachers

Week 4

'Unit 2, Week 4, Session 1: Sun, Earth, and the Moon Unit: Student Teachers' Copy'

Week 5

'Unit 2, Week 5, Session 1: Forms for Recording Student Participation in Classroom Discussions'

'Unit 2, Week 5, Session 3: Grade 3 Mathematics in Pakistan's 2006 National Curriculum'

Resources for faculty

Week 4

'Unit 2, Week 4, Session 1: Sun, Earth, and the Moon Unit: Instructor's Copy'

'Unit 2, Week 4, Session 2: Guide for Using the Sun, Earth, and the Moon Unit'

Week 5

'Unit 4, Week 14, Session 1: The Assessment Tracker'

Readings

Week 4

- Clarke, pp. 92–117
- McMillan, pp. 28–36
- Miller, Linn, and Gronlund, pp. 47–70
- Stiggins, Arter, Chappius, and Chappius, pp. 53–80
- Wiliam, pp. 51–69

Week 6

- McMillan, pp. 69–82
- Miller, Linn, and Gronlund, pp. 71, 86–87, 71–72, 109–110

Week 4: Learning objectives, learning targets, and success criteria

Session 1: Introduction to learning objectives, learning targets, and success criteria

In class today (10 minutes)

Tell Student Teachers that one of the most important tasks in creating assessment-embedded lessons is to set learning objectives, learning targets, and success criteria for a lesson.

Inform Student Teachers that in textbooks about assessment, the terms *learning goals, learning objectives* and *learning targets* are often used interchangeably (to mean similar things). In this unit they are introduced as different concepts that mean different things in the assessment process. Their differences and meaning will be clarified through the use of an example of a seven-lesson unit and the accompanying activities included in this week's sessions.

Also tell Student Teachers that *success criteria* is a relatively new term. It refers to the specific knowledge or skill that a student must demonstrate to show that she or he has mastered the lesson targets.

Use a short class discussion to check Student Teachers' previous knowledge of *learning objectives, learning targets, success criteria*, and *formative assessments*. Ask if they have ever come across these terms. If yes, in what context?

Encourage Student Teachers to describe these four terms in their own words and to write down the descriptions in their notebooks. Take a few responses and note them on the board. At this point in the session, Student Teachers will need the handout 'Assessment in a Lesson about the Solar System' (shared with Student Teachers in Unit 1).

Lecture on learning objectives, learning targets, success criteria, and formative assessments (15 minutes)

When describing the definitions of *learning objectives, learning targets, success criteria*, and *formative assessments*, try to include the Student Teachers' definitions of these concepts as much as possible.

Cover the following concepts in this lecture:

- Learning objectives, learning targets, and success criteria are important pillars of assessment components of the lesson.
- Definition of *learning goals*, *learning objectives*, *learning targets*, and *success criteria*:
    - ***Learning goals:*** Learning goals are broad statements included at the unit level to describe the topics covered in the unit and are the first step in building the unit, lesson, and assessments within a unit. Learning goals are usually outlined in the curriculum a teacher is expected to implement. For the 'Sun, Earth, and the Moon' unit used in this course, the learning goal is stated as 'Students will be able to explain the relationships between the Sun, Earth, and the Moon and the effect of these relationships on life on the Earth'.
    - ***Learning objectives:*** A learning objective is the knowledge and/or skill a student is expected to learn from a lesson. Learning objectives in each lesson are either essential (must be achieved to achieve the goal of the unit) or supportive (introduce students to the broader vision of the unit).
    - ***Learning targets:*** Learning objectives that are essential to achieve the goal of the unit are called *learning targets*. In other words, learning targets represent main learning objectives of a lesson and leave out the supporting learning objectives.
    - ***Success criteria:*** Success criteria are written in action verb format and describe what a student should be able to do in order to show that they have mastered the learning targets for the lesson. (Direct Student Teachers' attention to the handout that is the first lesson in the solar system unit. Remind them of the goal of the unit and ask them to cover the learning targets with a book or their hand and pick out the essential objectives from the list of learning objectives. Discuss any differences between the students' responses and the lesson targets in the lesson plan. Tell Student Teachers to cover the success criteria. Lead them though the same exercise they did with the learning objectives and learning targets. Remind them that there isn't one right way to make a lesson plan including the objectives, targets, and success criteria. For example, some teachers might argue that given the goal of this unit, being able to name and locate all eight planets is a supportive rather than essential learning objective).
    - ***Formative assessment:*** Formative assessment is assessment conducted during a lesson to get evidence about learning that gives feedback to students and the teacher that is used to improve teaching and learning.

Group discussion on the process of setting up learning objectives, learning targets, and success criteria (30 minutes)

NOTE: The faculty should consult the 'Sun, Earth, and the Moon Unit: Instructor's Copy' handout for complete lesson plans with all the learning objectives, learning targets, success criteria, and formative assessments for all seven lesson plans.

In this activity, Student Teachers will take a look at the 'Sun, Earth, and the Moon Unit: Student Teachers' Copy' to understand the process of setting learning objectives, learning targets, and success criteria. (Tell Student Teachers to put the lesson from the unit that they took from their notebooks earlier back into their notebooks. That lesson is a duplicate of the first of the seven lessons they will use from now on.)

Tell Student Teachers that there are many different ways of creating assessment-embedded lessons. Different teachers create different lesson/assessment plan formats. They will develop their own way after some experience in the classroom.

This session previews one of the ways of creating assessment-embedded lessons and is by no means the only one.

Divide Student Teachers into groups of three or four and provide them with a copy of the 'Sun, Earth, and the Moon Unit: Student Teachers' Copy' handout. Give the groups 10 to 15 minutes to take a look at the unit learning goal and learning objectives, learning targets, and success criteria for lessons 1, 2, and 7. At this time, Student Teachers do not need to study the whole unit.

Ask the groups to discuss and write down the order and process in which (they think) that the learning objectives, learning targets, and success criteria are set up.

NOTE: Make sure Student Teachers understand that the learning goal is the broader topic, which is often provided to teachers in a curriculum guide (or any other source a school is using as a guide for creating instruction).

This discussion should bring up the following points:

- The first step in creating assessment-embedded lessons is to study the learning goal or goals (provided in the curriculum, and they may be presented under a different name).
- After studying the learning goals for a unit, break them down into learning objectives.
- Based on the length of the class session, decide how many learning objectives can be covered in one class session. While deciding this, try to group learning objectives covering similar topics into one session. If there are more similar learning objectives than one session can cover, spread them over two or even three class sessions.
- Now separate the learning objectives that are essential to understanding the lesson and unit in question. These will be your learning targets.
- Now convert the learning targets into success criteria by using action verbs.

If the Student Teachers do not bring these points up themselves, make sure to go over and explain them.

Explain that in order to write strong success criteria, it is important to make sure that they are easily measurable. Because success criteria form the basis for creating assessments for the lesson as well as the unit, their measurability shows the teacher if the students have mastered the essential learning objectives.

The groups should also discuss the significance of and difference between learning objectives, learning targets, and success criteria.

After the groups are done with their discussion, ask a volunteer to share their discussion points with the rest of the class. Note down these discussion points on the blackboard and make additions or corrections if needed.

Ask Student Teachers to correct their responses if needed.

Closing (10 minutes)

Ask Student Teachers to reflect on the classroom activities for this session and, using their course notebooks, write about their understanding of the learning goals, learning objectives, learning targets, and success criteria in their own words. Student Teachers should also reflect on the importance of setting precise learning objectives, learning targets, and success criteria to writing assessment-embedded lesson plans.

Collect Student Teachers' notebooks at the end of the session and read them to get an idea of Student Teachers' understanding of learning objectives, learning targets, and success criteria.

Homework

Ask Student Teachers to take home the handout 'Sun, Earth, and the Moon Unit: Student Teachers' Copy' and to read through the whole unit so that they are familiar with it.

Session 2: Practice with learning objectives, learning targets, and success criteria

In class today (5 minutes)

In this session and the next session, Student Teachers practice writing the learning objectives, learning targets, success criteria, and formative assessments (pertaining to success criteria) for lessons 2 and 3 from the 'Sun, Earth, and the Moon' unit and will be using the 'Sun, Earth, and the Moon Unit: Student Teachers' Copy' handout.

Tell Student Teachers that in this and the next session, they will be working backward in that they will study lessons 2, 3, 5, and 6 in detail first and then write their learning objectives, learning targets, and success criteria for these lessons.

In real life, the Student Teachers will write the learning objectives, learning targets, and success criteria first (using the learning goals) and then create the lesson activities and assessments. Even though this exercise does not mirror reality, it is set up to help Student Teachers become familiar with and get practice in using the correct language format to write assessment-embedded lessons and units.

Discussion on the relationship between learning objectives, learning targets, success criteria, and formative assessments (pertaining to success criteria) of the lessons (15 minutes)

Divide the Student Teachers into groups of two or three and ask them to take some time to study lessons 1, 4, and 7 in their entirety. They should focus on the relationship between the learning objectives, learning targets, success criteria, and lesson activities. The Student Teachers should also pay special attention to the relationship between success criteria and the assessments marked as 'formative assessments' in the lessons.

Make sure the Student Teachers know that the assessments marked as 'formative assessments' are not the only formative assessments used in the lessons. Formative assessments are spread throughout the lessons. Even though most explorations and guiding questions serve as formative assessments for this unit, the sections especially marked as 'formative assessment' cover the success criteria of the lessons.

Ask Student Teachers to discuss the relationship between the learning objectives, learning targets, success criteria, and formative assessments (pertaining to success criteria) by going over following points:

- Do the learning objectives relate to the content covered in the lessons?
- Are the learning targets chosen well? Do you think they are essential to understanding the lessons? Are there any learning targets that are left out?
- Do the success criteria represent the learning targets? Are there any learning targets that are left out?
- Do the assessment activities marked as 'formative assessment' test the success criteria well? Are there any assessment activities that are inefficient in assessing the success criteria?

After the Student Teachers have discussed these questions, take a few responses from the class and conduct a short discussion on the above-mentioned discussion points. Encourage Student Teachers with different opinions to participate in the discussion.

Activity in writing learning objectives, learning targets, success criteria, and formative assessments (25 minutes)

In this activity, Student Teachers will practice writing the learning objectives, learning targets, success criteria, and formative assessments (pertaining to success criteria) for lesson 2 from the 'Sun, Earth, and the Moon' unit and will be using the 'Sun, Earth, and the Moon Unit: Student Teachers' Copy' handout.

> NOTE: This task is explained in detail in the 'Sun, Earth, and the Moon Unit: Instructor's Copy' handout. Please consult the guide to the unit before explaining the task to the Student Teachers.

Tell the Student Teachers that now that they understand the relationships between learning objectives, learning targets, success criteria, formative assessments (based on success criteria), and the lesson content, they will practice writing them.

Divide Student Teachers into pairs. These can be called the work pairs and will remain the same for this and the next session. Ask the work pairs to study lesson 2 from the 'Sun, Earth, and the Moon' unit. After studying the lesson, Student Teachers should write three to five learning objectives for the lesson.

Ask Student Teachers to pick two learning objectives from the list and write them as learning targets (two to four).

Next, the Student Teachers should write success criteria for each learning target. Advise them not to write more than three per target and remind them that success criteria should be easily measurable and written using verbs to denote an action.

After Student Teachers have written objectives and success criteria, ask them to do two things:

1) Look through the guiding questions and the culminating activities in the lesson to find questions and activities that can produce evidence that students have met criteria for achieving one or more of the lesson's learning targets. They should note which success criteria the assessment question or activity is measuring.
2) They should try to write a new question or activity that can produce evidence that students have met criteria for achieving one or more of the lesson's learning targets. They should note which success criteria the assessment question or activity is measuring.

Feedback activity (15 minutes)

In this activity, Student Teachers will swap their lessons and give each other feedback on the quality and language of learning objectives, learning targets, success criteria, and formative assessments (pertaining to success criteria).

Ask each Student Teacher to find a different partner (from another work pair group). These groups can be called the feedback pairs and will remain the same for this and the next session. After forming the feedback pairs, Student Teachers will swap their lessons with each other.

The pair should use the first five minutes to study the other person's work and the next five minutes to provide feedback to the other person. The Student Teachers in feedback pairs should provide each other with written feedback and discuss any issues they might have with their peer's feedback.

Tell the Student Teachers that they will continue this activity in the next session.

Closing (5 minutes)

Explain the homework assignment and give the work groups some time to make arrangements to meet each other after class to work on the assignment.

Homework

Student Teachers will work in same work group pairs to write learning objectives, learning targets, success criteria, and formative assessments (pertaining to success criteria) for lesson 3 of the 'Sun, Earth, and the Moon' unit.

Instruct Student Teachers to use the same set of directions they used for lesson 2 from this session's last activity to accomplish the task.

Collect lesson 3 from the Student Teachers at the beginning of the next session to review their work and provide feedback.

Session 3: Practice with learning objectives, learning targets, and success criteria (continued)

In class today (5 minutes)

Tell the Student Teachers that they will continue to practice writing learning objectives, learning targets, success criteria, and formative assessments (pertaining to success criteria). Before class, write the significant features of effective feedback on the board and direct attention to the list as a review for the work they are going to do together (providing each other with feedback).

Feedback activity continued (15 minutes)

Ask the Student Teachers to sit next to their feedback pair partner because they are continuing the feedback activity from the previous session. The feedback pair will continue providing each other feedback on learning objectives, learning targets, success criteria, and formative assessments (pertaining to success criteria) for lesson 2.

The groups should provide each other with written feedback and discuss any issues they might have with their peer's feedback.

After discussing and resolving the issues, Student Teachers from the feedback pairs should go to their work pair partner. At this point, both Student Teachers in the work pair will have feedback on their lessons. The work pair should combine their feedback and incorporate it into their lesson.

Activity writing learning objectives, learning targets, success criteria, and formative assessments (25 minutes)

In this activity, Student Teachers will continue to practice writing the learning objectives, learning targets, success criteria, and formative assessments (pertaining to success criteria) for lesson 5 from the 'Sun, Earth, and the Moon' unit and will be using the 'Sun, Earth, and the Moon Unit: Student Teachers' Copy' handout.

Student Teachers will work with the same work pair partner and use the same procedure (explained in the previous session) as lessons 2 and 3 to complete this task.

Feedback activity (15 minutes)

Return Student Teachers' lesson 3 (with written feedback) and ask each work pair group to study their feedback in detail and incorporate it into their work.

While groups are working on studying and incorporating feedback, visit each group to resolve any issues they might have with the feedback or provide any help they might need.

Closing (3 minutes)

Explain the homework assignment to Student Teachers and give the work pair groups some time to make arrangements to meet each other after class to work on the assignment.

Homework

Student Teachers will work in the same work pairs from the previous activity to write learning objectives, learning targets, success criteria, and formative assessments (pertaining to success criteria) for lesson 6 of the 'Sun, Earth, and the Moon' unit.

Instruct Student Teachers to use the same set of directions they used for lessons 2, 3, and 5 to accomplish the task.

Collect lesson 5 from Student Teachers at the beginning of the next session to review their work and provide written feedback.

Week 5: Recording assessment data

Classroom teaching involves continuous interaction between one teacher and many students. This fact creates a challenge for classroom teachers who want to use a variety of assessment tools and track students' progress (learning) over time. Frequent assessment focused on monitoring the effects of instruction and students' progress in school requires keeping records that are more detailed than grade books. The challenge for teachers is to develop record-keeping procedures that do not take excessive time from teaching and that do not make excessive homework for teachers. This challenge can be met by 1) focusing assessment on learning objectives that represent significant educational goals, 2) teaching students to keep their own records for some learning objectives, and 3) developing efficient record-keeping procedures.

There are three outcomes that Student Teachers should expect from this week's course work. First, they should expect to learn how to use a procedure for documenting student participation in classroom discussions. Then they should have a brief and candid discussion of their current opinions about using it or a similar assessment procedure when they are teachers. Second, after a discussion, they should record the ways students can participate in keeping records of their progress in school. Finally, they should have an example that they created of a whole-class record-keeping procedure for learning objectives attained in math.

Remember, assessment is a series of interrelated decision/action components that lead to a specific result. This unit is about three of those interrelated components: setting clear assessment targets and success criteria, gathering evidence about learning from students and the teacher, and interpreting that evidence before making decisions and taking action. Records preserve evidence of learning so it can be interpreted. Some assessment tools produce their own records: written tests, for example. Other assessment tools need a separate document to preserve the evidence they produce: oral questions and answers, for example.

Session 1: One way to record individual participation in class discussions

The following activities are suggestions for conducting this session.

Ask Student Teachers to form groups of three and choose a reporter/recorder.

Distribute the forms for documenting participation in class discussions (handout 'Forms for Recording Student Participation in Classroom Discussions') and ask them to work together to figure out how to use them.

After a time interval that you believe is appropriate, bring them back together as a class. Select a few groups to give a report back.

Have one group report on one of the three forms that can be used to document student participation in class discussions.

If the reporters make an error in describing how the form is to be used, you can ask for corrections from other class members using the notes describing how the forms are to be used. Correct from your notes, if necessary.

When you believe that Student Teachers know how to use the forms, send them back to their groups to talk about ways the data collected on the form might be used to alter the way class discussions are conducted. In particular, the Student Teachers' small group discussions should focus on how teachers can encourage participation by students who are reluctant to contribute to discussions.

Bring class members back together and ask reporters from the groups that didn't report earlier to share their groups' discussion about using data from an assessment procedure such as the individual participation record to alter instruction.

Keep class members together (rather than forming groups) and ask for recommendations about changing the student participation form.

If Student Teachers have good recommendations, tell class members to note those recommendations in their course notebooks.

End the session by eliciting opinions about the value of the data this form might produce.

Session 2: Students' participation in recording evidence of learning

The following activities are suggestions for conducting this session.

Give Student Teachers approximately 10 minutes to study their course notes and the handouts they were given that are examples of assessments (handouts 'Assessment Helps Asim Gain Weight', 'Assessment in Ms Khan's Grade 4 Class', and 'Assessment in a Lesson about the Solar System'). Tell them to concentrate on the procedures in these examples that are used for recording assessment data.

After each member of the class has reviewed their course notes and handouts, tell them to form groups of three, choose a reporter, and talk about the recording procedures in the examples. They should distinguish between those procedures used by students from those used by a teacher. Tell them to think of additional ways that students can keep track of their progress learning (for example, assessment folders, in which they put homework assignments, quizzes, essays, and drawings. This would be a portfolio created to show 'evidence of learning').

Bring Student Teachers together as a class so that each group can share their recommendations for procedures that primary school students can use to keep records of learning for themselves. Remind Student Teachers to make a list in their notebooks (annotated, if possible) of the procedures primary school students can use to keep records that show evidence of learning.

Tell Student Teachers that, if they choose to have their students keep assessment folders, the primary school students will have to explain in a short written comment how each of the documents in that folder shows 'evidence of learning'. Tell them they will learn more about those explanations in Week 10 of the course, when they study the creation of portfolios.

Session 3: Constructing a class record to record the achievement of selected mathematics learning objectives

The following activities are suggestions for conducting this session.

Tell Student Teachers that they are going to construct a form for keeping a class record of performance on a 12-item math quiz for students in grade 3. Tell them that, while they are going to select the topics for the 12 questions, they will not write the test questions and will not construct the test.

Using an overhead projector, if you can, show them the 'Assessment Tracker' handout from Week 14.

NOTE: Student Teachers are going to learn how to use the assessment tracker during Week 14. All they need to know now is what a class record looks like (as opposed to an individual record). They also need to know that their record form will be different from the assessment tracker in a very important way. They will have many fewer items (12 as opposed to 35), and they will put the items in the row across the top of the form rather than number the items, as in the assessment tracker.

Announce that each group of three will produce one record form and that it will be due at the beginning of the first class session in Week 6. They will begin working on it today and finish it as a homework assignment.

If they haven't already done so, ask them to form into their working groups.

Again, using an overhead projector, if possible, show them Table 9.2 from the book by Stiggins, Arter, Chappius, and Chappius (page 289). Tell them you are showing this to illustrate what you mean when you say that rather than specifying the number of the question in the row (or rows) across the top, they should identify the math problem that would be on the quiz.

Distribute the handout from the National Curriculum 2006 ('Grade 3 Mathematics in Pakistan's National Curriculum').

Tell Student Teachers to use topics from Pakistan's National Curriculum in the form they create. Ask for questions. Then give them time (30 minutes) to work. Tell them to select the math topics and create a draft of the form.

Bring the class back together and have each group share their quiz topics with the rest of the class. Ask if they have questions about the form and remind them when it is due at the end of the session.

Week 6: Interpreting assessment data

Week 6 does not have any handout exercises and bases its content on reading from McMillan (pages 69–82) and Miller, Linn, and Gronlund (pages 71, 86–87, 71–72, 109–110). Instructors design their own activities to teach the concepts covered in the assigned readings and the course guide outline for week 6. It is important to make connections between this week and the previous week (week 5).

Tell the Student Teachers that last week they learned about different ways of collecting assessment data. This week, they will study ways of interpreting the collected assessment data. Remind them that without interpretation, collected data is useless. Interpreting assessment data (collected using various methods) helps a teacher tailor instruction to students' needs. While designing activities for week 6, the Instructors should be aware of the following.

Session 1

Build this session around the following ideas.

Test scores do not lead directly to educational decisions. Instead, educational decisions are made and actions are taken on the basis of interpretations of test scores.

Interpretations and conclusions made from test scores should be valid and reliable. Provide and discuss the definitions of *validity* and *reliability*.

Validity and reliability are not properties of tests but interpretations that derive from test scores.

The following connections to week 14 should be made:

- Teachers use different tools to interpret assessment data. One of these tools presented in this course is called the assessment tracker.
- Give a brief definition of *assessment tracker* (see Week 14, Session 1 for the definition).

Session 2

Build this session around the following ideas.

Test scores can be interpreted using different frames of reference. Use this session to introduce Student Teachers to the following concepts:

- Norm-referenced frame of reference
- Criterion-referenced frame of reference
- Self-referenced frame of reference
- Other names for norm-referenced and criterion-referenced interpretations of students' scores on assessment tasks
    - Relative interpretations (comparable to norm-referenced interpretations)
    - Absolute interpretations (comparable to criterion-referenced interpretations)

Give an explanation for each of these interpretations of performance.

(Consult week 11, session 3 for further explanation of norm-referenced and criterion referenced tests.)

Session 3

Now that Student Teachers understand the connection between assessment and instruction, ask them to display their understanding by drawing a diagram of the assessment process. Divide them into groups of two or three to work on the diagram and ask each group to present the diagram to the class.

After the groups have presented their diagrams, conduct a class discussion to endorse one diagram or to create a diagram from parts of the various groups' diagrams. (At this point, show Student Teachers the diagram on page 7 of James McMillan's book so they can use an assessment specialist's diagram as a tool in refining their diagrams.)

UNIT 3

ASSESSMENT TOOLS

UNIT 3: ASSESSMENT TOOLS

(4 weeks/12 hours)

Teaching and learning resources for Unit 3

Handouts for Student Teachers

Week 9

'Unit 3, Week 9, Session 1: Performance-based Assessment'

'Unit 3, Week 9, Session 1: The Green Bean Competition' (PowerPoint presentation)

Week 10

'Unit 3, Week 10, Session 1: The Professional Portfolio'

'Unit 3, Week 10, Session 1: National Professional Standards for Teachers in Pakistan (NPSTP): Standard 1 Subject Matter Knowledge'

'Unit 3, Week 10, Session 1: National Professional Standards for Teachers in Pakistan (NPSTP): Standard 4 Assessment'

Resources for faculty

Week 8

'Unit 4, Week 12, Session 3: Guidelines for Writing Test Questions'

Week 9

'Unit 3, Week 9, Session 1: Performance-based Assessment'

Readings

Week 7

- McMillan, pp. 103–120
- Miller, Linn, and Gronlund, pp. 117–119, 268–279, 309–315

Week 8

- McMillan, pp. 202–215
- Miller, Linn, and Gronlund, pp. 232–250
- Stiggins, Arter, Chappius, and Chappius, pp. 167–186

Week 9

- McMillan, pp. 220–252
- Stiggins, Arter, Chappius, and Chappius, pp. 189–230

Week 10

- McMillan, pp. 256–276
- Miller, Linn, and Gronlund, pp. 282–303
- Stiggins, Arter, Chappius, and Chappius, pp. 335–355

Week 7: Interviewing teachers about assessment

Session 1: Constructing an interview form

In class today (5 minutes)

This week they will conduct an interview with a teacher asking about her or his perceptions and beliefs about assessment. Today, they will construct the interview form or tool.

Give the class this outline for today:

- Presentation about the purpose of the interview. Review questions and format for the teacher interview about assessment
- Design an interview form for a teacher interview about assessment
- Preparing for the interview

Presentation: The interview (5–10 minutes)

Content for the presentation is here for your consideration. The information you actually present and the way you present it is your choice.

Interviews and questionnaires are similar informal assessment procedures. They are used in classroom assessment to obtain factual information and opinions and beliefs from those with the most interest in what happens in the classroom: students, teachers, and parents. Interviews have an advantage over questionnaires in that the interviewer can probe and get below the surface of the initial response. One disadvantage to both procedures is that responses can be biased and the interviewer may not know it. Also, responses are not standardized, and thus it is harder to compare answers from people who participate in the same interview. Despite this, interviews can be used with individuals and with small groups (such as focus groups). The primary purpose of this interview is to give Student Teachers practice creating the questions and form for an interview.

The secondary purpose of the interview is to introduce Student Teachers to classroom teachers' knowledge, opinions, and attitudes toward assessment. Each Student Teacher will only interview one teacher. Because interview responses are intended to be individualized rather than standardized, it is difficult to draw reliable conclusions about the topic from a collection of individual responses.

However, there will be approximately 25 teachers interviewed in each college or university class, and so, if they look at all of the data collected, they may be able draw some conclusions about this group of teachers and their opinions and beliefs about assessment. They may find, for example, that all the teachers they interview equate assessment with testing. Or they may find that all the teachers equate feedback with praise.

Discussing a format and questions (15 minutes)

Ask Student Teachers what information they want to collect about the teacher before they start asking questions.

Student Teacher responses may include background information such as the teacher's name (optional), date, school (optional), teacher's grade and/or subject(s), number of students in the class, number of years of teaching experience, preparation for teaching (degree), and assessment course(s) taken and when.

Ask Student Teachers which questions they might include on their interview form. Possible questions include:

- Do you assess children's learning? Why do you assess learning? How do you assess their learning? How often do you assess learning?
- Some people say that assessment is part of teaching. Do you agree? Why? Why not?
- Do you keep records of assessment? What records do you keep?
- Do you give tests? How often? How do you prepare a test? Do you think students should be allowed to mark each other's tests?
- Do you make adjustments in your teaching based on assessment? Can you give me an example?
- What does *feedback* mean to you? Please give me an example of feedback you might give to a student in your class. How do you give feedback?
- Do children in your class assess their own learning? Can you give me an example?

You might want to provide a set of questions for Student Teachers to choose from to help them get started.

Advise Student Teachers to avoid asking too many questions and to think carefully about the sequence of questions.

Encourage them to prepare probes to initial questions so that they receive detailed responses; for example, 'Tell me more about what you mean by …,' 'Can you give me an example?', and 'Why do you say that?' Finally, remind them to provide plenty of space on their forms to write the teacher's full response.

Drafting the interview form (30 minutes)

Ask Student Teachers to design their interview form.

Review the forms they design and encourage them to seek feedback from peers.

Preparing for the interview (10 minutes)

Explain to Student Teachers that they should all plan to interview a teacher. They should work in pairs, and while one Student Teacher asks questions, the other should record the responses. However, a teacher should only be interviewed once, so each Student Teacher needs to interview a different teacher.

Remind Student Teachers to conduct the interview when students are not in the classroom so the teacher's attention isn't divided between responsibilities to them and to the Student Teacher. The interview should last no more than 15–20 minutes.

Explain to Student Teachers to be careful not to evoke negative feelings on the part of the teacher. They can tell the teacher that they are doing this to practice writing questions for an interview and creating a form on which to record responses to the interviewer's questions. The Student Teacher can remind the teacher that they are not judging the teacher's responses. There are no right or wrong answers.

Finally, remind them that they will need two copies of their interview form: one to ask questions from and another on which to record responses.

Session 2: Conducting the interview

Arrange for Student Teachers to be in schools on this day carrying out their interviews.

Session 3: Reviewing the data—What did you learn?

In class today (5 minutes)

Explain that in this session Student Teachers will discuss data from the interviews; the second half is used to discuss data from the observation:

- Small group discussion of responses to the interview questions
- Class discussion of responses to the interview questions
- Critique of the interview tool
- Homework assignment
- Closing

Small group discussion of responses to the interview questions (20 minutes)

Student Teachers form groups of five and choose one person to report to the class. The group discussion centres on teachers' responses to the big questions about the meaning of assessment and feedback. Discussion should also include questions and concerns about the interview tool, both its questions and format. There isn't much time, so the discussion needs to move fast.

Class discussion of responses to the interview questions (20 minutes)

A selection of the following questions can shape the discussion:

- Did anyone get an answer with which they strongly agreed? Tell the answer.
- Did anyone get an answer with which they strongly disagreed? Tell us.
- Are these answers consistent or inconsistent with what you are learning in this course?
- Did you get the impression that teachers value tests? Do they make their own?
- Can you tell from their responses if the teachers use information about their students' knowledge and skills to make decisions about teaching? For example, do they check on prior knowledge before they begin to teach a new topic?

- Did the interview cause you to feel that you may have a different attitude toward assessment and different skills from other teachers working in the school where you are hired to teach after you graduate?
- If so, will that be a particular challenge for you?
- What will you do about the challenge, if it exists?

Critique of the interview tool (10 minutes)

Remind Student Teachers about the limitations of open-ended interviews as a method of collecting information. One challenge is that the same question can produce 20 different responses from 20 interviewees, so it can be difficult to generalize across a set of data collected—especially when responses are very different.

Interviews can be biased. Respondents often say what they think an interviewer wants to hear. Questions and probes must be selected carefully so as to avoid bias or leading respondents to a particular answer. For example, an interview on the same topic as the Student Teachers' would not begin with a question such as 'Why do you do assessment?' because it must first be established that the teacher actually does assessment.

On the other hand, interviews produce rich, descriptive data that can be very revealing and interesting.

Ask Student Teachers if they think interviews have a place in assessing children's learning in the classroom. Is this a technique they would use to find out what children understand or know, or believe about a topic?

Closing (5 minutes)

Call on five Student Teachers and ask each to give an original statement or question (with no repetitions) representing the most important fact, concept, or uncertainty they encountered during this week's class sessions.

Week 8: Essay questions—Measuring complex achievement

Week 8 does not have any handout exercises and bases its content on reading from McMillan (pages 202–215), Miller, Linn, and Gronlund (pages 232–250), Stiggins, Arter, Chappius, and Chappius (pages 167–186).

The absence of handouts makes it possible for Instructors to design their own activities to teach the concepts covered in the assigned readings and the course guide outline for week 8. It is important to make connections between this week and the previous week (week 7).

Tell Student Teachers that this week they will continue to study the assessment tools. This week will focus on essay questions, which are more challenging to create and mark as compared to the assessment tools studied last week but are very useful for assessing complex achievement. Tell Student Teachers that in week 16 of the course they will be asked to write essay questions for this course to help them prepare for the final exam; thus, they should start paying special attention to course topics and skills that can be better measured by essay questions.

Session 1

In addition to using the assigned readings and the course guide, consult the handout 'Guidelines for Writing Test Questions' and refer to the 'essay questions' section of the handout. Design an activity that includes working with this handout to teach the following concepts:

- Definition of short-answer essays (restricted-response questions)
- Definition of longer-answer essays (extended-response questions)

Use assigned readings for week 8 to design learning activities to cover the following:

- Learning goals that can be measured by short-answer essays
- Learning goals that can be measured by longer-answer essays
- Advantages and disadvantages of essay tests

Session 2

In addition to using the assigned readings for this week, use the handout 'Guidelines for Writing Test Questions' to teach Student Teachers about the following concepts:

- Guidelines for writing essay questions
- Practice writing essay questions

The following connection can be made with week 16: Design a classroom activity or homework assignment for Student Teachers that requires writing essay questions using the content from any week from this course.

Session 3

Use readings assigned for this week to teach Student Teachers about guidelines for scoring essay questions.

During week 16, when Student Teachers are expected to write essay questions for a final examination for this course, they are asked to write a sample answer for an essay question. Discuss this practice with them so they are familiar with the idea of writing model answers to use when grading essay questions.

Week 9: Performance-based assessment (project-based assessment)

Student Teachers must prepare in advance for session 1, week 9.

At the end of the previous session, provide each Student Teacher with the 'Performance-based Assessment' handout and an example of a student group PowerPoint presentation for 'The Green Bean Competition'.

Before the first class of this week, Students Teachers should have read 'Performance-based Assessment' and the PowerPoint presentation 'The Green Bean Competition'.

The Instructor as well as Student Teachers need to prepare for this class. Before class write these definitions of *performance assessment* on chart paper (or choose other definitions that you prefer):

> Performance assessment requires students to demonstrate knowledge and skills, including the process by which they solve problems. (Project Appleseed)
>
> Any assessment strategy designed to estimate a child's knowledge, understanding, ability, skill, and/or attitudes in a consistent fashion across individuals emphasizing methods other than standardized achievement tests, particularly those using multiple-choice formats. Performance-based assessments typically include exhibitions, investigations, demonstrations, written or oral responses, journals, and portfolios. (New York State Education Department)
>
> A set of strategies for the...application of knowledge, skills, and work habits through the performance of tasks that are meaningful and engaging to students'. (K. M. Hibbard, *A Teacher's Guide to Performance-Based Learning and Assessment*)

Session 1: Introduction to performance-based assessment

In class today (10 minutes)

This week, Student Teachers will learn about performance-based assessment tasks, what goes into creating them, and how to use them in class to measure learning.

Tell Student Teachers that they will study and interact with two examples of performance-based assessment projects, one extended task (three weeks) and one short-duration task (three to four days).

Have a short class discussion to check Student Teachers understanding of performance-based assessment by asking the following question: 'Have you heard the term *performance-based assessment*? If yes, in what context?' After giving Student Teachers a minute or two to respond, share the definitions on the charts.

To check Student Teachers' understanding, discuss a few examples of performance assessment that will be familiar to them.

Advance preparation for the next session

Provide each Student Teacher with the 'Performance-based Assessment' handout and the example of a student group PowerPoint presentation for the 'The Green Bean Competition'. Ask them to read and become familiar with these documents before the next session.

Group activity for rubric interaction (40 minutes)

Student Teachers should have read the 'Example for Extended Assessment: The Green Bean Competition', and the PowerPoint presentation in detail for homework.

Tell Student Teachers that in this activity, they will study an example of an extended performance-based assessment called 'the green bean competition'. This assessment task is called *extended assessment* because it takes three weeks to conduct when done in its entirety. Make sure that Student Teachers know that they will not be performing the green bean competition. Instead they will use the task to study the features and rubric set-up of a performance-based assessment task.

Divide Student Teachers into groups of two or three and ask them to take a few minutes to study the green bean competition and then note its features. Some of the features are:

- Subject content and skills being covered by the task
- Learning objectives being assessed
- List of assessment tasks used to assess the learning objectives
- The rubric

After the groups are done, take a few responses from the class and note them on the board. Ask Student Teachers to check their responses and correct them if necessary.

Now ask the Student Teachers to study the rubric for the green bean competition, the learning objectives for the task, and the list of assessment tasks in detail and answer the following:

- Which row of the rubric is used at which point during the assessment task and what student skill is it assessing?
- Which parts (rows) of the rubric would they use daily, only once, or more than once during the assessment task?

After the groups are done, ask them to merge with another group and study each other's answers. Pay special attention to answers that are different and discuss why the other group has chosen that specific answer.

Student Teachers may change their answer after the discussion if they feel the other group's answer makes more sense as compared to their own.

After the groups are done, go over the questions of the activity with the whole class. Take a few responses for each question and make corrections if necessary.

Ask the groups to pay special attention during this part of the activity, ask questions, and clarify any misunderstandings they might have.

Student Teachers should also make any corrections to their work if needed.

Closing (10 minutes)

Ask Student Teachers to write about their understanding of performance-based assessment tasks and how they could or could not be useful in assessing student learning.

Collect Student Teachers' responses at the end of the class.

Homework

Ask the Student Teachers to read the 'Example of short assessment: Who has the best apples?' from the 'Performance-based Assessment' handout for homework.

Session 2: Grading performance-based assessment tasks

In class today (5 minutes)

In this session Student Teachers will perform a short performance-based assessment task and then grade it using a rubric provided with the task. These two activities are designed to give Student Teachers a chance to get hands-on experience with a performance-based assessment task and practice grading it using a rubric.

Conducting a performance-based assessment task in class (30 minutes)

Tell Student Teachers that they will conduct the performance-based assessment task 'Who has the best apples?' by following all the instructions listed under the task in the 'Performance-based Assessment' handout.

Ask Student Teachers to form groups of two to perform the task as listed in the 'Performance-based Assessment' handout and follow all the instructions. At the end of the task, each group draws two bar graphs and writes a letter to the farmer of the winner apple.

NOTE: Even though the task asks for only one person per group, groups of two would work best for providing Student Teachers a chance to conduct the task in a shorter amount of time.

Activity for grading a performance-based assessment task using a rubric (15 minutes)

After completing the assessment tasks, groups swap their data charts, graphs, and letters with another group and use the rubric (included with the task) to grade each other's assessment tasks.

Closing (10 minutes)

After completing the grading tasks, bring the class together to discuss Student Teachers' experience of the performance-based assessment task and use of a rubric for grading purposes. The following questions can be used to guide the discussion:

- What did you like about this task?
- What did you not like about this task?
- What would you add or take out to make this task more effective?
- Do you think there is a value to students in using performance-based assessment tasks? Why or why not?
- What problems, if any, do you envision in using performance-based assessment tasks in your own classroom?
- What was your experience like using a rubric to grade the assessment task?
- What did you like about this rubric?
- What did you not like about this rubric?
- Do you think there is a value to students in using rubrics? Why or why not?
- What problems, if any, do you envision in using rubrics to grade assessment tasks in your own classroom?

After the discussion, collect groups' graded tasks to provide feedback on their use of rubrics to grade the performance-based assessment task.

NOTE: If Student Teachers are not done with their performance-based assessment task at the end of the allotted 25 minutes, let them continue with it and ask the groups to finish the second activity (where they grade the other group's task using a rubric) for homework. In this case, allow each group enough time to swap their completed performance-based assessment tasks with the other group before they leave the class.

Session 3: Designing performance-based assessment tasks

In class today (5 minutes)

In this session, Student Teachers will work in groups to design a performance-based assessment task for a subject and topic of their own choosing.

Ask Student Teachers to find a partner and give them some time to work together to pick a subject and topic for designing a performance-based assessment task.

Visit each group to find out which topics they are choosing and if they need any help picking a topic. After they are done picking a topic and subject, ask them to write the subject and topic on a piece of paper with their names and submit it you.

Activity for designing a performance-based assessment task (50 minutes)

Tell the groups (with two Student Teachers per group) that in this activity they will design a short performance-based assessment task. The duration of the task should not be longer than one (45-minute) class period.

Tell the groups to closely follow the format of the two performance-based assessment task examples from the 'Performance-based Assessment' handout.

Following are some of the important components Student Teachers should include in their tasks:

- Title and duration of the task
- The subject content and skills assessed by the task
- Grade level and suggested grouping of students to complete the task
- Description of the task, including instructions for the students
- Learning objectives being assessed by the task
- Description and placement (where during the task each assessment activity will occur) of assessment activities included in the task (it should not have more than two assessment activities)
- Rubric (addressing all assessment activities) for the task (the rubric should not be longer than a page)

NOTE: This activity can be used as a graded assignment for this course.

Closing (5 minutes)

Let Student Teachers know that they should finish the task for homework and be ready to hand it in next week.

Give the groups time to decide on a time and place to meet after class to finish this task for homework.

Week 10: Portfolios—A tool for assessment and instruction

Three of the books chosen as texts for this course have chapters on portfolios: McMillan (pages 256–283); Miller, Linn, and Gronlund (pages 282–307); and Stiggins, Arter, Chappius, and Chappius (pages 335–359). The portfolio chapters in all three books are written from the perspective of a teacher using portfolios with students in grades 1 through 12. Portfolios created by students in primary and secondary schools typically have a subject matter focus. Of the three textbooks with chapters on portfolios as an assessment tool, the chapter in the McMillan book is more comprehensive than Stiggins and easier to read than Miller. Near the end of the last session of Week 9, tell Student Teachers to read the chapter on portfolios in the McMillan book before coming to the first session of Week 10.

Student Teachers created a portfolio in the Semester 3 Student Teaching Practicum and will create another portfolio in the Semester 4 Student Teaching Practicum. Student Teachers' portfolios are more like portfolios created by artists, architects, journalists, photographers, and models than portfolios created by primary school students. Guidelines for creating a portfolio are similar whether the portfolio belongs to a student in grade 1 or a student studying architecture.

This week's course work will capitalize on Student Teachers' experience preparing their portfolios for the Semester 3 Developmental Practicum and will serve as preparation for constructing the portfolio for the Semester 4 Teaching Practicum. The first session is a discussion between the Instructor and Student Teachers about guidelines for planning a portfolio. Material from the McMillan text is interwoven with the experience of creating a portfolio in last semester's Student Teaching Practicum. Sessions 2 and 3 are used for practice and feedback involving two particularly important actions required from students constructing a portfolio: selecting the documents to include and constructing an evaluation of those documents.

Session 1: Guidelines for planning a portfolio

Individual work (10 minutes)

Allow approximately 10 minutes for Student Teachers, working individually, to write a description of the Semester 3 Student Teaching Portfolio that can be used as a prompt, if necessary, for today's discussion.

Whole-class discussion (30 minutes)

Begin the discussion with this statement: 'A portfolio is a purposeful collection of a student's work that tells a story of effort, progress, or achievement'. Tell Student Teachers that a portfolio is classified as an assessment tool. Assessment specialists recommend that portfolios also be classified as teaching tools. These specialists want teachers to know that creating a portfolio is an excellent way for a student to learn how to evaluate their own work. This is the instructional outcome of making a portfolio to which assessment specialists refer.

Ask Student Teachers to name and describe the different types of portfolios as indicated by McMillan (on page 259). (Answer: celebration, competence, growth, project, and evaluation.)

Ask for the name and purpose of the Semester 3 portfolio. Indicate the obvious fact that it is easy to place that portfolio in the list because it is a growth portfolio.

Distribute the portfolio handout from the Student Teaching Handbook for Semester 4 ('The Professional Portfolio'). Give Student Teachers a few minutes to read the document.

Ask, 'Where does this portfolio fit in the list of portfolio types?' (Answer: Though 'best practices' are emphasized in the description of the portfolio, the purpose of the portfolio is to determine a prospective teacher's competence relative to professional standards. Therefore a professional portfolio is more like a competence portfolio than a celebration portfolio.)

With the Student Teachers (using McMillan's text as a guide; page 257), create a list of characteristics of portfolios. (Answer: The purpose and audience for the portfolio are determined first; the type of documents and artefacts that will be put in the portfolio is determined; a structure for the portfolio is established; the persons [student, teacher, both] who will select the entries to the portfolio are determined; evaluation criteria for individual entries and the completed portfolio are determined; student responsibility for reflection and evaluation of individual entries and the completed portfolio is established; a schedule for student–teacher conferences is established, and students understand that they will make [and date] continuous entries to the portfolio until such time as the portfolio is complete.)

Distribute the professional standards handout, 'Standard 1 Subject Matter Knowledge' and 'Standard 4 Instructional Planning and Strategies' of the National Professional Standards for Teachers in Pakistan (NPSTP).

Using the created list (written on board or posted on wall), ask Student Teachers to describe the Semester 3 Student Teaching Portfolio.

Expected response: The Semester 3 Student Teaching Portfolio is a growth portfolio, and the primary audience is the Student Teacher's college or university student teaching Supervisor; every artefact the Student Teacher produces during the practicum is an entry for the portfolio; the entries are organized in four sections (school-based assignments, planning, teaching, and feedback); evaluation criteria are all nine standards, including the sub-standards in NPSTP; Student Teachers received a form in the Student Teaching Handbook for Semester 3 that they used to make regular entries in the portfolio; they also received a final self-assessment form on which they were expected to record the portfolio documents for each of the nine standards and rate their performance on the standard; subsequently, the college or university student teaching Supervisor rated the Student Teacher's performance and converted the rating to a grade using a standardized procedure; a conference between the Student Teacher and College/University Supervisor was the culminating activity for this process.

Guide Student Teachers to compare their experience with the Semester 3 Student Teaching Portfolio with the list of characteristics of portfolios that they created from the McMillan text.

Expected response: There are many similarities. The two major differences are that Student Teachers did not select entries for the Semester 3 Student Teaching Portfolio (they entered every artefact they created) and they produced reflections of some of their work, but these reflections were not necessarily evaluations.

Homework (20 minutes)

Ask Student Teachers to look again at the handout for the professional portfolio they will construct during the Semester 4 Teaching Practicum. Draw their attention to the fact that they are supposed to include some artefacts from the developmental portfolio in their professional portfolio.

Ask the Student Teachers what they think that means in terms of the work they are expected to do with the portfolios from Semester 3. (Expected response: Student Teachers will have to select artefacts from the Semester 3 portfolio that represent growth [positive changes over time] and demonstrate skill at self-evaluation by explaining in writing the evidence they used to document change [growth] for each artefact.)

Tell the Student Teachers that the remaining class sessions for this week will be used for practice evaluating their own work. The practice will be selective. Rather than working with all nine standards from the NPSTP, they will work with two: Standards 1 and 4. Direct their attention to the handout distributed earlier in this session that has levels for each sub-standard in Standards 1 and 4.

Give Student Teachers the following homework assignment: tell them to use their growth portfolio and select three lessons they taught over the semester. (These will be lesson fragments—the beginning, middle, or end of a lesson—of which two fragments were taught by the cooperating teacher. The three fragments they select should be either the beginning of the lesson or the end of the lesson.) For each lesson plan they select, they should also select the pre-observation note to the observing cooperating teacher, examples of students' work during the lesson with feedback from them, the teaching resources they used during the lesson, the observation tool they requested the cooperating teacher to use, the cooperating teacher's feedback based on their observation, and their own reflection after the lesson.

Ask Student Teachers to bring these three lesson plans and all supporting documents to the next class session. Emphasize that these lessons are supposed to document growth in their knowledge and skill as teachers as indicated by the criteria in two of the National Professional Standards for Teachers in Pakistan. Tell Student Teachers that they should use those two standards and their earlier evaluation of their performance on those standards to choose the lessons. They should also use their student teaching Supervisor's evaluation of their performance on the two standards. Ask them to bring the two standards to the next class and advise them to bring the two previous evaluations (theirs and the student teaching Supervisor's) to class also.

Session 2: Self-evaluation of entries in a portfolio

NOTE: For the oral presentation on Student Teachers' evaluation of evidence of growth in their lessons, there is useful information in Miller (pages 297–303).

Whole-class discussion about the difference between reflection and evaluation (10 minutes)

Ask for a definition of *reflection*. (Answer: *Reflection* has more than one meaning. When it is used in reference to thinking, it means thinking deeply or seriously about an idea or experience. Reflection can be an evaluative or can lead to an evaluation, but the two concepts are not synonymous.)

Ask for a definition of *evaluation*. (Answer: Judging an event, object, idea, or person carefully; determining the value of an event, object, idea, or person. Evaluation always carries the idea of judging and placing value on something.)

Acknowledge with the Student Teachers that many of their courses emphasize reflection as an important mental process in learning to teach. In this course at this time, they are asked to evaluate their own work. That is a task that is normally the responsibility of college or university faculty. The ability to evaluate one's own work is an important cognitive / emotional process for teachers as well as for students. To repeat a message made earlier this week, making a portfolio can be an effective way to learn the process of self-evaluation.

Presentation: Documenting evidence of growth through portfolio artefacts (10 minutes)

Explain to Student Teachers that their task is to prove they learned to teach more effective lessons over the course of their first student teaching practice. The criteria for 'more effective lessons' are specified in the National Professional Standards for Teachers in Pakistan. (For example, one criterion for improved lessons is the use of sources in addition to textbooks for lesson content. Another criterion is lessons that include teaching resources clearly linked to individual learning outcomes rather than teaching resources that bear little relationship to individual learning outcomes.)

Tell Student Teachers that they are to write short commentaries on three documents in each lesson: the lesson plan, the examples of student work with their feedback, and their reflections after teaching. In these commentaries they will cite the evidence that the second lesson is improved over the first and the third lesson is improved over the second. They can use all of the documents they have for each lesson as sources of evidence.

For the first lesson, which will be the weakest of the three, the Student Teacher can use the commentaries on the lesson plan, student work, and Student Teacher reflection to respond to these points:

- I chose this entry for my portfolio because …
- These are the weaknesses in this entry (lesson plan, feedback, reflection).
- These are the strengths in this entry.
- This is what I need to learn to improve the lesson, etc.

For the second and third lessons, Student Teachers can use the commentaries to respond to these points:

- Remember that the major weaknesses in the first lesson entries were …
- Please notice these changes in this lesson plan, feedback to students, and reflection about teaching.
- This is what I am particularly proud about with this lesson plan.
- This is what I would do differently if I were to teach this lesson again.

Tell Student Teachers that it will be helpful if they highlight the sentences in each of the documents they use that are evidence for change.

Independent work: Preparing commentaries for the first lesson entries (15 minutes)

Student Teachers work alone to search documents for the first lesson and write the commentaries for documents in that lesson.

Pair work: Student Teachers provide feedback to each other (10 minutes)

Student Teachers form pairs and provide feedback to each other.

Independent work: Preparing evaluation commentaries for the second and third lessons (15 minutes)

Student Teachers work alone to prepare commentaries that include evidence of improvement in the second lesson over the first and the third lesson over the second lesson.

Tell Student Teachers that unfinished work at the end of the session is homework to be completed by the next class session.

Session 3: Self-evaluation of entries in a portfolio (cont.)

At the beginning of this session, ask four students, two whose work is above-average for the class and two whose work is average for the class, to be prepared to present their summary statements about growth in teaching based on evidence from their Semester 3 Student Teaching Practicum Portfolio. Ask them in particular to talk about how they used the NPSTP to look for evidence of growth in teaching skill in their lessons.

Pair work: Feedback on the commentaries prepared for Lessons 2 and 3 (15 minutes)

Student Teachers work in the pairs they formed in the last class session to provide feedback to each other on the evidence they are using to make the case for improvement in their lessons over the course of the Student Teaching Practicum.

Independent work: Summary with supportive evidence from portfolio of growth in teaching over time (15 minutes)

Student Teachers work alone to summarize the evidence they used from entries to a portfolio to argue the case for improved teaching. They are expected to use Standards 1 and 4 of the National Professional Standards for Teachers in Pakistan as the criteria for growth. These criteria should be in the summaries.

Individual reports to the class on the use of entries in a growth portfolio (20 minutes)

Remind Student Teachers that the work they have been doing with their Semester 3 portfolios can be used (probably with some revision) to fulfil part of the requirement for the Semester 4 portfolio.

Encourage members of the class to ask questions of those who report to the class on their efforts to use entries from the Semester 3 portfolio to document growth in teaching skill.

Whole-class discussion: Advantages and disadvantages of portfolios for instruction and assessment (10 minutes)

Use the McMillan text (pages 259–261) as the basis for this discussion.

Explain that:

- Portfolios may be more useful for teaching and learning than they are for assessment. Making a portfolio requires students to use the higher-order cognitive skills in Bloom's Taxonomy of educational objectives (analysis, synthesis, and evaluation).
- Portfolios are particularly useful for teaching students how to evaluate their own work.
- Portfolios may work for formative assessment but are very difficult to use for summative assessment because scoring is unreliable.
- Standardizing a portfolio makes it easier to score with some confidence that the score is reliable. Standardizing a portfolio means that it is no longer only the individual story of a student's efforts, progress, and achievement.
- The individual nature of a portfolio has always been considered one of its virtues.

UNIT 4

TEACHER-MADE TESTS—HOW DO TEACHERS DO IT?

UNIT 4: TEACHER-MADE TESTS—HOW DO TEACHERS DO IT?

(4 weeks/12 hours)

Teaching and learning resources for Unit 4

Handouts for Student Teachers

Week 11

'Unit 4, Week 11, Session 3: Sun, Earth, and the Moon Unit Test'

'Unit 4, Week 11, Session 3: 'Sun, Earth, and the Moon Unit Test Key'

Week 12

'Unit 4, Week 12, Session 1: Template for Table of Specifications for the Sun, Earth, and Moon Unit Test'

Unit 4, week 12, session 1: Subject matter topics for the Sun, Earth, and the Moon unit grouped by learning objective

'Unit 4, Week 12, Session 2: Learning Objectives from Lessons in the Sun, Earth, and the Moon Unit Grouped by Subject Matter Topics'

'Unit 4, Week 12, Session 1: Table of Specification for the Sun, Earth, and Moon Unit Test'

'Unit 4, Week 12, Session 2: Use of Bloom's Taxonomy of Educational Objectives to Create Test Questions'

'Unit 4, Week 12, Session 2: Use of Bloom's Taxonomy of Educational Objectives to Create Test Questions (Answer Key)'

'Unit 4, Week 12, Session 3: Guidelines for Writing Test Questions'

'Unit 4, Week 12, Session 3: Sample Questions: Student Teacher Copy'

'Unit 4, Week 12, Session 3: Question-writing Exercise'

Week 13

'Unit 4, Week 12, Session 3: Guidelines for Writing Test Questions'

'Unit 4, Week 12, Session 3: Question-writing Exercise'

'Unit 4, Week 12, Session 3: Sample Questions: Student Teacher Copy'

NOTE: The week 13 handouts were distributed during Week 12.

Week 14

'Unit 4, Week 14, Session 1: Assessment Tracker'

'Unit 4, Week 14, Session 2: Sun, Earth, and the Moon Unit Test' (This was used in Unit 4, Week 11, Session 3)

Resources for faculty

Week 12

'Unit 4, Week 12, Session 3: Sample Questions: Instructor Key'

'Unit 4, Week 14, Session 3: Sun, Earth, and the Moon Unit: Instructor's Copy' (From Unit 2, Week 4, Session 1)

Readings

Weeks 11–14

- McMillan, pp. 156–196
- Miller, Linn, and Gronlund, pp. 78–79, 142–149, 159–160 and 512–551

Week 11: Tests as assessment tools

Session 1: Personal experience with tests

In class today (2 minutes)

Tell Student Teachers that tests are one of the most commonly used assessment tools.

Student Teachers will learn about the process of test construction in this unit, but before getting started with that, they will explore their personal experiences and previous knowledge about tests.

Group discussion on personal experiences with tests (25 minutes)

This exercise will help Student Teachers see how going through this course might have affected their experiences and preconceived notions about tests.

Tell the class that all of them have had extensive experience with tests as students. In this activity, they will think back on their experiences with tests and discuss them in small groups.

Divide Student Teachers into groups of two or three and ask them to reflect on their experiences with tests during their student life and their feelings about tests. They should also discuss their opinions about using tests after becoming teachers.

After discussing each group member's feelings, the groups should explore any differences of opinion they might have and if possible ways to resolve these differences.

Give the groups 10 minutes to reflect and write their thoughts in their notebooks.

Ask each group to share their group's feelings, experiences, opinions, and differences of opinions with the rest of the class.

Write any common themes emerging from the discussion on the board and ask Student Teachers to write them down in order to refer to them at the end of this unit and course.

Group discussion on strengths and limitations of tests (25 minutes)

In this discussion, Student Teachers will explore strengths and limitations of tests as assessment tools by connecting what they learned about tests in this class and their previous knowledge, feelings, and opinions about tests.

The main purpose of this discussion is to understand that just like other assessment tools, tests have strengths and limitations that are important for teachers to know in order to make good tests and use them appropriately.

Ask Student Teachers to go back to their original groups and connect their previous discussion on their personal feelings, experiences, and opinions about tests as assessment methods to what they have learned about the tests in previous sessions of this course.

Ask Student Teachers to focus on strengths and limitations of tests as assessment tools in light of their personal experiences and the knowledge acquired about tests and other assessment methods in this class.

Each group should come up with at least two strengths and two limitations of tests, and based on these, the groups should come up with two classroom situations:

- One situation in which a test would be the best assessment choice
- One situation in which a test would not work very well

Student Teachers should explain their choices.

Pick a volunteer from each group to share the responses to the discussion points.

Write the groups' discussion points on strengths and limitations of tests on a board and underline the ones repeated by more than one group.

Bring the class's attention to strengths and limitations that are common among the groups and solicit ideas to minimize these limitations.

Brainstorm with the class about more learning assessment situations where tests are the best fit and others where they are not. Also discuss the reasons behind Student Teachers' choices.

Encourage different opinions from the class on this issue and highlight the reasons behind these different opinions.

Closing (5 minutes)

Ask Student Teachers to take this time to reflect on today's class discussions and write one short paragraph on how the class discussion affected or did not affect their feelings or opinions about tests as assessment tools and to note at least one new thing they learned about tests.

Session 2: Achievement tests

In class today (10 minutes)

Tell the Student Teachers that after exploring their personal experience with tests and the strengths and limitations of tests as assessment tools, in this session they will focus on achievement tests. Student Teachers will comprehend the purpose of achievement tests and learn the characteristics of standardized tests.

Start a class discussion to find out what Student Teachers already know about achievement tests. Ask Student Teachers the following questions to start the discussion but do not limit the class to these questions. Let the discussion flow naturally. Be sure to keep this and all discussions Student Teacher–led discussions.

- You must have come across the phrase 'achievement tests'. What does it mean?
- In what context have you heard this phrase?
- In your opinion, what is the purpose of achievement tests?
- What role do achievement tests play in educational settings in Pakistan?

Take a few responses on each question from the class. If a Student Teacher raises a question or makes an interesting observation, be sure to include that in the class discussion.

Lecture on achievement tests (10 minutes)

Cover the following topics in this lecture:

- The definition of achievement tests. Try to tie in the Student Teachers' definitions from the introduction discussion as much as possible.
    - Achievement tests measure acquired knowledge or skill level in a specific area. In other words, it assesses the amount of knowledge students have retained after classroom instruction. Achievement tests are most often standardized.
- The purpose and significance of achievement tests in educational settings.

Introduction to standardized tests (15 minutes)

Tell Student Teachers to envision their educational experiences from primary level up until this point and think about the type of achievement tests they have come across.

Give them a minute or two to think and take a few responses from the class.

Even if Student Teachers do not know the name, ask them to describe the tests (for example, if the directions given on the test were predetermined and the same for everyone taking the test, if the scoring procedures and test-taking conditions were consistent for all the test takers).

NOTE: Most will describe some aspects or characteristics of standardized tests as most achievement tests administered in educational settings are standardized tests.

Incorporating Student Teachers' descriptions of standardized tests as much as possible, provide them with a definition of *standardized tests* and ask them to note it down in their notebooks.

Standardized tests are administered under standard conditions that are the same for all test takers. Characteristics of standardized tests include predetermined test directions, scoring standards, scoring interpretations, and test-taking conditions. These characteristics are standard and the same for all test takers.

Tell Student Teachers that standardized achievement tests will be the focus of this and the next session.

Group activity on examples of standardized tests (15 minutes)

Now that Student Teachers know what standardized tests are, ask them to work in groups of two to three to think of at least three examples of standardized tests they have taken and the characteristics of those tests that make them standardized.

Give the groups five to seven minutes to discuss and complete the task.

Ask a volunteer from each group to share their examples and characteristics and note them on the board.

After all the groups have shared their examples, ask the class if in their opinion, any one of those examples is not a standardized test. Student Teachers should also provide reasons for their opinions.

Closing (5 minutes)

Ask Student Teachers to take a few minutes to reflect on the session's discussions and write a short paragraph on their understanding of achievement tests and standardized tests. They should also include at least one new thing they learned about achievement tests and standardized tests.

Collect Student Teachers' reflections at the end of the class and read them carefully to get an idea of their understanding of achievement and standardized tests.

Session 3: Standardized tests

In class today (5 minutes)

Now that Student Teachers understand the characteristics of a standardized test, tell them that in this session they will work with a standardized test to highlight those characteristics. They will also study two types of score interpretations used with standardized tests: norm-referenced and criterion-referenced tests.

Have a short class discussion to review the definition, characteristics, and examples of standardized tests.

Group activity on standardized tests (25 minutes)

In this activity, Student Teachers study a standardized test (the 'Sun, Earth, and the Moon Unit Test') and look for the characteristics that make it a standardized test.

Divide Student Teachers into groups of two or three and provide each group with the 'Sun, Earth, and the Moon Unit Test' and the 'Sun, Earth, and the Moon Unit Test Key' handouts. Each group should take 10 minutes to study the test and come up with three characteristics that make it a standardized test.

NOTE: The answer key is also one of the characteristics of a standardized test, as it allows teachers to grade test takers' responses in a standard manner. Let the Student Teachers know about this characteristic if they do not come up with it on their own.

After 10 minutes of group work, have one Student Teacher from each group share their characteristics of the test with the rest of the class. Write these characteristics on the board and ask Student Teachers to make a note of them.

Lecture on two types of score interpretations for standardized tests (10 minutes)

Now that Student Teachers have an understanding of characteristics of a standardized test, introduce them to two ways to interpret scores (norm referenced versus criterion-referenced) from standardized tests.

Ask Student Teachers if they have heard about norm-referenced versus criterion-referenced scores and ask them for definitions first.

Write definitions of both types of scores and try to incorporate Student Teachers' explanations of the two concepts as much as possible. Ask Student Teachers to make a note of these definitions.

- **Norm-referenced test:** Compares each test taker's score against others taking the same test and identifies if the individual test taker did better or worse than others taking the same test.
- **Criterion-referenced test:** Compares the test taker against set standards on a test score scale and is used to determine the candidates' mastery of content material or skill level.

Group discussion on norm-referenced vs. criterion-referenced scores (15 minutes)

Ask the Student Teachers to work in groups of two or three to name two examples each of norm-referenced and criterion-referenced tests and explain their reasoning for choosing those examples.

After the groups are done, ask one person from each group to share their examples and reasons for choosing those examples with the rest of the class.

Student Teachers should come to the conclusion that most tests given in school settings (such as unit tests, exams, etc.) are criterion referenced whereas most competitive exams are norm referenced.

Closing (10 minutes)

Ask Student Teachers to brainstorm and write a short paragraph on reasons for the use of criterion-referenced exams in school settings and norm-referenced in competitive settings (such as university admissions exams).

Ask a few Student Teachers to share their responses with the rest of the class and make corrections if needed.

Homework

Ask Student Teachers to read pages 78–79, 142–149, 159–160 and 512–513 from the textbook *Measurement and Assessment in Teaching*.

This text explains the process of creating a of Table of Specifications (blueprint for a test) very well and will provide Student Teachers with a good background for next week's sessions.

Week 12: The test construction process

Session 1: Begin with a blueprint (Table of Specifications) for the test

In class today (5 minutes)

Tell the Student Teachers that this week they will learn how to create an achievement test. To begin, three terms need to be clarified: *objective*; *topic*, and *category*. When Benjamin Bloom created his taxonomy, he referred to the cognitive processes he thought teachers should help students develop as learning *objectives*. That terminology is a variation on the way the term *learning objective* is used in this course.

In the course, *learning objective* refers to a knowledge and/or skill that a student should acquire from a specific lesson and is tied to a particular subject matter topic. In each case (Bloom's use of the term *objective* and the use of the term *objective* in the lesson plan template taught in this course), the focus is learning. Bloom was thinking about learning and mental processes. The lesson plans in the course are focused on learning and subject matter topics. The two perspectives are not identical, but they are complementary. The terms *category* and *topic* are used in reference to subject matter. *Category* refers to clusters of related subject matter topics (for example, celestial motion). *Topic* refers to more specific subject matter knowledge or skill (for example, the Earth's axis and related motion).

Introduce a template for a Table of Specifications (5 minutes)

Distribute the handout 'Template for Table of Specifications for Sun, Earth, and Moon Unit Test'. Tell Student Teachers that a fair test assesses all the topics taught during an instructional unit (that the test is assessing) and stays away from topics not covered by the teacher. How do teachers make sure that they fairly cover the content taught during an instructional unit?

One of the tools used by teachers is a blueprint for the test called a Table of Specifications. In other words, the Table of Specifications is a technical name for the blueprint of a test. Constructing a blueprint for a test assures that the teacher has adequately covered the subject matter for the test and matched the test items with the appropriate learning objectives.

Direct Student Teachers' attention to the template. A Table of Specifications is a two-way grid on which the teacher lists the subject matter topics (typically called *content*) to be included in the test. (The subject matter topics [content] are listed in the far left column of the grid.) The learning objectives to be included in the test are typically drawn from Bloom's Taxonomy of educational objectives and written into the lessons to be covered in the test. The learning objectives are written across the top row of the grid.

Bloom's original taxonomy includes six cognitive processes arranged in a sequence of increasing complexity (knowledge, comprehension, application, analysis, synthesis, and evaluation). Assessment specialists suggest that teachers creating a Table of Specifications for the first time start with a simple cognitive framework that includes the first three cognitive processes (knowledge, comprehension, and application).

Introduce the process of constructing a Table of Specifications (15 minutes)

In this activity Student Teachers will study the template for a Table of Specifications for the 'Sun, Earth, and the Moon' unit test to learn about different features of a Table of Specifications. Keep Student Teachers' attention focused on the template and discuss the process for constructing a Table of Specifications with them.

When constructing a Table of Specifications for a test, teachers:

- identify the learning objectives in the lessons on which the test is based and place them in the top row of the table.
- group the subject matter topics in the lessons to be covered by the test under the appropriate learning objective. (This has been done for the Student Teachers. See 'Learning objectives from lessons in the Sun, Earth, and the Moon unit grouped by subject matter topics '.)
- group the subject matter topics into four or five content categories and label each category (for example, 'objects in the solar system').
- decide on the total number of questions on the test based on the number and complexity of the subject matter topics to be covered by the test and the time that can be allocated for taking the test.
- record this total number of test questions in the appropriate place on the table.
- decide on the number of test questions to be assigned to each subject matter topic and learning objective based on professional judgement about the importance of the subject matter topic and the learning objective to the goal of the unit and the amount of instructional time devoted to the subject matter topic and the learning objective in the unit's lessons.
- record the number of proposed questions in each of the boxes in the table.
- total the number of test questions proposed for each subject matter topic (rows).
- record numbers in the appropriate boxes on the table.
- total the number of questions proposed for each learning objective (columns).
- record numbers in the appropriate boxes on the table.
- determine the percentage of questions assigned to each subject matter topic and each learning objective and record in the appropriate boxes on the table.
- study the distribution of questions by subject matter and learning objective and determine if the distribution reflects adequate coverage of the content and learning objectives in the lessons on which the test will be based. If not, they revise the distribution of questions.
- write test questions for the test using the distribution by topics and objectives in the table.

NOTE: In the template for the table distributed to Student Teachers, Bloom's knowledge category is subdivided into definition and recognition and identification.

Small group activity: Creating subject matter (content) categories (10 minutes)

After discussing the process of creating a Table of Specifications, divide Student Teachers into groups of three. Ask each group to choose a reporter. Make sure they have two handouts (the template and the subject matter topics for the Sun, Earth, and Moon unit grouped by learning objective). Tell the Student Teachers to group the subject matter topics into four or five content categories (for example, relationships between the Sun, Earth, and Moon). Tell them to enter their content categories on the Table of Specifications template in the column labelled 'content'.

Small group activity: Creating a Table of Specifications (25 minutes)

Ask Student Teachers to remain in their groups but direct their attention to the front of the classroom. Choose four groups to send their reporters (one at a time) to the front of the room to report on their content categories. The purpose of this exercise, hopefully, is to show that, though they are working with the same list of subject matter topics, groups will not necessarily create the same content categories. Then tell them to return to work with their groups and turn the template into a completed Table of Specifications. Because they are familiar with the lessons in the solar system unit, they can use that knowledge to decide how many questions to include in the test and how to distribute those questions across the subject matter categories and learning objectives. After deciding on the total number of questions for the test and assigning numbers of questions to each subject matter category and learning objective, it is easy to calculate totals and figure percentages. Then each group must decide if their Table of Specifications gives adequate coverage to the solar system content and the learning objectives in the unit (knowledge, comprehension, and application). If not, they have to revise the numbers in the table.

The goal for this activity is to finish it in the time allotted so each group's table can be given to you, the Instructor, when the class ends. You can then provide written feedback and return the tables at the beginning of the next class.

Homework (10 minutes)

If most groups are not finished completing the Table of Specifications and you choose to give them additional time as homework, assign a one-page paper in which Student Teachers:

- explain the purpose of a Table of Specifications for a test
- describe any challenges they foresee in constructing blueprints for tests when they have their own classrooms
- give an opinion as to whether the value of a blueprint makes facing the challenges worthwhile.

If Student Teachers have given you their test blueprints, distribute the completed 'Table of Specifications for the Sun, Earth, and the Moon Unit Test'. Tell Student

Teachers to study it in preparation for comparing it with the Table of Specifications they created for the same science content and learning objectives. It is important for them to think for themselves in this exercise rather than be influenced by the blueprint on which the unit test was based. Ask them to think about the claim assessment specialists make when they write 'professional judgement is the essence of classroom assessment'. Ask the Student Teachers to consider if creating a Table of Specifications for a test is a good example of that claim. If so, why? Tell Student Teachers that the role of professional judgement in creating a Table of Specifications will be a discussion topic for the next class.

Session 2: From learning to create a Table of Specifications to learning to write test questions

If Student Teachers have not been given the 'Table of Specification for the Sun, Earth, and the Moon Unit Test' handout and 'Learning Objectives from Lessons in the Sun, Earth, and the Moon Unit Grouped by Subject Matter Topics', do so now.

In class today (5 minutes)

Announce the plan for today's class:

- Study the subject matter categories in Student Teachers' tables in comparison with the table created for the solar system unit test.
- Study the distribution of test questions across learning objectives in Student Teachers' tables in comparison with the distribution in the table created for the solar system unit test.
- Consider the role of professional judgement in creating a Table of Specifications for a test: what do educators mean when they use the term 'professional judgement'?
- Discussion of the role of professional judgement in creating a Table of Specifications for a test.

Class activity: Comparisons between Student Teachers' tables and the table created for the solar system unit test (20 minutes)

Write the subject matter categories from the table on the board or chart paper. (These were the subject matter categories used to create the test for the unit on the solar system.)

Ask the reporter for each group to report on the group's subject matter categories.

For each category that is the same as a category in the example, put a check beside it in the list of categories in the example.

For categories that are not in the example, write each category name on the board or chart paper.

Follow the same procedure with the distribution of questions across learning objectives.

For each total distribution that is the same (knowledge 16 [combine the two knowledge objectives], comprehension 10, and application 9), put a check in the box with the total number of application questions.

Write each different distribution on the board or chart paper.

Discuss each subject matter category that is different from the example.

Decide if the category is really not in the example or if it is actually similar in content to a category in the example. If the majority of Student Teachers in the class believe that it is similar, erase or mark through that category. If there are categories that remain, ask the members of the group that included that subject matter category to explain the reason. Tell Student Teachers to use their memory of the lessons in the solar system unit and the list of subject matter topics in the handout that groups subject matter topics by learning objectives to help with this task.

Follow the same procedure with the distribution of questions across learning objectives. If the numbers really aren't very different, erase or mark them out. If distributions are different (for example, 9 knowledge questions and 17 comprehension questions), ask for an explanation. Ask Student Teachers if, based on this comparison between the table for the solar system unit test and the Student Teachers' tables, they have recommendations for changing the Table of Specifications for the unit test. (In actual practice, this would also mean changing the test.)

A definition of professional judgement (10 minutes)

Explain that *judgement* refers both to an outcome (a decision, an opinion, or a conclusion) and to the mental process of reaching that outcome (for example, Ms Khan uses good judgement when she makes decisions about thought-provoking questions for a classroom discussion). Professional judgement is judgement used in the context of work. Professional judgement is formed, in part, by knowledge and skill and also by experience and personal values. Professional judgement is necessary when a teacher has to make decisions for which there are no rules and when he or she does not have a prescription or script to follow while teaching.

Ask Student Teachers if and when a teacher uses professional judgement in the creation of a Table of Specifications.

Group activity on classifying test questions (25 minutes)

The purpose of this exercise is to familiarize Student Teachers with the format of questions associated with the first three categories of Bloom's Taxonomy. Tell Student Teachers that dividing test questions according to Bloom's objectives is important for testing basic as well as higher-order thinking skills.

Remind Student Teachers that assessment specialists recommend using Bloom's first three objectives when Student Teachers and teachers are learning to construct tests.

Divide Student Teachers into groups of two or three and give them the 'Use of Bloom's Taxonomy of Educational Objectives to Create Test Questions' handout. The handout provides the description of the first three of Bloom's objectives. Ask the Student Teachers to take a few minutes to read them to refresh their memories.

The handout explains the task. Each group should carefully read the questions and identify one of Bloom's objectives for each of the 10 questions. Give Student Teachers 10 minutes to complete the task.

After the groups are done, one Student Teacher from each group should share their answers with the rest of the class. Take note of the questions that were assigned different objectives by different groups. Ask one Student Teacher from each group to go over each of the questions and discuss their reasons for assigning them to a specific objective.

After the discussion, provide groups with the handout 'Use of Bloom's Taxonomy of Educational Objectives to Create Test Questions (Answer Key)'. Each group should check their answers using the key and make corrections, if needed.

Ask the class if anyone disagrees with the answers from the answer key. If yes, they should explain their reasons. Make sure the Student Teachers understand that some questions are difficult to fit into any one of Bloom's objectives and can belong to more than one.

Homework

Give Student Teachers the 'Guidelines for Writing Test Questions' handout and ask them to read it before coming to the next session.

Session 3: Writing test questions

In class today (5 minutes)

Conduct a short class discussion to review Student Teachers' understanding of Bloom's first three objectives (knowledge, understanding, and application).

Tell Student Teachers that because they are now familiar with the question format and style associated with Bloom's first three objectives, in this session they will practice writing the sentence-completion (fill in the blank) and short-answer questions in each category.

Group activity on strong and weak test questions (25 minutes)

The purpose of this activity is to help Student Teachers internalize the guidelines for writing good test questions.

Divide Student Teachers into groups of two or three and tell them that they will use two handouts, 'Guidelines for Writing Test Questions' and 'Sample Questions: Student Teacher Copy' for this activity.

Ask the groups to use 'Guidelines for Writing Test Questions' to explore differences between weak and strong test question examples in 'Sample Questions: Student Teacher Copy'.

After taking some time to study the strong and weak question illustrations, ask the groups to write about the differences between the two and describe what makes a strong and a weak illustration for different question types.

Go through the exercise and ask Student Teachers to share their opinions about differences between strong and weak questions for each question type.

During this class discussion, encourage Student Teachers to give different opinions. For example, after eliciting opinions from one Student Teacher, ask the class if anyone has a different opinion and give that Student Teacher a chance to share their opinions, as well.

After the discussion, provide the groups with 'Sample Questions: Instructor Key' handout and give them some time to go through the explanation of differences between a strong and a weak question for each question type.

Question-writing activity (25 minutes)

In this activity, Student Teachers will practice writing sentence-completion (fill in the blank) and short-answer questions.

Tell the Student Teachers that now that they have learned about characteristics of good test questions, they will get a chance to write test questions.

Make sure that each Student Teacher has the 'Guidelines for Writing Test Questions' handout to consult when writing questions.

Provide each Student Teacher with the 'Question-Writing Exercise' handout. This handout explains the task in detail. The handout also contains two articles that Student Teachers will use for their test questions. One of the texts describes the monsoon season and the other is about the weather in Pakistan. The text on weather in Pakistan is available in the handout itself, but the monsoon article will need to be printed by the Instructor (the website is provided in the handout).

Ask Student Teachers to read the instructions in the handout carefully and go through both articles. After reading the articles, each Student Teacher should write one test question for each question type (a sentence completion [fill in the blank] question and a short-answer question) in each of the first three of Bloom's objectives (knowledge, understanding, and application). This means that each Student Teacher will write two questions in each category, thus six questions in total. They will write the other two question types (multiple-choice and true-false questions) described in the handout in the next class session.

Closing (5 minutes)

Let the Student Teachers use this time to work on writing their questions. Circulate in the class to provide them with assistance and answer any questions they might have.

Homework

Student Teachers should finish writing the six questions (sentence-completion [fill in the blank] and short-answer) from the activity for homework.

Week 13: Writing test questions

Session 1: Writing test questions, continued

In class today (5 minutes)

Tell the Student Teachers that in this session, they will practice writing multiple-choice and true-false test questions and will compile a short 12-item test together.

Conduct a short class discussion to review the guidelines for writing good multiple-choice and true-false questions. Use the 'Guidelines for Writing Test Questions' handout to carry on this discussion.

Question-writing activity (35 minutes)

In this activity, Student Teachers will practice writing multiple-choice and true-false questions.

Tell the Student Teachers that now that they have learned about characteristics of good multiple-choice and true-false questions, they will get a chance to write test questions.

Make sure that each Student Teacher has the 'Guidelines for Writing Test Questions' handout to consult when writing questions.

Student Teachers will be working with the handout 'Question-Writing Exercise' from the previous session and finish writing the other two questions types (multiple-choice and true-false).

Ask Student Teachers to read the instruction in the handout carefully and then go through both articles. After reading the articles, each Student Teacher will write one test question for each question type (multiple-choice and true-false) in each of the first three of Bloom's categories (knowledge, understanding, and application). This means that each Student Teacher will write two questions in each category, thus, six questions in total.

After writing the questions, Student Teachers should compile the six questions (sentence completion and short answer) from the previous session and six questions from this session (multiple-choice and true-false) on one piece of paper to create a 12-question mini-test.

Test feedback activity (15 minutes)

Tell the Student Teachers that in this activity, they will swap their tests with another Student Teacher and provide each other feedback on the quality of their test questions.

Divide the Student Teachers into groups of two and ask them to exchange their test with their partner.

Each Student Teacher should consult the 'Guidelines for Writing Test Questions' handout to review their partner's test questions.

They should write suggestions and feedback for their partners on the questions that (in their opinion) need improvement.

Closing (5 minutes)

Tell the Student Teachers that they will continue to work on the feedback exercise in the next session.

Tell the Student Teachers that now that they have understood the process of writing good test questions, they should take a few moments to think about how the questions they have written are different from questions they have encountered as students.

Ask Student Teachers to write their opinions about the above-mentioned question in a short paragraph.

Homework

Student Teachers should finish the closing activity exercise as homework.

Session 2: Putting the test together

In class today (10 minutes)

The purpose of this discussion is to learn about Student Teachers' understanding of the question-writing process.

Conduct a small discussion on the prompt from the previous session's closing writing exercise: 'How are the questions you have written different from the questions you have encountered as students?'

Take a few responses from the class and follow the Student Teachers' lead to carry the discussion. Encourage those with different answers and opinions to share their views and raise further questions.

Test feedback activity continued (25 minutes)

After learning about Student Teachers' understanding of the test-writing process, direct their attention to the test feedback.

Tell the Student Teachers to return to their partners from the previous session and continue to provide feedback on each other's tests. Give groups 15 minutes to finish the task.

After they are done providing each other written feedback, ask them to return their partners' tests.

Each Student Teacher should carefully study the feedback provided by their partner and discuss any conflicts they might have about the feedback.

After resolving the issues, Student Teachers should incorporate their partners' feedback to improve their test questions.

Group discussion on clear test directions (20 minutes)

The purpose of this discussion is to familiarize Student Teachers with the process of writing clear and concise test directions.

Tell the Student Teachers that now that they have learned about writing effective test questions, during the rest of this session they will study writing clear and concise test directions.

Divide the Student Teachers into groups of three or four and ask them to consult the 'Sample Questions: Student Teacher Copy' handout. The groups should take five minutes to study the directions for answering different types of questions presented in this handout.

After studying the handout, ask the groups to discuss the following:

- What are the characteristics of good test directions? Explain reasons for your choices.
- Why is being able to write good test directions important for a teacher?

Give the groups time to discuss the questions and write responses in their notebooks.

Ask a Student Teacher from each group to present their responses to the rest of the class.

Note the characteristics of good test question directions on the board. Make additions to the list if Student Teachers have left out any important characteristics.

Closing (5 minutes)

Ask: 'Why are good test directions important for creating a fair test for students?'

Take a few responses from the class.

Homework

Ask Student Teachers to brainstorm about the question from the closing activity and answer it in a short paragraph. Collect responses in the next session and read them to get an idea of Student Teachers' understanding of the test direction writing process.

Session 3: Writing directions for tests

In class today (5 minutes)

Take this time to review the characteristics of good test directions with the Student Teachers.

Tell them that in this session they will write test directions for their mini-test.

Test directions writing activity (25 minutes)

Tell the Student Teachers that in this activity, they will write test directions for the test they created in the previous session. Student Teachers will consult the 'Sample Questions: Student Teacher Copy' handout for help.

Student Teachers should write the directions for the test as a whole (directions that apply to all the questions in the test, such as using a certain kind or colour of pencil or pen) as well as separate directions for each question type.

Activity for feedback on test directions (25 minutes)

In this activity, Student Teachers partner with each other to provide detailed feedback on their test directions.

Ask Student Teachers to find a partner and exchange their tests with each other.

Student Teachers should study their partner's test directions and provide detailed written feedback. If the partner feels that certain directions are unclear, they should not only point out those directions but provide suggestions for improvement.

After getting back the test, Student Teachers should study the detailed feedback provided by their partners.

If they do not agree with any suggestions or feedback, they should discuss those with their partners.

After the discussion, Student Teachers should incorporate their partner's feedback to improve their test directions.

NOTE: This test and the test key may count toward Student Teachers' grades.

Closing (5 minutes)

Student Teachers should continue working on improving the directions for their 12-question mini-test and use this time to ask any questions they might have.

Homework

Ask Student Teachers to write a complete answer key for their 12-question mini-test for homework.

Student Teachers are required to hand in their test as well as the test key at the beginning of the next class session to the Instructor.

Tell the Student Teachers that their test and the test key may count toward their grade.

NOTE: To prepare for next week, suggest that Student Teachers re-read their class notes for Weeks 2 and 6. The topic for Week 2, feedback, moves learning forward. That topic returns as a practice exercise in Session 2 of Week 14. The topic for Week 6 is 'Interpreting assessment data'. That topic returns in Sessions 1 and 2 of Week 14 as a practice exercise for interpreting test scores.

Week 14: Practice interpreting test scores

Session 1: One procedure for interpreting test scores

In class today (5 minutes)

Topics include:

- Raw scores (numbers) obtained from an assessment have to be interpreted to be useful in making decisions about teaching and learning.
- Sources that can be used to interpret scores: the assessment tool, especially tests; the learning environment in the classroom; the student's prior knowledge; and the instruction the teacher has provided.
- Assessment trackers as a framework for interpreting test scores.

NOTE: Remember to collect the Student Teachers' 12-question mini-tests and test answer keys from the previous class session. Remind Student Teachers again that these two items may count toward their course grade.

Class discussion: Interpreting test scores (15 minutes)

Ask Students Teachers if they had the opportunity to study their notes from Unit 2, Week 6 about interpreting numbers that some assessment tools, especially tests, produce. If half or more of class members indicate that they did study their notes, treat this as a question-and-answer session. If most Student Teachers did not re-read their notes, treat this as an oral presentation from the Instructor.

What did you learn previously in this course about the use of test scores?

Answer: The score that a test produces (the number of answers correct or incorrect) gives the teacher guidance about how much a student learned from the instruction on which the test was based, but it doesn't give guidance to the teacher about how to change instruction or to the student about changing learning strategies.

What does an assessment specialist mean when they say that a test score has to be interpreted?

Answer: They mean that the teacher has to look for explanations for a student's score.

Can you identify where a teacher might look for explanations?

Answer: The teacher might look first at other students' scores on the test to find those questions that were too hard for other students, and then how many of those questions were on the test. (To improve the test, the teacher will also look for those questions that are too easy.)

Is there another way to find out if the test was too hard?

Answer: Yes, the teacher can set a pass/fail criterion for the test. If more than 15 per cent of the students fail, the test is probably too hard for that particular group of students.

Is there another possible explanation for a student's score on a test?

Answer: Yes, the classroom environment may not be conducive to learning. It may be too unruly, making it difficult for students to pay attention. In contrast, the teacher may control students through punishment and fear, creating anxiety that interferes with learning. In either case, the number of students failing a test would be higher than expected.

Should the teacher look to the student for explanation(s) of the test score?

Answer: Yes. This is where a careful examination of a student's performance on the test can really help the teacher make decisions about corrective instruction. The student can also get information that will help her or him make decisions about learning strategies to use. If the student's score on the test is lower than usual for that student, the teacher can find out if the student was sick or in some other way troubled on the day the test was taken.

Is the teacher a possible source of explanations for students' test scores?

Answer: The instruction a teacher provides is certainly a possible explanation for students' test scores. This is one reason that a Table of Specifications is so important in the process of constructing a test. If the test includes questions that the instruction didn't cover or if the test contains many questions on a topic that wasn't emphasized in instruction, it isn't surprising that students will make errors on the test. Again, many students' scores will be affected by this problem.

Activity for introducing the assessment tracker (30 minutes)

Tell the Student Teachers that in this activity they will be introduced to a tool called the assessment tracker, which will help them interpret students' test scores. Explain that the example of this tool was created by a teacher based on the 'Sun, Earth, and the Moon Unit' and the unit test. The student responses to the test are hypothetical.

Tell Student Teachers that teachers use different types of tools to interpret students' test scores, some of which are very sophisticated computer programs. In this activity, they will learn to use a fairly simple tool called the assessment tracker. This can be created in a spreadsheet program or simply with pen and paper.

Divide Student Teachers into groups of two or three and provide them with the 'Assessment Tracker' handout. Also provide the 'Sun, Earth, and the Moon Unit Test' handout to use with the assessment tracker. Ask the groups to take some time to study the tracker and the 'Sun, Earth, and the Moon' unit test. Write down the features of the assessment tracker and answer the following questions:

- What do the *knowledge*, *comprehension*, and *application* headings in the top row mean?
    - They are the three learning objectives from Bloom's Taxonomy represented in the 'Sun, Earth, and the Moon' unit test.
- What do the numbers in the second row represent?
    - They represent the test question numbers in each objective. For example, question 30 on the test is a comprehension question.
- What do the numbers in the first column represent?
    - They represent the number of students.
- How many students are in this class?
    - Thirty-one students.
- What do the letters in the second column under 'student' represent?
    - They represent the initials of student names.
- What do the numbers in the last column under 'totals' represent?
    - They represent the number of questions a student answered correctly. For example A. A. got 30 out of 35 questions right.
- What do the numbers in the last row next to the heading 'sum' mean?
    - They represent the number of students that answered each question correctly. For example, 29 out of 31 students got the first question right.
- What does the number '1' entered in the cells of the table mean?
    - It means that the student answered that specific question correctly.
- What does '0' entered in the cells mean?
    - It means that the student did not get that answer right.

NOTE: The answers provided here are for the Instructor, to be used after Student Teachers have finished answering questions and sharing their answers with the class.

Give the groups 20 minutes to answer these questions and then go over the questions with the whole class. Ask the class each question one by one, take a few responses, and note down the correct answer on the board. Ask Student Teachers to make any corrections to their answers if needed.

Closing (10 minutes)

Ask Student Teachers to write a short paragraph on this topic: 'Do you think the use of an assessment tracker can improve your teaching? Why or why not?'

Homework

Ask Student Teachers to finish writing their response to the closing activity at home and be prepared to share it in the next class.

Session 2: Using the assessment tracker

In class today (5 minutes)

Topics include:

- A brief discussion of Student Teachers' initial opinions of the assessment tracker
- Practice identifying inappropriate questions (too easy or too hard) and eliminating them from the test
- Practice adjusting each test takers' score when the too-easy and too-hard questions are eliminated
- Practice identifying those students who failed the test
- Practice interpreting the test performance of those students who failed the test

Individual and group activity: Using the assessment tracker (30 minutes)

Remind Student Teachers that they are using a record of primary school students' performance on the 'Sun, Earth, and the Moon' unit test that is hypothetical. Remind them, also, that the teacher who created the assessment tracker entered the number '1' in a cell if the test taker answered the question correctly and a '0' if the test taker did not provide a correct answer to the question.

Give Student Teachers time to study the assessment tracker for the 'Sun, Earth, and the Moon' unit test.

Tell Student Teachers that their first task is to identify test questions that are too easy and too hard for these test takers by using the assessment tracker. Usually teachers use their professional judgement to set a criterion for determining if a question is too easy or too hard for students. For this test, if 15 per cent or fewer test takers answered a question incorrectly, it is safe to assume that the question was too easy. If only 15 per cent or fewer students answered a question correctly, it is safe to assume that the question was too hard. In the case of the 'Sun, Earth, and the Moon' test, 15 per cent translates into $(15/100) * 31 = 4.65$ students, which can be rounded off to 5. This means that if five or fewer students answered a question incorrectly, it is a too easy, and if five or fewer students answered a question correctly, it is too hard. Note: tell the Student Teachers that there are no research-based rules for picking questions that are too easy or too hard. Teachers use professional judgement to set the criterion for what is too easy and what is too hard. (The teacher who created the assessment tracker they are using set the 15 per cent criterion described for questions in the 'Sun, Earth, and the Moon' unit test.)

Tell the Student Teachers that after picking questions that are too easy or too hard, they should eliminate those from the test and readjust the test score (overall as well as individual test scores) accordingly. For example, if two questions are eliminated from the test, it will become a 33-question test (from a 35-question test). They will have to recalculate all test takers' scores out of a total score of 33.

Give the Student Teachers time to identify the questions that are too easy (questions 1, 16, 22, and 26) and too hard (questions 8 and 9). Eliminating these questions results in a test composed of 29 questions. After identifying and eliminating the questions that are too easy and too hard, have the Student Teachers adjust test scores for all the test takers.

The next interpretive task is to identify those students who fail to pass the test. Tell Student Teachers to rank the students from highest to lowest scores using the adjusted scores they created by eliminating the four questions that are too easy for these test takers and the two questions that are too hard. Again, the teacher who constructed the 'Sun, Earth, and the Moon' unit test and the assessment tracker for the test used professional judgement to set a pass/fail criterion. Tell the Student Teachers that sometimes pass/fail criteria are set by the school or the school district.

For the purpose of this test, the teacher's pass/fail criterion is 55 per cent; that is, if a test taker answers 55 per cent or more of the 29 (adjusted score) questions on the test correctly, they are given a passing grade. (Fifty-five per cent of 29 is 15.9, rounded off to 16.) Tell the Student Teachers to use this criterion to make a list of the students who were not able to pass the test. Using this criterion, three students (T. T., C. W., and Z. W.) failed the test. The teacher decided, based on information about the student from other sources, to include M. K. in the group that failed the test, although this student earned a score right at the cut-off for passing.

Having identified those students who failed the test, the next and most important task facing the teacher is to decide on the additional help to provide for these students. This is purely a matter of professional judgement, as is the decision to include the student who earned a passing score of 16 on the unit test with the students who will receive additional instruction on the content of the 'Sun, Earth, and the Moon' unit.

For their next task in this practice exercise, ask Student Teacher to select one of the four students identified for additional help and to circle the questions answered incorrectly by the student they chose.

(Key for Instructor: M. K. missed questions 3, 7, 17, 18, 19, 23, 5, 13, 30, 34,11, 12, and 14; Z. W. missed questions 3, 6, 18, 20, 23, 24, 27, 31, 2, 10, 30, 34, 11, and 12; C. W. missed questions 3, 4, 7, 17, 18, 20, 23, 24, 27, 31, 2, 10, 30, 34, 11, 21, and 25; and T. T. missed questions 3, 19, 28, 5, 10, 13, 35, 11, 14, 21, 29, 32, and 33.)

Remind Student Teachers of the obvious fact that when they are teaching, they will provide corrective instruction for all students who fail a test. In this course they are engaged in a practice exercise.

Homework (10 minutes)

Before class ends today, Student Teachers should have chosen one of the four students identified for corrective instruction and recorded the questions that those students answered incorrectly on a copy of the unit test. The homework assignment is to study those questions and identify the subject matter topics for corrective instruction. Each Student Teacher should come to the next class session with a written statement about the subject matter topics chosen for the student, the lessons from the 'Sun, Earth, and the Moon' unit that will be used to prepare lessons for the student, and an explanation for these choices based on data from the assessment tracker.

Closing (5 minutes)

Revisit the discussion at the beginning of this class session. Ask Student Teachers their opinion of the assessment tracker's value: 1) as a means for improving their teaching and 2) as a means for improving the test. Take as many responses from Student Teachers as time permits.

Session 3: Using the assessment tracker (cont.)

In class today (5 minutes)

Topics and activities include:

- Small group discussions of yesterday's homework assignment
- Targeted feedback to a primary school student who performed well on the 'Sun, Earth, and the Moon' unit test
- Opinions at this time about the value of the assessment tracker to teaching and learning
- Ideas for changing and improving the assessment tracker

Small group discussions: Planning corrective instruction for students who failed the 'Sun, Earth, and the Moon' unit test (25 minutes)

Guide Student Teachers to place themselves in groups based on the student whose test performance they chose to study (M. K., C. W., Z. W., or T. T.). Groups should not be larger than four Student Teachers. It will be necessary to create more than one group when more than four Student Teachers have chosen one of the (hypothetical) students.

Tell each group to choose a reporter. Each group should have at least one copy of the assessment tracker and one copy of the 'Sun, Earth, and the Moon' unit. Each Student Teacher will have their copy of the unit test with the questions the student misidentified. Each Student Teacher will have the first phase of a plan for corrective instruction for the student that, based on the assessment data, identifies the subject matter topics and lesson learning objectives as well as the unit lessons that present those topics. These initial plans are the focus of the groups' discussions. After 15 minutes, call the Student Teachers together so that each group can share with the class.

Here is an example to share with Student Teachers after they have shared their work.

> The student M. K. missed 13 questions, placing her at the cut-off point for passing the test. She made an error on two questions each for three important concepts in the 'Sun, Earth, and the Moon' unit: distance affects size perception, celestial movement that produces day and night on Earth, and phases of the Moon. While these six questions represent approximately half the errors she made, the concepts are important to the goal of unit. The concepts are important to further study of the solar system. Focus for corrective instruction suggests that the new lessons would be created from subject matter content in Lessons 2, 5, and 7. Learning objectives for the corrective lessons might include: M. K. will understand the concept of a scale model, M. K. will be able to explain the roles of the Sun and Earth in creating day and night, and M. K. will understand the lunar/Moon cycle and be able to explain it in her own words.

It is not wise to proceed further with corrective lessons because the questions M. K. answered incorrectly are not available. Those errors are important for interpreting M. K.'s performance on the test. Help Student Teachers understand that the original unit lessons will not be repeated but do represent a starting place for planning corrective instruction.

Individual activity: Targeted feedback to a student who performed well on the 'Sun, Earth, and the Moon' unit test (20 minutes)

Ask Student Teachers to write feedback to a student who earned a maximum score on the test after the score was adjusted. Make another copy of the unit test available to Student Teachers.

Tell Student Teachers feedback cannot be provided to other students in the group because their answers to the questions are not available. Student Teachers will probably agree that students who perform well on a test have an equal right to feedback as do those who earn lower scores.

Remind Student Teachers that feedback needs to be selective and should cause a student to think, and that praise by itself doesn't meet these conditions. After 10 minutes of individual work, tell Student Teachers to find a partner and exchange tests with feedback statements for feedback.

Group discussion: Opinions about the value of the assessment tracker for teaching and learning and ideas for improving the assessment tracker (10 minutes)

Class sessions this week have been used to introduce one framework for interpreting test scores. Student Teachers now have some experience with test interpretation. The purpose of this last session of the week is to hear their opinions about the assessment tracker they have been using and their ideas about making the tracker easier to use and/or more useful. Suggest that Student Teachers make notes about this discussion in their course notebooks.

One example is that the assessment tracker does not provide any feedback about what wrong answers the test takers chose. This can easily be improved for multiple-choice and true-false questions by inserting the wrong answer instead of '0' in the assessment tracker. By doing so, teachers can provide students with more targeted help.

Closing (5 minutes)

Ask Student Teachers to leave their homework assignments that they used in class today on your desk as they leave class.

Remind them to bring the science unit lessons for which they wrote learning objectives, assessment targets, success criteria, and assessment tools and activities with them to the next session.

UNIT 5

REVIEW THROUGH PRACTICE

UNIT 5: REVIEW THROUGH PRACTICE

(2 weeks/6 hours)

Teaching and learning resources for Unit 5

Handout for Student Teachers

Week 15

'Unit 5, Week, 15, Session 1: Sample Lesson Plans with Embedded Assessment Plans'

Week 15: Writing an assessment-embedded lesson plan

Session 1: Preparation for writing a lesson plan with an embedded assessment plan

At the end of the previous session, Student Teachers were asked to bring to class the science unit lessons for which they wrote learning objectives, assessment targets, success criteria, and assessment tools and activities.

Today in class (5 minutes)

The outline for today's class:

- Review the difference between *learning goal*, *learning objective*, and *learning target*.
- Review the meaning of *success criteria*.
- Elicit illustrations of learning objectives, learning targets, and success criteria from Student Teachers using their work with lessons from the solar system unit.
- Elicit illustrations of assessment tools and procedures from Student Teachers using their work with lessons from the solar system unit.
- Study lesson plans with embedded assessment plans in school subjects other than science.
- Create a lesson plan template using lesson plans in science, English, and math.
- Homework assignment.

Review the meaning of *learning goal*, *learning objective*, and *learning target* (10 minutes)

If you look back through the course guide to Unit 2, Week 4, Session 1, you will find the definitions of *learning goal*, *learning objective*, and *learning target*. The intent here is to have students use their notes to review the meanings of these concepts. If they have difficulty, write the meanings on chart paper and post it on the wall. Perhaps these concepts should be left visible throughout the week. Though this is a review lesson, you might want to add some information about goals that was not included in the original lesson. You might want to add that a goal is a broad statement of a desired outcome. A goal is composed of several objectives and does not have a specific, measurable outcome. Goals are usually long term, while objectives are to be achieved by the end of a lesson.

Review the meaning of *success criteria* (5 minutes)

Success criteria is a concept that is also defined in Session 1 of Week 4. Again, rely on the Student Teachers to produce the definition. Assist them only if they are struggling with the meaning.

Elicit examples of learning objectives, learning targets, and success criteria from Student Teachers (10 minutes)

These examples come from lessons in the solar system unit. Student Teachers will cite examples they wrote into the lessons they used from the unit during Week 4. You might want to start this segment of today's session by reminding them of the learning goal of the solar system unit (Unit 2, Week 4, Session 1). If you find that they were not as precise when they wrote the objectives, targets, and criteria for the solar system lessons, you can give them the following example from another subject:

Learning objectives:	Students will be able to define the English word *homophone* Students will be able to give three examples of homophone pairs
Learning targets:	Students will define the word *homophone* Students will write three examples of homophone pairs
Success criteria:	Students' definitions will include the phrases 'sound the same, spellings and meanings are different' Students' written examples will include correct spellings and definitions. Example: heal (to get back health), heel (the back part of the foot)

Small group work: Recalling the assessment tools that have been used or studied in the course (10 minutes)

Form groups of four or five students. Ask each group to list all of the assessment tools they have either worked with or read about during the course. The tools that have been created, used, and/or studied or discussed are monitoring logs (teacher), subject matter journals (students), structured observation, interviews, anecdotal records, essays, projects, summative tests, and portfolios. In addition, Student Teachers have created or studied record-keeping devices for assessment data: a line graph and different forms for recording assessment data (calories and exercise minutes per day, performance on a math quiz, and student participation in class discussions).

Invite one group to report. After they have reported their list, invite other groups to add anything that is missing. If convenient, copy the complete list and give it to each Student Teacher at the beginning of the next class. The list may help them choose assessment tools for their lesson plans.

Small group work: Discussion of English and math lesson plans with embedded assessment plans (5 minutes)

Hand out the lesson plans in English and math ('Sample Lesson Plans with Embedded Assessment Plans'). Tell Student Teachers to look just at the lesson plan format and compare it with the format for the science lessons in the solar system unit. The purpose is to determine if the two templates are the same or different.

Create a template for a lesson plan (10 minutes)

Remind Student Teachers that there are several ways to structure a lesson plan. The lesson plans in English and math have essentially the same structure as the science lessons they have been looking at throughout the course.

Choose two Student Teachers whose penmanship and English are good. They will be the scribes. (To avoid fatigue, they can split the task in half.) While you guide Student Teachers to identify each element of the lesson plan structure, the scribes will write it in outline form on the chart paper.

Use their ideas to create a lesson planning template that may look something like this:

Subject:
Topic:
Grade level:
Time required:

Learning objectives:
Learning targets:
Success criteria:
Assessment tools:

Materials required for the lesson:

New vocabulary in the lesson:

Introduction to the lesson: connections to prior knowledge
Guiding questions

Exploration 1
Guiding questions

Exploration 2
Guiding questions

Exploration 3
Guiding questions

NOTE: These explorations are the equivalent of learning activities and pacing in other lesson plan templates. The number of explorations depends upon the subject and topic.

Culminating activity: Assessment

Remind Student Teachers that although the template includes a culminating activity for assessment, they should remember that assessment can occur at any point in the lesson and that questions are an important assessment tool.

Homework (5 minutes)

Tell Student Teachers that their assignment is to choose a topic for their lesson plan and that it should be submitted to you at the end of the third session this week. They can choose any topic, but they should follow the template.

Their lesson plan should demonstrate how to embed assessments that are valid indicators of success criteria in the lesson; that is, how to make assessment part of teaching and learning.

Sessions 2 and 3

Student Teachers will complete their lesson plans in class during Sessions 2 and 3. Feedback from a partner is an important part of the process. One feedback session should be scheduled in the last 20 minutes of Session 2. A second feedback session should be scheduled midway through Session 3. The outcomes from these feedback sessions can be shared with the class in the last 15 minutes of Session 3.

Week 16: Writing a test based on essay questions that could be used as a final examination for this course

Session 1: Preparing to write essay questions for a final examination

Although Student Teachers in this course have studied essay questions, they have not yet tried to write them. Researchers have determined that writing and answering test questions for a test you are about to take is a particularly good way to study for the test. The purpose of this week's work is to 1) give Student Teachers the opportunity to practice writing essay questions using topics covered in this course and 2) simultaneously provide the opportunity for the Student Teachers to review the content of the Classroom Assessment course. If the books are available, Student Teachers should refresh their memory about essay questions by re-reading McMillan, pages 202–215, and Miller, Linn, and Gronlund, pages 232–250.

Although effective writing is a foundation for written communication that reveals knowledge and reasoning skills, essay test questions are not primarily tests of writing skill. Essay questions are primarily a test of how much a student knows about a particular topic and how well she or he can think using that knowledge. To say this another way, teachers develop tests of writing skill that are different from essay tests, which are intended to assess higher-order mental processes. Essay questions are the test of choice when a teacher wants to assess students' ability to think and reason. This distinction between a test of writing skill and a written test of reasoning skills is important for teachers to understand.

Essay questions are a very powerful. With essay questions, there is one question or proposition that allows the student to demonstrate reasoning. Essay questions demand the use of higher-level thinking skills such as analysis, synthesis, and evaluation.

Given the importance of learning how to write good essay questions and the fact that this may be the first practice session for these Student Teachers, you can exercise the option of providing lots of opportunity for feedback on their work but not grading it. The assumption here is that Student Teachers will feel freer to be creative and take risks with the questions they write if they know they will not be graded. If, however, you gave them opportunity to practice writing essay questions in Week 8 with good feedback on their work, you may want to give them grades on these questions. They should know in advance whether their questions will be graded or not. Finally, be sure they know in advance that the content of their questions comes from the content of the Classroom Assessment course.

In class today (5 minutes)

The first 40 minutes of this session will be used to review guidelines for writing essay questions. The remaining 20 minutes will be used to review the content of the Classroom Assessment course. The agenda for today:

- Review the purpose and limitations of essay questions (5 minutes)
- Review the difference between restricted-response essay questions and extended-response essay questions (10 minutes)
- Examine types of thought questions and related item stems (15 minutes)
- Scoring essay questions: The practice of composing an outline of an acceptable answer or an example of an acceptable answer (10 minutes)
- Small group study of course syllabus to identify topics for essay questions (10 minutes)
- Class discussion of course topics for essay questions (10 minutes)
- Closing (5 minutes)

Question and answer interaction: Purpose and limitations of essay questions (5 minutes)

NOTE: You and the Student Teachers studied essay questions in Week 8. The first part of this session is an opportunity for Student Teachers to review what they have previously learned. Use questions to prompt them to recall knowledge they should have.

Ask the question, 'What do essay questions assess?'

- If properly written, an essay question requires the person answering the question to organize, integrate, and interpret information; to argue for a point of view; and to evaluate ideas.
- Essay questions assess complex thinking that is difficult to assess with objective test items.
- Essay questions require the person answering the question to compose rather than select an answer.

Ask the question, 'What are the limitations of essay questions?'

- Essay questions seem to be easy to write, but that is a misconception. Essay questions often assess factual knowledge rather than reasoning. That is a mistake.
- Essay questions are very hard to score reliably. Studies show that one teacher grading the same tests twice will give different grades to the same test the second time. Scoring essay tests is unreliable.
- Essay questions are focused on just one or two topics.

NOTE: If necessary, ask more than one Student Teacher to respond to each of these questions by asking, 'Does anyone want to add to their answer?'

Presentation: Differences between restricted-response essay questions and extended-response essay questions (10 minutes)

Share an example of a restricted-response essay question. For example: 'Using your own words, explain two differences between igneous and sedentary rocks and give one example of each not discussed in class'.

Extended-response questions allow the student to determine the length and complexity of the answer. This type of question is most useful at the analysis, synthesis, and evaluation levels of cognitive complexity.

Here is an example of an extended response question: 'Compare and contrast the presidential administrations of Pervaiz Musharraf and Asif Ali Zardari. Consider economic, social, and military policies. Avoid taking a position in support of either president. Your answer will be judged on objectivity, organization, accuracy, and clarity'.

Presentation and small group work: Types of thought questions and sample item stems (15 minutes)

For this presentation, use the material on pages 240 and 241 of the text by Miller, Linn, and Gronlund. Select five of the thought questions (such as comparing, explaining, and persuading) that you think are most likely to be used by primary school teachers in Pakistan and write them on the board or chart paper. Underneath each thought question, write the item stems.

Example: Comparing
Describe the similarities and differences between _______.
Compare the following two methods for _______.

Tell Student Teachers to assemble quickly into five groups and choose a reporter. Assign each group one type of thought question and give them five minutes to write one restricted-response essay question and one extended-response essay question using the item stems. If time permits, have each group read one of the essay questions the group wrote to the class.

Presentation on scoring essay questions (10 minutes)

Remind the class that essay questions are very hard to grade. Remind them, also, that essay questions can be graded using a holistic method or an analytic method and that each method is described in the textbooks for the course. Tell them that writing an outline identifying criteria for a good answer when they write the question will help them grade the answer. Or they can put themselves in the role of the student when they write the question and also write the answer, using the answer as a model when grading the students' answers.

Return to the questions they wrote in response to the thought questions and item stems on the board/chart paper. Choose one of the questions. Ask the Student Teachers as a class to think about the criteria a teacher could use to grade the answer to that question. If you have time, do this with two of the questions written by the small groups.

Small group study of the course syllabus to identify topics for essay questions on a final examination (10 minutes)

Student Teachers can remain in the groups they formed when they studied types of thought questions and related item stems. They have a reporter. Ask them to scan the course syllabus and identify topics for both restricted-response and extended-response essay questions.

Class discussion of course topics for essay questions on a final examination (10 minutes)

As each group reports the topics that the group identified as course topics for essay questions on a final examination, write the topic on the board or chart paper. These topics, along with the types of thought questions and item stems, can remain in public view during the next two class sessions as Student Teachers write their essay questions.

Closing (5 minutes)

Tell Student Teachers that the remaining sessions of the course will be used to write essay questions based on topics covered in the Classroom Assessment course. Though they will depend upon each other for feedback, each Student Teacher will write their own questions. This is the time to tell them if the questions will be graded. Suggest that they review their course notebooks as homework before the next class. Recommend that they bring their notebooks to class as an aid to selecting topics and developing questions. Their copy of the course syllabus might be helpful, too.

Sessions 2 and 3

The end product of work in the second week of the unit is an essay test based on the content of this course. The number of questions will depend on the length of the examination period. That should be specified at the beginning of the second session.

This experience will be enhanced for Student Teachers if they are required to develop grading criteria for at least one of their essay questions.

At the beginning of the second session, Student Teachers can exchange the questions for which they wrote the scoring criteria with their feedback partners. Each person keeps the grading criteria they developed for the question without showing the criteria to the feedback partner. The partners will answer each other's questions and then return them to the writer for marking. Each partner should see how her or his answer was marked.

The essay tests must be finished before the start of Session 3. Session 3 is devoted to answering partner's questions and then marking partner's answers using the criteria developed while writing the question. Each partner is allowed to see the way her or his answer was marked.

Course resources

National Professional Standards for Teachers in Pakistan (NPSTP): Standard 5 Assessment

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	Level 1	Level 2	Level 3	Level 4
5.1 Linked to learning outcomes	Formal and informal assessment is conducted in a general way not clearly linked to learning outcomes or instruction.	**Formal assessment is linked to planned learning outcomes and a variety of appropriate assessment strategy(ies) are used. Informal assessment is still general in nature.**	Formal and informal assessment is clearly linked to planned learning outcomes using a variety of assessment strategies. **Assessment is fully integrated into teaching and learning planning and classroom activities to achieve ILO's.**	Assessment is linked to planned learning outcomes and a range of strategies are used effectively to assess learning; assessment is integrated into teaching and learning and **there is a belief that children's learning outcomes are the basis for growth and development and opportunities for learning for the children and the teacher.**
5.2 Formative Assessment	Occasionally checks for understand of the whole class in general, but does not use this to change teaching or reinforce learning.	**Conducts formative assessment through continuous checking for understanding throughout the lesson. Uses standard assessment tools for the whole group to ensure that all children are learning progressively and attempts to modify teaching as a result.**	Plans and conducts formative assessment through continuous checking for understanding. **Uses a variety of teaching strategies to assess how children are learning, what they know, what they are able to do, and what kinds of learning experiences will support further growth and development. Modifies teaching based on assessment data.**	Plans and conducts a variety of formative assessment measures using teaching strategies that provide opportunities for continuous checking for understanding and uses these to change teaching and reinforce learning during the lesson. **Sets and modifies appropriate teaching and learning objectives.**
5.3 Summative Assessment	Assessment of child's learning is conducted in traditional 'test taking' manner with very little variety and opportunity for children to display a variety of strengths and learning.	**Assessment of child's learning / progress includes a variety of fair and objective assessment tools, which provide an opportunity for children to display a variety of strengths and learning.**	Assessment of child's learning / progress includes a variety of fair and objective assessment tools **including self-made tools** (**based on theoretical knowledge and experience in the classroom) which provide an opportunity for children to showcase a variety of strengths and learning.**	Assessment of child's learning / progress includes a variety of fair and objective assessment tools including self-made tools (based on theoretical knowledge and experience in the classroom) which provide an opportunity for children to display a variety of strengths and learning. **Accurately documents, reports assessment data, and ongoing child's achievement, to parents and professional staff.**
5.4 Providing feedback	Provides basic feedback to children in a general way within class and on written work.	Provides feedback to children, which **is sometimes specific and constructive in class. Written feedback is starting to become constructive and specific.**	Provides feedback to children within class **and on written work, which is consistently specific and constructive.**	Provides feedback to children, which is consistently specific and constructive. **Coaches children to engage in objective self-assessment and monitor their progress towards achieving their personal goals.**

NPSTP Standard 5 Assessment (by level)

Level 1

- Formal and informal assessment is conducted in a general way not clearly linked to learning outcomes or instruction.
- Occasionally checks for understanding of the whole class in general, but does not use this to change teaching or reinforce learning.
- Assessment of child's learning is conducted in traditional 'test taking' manner with very little variety and opportunity for children to display a variety of strengths and learning.
- Provides basic feedback to children in a general way within class and on written work.

Level 2

- Formal assessment is linked to planned learning outcomes and a variety of appropriate assessment strategy(ies) are used. Informal assessment is still general in nature.
- Conducts formative assessment through continuous checking for understanding throughout the lesson. Uses standard assessment tools for the whole group to ensure that all children are learning progressively and attempts to modify teaching as a result.
- Assessment of child's learning/progress includes a variety of fair and objective assessment tools, which provide an opportunity for children to display a variety of strengths and learning.
- Provides feedback to children, which is sometimes specific and constructive in class. Written feedback is starting to become constructive and specific.

Level 3

- Formal and informal assessment is clearly linked to planned learning outcomes using a variety of assessment strategies. Assessment is fully integrated into teaching and learning planning and classroom activities to achieve ILOs.
- Plans and conducts formative assessment through continuous checking for understanding. Uses a variety of teaching strategies to assess how children are learning, what they know, what they are able to do, and what kinds of learning experiences will support further growth and development. Modifies teaching based on assessment data.
- Assessment of child's learning/progress includes a variety of fair and objective assessment tools including self-made tools (based on theoretical knowledge and experience in the classroom), which provide an opportunity for children to showcase a variety of strengths and learning.
- Provides feedback to children within class and on written work, which is consistently specific and constructive.

Level 4

- Assessment is linked to planned learning outcomes and a range of strategies is used effectively to assess learning; assessment is integrated into teaching and learning, and there is a belief that child-learning outcomes are the basis for growth and development and opportunities for learning for the children and the teacher.

- Plans and conducts a variety of formative assessment measures using teaching strategies that provide opportunities for continuous checking for understanding and uses these to change teaching and reinforce learning during the lesson. Sets and modifies appropriate teaching and learning objectives.
- Assessment of child's learning/progress includes a variety of fair and objective assessment tools including self-made tools (based on theoretical knowledge and experience in the classroom) that provide an opportunity for children to display a variety of strengths and learning. Accurately documents, reports assessment data and ongoing child's achievement to parents and professional staff.
- Provides feedback to children, which is consistently specific and constructive. Coaches children to engage in objective self-assessment and monitor their progress toward achieving their personal goals.

Notes on the use of the assessment standards:

This is one of 10 Professional Standards for Teachers adopted by the Policy and Planning Wing of Pakistan's Ministry of Education in 2009. The Standards are included in the Student Teaching Handbook for the Semester 3 practicum. Students should know how a *standard* is different from a *goal* and an *objective*. A standard is an approved example of a desired result. In this case the Professional Standards for Teachers in Pakistan represent knowledge that a person must have and skills that person must demonstrate to be considered competent to teach. A standard is more comprehensive than a goal: a goal is more comprehensive than an objective. Using Standard 5 as an example: assessment integrated into teaching and learning is a *standard*, lesson plans that include an assessment plan is a *goal*, assessment criteria in the plan that are a valid indicator of the lesson's learning outcome(s) is an *objective*.

The rubric for the standard is presented in two ways: as a table and as a list. The purpose of including these rubrics in the course is twofold: 1) to familiarize Student Teachers with the assessment standards they are expected to achieve by the time they complete the teacher education program in which they are enrolled: and 2) to identify those experiences in the Classroom Assessment course that should help them acquire some of the knowledge and develop some of the skills the assessment standard requires.

Student Teachers write a lesson plan that includes an assessment plan. Prior to writing their own plan, they study lesson plans that include assessment plans and practice writing learning objectives (outcomes) with linked assessment targets. They also practice writing assessment activities into existing lesson plans. Throughout the course they see examples of assessment tools; they conduct an interview and observation and design an informal math assessment. They also design a performance assessment and write a test composed of essay questions. They construct an objective test from a blueprint they created and study how to revise a test. Finally, they practice learning to give constructive feedback throughout the course by exchanging their practice exercises with a partner and giving feedback to each other.

As you teach the course you will find that it doesn't provide instruction and practice for all the skills and related knowledge contained in Standard 5. Identify skills that are missing and, if you have time, talk with Student Teachers about how they might practice some of them in the Semester 4 practicum. Student Teachers engage in a self-assessment based on the NPSTP at the end of the Semester 4 practicum. A dialogue in class throughout the course focused on expectations in Standard 5 and the course experiences that relate to those expectations can help with that assessment.

Unit 1, week 1, session 2

Assessment helps Asim gain weight

S

Twelve-year old Asim sits with his legs hanging from the clinic bed in the doctor's office and asks his mother, 'How long will this take? My friends are waiting for me to play cricket. We've been waiting too long!' Dr Qureshi walks in at that moment clutching Asim's files. 'Good morning, Naema. Good morning Asim. So, why are we here today?'

'Good morning, Dr Qureshi. I have just come for his regular health examination. And I am afraid he is not gaining weight'.

'Hmm. Let's see what is happening'. Dr Qureshi moves through his regular health examination procedures: he checks Asim's ears, heart, and respiratory system. 'Asim, please get on the scale so we can check your weight'. Asim lifts himself off of the bed and moves to the scale. Dr Qureshi moves the numbers on the balance beam on the scale until it comes to balance. He copies down the number onto Asim's medical chart.

'Naema, it's like they say, never underestimate a mother's hunch. You are right. Asim's weight is quite below the average he should be at this age. He is more than one standard deviation below where he should be. This is not good, but we can easily fix this! You have to be ready', he declares while looking directly at Asim.

'We will set a weight gain goal for eight weeks from now. Asim, I've written down your goal here and will also give this to you. Naema, make sure he eats at least one cup of curd, roti with butter, and vegetables every day. He should also have one cup of lentils or meat twice a day to increase his protein. In this booklet, you will find the calorie count for different types of food depending on the serving. Every day, Asim should be eating 2500 calories. In this book, Asim, you will log the calories so you can make sure that you are eating the amount you need to gain the weight we have set as your goal. Every other day, you should weigh yourself to see the progress you are making. Naema, I've written down the approximate weight gain Asim should have each week to reach the eight-week goal. In this book I gave you, Asim, you should also log the amount of time that you exercise, as you use calories during that time. You'll have to factor that in to ensure that you are eating enough. This will increase the amount of calories you intake daily, which will be very good for you to gain weight. Asim, tell me what this will help do and why we are doing this'.

'Dr Qureshi, I don't weigh enough, so I have to gain more weight! This way I can track my progress to the goal we set'.

'Exactly, Asim. Naema, do you have any questions? Be sure to let Asim do most of the recording and tracking. It will be important for him to take control of this process'.

'Okay. I will report back to you. This monitoring will help'.

Naema and her husband post the monitoring document on their cupboard in their kitchen so that Asim could reach it. The family travels to the market in the evening to pick up important foods Dr Qureshi has asked them to add to Asim's diet. At the market, Asim requests various items.

'I want toffees!', cries Asim.

'Toffees aren't good for you', says Naema.

'Okay, what about guava and bananas?'

'Yes, let's get some fruit'.

'Asim's family is diligent and persistent. With Asim at their side, they plan out his meals at the beginning of the week. Asim records his calories daily (see Figure 1) and subtracts the amount of calories he has used from exercising. Every other day, as the doctor has requested, Asim weighs himself and also records this information.

At the end of the first week, Naema and Asim are dismayed that he has not gained additional weight despite their concentrated efforts. 'It's okay, Ma. We will keep trying', Asim reassures her. 'I think I played a lot of cricket on Thursday, and didn't eat enough calories. That might have been a problem. That happened a couple times this week'.

At the end of the second week, Naema, her husband, and Asim sit down for tea and look at Asim's monitoring and tracking log. To their dismay, they find that he has only gained one kilogram. At this rate, they realize that Asim will be far from meeting his eight-week goal. Naema calls Dr Qureshi to seek advice, and the doctor asks Naema to bring Asim in to the clinic.

Naema and Asim go to Dr Qureshi's clinic. 'This is surprising. I'm glad you came'.

Dr Qureshi, the plan you gave us is not working', Asim exclaimed. Dr Qureshi chuckles, and responds, 'I know. Asim. I'm going to make a new plan for us to try'.

'I also played too much cricket and didn't eat enough a couple days, so maybe it's my fault', Asim confesses.

'We'll find a solution', assures Dr Qureshi.

Dr Qureshi takes multiple tests and draws Asim's blood to gather more information.

'Okay, let's change a couple things in your diet. Naema, why don't you add some more protein and have Asim drink three cups of milk daily. Asim, make sure you keep exercising to build muscle, but eat enough calories daily. Let's see what that does. Keep tracking this information as you have been doing'.

Naema and her husband become even more diligent about the food Asim eats. At the end of the third week, Asim gains three kilograms, and at the end of the fourth week, he is on track to meeting the eight-week goal. 'Look at my arms! They're bigger', Asim confirms. Naema calls the doctor to inform him of this news.

'That's wonderful, Naema. Please pass the phone to Asim'. Naema hands Asim the phone, and Dr Qureshi says, 'Tell me Asim, what are you learning about what kinds of foods help you gain weight?'

'Dr Qureshi, I have to eat a lot more protein but can't forget other foods. When I exercise too, it becomes muscle'.

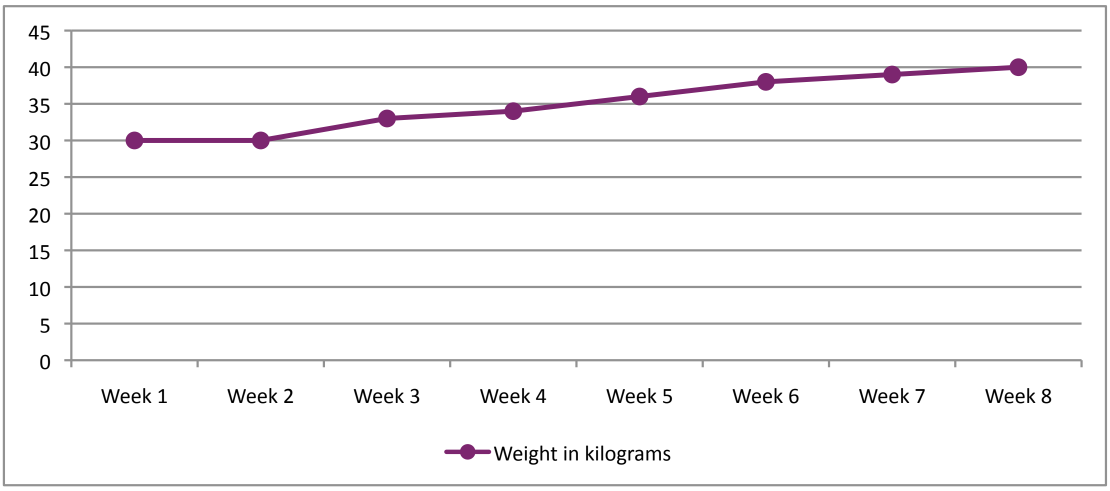
'That's right!'

At the end of the eight weeks, Asim has nearly reached his targeted goal for weight gain prescribed by his doctor.

Figure 1: Asim's monitoring chart

Day	Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
Calories consumed	3000	2500	2800	2950	2500	2600	2,700
Exercise (calories used)	300 (cricket)	200 (bike)	250 (cricket)	300 (cricket)	300 (cricket)	—	—
Total calories	2700	2300	2550	2650	2200	2600	2,700
Weight (kg)		30 kg		30 kg		30 kg	

Figure 2: Asim's weight gain



Discussion questions

1) You learned about formative assessment in Session 1. What features of formative assessment do you see in this example?
2) Learning goals drive instruction. What is a primary goal in this example, and how does this goal drive the action plan? What secondary goals are present, and what efforts are made toward those goals?
3) When and why are modifications to the action plan made? How might this compare to classroom practices?
4) In what ways does Dr Qureshi have Asim take charge of his goal? Why is this important?
5) How do the data records, both the chart and the graph, influence the action plan?

Unit 1, week 1, session 2

Assessment in a lesson about the solar system

Lesson 1: Objects in the sky

Learning objectives

Students will:

- understand that the universe is vast and has millions of different types of objects, including our solar system
- understand that the Sun is the centre of our solar system, which has eight planets.
- recognize the position of the Sun, Earth, and its Moon in the solar system
- know that all the planets revolve around the Sun in a circular path
- know the meaning of *orbit* and that paths of the planets around the Sun are called *orbits*.

Learning targets

Students will:

- understand that Sun is the centre of our solar system, which has eight planets
- recognize the position of the Sun, Earth, and its Moon in the solar system
- know that all the planets revolve around the Sun in a circular path called an *orbit*.

Success criteria

Students will:

- write the names of all eight planets in correct order
- draw a labelled diagram of the Sun, Earth, and the Moon to show their correct positions
- draw and label the paths of the Earth and Moon.

Vocabulary

solar system, planets, Sun, orbit, Moon, star

Advanced preparation

Assign the students the following homework the day before this lesson:

- Spend 10 minutes observing the sky at night and write and draw the objects in the sky.
- Write about your experiences and reactions while viewing the sky.

Materials required

- Chart paper
- Internet connection
- Video projector

Introduction (connections to prior knowledge)

Initiate a discussion to find out what students already know about the solar system, Earth, Sun, and the Moon. Ask students the following questions to conduct a class discussion:

- What do you know about the Sun?
- What do you know about the Earth?
- What do you know about the Moon?
- How are the Sun, Earth, and the Moon related?

Note student replies on a piece of chart paper so they can be used later in this lesson or the unit.

Exploration 1

Take students to the play yard and ask them to observe the sky and note the objects they see. The students should write and/or draw these objects. Encourage the students to draw any observations or conclusions about the size and number of objects or any other observations about the sky in general.

Ask the students to make a comprehensive list of images from the day and night skies.

Ask the students to note down the objects that they think exist in the sky but might not have been visible to them during the day and night observations.

Share

Bring all the students back to the classroom and give them a chance to share their observations.

Note students' observations on a chart paper.

Initiate a class discussion about the students' experiences during their sky observations. Use the following guiding questions and write the students' responses on the blackboard.

Guiding questions

- What are the different types of objects you saw in the sky?
- Were all the objects in the sky visible to us? Might there be other objects in the sky? Name them.
- What do you know about the Sun?
- Ask the students to write down at least three things they know about the solar system.
- Take a few student volunteers and ask them to share their responses with the rest of the class. Write these responses on the blackboard.

Exploration 2

In this activity, students will act like young astronauts and take a trip to the solar system through a short video.

During the video, students should write down and/or draw at least five interesting things about the solar system.

Show the following video, 'Solar System Animation for Kids', to the class. The video is 7 minutes and 41 seconds long:

➢ http://www.youtube.com/watch?v=sJrDiUG2JAo

Notes

This video features the following concepts:

- Even things big in size will look smaller from a distance. This gives the children an idea that the stars and planets look small from the Earth because they are really far away.
- It showcases the solar system and its planets and gives the order of the planets.
- It goes over the sizes of different planets and their few distinguishing features.

Share

Tell the students, 'Now that our space trip is over, let us share what we observed during our journey to space'. Take responses from as many students as time allows and note them on the blackboard.

Ask the students to write these responses in their science notebooks.

Guiding questions

Initiate a class discussion to give students a chance to share their observations with the whole class. Use the following guiding questions to conduct the classroom discussion and note students' responses on the blackboard. Ask the students to write their classmates' observations in their science notebooks.

- Describe the solar system in your own words.
- Why do objects in space seem so small?
- What is the position of our Earth and Moon in the solar system? Is the Moon also a planet?
- Is the Moon smaller, bigger, or the same size as the Sun? Why?
- Are planets stationary or in motion? Can anyone describe their motion?
- What are the paths of the planets called? Where does that name come from?

Ask students to note these observations in their notebooks if they have missed them during the video.

Refer to the chart paper from the introduction activity and Exploration 1 and explore with the students how and why their responses have changed or not changed after their virtual tour to the solar system.

Culminating activity

Formative assessment: Ask the students to write down the names of the eight planets in correct order.

Formative assessment: Ask the students to also draw a labelled diagram of the Sun, Earth, and the Moon in their correct positions. Also draw and label the paths of the Earth and the Moon.

> NOTE: At this point, students can use their judgement to capture the sizes in this diagram.

Go over the formative assessment answers with the students.

Ask a few students to share their answers with the class. Make corrections if needed.

Ask all the students to check their answers and make any corrections if needed.

Tell students that they will further explore the relative sizes of the Sun, Moon, and the Earth in the next lesson.

Additional resources

This site has cool animations of the movement of the solar system and other celestial objects.

- http://www.kidsastronomy.com/solar_system.htm

This site has a lot of useful information on the solar system and also contains some great pictures of the solar system.

- http://science.nationalgeographic.com/science/space/solar-system

Unit 1, week 1, session 2

Assessment in Ms Khan's grade 4 class

S

Introduction

Using Pakistan's 2006–2007 National Curriculum, Ms Khan created a science unit on the solar system for her grade 4 students. The fourth of seven lessons intends for students to learn how the Earth moves in relation to the Sun and Moon.

At the end of the lesson yesterday, Ms Khan gave a 10-item short-answer quiz. Twenty of her 31 students made errors on the questions about rotation and revolution. She looked at the papers of the 11 students whose answers to those questions were correct and found that only four had earned the highest scores on previous quizzes. This analysis led her to believe that students who scored correctly were not necessarily the smartest students in the class who could answer any type of question no matter how it was phrased. This led her to conclude that the problem was not in the phrasing of the question. Rather, students misunderstood the concepts that the questions attempted to address.

Consequently, she decided to reteach those concepts today using an English-language video she didn't use yesterday because she thought the English narration was too advanced for her students. The video uses three-dimensional models of the movements of the Earth in relation to the Sun and Moon. She decided to pause the video more frequently than she would ordinarily do to translate the English narration into Urdu.

A look into Ms Khan's classroom

Ms Khan and the students are in the assessment phase of that corrective lesson when you enter the narrative.

'Can someone review what the task will be for the next 20 minutes?' Ms Khan asked her students. Ms Khan scanned the room and noted that approximately 70 per cent of her students raised their hands. In her mind, she mentally recorded which students had not raised their hands to ensure she checked with them after she had given instructions. 'Yes, Asiya. Remind the class of the directions I just gave'.

'We should look at our notes from the video we watched and write a brief explanation of rotation and revolution in our science notebooks. This will show how much we understand', Asiya recalled.

'Exactly. Quietly begin your independent work', Ms Khan instructed. The 31 students in Ms Khan's classroom began to read their notes and write their explanations. Ms Khan walked to the groups of students that she noted had not raised their hands to make sure they understood what the task was. Most of these students had begun to write. She restated the instructions to Mustafa and Rafaz, who were not working, and watched them as they began their work. When the students were redirected, she saw that they were accurately summarizing the key concepts from the lesson. She inferred that perhaps they were not paying attention to the directions, and noted that in her monitoring notebook. 'Mustafa and Rafaz, be sure to pay close attention when directions are given', she clearly stated.

'Yes, Ms Khan', the boys replied in unison.

Ms Khan walked through the aisles of student benches to assess what students were writing in order to gather data on the students' understanding of the lesson's objectives. She wrote a quick note in her notebook that Farhad had written the exact oration of the video about the Earth's axis. Ms Khan asked herself, 'I wonder if Farhad can explain this concept in his own words?' She asked calmly, 'Farhad, talk to me about what you wrote'. Farhad drew a quick image of the Earth and explained how the Earth revolves as he delineated the line on the image he had drawn in his science notebook. 'Farhad, you understand the definition of the axis and its importance clearly! Work on writing your notes in your own words next time'. She took note of this in her monitoring notebook and moved to the next group of students.

Here, she noticed Nafisa and Amir writing incorrect information about the difference between rotation and revolution. They were working together and had decided that the Sun revolved around the Earth. Ms Khan urgently exclaimed to herself, 'There seems to be a misunderstanding here. I will need to clarify'. She bent down to have a mini-conference with the two students and presented a clear explanation by showing them a diagram. She checked Nafisa's understanding by asking her to repeat this explanation to Amir to make sure they understood. Ms Khan looked at her watch and noted that it was time to move into reading groups. As she walked to the front of the room, she jotted down the key points of the conversation she had with Nafisa and Amir.

'Students, I need your attention. You worked very hard and wrote strong summaries of the lesson. Take two minutes to share your summary with your partner'. As students read their summaries to their classmates, Ms Khan listened to two partnerships. 'Table monitors, please collect the science notebooks. I look forward to reading what you have written! We will now move into reading groups. Based on the oral reading and comprehension test you took last week with me, you were given a colour. I would like the purple group to come meet with me in the front of the room. The rest of the class will be given different articles to read about rotation and revolution'.[1] The student monitors passed out the articles, and students began to read.

1 Groupings were formed based on an oral reading assessment that Ms Khan gave to students the previous week. Articles were chosen according to reading ability. Ms Khan will instruct each group for 10 minutes in this period and work with each group on a particular reading strategy (for example, making predictions about the plot of the story before they start to read).

Discussion questions

1) Now that you have had a chance to read the description of Ms Khan's classroom, identify the assessment activities that you notice.
2) While the students are working independently, Ms Khan interacts with individuals or pairs four times. Identify which of these interactions you think are assessments of learning. Distinguish between assessments of learning and checks that Ms Khan makes to be sure her students understand directions. What is the value (if any) in both of these kinds of teacher actions?
3) Think about Ms Khan's analysis that was described in the beginning of this narrative. How do you think she came to the realization that students faced conceptual misunderstandings? Is her reasoning clear to you? If so, do you think she is right?
4) Why does Ms Khan stop to talk with Farhad? What does she learn? What can she do with this information?
5) Ms Khan takes notes in her monitoring notebook. Refer back to one of the notes she writes, and discuss what she might do with that information. How might this information inform her immediate practice and her future instructional decisions?
6) Think about a classroom you have seen recently. Which assessment practices did you notice? Which assessment practices might you add to enhance the quality of instruction that students experience based on your new knowledge?
7) Compare this example to the other examples of formative assessment. What is similar? Different?

Unit 1, week 2, session 3

Teacher feedback on the solar system unit test (before receiving advice)

S

Section I: Multiple-choice questions

27/35 = 77%

Please choose the best answer for the questions below.

1. Which of the following objects does not exist in the sky?
   a. the Sun
   b. meteors
   c. mammoths
   d. asteroids

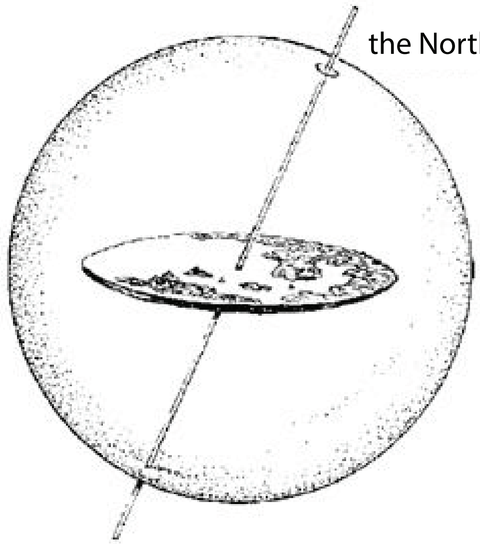
2. Which of the following objects resembles the shape of the Earth?
   a. an egg
   b. an orange
   c. a leaf
   d. a disc

3. The movement of the Earth around the Sun is called
   a. rotation.
   b. oscillation.
   c. revolution.
   d. vibration.

when an object rotates, it moves around itself. when the Earth moves around the sun it's called a revolution.

4. The time it takes for the Earth to orbit the Sun is
   a. a year.
   b. a month.
   c. a week.
   d. a day.

Use the following diagram to answer the question below.



Note: The diagram is not drawn to scale.

5. At one point, the ancient Greeks thought of the Earth as shown in the diagram above (a flat disc situated in a ball of hollow sky that moves). Which of the following statements would have to be true for this model to be true?

   a. We would be able to travel to a place on the Earth where the Earth meets the sky.

   b. We would be able to travel to a place on the Earth where the Sun sets.

   c. We would be able to travel to a place on the Earth where the Sun rises.

   d. All of the above would have to be true.

   e. None of the above would have to be true.

6. The northern hemisphere of the Earth is

   a. an imaginary line around which the Earth spins.

   b. the half of the planet that is north of its equator.

   c. the half of the planet that is south of its equator.

   d. the part of the Earth facing the Sun.

7. Day and night happen because

   a. the Earth is spinning around its axis.

   b. the Sun hides in the deep sky.

   c. someone turns off the lights of the universe.

   d. the Earth goes far away from the Sun.

can the Earth move near and far from the sun within 24 hours?

Use the diagram below to answer the next ***two*** questions. In this diagram, 'e' represents the Earth and 'N' represents north.

Note: The diagram is not drawn to scale.

8. In the northern hemisphere, which season is occurring in the above diagram?
   a. Winter
   b. Summer
   c. Spring
   d. Fall

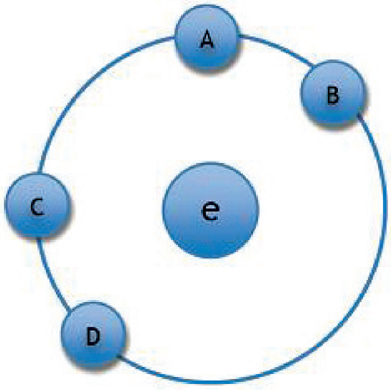
If the Earth's northern hemisphere is tilted away from the Sun's, energy will not be warming that portion.

9. Which season will occur in the northern hemisphere six months after the season shown in the above diagram?
   a. Winter
   b. Summer
   c. Spring
   d. Fall

See above feedback.

10. When the Moon is between the Earth and the Sun and we cannot see its lit-up side at all from the Earth, this phase of the Moon is called the
    a. first-quarter phase.
    b. full Moon phase.
    c. last-quarter phase.
    d. new Moon phase.

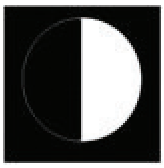
Use the following diagram to answer the next question. In this diagram, 'e' represents the Earth; 'S' represents the Sun; and A, B, C, and D are different positions of the Moon.



Note: The diagram above and the diagrams in questions 11 and 12 are not drawn to scale.

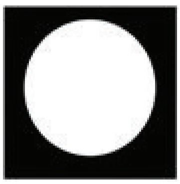
11. From Earth, which position would show the half Moon phase?

a. Position A
b. Position B
c. Position C
d. Position D



12. From Earth, which position would show the full Moon phase?

a. Position A
b. Position B
c. Position C
d. Position D



13. If a complete Moon cycle takes approximately 28 days, about how many days during a month could you expect to see a crescent Moon?

a. 1
b. 2
c. 7
d. 13

14. Imagine you are an astronaut and your mission is to pull out the Earth's axis. Which one of the following is true about your mission?

a. Because the axis of the Earth is an imaginary line, you cannot physically pull it out.
b. If you put a very strong magnet in space next to the Earth, it will be able to pull out the axis.
c. The axis of the Earth is too large and heavy to be pulled out of the Earth.
d. The axis of the Earth is too delicate and will break into pieces before it can be pulled out.

15. If you saw a full Moon last night, which phase of the Moon would you see in a week?

a. First-quarter Moon

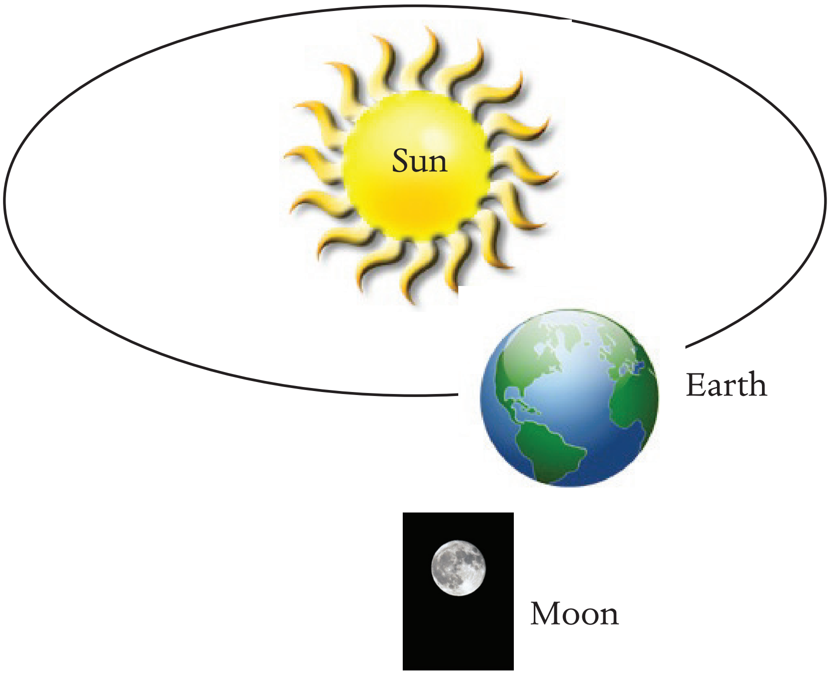
b. Third-quarter Moon

c. Waxing crescent Moon

d. New Moon

Section II: True-false questions

Use the following diagram to answer the next question.



Note: The diagram is not drawn to scale.

16. The diagram above represents the correct positions of the Sun, Moon, and the Earth in the solar system.

a. True

b. False

17. The solar system is composed of eight planets, and the Sun is in the centre.

a. True

b. False

18. Viewed from the Earth with the human eye, planets look very small because they are so far away.

a. True

b. False

19. Winter and summer are determined by the Earth's distance from the Sun.

a. True
b. False

The Earth's tilt, not distance, determines seasons.
Refer to diagram for questions 8 and 9.

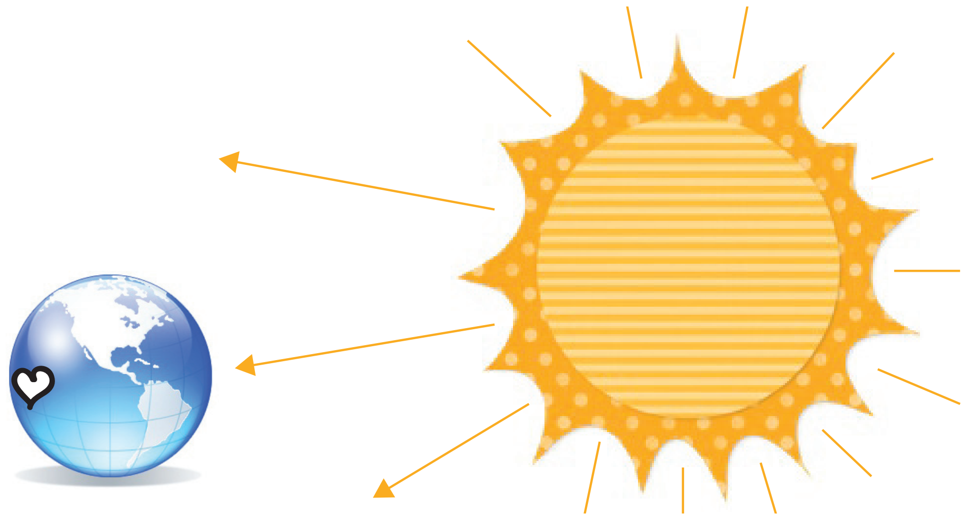
20. Earth's seasonal temperature changes—cold in the winter, hot in the summer, and mild in the spring and fall—are the result of the tilt of the Earth's axis as it spins around the Sun.

a. True
b. False

See above feedback

21. According to the following diagram of the Earth and the Sun, the location indicated by the white heart (on Earth) is experiencing day.

a. True
b. False



Note: The diagram is not drawn to scale.

Section III: Sentence-completion questions

Please fill in the missing blanks for the questions below.

22. The Sun's diameter is __100__ times that of the Earth's diameter.

23. The Earth is __100__ Sun diameters away from the Sun.

24. The Moon's diameter is __1/4__ the size of the Earth's diameter.

25. The Sun's diameter is __400__ times that of the Moon's diameter.

26. When the Earth spins around itself, this movement is called revolution.

it seems you are having trouble distinguishing between rotation and revolution.

27. One complete revolution of the Moon around the Earth is called lunar cycle.

Section IV: Matching questions

Match the terms in the following questions with the correct choices.

28. Match the following movements of the Sun, Earth, and the Moon with the phenomena they cause.

a. Earth's movement around itself
b. Moon's movement around the Earth
c. Earth's movement around the Sun

One week (7 days)
One day (24 hours)
One year (365 days)
Approximately one month (28 days)

29. Your teacher has asked you to pick objects to represent a scale model of the Sun, Earth, and the Moon. Match the name of the object you would use to represent the Sun, Earth, and the Moon. Put the correct letter in front of the Sun, Earth, and Moon. (A)

a. A ball (1 metre in diameter)
b. A ball (1 centimetre in diameter)
c. A marble (3 centimetres in diameter)
d. A tiny bead (3 millimetres in diameter)

The Sun
The Moon
The Earth

Section V: Short-answer questions

Provide answers for the questions below in one or two sentences.

30. The planet Mars is bigger than the Moon, but the Moon seems much bigger in the night sky. Why?

The Moon appears to be bigger than Mars because the distance between the Earth and Mars is much greater than the distance between the Earth and the Moon.

31. How far is the Moon from the Earth?

The Moon is 30 Earths away from the Earth.

32. Using the answer from question 31, draw a scale model of the Sun, Earth, and the Moon. (Hint: Use appropriate distance and size.)

You show understanding of this relationship model in previous answers, but have trouble representing it. Look at question 29 to rethink this.

33. Name an example of a scale model from your everyday life and explain in one line why it is a scale model. *Note: First part of the question is application and second part is comprehension.*

A map shows the things that are on the Earth and that is why it is a scale model.

34. Do all places on Earth experience day and night at the same time? Why or why not?

No. They are in different places, so they do not face the Sun at the same time.

35. Describe in one or two sentences the major difference between rotation and revolution.

Rotation is when the Earth moves around the Sun.
Revolution is when the Earth moves around itself.

Unit 1, week 2, session 3

Teacher feedback on the solar system unit test (after receiving advice)

S

Section I: Multiple-choice questions

Please choose the best answer for the questions below.

1. Which of the following objects does not exist in the sky?
   a. the Sun
   b. meteors
   c. mammoths
   d. asteroids

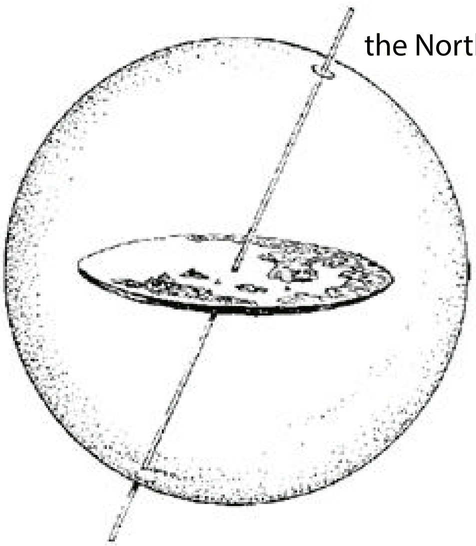
2. Which of the following objects resembles the shape of the Earth?
   a. an egg
   b. an orange
   c. a leaf
   d. a disc

3. The movement of the Earth around the Sun is called
   a. rotation.
   b. oscillation.
   c. revolution.
   d. vibration.

Refer to your notes from lesson four. The movement around the Sun is a big movement, whereas rotation is a smaller movement.

4. The time it takes for the Earth to orbit the Sun is
   a. a year.
   b. a month.
   c. a week.
   d. a day.

Use the following diagram to answer the question below.



Note: The diagram is not drawn to scale.

5. At one point, the ancient Greeks thought of the Earth as shown in the diagram above (a flat disc situated in a ball of hollow sky that moves). Which of the following statements would have to be true for this model to be true?

   a. We would be able to travel to a place on the Earth where the Earth meets the sky.

   b. We would be able to travel to a place on the Earth where the Sun sets.

   c. We would be able to travel to a place on the Earth where the Sun rises.

   d. All of the above would have to be true.

   e. None of the above would have to be true.

6. The northern hemisphere of the Earth is

   a. an imaginary line around which the Earth spins.

   b. the half of the planet that is north of its equator.

   c. the half of the planet that is south of its equator.

   d. the part of the Earth facing the Sun.

7. Day and night happen because

   a. the Earth is spinning around its axis.

   b. the Sun hides in the deep sky.

   c. someone turns off the lights of the universe.

   d. the Earth goes far away from the Sun.

Use the diagram below to answer the next ***two*** questions. In this diagram, 'e' represents the Earth and 'N' represents north.

Note: The diagram is not drawn to scale.

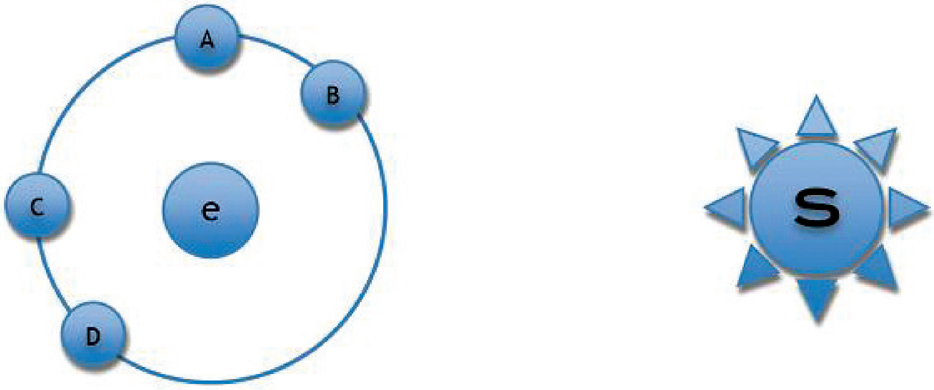
8. In the northern hemisphere, which season is occurring in the above diagram?
   a. Winter
   b. Summer
   c. Spring
   d. Fall

9. Which season will occur in the northern hemisphere six months after the season shown in the above diagram?
   a. Winter
   b. Summer
   c. Spring
   d. Fall

10. When the Moon is between the Earth and the Sun and we cannot see its lit-up side at all from the Earth, this phase of the Moon is called the
    a. first-quarter phase.
    b. full Moon phase.
    c. last-quarter phase.
    d. new Moon phase.

* We will think about questions 7, 8, 9, 26, and 35 together because the mistakes are related. Take a look at the diagram on this page. When the Earth moves around its axis, part of the Earth faces the sun and part faces away. What time of day will it be on the hemisphere that faces the sun and receives direct light? Think about this question to help you revise #7. Refer back to your notes for lesson 4 when we watched the video and rework your responses in the margins. We will talk together about the differences between rotation and revolution and what phenomena these movements create.

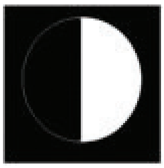
Use the following diagram to answer the next question. In this diagram, 'e' represents the Earth; 'S' represents the Sun; and A, B, C, and D are different positions of the Moon.



Note: The diagram above and the diagrams in questions 11 and 12 are not drawn to scale.

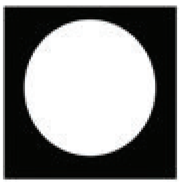
11. From Earth, which position would show the half Moon phase?

a. Position A
b. Position B
c. Position C
d. Position D



12. From Earth, which position would show the full Moon phase?

a. Position A
b. Position B
c. Position C
d. Position D



13. If a complete Moon cycle takes approximately 28 days, about how many days during a month could you expect to see a crescent Moon?

a. 1
b. 2
c. 7
d. 13

14. Imagine you are an astronaut and your mission is to pull out the Earth's axis. Which one of the following is true about your mission?

a. Because the axis of the Earth is an imaginary line, you cannot physically pull it out.

b. If you put a very strong magnet in space next to the Earth, it will be able to pull out the axis.

c. The axis of the Earth is too large and heavy to be pulled out of the Earth.

d. The axis of the Earth is too delicate and will break into pieces before it can be pulled out.

* It takes approximately 28 days for the Moon to complete a lunar cycle. If the new Moon just occurred, and the waxing crescent occurs at the very beginning of the cycle after the new Moon. what phase would the Moon be in? Refer to your notes and diagrams from lessons 7 and 8. Create a diagram to help you think through this answer. Write the correct response in the margin and explain your thinking.

15. If you saw a full Moon last night, which phase of the Moon would you see in a week?

a. First-quarter Moon

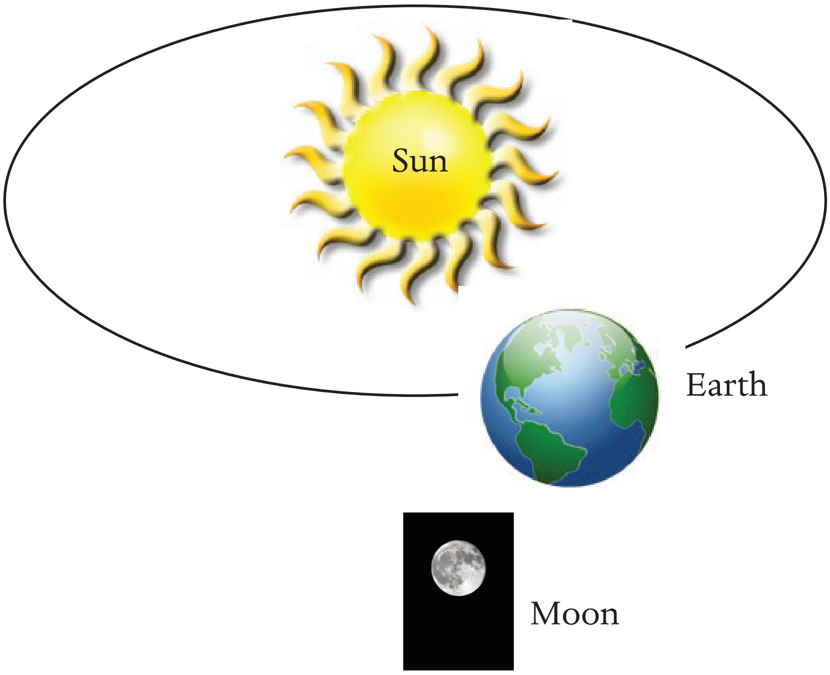
b. Third-quarter Moon

c. Waxing crescent Moon

d. New Moon

Section II: True-false questions

Use the following diagram to answer the next question.



Note: The diagram is not drawn to scale.

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a. True

b. False

17. The solar system is composed of eight planets, and the Sun is in the centre.

a. True

b. False

18. Viewed from the Earth with the human eye, planets look very small because they are so far away.

a. True

b. False

19. Winter and summer are determined by the Earth's distance from the Sun.

a. True

b. False

20. Earth's seasonal temperature changes—cold in the winter, hot in the summer, and mild in the spring and fall—are the result of the tilt of the Earth's axis as it spins around the Sun.

a. True

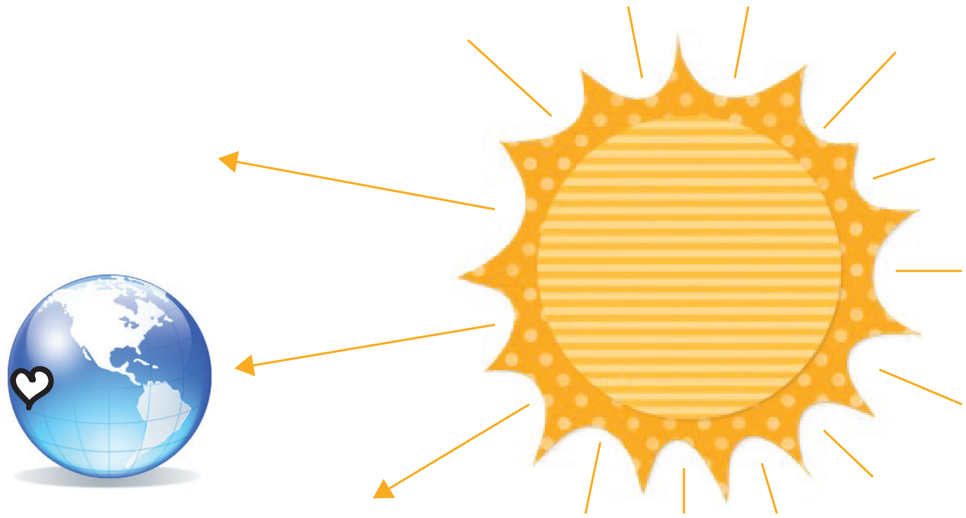
b. False

21. According to the following diagram of the Earth and the Sun, the location indicated by the white heart (on Earth) is experiencing day.

a. True

b. False

* We will consider your answers to questions 19 and 20 together because they are related to the same content misunderstanding. Refer back to your notes from lesson 6 where we learned about how seasonal changes are related to the tilt in the Earth's axis. Review your notes from the video.



Note: The diagram is not drawn to scale.

Section III: Sentence-completion questions

Please fill in the missing blanks for the questions below

22. The Sun's diameter is 100 times that of the Earth's diameter.

23. The Earth is 100 Sun diameters away from the Sun.

24. The Moon's diameter is 1/4 the size of the Earth's diameter.

25. The Sun's diameter is 400 times that of the Moon's diameter.

26. When the Earth spins around itself, this movement is called revolution.

27. One complete revolution of the Moon around the Earth is called lunar cycle.

Section IV: Matching questions

Match the terms in the following questions with the correct choices.

28. Match the following movements of the Sun, Earth, and the Moon with the phenomena they cause.

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b. Moon's movement around the Earth
c. Earth's movement around the Sun

One week (7 days)
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a. A ball (1 metre in diameter)
b. A ball (1 centimetre in diameter)
c. A marble (3 centimetres in diameter)
d. A tiny bead (3 millimetres in diameter)

The Sun
The Moon
The Earth

Section V: Short-answer questions

Provide answers for the questions below in one or two sentences.

30. The planet Mars is bigger than the Moon, but the Moon seems much bigger in the night sky. Why?

The Moon appears to be bigger than Mars because the distance between the Earth and Mars is much greater than the distance between the Earth and the Moon.

31. How far is the Moon from the Earth?

The Moon is 30 Earths away from the Earth.

~~32.~~ Using the answer from question 31, draw a scale model of the Sun, Earth, and the Moon. (Hint: Use appropriate distance and size.)

*You show understanding of this relationship model in previous answers but have trouble drawing it. Look at question 29 to rethink this.

33. Name an example of a scale model from your everyday life and explain in one line why it is a scale model.

A map shows the things that are on the Earth and that is why it is a scale model.

−1/2

*Can you tell me why it is a <u>scale</u> model? Think of the meaning of scale model.

34. Do all places on Earth experience day and night at the same time? Why or why not?

No. They are in different places, so they do not face the Sun at the same time.

35. Describe in one or two sentences the major difference between rotation and revolution.

Rotation is when the Earth moves around the Sun.
Revolution is when the Earth moves around itself.

Unit 1, week 2, session 3

Memo to teacher about feedback on the solar system unit test

S

To the Classroom Teacher,

Thank you for giving me a copy of the feedback that you wrote on the solar system test. I am happy to have the opportunity to make some comments about your feedback.

Use the bottom of page three and tell the student that you are going to help her find the correct answers to questions 6, 7, 8, and 20. Direct her attention to the diagrams and prompt her to think about the position of the Earth in relation to the Sun using those diagrams. A series of questions about what she sees can lead to correct answers. She should take the lead in finding the information she needs in the notebook to correct her errors.

There is another mistake, on question 15. Again, I would direct her to her science notebook (to the notes for lesson 7) and tell her to look for her drawings and notes about phases of the Moon. Let her take it from there. When she finds it, she should write the correct answer in the margin next to the question.

Your feedback on question 32 is just right. This child is in the fifth grade though, so I would use the word *drawing* rather than *representing*.

Your feedback to question 28 is important to reconsider. Read it again. Yes, she is having trouble distinguishing between the two concepts. But it doesn't help to tell her that if you don't suggest a way to *find* the correct answer. She needs to be led to think about the distinction between rotation and revolution herself rather than being *told* the distinction. (See also question 35.) Go back to lesson 6 and see if there is a place in the lesson where she was instructed to write notes that might help her if she looked in her science notebook.

She may know the difference between rotation and revolution but may not remember which word goes with which movement. If that's the case, advise her to use a mnemonic, i.e. the smaller movement goes with the shorter word.

In summary, I think it is a very good idea to group all questions that reflect the same error together for the purpose of providing feedback. You need to be very clear about what you are doing, though (i.e. write to the student, 'The mistakes in questions 6, 7, 8, and 20 are related, so we are going to think about them together').

Pointing out a problem is only useful if it is accompanied by suggestions on finding solutions. Feedback is questioning and probing rather than telling.

Sincerely,

Professional Development Coordinator

Unit 1, week 3, session 2

List of contrasts between a test-based culture and an assessment-based culture in schools

People who favour a test-based culture in schools...	People who favour an assessment-based culture in schools...
Place more importance on numerical data than on anecdotal data	Believe that human traits and behaviours are too complex to be measured by one tool
Believe that the measurement of human traits and behaviour can be reduced to numbers	Argue that learning and achievement in school must be studied from different perspectives using more than one assessment tool
Believe in the value of extrinsic rewards for learning and academic achievement	Believe that intrinsic motivation is more likely than external rewards to lead to sustained effort to learn in school
Maintain trust in grades as praise or criticism as effective feedback to students	De-value grades and praise in favour of messages, oral and written, that encourage students to think and learn from their mistakes
Maintain separation between instruction and testing/assessment	Attempt to integrate assessment and instruction
Believe in the value of competition between students in school	Value co-operation over competition between students in school
Believe that learning proceeds in increments and trust the idea of 'readiness' for the next increment in instruction	Encourage students to take risks with challenging tasks and new ideas

List of contrasts between a test-based culture and an assessment-based culture in schools, continued

People who favour a test-based culture in schools...	People who favour an assessment-based culture in schools...
Prefer to measure the products of learning rather than the process of learning	Assess the way a student works through a task as well as the product of that work
Value adult authority in the classroom	Enable students to share responsibility with the teacher for learning and assessment
Are not troubled by long intervals between tests	Believe that assessment needs to be continuous to have a positive effect on learning and achievement
Assess instruction by drawing inferences from measures of learning	Assess instruction by experimenting with instruction's effects on learning

This is not an exhaustive list. There is plenty of room for other ideas!

Unit 2, week 4, session 1:

Sun, Earth, and the Moon unit: Student Teachers' copy

S

Description of the unit

The 'Sun, Earth, and the Moon' unit is a mini-science unit for grade 4 or 5. This unit uses interactive and participatory teaching methods to teach students about the Sun, Earth, and Moon system. Each lesson in this unit is designed to be 1–1.5 hours long.

This document is prepared for Student Teachers. The learning objectives, learning targets, success criteria, and formative assessments from lessons 2, 3, 5, and 6 have been omitted from the Student Teachers' copy of this unit.

This is because Student Teachers will create learning objectives, learning targets, success criteria, and formative assessments (pertaining only to success criteria) for lessons 2, 3, 5, and 6. Student Teachers will either add the formative assessment activities or find ones that are already built into the lessons.

Learning goal for the unit

Students will understand the interactions between the Sun, Earth, and the Moon and how these interactions affect life on Earth.

Lesson 1: Objects in the sky

Learning objectives

Students will:

- understand that the universe is vast and has millions of different types of objects, including our solar system
- understand that the Sun is the centre of our solar system, which has eight planets
- recognize the position of the Sun, Earth, and its Moon in the solar system
- know that all the planets revolve around the Sun in a circular path
- know the meaning of *orbit* and that paths of the planets around the Sun are called *orbits*.

Learning targets

Students will:

- understand that the Sun is the centre of our solar system, which has eight planets
- recognize the position of the Sun, Earth, and its Moon in the solar system
- know that all the planets revolve around the Sun in a circular path called an *orbit*.

Success criteria

Students will:

- write the names of all eight planets in correct order
- draw a labelled diagram of the Sun, Earth, and the Moon to show their correct positions
- draw and label the paths of the Earth and Moon.

Vocabulary

solar system, planets, Sun, orbit, Moon, star

Advanced preparation

Assign the students the following homework the day before this lesson:

- Spend 10 minutes observing the sky at night and write and draw the objects in the sky.
- Write about your experiences and reactions while viewing the sky.

Materials required

- Chart paper
- Internet connection
- Video projector

Introduction (connections to prior knowledge)

Initiate a discussion to find out what students already know about the solar system, Earth, Sun, and the Moon. Ask students the following questions to conduct a class discussion:

- What do you know about the Sun?
- What do you know about the Earth?
- What do you know about the Moon?
- How are the Sun, Earth, and the Moon related?

Note student replies on a piece of chart paper so they can be used later in this lesson or the unit.

Exploration 1

Take students to the play yard and ask them to observe the sky and note the objects they see. The students should write and/or draw these objects. Encourage the students to draw any observations or conclusions about the size and number of objects or any other observations about the sky in general.

Ask the students to make a comprehensive list of images from the day and night skies.

Ask the students to note down the objects that they think exist in the sky but might not have been visible to them during the day and night observations.

Share

Bring all the students back to the classroom and give them a chance to share their observations.

Note students' observations on a chart paper.

Initiate a class discussion about the students' experiences during their sky observations. Use the following guiding questions and write the students' responses on the blackboard.

Guiding questions

- What are the different types of objects you saw in the sky?
- Were all the objects in the sky visible to us? Might there be other objects in the sky? Name them.
- What do you know about the Sun?
- Ask the students to write down at least three things they know about the solar system.

Take a few student volunteers and ask them to share their responses with the rest of the class. Write these responses on the blackboard.

Exploration 2

In this activity, students will act like young astronauts and take a trip to the solar system through a short video.

During the video, students should write down and/or draw at least five interesting things about the solar system.

Show the following video, 'Solar System Animation for Kids', to the class. The video is 7 minutes and 41 seconds long:

➢ http://www.youtube.com/watch?v=sJrDiUG2JAo

Notes

This video features the following concepts:

- Even things big in size will look smaller from a distance. This gives the children an idea that the stars and planets look small from the Earth because they are really far away.
- It showcases the solar system and its planets and gives the order of the planets.
- It goes over the sizes of different planets and their few distinguishing features.

Share

Tell the students, 'Now that our space trip is over, let us share what we observed during our journey to space'. Take responses from as many students as time allows and note them on the blackboard.

Ask the students to write these responses in their science notebooks.

Guiding questions

Initiate a class discussion to give students a chance to share their observations with the whole class. Use the following guiding questions to conduct the classroom discussion and note students' responses on the blackboard. Ask the students to write their classmates' observations in their science notebooks.

- Describe the solar system in your own words.
- Why do objects in space seem so small?
- What is the position of our Earth and Moon in the solar system? Is the Moon also a planet?
- Is the Moon smaller, bigger, or the same size as the Sun? Why?
- Are planets stationary or in motion? Can anyone describe their motion?
- What are the paths of the planets called? Where does that name come from?

Ask students to note these observations in their notebooks if they have missed them during the video.

Refer to the chart paper from the introduction activity and Exploration 1 and explore with the students how and why their responses have changed or not changed after their virtual tour to the solar system.

Culminating activity

Formative assessment: Ask the students to write down the names of the eight planets in correct order.

Formative assessment: Ask the students to also draw a labelled diagram of the Sun, Earth, and the Moon in their correct positions. Also draw and label the paths of the Earth and the Moon.

NOTE: At this point, students can use their judgement to capture the sizes in this diagram.

Go over the formative assessment answers with the students.

Ask a few students to share their answers with the class. Make corrections if needed.

Ask all the students to check their answers and make any corrections if needed.

Tell students that they will further explore the relative sizes of the Sun, Moon, and the Earth in the next lesson.

Lesson 2: How big, how far

Learning objectives

Learning targets

Success criteria

Vocabulary

scale model, diameter, ruler

Materials required

- A blown-up balloon (one metre in diameter)
- Several balls of different sizes (1 centimetre, 5 centimetres, 10 centimetres)
- A football
- A few coriander seeds or peppercorns (two to three millimetres)

Introduction (connections to prior knowledge)

Students will look at how big the Sun, Earth, and the Moon are when compared to one another and how far they are located from one another. Students should look at their observations and drawings from the previous lesson.

Guiding questions

Use the following guiding questions to continue the discussion on the Sun, Moon, and the Earth.

- Which one is the biggest object among the Sun, Earth, and the Moon?
- Why do the Sun and the Moon look about the same size?
    - Bring up the tree analogy from the video from the previous lesson to remind students of the relationship between distance and size appearance.
    - Large things look smaller in size when viewed from a distance.

Students will use different objects to understand how big or small the Sun, Earth, and the Moon are as compared to one another. The students will also look at the relative distances of the Sun, Earth, and the Moon to get an idea of how far they are from one another.

Exploration 1

In this activity, students will investigate the sizes of the Sun, Earth, and the Moon by using scale models.

Check the students' understanding of a scale model by asking, 'What is a scale model?' Students should write down their predictions of what a scale model is in their science notebooks.

Take responses from a few students. Then tell them that when we reduce the size of all parts of an object by the same proportion, it is called a *scale model* of the object. A globe is an example of a scale model of the Earth because the sizes of all the large bodies of Earth (the continents and oceans) have been reduced by the same proportion.

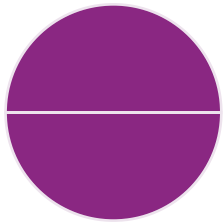
Ask the students to give at least three examples of scale models and write them in their notebooks.

Divide the class into groups of three or four students and provide them objects of different sizes. Each group should get a balloon and three balls of different sizes (1 centimetre, 5 centimetres, 10 centimetres), a football, and a few coriander seeds.

Show the students the blown-up balloon and ask, 'If we assume that the Sun is as big as this balloon, how big do you think the Earth and the Moon are?'

Take a ruler and put it across the diameter of the balloon to make sure that the students understand the concept of diameter. Tell the students that the balloon is one metre across, which means it is one metre in diameter.

NOTE: The teacher should blow the balloon to one metre diameter. Before demonstrating the diameter with the ruler, draw a diagram on the blackboard to explain diameter to the students Use the diagram below as a guide. The line drawn across the widest part of the balloon should measure one metre.



Ask the students to pick two items to represent the Earth and the Moon.

Give each group a chance to share their assumptions with the class.

Tell the students that the Sun's diameter is about 100 times greater than the Earth's diameter, which means we will need 100 Earths to stretch across the Sun.

Give the students some time to come up with ideas to calculate the diameter of the Earth.

Help each group come to the conclusion that they should use a one-centimetre ball to represent the Earth because the Earth's diameter is a 100 times smaller than the Sun's diameter.

Ask the students to make predictions about which object they could place 100 times across the surface of the balloon.

Ask students if they want to change the object they chose earlier to represent the Earth (based on the new information they now have) and give them a few moments to correct their model of the Earth.

Tell the students that the Moon's diameter is one-fourth the diameter of the Earth, and ask them to find the diameter of the Moon based on this information.

Go around the class to help groups calculate the diameter of the Moon and make sure that they calculate it correctly as two millimetres to three millimetres.

Ask the students if they need to change their model of the Moon based on this new information and give them a few moments to do that.

Ask the students to note their observations and reactions after finding out about the size differences between the Sun, Earth, and the Moon and encourage them to write as well as draw their observations and reactions.

> NOTE: Students should always use their science notebooks for their science class work and homework.

Share
Ask a student from each group to share their observations and reactions with the class.

Ask the students, 'Keeping our model of the Sun, Earth, and the Moon in mind, can anyone tell me how much smaller the Moon is as compared to the Earth?'

Take a few student responses from the class and write them on the board or chart paper.

Discuss this question with the students and make any corrections if required.

Ask the students to note their classmates' responses down in their science notebooks.

Exploration 2

In this activity, students will investigate relative distances between the Sun, Earth, and the Moon.

Before starting the activity, ask the students to make predictions about the distances between the Sun, Earth, and the Moon. Ask the students the following question to guide their predictions: 'In your opinion, is the Sun closer to the Earth or the Moon? Why do you think that?'

Remind the students of the video they watched in lesson 1 and their notes from the video about why the Sun and the Moon look as if they were the same size, even though they now know that the Sun is about 400 times bigger than the Moon.

The students should be able to make the connections between lessons 1 and 2 that the farther an object is, the smaller it looks. The Sun's farther distance from the Earth as compared to the Moon makes the Sun appear to be the same size as the Moon.

Ask each group to pick members to represent the Sun, Earth, and the Moon.

Tell the students to estimate how far the Earth and the Moon are from the Sun and stand accordingly while holding the objects representing the Sun, Earth, and the Moon.

For example, the student representing the Sun should hold the balloon in their hands, the student representing the Earth should hold a one-centimetre ball in their hands, and the student representing the Moon should hold a small coriander seed in their hands.

Go around the classroom to check the distance representation of all the groups.

Ask for a volunteer from each group to interpret their representation.

Provide the students with the following information to check the accuracy of their representation of distances between the Sun, Earth, and the Moon.

- The Earth is about 100 Sun diameters away from the Sun, so if our Sun is one metre, how far would it be from the Earth?
  - Give the students time to calculate the distance.
  - The Earth would be 100 metres away from a one-metre-diameter Sun.
- Tell the students that the Moon is about 30 Earth diameters away from the Earth and give them some time to calculate the distance between the Earth and the Moon.
  - The Moon would be 30 centimetres away from a one-centimetre-diameter Earth.

Help students realize that the Moon is a lot closer to the Earth as compared to the Sun.

Take the students to a nearby playground and ask them to stand in position (according to the distances they calculated) to represent the Sun, Earth, and the Moon.

Ask the students to write down their observations and reactions in their notebooks.

Reference: Education Development Center, Kendall/Hunt Publishing, National Science Foundation, '*Sun, Earth and Moon*'. Insights: An Elementary Hands-on Inquiry Science Curriculum, Teacher guide, 2nd ed. (Dubuque, IA: Kendall/Hunt, 2007), 195–197.

Share

Ask at least one person from each group to share their observations and reactions after looking at how far the Sun, Earth, and the Moon are from each other.

Ask the students to make predictions about the travel time between the Moon and the Earth.

Take responses from a few students and write them down on the board. Share with the students that it takes an astronaut about three days to travel between the Earth and the Moon even in a rocket going as fast as 6 kilometres per second.

Ask the students, 'Now that you know how long it takes to go to the Moon, can anyone predict how long it will take to travel to the Sun on the same rocket?'

Share with the students that it will take several months to reach the Sun, but the Sun is so hot that we cannot even get close to it.

Reference: Joan Board, *Stargazing Live: Lesson Plans* (BBC Learning, 2012), 6–7. Retrieved 19 April, 2012.

- http://downloads.bbc.co.uk/tv/guides/BBC_Stargazing_Live_2012_Lesson_plans_KS2.pdf

Culminating activity

Ask the students to write and/or draw three new things they learned in this lesson.

Go over the formative assessments to give students a chance to correct their answers.

Tell the students to read chapter 10, pages 89–90, from their science textbook.

Lesson 3: Endless Earth

Learning objectives

Learning targets

Success criteria

Vocabulary

sphere, satellite, Earth

Materials required

- Printouts of the story 'How Did We Find Out that the Earth Is Round?' by Isaac Asimov (one per student)
- Printouts of satellite pictures of the Earth

Introduction (connections to prior knowledge)

Initiate a discussion to find out what students know about the shape of the Earth.

Probe students to talk about their idea of the shape of the Earth and how they came to their conclusions.

Ask the students, 'Imagine that you are in space looking directly at our Earth. What do you think the Earth will look like?' Ask them to make predictions and draw this view of the Earth from space.

After giving students a few minutes to draw, share with the students that people's ideas about the Earth's shape have changed over the years and the next activity will explore this topic in detail.

Exploration 1

In this activity, students will discuss how people in the past found out that the Earth is a sphere.

Check students' knowledge of the definition of *sphere*. If the students are not aware of the meaning of sphere, show them a few spherical shapes such as a cricket ball, tennis ball, or an orange to make sure the students understand what a spherical shape looks like.

After showing them a few spherical shapes, ask the students to come up with at least two examples of a sphere and write and/or draw them in their notebooks. Ask a few students to share their examples with the class and note them on the board.

Use the story 'How Did We Find Out that the Earth Is Round?' by Isaac Asimov (pages 1 to 10). It can be retrieved at:

➢ http://www.arvindguptatoys.com/arvindgupta/earthpix.pdf

Tell the students that while reading the book, they should keep the following questions in mind:

- What were people's very first ideas about the shape of the Earth?
- Why were those ideas disregarded?
- What evidence did people find that supported the idea that the Earth had a spherical shape?

Read the first few pages with the students and point out the important elements in the text. This exercise will teach students how to pay attention to crucial details. Ask the students to finish reading the rest of the book on their own.

Ask the students to work in groups of two or three and answer the questions (listed at the beginning of this activity) by reading until the end of page 10 (the end of section 3, 'The Disappearing Ships').

Ask the students to note the evidence (answers to questions presented at the top of this activity) and their ideas in their science notebooks.

Share

After the students are finished reading and recording their ideas, ask one student from each group to share his or her ideas with the rest of the class. Write down these ideas on the board.

Ask groups to write down anything they might have missed while making their observations.

Exploration 2

Mention to the students that people came to the conclusion that the Earth is a sphere (using the evidence discussed previously). At that time, people did not have modern equipment such as satellites to visit space and directly observe the shape of the Earth.

Ask the students: 'What do you know about satellites?' Note a few students' responses on the board.

Use student responses to construct a definition of *satellite* and ask the students to write it down.

A satellite is a smaller object orbiting around a larger object. Scientists use electronic satellites to observe objects in space.

Ask the students, 'Can anyone give me an example of a natural satellite that revolves around the Earth?' (The Moon is a satellite that revolves around the Earth.)

Divide the students into groups of two or three and provide each group with satellite pictures of the Earth. The pictures can be printed from the following sites:

- http://visibleearth.nasa.gov/view_cat.php?categoryID=1484
- http://www.earth-images.com/index3.htm
- http://jtintle.wordpress.com/2005/12/07/europe-at-night/

Share

Conduct a class discussion using the following question. Write students' responses on the board.

After looking at the pictures, ask the students, 'Why does the Earth seem flat in these pictures?'

Take a few responses from the students, and incorporating these responses as much as possible, tell the students that because we are viewing the Earth on a flat computer screen or a flat sheet of paper, the Earth looks flat. That is why many satellite pictures of the Earth from different angles are required to confirm that Earth is a sphere and not a flat disc.

Putting it all together

Now students will put all the evidence together that points to the fact that Earth is a sphere. Draw the following table on the blackboard and ask the students to look at their observations from Exploration 1 and Exploration 2.

Ask the students to make a similar table in their science notebooks.

Tell the students that the table will help them organize their data in a concise manner.

Observations	Fact
Ship sailing away and disappearing gradually	Earth is a sphere
Satellite pictures	

NOTE: Only a few observations are listed here as an example. The table needs to be completed using the observations from Explorations 1 and 2. The number of rows in the table is not representative of the number of observations.

Culminating activity

Ask the students to draw and/or write about three new things they learned in this lesson.

The students should note down at least one fact they learned from the textbook reading assigned to them as homework and describe if that fact was clarified or not at the end of this lesson.

Go over the formative assessment responses with the students. Ask a few students to volunteer their responses and make any corrections if needed. Ask the whole class to check their formative assessment responses against the correct responses and make any corrections if needed.

Collect students' science notebooks to check their responses to formative assessment activities and to note if all the students are self-checking their answers and making appropriate corrections.

In the next lesson they will learn about how the Earth moves. Ask the students to read chapter 10, sections 10.2 and 10.4, on pages 90 and 91 from the grade 4 science textbook to prepare.

Lesson 4: Movements of the Earth

Learning objectives

Students will:

- understand that the Earth moves around itself and around the Sun
- be able to define the rotation and revolution of the Earth
- be able to differentiate between the concepts of rotation and revolution
- understand that the Earth spins around itself (on its axis)
- understand that the Earth's axis is an imaginary line drawn through the Earth's centre to represent its tilt and movement
- know the time it takes the Earth to complete a rotation and a revolution.

Learning targets

Students will:

- understand that the Earth moves around itself and around the Sun
- be able to define the rotation and revolution of the Earth
- understand that the Earth's axis is an imaginary line drawn through the Earth's centre to represent its tilt and movement.

Success criteria

Students will:

- draw the diagram of the Sun and the Earth with arrows indicating the movements of the Earth
- define the Earth's axis in their own words and label it in the same diagram
- write one example of rotation and one of revolution from their daily lives and describe why she or he thinks these movements are examples of rotation and revolution.

Vocabulary

rotation, revolution, axis

Advanced preparation

Print copies of pictures of the Earth's axis (provided in this lesson plan).

Materials required

- Internet connection
- Video projector
- Computer
- Printed pictures of the Earth's axis
- Chart paper
- Markers

Introduction (connections to prior knowledge)

Initiate a discussion to find out what students already know about the movements of the Earth. Ask the students to make predictions about the following guiding questions.

Guiding questions

- Do you think the Earth moves?
- How does it move?
  - The Earth spins around itself and moves around the Sun at the same time.
- When the Earth spins, what is that movement called?
- When the Earth moves around the Sun, what is that movement called?

Note student replies on a large piece of chart paper and refer to this later in this lesson or the unit. If no one has provided correct responses to the questions, do not provide the students with the correct answers at this point.

Exploration 1

During this activity, students will understand the movement patterns of the Earth.

Show the students a video on movements of the Earth, 'Rotation and Revolution of the Earth', and ask them to note their observations. The video can be found at:

➢ http://www.youtube.com/watch?v=eV4nk9or9SE&feature=fvst

NOTE: Only shows the first 2 minutes and 47 seconds of the video.

Tell the students to keep the following questions in mind when making their observations:

- Does the Earth spin around itself? What is that movement called?
- Does the Earth spin around the Sun? What is that movement called?
- Does it take longer for the Earth to spin around itself or to go around the Sun?
- What are at least two interesting facts about the Earth that you learned from this video?

Notes

This video features the following concepts:

- The video starts by defining the concepts of rotation and revolution of the Earth.
- The video then explains how the Earth rotates around itself and revolves around the Sun.
- It takes the Earth more time to revolve around the Sun and less time to rotate around itself.

At this point, tell the students that 'even though this video does not show it, scientists, in order to understand the rotation of the Earth, draw an imaginary line through the centre of the Earth. This line passes from the North Pole to the South Pole and is called the Earth's *axis*'.

Draw a picture of the Earth with its axis and arrows for rotation to show the students.

Formative assessment: Tell the students to carefully observe the picture of the Earth with its axis and arrows for rotation. Ask them to describe the axis of the Earth in their own words and to write and draw the descriptions in their science notebooks.

Sharing

Tell the students, 'Now it is time to share what we learned from the video and the picture'.

Pick a few volunteers from the class and ask them to share their observations of the video with the rest of the class. Note these responses on the chart paper.

Guiding questions

Conduct a class discussion to give students a chance to share their observations about the movements of the Earth with their classmates. Use the following questions to guide the class discussion:

- Does the Earth spin around itself? What is that motion called?
- Can anyone define the axis of the Earth? Is it real? Why is it useful?
- Does the Earth move around the Sun? What is that motion called?
- Does anyone remember from lesson 1 what the path of the Earth around the Sun is called?
- Which movement takes Earth longer: rotation or revolution?

Bring out the chart paper from the introduction activity and show the students if and how their answers to the guiding questions might have changed after watching the video.

Ask the students to note the observations from the video in their science notebooks.

Exploration 2

In this activity, students will make a human model of the rotation and revolution of the Earth.

Divide the class into groups of three students and ask the students to pick a Sun, an Earth, and a narrator in their groups. The role of the narrator is to describe the model to the rest of the class.

Give groups about five minutes to put together and act out their rotations and revolutions of the Earth.

Call each group one by one to the front of the class to present their model. Observe if the students are depicting these movements correctly.

Ask the students to write about their reactions and observations of the models.

Formative assessment: Ask the students to write one example of rotation and one of revolution from their daily lives and describe why these movements are examples of rotation and revolution.

Share

Initiate a classroom discussion to give students a chance to share their experiences and observations from their own as well as their peers' presentations. Use the following guiding questions.

Note student responses on the board and ask them to write them in their notebooks.

Guiding questions

- How is the Earth's rotation different from the Earth's revolution?
- What is the shape of the Earth's orbit? (One is oval, and one is elliptical.)
- What natural phenomenon does the Earth's rotation cause? (Day and night.)
- What natural phenomenon is the Earth's revolution related to? (The seasons.)

Culminating activity

Formative assessment: Ask the students to draw a diagram of the Sun and Earth with arrows indicating movements of the Earth. The students should also draw and label the Earth's axis.

Ask the students to write or draw two new things that they learned in this lesson.

Tell the students that one of these facts should be from the textbook. Ask the students to describe if knowledge of this fact from the textbook reading was clarified or not by the end of this lesson.

> NOTE: The purpose of this step is to examine how students connect the knowledge they learned from the textbook to the in-class lesson.

Go over the responses to formative assessment activities with the students. Ask a few students to volunteer their responses and make any corrections if needed. Ask the class to check responses and make any corrections if needed.

Tell the students that in the next lesson they will explore day and night, and leave them with the question, 'What do you think causes day and night?'

Ask the students to read chapter 10, section 10.3 on page 90 from the grade 4 science textbook.

Lesson 5: Day and night

Learning objectives

Learning targets

Success criteria

Vocabulary

rotation, revolution, Earth's axis

Materials required

- Globe
- Small-sized sticker
- Torch
- Lamp (without the cover)
- Styrofoam ball
- Three index cards

Introduction (connections to prior knowledge)

Start this section with a demonstration of night and day by using a globe.

Gather all the students around a desk and bring out a globe. Ask the students to make predictions about what the globe represents (the Earth).

Ask the students if they can find their location on the globe, and then put a small sticker on it.

Turn off all the lights in the classroom and shine a light on the globe. Ask the students to make predictions about what the torch represents.

If needed, provide the students with a hint by asking them the following question: 'Which object in the solar system provides the Earth with light? Think back to the first lesson in this unit'. (The Sun.)

Shine the torch directly onto the sticker indicating the city in which the school is located, and ask the students if this demonstration represents day or night in their city (Day.)

Ask the students, 'Explain why the demonstration at this point represents day?' (Because our location is directly facing the sunlight.)

Spin the globe to the other side and ask the students, 'Now, is it day or night at our location (according to the demonstration)?' (Night.)

Ask the students, 'Please explain why the demonstration now represents night?' (Because our location is facing away from the Sun, and it is not receiving any direct sunlight.)

Initiate a discussion to check for students' understanding of Earth's rotation and revolution and day and night. Ask the students to make predictions about the following questions.

Guiding questions

- What provides us with light during the day? (The Sun.)
- When an object spins around itself, what is that movement called? (Rotation.)
- Does the Earth rotate? (Yes.)
- Around what does the Earth rotate? (Around its own axis.)
- When an object moves around another object, what is that movement called? (Revolution.)
- Does the Earth revolve? Around what does it revolve? (The Earth revolves around the Sun.)
- Can anyone explain why, during the demonstration, our location first faced toward the Sun and then away? In this case, we moved the globe by hand, but does that occur in real life? How does it occur?
    - Because the Earth spins around itself while revolving around the Sun, our location is sometimes in front of the Sun (that is, in direct sunlight; day) and at other times away from the Sun (night).
    - The movement of the Earth moves our location to different points in reference to the Sun's position.

After the discussion, ask the students to think about the question posed during the culminating activity of the previous lesson: 'What do you think causes day and night?'

Ask the students to write as well as draw their observations from the demonstration. (Ask the students to also keep the previous lesson about the movement of the Earth in mind while writing and drawing their responses.)

Exploration

In this activity, students will learn about the causes of day and night.

Divide the class into groups of three students and give each group the materials (a lamp, a Styrofoam ball, and two index cards labelled 'Sun' and 'Earth').

Tell the students that they will demonstrate the Earth's movements in relation to the position of the Sun, and that each group will share their demonstration with the rest of the class.

Tell the students that in each group one of them should represent the Sun, one should represent the Earth, and one should be the narrator.

Ask the students to draw a diagram of the phenomenon (the Earth's movements in relation to the position of the Sun) before acting it out.

Before working on their demonstration, ask students to make predictions about the following:

- What does the lamp represent? (The Sun.)
- What does the Styrofoam ball represent? (The Earth.)
- Which object rotates around its axis? (The Earth.)
- Which object revolves? (The Earth revolves around the Sun.)

Ask a few volunteers from the class to share their responses with the rest of the class.

Give the groups some time to put together their demonstrations, and during this time go around the classroom to check on every group.

Share
Ask each group to present their demonstration to the class.

Provide feedback to each group at the end of their presentation.

Initiate a class discussion to give students a chance to share their observations of their as well as their peers' presentations. Use the following questions to guide the discussion.

Guiding questions

- What are some of the limitations of your demonstrations? (Think back to lesson 2, where we studied scale models.)
    - One limitation of these models is that they are not to scale. The ratio between the sizes of the Earth and the Sun are not true to size.
    - The distances between the Earth and the Sun are also not represented to size.
    - Also, the time it takes for the Earth to complete a rotation and revolution is not correct.
- Does anyone know how long it takes for the Earth to rotate around itself? (Twenty-four hours.)
- What is another term for this time period? (One complete calendar day.)
    - One complete rotation of the Earth around its axis takes 24 hours and makes one complete day.
- Do all of us living on Earth experience day or night at the same time? (No.)
- Why?
    - The Earth is constantly rotating around its axis, and so all regions on the Earth are not in front of the Sun at the same time. Due to the constant rotation of the Earth, different regions experience sunlight at different angles (in different amounts) at any point in time.
- How long does it take the Earth to orbit around the Sun? (One year: 365 days.)

Culminating activity

Tell the students that the rotation of the Earth around its axis while revolving around the Sun causes day and night in different time zones because different regions on Earth receive different amounts of light at any point in time.

Ask the students to take a few minutes to write in their science notebooks about what they have learned about the occurrence of day and night. This account should include the role of the Sun and the rotation of the Earth around its axis in causing day and night.

Students should include at least one fact about the occurrence of day and night that they learned from their textbook.

Ask the students to explain if their textbook reading about the occurrence of day and night was clarified or not after lesson. The students can also comment on how their textbook reading about the occurrence of day and night was enhanced and what (if any) confusion still remains after the lesson.

Ask the students to trade their science notebook with another student sitting next to them.

After they have traded their notebooks, each student will check the formative assessment responses of their peers.

Ask a few students to volunteer their responses to the formative assessment activities and make any corrections if needed.

Ask the students to check their peers' formative assessment responses and correct them if needed.

Tell the students that in the next lesson they will learn about the occurrence of the seasons. Ask them to read chapter 10, section 10.5, on page 93 from their science textbook.

Reference: teachHouston, University of Houston. Retrieved 29 April, 2012.
- http://teachhouston.uh.edu/TeachHouston_document/lesson_plans1/science_lesson/files/Day%20and%20Night-Final_5-21-10.pdf

Lesson 6: Reason for seasons

Learning objectives

Learning targets

Success criteria

Vocabulary

Earth's axis, tilt, northern hemisphere, southern hemisphere, Earth's equator

Materials required

- Computer with an Internet connection
- Globe
- Lamp without shade

Introduction (connections to prior knowledge)

In this section, check for students' knowledge of concepts (northern hemisphere, southern hemisphere, and equator) that are necessary for understanding this lesson.

Use this time to connect previous lessons learned to concepts in this lesson.

Initiate a discussion to check students' understanding of background concepts for this lesson.

Ask the students about the following and note their responses.

Guiding questions

- Can we remember from our previous lesson what the axis of the Earth is?
  - It is an imaginary line going through the centre of the Earth. The Earth rotates around its axis.
- How long does it take the Earth to complete a rotation on its own axis? (Twenty-four hours.)
- What causes day and night? (The Earth's rotation on its axis.)
- Can anyone tell us about the position of the Earth's axis? Is it straight or tilted at an angle?
  - The students might not know the answer to this question. After taking a few responses from the students, share with them that the axis of the Earth is not straight. It is tilted slightly at an angle of about 23.5 degrees. Tell the students this concept is very important for today's lesson and we will explore it later in the lesson.
  - Bring a globe for demonstration to show the students how the Earth's axis is tilted.

NOTE: Students should understand that the Earth's axis is an imaginary line and that there is no actual line going through the Earth. We use the imaginary axis to help us calculate the tilt in the Earth's position.

Ask the students to draw a labelled diagram of the Sun and the Earth with its axis. The diagram should also show the equator, the northern hemisphere, and the southern hemisphere. You may need to explain the northern and southern hemispheres and the equator.
(Note: Students' diagrams should show the 23.5-degree tilt in Earth's axis.)

- What are seasons?
- What causes seasons?
  - A common misconception: Many students think that the seasons are caused by the distance of the Earth from the Sun; that is, they believe that when the Earth is farther away from the Sun it is winter, and when it is closer to the Sun, it is summer.
  - To clarify this misconception, ask the students if all parts of the Earth experience winter and summer at the same time. The answer is no, and this is proof for the fact that the summer and winter are not caused by the distance of Earth from the Sun. When it is winter in the northern hemisphere, it is summer in the southern hemisphere, and vice versa. If seasons changed because of the distance of the Earth from the Sun, both hemispheres would experience summer and winter at the same time.

Note the students' responses on the board. These responses will be very important in assessing how much the students know about the seasons.

Tell the students that in this lesson we will explore the causes of the different seasons.

Exploration 1

Tell students that during this activity, they will explore how the Earth's tilted axis and the Earth's revolution around the Sun cause the change in seasons.

During this activity, students will watch a video animation of what causes seasons to change.

Draw a round circle (Earth) on a board and then draw a line across the middle to show the equator.

Check for students' knowledge of some concepts necessary for understanding the causes of the seasons.

Guiding questions

Ask students the following questions to lead the discussion. Point to the diagram of the Earth and ask the following questions:

- What is the equator? (It is an imaginary line drawn across the middle of the globe that divides the Earth into the northern and southern hemispheres.)
- What is a hemisphere? (*Hemisphere* in Greek means 'half of a sphere', so a hemisphere of Earth is half of the Earth.)
- Can anyone name the two hemispheres? (The northern hemisphere and the southern hemisphere. The northern hemisphere is the half of the Earth north of the equator, and the southern hemisphere is the half of the Earth south of the equator.)

Label the diagram of the Earth as the definitions come up during the discussion.

After the discussion is over, show the students the video 'Science for Kids: How Do Seasons Change?' The video can be found at:

➢ http://www.videojug.com/film/why-does-the-earth-have-seasons

After viewing the video, ask the students to take a few minutes to write down their observations and reactions to the video.

Ask the students to write down at least two interesting things they remember from the video.

Share

Initiate a discussion in which students share what they learned from the video.

Ask students to share at least one interesting fact they learned from the video. Take a few responses and note them on the board.

Clarify any further misconceptions the students might have about the concepts from the video.

Initiate a class discussion to give the students a chance to share their observations about the video with their peers and use the following guiding questions to conduct the classroom discussion.

Guiding questions

- Is the Earth's axis straight? (No, it is tilted at about 23.5 degrees.)
- How does the tilt in the Earth's axis affect the sunlight hitting the Earth?
  - Because of the tilt, the sunlight hits the Earth at different angles, and so different parts of the Earth receive different amounts of sunlight.
- How does the tilt cause changes in the seasons on Earth?
  - During Earth's revolution around the Sun, its tilt (direction of the axis) always points in the same direction. When Earth is at one place in its path, the northern hemisphere faces more direct sunlight as compared to the southern hemisphere, and when the Earth moves to the opposite location, the other hemisphere receives more direct sunlight. The hemisphere that faces more sunlight experiences summer and the other experiences winter.

Note the responses to these questions on the board. Ask the students to note their as well as their peers' observations in their science notebooks.

Exploration 2

Start this exploration by asking the students to make predictions about the following questions and write their responses on the board.

- How do we know when seasons change? (We see flowers bloom, birds migrate, and we experience hot or cold temperatures.)
- How does the weather change in different seasons?
- Why do seasons change?

Ask the students to describe the hottest day they can remember. Take the responses from a few students and note them on the board.

Ask the students to describe the coldest day they can remember. Take responses from a few students and note them on the board.

Divide the students into groups of three or four and provide each group with materials (lamp without a shade, a globe, and a small sticker).

Turn off the classroom light and ask the students to turn on their lamps.

Help the groups to locate their town on the map and ask them to place a small sticker on it.

Fix a marker in the classroom (such as a picture, a flagpole, etc.). Make sure the axes of all the globes point toward this marker at all times during this activity. This will help students simulate the fact that the direction of the Earth's axis never changes.

Ask the students, 'Why do we have the axes of all the globes pointing toward this marker?'

NOTE: Students should understand that the Earth's axis always points in the same direction.

Go around the class to make sure that the students are performing this step correctly.

Ask the students to tilt the globe so that the sticker faces the lamp.

Instruct the students to make sure that the tilt of the globe is always facing toward the marker (in the same direction) at all times during this activity.

Ask the students, 'What season is it in the northern hemisphere?' It is summer because the northern hemisphere is facing the Sun and receiving the maximum amount of sunlight. The maximum exposure to sunlight is causing the northern hemisphere to heat up more than the southern hemisphere.

Ask the group to slowly rotate the globe around its axis (while the Earth's axis points toward the marker in the classroom at all times) and observe the northern hemisphere as the day goes by. Direct the students to note their observations in their science notebooks.

Even though the northern hemisphere (the top half of the Earth) experiences day and night (due to rotation of the Earth around its own axis), it experiences more sunlight during the day because at that point in the Earth's orbit around the Sun, it is tilted toward the Sun and so receives more direct sunlight.

Show the students the diagram on the following website to explain the concept further:

➢ http://scienceforkids.kidipede.com/physics/weather/seasons.htm

NOTE: The person in the diagram is located in the northern hemisphere, and seasons listed on the diagram refer to the northern hemisphere (the location specifically indicated by the human figure).

Tell the students that one of the students in the group (while holding the globe and keeping the tilt of the axis in the same direction) should go around the lamp (the Sun) and stop at the opposite location (on the other side of the lamp). In this position, the southern hemisphere of the globe should be facing the lamp.

Ask the students, 'What season is it in the northern hemisphere now? Why?' It is winter because now the northern hemisphere is facing away from the Sun, and so it is not receiving direct sunlight, which causes it to remain cool.

At the end of the activity, to clarify the importance of the Earth's tilt in creating seasons, tell the students, 'Now we are going to model what would happen if the Earth was not tilted'. Ask the students to note their predictions about what would happen if the Earth's axis were straight.

Ask the groups to straighten their globes and while holding them revolve around the lamp to test their predictions.

Students should write or draw their predictions and observations in their science notebooks.

Share

Initiate a class discussion to give students a chance to share their observations and predictions with their peers. Use the following questions to conduct the class discussion:

- What did you observe during this activity? Share at least one observation.
- What do you think would happen if the Earth were not tilted? (We would not experience seasons because most of the Earth would receive a similar amount of light at all times.)
- During the experiment, why did we make sure the Earth's axis was tilted and always pointed in the same direction? (In reality the Earth's axis is tilted and always points in the same direction.)
- What is the angle of the Earth's tilt? (23.5 degrees.)
- Do all places on Earth experience the same season at the same time? (No.)
- Why? (Because of the Earth's tilt, when the northern hemisphere is facing the Sun, experiencing summer, the southern hemisphere is facing away from the Sun, experiencing winter. When it is summer in the northern hemisphere, it is winter in the southern hemisphere, and vice versa.)
- Why do we have different seasons?

Note the student responses on the board. Ask them to write their as well as their peers' observations in their science notebooks.

Culminating activity

Ask the students to explain in their own words the reason for the seasons and note it in their science notebooks. The explanation should include why the hemispheres experience different seasons at any given time.

The students can write and/or draw their explanations. The explanation should include the role of the permanent tilt in the Earth's axis and the Earth's revolution around the Sun in creating seasons.

Ask the students to write down if their reading from the textbook about the occurrence of seasons was clarified or not after the lesson. The students also can comment on how their reading from the textbook was enhanced by this lesson and what (if any) unanswered questions still remain.

Ask the students to trade their science notebooks with a student sitting next to them.

After they have exchanged their notebooks, each student will check the formative assessment responses of their peers.

Ask a few students to volunteer their responses to the formative assessment activities and make any corrections if needed.

Ask the students to check their peers' formative assessment responses and correct them if needed.

Collect students' science notebooks at the end of the class to check:

- their written work
- their answers to formative assessments
- that the students are making necessary corrections to their formative assessment responses during self-check and peer-check activities.

Reference: CASES, 'What Causes Seasons?' Retrieved 1 May, 2012 from:
➢ http://cases.soe.umich.edu/plans.php?nav=showplan&dqid=320&lpid=32774&printfriendly=yes&packet=n

Lesson 7: Phases of the Moon

Learning objectives

Students will:

- know that the Moon does not generate any light; it only reflects the light from the Sun
- learn that the Moon revolves around the Earth in a counter-clockwise fashion
- understand that the journey of the Moon around the Earth is called a lunar, or Moon phase, cycle
- know that it takes the Moon approximately 28 days* to complete one lunar cycle
- learn that there are four major phases of the Moon
- be familiar with the names of the four major phases of the Moon.

Learning targets

Students will:

- learn that the Moon revolves around the Earth in a counter-clockwise fashion
- understand that the journey of the Moon around the Earth is called a lunar, or Moon phase, cycle, which takes approximately 28 days and represents one calendar month
- be familiar with the names of the four major phases of the Moon and the position of the Moon in relation to the Earth and the Sun during these four phases.

* The time between two full moons (a Lunar cycle) is about 29.5 days. However, the time it takes the Moon to make one orbit around the Earth is about 27.5 days. This difference is caused by the fact that the Earth-Moon system is orbiting around the Sun at the same time the Moon is orbiting around the Earth. For simplicity, this document talks about the lunar cycle and the Moon's orbit around the Earth as if they are the same duration, approximately 28 days.

Success criteria

Students will:

- draw a labelled diagram of the Earth and Moon system and represent the direction of the Moon's movement with an arrow
- write the names of four major lunar phases in correct order
- write an explanation of the lunar cycle in their own words
- depict the position of the Moon in relation to the Earth and Sun during each of the four lunar phases, in a Moon-phase book.

Vocabulary

crescent, first-quarter phase, full Moon phase, gibbous, lunar cycle, last-quarter phase, new Moon phase, waning, waxing

Materials required

- Styrofoam balls (one for each student)
- Lamp without a shade

Advance preparation

- A month before this lesson, ask students to take some time every evening to observe the Moon and draw the shape of the Moon in their science notebooks.
- Instruct the students to be sure to put the date on every Moon observation and continue the exercise for a month.
- If the students are not able to see the Moon due to weather conditions, they should still put the date for that night and leave the observation section blank.

Introduction (connections to prior knowledge)

Initiate a discussion to find out what students already know about the Moon and its phases.

Ask the students to take out their science notebooks in which they made their Moon observations during the previous month.

Initiate the discussion by asking the students the following questions.

Guiding questions

- What do you know about the Moon?
  - It revolves around the Earth. It takes a month, or approximately 28 days, to complete a revolution around the Earth.
- Does the Moon move? (Yes.)
- Around what does the Moon move? (It rotates around itself and revolves around the Earth.)
- How long does it take the Moon to revolve around the Earth? (approximately 28 days)
  - A common misconception: Students might also say that the Moon emits light. Make sure to let students know that the Moon does not emit light, but rather it reflects the light of the Sun and that is the reason we are able to see it.

- What did you see while drawing the Moon during the last month? (The Moon seemed to change its shape.)
- How does the Moon change its shape? (It seems to disappear and reappear. The shapes repeat after two weeks.)
- Why do you think the Moon changes it shape?
    - Students might not know the answer to this question, but it is a critical question in that it tells the teacher what students know about the phases of the Moon.

Note the students' responses on the board.

Tell the students that this lesson will explore the phases of the Moon and why they occur.

Exploration 1

The students will take a virtual trip to the Moon to observe what causes the phases of the Moon.

Show the students the following two videos.

The first video, 'The Phases of the Moon', can be found at:

➢ http://www.youtube.com/watch?v=0vXWXqGmPCk

This video explains that the phases of the Moon are caused by its position relative to the Earth and the Sun. Because only one side of the Moon is visible to us (because that side is lit up by the Sun), the portion of the side of the Moon that we can see depends upon the Moon's position in its orbit around the Earth. In other words, because the Moon keeps moving in an elliptical path around the Earth, we on Earth can only see different portions of the lit-up side of the Moon.

Share

Initiate a discussion with the students to process the content they learned in the video and use the following questions to guide the classroom discussion. Note the student responses on the board and ask them to write down their own and their peers' observations in their science notebooks.

Guiding questions

- How long does it take the Moon to revolve around the Earth and complete the cycle of its phases, also called the lunar cycle? (approximately 28 days.)
- What causes the phases of the Moon? (By the position of the Moon relative to the position of the Sun and the Earth.)
- Does the Sun light the entire Moon? (No, half the Moon is always lit by the Sun, and that is the side of the Moon that we can see from the Earth.)
- Can we see the entire lit-up side of the Moon?
    - At one point in the Moon-phase cycle (the full Moon), we can see the entire lit-up side of the Moon. At other times in the lunar cycle, we see portions of the lit-up side of the Moon, and these portions depend on the position of the Moon in its orbit around the Earth.

After the discussion, show the students the second video, 'The Universe: The Phases of the Moon', which can be found at:

➢ http://www.youtube.com/watch?v=WD-H1xqoAAg&feature=relmfu

This video also explains the phases of the Moon and has a simple way of naming the phases. Only show the first 2 minutes and 12 seconds of this video.

Share

Initiate a discussion with the students to process the content they learned in the video and use the following questions to guide the classroom discussion. Note students' responses on the board and ask them to write down their own and their peers' observations in their science notebook.

Guiding questions

- When none of the lit-up side of the Moon is visible from the Earth, what is the Moon's position relative to the Earth and the Sun? (The Moon is between the Earth and the Sun.)
- What is this phase called? (The 'new Moon phase' marks the beginning of the lunar cycle.)
- How does the Moon move around the Earth? (Counter-clockwise.)
- When can we see the half of the lit-up side of the Moon?
    - When the Moon starts to move counter-clockwise around the Sun, we can see more and more of the Moon. When the Moon is at a right angle with the Earth and the Sun, we can see half of the lit-up side of the Moon. At this point, the Moon has completed one-quarter of its cycle.
- What is this phase called? (It is called the first-quarter phase.)
- When can we see a full lit-up side of the Moon during the lunar cycle?
    - When the Moon moves to a position where it is in a straight line again with the Earth and the Sun, we can see a full Moon. At this point, the Earth is between the Sun and the Moon, and the Moon has completed one-half of its cycle.
- What is this phase called? (It is called the full Moon phase.)
- When does the visible portion of the lit-up side of the Moon begin to decrease? (When the Moon moves past its half-cycle position.)
- Do we see half the Moon again?
    - Yes. We see half the Moon in the lunar cycle when the Moon is at a right angle again with the Sun and the Earth. At this point the lunar cycle is three-quarters complete.
- What is this phase of the Moon called? (This phase is called the last-quarter phase.)
- What happens to the Moon in the last part of the lunar cycle?
    - When the Moon is in the last part of the lunar cycle, it appears to become smaller and smaller, until it is in line with the Sun and the Earth again (back at its starting position). At this point, we do not see the Moon. This is the new Moon phase).

NOTE: Students should write the answer to this question in their science notebooks.

- How long does it the Moon to go from one phase to another? (One week.)
- What does the Moon look like in between these phases? (Either a crescent Moon [less than half] or gibbous Moon [more than half].)
- What is the technical term that describes the Moon when it seems to be growing during the first half of its cycle? (Waxing.)
- When does the Moon seem to be waxing during its cycle? (During the first half of the cycle.)
- What is the technical term that describes the Moon when it seems to become smaller and smaller? (Waning.)
- When does the Moon seem to be waning during its cycle? (During the last half of its cycle.)

Exploration 2

In this activity, students will model the Sun, Earth, and the Moon to observe how phases of the Moon occur.

Place a light source (the lamp without a shade) in the middle of the room.

Ask the students to make predictions about what the lamp represents. (The Sun.)

Turn off the lights to darken the room so that the Moon phases are more visible.

Give each student a Styrofoam ball and ask them to make predictions about what the ball represents. (The Moon.)

Tell the students that their heads represent the Earth.

Ask the students to take the Styrofoam ball and gather around the light source (the Sun).

Ask the students to model the new Moon position; that is, where the Moon is situated in relation to the Earth and Sun during the new Moon phase. (Between the Earth and the Sun.)

Go around the room to check all the students' models.

Ask the students in which direction the Moon revolves around the Earth. (Counter-clockwise.)

Tell the students to turn their bodies counter-clockwise to keep the Earth facing the Moon and stop once they have completed one-forth of the lunar cycle.

Ask the students to notice the edge of the shadow moving across the Moon and to stop and draw the shadow at this point.

Tell the students to continue turning their bodies counter-clockwise until they have completed one-half of the revolution and the Sun is behind them.

The students will have to raise the Moon (lift the ball up) so that the shadow of their head does not interfere with the shadow cast on the Moon.

Ask the students to draw their observations of the shadow on the Moon at this point.

Ask the students to continue their journey until they have completed three-quarters of the revolution. The students should stop and note the appearance of the Moon at this point in their science notebooks.

Ask the students to continue turning counter-clockwise until they have completed one full revolution (the lunar cycle) and note the appearance of the Moon at this point in their notebooks.

Share
Initiate a discussion to give students a chance to share their observations with their peers. Use the following questions to guide the class discussion.

Guiding questions

- What are some of the limitations of this model?
    - The model is not to size. Only the Earth is moving and the Moon is staying stationary, but in reality both the Earth and the Moon are in motion.
- What does the very first phase (when the ball is between the student and the lamp) represent? (This represents the new Moon phase, when the Moon is between the Earth and Sun.)
- How much of the Moon is visible during this phase? (None, and that is why there is no shadow on the ball.)
- How much of the shadow on the ball did we see after one-quarter revolution was complete? (One-half shadow.)
- What is this phase called in the lunar cycle? (The first-quarter phase.)
- How much of the shadow was seen after one-half revolution was complete? (The whole ball was lit up.)
- What is this phase called in the lunar cycle? (The full Moon phase.)
- How much of the shadow did we see after three-quarters of the lunar cycle was complete? (One-half of the Moon was lit up.)
- What is this phase called in the lunar cycle? (The last-quarter phase.)
- Between the new Moon phase and the full Moon phase, what was happening to the appearance of the Moon? (It appeared to become bigger and bigger.)
- What is this phenomenon called? (The waxing phase.)
- What was happening to the appearance of the Moon between the full Moon phase (going toward the end of the revolution) and the new Moon phase? (The Moon appeared to become smaller and smaller.)
- What is this phenomenon called? (The waning phase.)

Note student responses on the board. Ask the students to write down their own as well as their peers' observations in their science notebooks.

Culminating activity

Ask the students to take a few minutes and write down what they learned about the Moon phases. What fascinated them about the phases of the Moon? What questions do they still have about the lesson?

Formative assessment: Ask the students to draw a labelled diagram of the Earth and the Moon system in their science notebooks and depict the direction of the Moon's movement with an arrow.

Ask the students to keep their science notebooks open and go over the formative assessments to give them a chance to correct their answers.

Ask a few students to share their responses and make any needed corrections.

Ask the whole class to check their formative assessment responses and make any corrections if need.

Reference: Utah Education Network, 'Phases of the Moon', 2002. Retrieved 6 May, 2012.

➢ http://www.uen.org/Lessonplan/preview?LPid=623

Sun, Earth, and the Moon unit: Instructor's copy

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This copy is prepared for Instructors' use and contains the learning objectives, learning targets, success criteria, and formative assessments for all lessons of the 'Sun, Earth, and the Moon' unit. The learning objectives, learning targets, success criteria, and formative assessments (pertaining only to success criteria) from lessons 2, 3, 5, and 6 have been omitted from the Student Teachers' copies of this unit. The reason for this omission is that one of activities asks Student Teachers to use lessons 1, 4, and 7 as examples to create learning objectives, learning targets, success criteria, and formative assessments (pertaining only to success criteria) for lessons 2, 3, 5, and 6. The Student Teachers can either add the formative assessment activities or find ones that are already built into the lessons. The assessment activities added to or identified in the lessons should aim at assessing students' mastery of the success criteria of the lessons.

Description of the unit

The 'Sun, Earth, and the Moon' is a seven-lesson mini-science unit for grade 4 or 5. This unit uses interactive and participatory teaching methods to teach students about the Sun, Earth, and the Moon system. Each lesson in this unit is designed to be 1–1.5 hours long.

Learning goal for the unit

Students will understand the interactions between the Sun, Earth, and the Moon and how these interactions affect life on Earth.

Lesson 1: Objects in the sky

Learning objectives

Students will:

- understand that the universe is vast and has millions of different types of objects, including our solar system
- understand that the Sun is the centre of our solar system, which has eight planets
- recognize the position of the Sun, Earth, and its Moon in the solar system
- know that all the planets revolve around the Sun in a circular path
- know the meaning of *orbit* and that paths of the planets around the Sun are called *orbits*.

Learning targets

Students will:

- understand that Sun is the centre of our solar system, which has eight planets
- recognize the position of the Sun, Earth, and its Moon in the solar system
- know that all the planets revolve around the Sun in a circular path called an *orbit*.

Success criteria

Students will:

- write the names of all eight planets in correct order
- draw a labelled diagram of the Sun, Earth, and the Moon to show their correct positions
- draw and label the paths of the Earth and Moon.

Vocabulary

solar system, planets, Sun, orbit, Moon, star

Advanced preparation

Assign the students the following homework the day before this lesson:

- Spend 10 minutes observing the sky at night and write and draw the objects in the sky.
- Write about your experiences and reactions while viewing the sky.

Materials required

- Chart paper
- Internet connection
- Video projector

Introduction (connections to prior knowledge)

Initiate a discussion to find out what students already know about the solar system, Earth, Sun, and the Moon. Ask students the following questions to conduct a class discussion:

- What do you know about the Sun?
- What do you know about the Earth?
- What do you know about the Moon?
- How are the Sun, Earth, and the Moon related?

Note student replies on a piece of chart paper so they can be used later in this lesson or the unit.

Exploration 1

Take students to the play yard and ask them to observe the sky and note the objects they see. The students should write and/or draw these objects. Encourage the students to draw any observations or conclusions about the size and number of objects or any other observations about the sky in general.

Ask the students to make a comprehensive list of images from the day and night skies.

Ask the students to note down the objects that they think exist in the sky but might not have been visible to them during the day and night observations.

Share
Bring all the students back to the classroom and give them a chance to share their observations.

Note students' observations on a chart paper.

Initiate a class discussion about the students' experiences during their sky observations. Use the following guiding questions and write the students' responses on the blackboard.

Guiding questions

- What are the different types of objects you saw in the sky?
- Were all the objects in the sky visible to us? Might there be other objects in the sky? Name them.
- What do you know about the Sun?
- Ask the students to write down at least three things they know about the solar system.

Take a few student volunteers and ask them to share their responses with the rest of the class. Write these responses on the blackboard.

Exploration 2

In this activity, students will act like young astronauts and take a trip to the solar system through a short video.

During the video, students should write down and/or draw least five interesting things about the solar system.

Show the following video, 'Solar System Animation for Kids', to the class. The video is 7 minutes and 41 seconds long:

➢ http://www.youtube.com/watch?v=sJrDiUG2JAo

Notes
This video features the following concepts:

- Even things big in size will look smaller from a distance. This gives the children an idea that the stars and planets look small from the Earth because they are really far away.
- It showcases the solar system and its planets and gives the order of the planets.
- It goes over the sizes of different planets and their few distinguishing features.

Share
Tell the students, 'Now that our space trip is over, let us share what we observed during our journey to space'. Take responses from as many students as time allows and note them on the blackboard.

Ask the students to write these responses in their science notebooks.

Guiding questions

Initiate a class discussion to give students a chance to share their observations with the whole class. Use the following guiding questions to conduct the classroom discussion and note students' responses on the blackboard. Ask the students to write their classmates' observations in their science notebooks.

- Describe the solar system in your own words.
- Why do objects in space seem so small?
- What is the position of our Earth and Moon in the solar system? Is the Moon also a planet?
- Is the Moon smaller, bigger, or the same size as the Sun? Why?
- Are planets stationary or in motion? Can anyone describe their motion?
- What are the paths of the planets called and where does that name comes from?

Ask students to note these observations in their notebooks if they have missed them during the video.

Refer to the chart paper from the introduction activity and Exploration 1 and explore with the students how and why their responses have changed or not changed after their virtual tour to the solar system.

Culminating activity

Formative assessment: Ask the students to write down the names of the eight planets in correct order.

Formative assessment: Ask the students to also draw a labelled diagram of the Sun, Earth, and the Moon in their correct positions. Also draw and label the paths of the Earth and the Moon.

NOTE: At this point, students can use their judgement to capture the sizes in this diagram.

Go over the formative assessment answers with the students.

Ask a few students to share their answers with the class. Make corrections if needed.

Ask all the students to check their answers and make any corrections if needed.

Tell students that they will further explore the relative sizes of the Sun, Moon, and the Earth in the next lesson.

Lesson 2: How big, how far

Learning objectives

Students will:

- understand the concept of a scale model.
- understand the relative size differences between the Sun, Earth, and the Moon
- be able to understand the relative distances between the Sun, Earth, and the Moon
- know that the Sun's diameter is more than 100 times as big as the Earth's diameter, and the Earth is about 100 Sun diameters away from the Sun
- understand that the Moon's diameter is around one-fourth the size of Earth's diameter, and it is about 30 Earths away from the Earth.

Learning targets

Students will:

- understand the concept of a scale model
- know that the Sun's diameter is more than 100 times as big as the Earth's diameter and the Earth is about 100 Sun diameters away from the Sun
- understand that the Moon's diameter is around one-fourth the size of Earth's diameter and it is about 30 Earths away from the Earth.

Success criteria

Students will:

- create a scale model (representing correct relative sizes) of the Sun, Earth, and the Moon system using different-sized objects
- act out a scale model (depicting correct relative sizes and distances) of the Sun, Earth, and the Moon system.

Vocabulary

scale model, diameter, ruler

Materials required

- A blown-up balloon (one metre in diameter)
- Several balls of different sizes (1 centimetre, 5 centimetres, 10 centimetres)
- A football
- A few coriander seeds or peppercorns (two to three millimetres)

Introduction (connections to prior knowledge)

Students will look at how big the Sun, Earth, and the Moon are when compared to one another and how far they are located from one another. Students should look at their observations and drawings from the previous lesson.

Exploration 1

In this activity, students will investigate the sizes of the Sun, Earth, and the Moon by using scale models.

Check the students' understanding of a scale model by asking, 'What is a scale model?' Students should write down their predictions of what a scale model is in their science notebooks.

Take responses from a few students. Then tell them that when we reduce the size of all parts of an object by the same proportion, it is called a *scale model* of the object. A globe is an example of a scale model of the Earth because the sizes of all the large bodies of Earth (the continents and oceans) have been reduced by the same proportion.

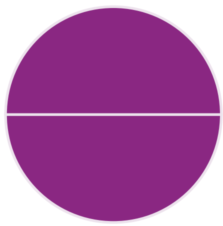
Ask the students to give at least three examples of scale models and write them in their notebooks.

Divide the class into groups of three or four students and provide them objects of different sizes. Each group should get a balloon and three balls of different sizes (1 centimetre, 5 centimetres, 10 centimetres), a football, and a few coriander seeds.

Show the students the blown-up balloon and ask, 'If we assume that the Sun is as big as this balloon, how big do you think the Earth and the Moon are?'

Take a ruler and put it across the diameter of the balloon to make sure that the students understand the concept of diameter. Tell the students that the balloon is one metre across, which means it is 1 metre in diameter.

NOTE: The teacher should blow the balloon to one metre diameter. Before demonstrating the diameter with the ruler, draw a diagram on the blackboard to explain diameter to the students Use the diagram below as a guide. The line drawn across the widest part of the balloon should measure one metre.



Ask the students to pick two items to represent the Earth and the Moon.

Give each group a chance to share their assumptions with the class.

Tell the students that the Sun's diameter is about 100 times greater than the Earth's diameter, which means we will need 100 Earths to stretch across the Sun.

Give the students some time to come up with ideas to calculate the diameter of the Earth.

Help each group come to the conclusion that they should use a one-centimetre ball to represent the Earth because the Earth's diameter is a 100 times smaller than the Sun's diameter.

Ask the students to make predictions about which object they could place 100 times across the surface of the balloon.

Ask students if they want to change the object they chose earlier to represent the Earth (based on the new information they now have) and give them a few moments to correct their model of the Earth.

Tell the students that the Moon's diameter is one-fourth the diameter of the Earth, and ask them to find the diameter of the Moon based on this information.

Go around the class to help groups calculate the diameter of the Moon and make sure that they calculate it correctly as two to three millimetres.

Ask the students if they need to change their model of the Moon based on this new information and give them a few moments to do that.

Ask the students to note their observations and reactions after finding out about the size differences between the Sun, Earth, and the Moon and encourage them to write as well as draw their observations and reactions.

NOTE: Students should always use their science notebooks for their science class work and homework.

Share

Ask a student from each group to share their observations and reactions with the class.

Ask the students, 'Keeping our model of the Sun, Earth, and the Moon in mind, can anyone tell me how much smaller the Moon is as compared to the Earth?'

Take a few student responses from the class and write them down on the board or chart paper.

Discuss this question with the students and make any corrections if required.

Ask the students to note their classmates' responses in their science notebooks.

Exploration 2

In this activity, students will investigate relative distances between the Sun, Earth, and the Moon.

Before starting the activity, ask the students to make predictions about the distances between the Sun, Earth, and the Moon. Ask the students the following question to guide their predictions: 'In your opinion, is the Sun closer to the Earth or the Moon? Why do you think that?'

Remind the students of the video they watched in lesson 1 and their notes from the video about why the Sun and the Moon look as if they were the same size, even though they now know that the Sun is about 400 times bigger than the Moon.

The students should be able to make the connections between lessons 1 and 2 that the farther an object is, the smaller it looks. The Sun's farther distance from the Earth as compared to the Moon makes the Sun appear to be the same size as the Moon.

Ask each group to pick members to represent the Sun, Earth, and the Moon.

Tell the students to estimate how far the Earth and the Moon are from the Sun and stand accordingly while holding the objects representing the Sun, Earth, and the Moon.

For example, the student representing the Sun should hold the balloon in their hands, the student representing the Earth should hold a one-centimetre ball in their hands, and the student representing the Moon should hold a small coriander seed in their hands.

Go around the classroom to check the distance representation of all the groups.

Ask for a volunteer from each group to interpret their representation.

Provide the students with the following information to check the accuracy of their representation of distances between the Sun, Earth, and the Moon.

- The Earth is about 100 Sun diameters away from the Sun, so if our Sun is one metre, how far would it be from the Earth?
  - Give the students time to calculate the distance.
  - The Earth would be 100 metres away from a one-metre-diameter Sun.
- Tell the students that the Moon is about 30 Earth diameters away from the Earth and give them some time to calculate the distance between the Earth and the Moon.
  - The Moon would be 30 centimetres away from a one-centimetre-diameter Earth.

Help students realize that the Moon is a lot closer to the Earth as compared to the Sun.

Take the students to a nearby playground and ask them to stand in position (according to the distances they calculated) to represent the Sun, Earth, and the Moon.

Ask the students to write down their observations and reactions in their notebooks.

Reference: Education Development Center, Kendall/Hunt Publishing, National Science Foundation, *'Sun, Earth and Moon'*. Insights: An Elementary Hands-on Inquiry Science Curriculum, Teacher guide, 2nd ed.(Dubuque, IA: Kendall/Hunt, 2007), 195–197.

Share

Ask at least one person from each group to share their observations and reactions after looking at how far the Sun, Earth, and the Moon are from each other.

Ask the students to make predictions about the travel time between the Moon and the Earth.

Take responses from a few students and write them down on the board. Share with the students that it takes an astronaut about three days to travel between the Earth and the Moon even in a rocket going as fast as 6 kilometres per second.

Ask the students, ‘Now that you know how long it takes to go to the Moon, can anyone predict how long it will take to travel to the Sun on the same rocket?’

Share with the students that it will take several months to reach the Sun, but the Sun is so hot that we cannot even get close to it.

Reference: Joan Board, *Stargazing Live: Lesson Plans* (BBC Learning, 2012), 6–7. Retrieved 19 April, 2012.
➢ http://downloads.bbc.co.uk/tv/guides/BBC_Stargazing_Live_2012_Lesson_plans_KS2.pdf

Culminating activity

Ask the students to write and/or draw three new things they learned in this lesson.

Go over the formative assessments to give students a chance to correct their answers.

Tell the students to read chapter 10, pages 89–90, from their science textbook.

Lesson 3: Endless Earth

Learning objectives

Students will:

- be familiar with the concept of spherical shapes
- know that the Earth is a sphere
- be able to explain why they think that the Earth is a sphere
- be familiar with the discovery that the Earth is a sphere.

Learning targets

Students will:

- be familiar with the concept of spherical-shapes
- be able to explain why they think that the Earth is a sphere.

Success criteria

Students will:

- give at least two examples of spherical-shaped objects
- give at least three evidences for the fact that the Earth is a sphere.

Vocabulary

sphere, satellite, Earth

Materials required

- Printouts of the story 'How Did We Find Out that the Earth Is Round?' by Isaac Asimov (one per student)
- Printouts of satellite pictures of the Earth

Introduction (connections to prior knowledge)

Initiate a discussion to find out what students know about the shape of the Earth.

Probe students to talk about their idea of the shape of the Earth and how they came to their conclusions.

Ask the students, 'Imagine that you are in space looking directly at our Earth. What do you think the Earth will look like?' Ask them to make predictions and draw this view of the Earth from space.

After giving students a few minutes to draw, share with the students that people's ideas about the Earth's shape have changed over the years and the next activity will explore this topic in detail.

Exploration 1

In this activity, students will discuss how people in the past found out that the Earth is a sphere.

Check students' knowledge of the definition of *sphere*. If the students are not aware of the meaning of sphere, show them a few spherical shapes such as a cricket ball, tennis ball, or an orange to make sure the students understand what a spherical shape looks like.

After showing them a few spherical shapes, ask the students to come up with at least two examples of a sphere and write and/or draw them in their notebooks. Ask a few students to share their examples with the class and note them on the board.

Use the story 'How Did We Find Out that the Earth Is Round?' by Isaac Asimov (pages 1 to 10). It can be retrieved at:

➢ http://www.arvindguptatoys.com/arvindgupta/earthpix.pdf

Tell the students that while reading the book, they should keep the following questions in mind:

- What were people's very first ideas about the shape of the Earth?
- Why were those ideas disregarded?
- What evidence did people find that supported the idea that the Earth had a spherical shape?

Read the first few pages with the students and point out the important elements in the text. This exercise will teach students how to pay attention to crucial details. Ask the students to finish reading the rest of the book on their own.

Ask the students to work in groups of two or three and answer the questions (listed at the beginning of this activity) by reading until the end of page 10 (the end of section 3, 'The Disappearing Ships').

Ask the students to note the evidence (answers to questions presented at the top of this activity) and their ideas in their science notebooks.

Share

After the students are finished reading and recording their ideas, ask one student from each group to share his or her ideas with the rest of the class. Write down these ideas on the board.

Ask groups to write down anything they might have missed while making their observations.

Exploration 2

Mention to the students that people came to the conclusion that the Earth is a sphere (using the evidence discussed previously). At that time, people did not have modern equipment such as satellites to visit space and directly observe the shape of the Earth.

Ask the students: 'What do you know about satellites?' Note a few students' responses on the board.

Use student responses to construct a definition of *satellite* and ask the students to write it down.

A satellite is a smaller object orbiting around a larger object. Scientists use electronic satellites to observe objects in space.

Ask the students, 'Can anyone give me an example of a natural satellite that revolves around the Earth?' (The Moon is a satellite that revolves around the Earth.)

Divide the students into groups of two or three and provide each group with satellite pictures of the Earth. The pictures can be printed from the following sites:

- http://visibleearth.nasa.gov/view_cat.php?categoryID=1484
- http://www.earth-images.com/index3.htm
- http://jtintle.wordpress.com/2005/12/07/europe-at-night/

Share

Conduct a class discussion using the following question. Write students' responses on the board.

After looking at the pictures, ask the students, 'Why does the Earth seem flat in these pictures?'

Take a few responses from the students, and incorporating these responses as much as possible, tell the students that because we are viewing the Earth on a flat computer screen or a flat sheet of paper, the Earth looks flat. That is why many satellite pictures of the Earth from different angles are required to confirm that Earth is a sphere and not a flat disc.

Putting it all together

Now students will put all the evidence together that points to the fact that Earth is a sphere. Draw the following table on the blackboard and ask the students to look at their observations from Exploration 1 and Exploration 2.

Ask the students to make a similar table in their science notebooks.

Tell the students that the table will help them organize their data in a concise manner.

Observations	Fact
Ship sailing away and disappearing gradually	Earth is a sphere
Satellite pictures	

NOTE: Only a few observations are listed here as an example. The table needs to be completed using the observations from Explorations 1 and 2. The number of rows in the table is not representative of the number of observations.

Culminating activity

Ask the students to draw and/or write about three new things they learned in this lesson.

The students should note at least one fact they learned from the textbook reading assigned to them as homework and describe if that fact was clarified or not at the end of this lesson.

Go over the formative assessment responses with the students. Ask a few students to volunteer their responses and make any corrections if needed. Ask the whole class to check their formative assessment responses against the correct responses and make any corrections if needed.

Collect students' science notebooks to check their responses to formative assessment activities and to note if all the students are self-checking their answers and making appropriate corrections.

In the next lesson they will learn about how the Earth moves. Ask the students to read chapter 10, sections 10.2 and 10.4, on pages 90 and 91 from the grade 4 science textbook to prepare.

Lesson 4: Movements of the Earth

Learning objectives

Students will:

- understand that the Earth moves around itself and around the Sun
- be able to define the rotation and revolution of the Earth
- be able to differentiate between the concepts of rotation and revolution
- understand that the Earth spins around itself (on its axis)
- understand that the Earth's axis is an imaginary line drawn through the Earth's centre to represent its tilt and movement
- know the time it takes the Earth to complete a rotation and a revolution.

Learning targets

Students will:

- understand that the Earth moves around itself and around the Sun
- be able to define the rotation and revolution of the Earth
- understand that the Earth's axis is an imaginary line drawn through the Earth's centre to represent its tilt and movement.

Success criteria

Students will:

- draw the diagram of the Sun and the Earth with arrows indicating the movements of the Earth
- define the Earth's axis in their own words and label it in the same diagram
- write one example of rotation and one of revolution from their daily lives and describe why she or he thinks these movements are examples of rotation and revolution.

Vocabulary

rotation, revolution, axis

Advanced preparation

Print copies of pictures of the Earth's axis (provided in this lesson plan).

Materials required

- Internet connection
- Video projector
- Computer
- Printed pictures of the Earth's axis
- Chart paper
- Markers

Introduction (connections to prior knowledge)

Initiate a discussion to find out what students already know about the movements of the Earth. Ask the students to make predictions about the following guiding questions.

Guiding questions

- Do you think the Earth moves?
- How does it move?
    - The Earth spins around itself and moves around the Sun at the same time.
- When the Earth spins, what is that movement called?
- When the Earth moves around the Sun, what is that movement called?

Note student replies on a large piece of chart paper and refer to this later in this lesson or the unit. If no one has provided correct responses to the questions, do not provide the students with the correct answers at this point.

Exploration 1

During this activity, students will understand the movement patterns of the Earth.

Show the students a video on movements of the Earth, 'Rotation and Revolution of the Earth', and ask them to note their observations. The video can be found at:

➢ http://www.youtube.com/watch?v=eV4nk9or9SE&feature=fvst

NOTE: Only shows the first 2 minutes and 47 seconds of the video.

Tell the students to keep the following questions in mind when making their observations:

- Does the Earth spin around itself? What is that movement called?
- Does the Earth spin around the Sun? What is that movement called?
- Does it take longer for the Earth to spin around itself or to go around the Sun?
- What are at least two interesting facts about the Earth that you learned from this video?

Notes

This video features the following concepts:

- The video starts by defining the concepts of rotation and revolution of the Earth.
- The video then explains how the Earth rotates around itself and revolves around the Sun.
- It takes the Earth more time to revolve around the Sun and less time to rotate around itself.

At this point, tell the students that 'even though this video does not show it, scientists, in order to understand the rotation of the Earth, draw an imaginary line through the centre of the Earth. This line passes from the North Pole to the South Pole and is called the Earth's *axis*'.

Draw a picture of the Earth with its axis and arrows for rotation to show the students.

Formative assessment: Tell the students to carefully observe the picture of the Earth with its axis and arrows for rotation. Ask them to describe the axis of the Earth in their own words and to write and draw the descriptions in their science notebooks.

Sharing

Tell the students, 'Now it is time to share what we learned from the video and the picture'.

Pick a few volunteers from the class and ask them to share their observations of the video with the rest of the class. Note these responses on the chart paper.

Guiding questions

Conduct a class discussion to give students a chance to share their observations about the movements of the Earth with their classmates. Use the following questions to guide the class discussion:

- Does the Earth spin around itself? What is that motion called?
- Can anyone define the axis of the Earth? Is it real? Why is it useful?
- Does the Earth move around the Sun? What is that motion called?
- Does anyone remember from lesson 1 what the path of the Earth around the Sun is called?
- Which movement takes Earth longer: rotation or revolution?

Bring out the chart paper from the introduction activity and show the students if and how their answers to the guiding questions might have changed after watching the video.

Ask the students to note the observations from the video in their science notebooks.

Exploration 2

In this activity, students will make a human model of the rotation and revolution of the Earth.

Divide the class into groups of three students and ask the students to pick a Sun, an Earth, and a narrator in their groups. The role of the narrator is to describe the model to the rest of the class.

Give groups about five minutes to put together and act out their rotations and revolutions of the Earth.

Call each group one by one to the front of the class to present their model. Observe if the students are depicting these movements correctly.

Ask the students to write about their reactions and observations of the models.

Formative assessment: Ask the students to write one example of rotation and one of revolution from their daily lives and describe why these movements are examples of rotation and revolution.

Share
Initiate a classroom discussion to give students a chance to share their experiences and observations from their own as well as their peers' presentations. Use the following guiding questions.

Note student responses on the board and ask them to write them in their notebooks.

Guiding questions

- How is the Earth's rotation different from the Earth's revolution?
- What is the shape of the Earth's orbit? (One is oval, and one is elliptical.)
- What natural phenomenon does the Earth's rotation cause? (Day and night.)
- What natural phenomenon is the Earth's revolution related to? (The seasons.)

Culminating activity

Formative assessment: Ask the students to draw a diagram of the Sun and Earth with arrows indicating movements of the Earth. The students should also draw and label the Earth's axis.

Ask the students to write or draw two new things that they learned in this lesson.

Tell the students that one of these facts should be from the textbook. Ask the students to describe if knowledge of this fact from the textbook reading was clarified or not by the end of this lesson.

NOTE: The purpose of this step is to examine how students connect the knowledge they learned from the textbook to the in-class lesson.

Go over the responses to formative assessment activities with the students. Ask a few students to volunteer their responses and make any corrections if needed. Ask the class to check responses and make any corrections if needed.

Tell the students that in the next lesson they will explore day and night, and leave them with the question, 'What do you think causes day and night?'

Ask the students to read chapter 10, section 10.3 on page 90 from the grade 4 science textbook.

Lesson 5: Day and night

Learning objectives

Students will:

- understand the process by which day and night occurs
- be able to explain the role of the Sun in creating day and night
- be able to explain the role of the Earth's rotation in creating day and night.

Learning targets

Students will:

- be able to explain the role of the Sun in creating day and night
- be able to explain the role of the Earth's rotation in creating day and night.

Success criteria

Students will write an explanation (in their own words) about how the Sun's light and the Earth's rotation around its own axis create day and night.

Vocabulary

rotation, revolution, Earth's axis

Materials required

- Globe
- Small-sized sticker
- Torch
- Lamp (without the cover)
- Styrofoam ball
- Three index cards

Introduction (connections to prior knowledge)

Start this section with a demonstration of night and day by using a globe.

Gather all the students around a desk and bring out a globe. Ask the students to make predictions about what the globe represents (the Earth.)

Ask the students if they can find their location on the globe, and then put a small sticker on it.

Turn off all the lights in the classroom and shine a light on the globe. Ask the students to make predictions about what the torch represents.

If needed, provide the students with a hint by asking them the following question: 'Which object in the solar system provides the Earth with light? Think back to the first lesson in this unit'. (The Sun.)

Shine the torch directly onto the sticker indicating the city in which the school is located, and ask the students if this demonstration represents day or night in their city. (Day.)

Ask the students, 'Explain why the demonstration at this point represents day?' (Because our location is directly facing the sunlight.)

Spin the globe to the other side and ask the students, 'Now, is it day or night at our location (according to the demonstration)?' (Night.)

Ask the students, 'Please explain why the demonstration now represents night?' (Because our location is facing away from the Sun, and it is not receiving any direct sunlight.)

Initiate a discussion to check for students' understanding of Earth's rotation and revolution and day and night. Ask the students to make predictions about the following questions.

Guiding questions

- What provides us with light during the day? (The Sun.)
- When an object spins around itself, what is that movement called? (Rotation.)
- Does the Earth rotate? (Yes.)
- Around what does the Earth rotate? (Around its own axis.)
- When an object moves around another object, what is that movement called? (Revolution.)
- Does the Earth revolve? Around what does it revolve? (The Earth revolves around the Sun.)
- Can anyone explain why, during the demonstration, our location first faced toward the Sun and then away? In this case, we moved the globe by hand, but does that occur in real life? How does it occur?
    - Because the Earth spins around itself while revolving around the Sun, our location is sometimes in front of the Sun (that is, in direct sunlight; day) and at other times away from the Sun (night).
    - The movement of the Earth moves our location to different points in reference to the Sun's position.

After the discussion, ask the students to think about the question posed during the culminating activity of the previous lesson: 'What do you think causes day and night?'

Ask the students to write as well as draw their observations from the demonstration. (Ask the students to also keep the previous lesson about the movement of the Earth in mind while writing and drawing their responses.)

Exploration

In this activity, students will learn about the causes of day and night.

Divide the class into groups of three students and give each group the materials (a lamp, a Styrofoam ball, and two index cards labelled 'Sun' and 'Earth').

Tell the students that they will demonstrate the Earth's movements in relation to the position of the Sun, and that each group will share their demonstration with the rest of the class.

Tell the students that in each group one of them should represent the Sun, one should represent the Earth, and one should be the narrator.

Ask the students to draw a diagram of the phenomenon (the Earth's movements in relation to the position of the Sun) before acting it out.

Before working on their demonstration, ask students to make predictions about the following:

- What does the lamp represent? (The Sun.)
- What does the Styrofoam ball represent? (The Earth.)
- Which object rotates around its axis? (The Earth.)
- Which object revolves? (The Earth revolves around the Sun.)

Ask a few volunteers from the class to share their responses with the rest of the class.

Give the groups some time to put together their demonstrations, and during this time go around the classroom to check on every group.

Share

Ask each group to present their demonstration to the class.

Provide feedback to each group at the end of their presentation.

Initiate a class discussion to give students a chance to share their observations of their as well as their peers' presentations. Use the following questions to guide the discussion.

Guiding questions

- What are some of the limitations of your demonstrations? (Think back to lesson 2, where we studied scale models.)
    - One limitation of these models is that they are not to scale. The ratio between the sizes of the Earth and the Sun are not true to size.
    - The distances between the Earth and the Sun are also not represented to size.
    - Also, the time it takes for the Earth to complete a rotation and revolution is not correct.
- Does anyone know how long it takes for the Earth to rotate around itself? (Twenty-four hours.)
- What is another term for this time period? (One complete calendar day.)
    - One complete rotation of the Earth around its axis takes 24 hours and makes one complete day.
- Do all of us living on Earth experience day or night at the same time? (No.)
- Why?
    - The Earth is constantly rotating around its axis, and so all regions on the Earth are not in front of the Sun at the same time. Due to the constant rotation of the Earth, different regions experience sunlight at different angles (in different amounts) at any point in time.
- How long does it take the Earth to orbit around the Sun? (One year: 365 days.)

Culminating activity

Tell the students that the rotation of the Earth around its axis while revolving around the Sun causes day and night in different time zones because different regions on Earth receive different amounts of light at any point in time.

Ask the students to take a few minutes to write in their science notebooks about what they have learned about the occurrence of day and night. This account should include the role of the Sun and the rotation of the Earth around its axis in causing day and night.

Students should include at least one fact about the occurrence of day and night that they learned from their textbook.

Ask the students to explain if their textbook reading about the occurrence of day and night was clarified or not after lesson. The students can also comment on how their textbook reading about the occurrence of day and night was enhanced and what (if any) confusion still remains after the lesson.

Ask the students to trade their science notebook with another student sitting next to them.

After they have traded their notebooks, each student will check the formative assessment responses of their peers.

Ask a few students to volunteer their responses to the formative assessment activities and make any corrections if needed.

Ask the students to check their peers' formative assessment responses and correct them if needed.

Tell the students that in the next lesson they will learn about the occurrence of the seasons. Ask them to read chapter 10, section 10.5, on page 93 from their science textbook.

Reference: teachHouston, University of Houston. Retrieved 29 April, 2012.
➢ http://teachhouston.uh.edu/TeachHouston_document/lesson_plans1/sciencelesson/files/Day%20and%20Night-Final_5-21-10.pdf

Lesson 6: Reason for seasons

Learning objectives

Students will:

- understand that the Earth rotates around itself on an axis
- understand the concepts of the southern hemisphere, northern hemisphere, and equator
- know that the axis of the Earth is tilted
- comprehend that the tilt in the Earth's axis causes different hemispheres of the Earth to experience different seasons.

Learning targets

Students will:

- know the axis of the Earth is tilted
- understand the concepts of the southern hemisphere, northern hemisphere, and equator
- comprehend that the tilt in the Earth's axis causes different hemispheres of the Earth to experience different seasons.

Success criteria

Students will:

- draw a labelled diagram of the Sun and the Earth showing the tilt in the Earth's axis, the northern hemisphere, the southern hemisphere, and the equator
- write in their own words or draw an explanation about how the permanent tilt in the Earth's axis and its revolution around the Sun cause the seasons
- explain why different hemispheres experience different seasons at any given time.

Vocabulary

Earth's axis, tilt, northern hemisphere, southern hemisphere, Earth's equator

Materials required

- Computer with an Internet connection
- Globe
- Lamp without shade

Introduction (connections to prior knowledge)

In this section, check for students' knowledge of concepts (northern hemisphere, southern hemisphere, and equator) that are necessary for understanding this lesson.

Use this time to connect previous lessons learned to concepts in this lesson.

Initiate a discussion to check students' understanding of background concepts for this lesson.

Ask the students about the following and note their responses.

Guiding questions

- Can we remember from our previous lesson what the axis of the Earth is?
  - It is an imaginary line going through the centre of the Earth. The Earth rotates around its axis.
- How long does it take the Earth to complete a rotation on its own axis? (Twenty-four hours.)
- What causes day and night? (The Earth's rotation on its axis.)

- Can anyone tell us about the position of the Earth's axis? Is it straight or tilted at an angle?
    - The students might not know the answer to this question. After taking a few responses from the students, share with them that the axis of the Earth is not straight. It is tilted slightly at an angle of about 23.5 degrees. Tell the students this concept is very important for today's lesson and we will explore it later in the lesson.
    - Bring a globe for demonstration to show the students how the Earth's axis is tilted.

NOTE: Students should understand that the Earth's axis is an imaginary line and that there is no actual line going through the Earth. We use the imaginary axis to help us calculate the tilt in the Earth's position.

Formative assessment
Ask the students to draw a labelled diagram of the Sun and the Earth with its axis. The diagram should also show the equator, the northern hemisphere, and the southern hemisphere. You may need to explain the northern and southern hemispheres and the equator.
(Note: Students' diagrams should show the 23.5-degree tilt in Earth's axis.)

- What are seasons?
- What causes seasons?
    - A common misconception: Many students think that the seasons are caused by the distance of the Earth from the Sun; that is, they believe that when the Earth is farther away from the Sun it is winter, and when it is closer to the Sun, it is summer.
    - To clarify this misconception, ask the students if all parts of the Earth experience winter and summer at the same time. The answer is no, and this is proof for the fact that the summer and winter are not caused by the distance of Earth from the Sun. When it is winter in the northern hemisphere, it is summer in the southern hemisphere, and vice versa. If seasons changed because of the distance of the Earth from the Sun, both hemispheres would experience summer and winter at the same time.

Note the students' responses on the board. These responses will be very important in assessing how much the students know about the seasons.

Tell the students that in this lesson we will explore the causes of the different seasons.

Exploration 1

Tell students that during this activity, they will explore how the Earth's tilted axis and the Earth's revolution around the Sun cause the change in seasons.

During this activity, students will watch a video animation of what causes seasons to change.

Draw a round circle (Earth) on a board and then draw a line across the middle to show the equator.

Check for students' knowledge of some concepts necessary for understanding the causes of the seasons.

Guiding questions

Ask students the following questions to lead the discussion. Point to the diagram of the Earth and ask the following questions:

- What is the equator? (It is an imaginary line drawn across the middle of the globe that divides the Earth into the northern and southern hemispheres.)
- What is a hemisphere? (*Hemisphere* in Greek means 'half of a sphere', so a hemisphere of Earth is half of the Earth.)
- Can anyone name the two hemispheres? (The northern hemisphere and the southern hemisphere. The northern hemisphere is the half of the Earth north of the equator, and the southern hemisphere is the half of the Earth south of the equator.)

Label the diagram of the Earth as the definitions come up during the discussion.

After the discussion is over, show the students the video 'Science for Kids: How Do Seasons Change?' The video can be found at:

➢ http://www.videojug.com/film/why-does-the-earth-have-seasons

After viewing the video, ask the students to take a few minutes to write down their observations and reactions to the video.

Ask the students to write down at least two interesting things they remember from the video.

Share

Initiate a discussion in which students share what they learned from the video.

Ask students to share at least one interesting fact they learned from the video. Take a few responses and note them on the board.

Clarify any further misconceptions the students might have about the concepts from the video.

Initiate a class discussion to give the students a chance to share their observations about the video with their peers and use the following guiding questions to conduct the classroom discussion.

Guiding questions

- Is the Earth's axis straight? (No, it is tilted at about 23.5 degrees.)
- How does the tilt in the Earth's axis affect the sunlight hitting the Earth?
  - Because of the tilt, the sunlight hits the Earth at different angles, and so different parts of the Earth receive different amounts of sunlight.
- How does the tilt cause changes in the seasons on Earth?
  - During Earth's revolution around the Sun, its tilt (direction of the axis) always points in the same direction. When Earth is at one place in its path, the northern hemisphere faces more direct sunlight as compared to the southern hemisphere, and when the Earth moves to the opposite location, the other hemisphere receives more direct sunlight. The hemisphere that faces more sunlight experiences summer and the other experiences winter.

Note the responses to these questions on the board. Ask the students to note their as well as their peers' observations in their science notebooks.

Exploration 2

Start this exploration by asking the students to make predictions about the following questions and write their responses on the board.

- How do we know when seasons change? (We see flowers bloom, birds migrate, and we experience hot or cold temperatures.)
- How does the weather change in different seasons?
- Why do seasons change?

Ask the students to describe the hottest day they can remember. Take the responses from a few students and note them on the board.

Ask the students to describe the coldest day they can remember. Take responses from a few students and note them on the board.

Divide the students into groups of three or four and provide each group with materials (lamp without a shade, a globe, and a small sticker).

Turn off the classroom light and ask the students to turn on their lamps.

Help the groups to locate their town on the map and ask them to place a small sticker on it.

Fix a marker in the classroom (such as a picture, a flagpole, etc.). Make sure the axes of all the globes point toward this marker at all times during this activity. This will help students simulate the fact that the direction of the Earth's axis never changes.

Ask the students, 'Why do we have the axes of all the globes pointing toward this marker?'

NOTE: Students should understand that the Earth's axis always points in the same direction.

Go around the class to make sure that the students are performing this step correctly.

Ask the students to tilt the globe so that the sticker faces the lamp.

Instruct the students to make sure that the tilt of the globe is always facing toward the marker (in the same direction) at all times during this activity.

Ask the students, 'What season is it in the northern hemisphere?' It is summer because the northern hemisphere is facing the Sun and receiving the maximum amount of sunlight. The maximum exposure to sunlight is causing the northern hemisphere to heat up more than the southern hemisphere.

Ask the group to slowly rotate the globe around its axis (while the Earth's axis points toward the marker in the classroom at all times) and observe the northern hemisphere as the day goes by. Direct the students to note their observations in their science notebooks.

Even though the northern hemisphere (the top half of the Earth) experiences day and night (due to rotation of the Earth around its own axis), it experiences more sunlight during the day because at that point in the Earth's orbit around the Sun, it is tilted toward the Sun and so receives more direct sunlight.

Show the students the diagram on the following website to explain the concept further:

- http://scienceforkids.kidipede.com/physics/weather/seasons.htm

NOTE: The person in the diagram is located on the northern hemisphere and seasons listed on the diagram refer to the northern hemisphere (the location specifically indicated by the human figure).

Tell the students that one of the students in the group (while holding the globe and keeping the tilt of the axis in the same direction) should go around the lamp (the Sun) and stop at the opposite location (on the other side of the lamp). In this position, the southern hemisphere of the globe should be facing the lamp.

Ask the students, 'What season is it in the northern hemisphere now? Why?' It is winter because now the northern hemisphere is facing away from the Sun, and so it is not receiving direct sunlight, which causes it to remain cool.

At the end of the activity, to clarify the importance of the Earth's tilt in creating seasons, tell the students, 'Now we are going to model what would happen if the Earth was not tilted'. Ask the students to note their predictions about what would happen if the Earth's axis were straight.

Ask the groups to straighten their globes and while holding them revolve around the lamp to test their predictions.

Students should write or draw their predictions and observations in their science notebooks.

Share

Initiate a class discussion to give students a chance to share their observations and predictions with their peers. Use the following questions to conduct the class discussion:

- What did you observe during this activity? Share at least one observation.
- What do you think would happen if the Earth were not tilted? (We would not experience seasons because most of the Earth would receive a similar amount of light at all times.)
- During the experiment, why did we make sure the Earth's axis was tilted and always pointed in the same direction? (In reality the Earth's axis is tilted and always points in the same direction.)
- What is the angle of the Earth's tilt? (23.5 degrees.)
- Do all places on Earth experience the same season at the same time? (No.)
- Why? (Because of the Earth's tilt, when the northern hemisphere is facing the Sun, experiencing summer, the southern hemisphere is facing away from the Sun, experiencing winter. When it is summer in the northern hemisphere, it is winter in the southern hemisphere, and vice versa.)
- Why do we have different seasons?

Note the student responses on the board. Ask them to write their as well as their peers' observations in their science notebooks.

Culminating activity

Formative assessment
Ask the students to explain in their own words the reason for the seasons and note it in their science notebooks. The explanation should include why the hemispheres experience different seasons at any given time.

The students can write and/or draw their explanations. The explanation should include the role of the permanent tilt in the Earth's axis and the Earth's revolution around the Sun in creating seasons.

Ask the students to write down if their reading from the textbook about the occurrence of seasons was clarified or not after the lesson. The students also can comment on how their reading from the textbook was enhanced by this lesson and what (if any) unanswered questions still remain.

Ask the students to trade their science notebooks with a student sitting next to them.

After they have exchanged their notebooks, each student will check the formative assessment responses of their peers.

Ask a few students to volunteer their responses to the formative assessment activities and make any corrections if needed.

Ask the students to check their peers' formative assessment responses and correct them if needed.

Collect students' science notebooks at the end of the class to check:

- their written work
- their answers to formative assessments
- that the students are making necessary corrections to their formative assessment responses during self-check and peer-check activities.

Reference: CASES, 'What Causes Seasons?' Retrieved 1 May, 2012 from:
➢ http://cases.soe.umich.edu/plans.php?nav=showplan&dqid=320&lpid=32774&printfriendly=yes&packet=n

Lesson 7: Phases of the Moon

Learning objectives

Students will:

- know that the Moon does not generate any light; it only reflects the light from the Sun
- learn that the Moon revolves around the Earth in a counter-clockwise fashion
- understand that the journey of the Moon around the Earth is called a lunar, or Moon phase, cycle
- know that it takes the Moon approximately 28 days* to complete one lunar cycle
- learn that there are four major phases of the Moon
- be familiar with the names of the four major phases of the Moon.

Learning targets

Students will:

- learn that the Moon revolves around the Earth in a counter-clockwise fashion
- understand that the journey of the Moon around the Earth is called a lunar, or Moon phase, cycle, which takes approximately 28 days and represents one calendar month
- be familiar with the names of the four major phases of the Moon and the position of the Moon in relation to the Earth and the Sun during these four phases.

Success criteria

Students will:

- draw a labelled diagram of the Earth and Moon system and represent the direction of the Moon's movement with an arrow
- write the names of four major lunar phases in correct order
- write an explanation of the lunar cycle in their own words
- depict the position of the Moon in relation to the Earth and Sun during each of the four lunar phases, in a Moon-phase book .

Vocabulary

crescent, first-quarter phase, full Moon phase, gibbous, lunar cycle, last-quarter phase, new Moon phase, waning, waxing

Materials required

- Styrofoam balls (one for each student)
- Lamp without a shade

* The time between two full moons (a Lunar cycle) is about 29.5 days. However, the time it takes the Moon to make one orbit around the Earth is about 27.5 days. This difference is caused by the fact that the Earth-Moon system is orbiting around the Sun at the same time the Moon is orbiting around the Earth. For simplicity, this document talks about the lunar cycle and the Moon's orbit around the Earth as if they are the same duration, approximately 28 days.

Advance preparation

- A month before this lesson, ask students to take some time every evening to observe the Moon and draw the shape of the Moon in their science notebooks.
- Instruct the students to be sure to put the date on every Moon observation and continue the exercise for a month.
- If the students are not able to see the Moon due to weather conditions, they should still put the date for that night and leave the observation section blank.

Introduction (connections to prior knowledge)

Initiate a discussion to find out what students already know about the Moon and its phases.

Ask the students to take out their science notebooks in which they made their Moon observations during the previous month.

Initiate the discussion by asking the students the following questions

Guiding questions

- What do you know about the Moon?
    - It revolves around the Earth. It takes a month, or approximately 28 days, to complete a revolution around the Earth.
- Does the Moon move? (Yes.)
- Around what does the Moon move? (It rotates around itself and revolves around the Earth.)
- How long does it take the Moon to revolve around the Earth? (approximately 28 days.)
    - A common misconception: Students might also say that the Moon emits light. Make sure to let students know that the Moon does not emit light, but rather it reflects the light of the Sun and that is the reason we are able to see it.
- What did you see while drawing the Moon during the last month? (The Moon seemed to change its shape.)
- How does the Moon change its shape? (It seems to disappear and reappear. The shapes repeat after two weeks.)
- Why do you think the Moon changes it shape?
    - Students might not know the answer to this question, but it is a critical question in that it tells the teacher what students know about the phases of the Moon.

Note the students' responses on the board.

Tell the students that this lesson will explore the phases of the Moon and why they occur.

Exploration 1

The students will take a virtual trip to the Moon to observe what causes the phases of the Moon.

Show the students the following two videos.

The first video, 'The Phases of the Moon', can be found at:

➢ http://www.youtube.com/watch?v=0vXWXqGmPCk

This video explains that the phases of the Moon are caused by its position relative to the Earth and the Sun. Because only one side of the Moon is visible to us (because that side is lit up by the Sun), the portion of the side of the Moon that we can see depends upon the Moon's position in its orbit around the Earth. In other words, because the Moon keeps moving in an elliptical path around the Earth, we on Earth can only see different portions of the lit-up side of the Moon.

Share

Initiate a discussion with the students to process the content they learned in the video and use the following questions to guide the classroom discussion. Note the student responses on the board and ask them to write down their own and their peers' observations in their science notebooks.

Guiding questions

- How long does it take the Moon to revolve around the Earth and complete the cycle of its phases, also called the lunar cycle? (approximately 28 days.)
- What causes the phases of the Moon? (By the position of the Moon relative to the position of the Sun and the Earth.)
- Does the Sun light the entire Moon? (No, half the Moon is always lit by the Sun, and that is the side of the Moon that we can see from the Earth.)
- Can we see the entire lit-up side of the Moon?
    - At one point in the Moon-phase cycle (the full Moon), we can see the entire lit-up side of the Moon. At other times in the lunar cycle, we see portions of the lit-up side of the Moon, and these portions depend on the position of the Moon in its orbit around the Earth.

After the discussion, show the students the second video, 'The Universe: The Phases of the Moon', which can be found at:

➢ http://www.youtube.com/watch?v=WD-H1xqoAAg&feature=relmfu

This video also explains the phases of the Moon and has a simple way of naming the phases. Only show the first 2 minutes and 12 seconds of this video.

Share

Initiate a discussion with the students to process the content they learned in the video and use the following questions to guide the classroom discussion. Note students' responses on the board and ask them to write down their own and their peers' observations in their science notebook.

Guiding questions

- When none of the lit-up side of the Moon is visible from the Earth, what is the Moon's position relative to the Earth and the Sun? (The Moon is between the Earth and the Sun.)
- What is this phase called? (The 'new Moon phase' marks the beginning of the lunar cycle.)
- How does the Moon move around the Earth? (Counter-clockwise.)
- When can we see the half of the lit-up side of the Moon?
    - When the Moon starts to move counter-clockwise around the Sun, we can see more and more of the Moon. When the Moon is at a right angle with the Earth and the Sun, we can see half of the lit-up side of the Moon. At this point, the Moon has completed one-quarter of its cycle.
- What is this phase called? (It is called the first-quarter phase.)
- When can we see a full lit-up side of the Moon during the lunar cycle?
    - When the Moon moves to a position where it is in a straight line again with the Earth and the Sun, we can see a full Moon. At this point, the the Earth is between the Sun and the Moon, and the Moon has completed one-half of its cycle.
- What is this phase called? (It is called the full Moon phase.)
- When does the visible portion of the lit-up side of the Moon begin to decrease? (When the Moon moves past its half-cycle position.)
- Do we see half the Moon again?
    - Yes. We see half the Moon in the lunar cycle when the Moon is at a right angle again with the Sun and the Earth. At this point the lunar cycle is three-quarters complete.
- What is this phase of the Moon called? (This phase is called the last-quarter phase.)
- What happens to the Moon in the last part of the lunar cycle?
    - When the Moon is in the last part of the lunar cycle, it appears to become smaller and smaller, until it is in line with the Sun and the Earth again (back at its starting position). At this point, we do not see the Moon. This is the new Moon phase.
- How long does it the Moon to go from one phase to another? (One week.)
- What does the Moon look like in between these phases? (Either a crescent Moon [less than half] or gibbous Moon [more than half].)
- What is the technical term that describes the Moon when it seems to be growing during the first half of its cycle? (Waxing.)
- When does the Moon seem to be waxing during its cycle? (During the first half of the cycle.)
- What is the technical term that describes the Moon when it seems to be getting smaller and smaller? (Waning.)
- When does the Moon seem to be waning during its cycle? (During the last half of its cycle.)

Exploration 2

In this activity, students will model the Sun, Earth, and the Moon to observe how phases of the Moon occur.

Place a light source (the lamp without a shade) in the middle of the room.

Ask the students to make predictions about what the lamp represents. (The Sun.)

Turn off the lights to darken the room so that the Moon phases are more visible.

Give each student a Styrofoam ball and ask them to make predictions about what the ball represents. (The Moon.)

Tell the students that their heads represent the Earth.

Ask the students to take the Styrofoam ball and gather around the light source (the Sun).

Ask the students to model the new Moon position; that is, where the Moon is situated in relation to the Earth and Sun during the new Moon phase. (Between the Earth and the Sun.)

Go around the room to check all the students' models.

Ask the students in which direction the Moon revolves around the Earth. (Counter-clockwise.)

Tell the students to turn their bodies counter-clockwise to keep the Earth facing the Moon and stop once they have completed one-forth of the lunar cycle.

Ask the students to notice the edge of the shadow moving across the Moon and to stop and draw the shadow at this point.

Tell the students to continue turning their bodies counter-clockwise until they have completed one-half of the revolution and the Sun is behind them.

The students will have to raise the Moon (lift the ball up) so that the shadow of their head does not interfere with the shadow cast on the Moon.

Ask the students to draw their observations of the shadow on the Moon at this point.

Ask the students to continue their journey until they have completed three-quarters of the revolution. The students should stop and note the appearance of the Moon at this point in their science notebooks.

Ask the students to continue turning counter-clockwise until they have completed one full revolution (the lunar cycle) and note the appearance of the Moon at this point in their notebooks.

Share

Initiate a discussion to give students a chance to share their observations with their peers. Use the following questions to guide the class discussion.

Guiding questions

- What are some of the limitations of this model?
  - The model is not to size. Only the Earth is moving and the Moon is staying stationary, but in reality both the Earth and the Moon are in motion.
- What does the very first phase (when the ball is between the student and the lamp) represent? (This represents the new Moon phase, when the Moon is between the Earth and Sun.)
- How much of the Moon is visible during this phase? (None, and that is why there is no shadow on the ball.)
- How much of the shadow on the ball did we see after one-quarter revolution was complete? (One-half shadow.)
- What is this phase called in the lunar cycle? (The first-quarter phase.)
- How much of the shadow was seen after one-half revolution was complete? (The whole ball was lit up.)
- What is this phase called in the lunar cycle? (The full Moon phase.)
- How much of the shadow did we see after three-quarters of the lunar cycle was complete? (One-half of the Moon was lit up.)
- What is this phase called in the lunar cycle? (The last-quarter phase.)
- Between the new Moon phase and the full Moon phase, what was happening to the appearance of the Moon? (It appeared to become bigger and bigger.)
- What is this phenomenon called? (The waxing phase.)
- What was happening to the appearance of the Moon between the full Moon phase (going toward the end of the revolution) and the new Moon phase? (The Moon appeared to become smaller and smaller.)
- What is this phenomenon called? (The waning phase.)

Note student responses on the board. Ask the students to write down their own as well as their peers' observations in their science notebooks.

Culminating activity

Ask the students to take a few minutes and write down what they learned about the Moon phases. What fascinated them about the phases of the Moon? What questions do they still have about the lesson?

Formative assessment: Ask the students to draw a labelled diagram of the Earth and the Moon system in their science notebooks and depict the direction of the Moon's movement with an arrow.

Ask the students to keep their science notebooks open and go over the formative assessments to give them a chance to correct their answers.

Ask a few students to share their responses and make any needed corrections.

Ask the whole class to check their formative assessment responses and make any corrections if need.

Reference: Utah Education Network, 'Phases of the Moon', 2002. Retrieved 6 May, 2012.

- http://www.uen.org/Lessonplan/preview?LPid=623

Unit 2, week 4, session 2

Guide for using the Sun, Earth, and the Moon unit

F

Introduction to the unit

The 'Sun, Earth, and the Moon' is a seven-lesson science unit (for grades 4 to 5) that is written for the purpose of teaching the assessment process. The major goal of this unit is to teach Student Teachers about writing assessment plans into lesson plans and to showcase assessment and instruction as a continuous process.

The format of the lesson plans is one of the many different formats that teachers follow to prepare their own lesson plans. An empty template for this lesson plan format accompanies this guide and the unit, and Student Teachers can use it for preparing their own lessons. Because this unit is written to teach about the interaction between assessment and instruction, it is more detailed than necessary for teaching a lesson on the solar system. When studying the lessons in the unit, Student Teachers should keep in mind that their lessons do not need to be as detailed as these lessons.

Student Teachers should also keep in mind that when writing their own lesson and unit plans, they do not need to write or explain the definitions of terms such as *learning objectives, learning targets, success criteria, formative assessment*, and *culminating activity*. Student Teachers should simply list and describe the learning objectives, learning targets, success criteria, formative assessments, and culminating activities for each lesson.

Following are some of the things included in these lessons that a teacher can omit from his or her own lesson plans:

- Detailed notes on advanced preparation. Teachers can include short reminders for themselves if they would like.
- Notes. Notes are included in these lessons for guidance purposes and can be left out when writing regular lesson plans. Or teachers can include brief reminders for themselves if needed.
- Detailed notes on videos included in the lesson plans are not required. Instead, teachers can write short reminders about the contents of the videos for themselves.
- Answers to the guiding questions or any other questions included in the lessons unless teachers need reminders for themselves.

Unit snapshot (lessons and lesson learning objectives)

Lesson 1: Objects in the sky

- Students will understand that the universe is vast and has millions of different types of objects, including our solar system.
- Students will understand that the Sun is the centre of our solar system, which has eight planets.
- Students will recognize the position of the Sun, Earth, and its Moon in the solar system.
- Students will know that all the planets revolve around the Sun in a circular path.
- Students will know the meaning of the word orbit and that paths of the planets around the Sun are called *orbits*.

Lesson 2: How big, how far

- Students will understand the concept of a scale model.
- Students will understand the relative size differences between the Sun, Earth, and the Moon.
- Students will be able to understand the relative distances between the Sun, Earth, and the Moon.
- Students will know that the Sun's diameter is more than 100 times as big as the Earth's diameter, and the Earth is about 100 Sun diameters away from the Sun.
- Students will understand that the Moon's diameter is around one-fourth the size of Earth's diameter, and it is about 30 Earths away from the Earth.

Lesson 3: Endless Earth

- Students will be familiar with the concept of spherical shapes.
- Students will understand that the Earth is a sphere.
- Students will be able to explain why they think that the Earth is a sphere.
- Students will be familiar with the discovery that the Earth is a sphere.

Lesson 4: Movements of the Earth

- Students will understand that the Earth moves around itself and around the Sun.
- Students will be able to define the rotation and revolution of the Earth.
- Students will be able to differentiate between the concepts of rotation and revolution.
- Students will understand that the Earth spins around itself (on its axis).
- Students will understand that the Earth's axis is an imaginary line drawn through the Earth's centre to represent its tilt and movement.
- Student will know the time it takes the Earth to complete a rotation and a revolution.

Lesson 5: Day and night

- Students will understand the process by which day and night occurs.
- Students will be able to explain the role of the Sun in creating day and night.
- Students will be able to explain the role of the Earth's rotation in creating day and night.

Lesson 6: Reason for seasons

- Students will understand that the Earth rotates around itself on an axis.
- Students will understand the concepts of the southern hemisphere, northern hemisphere, and equator.
- Students will know that the axis of the Earth is tilted.
- Students will comprehend that the tilt in the Earth's axis causes different hemispheres of the Earth to experience different seasons.

Lesson 7: Phases of the Moon

- Students will know that the Moon does not generate any light; it only reflects the light from the Sun.
- Students will learn that the Moon revolves around the Earth in a counter-clockwise fashion.
- Students will understand that the journey of the Moon around the Earth is called a lunar, or Moon phase, cycle.
- Students will know that it takes the Moon approximately 28 days* to complete one lunar cycle.
- Student will learn that there are four major phases of the Moon.
- Students will be familiar with the names of the four major phases of the Moon.

Learning objectives, learning targets, and success criteria

In this unit *learning objectives* represent the broader vision of the lesson, and learning targets represent learning objectives that are essential to understanding the lesson and the whole unit. In other words, learning targets represent the main learning objectives of a lesson and leave out the supporting learning objectives. *Success criteria* are written using action verbs and describe what a student should be able to do in order to show that she or he has mastered the learning targets for the lesson.

Formative assessment

Formative assessment involves collecting information about student learning while it is in progress so that students and the teacher can receive feedback and make changes in teaching strategies and learning tactics to increase learning. Formative assessments are spread out throughout the lessons. Even though most explorations and guiding questions serve as formative assessments for this unit, the sections especially marked as 'formative assessment' cover the success criteria of the lessons.

* The time between two full moons (a Lunar cycle) is about 29.5 days. However, the time it takes the Moon to make one orbit around the Earth is about 27.5 days. This difference is caused by the fact that the Earth-Moon system is orbiting around the Sun at the same time the Moon is orbiting around the Earth. For simplicity, this document talks about the lunar cycle and the Moon's orbit around the Earth as if they are the same duration, approximately 28 days.

Culminating activities and record-keeping

The culminating activity is at the end of each session. It is specifically an assessment activity.

At the end of each culminating activity, the teacher leads a discussion that allows the students to either self-check or peer-check their responses to the formative assessments in that particular lesson. The teacher can alternate between self-checking or peer-checking throughout the unit. For the self-check or peer-check, the teacher picks a few volunteers from the class and asks them to share (write or draw on the board) their responses to formative assessments. After the students are done writing or drawing their responses, the teacher makes any corrections, if needed. The corrections can be made by asking the students about the mistakes in the formative assessment responses written on the board. After all the correct answers are on the board, the students (if self-checking) or their peers (if peer-checking) check their answers and correct them, if needed (see the culminating activity section at the end of each lesson).

This exercise can be very helpful for students as well as teachers. This exercise can help students understand and correct their mistakes and help the teachers keep accurate records of each student's performance in classroom lessons. The teachers should ask the students to make corrections in a different-coloured pen or pencil than first used so that they can track the student changes. This makes record-keeping easier for teachers. When the teachers collect students' notebooks every two or three lessons, they can clearly see and note the areas where the students are struggling. This can also help students prepare for tests and quizzes by highlighting the areas and topics that need more time and attention.

Student Teachers' task

The learning objectives, learning targets, success criteria, and formative assessments (pertaining only to success criteria) from lessons 2, 3, 5, and 6 have been omitted from the Student Teachers' copy of the unit. Student Teachers' should use lessons 1, 4, and 7 as examples to come up with learning objectives, learning targets, success criteria, and formative assessments (pertaining only to success criteria for lessons 2, 3, 5, and 6. The spaces for learning objectives, learning targets, and success criteria) are left blank. The Student Teachers' task is to fill these spaces with appropriate learning objectives, learning targets, and success criteria to make these lessons look like lessons 1, 4, and 7. They should come up with a minimum of three and maximum of five learning objectives, a minimum of two and maximum of four learning targets, and minimum of one and maximum of three success criteria.

The formative assessment activities are either not labelled or have been taken out from lessons 2, 3, 5, and 6. Student Teachers' can either write new formative assessment activities or find those that are already built into the lessons. The assessment activities added to or identified in the lessons should aim at assessing students' mastery of the success criteria of the lessons. Student Teachers should come up with at least two new formative assessment activities and choose at least two that are already embedded in the lesson plans. The Instructor can leave the decision of where to add new and where to identify the already built-in assessment activities to the Student Teachers' discretion.

When creating their own or identifying already-present formative assessment activities, Student Teachers should also include the following information:

- Write a new activity (in its appropriate place in the lesson) or underline and label the already-present formative assessment activity.
- Write which success criteria the assessment activity is measuring.
- Write how and why the formative assessment activity is well suited to measure that specific assessment criterion.

NOTE: These three tasks should be completed for each success criteria that Student Teachers have created for the lessons. Student Teachers should not have more than three success criteria for a lesson.

Unit 2, week 5, session 1

Forms for recording student participation in classroom discussions

F S

Notes to faculty about the use of these forms

As the title indicates, this handout contains forms that enable a teacher to record student participation in classroom discussions. There are three forms.

The first is a record of participation. The form is a seating chart. Each square represents a desk. The initials, obviously, belong to the student who uses that desk. The teacher uses this form when she or he wants to know which students are participating in discussions and which students are silent. When a student participates, the teacher makes a tally on that student's desk on the form and indicates whether the student was called upon by the teacher or initiated the response.

A teacher uses the second form when he or she wants to know if a student's answer to a question by the teacher is relevant to the question or not. The teacher notes the student's response and then codes it as relevant (CR), semi-relevant (SR), or irrelevant (IR). The numbers indicate the order in which the answers were given, which matches the order in which the questions are listed in the teacher's lesson plan. This allows the teacher to check if irrelevant answers are a signal that the question was vague.

The third form is used to record a student's question. These student questions are coded as clarifying (C), fact-based (F), or open (O).

Participation in classroom discussions is usually an indication of a student's knowledge about and interest in the topic. It is important for a teacher to know who is participating and who is not. It is very hard for a teacher to remember student participation at the same time she or he is keeping the discussion focused on the topic. For these reasons, records of student participation in discussion are important.

Suggestions for using the forms in a college or university class:

- Lead Student Teachers through a discussion to acknowledge the importance of record-keeping during a class discussion.
- Make sure they understand the way the three forms are used.
- Taking each form separately, ask them what they might learn from the form and what decisions about instruction they might make.
- Lead them to talk about improvements in the forms.

Forms for recording student participation in classroom discussions

Discussion recording form 1: Recording student responses

Directions

First, record students' names on this chart. During classroom discussion, record the number of times the students answer questions. Place a tally mark to signify student participation in discussion. Record whether you called on the student to relay a response or the student raised their hand to participate.

Code

T: Teacher called on the student
S: Self-initiated

Front of room

A.A. I T	C.A. IIII S	K.H.	M.H. II T	A.H.
L.K. III T	U.K.	Z.K. II T	M.K. II T	A.K. I T
P.K.	M.M. I T | I S	L.M. I T	F.M.	M.M.
O.M.	P.M. I T	N.N.	M.N. I S	P.N.
Z.N.	F.T.	P.T. I S	Q.T.	S.T.
T.T.	A.W.	C.W.	Z.W.	

Discussion recording form 2: Recording the relevance of student answers

Directions

This form can be used to document the relevance of student responses to questions you ask. First, number and code the type of question you ask in the box labelled 'questions asked'. Next, instead of using a tally mark to record student responses, use the codes listed below to record. If time permits, jot down a few notes as well. This information will help you to clarify misunderstandings and may provide you with a general gauge of the range of student knowledge in the classroom.

Questions asked

Codes: F: Fact-based question; O: Open-ended question*

Code

CR: Correct or relevant response
SR: Semi-relevant response
IR: Irrelevant/incorrect response

The numbers signify the order in which the questions were asked.

Front of room

A.A. 1. CR	C.A. 2. CR	K.H.	M.H. 14. CR	A.H. 13. CR
L.K. 15. SR	U.K. 16. SR	Z.K.	M.K. 3. CR	A.K. 4. CR
P.K. 6. SR	M.M.	L.M.	F.M. 5. CR	M.M. 12. CR
O.M.	P.M. 7. IR	N.M.	N.M. 9. IR	P.N. 8. SR
Z.N.	F.T.	P.T. 10. IR	Q.T.	S.T.
T.T.	A.W. 11. IR	C.W.	Z.W.	

Examples of clarifying questions: 'How much larger is the Sun's diameter than the Earth's diameter? What about the comparison between the Moon's and the Earth's diameters?'

These are considered clarifying questions because the information they request has been presented and discussed in a previous class discussion.

Discussion recording form 3: Recording student initiation of questions

Directions

This form can be used to record the type of student responses, student initiation of questions, and types of questions students ask. Use the codes listed to help you assess the discussion patterns in your classroom. This information will help you assess content knowledge as well as the extent to which the classroom climate encourages students to ask questions.

Code

C: Clarifying question*
F: Fact-based question
O: Open-ended question

Front of room

A.A. **C**	**C.A.** **FCF**	**K.H.** **C**	**M.H.**	**A.H.**
L.K.	**U.K.**	**Z.K.**	**M.K.** **F**	**A.K.**
P.K.	**M.M.** **C**	**L.M.**	**F.M.**	**M.M.** **C**
O.M.	**P.M.**	**N.M.** **F**	**N.M.**	**P.N.**
Z.N.	**F.T.**	**P.T.**	**Q.T.**	**S.T.** **O**

Examples of clarifying questions: 'How much larger is the Sun's diameter than the Earth's diameter? What about the comparison between the Moon's and the Earth's diameters?'

These are considered clarifying questions because the information they request has been presented and discussed in a previous class discussion.

Grade 3 Mathematics in Pakistan's 2006 National Curriculum

S

Curriculum for mathematics—Grade III

Contents and scope	Learning outcomes/skills
	All students will be able to

Unit 1: Numbers

Contents and scope	Learning outcomes/skills
1.1 Roman Numbers	i) Read Roman numbers up to 20. ii) Write Roman numbers up to 20.
1.2 Even and Odd Numbers	i) Identify even and odd numbers up to 99 within a given sequence. ii) Write even or odd numbers within a given sequence.
1.3 Place Values	Identify the place value of numbers up to 6 digits.
1.4 Numbers up to 100,000	Read and write given numbers up to 100,000 (hundred thousand) in numerals and in words.
1.5 Comparing and Ordering the Numbers	i) Compare two numbers using symbols '<', '>' and '='. ii) Write the given set of numbers in ascending and descending order.
1.6 Number Line	i) Represent a given number on number line. ii) Identify the value of a number from number line.

Unit 2: Number operations

Contents and scope	Learning outcomes/skills
2.1 Addition	i) Add numbers up to four digits (with and without carrying) vertically and horizontally. ii) Add numbers up to 100 using mental calculation strategies. iii) Solve real-life problems involving addition.

National Curriculum for Mathematics 2006 – Grade III

Contents and scope	Learning outcomes/skills
2.2 Subtraction	i) Subtract numbers up to four digits with and without borrowing. ii) Subtract numbers up to 100 using mental calculation strategies. iii) Solve real-life problems involving subtraction.
2.3 Multiplication	i) Using the term 'product' for multiplication of two numbers. ii) Develop multiplication tables for 6, 7, 8, and 9. iii) Multiply 2-digit numbers by 1-digit numbers. iv) Multiply a number by zero. v) Apply mental mathematical strategies to multiply numbers up to the table of 10. vi) Solve real life problems involving multiplication of 2-digit numbers by 1-digit numbers.
2.4 Division	i) Divide 2-digit numbers by 1-digit numbers (with zero remainder). ii) Apply mental mathematical strategies to divide numbers up to the table of 10. iii) Solve real-life problems involving division of 2-digit numbers by 1-digit numbers.

Unit 3: Fractions

Contents and scope	Learning outcomes/skills
3.1 Common Fractions	i) Express the fractions in figures and vice versa. ii) Match the fractions with related figures.
3.2 Equivalent Fractions	i) Identify equivalent fractions from the given figures. ii) Write three equivalent fractions for a given fraction.
3.3 Proper and Improper Fractions	Differentiate between proper and improper fractions.
3.4 Comparing Fractions	Compare fractions, with same denominators, using symbols '<', '>' and '='.
3.5 Addition of Fractions	i) Add two fractions with same denominators. ii) Represent addition of fractions through figures.

Contents and scope	Learning outcomes/skills
3.6 Subtraction of Fractions	i) Subtract fractions with same denominators. ii) Represent subtraction of fractions through figures.

Unit 4: Measurement of length, mass, and capacity

Contents and scope	Learning outcomes/skills
4.1 Length	
4.1.1 Units of Length	i) Read standard units of length (kilometre, metre and centimetre) including abbreviations. ii) Measure and write standard units of length including abbreviations.
4.1.2 Addition of Units of Length	iii) Add measures of length in same units with and without carrying. iv) Solve real-life problems involving same units of length for addition with and without carrying.
4.1.3 Subtraction of Units of Length	v) Subtract measures of length in same units with and without borrowing. vi) Solve real-life problems involving same units of length for subtraction with and without borrowing.
4.2 Mass/Weight	
4.2.1 Units of Mass/Weight	i) Read standard units of mass/weight (kilogram and gram) including abbreviations. ii) Measure and write standard units of mass/weight including abbreviations.
4.2.2 Addition of Units of Mass/Weight	iii) Add measures of mass/weight in same units with and without carrying. iv) Solve real-life problems involving same units of mass/weight for addition with and without carrying.
4.2.3 Subtraction of Units of Mass/Weight	v) Subtract measures of mass/weight in same units with and without borrowing. vi) Solve real-life problems involving same units of mass/weight for subtraction with and without borrowing.

Contents and scope	Learning outcomes/skills
4.3 Volume/Capacity	
4.3.1 Units of Volume	i) Read standard units of volume (litre and millilitre) including abbreviations. ii) Measure and write standard units of volume including abbreviations.
4.3.2 Addition of Units of Volume	iii) Add measures of volume in same units with and without carrying. iv) Solve real-life problems involving same units of volume for addition with and without carrying.
4.3.3 Subtraction of Units of Volume	v) Subtract measures of volume in same units with and without borrowing. vi) Solve real-life problems involving same units of volume for subtraction with and without borrowing.

Unit 5: Time

Contents and scope	Learning outcomes/skills
5.1 Units of Time	i) Use a.m. and p.m. to record time from 12-hour clock. ii) Read and write time from analog and digital clocks. iii) Read and write days and dates from the calendar.
5.2 Addition of Units of Time	i) Add units of time hours. ii) Solve real-life problems involving units of time for addition of hours.
5.3 Subtraction of Units of Time	i) Subtract units of time hours ii) Solve real-life problems involving subtraction of units of time in hours.

Unit 6: Geometry

Contents and scope	Learning outcomes/skills
6.1 Geometrical Shapes	i) Recognize point, line segment, ray. ii) Classify figures according to number of sides as quadrilaterals (rectangles, squares) and triangles. iii) Identify circle, its radius and diameter.
6.2 Perimeters	Calculate perimeters of squares, rectangles and triangles.

Unit 7: Data representation

Contents and scope	Learning outcomes/skills
7.1 Picture Graphs	Read and interpret a picture graph.

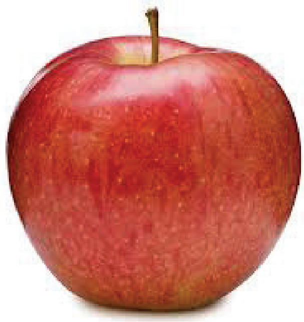
Unit 3, week 9, session 1

Performance-based assessment

This type of assessment examines students' competencies and skills by engaging them in hands-on tasks. The time required to conduct this type of assessment varies and could last from one class period (short assessment) to a few weeks (extended assessment).

Example of short assessment

Who has the best apples?



Assessment duration: 3 to 4 class periods

Subject content: Science, math, and English

- Science: Knowledge of mass and measuring mass
- Math: Knowledge of circumference, measuring circumference, displaying experimental data using bar graphs
- English: Spelling, grammar, and punctuation (in a letter)

Groupings: One student

Appropriate for: Class levels 4 to 5

Description

The purpose of this assessment task is to test students' ability to find the mass (using a balance and mass pieces) and circumference of an object and display the results using a bar graph.

The students are told that they are acting as judges at an agricultural fair where four different apple growers are taking part in a challenge called 'Who has grown the best apples?' The students are given different parameters to judge the apples and are required to write a letter congratulating the winner of the challenge and explaining why his apple was the winner.

The teacher gives each student the following prompt for the assessment task.

Prompt
You are a judge at a local agricultural fair for an apple-growing contest. There are four apple growers participating in the contest, and your job is to decide which farmer has grown the best apples. You will be using following factors to judge the apples:

- Taste
- Mass
- Circumference
- Shape

You have already tasted all four apples and found them to be juicy and sweet. To decide which apple is the winner, you will have to rely on the apples' mass, circumference, and shape.

You can tell the shape of the apples by looking at them. Use a balance and mass pieces to find the mass of the apples and a measuring tape to find the circumference. Record your results in your science notebook in a data chart.

To get a clear visual of your results, display them using a bar graph. It is important to add labels so that your bar graphs are clear and easy to understand. Draw one bar graph that shows the comparison of mass and another that shows the comparison of circumference of the four apples.

After you have displayed your results, decide which apple is the winner. Write a letter to the farmer to congratulate him and explain why his apple is the winner of the contest. The letter should not be more than one page long.

Learning objective being assessed

- Students are able to use a balance to measure the mass of an object accurately.
- Students are able to use a measuring tape to accurately measure the circumference of an object.
- Students are able to accurately analyse experimental data.
- Students are able to draw a bar graph to compare results of an experiment.

NOTE: These learning objectives are not taken from any specific unit or curriculum. They are written in a general format to outline the topics assessed by 'who has the best apples' task.

Assessment tasks

During the project: Student data chart
During the project, the teacher assesses students on how well they are measuring the mass and circumference of the apples. The teacher also judges students' ability to note their observations in a data chart.

The teacher can provide students with the following data chart for recording experimental results.

	Taste	Shape	Mass (grams)	Circumference (centimetres)
Mr Khan's apple	Juicy and sweet			
Mr Farooq's apple	Juicy and sweet			
Mr Noorani's apple	Juicy and sweet			
Mr Shah's apple	Juicy and sweet			

At the end of the project: Two bar graphs
This task assesses students' ability to display the result of an experiment using bar graphs.

At the end of the project: Letter to the farmer
This task tests students' ability to apply logical reasoning skills and to communicate their reasoning in a clear and concise manner.

Rubric for the project

Learning standards	Performance indicators			
	4	3	2	1
Can determine mass of apples	Correctly measures mass of all four apples in grams	Correctly measures mass of three apples in grams	Correctly measures mass of two apples in grams	Correctly measures mass of one apple in grams
Can measure circumference of apples	Correctly measures circumference of all four apples in centimetres	Correctly measures circumference of three apples in centimetres	Correctly measures circumference of two apples in centimetres	Correctly measures circumference of one apple in centimetres
Can analyse experimental data	Creates accurate bar graphs Clearly labels the bar graphs The bar graphs clearly show data	Creates bar graphs that do not have more than one minor mistake Labels the bar graphs The bar graphs show data but has one or two minor errors	Creates bar graphs with one critical mistake Does not clearly label the bar graphs The bar graphs show data but have one critical error	Creates bar graphs with more than one critical mistake Bar graphs are not labelled The bar graphs do not display data correctly

Learning standards	Performance indicators			
	4	3	2	1
Can communicate experimental results	The letter clearly outlines at least three reasons for choosing a winner The letter does not have any spelling, punctuation, or grammatical mistakes	The letter outlines two clear reasons for choosing a winner The letter has up to three spelling, punctuation, or grammatical mistakes	The letter contains one or two reasons for choosing a winner but lacks focus and is difficult to understand The letter contains more than three spelling, punctuation, or grammatical mistakes	The letter offers some reasons that are not relevant to picking a winner and completely lacks understanding on student's part

The concept of this activity was adapted from S. Strating, R. Mitchell, S. Mumm, and A. Martin, 'What's the "Matter" with Those Apples', Northwest Missouri State University. Retrieved from:

➢ http://www.discoverycenter.org/curriculum/items/MatMap2.pdf

Example of extended assessment

The green bean competition

Assessment duration: 3 weeks

Subject content: Science, math, and English

- Science: Knowledge of conditions for growing bean plants, parts of a plant, functions of different parts of a plant, and the importance of plants to our lives and the environment
- Math: Measuring bean plant length, presentation of experimental results with charts
- English: Spelling, grammar, and punctuation (in notes, newsletter, and presentation); bean plant poems (optional)

Groupings: 4 or 5 students

Appropriate for: Classes 4 to 6

Background knowledge

The background knowledge needed to complete this challenge can be found at 'The Green Bean Race':

➢ http://educate.intel.com/en/ProjectDesign/UnitPlanIndex/GreatBeanRace/

This challenge requires students to know about the following concepts:

- Parts of a plant (at least three different parts)
- Functions of parts of a plant
- Knowledge of conditions required for the growth of a bean plant (at least three conditions)
- Importance of plants to our lives and the environment (at least three different roles)

The website listed above describes the conditions required for a bean plant to grow but does not review the parts of a plant, functions of the parts of a plant, or the importance of plants to our lives and the environment. These three topics are chosen for students' independent research. The students should research these topics (using the Internet, library, or gardener/farmer interviews) to find the information and include it in their newsletter or PowerPoint presentation.

After conducting their research, the students should find the following information.

The webpage 'Part of a Bean Plant' describes different parts of a bean plant in detail:
➢ http://www.ehow.co.uk/list_7383883_parts-bean-plant.html

The video below shows a labelled diagram of a bean seedling growing into a bean plant:
➢ http://www.ehow.co.uk/list_7383883_parts-bean-plant.html

The webpage 'Plants' describes the importance of plants to our lives and our environment:
➢ http://www.globio.org/glossopedia/article.aspx?art_id=30

Description

This assessment tests students' knowledge of plant growth processes, hypothesis development, experimental design, and analysing and reporting results by involving students in a plant growth contest. The challenge is to see which student group grows the tallest bean plant in three weeks.

The students learn about the conditions affecting plant growth during the unit and use that knowledge to grow their own bean plants.

The teacher divides the class into groups of four or five students. Each group comes up with a hypothesis of how to grow the tallest bean plant and designs an experiment to test the hypothesis (the bean plan).

The PowerPoint presentation below is an example of how teachers can introduce this assessment task to the class:
➢ http://educate.intel.com/en/ProjectDesign/UnitPlanIndex/GreatBeanRace/

If a teacher cannot review a PowerPoint presentation in the classroom, he or she can use the following directions to introduce the task to the students:

- During this task you will work in teams, and your team goal is to grow the tallest bean plant.
- The team who is able to grow the tallest bean plant in three weeks will win.
- After the contest, you will create a PowerPoint presentation or newsletter to share your experiments and the results.

NOTE: Because the challenge (assessment task) is introduced at the beginning of the instructional unit, it is important to remind students to take careful notes throughout the unit to use later during the assessment.

This competition will start at the end of our instructional unit about plants. Take careful notes in your science journals about the ideal conditions to grow bean plants so you can use this knowledge later in your experiment.

At the beginning of the contest, each team will be given the following materials:

- Two beans
- A polystyrene cup
- Soil (different types)
- Lid

Water (perhaps every day depending upon the team plan) and measure the length of your plant every other morning for three weeks to the nearest centimetre and record the results in your plant log.

At the end of each week, compare your results with one other group and note the differences and similarities between the two plants in your science journal.

Come up with a hypothesis explaining these differences and similarities.

The teacher will collect your science journals every week to assess your daily and weekly entries. You will be assessed on the entire process of growing a plant and recording data and not only the height of the plant.

At the end of the contest, each group will create a newsletter or PowerPoint presentation to describe the hypothesis, plan, and results of the experiment.

This assessment is set up as a challenge. The student groups can compete against one another in the same classroom, with student groups from other classrooms or other schools in the area, across the country, or across the world. If the teacher has access to the Internet, she or he can have the students connect with other classes across the country or the world via the Internet community ePals (www.epals.com).

Learning objectives being assessed:

- Students are able to name different parts of a plant.
- Students are able to explain functions of different parts of a plant.
- Students are able to explain the role of plants in our lives and environment.
- Students are familiar with perfect conditions for growing a plant.
- Students are able to develop a testable hypothesis.
- Students are able to design an experiment to carry out the hypothesis.
- Students are able to draw conclusions and communicate the results after conducting an experiment.

NOTE: These learning objectives are not taken from any specific unit or curriculum. They are written in a general format to outline the topics assessed by the 'Green Bean Competition'.

Assessments tasks

Beginning of the project: Hypothesis and the bean plan
The teacher asks the student groups to develop a hypothesis and create a plan (the bean plan) to grow the tallest bean plant. The student groups should describe their experimental design (a plan of how to grow the tallest bean plant) in their bean plan. Students write their group's bean plan in their science notebooks.

The teacher assesses the following:

- Student groups' hypotheses of how to grow the tallest bean plant
- Student groups' bean plans (an experimental design to test student groups' hypotheses)

During the project: Plant journals
In their plant journals, student groups should include the following from daily observations of their plants:

- Plant growth (how much has the plant grown)
- Daily temperature
- Notes of any additional observation

The teacher can use the following table for students' results or create their own.

Group names:		
Date	Plant height	Temperature

NOTE: The table is only an example, and the rows in the table do not represent the number of observations.

Student groups need to make observations every day over three weeks. Each student needs to include the observations table in his or her plant journal. The teacher should check student plant journals daily to assess students' ability to measure and record experiment results.

After the project: Group newsletter or PowerPoint presentation
After the completion of the project, each student group creates either a newsletter or PowerPoint presentation to share the results of their experiment. The classroom teacher can choose between a newsletter or PowerPoint presentation.

If the teacher does not have the technology to show PowerPoint presentations in the classroom, students can use chart paper to make their presentations.

This is the final part of the three-week assessment project and each student in the group will be evaluated for it individually and collaboratively. The teacher should make sure that each student has a clear role in creating the final assessment task. Each student should be responsible for at least one article or slide for the final assessment task.

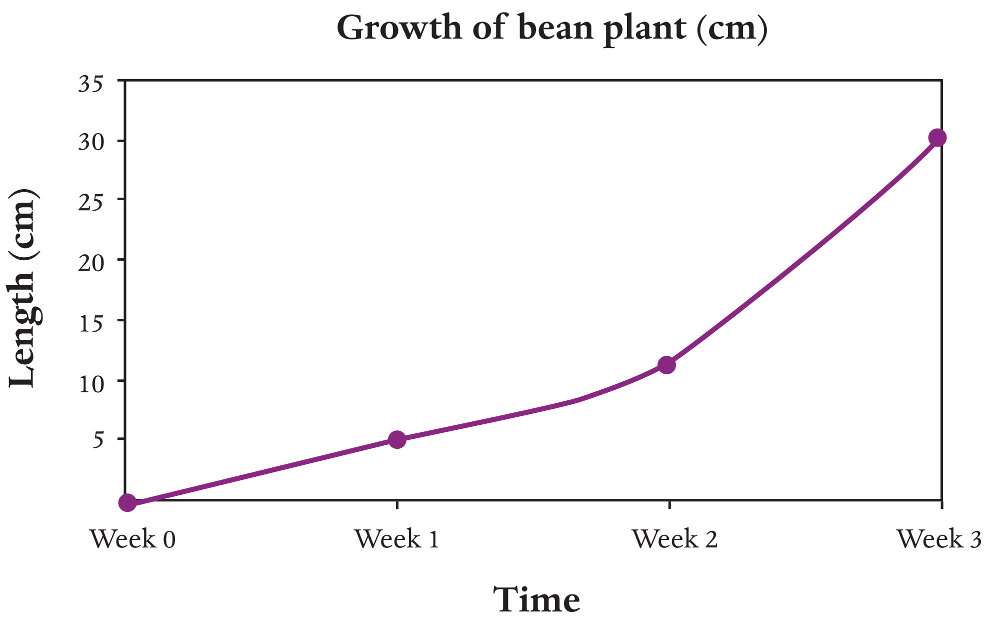
The PowerPoint presentation or newsletter should include the following:

- Information about the green bean competition
- Group's bean plan (should include knowledge of at least three different conditions needed for growing plants)
- Importance of plants to our lives and our environment (at least three different uses of plants)
- Parts of a plant (at least three different parts)
- Functions of different parts of a plant (at least three different parts)
- Some interesting facts about beans (optional)
- Graph to display experiment results (growth of plant over time with a line graph or comparison of plant growth in different weeks with a bar graph)
- A poem on beans (optional, can be done in English class)

Sample line and bar graphs:

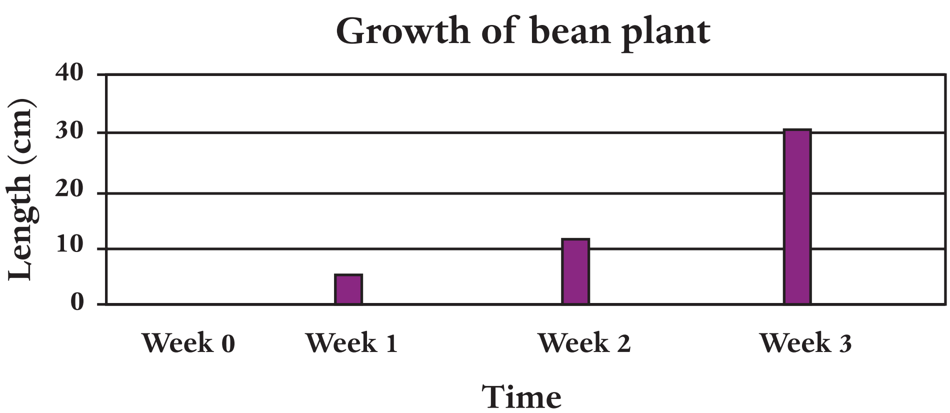
- In the two graphs below, the student used the length of the tallest bean plant on the last day of each week.
- For a more detailed graph, the teacher can ask students to plot the growth of the plant every three or four days.

Sample line graph (showing growth of the bean plant over time):



NOTE: The line of the graph becomes steeper with every passing week, which shows that the rate at which the bean plant grew became faster every week.

Sample bar graph (comparing bean plant growth during different weeks)



NOTE: It can be seen in the graph above that the tallest bar is in week 3, which means that the plant grew the fastest in week 3 compared to weeks 0, 1, and 2.

If the students wish, they can also use the bar graph to compare the length of their bean plants (on the last day of the challenge) with the length of their challengers' bean plants.

An example of a student group PowerPoint presentation is available as an accompanying document.

Students can use these examples to create their own projects.

Rubric for the project

The following rubric is used to assess student performance on assessment tasks performed during and after this project. The rubric covers student performance on knowledge of plant growth, designing and conducting an experiment, group collaboration, and communication of results.

Learning standards	**Performance indicators**			
	4	3	2	1
Understands conditions for plant growth	Correctly identifies and explains at least three conditions necessary for plant growth	Identifies and explains at least three conditions necessary for plant growth with one minor error	Identifies and explains two conditions necessary for plant growth with an error	Identifies and explains conditions necessary for plant growth with two or more major errors
Can identify parts of a plant and their functions	Correctly identifies and labels at least three parts of a plant using a diagram	Identifies and labels at least three parts of a plant using a diagram	Lists three parts of a plant without using a diagram ***or*** Uses a diagram but is missing at least one part of the plant	Lists two or less parts of a plant
	Correctly identifies functions of at least three parts of a plant	Identifies functions of at least three parts of a plant with minor details either missing or wrong	Identifies functions of three parts of a plant with one function either wrong or missing	Identifies functions of parts of a plant with two functions either missing or wrong
Can develop a hypothesis	Develops a clear, precise, and testable hypothesis	Develops a hypothesis that is testable but not clearly thought out	Needs minimal direction in developing a hypothesis	Needs a lot of direction in developing a hypothesis

Learning standards	Performance indicators			
	4	3	2	1
Can plan and design an experiment	Outlines a clear plan to test the hypothesis	Outlines a plan to test the hypothesis but is missing one step	Needs minimal direction in planning the experiment	Needs a lot of direction in planning the experiment
Can make experimental observations	Correctly observes, measures, and records change in plant growth every day	Correctly observes, measures, and records change in plant growth sometimes	Observes, measures, and records change in plant growth with one to two errors	Observes, measures, and records change in plant growth with more than two errors
Can draw conclusions	Successfully draws all major conclusions based on experimental evidence	Successfully draws most major conclusions except one based on experimental evidence	Draws conclusions that are not based on experimental evidence	Does not draw any conclusions
Can make connections with prior knowledge	Successfully connects previously learned knowledge about plants with experimental results	Makes some connections between previously learned knowledge about plants and experimental results	Makes only one or two connections between previously learned knowledge about plants and experimental results	Does not make any connections between previously learned knowledge about plants and experimental results
Can present experimental results	Draws detailed diagrams, table, and chart with correct labelling to write experimental results	Draws diagrams, table, and chart with correct labelling to write experimental results	Draws diagrams, table, and chart with correct labelling to write experimental results (with some details missing or incorrect)	Draws diagrams, table, and chart with labelling to note experimental results (with most details missing or incorrect)
Can manage group work project	Works cooperatively and successfully	Works cooperatively and successfully	Sometimes works cooperatively and successfully	Does not work cooperatively or fulfil role
	Fulfils role and shows leadership abilities	Fulfils role	Fulfils role	Does not work cooperatively or fulfil role

Learning standards	Performance indicators			
	4	3	2	1
PowerPoint presentation	Slide has an appropriate title	Slide has a title	Slide is missing a title	Slide is missing a title
	Slide has appropriate graphics	Slide has graphics that are not relevant	Slide does not have any graphics (the slide needed graphics but did not have any)	Slide does not have any graphics (the slide needed graphics but did not have any)
	No grammatical, spelling, or punctuation errors on the slide	No grammatical, spelling, or punctuation errors on the slide	One or two grammatical, spelling, or punctuation errors on the slide	Slide has more than two grammatical, spelling, or punctuation errors
	Student speaks with clarity and confidence	Student speaks with clarity	Presentation is missing one point that affects clarity of thought	Presentation is missing more than one major point
	Presents slide with loud, clear voice	Voice is not very loud and clear but can be heard	Student has to be reminded at least once to speak louder	Student has to be reminded more than once to speak louder

NOTE: This is a long rubric because it is assessing a complex assessment task that tests a few different skills (knowledge, research, collecting data, etc.). Rubrics that assess fewer skills are not as long and complex.

Rubrics should be shared with students at the beginning of assessment tasks so they are clearly aware of the criteria they are being assessed against.

The idea for this activity was adapted from:
Intel Corporation, 'The Great Bean Race'. Retrieved from:

- http://educate.intel.com/en/ProjectDesign/UnitPlanIndex/GreatBeanRace/

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The green bean competition

Title slide

The Green Bean Competition

By
Green Heroes
Ahmad Malik, Tania Baig, Naila Khan,
and Zeeshan Hamid

Slide 1

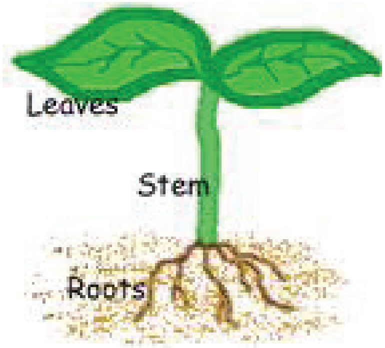
Introduction

- Our class was asked to participate in a competition to see who could grow the tallest bean plant. The competition was called 'The Green Bean Competition'.
- We competed against another group (the Green Machine) from Mr Cheema's science class.
- Our group has four members, and each member worked with the group to come up with a plan to grow the tallest bean plant.
- We planted our bean plant on May 1 and nourished it until May 24.

Slide 2

Parts of a plant

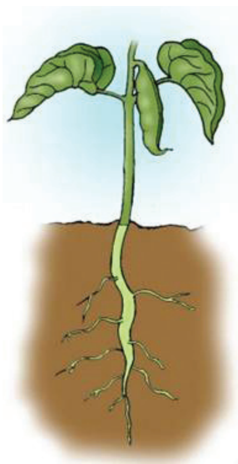
Most common parts of a plant are as follows:



Slide 3

Functions of parts of a plant

The functions of the main parts of a plant:



Roots: Absorb water and minerals for the plant from the soil. They also hold the plant in place.

Stem: The stem holds the plant up. It carries nutrients and water from the roots to the leaves and food from the leaves back to the roots.

Leaves: The leaves help the plant breathe, capture sunlight energy, and prepare food through a process called *photosynthesis*.

Slide 4

Importance of plants to our lives and environment

Food

- Plants make food for all humans and other animals.
- Through the process of photosynthesis, plants convert sunlight energy into food.

Oxygen

- While making food through photosynthesis, plants produce oxygen (the gas we breathe).

Soil

- Roots of a plant hold the soil together, which reduces erosion.

Slide 5

Our bean plan

The three most important conditions for growing plants are light, water, and soil. Keeping these conditions in mind, our group came up with the following bean plan:

- **Light:** We decided to put our plant under artificial light for 12 hours a day.
- **Soil:** We used soil that was two parts clay, one part sand, and one part humus.
- **Water:** We watered our plant after our soil looked dry.

Slide 6

Materials used in the experiment

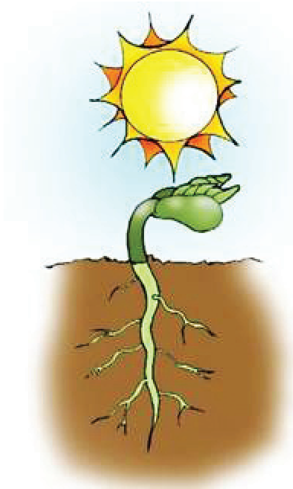
We used the following materials during this experiment:

- Two beans
- Polystyrene cup
- Ruler
- Our science notebooks (plant data log)
- Soil
- Plastic bags
- Saucer

Slide 7

Procedure

1) We germinated bean seeds in plastic bags that contained soil and water.
2) We transferred our germinated seeds to a plastic cup with our combination soil.
3) We kept our plants under artificial light for 12 hours a day for 3 weeks.
4) We watered our plants when the soil dried out.



Slide 8

Procedure

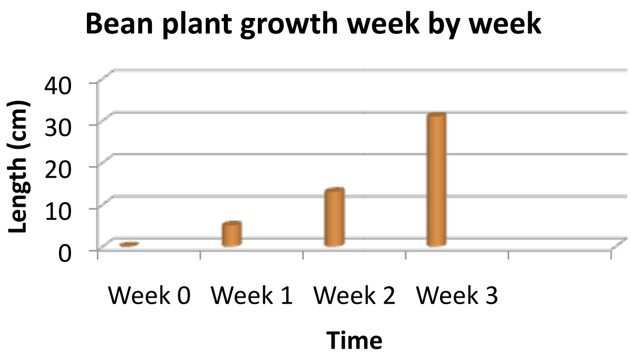
We did the following to monitor our plants daily:

- Checked for soil moistness every morning
- Watered the plants if the soil was dry
- Measured the plants every morning
  - Recorded the data in our plant data logs

Slide 9

Results

We used the tallest plant in our collection to make the following graph:



The graph shows that our plant grew the tallest in the third week.

Slide 10

Comparison of results

We competed with another group from Mr Cheema's science class (the Green Machine). The comparison is as follows:

Similarities:

- Both groups watered the plants as needed.
- Both groups used the same combination of soil.

Differences:

- The Green Machine's plant was taller than ours. It measured 45 cm, and our plant measured 31 cm.
- The Green Machine group gave their plant 24 hours of light, as compared to 12 hours.

Slide 11

Conclusion

- We believe that the Green Machine's plant grew faster and became taller than our plant because it received more light.
- Because plants use light to make food, we believe that more light helped the plant grow taller.

Slide 12

References

The last slide should include information about the sources (websites, books, newspapers) that were used to prepare the presentation.

Examples

1. eHow:
- ➢ http://www.ehow.co.uk/list_7383883_parts-bean-plant.html

2. Globio:
- ➢ http://www.globio.org/glossopedia/article.aspx?art_id=30

3. Tennessee State Improvement Grant:
- ➢ https://umdrive.memphis.edu/g-sig/www/beanplant.htm

Unit 3, week 10, session 1

The professional portfolio

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During Semester 4, Student Teachers will produce a professional portfolio, which is different from the developmental portfolio developed during the previous semester. The developmental portfolio included all the work completed during Semester 3. The professional portfolio will consist only of Student Teachers' 'best practices' over the course of both semesters.

Using the rubric developed for the National Professional Standards for Teachers in Pakistan (NPSTP), Student Teachers are required to develop a professional portfolio that contains only artefacts that indicate how they meet at least Level 2 and above of the rubric. This could include the work completed by the Student Teachers during Semester 3, such as school-based assignments, lessons planned, observational tasks, feedback received, student work done, and other documents that illustrate the Student Teachers' ability to enter their chosen profession. The transition from a developmental portfolio to a professional one demands that Student Teachers systematically select specific artefacts that illustrate their best work from the previous semester and any new artefacts from the current semester. It is important for Student Teachers to be selective during this process. The bulk of the professional portfolio should consist of the very best work completed by Student Teachers during Semester 4.

Throughout Semester 4, the Cooperating Teacher and College/University Supervisors should provide Student Teachers with feedback on their selection of artefacts and encourage them in the process. The Student Teacher will use the 'Notes for Self-Assessment by Student Teacher' template provided to keep continuous track (on a daily/weekly basis) of the artefacts being collected. The artefacts included in the professional portfolio should provide evidence of how the Student Teachers meets the National Professional Standards for Teachers in Pakistan rubric (aiming for Level 3), the standards set by the college and university, and the school site. This collection of materials will provide the opportunity for a multifaceted assessment of each Student Teacher's ability to teach.

Although the professional portfolio is highly personalized and as such should represent the Student Teachers, the Student Teachers should include the best examples of the following items in their professional portfolios:

- Artefacts that reflect their best practices from Semester 3 (taken from their developmental portfolio)
- Complete lesson plans that include the following items:
  - Lesson plan
  - Feedback on the lesson plans
  - Worksheets and assessment tools to be used with these lesson plans
  - Worksheets used in teaching
  - Samples of work completed by the children and feedback given to them
  - Reflections on the lesson planned and taught
- Photos, videotape, or recording of teaching (if available)
- Informal and formal observation by Cooperating Teachers and College/University Supervisors
- Pre-observation guides and post-observation reflections
- Any other material that provides evidence of how Student Teachers meet Level 3 of the rubric for the NPSTP
  - A note is provided in the evaluation section about how the portfolio will be graded.

NOTE: Student Teachers should not add blank copies of materials (such as formats for teacher-parent meetings, etc.) without indicating how the Student Teachers have used these materials.

National professional standards for teachers in Pakistan (NPSTP): Standard 1subject matter knowledge

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Standard 1: Subject matter knowledge

	Level 1	Level 2	Level 3	Level 4
1.1 Source of the lesson content	Teaches content using the textbook for the sole source of subject matter knowledge in the classroom.	Teaches content using the **national curriculum as a guide along with the textbook. In addition, uses own experience, and understanding to enhance lesson.**	Teaches content using the national curriculum as a guide along with the textbook. In addition uses own knowledge, experience and understanding **and seeks other readily available sources of information for teaching and learning of subject matter.**	Teaches content using the national curriculum as a guide along with the textbook. In addition uses own knowledge, experience and understanding and seeks other readily available sources of information for teaching and learning of subject. **Is aware of new emerging concepts, theories, research and latest trends in the subject material, at the national and international level.**
1.2 Understanding of the subject matter knowledge/ curriculum	Displays a basic knowledge of the subject matter taught. Might make occasional errors.	Displays a **good knowledge of the basic concepts and theories of the subject matter taught. Understands connections between the content and its application to practical life.**	Displays **excellent knowledge** of subject matter taught and the connections between the content and its application to practical life. **Understands the sequencing of learning topics and processes and uses these for planning instruction.**	Displays excellent knowledge of subject matter taught and the connections between the content and its application to practical life. **Understands the sequencing of learning topics and processes and uses these for planning instruction. Understands the relationship between the subject matter and other content areas.**

	Level 1	Level 2	Level 3	Level 4
1.3 Teaching strategies/ pedagogy employed	Teaches content using generic teaching methods without planning for misconceptions by children within the subject matter.	Teaches content and thinks about subject specific teaching techniques. Is developing **a general idea of possible types of misconceptions that children may have about the subject and has started to reflect on how to plan lessons differently to correct these misconceptions.**	Teaches content **using a variety of subject specific techniques. Uses strategies to deal with misconceptions that children may have within the subject. Provides opportunities for children to apply the subject matter knowledge to their practical lives. Works with children to develop their self confidence in the subject matter.**	Plans lessons using new emerging subject specific techniques, planning for misconceptions, application of material to children's lives and implements **specific strategies to help children to reflect on, check and correct their own work/ learning. Promotes meta-cognition, self confidence, and self assessment. Challenges all children to achieve at their highest level.**
1.4 Activating child's knowledge	Teaches content without specifically building on, or seeking out children's prior knowledge of the new content.	Teaches content **with the knowledge that children might have knowledge about the topic and includes questions to connect to their prior knowledge and experience.**	Teaches content **by building on the prior knowledge and experience of the range of children in the classroom, in order for children to understand the new concepts.**	Teaches content by building on different children's prior knowledge and helps the range of diverse children to connect their own prior knowledge and experience to what is being taught. **Understands the diverse learner's talents and finds engaging ways to connect the content to a variety of learner's interests.**

Unit 3, week 10, session 1

National professional standards for teachers in Pakistan (NPSTP): Standard 4 assessment

Standard 4: Instructional planning and strategies

	Level 1	Level 2	Level 3	Level 4
4.1 Long term planning	Plans lessons on a day-to-day basis following the textbook as a guide. Has some idea of what to plan for the next day and can share general goals for child's learning.[1]	**Evidence of ability to prepare long term plans: which include goals and objectives for each lesson, within the overall goals and objectives of the NC.**[2]	Evidence of ability to prepare long term plans: which include goals and objectives for each lesson, within the overall goals and objectives of the NC.[3] **Incorporates goals and objectives of education in general as well as those of the curriculum for the specific subject matter.**	Evidence of ability to prepare long term plans: which include goals and objectives for each lesson, within the overall goals and objectives of the NC[4], includes objectives of education in general as well as those of the curriculum for the specific subject matter. **Modifies plans based on assessment of child's learning.**
4.2 Lesson planning	Develops lesson plans that include instructional activities, materials, individual learning outcomes (ILO's). These are not necessarily clearly aligned with the assessment strategies.	Develops lesson plans that include instructional activities, materials, individual learning outcomes (ILOs) and assessment strategies. **There is a clear alignment between the ILO's, the instructional activities and the assessment strategies.**	Develops effective lesson plans where instructional activities, ILO's, and assessment strategies are clearly aligned. **Lesson plans include formal and informal methods of assessment, as well as a wide range of community and technology resources to promote achievement of lesson objectives. Includes reading and writing strategies appropriate for this age.**	Develops effective lesson plans which include well aligned instructional activities, ILO's, formal and informal assessment strategies. Community and technology resources are also incorporated. **Includes pedagogical knowledge and research on teaching and learning as sources for active reflection, evaluation and revision of practice.**

	Level 1	Level 2	Level 3	Level 4
4.3 Using instructional resources	Uses some instructional resources with each lesson, not necessarily matched to achieving planned learning outcomes.	Uses instructional resources **in ways that are matched to achieving planned learning outcomes but use is still teacher centered. Children benefit from using the materials.**	Uses a variety of available instructional resources in ways that are well matched to achieving planned learning outcomes **and promote higher order thinking and understanding. The instructional resources accommodate different learning styles.**	Use a variety of available instructional resources in ways that are well matched to achieving planned learning outcomes, **and children are actively engaged in, create and make choices about using instructional resources. Teacher is able to evaluate the resources for their comprehensiveness, accuracy and usefulness for representing particular ideas and concepts.**

Learner centred: In the learner-centred paradigm, effective teaching is defined as facilitating student learning. Learner-centred classroom instruction involves less instructor domination and shifts more communication, control, and responsibility to the children. In student-centred learning, children construct knowledge for themselves with the help of their teacher and their peers.

Teacher centred: A teacher-centred approach is one in which activity in the class is centred on the teacher. Teacher-centred lessons are generally associated with traditional approaches to education, but teacher-centred activities can be useful in a variety of ways in teaching.

[1] Goal: The purpose toward which teaching and learning is directed

[2] Long-term plan: A plan for a term, semester, or several weeks

[3] Long-term plan: A plan for a term, semester, or several weeks

[4] Long-term plan: A plan for a term, semester, or several weeks

Unit 4, week 11, session 3

Sun, Earth, and the Moon unit test

Section I: Multiple-choice questions

Please choose the best answer for the questions below.

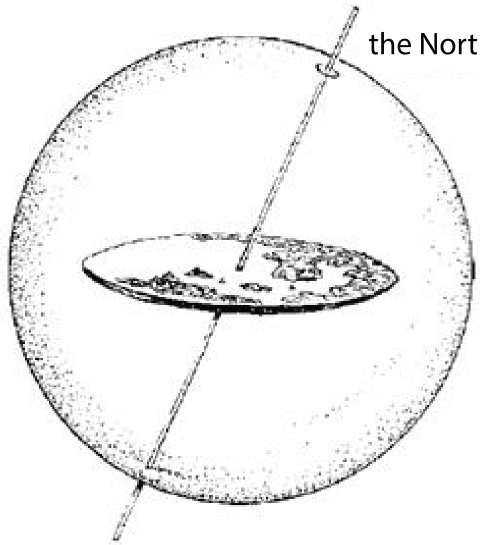
1. Which of the following objects does not exist in the sky?
   a. the Sun
   b. meteors
   c. mammoths
   d. asteroids

2. Which of the following objects resembles the shape of the Earth?
   a. an egg
   b. an orange
   c. a leaf
   d. a disc

3. The movement of the Earth around the Sun is called
   a. rotation.
   b. oscillation.
   c. revolution.
   d. vibration.

4. The time it takes for the Earth to orbit the Sun is
   a. a year.
   b. a month.
   c. a week.
   d. a day.

Use the following diagram to answer the question below.



the sphere of the sky around a central axis

Note: The diagram is not drawn to scale.

5. At one point, the ancient Greeks thought of the Earth as shown in the diagram above (a flat disc situated in a ball of hollow sky that moves). Which of the following statements would have to be true for this model to be true?
   a. We would be able to travel to a place on the Earth where the Earth meets the sky.
   b. We would be able to travel to a place on the Earth where the Sun sets.
   c. We would be able to travel to a place on the Earth where the Sun rises.
   d. All of the above would have to be true.
   e. None of the above would have to be true.

6. The northern hemisphere of the Earth is
   a. an imaginary line around which the Earth spins.
   b. the half of the planet that is north of its equator.
   c. the half of the planet that is south of its equator.
   d. the part of the Earth facing the Sun.

7. Day and night happen because
   a. the Earth is spinning around its axis.
   b. the Sun hides in the deep sky.
   c. someone turns off the lights of the universe.
   d. the Earth goes far away from the Sun.

Use the diagram below to answer the next ***two*** questions. In this diagram, 'e' represents the Earth and 'N' represents north.

Note: The diagram is not drawn to scale.

8. In the northern hemisphere, which season is occurring in the above diagram?

   a. Winter
   b. Summer
   c. Spring
   d. Fall

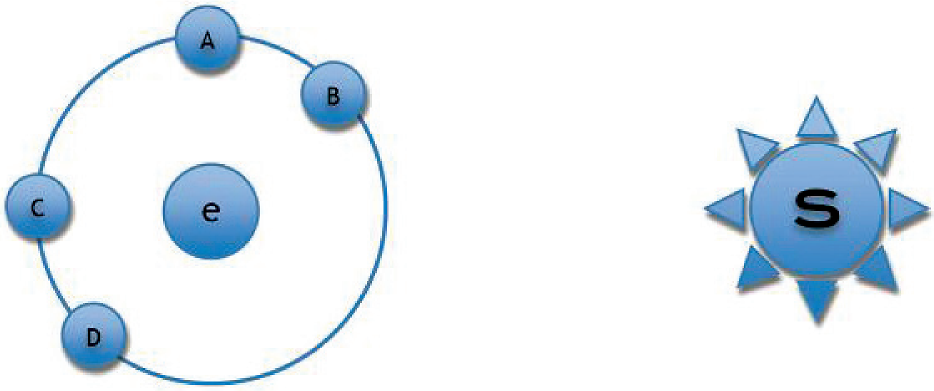
9. Which season will occur in the northern hemisphere six months after the season shown in the above diagram?

   a. Winter
   b. Summer
   c. Spring
   d. Fall

10. When the Moon is between the Earth and the Sun and we cannot see its lit-up side at all from the Earth, this phase of the Moon is called the

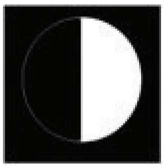
   a. first-quarter phase.
   b. full Moon phase.
   c. last-quarter phase.
   d. new Moon phase.

Use the following diagram to answer the next question. In this diagram, 'e' represents the Earth; 'S' represents the Sun; and A, B, C, and D are different positions of the Moon.



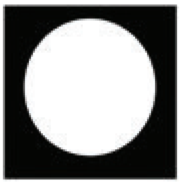
Note: The diagram above and the diagrams in questions 11 and 12 are not drawn to scale.

11. From Earth, which position would show the half Moon phase?



a. Position A
b. Position B
c. Position C
d. Position D

12. From Earth, which position would show the full Moon phase?



a. Position A
b. Position B
c. Position C
d. Position D

13. If a complete Moon cycle takes approximately 28 days, about how many days during a month could you expect to see a crescent Moon?

a. 1
b. 2
c. 7
d. 13

14. Imagine you are an astronaut and your mission is to pull out the Earth's axis. Which one of the following is true about your mission?

a. Because the axis of the Earth is an imaginary line, you cannot physically pull it out.

b. If you put a very strong magnet in space next to the Earth, it will be able to pull out the axis.

c. The axis of the Earth is too large and heavy to be pulled out of the Earth.

d. The axis of the Earth is too delicate and will break into pieces before it can be pulled out.

15. If you saw a full Moon last night, which phase of the Moon would you see in a week?

a. First-quarter Moon

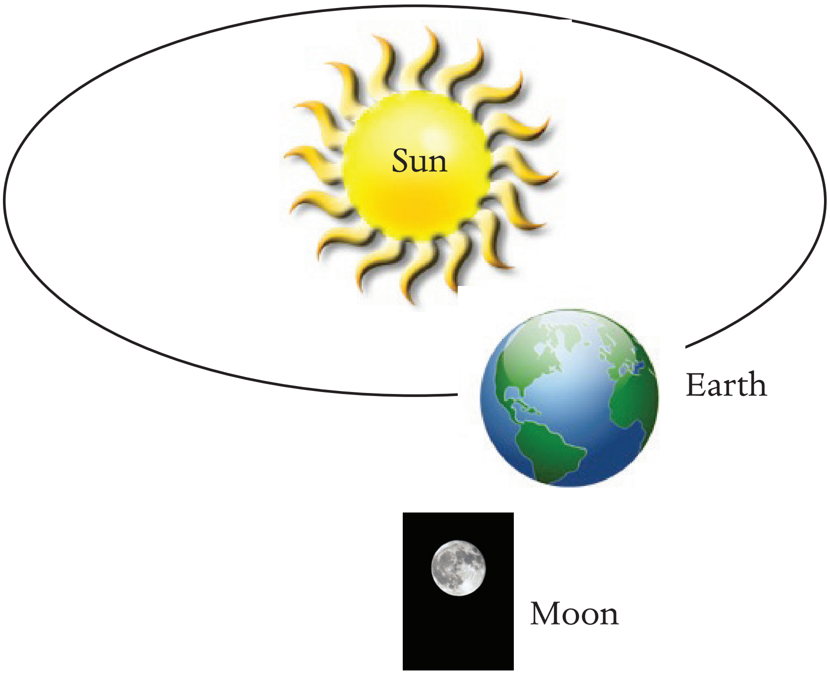
b. Third-quarter Moon

c. Waxing crescent Moon

d. New Moon

Section II: True-false questions

Use the following diagram to answer the next question.



Note: The diagram is not drawn to scale.

16. The diagram above represents the correct positions of the Sun, Moon, and the Earth in the solar system.

a. True

b. False

17. The solar system is composed of eight planets, and the Sun is in the centre.

a. True

b. False

18. Viewed from the Earth with the human eye, planets look very small because they are so far away.

a. True

b. False

19. Winter and summer are determined by the Earth's distance from the Sun.

a. True

b. False

20. Earth's seasonal temperature changes—cold in the winter, hot in the summer, and mild in the spring and fall—are the result of the tilt of the Earth's axis as it spins around the Sun.

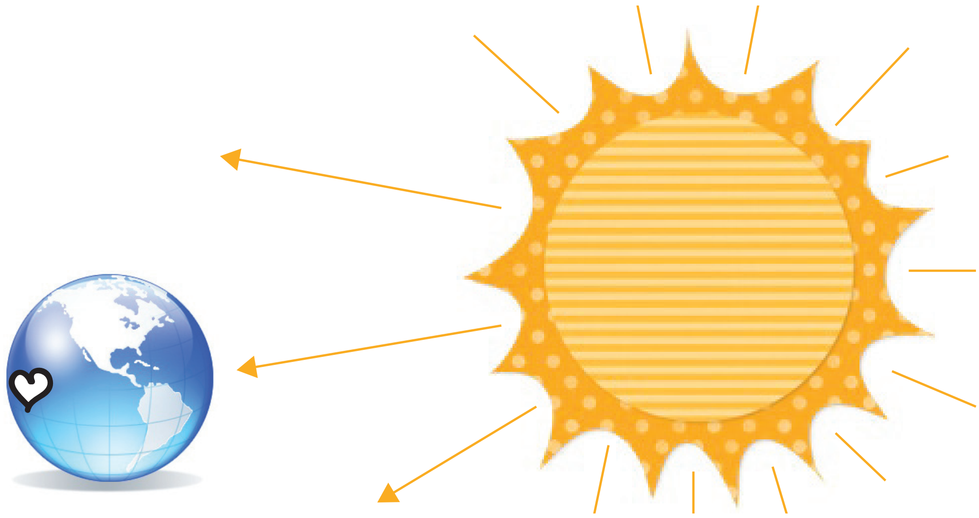
a. True

b. False

21. According to the following diagram of the Earth and the Sun, the location indicated by the white heart (on Earth) is experiencing day.

a. True

b. False



Note: The diagram is not drawn to scale.

Section III: Sentence-completion questions

Please fill in the missing blanks for the questions below

22. The Sun's diameter is _______ times that of the Earth's diameter.

23. The Earth is _______ Sun diameters away from the Sun.

24. The Moon's diameter is _______ the size of the Earth's diameter.

25. The Sun's diameter is _______ times that of the Moon's diameter.

26. When the Earth spins around itself, this movement is called ______________.

27. One complete revolution of the Moon around the Earth is called __________.

Section IV: Matching questions

Match the terms in the following questions with the correct choices.

28. Match the following movements of the Sun, Earth, and the Moon with the phenomena they cause.

	One week (7 days)
a. Earth's movement around itself	One day (24 hours)
b. Moon's movement around the Earth	One year (365 days)
c. Earth's movement around the Sun	Approximately one month (28 days)

29. Your teacher has asked you to pick objects to represent a scale model of the Sun, Earth, and the Moon. Match the name of the object you would use to represent the Sun, Earth, and the Moon. Put the correct letter in front of the Sun, Earth, and Moon.

a. A ball (1 metre in diameter)	The Sun
b. A ball (1 centimetre in diameter)	The Moon
c. A marble (3 centimetres in diameter)	The Earth
d. A tiny bead (3 millimetres in diameter)	

Section V: Short-answer questions

Provide answers for the questions below in one or two sentences.

30. The planet Mars is bigger than the Moon, but the Moon seems much bigger in the night sky. Why?

31. How far is the Moon from the Earth?

32. Using the answer from question 31, draw a scale model of the Sun, Earth, and the Moon. (Hint: Use appropriate distance and size.)

33. Name an example of a scale model from your everyday life and explain in one line why it is a scale model.

34. Do all places on Earth experience day and night at the same time? Why or why not?

35. Describe in one or two sentences the major difference between rotation and revolution.

Sun, Earth, and the Moon unit test key

S

Section I: Multiple-choice questions

Please choose the best answer for the questions below.

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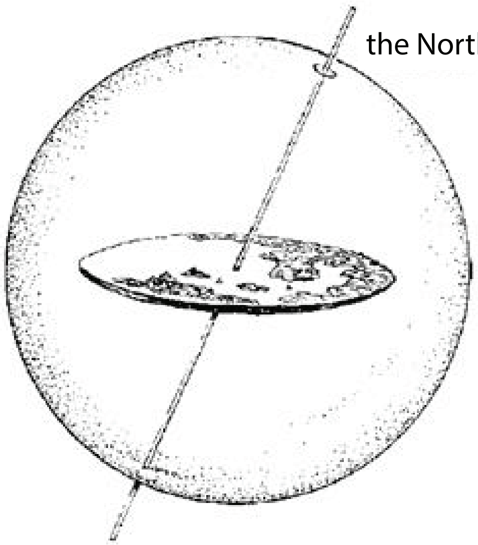

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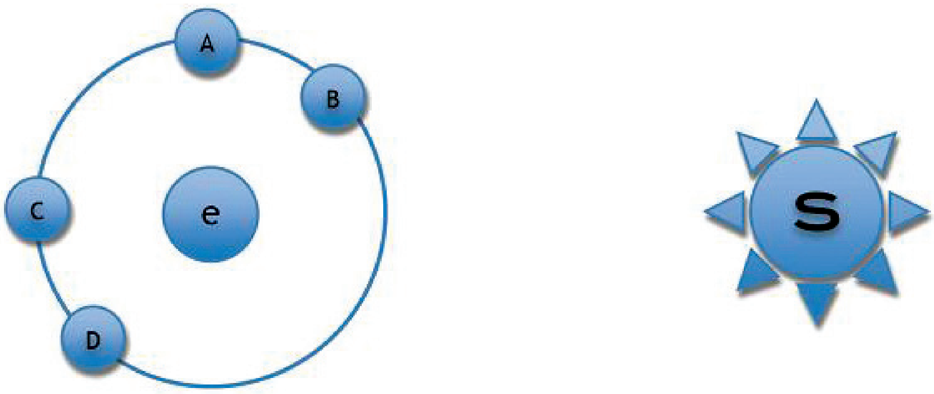

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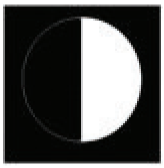

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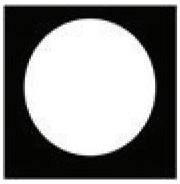

13. If a complete Moon cycle takes approximately 28 days, about how many days during a month could you expect to see a crescent Moon?

a. 1
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15. If you saw a full Moon last night, which phase of the Moon would you see in a week?

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Section II: True-false questions

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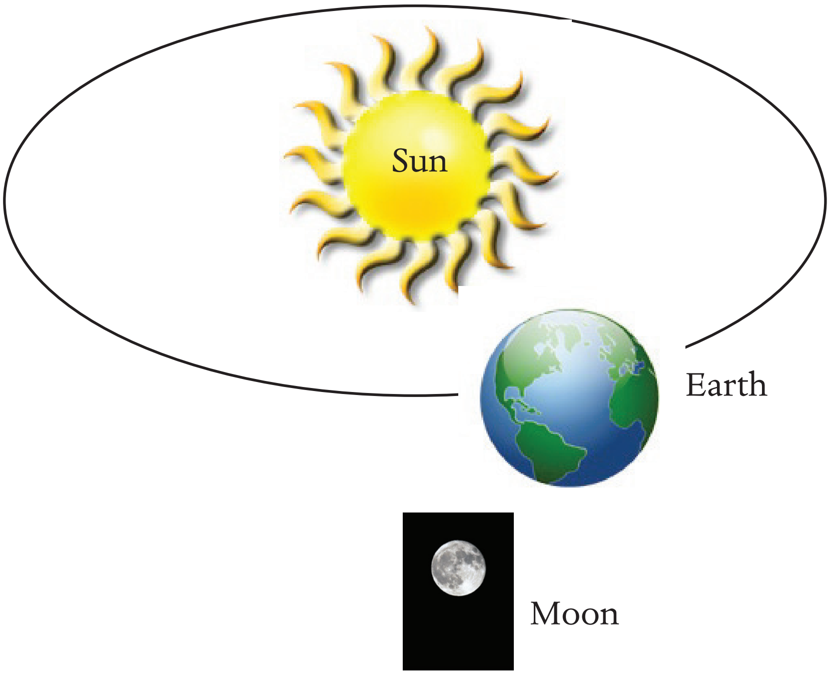

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a. True

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17. The solar system is composed of eight planets, and the Sun is in the centre.

a. True

b. False

18. Viewed from the Earth with the human eye, planets look very small because they are so far away.

a. True

b. False

19. Winter and summer are determined by the Earth's distance from the Sun.

a. True

b. False

20. Earth's seasonal temperature changes—cold in the winter, hot in the summer, and mild in the spring and fall—are the result of the tilt of the Earth's axis as it spins around the Sun.

a. True

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21. According to the following diagram of the Earth and the Sun, the location indicated by the white heart (on Earth) is experiencing day.

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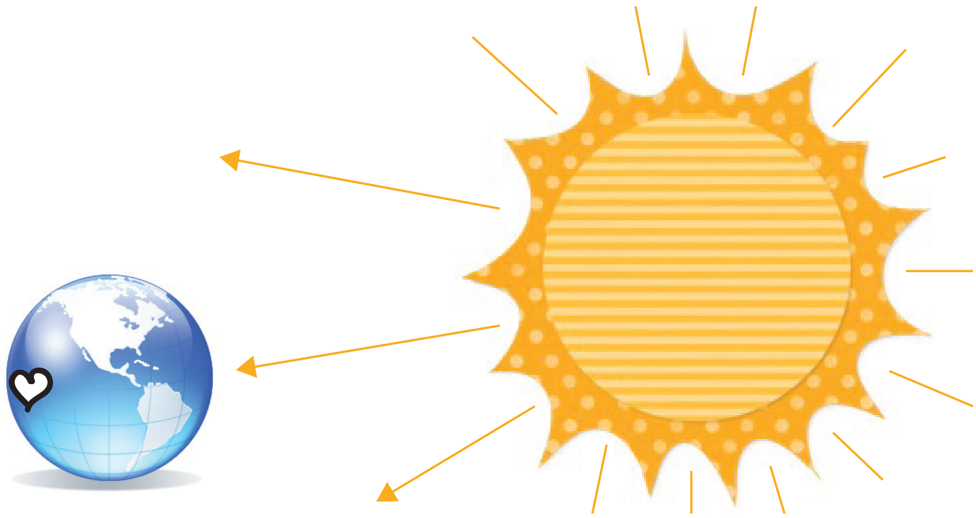
b. False



Note: The diagram is not drawn to scale.

Section III: Sentence-completion questions

Please fill in the missing blanks for the questions below

22. The Sun's diameter is **100** times that of the Earth's diameter.

23. The Earth is **100** Sun diameters away from the Sun.

24. The Moon's diameter is **one-fourth (or 1/4)** the size of the Earth's diameter.

25. The Sun's diameter is **400** times that of the Moon's diameter.

26. When the Earth spins around itself, this movement is called **rotation**.

27. One complete revolution of the Moon around the Earth is called **the lunar cycle**.

Section IV: Matching questions

Match the terms in the following questions with the correct choices.

28. Match the following movements of the Sun, Earth, and the Moon with the phenomena they cause.

    a. Earth's movement around itself Answer: One day (24 hours)

    b. Moon's movement around the Earth Answer: Approximately one month (28 days)

    c. Earth's movement around the Sun Answer: One year (365 days)

29. Your teacher has asked you to pick objects to represent a scale model of the Sun, Earth, and the Moon. Match the name of the object you would use to represent the Sun, Earth, and the Moon. Put the correct letter in front of the Sun, Earth, and Moon.

    a. A ball (1 metre in diameter) Answer: The Sun

    b. A ball (1 centimetre in diameter) Answer: The Earth

    ~~c. A marble (3 centimetres n diameter)~~

    d. A tiny bead (3 millimetres in diameter) Answer: The Moon

Section V: Short-answer questions

Provide answers for the questions below in one or two sentences.

30. The planet Mars is bigger than the Moon, but the Moon seems much bigger in the night sky. Why?
    Answer: *The Moon appears to be bigger than Mars because the distance between the Earth and Mars is much greater than the distance between the Earth and the Moon.*

31. How far is the Moon from the Earth?
    Answer: *The Moon is 30 Earths away from the Earth.*

32. Using the answer from question 31, draw a scale model of the Sun, Earth, and the Moon. (Hint: Use appropriate distance and size.)
    Answer: A lot of diagrams are possible so no example is given here.

33. Name an example of a scale model from your everyday life and explain in one line why it is a scale model.
    Possible answer: *A globe. It is a scale model because even though it is much smaller than the Earth, the sizes of water and land bodies are proportional to their actual size.*

34. Do all places on Earth experience day and night at the same time? Why or why not?

Answer: *All places on Earth do not experience day and night at the same time because all parts of the Earth are not facing the Sun at the same time.*

or

Answer: *When the Earth spins on its axis, the side facing the Sun experiences day and the side facing away from the Sun experiences night.*

35. Describe in one or two sentences the major difference between rotation and revolution.

Answer: *When a body spins around itself, it is considered to rotation. When a body spins around another body, it is considered to be revolving.*

Unit 4, week 12, session 1

Template for Table of Specifications for the Sun, Earth, and the Moon unit test

S

Content	**Knowledge** definition	**Knowledge** Recognition and identification	Comprehension	Application	Total number	Per cent
Number of items					T:	--
Per cent					--	**100**

Unit 4, week 12, session 1

Subject matter topics for the Sun, Earth, and the Moon unit grouped by learning objective

S

This document lists the name of the lessons and their objectives from the 'Sun, Earth, and the Moon' unit. This is a resource for Student Teachers to use when working with the Table of Specifications in Unit 4, Week 12.

Lesson 1: Objects in the sky

Learning objectives

- Students will understand that the universe is vast and has millions of different types of objects, including our solar system.
- Students will understand that the Sun is the centre of our solar system, which has eight planets.
- Students will recognize the position of the Sun, Earth, and its Moon in the solar system.
- Students will know that all the planets revolve around the Sun in a circular path.
- Students will know the meaning of the word *orbit* and that paths of the planets around the Sun are called *orbits*.

Lesson 2: How big, how far

Learning objectives

- Students will understand the concept of a scale model.
- Students will understand the relative size differences between the Sun, Earth, and the Moon.
- Students will be able to understand the relative distances between the Sun, Earth, and the Moon.
- Students will know that the Sun's diameter is more than 100 times as big as the Earth's diameter, and the Earth is about 100 Sun diameters away from the Sun.
- Students will understand that the Moon's diameter is around one-fourth the size of Earth's diameter, and it is about 30 Earths away from the Earth.

Lesson 3: Endless Earth

Learning objectives

- Students will be familiar with the concept of spherical shapes.
- Students will understand that the Earth is a sphere.
- Students will be able to explain why they think that the Earth is a sphere.
- Students will be familiar with the discovery that the Earth is a sphere.

Lesson 4: Movements of the Earth

Learning objectives

- Students will understand that the Earth moves around itself and around the Sun.
- Students will be able to define the rotation and revolution of the Earth.
- Students will be able to differentiate between the concepts of rotation and revolution.
- Students will understand that the Earth's axis is an imaginary line drawn through the Earth's centre to represent its tilt and movement.
- Student will know the time it takes the Earth to complete a rotation and a revolution.

Lesson 5: Day and night

Learning objectives

- Students will understand the process by which day and night occurs.
- Students will be able to explain the role of the Sun in creating day and night.
- Students will be able to explain the role of the Earth's rotation in creating day and night.

Lesson 6: Reason for seasons

Learning objects

- Students will understand that the Earth rotates around itself on an axis.
- Students will understand the concepts of the southern hemisphere, northern hemisphere, and equator.
- Students will know that the axis of the Earth is tilted.
- Students will comprehend that the tilt in the Earth's axis causes different hemispheres of the Earth to experience different seasons.

Lesson 7: Phases of the Moon

Learning objectives

- Students will know that the Moon does not generate any light; it only reflects the light from the Sun.
- Students will learn that the Moon revolves around the Earth in a counter-clockwise fashion.
- Students will understand that the journey of the Moon around the Earth is called a lunar, or Moon phase, cycle.
- Students will know that it takes the Moon approximately 28 days* to complete one lunar cycle.
- Student will learn that there are four major phases of the Moon.
- Students will be familiar with the names of the four major phases of the Moon.

* The time between two full moons (a Lunar cycle) is about 29.5 days. However, the time it takes the Moon to make one orbit around the Earth is about 27.5 days. This difference is caused by the fact that the Earth-Moon system is orbiting around the Sun at the same time the Moon is orbiting around the Earth. For simplicity, this document talks about the lunar cycle and the Moon's orbit around the Earth as if they are the same duration, approximately 28 days.

Unit 4, week 12, session 1

Learning objectives from lessons in the 'Sun, Earth, and the Moon' unit grouped by subject matter topics

S

Basic knowledge

Basic terms

- Identifies the definition of all vocabulary terms

Positions of solar objects

- Recognizes that there are many different types of objects in the sky (is able to name objects)
- Identifies the position of Sun, Earth, and the Moon in the solar system
- Arranges Sun, Earth, and Moon pictures in correct order in the solar system

Nature of solar objects

- Identifies the correct shape of the Earth
- Identifies the correct movement of the Earth around itself and around the Sun
- Recognizes the time it takes the Earth to complete one full rotation and revolution
- Recognizes that the Moon revolves around the Earth
- Recognizes the time it takes the Moon to revolve around the Earth
- Recognizes that the Moon does not emit its own light but reflects the light from the Sun
- Recognizes that it takes the Moon approximately 28 days* to complete one revolution around the Earth
- Names the four major phases of the Moon

Understanding

Roles of the Sun, Earth, and Moon system in our lives

- Distinguishes between the actual size differences and the relative size differences of the Sun, Earth, and Moon
- Distinguishes between the actual distances and the relative distances between the Sun, Earth, and Moon
- Explains why things that are farther away look smaller
- Identifies the relative size differences between the Sun, Earth, and the Moon
- Identifies the evidence that proves that Earth is a sphere
- Distinguishes between rotation and revolution
- Differentiates between examples of rotation and revolution
- Identifies that the occurrence of day and night are caused by the rotation of the Earth around its axis

* The time between two full moons (a Lunar cycle) is about 29.5 days. However, the time it takes the Moon to make one orbit around the Earth is about 27.5 days. This difference is caused by the fact that the Earth-Moon system is orbiting around the Sun at the same time the Moon is orbiting around the Earth. For simplicity, this document talks about the lunar cycle and the Moon's orbit around the Earth as if they are the same duration, approximately 28 days.

- Identifies the role of the Sun in creating day and night
- Identifies the role of the tilt of the Earth's axis and revolution of the Earth around the Sun in creating seasons
- Recognizes the role of the Sun in creating seasons
- Identifies the correct diagram of revolution of the Moon around the Sun
- Matches the names of the different phases of the Moon to their correct diagrams

Application

Diagram interpretation

- Picks the correct diagram to represent the relative size differences between the Sun, Earth, and the Moon
- Arranges the diagrams of the Sun, Earth, and the Moon in their correct positions according to their relative distances from one another
- Identifies the correct diagram of the Sun and Earth depicting day and night at a marked location
- Identifies the correct diagram of the Sun and Earth depicting winter and summer at the marked location
- Uses the waxing and waning Moon terminology to match the name of the Moon phase to its correct diagram

Daily life examples

- Provides examples of revolution and rotation movements from daily life
- Picks correct examples depicting the relationship between distance and size

Content outline

Solar system

- Names of solar objects
- Positions of the Sun, Earth, and the Moon

Sizes and distances

- Relative size differences between the Sun, Earth, and the Moon
- Relative distances between the Sun, Earth, and the Moon

Earth

- Earth's shape
- Evidence for Earth's shape
- Movements of the Earth

Phenomena caused by movements of the Earth

- Day and night
- Seasons

Moon

- Movements of the Moon
- Lunar phases

Unit 4, week 12, session 1

Table of Specifications for the Sun, Earth, and the Moon unit test

S

Content	**Knowledge** definition	**Knowledge** Recognition and identification	Comprehension	Application	Total number	Per cent
Solar system relationships	1	1	2	2	6	**17.1**
Sizes, shapes, distances	2	3	1	2	8	**22.9**
Earth	1	1	2	1	5	**14.3**
Phenomena caused by Earth movements	1	3	3	2	9	**25.7**
Moon	1	2	2	2	7	**20**
Number of items	6	10	10	9	T: 35	**--**
Per cent	**17.1**	**28.6**	**28.6**	**25.7**	**--**	**100**

Unit 4, week 12, session 2

Use of Bloom's Taxonomy of educational objectives to create test questions

S

Benjamin Bloom identified six learning objectives, ranging from 'knowledge', which represented simpler mental processes, to 'evaluation', which represented the highest level of cognitive skills. Moving from knowledge toward evaluation requires students to use higher-order mental skills at each level. The 'Sun, Earth, and the Moon' unit test uses the first three levels (knowledge, comprehension or understanding, and application) from Bloom's taxonomy. The definitions of these categories used to create the unit test are as follows.

Knowledge

This category requires the lowest level of cognitive skills and involves recognition and/or recollection of previously learned material.

Verbs used in questions asking for knowledge include *define*, *list*, *identify*, *describe*, *match*, and *locate*.

Examples of stems for questions asking for knowledge: 'Where did …?', 'What was …?', Who was …?', and 'When did …?'

Comprehension/understanding

As is apparent from the name, this category represents understanding of the learned material, and it requires higher-level cognitive skills than the knowledge category. Tasks such as summarizing information, interpreting the material, and recognizing trends are examples of this category.

Verbs used in questions asking for comprehension include *summarize*, *interpret*, *rewrite*, and *give an example*.

Examples of stems for questions asking for comprehension: 'Tell me in your own words …', 'What it is meant by …?', and 'What is the main idea of …?'

Application

This category goes one step beyond comprehension and represents the level where a student is able is to use the learned material in new and concrete situations.

Verbs used in questions asking for application include *demonstrate*, *show*, *operate*, *construct*, and *apply*.

Examples of stems for questions asking for application: 'What would happen if …?', 'How would you solve this problem …?', and 'Would you have done the same as …?'

Task

Keep these descriptions, verbs, and question stems in mind as you identify the categories for the following 10 questions. Write 'K' for knowledge, 'C' for comprehension, and 'A' for application at the end of each question to denote its category.

1. The Moon cycle repeats itself every ______________.

2. The Moon produces its own light.
   a. True
   b. False

3. Explain what would happen if the Earth stopped moving around itself.

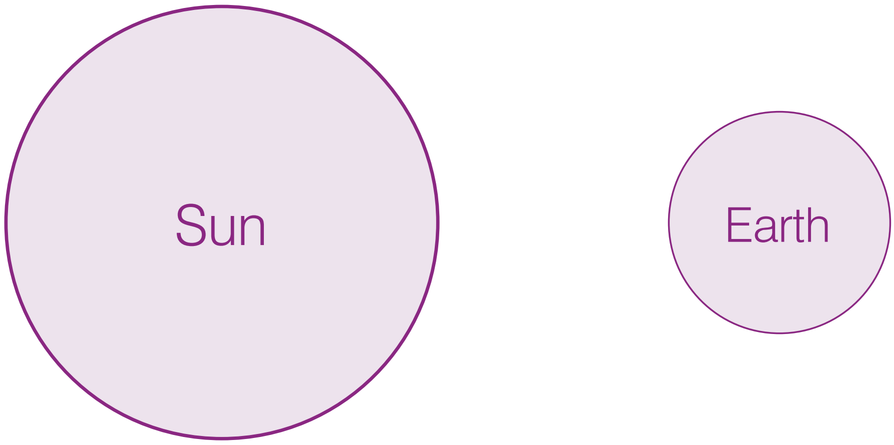
4. Why is it summer in the southern hemisphere when it is winter in the northern hemisphere?
   a. The southern hemisphere heats up really fast.
   b. The southern hemisphere receives the most direct rays from the Sun.
   c. The southern hemisphere is in the path of warm winds from the north.
   d. The southern hemisphere balances out the temperatures for Earth.

5. What happens every 24 hours?
   a. The Sun goes around the Earth once.
   b. The Earth goes around its axis once.
   c. The Earth goes around the Sun once.
   d. None of the above happens.

6. If you saw a full Moon last night, when would you see the full Moon again?

7. Think about how far the Moon is from the Earth. The Sun is
   a. about the same distance from the Moon.
   b. about twice as far as the distance to the Moon.
   c. 10 times farther than the distance to the Moon.
   d. much farther than any of these distances.

8. The following diagram represents the Sun and Earth. Write the letters A, B, C, and D to represent the positions of the Moon relative to Earth and the Sun when it is in the following phases: full (A), new (B), waxing gibbous (C), and waning crescent (D).



9. Why do we only see one side of the Moon?

10. Illustrate the positions of the Earth, Moon, and Sun at the waxing crescent phase. Make sure to label the diagram. The diagram does not have to be drawn to scale.

Unit 4, week 12, session 2

Use of Bloom's Taxonomy of educational objectives to create test questions (answer key)

S

Task

Keep these descriptions, verbs, and question stems in mind as you identify the categories for the following 10 questions. Write 'K' for knowledge, 'C' for comprehension, and 'A' for application at the end of each question to denote its category. Use the unit test questions as examples to complete this task.

NOTE TO INSTRUCTOR: The category group for each question is written in parentheses.

1. The Moon cycle repeats itself every ______________. (K)

2. The Moon produces its own light. (K)
   a. True
   b. False

3. Explain what would happen if the Earth stopped moving around itself? (A)

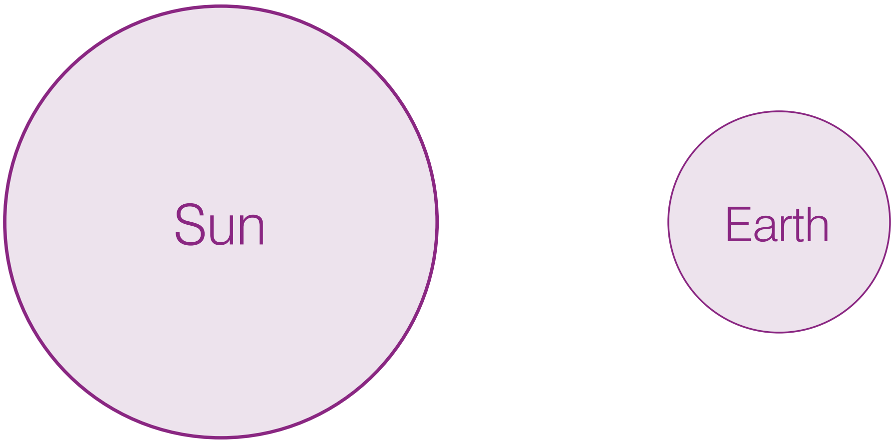
4. Why is it summer in the southern hemisphere when it is winter in the northern hemisphere? (C)
   a. The southern hemisphere heats up really fast.
   b. The southern hemisphere receives the most direct rays from the Sun.
   c. The southern hemisphere is in the path of warm winds from the north.
   d. The southern hemisphere balances out the temperatures for Earth.

5. What happens every 24 hours? (K)
   a. The Sun goes around the Earth once.
   b. The Earth goes around its axis once.
   c. The Earth goes around the Sun once.
   d. None of the above happens.

6. If you saw a full Moon last night, when would you see the full Moon again? (C)

7. Think about how far the Moon is from the Earth. The Sun is (C)
   a. about the same distance from the Moon.
   b. about twice as far as the distance to the Moon.
   c. 10 times farther than the distance to the Moon.
   d. much farther than any of these distances.

8. The following diagram represents the Sun and Earth. Write the letters A, B, C, and D to represent the positions of the Moon relative to Earth and the Sun when it is in the following phases: full (A), new (B), waxing gibbous (C), and waning crescent (D). (C)



9. Why do we only see one side of the Moon? (C)

10. Illustrate the positions of the Earth, Moon, and Sun at the waxing crescent phase. Make sure to label the diagram. The diagram does not have to be drawn to scale. (A)

Guidelines for writing test questions

S

Selected-response test questions

True-false questions

Example:

Read the following sentences. If the sentence is grammatically correct, circle the 'C'. If it is grammatically incorrect, circle the 'I'.

Sentence	Correct	Incorrect
1. I heard you was at the bowling party.	C	I
2. He don't plan to study engineering at college.	C	I
3. Are you calling us?	C	I
4. The rear tires had wore out.	C	I

Guidelines for writing true-false questions

1. Write clear directions about how to mark the correct answers (for example, underline or circle the T or F) on the test paper. Repeat these directions orally before students start the test.

2. Write questions based on statements that have been presented to students in lessons and discussions as definitely true or definitely false. Ideas that have been presented to students as opinion are not eligible to be true-false questions.

3. Make sure there are equal numbers of true and false questions in the test.

4. Make sure the true and false questions are of approximately equal length.

5. Questions should not contain two negatives (for example, *no*, *not*, and *never*).

   Do not write questions that contain words indicating an indefinite quantity or time (*small*, *briefly*, or *frequently*, for example) or absolutes (for example, *never*, *only*, *always*).

6. Be careful not to place questions in the test in a pattern (true-true-false-false, for example), because students may detect the pattern and use it to choose an answer rather than reading the question.

7. Create your own questions rather than taking sentences out of context from a textbook and turning the sentences into test questions.

8. True-false questions create a 50 per cent chance that the student who guesses will choose the right answer. Before the test begins, encourage all students to guess if they don't know the correct answer.

Matching questions

Example:

Match each term with its definition.

Deposition
Erosion
Lithification
Weathering

a. The chemical alteration and breakdown of rock
b. The conversion of sediment to rock
c. The dropping of sediment into a long-term reservoir
d. The picking up and carrying away of sediment

Guidelines for writing matching questions:

1. The description list (the items for which the question seeks a match) and the options list (the matches) should be short.

2. Lists for matching should be homogeneous (for example, all names, or all places, or all events, or all dates). Students should not be expected to match some names and some dates in the same question, for example.

3. Number each description (1, 2, 3, etc.) and letter each option (a, b, c, etc.).

4. Include more options than descriptions. In the example above, this could mean taking out definition 'D' so that students choose from four terms for three definitions.

5. In some questions, include options that can be used with more than one description.

6. Directions for answering matching questions on the test should tell (or show) students how to answer the question (for example, by drawing a line to connect the correct option with the description or by writing the letter of the correct option next to each description).

7. Tell students before they begin the test if an option can match more than one description.

Multiple-choice questions

Example:

Why is it summer in the southern hemisphere when it is winter in the northern hemisphere?

a. The southern hemisphere heats up really fast
b. The southern hemisphere receives the most direct rays from the Sun
c. The southern hemisphere is in the path of warm winds from the north
d. The southern hemisphere balances out temperatures for the Earth

The question's stem is 'Why is it summer in the southern hemisphere when it is winter in the northern hemisphere?' The students' choices for answers to the question are a, b, c, and d.

Most multiple-choice questions assess either knowledge or understanding (comprehension). This question assesses knowledge:

What happens to the relationship between the Earth and Sun every 24 hours?

a. The Sun goes around the Earth once
b. The Earth rotates on its axis once
c. The Earth goes around the Sun once

Guidelines for writing multiple-choice questions

1. Make sure that the stem contains enough information for students to understand the question.

2. All distracter (wrong answer) choices must be plausible, yet wrong.

3. Keep the length and form of the answer choices approximately equal.

4. Avoid negative stems. For example:

   Which of the following is not a symptom of malaria?

   a. Tiredness
   b. Fever
   c. Chills
   d. Skin rash

   Better to write:

   Which of the following is a symptom of malaria?

   a. Spots
   b. Swollen ankles
   c. Fever
   d. Skin rash

5. Eliminate unintentional grammatical clues. In the following example, the use of 'a' suggests the answer.

   Albert Eisenstein was:

   a. anthropologist
   b. astronomer
   c. chemist
   d. a mathematician

6. Rotate the position of the correct answer on a random basis from question to question.

7. You don't need to have the same number of distracters for each question. Distracters can range from three to five in one test.

8. Try to test for knowledge rather than encourage guessing.

9. Try to avoid repetition of concepts and vocabulary in response options.

10. Avoid using the response options 'all of the above' and 'none of the above'.

Interpretive questions

Most true-false, matching, and multiple-choice questions test knowledge, understanding (comprehension), and application (using learned material in new situations). However, true-false and/or multiple-choice questions can be created that require the use of higher-order cognitive skills, which Benjamin Bloom would identify as analysis, synthesis, and evaluation. Such test questions are often called interpretive questions.

Interpretive questions present students with some information (a story, table of data, map, graph, chart, mathematical principle, or picture) and then ask questions that can be answered using the information provided. The intent is to assess reasoning, critical thinking, and problem-solving skills.

This is an example of an interpretive question that asks students to identify the information that will help solve a simple problem.

> Fauzia lost her notebook on the way to school this morning. The notebook was a gift from her aunt. It has a blue cover. Fauzia drew a border of flowers on the first page of the notebook. The notebook is new, and she can't remember if she wrote her name on it. She wants her teacher to tell the students in her class about the lost notebook so they can help her find it.

What should the teacher tell the class? Circle ***yes*** if you think the information in the sentences that follow will help Fauzia's classmates find the notebook.

yes no 1. The notebook was new.

yes no 2. Fauzia rides in a car to school.

yes no 3. The notebook was a gift.

yes no 4. The notebook was purchased in Karachi.

yes no 5. The notebook has a blue cover.

yes no 6. Fauzia's teacher knows Fauzia's aunt.

1. Define the cognitive task (for example, distinguish between fact and opinion, make an inference, apply a principle, recognize an assumption, or evaluate an argument) to be assessed precisely before writing the question.
2. Make sure the information to be interpreted is new to students, brief, and accurate.
3. Ask several questions. Mix multiple-choice and true-false questions.
4. Make sure the material to be interpreted can be read by the students.
5. Write the questions so that students cannot answer them unless they read and understood the information provided in the question.

Constructed-response test questions

The simplest forms of constructed response questions are fill-in-the-blank or sentence-completion questions. For example, the question may take one of the following forms:

1. Who was the president of Pakistan in 1968?
2. The president of Pakistan in 1968 was ___________________________.

Guidelines for writing simple sentence-completion questions

1. Construct your own sentences and questions.
2. Avoid taking questions out of context by using sentences from textbooks.
3. Word the question so that only one answer is correct.
4. Make all of the blanks of equal length.
5. Place the blank near the end of the statement or question.
6. Be sure the question is free of grammatical clues.
7. Be sure there is only one answer and that it is factually correct.

8. Most completion questions assess knowledge.

9. The word that you omit to make a sentence-completion question should be significant to the meaning of the question.

Short-answer questions

Example:

What is the main purpose of formative assessment in the classroom?

1. Short-answer questions assess knowledge and comprehension.

2. Write the question so that the only one answer is correct.

3. Write the question so the answer is brief.

4. Construct your own questions. Avoid questions taken directly from a textbook.

5. Use words in the question that you know students understand.

6. Make it clear to students that the answer is brief.

7. Make sure that the space allocated for the answer is consistent with the length of the answer.

NOTE: Sentence-completion questions have a one- to three-word answer written in the one blank in the sentence. Short-answer questions may have a one- to three-sentence answer.

Essay questions

1. Many education-measurement specialists believe that essay questions should be restricted to those learning outcomes that cannot be measured satisfactorily by objective test questions.

2. Essay questions on a test are designed to assess students' ability to communicate what they know and how they think on particular topics in subjects they study in school.

3. Good performance on an essay question depends on writing ability.

4. If essay tests are to be used, students need to be taught how to plan and write essays within restricted time limits.

5. It is important to write the essay question so that the student's writing task is clearly indicated.

6. Essay questions are either restricted-response or extended-response questions.

Example of restricted-response essay question:

Why is the barometer a useful instrument for forecasting weather? Answer in a brief paragraph.

Example of extended-response essay question:

We learned during class that some natural resources are renewable and others are not.

In two pages, defend the importance of conserving natural resources in our everyday lives.

Make sure to include the following in your answer:

- Definition of *natural resources*
- At least three different arguments for the importance of conservation of natural resources in our everyday lives
- At least three different ways we can conserve natural resources

7. Restricted-response essay questions should be framed in a way to provide students with boundaries for their responses. For example, rather than a question that asks 'explain the workings of the digestive system', a better question would be 'in one page, explain the role of the large intestine in the digestion process'. The first example does not provide students with definite boundaries, whereas the second example clearly outlines the boundaries for the student response. Because the digestive system is very complex and cannot be explained in its entirety using the restricted-response question, it is important to restrict students' responses to only one or two aspects of the whole system.

8. When writing extended-response essay questions, it is important to provide the students with the background information or a scenario for the question, state the question clearly, and then provide directions about material to be addressed in the question.

9. Students should be told the approximate amount of time required to answer each essay question.

10. Avoid presenting students with a choice of essay questions in a test.

11. Essay questions are scored using a rubric.

Adapted from:

G. D. Borich, *Effective Teaching Methods: Research-based Practice*, 6th ed. (Upper Saddle River, NJ: Pearson, 2007), 405–413.

J. Chappuis, R. Stiggins, S. Chappuis, and J. Arter, *Classroom Assessment for Student Learning: Doing It Right–Using It Well*, 2nd ed. (Upper Saddle River, NJ: Pearson, 2012), 123–189.

J. H. McMillan, *Classroom Assessment: Principles and Practice for Effective Standards-based Instruction*, 5th ed. (Upper Saddle River, NJ: Pearson, 2011), 172–218.

M. D. Miller, R. L. Linn, and N. E. Gronlund, *Measurement and Assessment in Teaching,* 11th ed. (Upper Saddle River, NJ: Pearson, 2013).

C. S. Taylor and S. B. Nolen, *Classroom Assessment: Supporting Teaching and Learning in Real Classrooms* (Upper Saddle River, NJ: Pearson, 2005), 190–229.

Sample questions: Student Teacher copy

S

True-false questions

Directions
Write 'T' for the true statement and 'F' for the false statement in the space provided in front of the question.

Weak illustration
_______ The line drawn from the North Pole to the South Pole of the Earth is called the *axis*.

Improved illustration
_______ The imaginary line drawn from the North Pole to the South Pole of the Earth is called the *axis*.

Multiple-choice questions

Directions
Circle the best answer for the question statement.

Weak illustration
What is one complete movement cycle of the Earth around itself called?

a. Revolution
b. The movement of the Earth around itself is called a rotation
c. One complete cycle of the Earth around itself is called a vibration
d. It is called oscillation

Improved illustration
What is one complete movement cycle of the Earth around itself called?

a. Revolution
b. Rotation
c. Vibration
d. Oscillation

Matching questions

Weak illustration

Please match the words in column A to their correct descriptions in column B. Place the letter for the description next to the correct word in column A. You may choose an option more than once or not at all.

Column A	Column B
1. Earth ___	a. Smallest in size of the Sun, Earth, and Moon
2. Orbit ___	b. Path of a celestial body as it goes around another body
3. Sun ___	c. Imaginary line going through the centre of the Earth
4. Axis ___	d. Spins around the Sun
5. Moon ___	e. Farthest planet from the Sun
	f. Centre of the solar system

Improved illustration

Please match the names of the Moon phases listed in column A to their definitions listed in column B. Place the letter for the definition next to the correct phase name in column A. You can use an option more than once or not at all.

Column A	Column B
1. First quarter ___	a. The Moon is between the Earth and the Sun
2. New Moon ___	b. The Moon is at a 90-dgree angle with the Earth and the Sun
3. Last quarter ___	c. The Earth is between the Sun and the Moon
4. Full Moon ___	d. The Moon is at a 45-degree angle with the Earth and the Sun
	e. The Moon is at a 120-degree angle with the Earth and the Sun

Completion questions

Directions

Answer the following question by completing the blank.

Weak illustration

Which phenomenon causes the Earth's movement? _____________

Improved illustration

Which phenomenon is caused by one complete spin of the Earth around its own axis? _____________

Short-answer questions

Weak illustration

How do we know that Earth is a sphere? ____
____
____
____

Improved illustration

In two to three sentences, describe one observation that illustrates the fact that the Earth is a sphere. ____
____
____
____

Essay questions

Restricted-response essay question

Weak illustration

What would happen if the Earth stopped moving suddenly?

Improved illustration

What would happen if the Earth suddenly stopped moving? Name at least one phenomenon related to the movement of the Earth that would change and explain how it would change. Restrict your answer to one page.

Extended-response essay question

Weak illustration

What will happen if suddenly the Earth moved away from the Sun?

Improved illustration

In our lesson about the solar system, you have learned that the Earth is about 100 Sun diameters away from the Sun. Describe what will change or not change if the Earth moved farther away from the Sun. Describe and explain the changes to natural phenomena caused by Earth's increased distance from the Sun in one to two pages. Make sure to include the following in your answer:

- Description of the phenomena that in your opinion will not be affected by the change in the Earth's position
- Description of the phenomena that in your opinion will change due to change in the Earth's position
- Explanation of what and how these changes will occur

Sample questions: Instructor key

F

True-false questions

Directions
Write 'T' for the true statement and 'F' for the false statement in the space provided in front of the question.

Weak illustration
_______ The line drawn from the North Pole to the South Pole of the Earth is called the *axis*.

Improved illustration
_______ The imaginary line drawn from the North Pole to the South Pole of the Earth is called the axis.

Explanation
The first question is a weaker option because it is not definitely true and there is an element of doubt in it. The line in the question could mean a physical line, which makes the statement confusing. Adding the word *imaginary* before *line* removes the uncertainty from the second questions and makes it clearer.

Multiple-choice questions

Directions
Circle the best answer for the question statement.

Weak illustration
What is one complete movement cycle of the Earth around itself called?

a. Revolution
b. The movement of the Earth around itself is called a rotation
c. One complete cycle of the Earth around itself is called a vibration
d. It is called oscillation

Improved illustration
What is one complete movement cycle of the Earth around itself called?

a. Revolution
b. Rotation
c. Vibration
d. Oscillation

Explanation
The first question is a weak illustration because the response choices do not follow a parallel structure or form and are of different lengths. The second question is a better option because the responses are of the same length and form. The response sentences do not need to be exactly the same length but huge discrepancies (such as one response sentence having 3 words and the other one having 10 words) should be avoided.

Matching questions

Weak illustration

Please match the words in column A to their correct descriptions in column B. Place the letter for the description next to the correct word in column A. You may choose an option more than once or not at all.

Column A	Column B
1. Earth ____	a. Smallest in size of the Sun, Earth, and Moon
2. Orbit ____	b. Path of a celestial body as it goes around another body
3. Sun ____	c. Imaginary line going through the centre of the Earth
4. Axis ____	d. Spins around the Sun
5. Moon ____	e. Farthest planet from the Sun
	f. Centre of the solar system

Improved illustration

Please match the names of the Moon phases listed in column A to their definitions listed in column B. Place the letter for the definition next to the correct phase name in column A. You can use an option more than once or not at all.

Column A	Column B
1. First quarter ____	a. The Moon is between the Earth and the Sun
2. New Moon ____	b. The Moon is at a 90-degree angle with the Earth and the Sun
3. Last quarter ____	c. The Earth is between the Sun and the Moon
4. Full Moon ____	d. The Moon is at a 45-degree angle with the Earth and the Sun
	e. The Moon is at a 120-degree angle with the Earth and the Sun

Explanation

The first question is a weak illustration because the list for matching questions is not homogenous; rather, it is a random collection of celestial bodies and concepts related to these bodies. The second question fixes this problem by providing students with a list of phases of the Moon and their definitions.

Completion questions

Directions

Answer the following question by completing the blank.

Weak illustration

Which phenomenon causes the Earth's movement? ______________

Improved illustration

Which phenomenon is caused by one complete spin of the Earth around its own axis? ______________

Explanation

The first question is weak because it is vague and has multiple correct answers. The second question is a better illustration because it precisely tests students' knowledge about the causes of day and night.

Short-answer questions

Weak illustration

How do we know that Earth is a sphere? ______________________________________
____
____
____

Improved illustration

In two to three sentences, describe one observation that illustrates the fact that the Earth is a sphere. ____
____
____
____

Explanation

The first question is a weak illustration because it is vague, as students can come up with several scenarios that illustrate the fact that the Earth is a sphere. The second question is better because it gives students more specific directions about how to answer the question.

Essay questions

Restricted-response essay question

Weak illustration

What would happen if the Earth stopped moving suddenly?

Improved illustration

What would happen if the Earth suddenly stopped moving? Name at least one phenomenon related to the movement of the Earth that would change and explain how it would change. Restrict your answer to one page.

Explanation

The first question is weak because it does not provide students with boundaries, and thus it can easily be treated as an extended-response question. The second illustration restricts students' responses to a certain length by providing them with boundaries.

Extended-response essay question

Weak illustration

What will happen if suddenly the Earth moved away from the Sun?

Improved illustration

In our lesson about the solar system, you have learned that the Earth is about 100 Sun diameters away from the Sun. Describe what will change or not change if the Earth moved farther away from the Sun. Describe and explain the changes to natural phenomena caused by Earth's increased distance from the Sun in one to two pages. Make sure to include the following in your answer:

- Description of the phenomena that in your opinion will not be affected by the change in the Earth's position
- Description of the phenomena that in your opinion will change due to change in the Earth's position
- Explanation of what and how these changes will occur

Explanation

The first question is a weak illustration because it does not set the proper context for the students and does not provide them with appropriate guidance for a strong response.

Unit 4, week 12, session 3

Question-writing exercise

S

Directions for Student Teachers

After carefully studying the 'Guidelines for Writing Test Questions' document and the strong and weak illustrations for different questions types (contained in the 'Sample Questions' document), read the following two texts and use the contents to write your own questions.

Write one item for each question type—multiple-choice, true-false, sentence-completion (fill-in-the-blank), and short-answer questions—in each learning category (knowledge, comprehension, and application). This means that you should have four questions for every learning category and 12 questions in total.

NOTE: You do not need to write weak illustrations for the questions. Write only one strong illustration for each question type in each learning category.

Content information

Please use the information from the following two articles to write your questions. One of the articles describes the causes of monsoons, and the other outlines general climate conditions in Pakistan.

The article 'What Causes Monsoons' can be found at:

- http://www.buzzle.com/articles/what-causes-monsoons.html

The article about the climatic conditions in Pakistan can be found below.

Pakistan's climate

Pakistan lies in the temperate zone. The climate is generally arid, characterized by hot summers and cool or cold winters, and wide variations between extremes of temperature at given locations. There is little rainfall. These generalizations should not, however, obscure the distinct differences existing among particular locations. For example, the coastal area along the Arabian Sea is usually warm, whereas the frozen snow-covered ridges of the Karakoram Range and of other mountains of the far north are so cold year round that they are only accessible by world-class climbers for a few weeks in May and June of each year.

Pakistan has are four seasons: a cool, dry winter from December through February; a hot, dry spring from March through May; the summer rainy season, or southwest monsoon period, from June through September; and the retreating monsoon period of October and November. The onset and duration of these seasons vary somewhat according to location.

The climate in the capital city of Islamabad varies from an average daily low of 2° C in January to an average daily high of 40° C in June. Half of the annual rainfall occurs in July and August, averaging about 255 millimeters in each of those two months. The remainder of the year has significantly less rain, amounting to about 50 millimeters per month. Hailstorms are common in the spring.

Pakistan's largest city, Karachi, which is also the country's industrial center, is more humid than Islamabad but gets less rain. Only July and August average more than 25 millimeters of rain in the Karachi area; the remaining months are exceedingly dry. The temperature is also more uniform in Karachi than in Islamabad, ranging from an average daily low of 13° C during winter evenings to an average daily high of 34° C on summer days. Although the summer temperatures do not get as high as those in Punjab, the high humidity causes the residents a great deal of discomfort.

Most areas in Punjab experience fairly cool winters, often accompanied by rain. Woolen shawls are worn by women and men for warmth because few homes are heated. By mid-February the temperature begins to rise; springtime weather continues until mid-April, when the summer heat sets in. The onset of the southwest monsoon is anticipated to reach Punjab by May, but since the early 1970s the weather pattern has been irregular. The spring monsoon has either skipped over the area or has caused it to rain so hard that floods have resulted. June and July are oppressively hot. Although official estimates rarely place the temperature above 46° C, newspaper sources claim that it reaches 51° C and regularly carry reports about people who have succumbed to the heat. Heat records were broken in Multan in June 1993, when the mercury was reported to have risen to 54° C. In August the oppressive heat is punctuated by the rainy season, referred to as *barsat*, which brings relief in its wake. The hardest part of the summer is then over, but cooler weather does not come until late October.

Source: Peter Blood, ed., *Pakistan: A Country Study* (Washington: GPO for the Library of Congress, 1994). Retrieved 19 November, 2012.

- http://countrystudies.us/pakistan/25.htm

Assessment tracker

‘Sun, Earth, and the Moon’ unit test—Data for item analysis

Knowledge

#	Student	1	3	4	6	7	17	18	19	20	22	23	24	26	27	28	31
1	A.A.	1	1	1	0	1	1	1	0	1	1	0	1	1	0	1	1
2	C.A.	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0
3	K.H.	1	1	1	0	0	1	1	0	1	1	1	1	1	1	1	1
4	M.H.	1	1	1	1	1	1	1	1	1	1	0	1	1	0	1	1
5	A.K.	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
6	L.K.	1	1	1	1	0	1	1	1	1	1	1	1	1	1	0	1
7	U.K.	1	0	0	1	0	1	1	1	1	1	1	0	1	1	1	1
8	Z.K.	1	1	1	1	1	1	0	1	1	1	1	1	1	1	0	0
9	M.K.	1	0	1	1	0	0	0	0	1	1	0	1	1	1	1	1
10	A.K.	1	1	1	1	0	1	1	0	1	1	1	0	1	1	0	1
11	P.K.	1	1	1	1	1	1	1	0	1	1	1	1	1	0	1	1
12	L.K.	1	1	0	1	0	1	1	0	0	1	1	1	0	1	1	1
13	A.K.	1	0	0	1	1	0	1	0	1	1	1	1	1	1	1	1
14	M.M.	1	1	1	0	1	1	1	1	1	1	0	0	1	0	0	1
15	L.M.	0	0	0	0	1	1	1	0	1	1	1	1	1	1	1	1
16	F.M.	1	0	0	0	1	1	1	1	1	1	1	1	1	0	1	1
17	M.M.	1	1	1	1	1	1	1	1	0	0	1	1	1	1	1	1
18	O.M.	1	1	1	1	1	0	1	1	1	1	1	1	1	1	0	0
19	P.M.	1	1	1	0	0	1	1	1	1	1	1	0	1	1	1	1
20	N.N.	1	1	1	0	1	1	1	1	1	1	1	1	1	0	0	1
21	M.N.	0	0	1	0	0	0	0	1	0	1	1	1	1	1	1	1
22	P.N.	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	1
23	Z.N.	1	1	0	0	0	1	1	1	1	0	1	1	1	1	1	1
24	F.T.	1	1	1	0	0	0	1	1	1	1	1	0	1	1	1	1
25	P.T	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1
26	Q.T.	1	1	1	0	1	1	1	0	0	1	1	1	1	1	0	1
27	S.T.	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	0
28	T.T.	1	0	1	1	1	1	1	0	1	0	1	0	1	1	0	1
29	A.W.	1	1	1	1	1	1	0	1	1	1	1	1	0	1	1	1
30	C.W.	1	0	0	1	0	0	0	1	1	1	0	1	1	1	0	0
31	Z.W.	1	0	1	0	1	1	0	1	0	0	0	0	1	0	1	0
Sum		29	22	23	19	20	25	25	21	25	27	25	24	29	23	20	25

		Comprehension								Application											
#	Student	2	5	10	13	16	30	34	35	8	9	11	12	14	15	21	25	29	32	33	Totals
1	A.A.	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	30
2	C.A.	1	1	1	1	1	1	1	1	0	0	1	1	1	1	1	1	1	0	1	30
3	K.H.	1	0	1	0	1	1	1	0	0	0	1	1	0	1	1	1	1	1	0	25
4	M.H.	1	1	1	0	1	0	0	1	0	0	1	0	1	1	1	0	1	1	1	26
5	A.K.	1	0	1	1	1	1	1	1	0	0	1	1	1	1	1	1	1	1	0	31
6	L.K.	1	1	1	0	1	0	0	1	0	0	1	1	0	1	1	1	1	0	0	25
7	U.K.	1	1	1	0	1	0	0	1	0	1	1	0	1	1	1	1	1	0	0	24
8	Z.K.	1	0	1	1	1	1	1	0	0	0	1	1	1	1	1	1	0	0	1	26
9	M.K.	1	0	1	0	1	0	0	1	0	0	0	0	0	1	1	1	1	1	1	20
10	A.K.	1	1	1	1	1	1	1	0	0	0	1	1	1	1	1	1	0	1	0	26
11	P.K.	1	0	1	1	1	1	0	1	0	0	0	1	1	1	1	1	0	1	0	26
12	L.K.	1	1	1	1	1	1	1	0	0	0	1	1	1	0	1	1	1	1	1	26
13	A.K.	0	1	1	0	1	1	0	1	0	0	0	0	1	1	1	1	0	1	1	23
14	M.M.	1	0	1	0	1	1	0	1	0	0	1	0	1	1	1	1	0	1	1	23
15	L.M.	1	1	1	1	0	1	0	1	0	0	0	1	1	0	1	1	1	0	1	23
16	F.M.	0	1	1	1	1	0	0	1	0	0	1	1	1	1	1	1	1	0	1	25
17	M.M.	1	1	1	1	1	1	1	1	0	0	0	1	1	1	0	1	1	1	1	29
18	O.M.	1	1	0	0	1	1	0	0	1	1	1	0	1	1	0	0	1	0	1	24
19	P.M.	0	0	1	1	1	1	0	1	0	0	1	1	0	1	1	1	0	1	0	24
20	N.N.	0	1	1	0	1	0	0	1	0	0	1	0	1	1	1	0	0	1	0	22
21	M.N.	1	0	1	1	1	1	1	1	0	0	1	1	1	1	1	1	1	0	0	23
22	P.N.	1	0	1	0	1	1	0	1	0	0	1	0	0	1	1	0	0	0	1	23
23	Z.N.	1	0	0	1	0	0	0	1	1	0	1	1	1	0	1	1	1	0	0	22
24	F.T.	1	0	1	1	1	1	1	1	0	0	1	1	1	0	1	1	1	1	1	27
25	P.T	1	1	1	1	1	0	0	1	0	0	1	1	1	1	0	0	0	1	1	27
26	Q.T.	1	0	1	0	0	1	1	1	0	0	0	0	1	1	1	0	1	1	1	23
27	S.T.	0	1	0	1	1	1	1	1	0	1	1	0	1	0	0	1	1	0	1	26
28	T.T.	1	0	0	0	0	1	1	0	0	0	0	1	0	1	0	1	0	0	0	17
29	A.W.	1	0	1	1	1	1	0	1	1	1	1	1	1	0	1	1	1	0	1	29
30	C.W.	1	1	0	0	0	0	1	1	0	0	1	1	0	0	1	0	0	1	1	18
31	Z.W.	0	1	0	1	1	0	0	1	0	0	0	1	1	1	0	1	1	1	1	18
Sum		25	17	25	18	26	21	14	25	4	5	23	21	24	24	25	23	20	18	20	

Unit 5, week 15, session 1

Sample lesson plans with embedded assessment plans

Lesson plan examples from English and mathematics

This document outlines interactive, hands-on lesson plans in English and mathematics.

These lesson plans are to serve as examples for Student Teachers on how to create assessment-embedded, interactive lessons in subjects other than science.

Task for Student Teachers

Student Teachers should study these lesson plans in detail with one or two partners and take some time to discuss:

- What are the differences between a learning objective, assessment target, and success criteria?
- Do you understand that all learning objectives do not become learning targets? Why?
- Can you explain to each other what *success criteria* means?
- Do the lesson plans adequately cover the learning objectives, learning targets, and success criteria of the lesson?
    - If not, what needs to be changed in the lesson plan or the learning objectives, learning targets, and success criteria?
- Is there a need to change the formative assessments to more accurately match the success criteria of the lesson? If yes, what change or changes need to be made?

After the discussion, each Student Teacher needs to pick a subject and topic and create an assessment-embedded lesson plan for that topic.

Student Teachers should use the lessons below as models/examples to complete this task. Lessons from the 'Sun, Earth, and the Moon' unit can also be used as models/examples.

English literacy lesson plan: Homophones

Grades: 4 to 5

Time: 1 to 2 class periods

Learning objectives

- Students will be able to define the word *homophone*
- Students will be able to recognize commonly used homophones
- Students will be able to give examples of homophones.

Learning targets

- Students will be able to define the word *homophone*
- Students will be able to give examples of homophones.

Success criteria

- Students will recall and write the definition of *homophone* and give at least three examples.
- Students will act out pairs of homophones and try to guess the homophones being acted out.
- Students will draw a short cartoon strip to show the difference between a set of homophones.

Vocabulary

homophones

Materials required

- Chart paper
- Coloured pencils or crayons
- Index cards or pieces of paper with one pair of homophones written on them

Introduction (connections to prior knowledge)

Tell the students that in this lesson they will learn about homophones. You can use the following questions to help the students understand the concept of homophones and check their previous knowledge.

Guiding questions

Tell the students, 'Let's take the word *homophone* apart'. Ask the students the following questions:

- What are two words it is made of? (*Homo* and *phone*.)
- What is the meaning of *homo*? ('Same'.)
- What is the meaning of *phone*? (*Phone* is also part of the word *telephone*, and it means 'sound'.)
- So now can someone guess the meaning of the word *homophone*? ('Same sound'.)

Take a few responses from the students and write them down on the board.

Now using students' responses as much as possible, write the definition of *homophone* on the board: 'Homophones are words that sound the same but have different spelling and meanings'.

Ask the students if they can come up with a few examples of homophones from their daily lives. Take a few responses and write them down on the board.

Exploration 1

Tell the students that they will watch the video 'Homophones', which features a song about homophones.

You can find the song on the PBS website at:

➢ http://pbskids.org/lions/parentsteachers/lionstogo/video_music.html

NOTE: Download the 'Music Video Mix 2'. Stop the video after the first song, 'Homophones'. The video can be downloaded ahead of time.

Ask students to listen to the song carefully and write down in their English literacy notebooks as many pairs of homophones as they can.

Play the song again if needed.

After watching the video, ask a few volunteers from the class to come to the board and write one pair of homophones from the video and their meaning.

Ask the students to note all the pairs of homophones that were in the video in their English literacy notebooks.

Exploration 2

Formative assessment
Divide the students into groups of two and tell them that in this activity they will act out a pair of homophones.

Give each group an index card with a pair of homophones written on it. Each student in the pair will act out one of the words, and the rest of the class will guess the pair of homophones the group acts out.

For example, if a group is given the pair 'eight and ate', one person could count on her fingers to eight and other person could mime the eating action.

Allow the group five minutes to prepare.

After five minutes, each group comes to the front of the class one by one and acts out their pair of homophones.

The rest of the class guesses which pair of homophones the group acted out.

Now ask the class to take out their English literacy notebooks and write the definition of the word *homophone* in their own words.

You can use the following list of homophones for this activity or come up with your own.

List of some commonly used homophones:

Red	Read
Two	To
I	Eye
Brake	Break
Cell	Sell
Dear	Deer
Weak	Week
For	Four
Heal	Heel
Whole	Hole
Knot	Not
Know	No
Meet	Meat

Exploration 3

Tell the students that in this activity they will draw the pair of homophones they acted out in the previous activity.

Give each student chart paper and at least three different coloured pencils or crayons. Students who are sitting at the same table can share the coloured pencils or crayons.

Tell the students that they should make a cartoon drawing of each word in the pair of homophones that they acted out in front of the class.

Formative assessment

The students should add short dialogues or descriptions to the drawings that explain the meaning of each word in the homophone pair.

Give students time to draw their cartoons and collect these drawings for formative assessment of students' understanding of homophones.

Culminating activity

Formative assessment

The students should also write at least three examples of homophones they have not come across in this lesson.

Ask a few volunteers to share their definitions and examples with the rest of the class.

Write the definition and a few examples on the board and ask the students to check their work and correct it with coloured pen (using a different colour than their original responses), if needed.

Collect students' notebooks at the end of the lesson to make sure that they have listed correct examples of homophones.

Source

The lesson plan is adapted from S. Dennis-Shaw, 'To, Too, or Two: Developing an Understanding of Homophones', International Reading Association/National Council of Teachers of English. Retrieved 26 January, 2013.

- http://www.readwritethink.org/classroom-resources/lesson-plans/developing-understanding-homophones-284.html

Math lesson plan: Odd eyes, even eyes?

Grade level: 1 to 2

Time: 1 to 2 class periods

Learning objectives

- Children will recognize odd and even numbers.
- Children will understand the difference between odd and even numbers.
- Children will recognize different patterns associated with odd and even numbers.

Learning targets

- Children will understand the difference between odd and even numbers.
- Children will recognize different patterns associated with odd and even numbers.

Success criteria:

- Children will be able to recognize a number as odd or even.
- Children will be able to name the next odd or even number in the series.

Vocabulary

even, odd, pair

Materials required

- Drawing paper
- Markers
- One cup containing 20 buttons (or small stones or beans) for each pair of children
- Coloured pencils for drawing

Introduction (connections to prior knowledge)

Initiate a class discussion to check how much children know about odd and even numbers and if they are familiar with the vocabulary used in the lesson. The teacher can use the following guiding exercise to carry out the discussion.

Guiding exercise

Make two columns on the board. Label one as 'odd' and the other as 'even'. Now call out a random number and ask children if the number is odd or even.

Ask children why they think the number is odd or even, then write the number in its appropriate column.

Listen to the reasons given for whether or not the number is odd or even.

Continue to call out numbers until all numbers from 1 to 10 are in one or other column.

This exercise will give the teacher an idea of how much children already know about odd and even numbers.

Exploration 1

Ask eight children to come to the front of the class. Ask children to find a partner and hold their hand. Ask: How many children are here? Can everyone find a partner?

Now ask one more child to come to the front of the class. Ask the children to find a partner and hold their hand. Ask: How many children are here? Can everyone find a partner?

Help children understand that even numbers can be divided by two with nothing left over.

Exploration 2

Ask children to work with a partner. Ask them to look at both lists of even and odd numbers they just made. Ask them: Can you see any patterns?

Each group should come up with patterns for even and odd numbers.

Give children a few minutes to find patterns and then invite responses from children. Write these down on the board.

Children might come up with following two patterns:

- For both even and odd numbers, you have to skip a number to come up with the next number on the list.
- For both even and odd numbers, two is added to each number to come up with the next number.

Ask, 'Which number would come in the even number list after 10?'

Take a volunteer from the class for each number and continue until you get into double digits (12, 14, 16 …). Twenty would be a good number to stop at.

Children should understand that the pattern of 0, 2, 4, 6, and 8 continues into double digits.

Ask, 'Which number would come in the even number list after nine?'

Take a volunteer from the class for each number and continue until you get into double digits (12, 14, 16 …). Stop at 19.

Children should understand that the pattern of 1, 3, 5, 7, and 9 continues into double digits.

Exploration 3

Divide children into groups of two or three and distribute a cup of 20 buttons, chart paper, and markers to each group.

Ask children to draw a simple circular face without eyes. Ask each group to draw 10 faces without eyes. Tell children that they will be using buttons as eyes and they should only use the number of eyes called out by the teacher.

Tell children to use buttons to put eyes onto six faces. Ask: How many buttons did they use? Do they have any left over? Is 12 an even number or an odd number?

Ask children to remove all the eyes from the faces.

Tell children to use buttons to put eyes onto nine faces. Ask: How many buttons did they use? Do they have any left over? Is 12 an even number or an odd number?

Circulate among the groups to see how children are working and if they need any guidance.

Now ask the children to collect 11 buttons. How many faces can they make? Do they have any leftover buttons? Is 11 an odd number or an even number?

Now ask children to collect 15 buttons. How many faces can they make? Do they have any leftover buttons? Is 15 an odd number or an even number?

Repeat these steps a few more times for extra practice.

Culminating activity

Formative assessment

Show children pictures of objects or shapes (for example, 9 triangles, 6 flowers, and 17 circles). Ask if they are odd or even numbers of objects.

Formative assessment

Write an odd number between 1 and 20 on the blackboard. Ask: What is the next odd number? Write an even number between 1 and 20 on the blackboard. Ask: What is the next even number?

Source

This lesson plan is adapted from Dena Reid, 'An Odd Pair of Eyes', Beacon Lesson Plan Library. Retrieved 22 January, 2013.

- http://www.beaconlearningcenter.com/Lessons/11743.htm

Higher Education Commission