

## Soils Pacing Guide<sup>1</sup>

Use the information below to assist you in determining the amount of time needed to complete the entire unit. These recommendations assume the **average science class period is 45-60 minutes in length**. We recommend teaching science a minimum of three sessions per week in order to maintain consistency and keep students engaged. Many teachers accomplish this by rotating a science unit with a social studies unit, enabling you to teach more science sessions in one week and finish the unit in fewer weeks. We highly recommend that all teachers participate in the Expository Writing and Science Notebook Program in order to more fully develop students' science understandings, as well as their scientific thinking and writing skills. To implement the science-writing curriculum requires a separate 20 to 30 minutes for a science-writing mini-lesson and independent writing time. Time for these mini-lessons is not included in this pacing guide.

Lesson and Common Assessments (See corresponding lesson in Instructional Guide for lesson planning)	Recommended Number of Periods	GLEs Addressed/Big Idea(s) of Lesson	Considerations for Planning	Recommended Applications and Extensions
<b>Lesson 1: What is in Soil?</b> Students examine garden soil with hand lenses. Teacher activates students' prior knowledge and records on class charts.	1	<b>GLE 1.1.5</b> Understand the physical properties of earth materials including rocks, soil, water and air. <i>Describe and sort soils based on physical properties (e.g. color, shape, size, texture).</i> <b>GLE 2.1.1</b> Understand how to ask a question about objects, organisms, and events in the environment. <b>Big Idea:</b> Soil contains plants, animals, and their remains, and other particles of different sizes.	<ul style="list-style-type: none"> <li>Collect about 4 liters of fresh garden soil for use in Lessons 1 and 2.</li> <li>Make sure to order redworms as soon as possible as they will be used for lesson 2.</li> </ul>	<ul style="list-style-type: none"> <li>A science center would be an excellent way to allow students to continue to practice using hand lenses to examine soil.</li> </ul>
<b>Lesson 2: Part 1: Where Do Dead Plants Go?</b> Students examine redworms with hand lenses and identify body parts.	1	<b>GLE 1.1.6</b> Understand characteristics of living organisms. <i>Observe and describe characteristics of living organisms [redworms have segmented bodies].</i> <b>Big Ideas:</b> Over time, dead plants mold and rot and become part of soil. Worms speed up the decomposition process and aerate the soil.	<ul style="list-style-type: none"> <li>Lesson 2 has been divided into 2 sessions.</li> <li>Students are just beginning to think about the decomposition process in this lesson. They will continue to learn and understand more about this throughout the unit.</li> </ul>	
<b>Lesson 2: Part 2: Where Do Dead Plants Go?</b> Students set up two compost containers. One will contain redworms and one will not. Both containers will contain garden soil, living things and non-living things.	1	<b>GLE 2.1.4</b> Understand that models represent real objects, events, or processes. <i>Describe how a model of something is similar to the real thing, such as an object, event, or process, and how it is different [redworms in a worm container].</i> <i>Create a simple model of a common object, event, or process [redworms in a worm container].</i> <b>Big Ideas:</b> Over time, dead plants mold and rot and become part of soil. Worms speed up the decomposition process and aerate the soil.	<ul style="list-style-type: none"> <li>You will need to gather living and non-living things to put in the containers with and without worms.</li> </ul>	<ul style="list-style-type: none"> <li>It is highly recommended that you set up two larger class containers for student observation and comparison with their own containers with and without worms.</li> </ul>
<b>Lesson 3: Introducing Sand, Clay and Humus.</b> Students investigate sand, clay and humus with their four senses and identify the properties of each kind of soil.	1	<b>GLE 1.1.5</b> Understand the physical properties of earth material: rocks, soil, water and air. <b>GLE 1.2.3</b> Know that common materials are made of smaller parts. <i>Understand that people use magnifiers to observe things they cannot see with their eyes.</i> <b>GLE 2.1.2</b> Understand how to plan and conduct simple investigations following all safety rules. <b>Big Idea:</b> Sand, clay, and humus are three of the basic components in soil and each has unique properties that can be identified using simple tests.	<ul style="list-style-type: none"> <li>In this lesson, students begin doing a series of tests on sand, clay and humus. These tests will help them to analyze the composition of their local soil in lessons 14, 15 and 16.</li> </ul>	<ul style="list-style-type: none"> <li>Extension 2 on page 46 in the teacher's manual can be done in order to get students thinking more about the size of particles for the different soil components.</li> </ul>

<sup>1</sup> Pacing Guide for use with the *SOILS* Teacher's Manual, National Academy of Science (1996)

<b>Assessment A: Observing Soil Components</b>	Embedded in Lesson 3	<b>GLE: 1.1.5</b> Understand the physical properties of earth material: rocks, <b>soil</b> , water and air.		
<b>Lesson 4: When Soils Get Wet.</b> 1. Students compare wet and dry soil samples. Students try to roll the wet soil samples into a ball. 2. Students observe containers with and without worms.	2	<b>GLE 1.1.5</b> Understand the physical properties of earth material: rocks, <b>soil</b> , water and air. <b>GLE 2.1.2</b> Understand how to plan and conduct simple investigations following all safety rules. <b>GLE 2.1.5</b> Understand how to record and report investigations, results and explanations.	<ul style="list-style-type: none"> <li>• Have students store their soil balls on a small piece of paper towel for lesson 5 part 2.</li> </ul>	
<b>Lesson 5: Part 1: More About Wet Soils.</b> Students conduct smear tests on the three soil components.	1	Same as in Lesson 4	<ul style="list-style-type: none"> <li>• Lesson 5 has been divided into 2 sessions.</li> <li>• These tests will be very useful in lessons 8 and 14 when students need to compare smears of mystery soil and local soil with these smears of three identified soil components.</li> </ul>	<ul style="list-style-type: none"> <li>• Language Arts Integration: Read, “Have You Seen Sand or Clay Today” on pages 65-67 in the teacher’s manual and discuss.</li> </ul>
<b>Lesson 5. Part 2: More About Wet Soils.</b> Students investigate dry and wet clay balls.	1	Same as in Lesson 4		<ul style="list-style-type: none"> <li>• When the clay dries, students should observe it so they realize that it looks the same as when they started.</li> </ul>
<b>Lesson 6. How Quickly Do Soils Settle in Water?</b> Students observe how quickly the different soil components settle in water.	1	Same as in Lesson 4	<ul style="list-style-type: none"> <li>• Give students a copy of the three tubes in the instructional guide to glue into their notebooks to record their observations.</li> </ul>	<ul style="list-style-type: none"> <li>• Extensions 1 and 2 on p 76 in the teacher’s manual are worthwhile.</li> </ul>
<b>Lesson 7. More Settling a Few Days Later.</b> 1. Students further investigate settling of sand, clay and humus. 2. Students observe containers with and without worms.	2	Same as in Lesson 4	<ul style="list-style-type: none"> <li>• Have students glue in another photocopy of the three tubes for this lesson.</li> <li>• Have students observe containers with and without worms unless you already have a designated 20 min. period for this once a week.</li> </ul>	
<b>Lesson 8. What is in Your Mystery Mixture?</b> Students conduct soil tests from previous lessons on unfamiliar “mystery mixture.”	1	<b>GLE 1.1.5</b> Understand the physical properties of earth materials including rocks, soil, water and air. <b>GLE 2.1.5</b> Understand how to record and report investigations, results, and explanations. <b>GLE 2.2.1</b> Understand that all scientific observations are reported accurately even when the observations contradict expectations. <b>Big Idea:</b> Sand, clay, and humus are three basic components in soil and each has unique properties that can be identified using simple tests.	<ul style="list-style-type: none"> <li>• It is important to prepare the mystery soils ahead of time.</li> <li>• This lesson is an embedded assessment so you will want to observe the students closely while they work and talk about results. This lesson gives students practice using the soils tests they have learned to identify a soil mixture.</li> </ul>	
<b>Assessment B: Mystery Soils Page 32</b>	Embedded in Lesson 8	<b>GLE: 1.1.5</b> Understand the physical properties of earth materials including rocks, <b>soil</b> , water and air. <b>GLE 2.2.1</b> Understand that all scientific observations are reported accurately even when the observations contradict expectations.	<ul style="list-style-type: none"> <li>• Students will use their data table as evidence to answer the following question: <b>What is your mystery mixture?</b></li> </ul>	

<p><b>Lessons 9/10. Growing Plants and Roots in Different Soils.</b> Students plant seeds in sand, clay, humus and local soil. They record their observations on their <i>Observing Plants and Roots in Different Soils</i> table.</p>	2	<p><b>GLE 1.1.5</b> Understand the physical properties of earth materials including rocks, soil, water and air. <b>GLE 2.1.1</b> Understand how to ask a question about objects, organisms, and events in the environment. <b>GLE 2.1.2</b> Understand how to plan and conduct simple investigations following all safety rules. <b>GLE 2.1.5</b> Understand how to record and report investigations, results, and explanations. <b>Big Idea:</b> Many factors, including soil, affect plant and root growth. Most plants grow best in loose, moist soil that provides good drainage along with high organic content.</p>	<ul style="list-style-type: none"> <li>• This lesson has combined Lessons 9 and 10 so that students are observing plants and roots in clear cups.</li> <li>• This lesson has also been adapted to give students a chance to plan and conduct a <u>fair test</u> in order to address the GLEs.</li> <li>• Be sure to read over the Background information on pages 111-112 in the teacher’s manual.</li> <li>• You will need to collect local soil for this lesson.</li> </ul>	<ul style="list-style-type: none"> <li>• Leave some seeds on a wet paper towel so students can watch them sprout.</li> <li>• Extension #2 on page 116 in the teacher’s manual is recommended.</li> </ul>
<p><b>Lesson 11. Can Soil Hold Water?</b> 1. Students observe how water moves through humus. Students discover how much water is held in the humus. 2. Students record their observations on their <i>Observing Plants and Roots in Different Soils</i> table.</p>	2	<p><b>GLE 1.1.5</b> Understand the physical properties of earth materials including rocks, soil, water and air. <b>GLE 2.1.1</b> Understand how to ask a question about objects, organisms and events based on observations. <b>GLE 2.1.2</b> Understand how to plan and conduct a simple investigation following all safety rules. <b>GLE 2.1.3</b> Understand how to construct a reasonable explanation using evidence. <b>GLE 2.1.4</b> Understand how to ask a question about objects, organisms, and events in the environment. <i>Create a simple model of a common object [cup, soil and dropper is a model for rain].</i> <b>GLE 2.1.5</b> Understand how to record and report investigations, results and explanations. <b>Big Idea:</b> Sand, clay, and humus are three of the basic components in soil and have unique properties that can be identified using simple tests. Many factors, including soil, affect plant and root growth.</p>	<ul style="list-style-type: none"> <li>• Students are creating a model to learn more about each soil’s ability to hold water.</li> <li>• Use the graduated cups with the milliliter markings so students can gather quantitative data about how much water is retained by the soil..</li> <li>• After this lesson, or at another time, have students observe their planting cups and record observations and changes on their <i>Observing Plants and Roots in Different Soils</i> table.</li> </ul>	
<p><b>Lesson 12. How Water Moves Through Sand and Clay.</b> 1. Students observe how much water moves through sand and clay. Students discover how much water is held in sand and clay and compare the amounts retained by the three soil components. 2. Students record their observations on their <i>Observing Plants and Roots in Different Soils</i> table.</p>	2	Same as in Lesson 11	<ul style="list-style-type: none"> <li>• Lessons 11 and 12 should be combined with Classroom-Based Assessment C (following Lesson 12 in the instructional guide).</li> </ul>	<ul style="list-style-type: none"> <li>• Consider creating a science center with the materials from lessons 11/12 so that students can create their own mixtures and test how fast each one drains, or how long it holds water.</li> <li>• Provide a clock or stopwatch for students to record and compare how long it takes for water to soak through the soil components.</li> </ul>
<p><b>Assessment C: Can Soil Hold Water?</b></p>	Embedded in Lesson 12	<p><b>GLE 1.1.5</b> Understand the physical properties of earth materials including rocks, <u>soil</u>, water and air. <b>GLE 2.1.1</b> Understand how to construct a reasonable explanation using evidence. <b>GLE 2.1.4</b> Understand how to ask a question about objects, organisms, and events in the environment. <b>GLE 2.1.5</b> Understand how to record and report investigations, results and explanations.</p>	<ul style="list-style-type: none"> <li>• For lesson 11 (humus) and lesson 12 (sand and clay) students should record their observations in the data table, “Water Moving Through Soils”.</li> </ul>	

<p><b>Lesson 13. Opening the Containers With and Without Worms.</b> Students observe containers with and without worms and see how soil and other contents in containers have changed over time.</p>	1	<p><b>GLE 1.3.8</b> Know that most living things need food, water, and air. <b>GLE 1.3.10</b> Know that plants and animals need a place to live. <i>Observe and show how organisms live in specific places (worms live in soil).</i> <b>Big Ideas:</b> Over time, dead plants rot and become part of soil (humus). Worms speed up the decomposition process and aerate the soil. Humus provides mineral nutrients that are absorbed along with water by the roots of the plants. Decomposition is nature’s way of recycling dead plants, which in turn, promotes the growth of new plants.</p>	<ul style="list-style-type: none"> <li>• Read the overview and Background information on pages 139-140 in the teacher’s manual for more information about the role of worms in the decomposition process.</li> <li>• Do not do Final Activities #4-5 on page 143 in the teacher’s manual (looking at the root growth).</li> </ul>	<ul style="list-style-type: none"> <li>• Language Arts Integration: There are two excellent reading selections about the role of worms in plant growth: “The Earthworm: Nature’s Plow” (page 118 in teacher’s manual) and “Anita’s Amazing Compost Pile” (page 146 in teacher’s manual).</li> </ul>
<p><b>Assessment D: What Happens to Plants When They Die?</b></p>	Embedded in Lesson 13	<p><b>GLE 1.2.3</b> Know that common materials are made of smaller parts. <b>GLE 3.2.4</b> Understand how humans depend on the natural environment.</p>		
<p><b>Lessons 14/15: Exploring Your Local Soil.</b> 1. Students conduct soil tests on local soil samples. 2. Students record their observations on their <i>Observing Plants and Roots in Different Soils</i> table.</p>	2	<p><b>GLE 2.1.1</b> Understand how to ask a question about objects, organisms, events in the environment. <b>GLE 2.1.2</b> Understand how to plan and conduct a simple investigation following all safety rules. <b>GLE 2.1.3</b> Understand how to construct a reasonable explanation using evidence. <b>GLE 2.1.5</b> Understand how to record and report investigations, results, and explanations. <b>GLE 2.2.1</b> Understand that all scientific observations are reported accurately even when the observations contradict expectations. <b>Big Idea:</b> Sand, clay, and humus are three of the basic components in soil and each has unique properties that can be identified using simple tests.</p>	<ul style="list-style-type: none"> <li>• This lesson combines lessons 14 and 15 in the teacher’s manual. The water-draining test does not help students identify the components of local soil so it is left out.</li> <li>• Remember to have students observe their planting cups and record their observations on their <i>Plants and Roots Growing in Different Soils</i> data table.</li> </ul>	<ul style="list-style-type: none"> <li>• Have students bring in samples of local soil and perform the soils tests on the samples at the science center. Have students begin to think about why the components of the soil samples might vary. (Teacher’s manual page 157 extension #3).</li> </ul>
<p><b>Lesson 16: What is in Your Local Soil?</b> 1. Students conduct soils tests on local soil samples. 2. Students record their observations on their <i>Observing Plants and Roots in Different Soils</i> table.</p>	1	<p><b>GLE 2.1.5</b> Understand how to record and report investigations, results, and explanations. <b>GLE 2.2.1</b> Understand that all scientific observations are reported accurately even when the observations contradict expectations. <b>GLE 3.2.4</b> Understand how humans depend on the natural environment. <i>Describe what organisms obtain from their environment (e.g., plants needs water, sunlight, [and good soil]).</i> <b>Math GLE 1.4.3</b> Understand the organization of a graph. <i>Construct a bar graph that includes a title, key, and single-unit increment.</i> <i>Name an appropriate title for a display of data.</i> <b>Big Idea:</b> Sand, clay, and humus are three of the basic components in soil and have unique properties that can be identified using simple tests. Many factors, including soil, affect plant and root growth.</p>	<ul style="list-style-type: none"> <li>• This lesson has been modified in order to construct the understanding of the cucumber plant as a system with interconnected parts.</li> <li>• Math Integration: Rather than using the craft sticks for measuring and creating a bar graph, as illustrated in the teacher’s manual on page 175, have the students use rulers to measure plant height.</li> </ul>	<ul style="list-style-type: none"> <li>• Have students conduct the water-draining test (Lessons 11/12) on the local soil and compare their results to their predictions.</li> </ul>
<p><b>Optional Extension:</b> Go to Seattle Tilth for an Earth Steward Garden Tour or have Seattle Tilth come to your classroom for “Soil in a Box” lessons.</p>			<ul style="list-style-type: none"> <li>• Call 206-633-0451 or go to <a href="http://www.seattletilth.org">www.seattletilth.org</a></li> </ul>	
<p><b>Optional Extension:</b> Forest Explorers was developed by Woodland Park Zoo staff to make environmental education accessible and fun for all second grade students in King County. Forest Explorers introduces students to the important components of tropical rain forests and temperate forests.</p>			<ul style="list-style-type: none"> <li>• Applications and reservations must be in writing. For a Reservation Form call the School Programs Registrar at 206.548.2424 or go to <a href="http://www.zoo.org/">http://www.zoo.org/</a></li> </ul>	

