



# Preparation Guide

## Level 4 Module 3

### Earth Systems

**Materials:** This section lists the quantity of each material necessary for the lesson. Lesson materials may be from a *PhD Science® TEKS EDITION* materials kit or they may be school supplied. In addition to the listed materials, teachers should have access to the following common classroom items: sticky notes, chart paper, pencils, a whiteboard, and markers. This section also lists items in the current lesson that are reused in future lessons. Note that items found in a typical elementary classroom (e.g., glue, tape, scissors) are not listed for reuse.

**Resources:** This section lists module resources (from Appendix A in the Teacher Edition) and core texts used in the lesson. Classrooms also need daily access to the module’s Teacher Edition, Science Logbooks, and, if applicable, PhD Projected. A symbol () identifies resources that appear in PhD Projected.

**Preparation:** This section identifies preparation teachers should complete before the lesson, including media teachers must cue before the lesson and activities that require setup. This section also describes advance preparation for upcoming lessons. For example, if teachers need to prepare 1 day in advance for an activity in Lesson 11, an advance preparation note appears in the Preparation section for Lesson 10. A symbol () identifies lessons with advance preparation notes.




## Advance Materials Preparation

Several activities in this module require advance preparation. A version of this list appears in the Module Overview of the Teacher Edition. The expanded version in this guide identifies all lessons for which preparation may take longer than a planning period. A symbol (+) identifies preparation that can be done earlier than the suggested time.







Lesson	Time in Advance	Investigation	Description
2	1 day <sup>†</sup>	Rice Consumption Demonstration	Cook 1 kg dry white rice. Transfer the rice to a clear plastic container or bag.
6	1 day <sup>†</sup>	Lake Model Investigation	Make or obtain 24 ice cubes for the lake models.
17	2 days <sup>†</sup>	Model Glacier Demonstration	Freeze water to create mini glacier, prepare containers to create mountain model, and set up demonstration.
17	1 day <sup>†</sup>	Frost-Weathering Demonstration	Fill two plastic water bottles with the same volume of water and then place one water bottle in a freezer overnight.
20	4 or more days <sup>†</sup>	Drought Model and Dust Bowl Investigation	Prepare containers for Drought and Dust Bowl Investigation. (See Lesson 20 Resources B and C.)

# Lesson Preparation

## Lesson 1

<b>Materials</b>	<b>Kit Items</b> None	<b>School Supplied Items</b> None
<b>Resources</b>	<input type="checkbox"/> Lesson 1 Resource A: Grains Photograph  <input type="checkbox"/> Lesson 1 Resource B: Rice Plant Photograph 	
<b>Preparation</b> 	None <b>Advance Preparation for Lesson 2</b> <b>1 Day Before:</b> Cook 1 kg dry white rice. Transfer the rice to a clear plastic container or bag.	



## Lesson 2

<b>Materials</b>	<b>Kit Items</b> None	<b>School Supplied Items</b> <input type="checkbox"/> Container or bag for rice, clear (1) <input type="checkbox"/> Rice, uncooked (1 kg) <input type="checkbox"/> Water (access)
<b>Resources</b>	<input type="checkbox"/> Lesson 2 Resource A: World Versus US in 2011 Rice Consumption  <input type="checkbox"/> Lesson 2 Resource B: Top 10 Global Rice Consumers  <input type="checkbox"/> Lesson 2 Resource C: Top 10 Global Rice Consumers Map  <input type="checkbox"/> Lesson 2 Resource D: Top 10 Global Paddy Rice Producers  <input type="checkbox"/> Lesson 2 Resource E: Map of Selected Countries in Asia  <input type="checkbox"/> Lesson 2 Resource F: Top Five Indonesian Paddy Rice Producers  <input type="checkbox"/> <i>Cycle of Rice, Cycle of Life</i> (Reynolds 2009)	
<b>Preparation</b>	<input type="checkbox"/> Print a copy of Lesson 2 Resource B for each student pair. <input type="checkbox"/> Print a copy of Lesson 2 Resource D for each student pair.	




## Lesson 3

<b>Materials</b>	<b>Kit Items</b> None	<b>School Supplied Items</b> None
<b>Resources</b>	<input type="checkbox"/> Lesson 3 Resource: Indonesian Rice Farm Photographs  <input type="checkbox"/> <i>Cycle of Rice, Cycle of Life</i>	
<b>Preparation</b>	<input type="checkbox"/> Load map of Indonesia in Google Earth™ mapping service: <a href="http://phdsci.link/1309">http://phdsci.link/1309</a> .	


### Lesson 4

<b>Materials</b>	<b>Kit Items</b> <input type="checkbox"/> Beaker, glass, 250 mL (1) <input type="checkbox"/> Pipette, disposable (1) <input type="checkbox"/> Watch glasses (2)	<b>School Supplied Items</b> <input type="checkbox"/> Pencils, at least 5 colors (24 sets) <input type="checkbox"/> Water (100 mL)
<b>Resources</b>	<input type="checkbox"/> Lesson 4 Resource A: Global Water Distribution Data  <input type="checkbox"/> Lesson 4 Resource B: 10 × 10 Grid 	
<b>Preparation</b>	<input type="checkbox"/> Load Google Earth™ mapping service: <a href="http://phdsci.link/1310">http://phdsci.link/1310</a> .	


### Lesson 5

<b>Materials</b>	<b>Kit Items</b> None	<b>School Supplied Items</b> None
<b>Resources</b>	<input type="checkbox"/> Lesson 5 Resource A: Marine Ecosystem Live Camera Feeds  <input type="checkbox"/> Lesson 5 Resource B: Coral Reef Ecosystems <input type="checkbox"/> Lesson 5 Resource C: Deep Ocean Ecosystems <input type="checkbox"/> Lesson 5 Resource D: Intertidal Zone Ecosystems <input type="checkbox"/> Lesson 5 Resource E: Hydrothermal Vent Ecosystems <input type="checkbox"/> Lesson 5 Resource F: Map of Fresh Surface Water in the US 	
<b>Preparation</b> 	<input type="checkbox"/> Load Google Earth™ mapping service: <a href="http://phdsci.link/1310">http://phdsci.link/1310</a> . <input type="checkbox"/> Cue marine ecosystem live cams. (See Lesson 5 Resource A.) <input type="checkbox"/> Set up marine ecosystem stations by placing one resource at each station. (See Lesson 5 Resources B–E.)	
<b>Advance Preparation for Lesson 6</b> <b>1 Day Before:</b> Make or obtain 24 ice cubes for lake models.		




## Lesson 6

<b>Materials</b>	<p><b>Kit Items</b></p> <ul style="list-style-type: none"> <li><input type="checkbox"/> Bins, clear plastic, 6 qt (4)</li> <li><input type="checkbox"/> Bucket, plastic, 10 qt (1)</li> <li><input type="checkbox"/> Heat lamps (2)</li> <li><input type="checkbox"/> Measuring cup, 1 L (1)</li> <li><input type="checkbox"/> Rubber stoppers (4, if needed)</li> </ul> <p><b>Module 1 Kit</b></p> <ul style="list-style-type: none"> <li><input type="checkbox"/> Heat lamps (2)</li> <li><input type="checkbox"/> Scale, digital, ± 0.1 g (1)</li> </ul> <p><b>Module 2 Kit</b></p> <ul style="list-style-type: none"> <li><input type="checkbox"/> Timer, digital (1)</li> </ul>	<p><b>School Supplied Items</b></p> <ul style="list-style-type: none"> <li><input type="checkbox"/> Bag, resealable plastic, 1 qt (4)</li> <li><input type="checkbox"/> Cooler bag, insulated (1) or freezer (access)</li> <li><input type="checkbox"/> Cup, clear plastic, 9 oz (4)</li> <li><input type="checkbox"/> Ice cubes (24)</li> <li><input type="checkbox"/> Objects for weight, small (20)</li> <li><input type="checkbox"/> Plastic wrap (partial roll)</li> <li><input type="checkbox"/> Salt (140 g)</li> <li><input type="checkbox"/> Tape, masking (partial roll)</li> <li><input type="checkbox"/> Water (4 L)</li> </ul>
	<p><b>Item Reuse</b></p> <ul style="list-style-type: none"> <li><input type="checkbox"/> Lesson 7 requires the prepared lake model.</li> <li><input type="checkbox"/> Lesson 11 requires the bin.</li> <li><input type="checkbox"/> Lesson 12 requires the scale.</li> </ul>	
<b>Resources</b>	<ul style="list-style-type: none"> <li><input type="checkbox"/> Lesson 6 Resource A: Lake Model Setup Instructions</li> <li><input type="checkbox"/> Lesson 6 Resource B: Dew Photograph </li> </ul>	
<b>Preparation</b>	<ul style="list-style-type: none"> <li><input type="checkbox"/> Set up lake models. (See Lesson 6 Resource A.)</li> </ul>	





## Lesson 7

<b>Materials</b>	<p><b>Kit Items</b></p> <ul style="list-style-type: none"> <li><input type="checkbox"/> Beaker, glass, 250 mL (1)</li> </ul> <p><b>Module 1 Kit</b></p> <ul style="list-style-type: none"> <li><input type="checkbox"/> Beaker, glass, 250 mL (1)</li> <li><input type="checkbox"/> Cooling pad (1)</li> <li><input type="checkbox"/> Hot plate (1)</li> <li><input type="checkbox"/> Safety goggles, teacher (1)</li> <li><input type="checkbox"/> Tongs (1)</li> </ul>	<p><b>School Supplied Items</b></p> <ul style="list-style-type: none"> <li><input type="checkbox"/> Gloves, protective (1 pair)</li> </ul>
	<p><b>Prepared Items from Previous Lessons</b></p> <ul style="list-style-type: none"> <li><input type="checkbox"/> Fresh and salt water lake models from Lesson 6.</li> </ul>	
<b>Resources</b>	<ul style="list-style-type: none"> <li><input type="checkbox"/> Lesson 7 Resource A: Lake Batur Photograph </li> <li><input type="checkbox"/> Lesson 7 Resource B: Evaporation Test Procedure</li> </ul>	
<b>Preparation</b>	<p>None</p>	




## Lesson 8

Materials	Kit Items	School Supplied Items
	None	None
Resources	<input type="checkbox"/> Lesson 6 Resource B: Dew Photograph  Lesson 8 Resource A: Atmospheric Temperature Data  <input type="checkbox"/> Lesson 8 Resource B: Illuminated Dust Photograph  <input type="checkbox"/> <i>Cycle of Rice, Cycle of Life</i> (Reynolds 2009)	
Preparation	<input type="checkbox"/> Set up lake models. (See Lesson 6 Resource A.)	




## Lesson 9

Materials	Kit Items	School Supplied Items
	None	None
Resources	<input type="checkbox"/> Lesson 9 Resource A: Days of Rain in Major US Cities Map  <input type="checkbox"/> Lesson 9 Resource B: Conceptual Checkpoint 	
Preparation	<input type="checkbox"/> Cue video “GEOS-5 Modeled Clouds” (NASA/Goddard Space Flight Center Scientific Visualization Studio 2010): <a href="http://phdsci.link/1317">http://phdsci.link/1317</a> .  <input type="checkbox"/> Cue video “Water Vapor & Cloud Fraction” (NASA Earth Observatory 2019): <a href="http://phdsci.link/1328">http://phdsci.link/1328</a> . 	

## Lesson 10

<p><b>Materials</b></p>	<p><b>Kit Items</b></p> <p>None</p>	<p><b>School Supplied Items</b></p> <p>None</p> <p><b>Optional Rain Shadow Model Extension</b></p> <ul style="list-style-type: none"> <li><input type="checkbox"/> Bin, clear plastic, 41 qt (1)</li> <li><input type="checkbox"/> Knife, utility (1, optional)</li> <li><input type="checkbox"/> Humidifier (1)</li> <li><input type="checkbox"/> Paper towels (1 roll)</li> <li><input type="checkbox"/> Paper towel tube (1)</li> <li><input type="checkbox"/> Plastic wrap (1roll)</li> <li><input type="checkbox"/> Soil, local (20 lb)</li> <li><input type="checkbox"/> Tape, masking (1 roll)</li> </ul>
<p><b>Resources</b></p>	<ul style="list-style-type: none"> <li><input type="checkbox"/> Lesson 10 Resource A: Yearly Precipitation Comparison Graph </li> <li><input type="checkbox"/> Lesson 10 Resource B: Additional Rain Shadow Examples</li> <li><input type="checkbox"/> Lesson 10 Resource C: Extension: Rain Shadow Model</li> </ul>	
<p><b>Preparation</b></p>	<ul style="list-style-type: none"> <li><input type="checkbox"/> Practice measuring distance in Google Earth™ mapping service: <a href="http://phdsci.link/1310">http://phdsci.link/1310</a>. </li> <li><input type="checkbox"/> Cue “Water Vapor &amp; Cloud Fraction” video (NASA Earth Observatory 2019) <a href="http://phdsci.link/1328">http://phdsci.link/1328</a>. </li> </ul>	

## Lesson 11




<b>Materials</b>	<p><b>Kit Items</b></p> <ul style="list-style-type: none"> <li><input type="checkbox"/> Bins, clear plastic, 6 qt (6)</li> <li><input type="checkbox"/> Clay, natural (2 tbsp)</li> <li><input type="checkbox"/> Measuring spoon, tbsp (1)</li> <li><input type="checkbox"/> Pipettes, disposable (6)</li> <li><input type="checkbox"/> Silt (2 tbsp)</li> <li><input type="checkbox"/> Spray bottles, plastic (6)</li> </ul> <p><b>Module 1 Kit</b></p> <ul style="list-style-type: none"> <li><input type="checkbox"/> Safety goggles, student (24)</li> <li><input type="checkbox"/> Safety goggles, teacher (1)</li> </ul> <p><b>Module 2 Kit</b></p> <ul style="list-style-type: none"> <li><input type="checkbox"/> Magnifiers, handheld, plastic (6)</li> </ul>	<p><b>School Supplied Items</b></p> <ul style="list-style-type: none"> <li><input type="checkbox"/> Aluminum foil (1 roll)</li> <li><input type="checkbox"/> Construction paper (6 sheets)</li> <li><input type="checkbox"/> Cups, clear plastic, 9 oz (6)</li> <li><input type="checkbox"/> Gravel (2 tbsp)</li> <li><input type="checkbox"/> Plates, paper (12)</li> <li><input type="checkbox"/> Rocks, approx. 2" long (6)</li> <li><input type="checkbox"/> Rulers, metric (6)</li> <li><input type="checkbox"/> Sand (6 <math>\frac{1}{2}</math> cups)</li> <li><input type="checkbox"/> Soil, potting or locally sourced (2 tbsp)</li> <li><input type="checkbox"/> Spoons, plastic (6)</li> <li><input type="checkbox"/> Tape, masking (partial roll)</li> <li><input type="checkbox"/> Water (2 L)</li> </ul>
	<p><b>Item Reuse</b></p> <ul style="list-style-type: none"> <li><input type="checkbox"/> Lesson 12 requires 300 g of the sand. Save all remaining sand for Lesson 16.</li> <li><input type="checkbox"/> Lesson 16 requires the bins.</li> <li><input type="checkbox"/> Lesson 20 requires 2 of the spray bottles.</li> </ul>	
<b>Resources</b>	<ul style="list-style-type: none"> <li><input type="checkbox"/> Lesson 11 Resource A: Mounts Agung and Batur Topographic Map </li> <li><input type="checkbox"/> Lesson 11 Resource B: Bali Mountain Model Procedure Sheet</li> <li><input type="checkbox"/> Lesson 11 Resource C: Surface Material Stations Setup Instructions</li> <li><input type="checkbox"/> Lesson 11 Resource D: Surface Material Size Diagram </li> <li><input type="checkbox"/> <i>Cycle of Rice, Cycle of Life</i> (Reynolds 2009)</li> </ul>	
<b>Preparation</b>	<ul style="list-style-type: none"> <li><input type="checkbox"/> Load interactive watershed map (FernLeaf Interactive n.d.): <a href="http://phdsci.link/1321">http://phdsci.link/1321</a>. </li> <li><input type="checkbox"/> Set up surface material stations. (See Lesson 11 Resource C.)</li> </ul>	



## Lesson 12



<b>Materials</b>	<b>Kit Items</b> <input type="checkbox"/> Clay, natural (300 g) <input type="checkbox"/> Digital timers (6) <input type="checkbox"/> Filters, coffee (24) <input type="checkbox"/> Jars with lids, plastic, 8 oz (4) <input type="checkbox"/> Silt (300 g)  <b>Module 1 Kit</b> <input type="checkbox"/> Scales, digital, ± 0.1 g (6) <input type="checkbox"/> Stopwatches (6)  <b>Module 2 Kit</b> <input type="checkbox"/> Graduated cylinders, 50 mL (6)	<b>School Supplied Items</b> <input type="checkbox"/> Bottles, plastic, 16.9 oz (24) <input type="checkbox"/> Gravel (300 g) <input type="checkbox"/> Knife, utility (1, optional) <input type="checkbox"/> Marbles ( $\frac{2}{3}$ cup) <input type="checkbox"/> Paper clips (72) <input type="checkbox"/> Popcorn kernels ( $\frac{2}{3}$ cup) <input type="checkbox"/> Rice, uncooked ( $\frac{2}{3}$ cup) <input type="checkbox"/> Sand (300 g) <input type="checkbox"/> Scissors (6) <input type="checkbox"/> Sponge, small (1) <input type="checkbox"/> Spoons, plastic (24) <input type="checkbox"/> Sugar, granulated white ( $\frac{2}{3}$ cup) <input type="checkbox"/> Water (600 mL)
	<b>Item Reuse</b> <input type="checkbox"/> Lesson 20 requires the scales.	
<b>Resources</b>	<input type="checkbox"/> Lesson 12 Resource: Sample Comparing Surface Materials Investigation Plan <input type="checkbox"/> <i>Cycle of Rice, Cycle of Life</i> (Reynolds 2009)	
<b>Preparation</b>	None	

## Lesson 13


<b>Materials</b>	<b>Kit Items</b> None	<b>School Supplied Items</b> None
<b>Resources</b>	<input type="checkbox"/> Lesson 13 Resource A: Physical Regions of Texas Map  <input type="checkbox"/> Lesson 13 Resource B: Colorado County Watershed Map  <input type="checkbox"/> Lesson 13 Resource C: Soil Article <input type="checkbox"/> Lesson 13 Resource D: Nutrient Levels in Rice Plants Image  <input type="checkbox"/> <i>Cycle of Rice, Cycle of Life</i> (Reynolds 2009)	
<b>Preparation</b>	<input type="checkbox"/> Prepare class rice conditions chart by creating three columns on a sheet of chart paper. Label the columns Conditions for Growing Rice, Conditions in Bali, and Conditions in Colorado County. Title the chart Does Colorado County have suitable conditions for growing rice? Allow space for the addition of five rows. <input type="checkbox"/> Print a copy of Lesson 13 Resource C for each student. <input type="checkbox"/> Use sticky notes to cover the nutrient labels on the nutrient levels in rice plants image (Lesson 13 Resource D) before displaying it.	






## Lesson 14

Materials	Kit Items	School Supplied Items
	None	None
Resources	<input type="checkbox"/> Lesson 14 Resource A: Soil Pit Photograph  <input type="checkbox"/> Lesson 14 Resource B: Soil Profile Illustrations  <input type="checkbox"/> <i>Cycle of Rice, Cycle of Life</i> (Reynolds 2009)	
Preparation	<input type="checkbox"/> Prepare class rice conditions chart by creating three columns on a sheet of chart paper. Label the columns Conditions for Growing Rice, Conditions in Bali, and Conditions in Colorado County. Title the chart Does Colorado County have suitable conditions for growing rice? Allow space for the addition of five rows.  <input type="checkbox"/> Print a color copy of Lesson 14 Resource B for each student pair.	




## Lesson 15

Materials	Kit Items	School Supplied Items
	None	<input type="checkbox"/> Scissors (1)
Resources	<input type="checkbox"/> Lesson 15 Resource: Texas A&M Rice Investigation Guidelines and Results	
Preparation 	<input type="checkbox"/> Prepare class rice conditions chart by creating three columns on a sheet of chart paper. Label the columns Conditions for Growing Rice, Conditions in Bali, and Conditions in Colorado County. Title the chart Does Colorado County have suitable conditions for growing rice? Allow space for the addition of five rows.  <input type="checkbox"/> Print a copy of Lesson 15 Resource for each student pair. Cut each copy to separate the investigation guidelines from the investigation results.	
	<b>Advance Preparation for Lesson 17</b>  <b>2 Days Before:</b> Prepare materials for the model glacier demonstration. (See Lesson 17 Resource B.)	





## Lesson 16

<b>Materials</b>	<b>Kit Items</b> <ul style="list-style-type: none"> <li><input type="checkbox"/> Bins, clear plastic, 6 qt (6)</li> <li><input type="checkbox"/> Cutting boards, plastic, 11" × 15" (2)</li> </ul> <b>Module 1 Kit</b> <ul style="list-style-type: none"> <li><input type="checkbox"/> Safety goggles, student (24)</li> <li><input type="checkbox"/> Safety goggles, teacher (1)</li> </ul>	<b>School Supplied Items</b> <ul style="list-style-type: none"> <li><input type="checkbox"/> Salt (96 g)</li> <li><input type="checkbox"/> Sand (9 kg)</li> <li><input type="checkbox"/> Water (3 L)</li> </ul>
	<b>Item Reuse</b> <ul style="list-style-type: none"> <li><input type="checkbox"/> Lesson 20 requires the bins.</li> </ul>	
<b>Resources</b>	<ul style="list-style-type: none"> <li><input type="checkbox"/> Lesson 16 Resource A: Coastal Landforms Photographs</li> <li><input type="checkbox"/> Lesson 16 Resource B: Coastline Investigation Procedure Sheet</li> <li><input type="checkbox"/> Lesson 16 Resource C: Sandbar Photograph </li> </ul>	
<b>Preparation</b> 	<ul style="list-style-type: none"> <li><input type="checkbox"/> Cue video of waves crashing on Socorro Island: <a href="http://phdsci.link/1262">http://phdsci.link/1262</a>. </li> <li><input type="checkbox"/> Print a copy of Lesson 16 Resource A for each group.</li> <li><input type="checkbox"/> Prepare materials for the coastline investigation by adding 16 g salt to 500 mL water (per group) and cutting the plastic cutting boards into quarters (approx. 7.75" × 5.5" each).</li> </ul> <p><b>Advance Preparation for Lesson 17</b></p> <p><b>1 Day Before:</b> Prepare the materials for the frost-weathering demonstration by filling two plastic water bottles with the same volume of water and placing one of the bottles in the freezer overnight.</p> <p><b>Advance Preparation for Lesson 20</b></p> <p><b>4 Days Before:</b> Prepare containers for Drought and Dust Bowl Investigations. (See Lesson 20 Resources B and C.)</p>	







### Lesson 17

<b>Materials</b>	<b>Kit Items</b> <input type="checkbox"/> Bins, clear plastic, 6 qt (1)	<b>School Supplied Items</b> <input type="checkbox"/> Bottles, clear plastic (2) <input type="checkbox"/> Food container, plastic, 4" x 4" x 2" (1) <input type="checkbox"/> Freezer (access) <input type="checkbox"/> Gravel (1 cup) <input type="checkbox"/> Potting soil or sand (12 cups) <input type="checkbox"/> Rocks, small (6) <input type="checkbox"/> Water (access)
	<b>Item Reuse</b> <input type="checkbox"/> Lesson 20 requires the bins.	
<b>Resources</b>	<input type="checkbox"/> Lesson 17 Resource A: Glacier Photograph  <input type="checkbox"/> Lesson 17 Resource B: Model Glacier Movement Setup Instructions and Classroom Procedure <input type="checkbox"/> Lesson 17 Resource C: Glacial Landform Photographs  <input type="checkbox"/> Lesson 17 Resource D: Frost-Weathering Photographs 	
<b>Preparation</b>	<input type="checkbox"/> Prepare Glacial Landform Photographs. (See Lesson 17 Resource C.)	


### Lesson 18

<b>Materials</b>	<b>Kit Items</b> None	<b>School Supplied Items</b> None
<b>Resources</b>	<input type="checkbox"/> Lesson 18 Resource A: Symphony Orchestra Diagram  <input type="checkbox"/> Lesson 18 Resource B: Conceptual Checkpoint 	
<b>Preparation</b>	<input type="checkbox"/> Cue video of a violinist playing music (Voices of Music 2019): <a href="http://phdsci.link/1323">http://phdsci.link/1323</a> .  <input type="checkbox"/> Cue video of an orchestra playing music (Voices of Music 2016): <a href="http://phdsci.link/1324">http://phdsci.link/1324</a> .  <input type="checkbox"/> Prepare for the Chalk Talk routine by writing a different pair of Earth’s systems at the top of each of 6 pieces of chart paper.	

## Lesson 19

Materials	Kit Items	School Supplied Items
	None	None
Resources	<input type="checkbox"/> Lesson 19 Resource A: 1935 South Dakota Photograph  <input type="checkbox"/> Lesson 19 Resource B: “The Great Dust Storm” (Guthrie 1960) <input type="checkbox"/> Lesson 19 Resource C: Most Severely Affected Area During the Dust Bowl  <input type="checkbox"/> Lesson 19 Resource D: 1935 Kansas Photograph  <input type="checkbox"/> Lesson 19 Resource E: Dust Bowl Precipitation Data  <input type="checkbox"/> Lesson 19 Resource F: “Covered in Dust” by Peter Roop (2012) <input type="checkbox"/> Lesson 19 Resource G: 1934 Drought Map 	
Preparation	<input type="checkbox"/> Cue “Woody Guthrie: The Great Dust Storm” (Burns 2012): <a href="http://phdsci.link/1325">http://phdsci.link/1325</a> .  <input type="checkbox"/> Print a copy of Lesson 19 Resource E for group analysis.	

## Lesson 20

Materials	Kit Items	School Supplied Items
	<input type="checkbox"/> Balloon pumps, handheld (6) <input type="checkbox"/> Bins, clear plastic, 6 qt (14) <input type="checkbox"/> Chenille stems (10) <input type="checkbox"/> Spray bottles, plastic (2)	<input type="checkbox"/> Cardboard, 7" × 7" (6) <input type="checkbox"/> Construction paper (14 sheets) <input type="checkbox"/> Drill with $\frac{3}{8}$ " bit (1) <input type="checkbox"/> Forks, plastic (2) <input type="checkbox"/> Plastic wrap (partial roll) <input type="checkbox"/> Scissors (2) <input type="checkbox"/> Soil, potting or locally sourced (14 cups) <input type="checkbox"/> Spoons, plastic (2) <input type="checkbox"/> Tape, masking (partial roll) <input type="checkbox"/> Water (2 L)
	<b>Module 1 Kit</b> <input type="checkbox"/> Scales, digital, ± 0.1 g (6)	
	<b>Item Reuse</b> <input type="checkbox"/> Lesson 21 requires the prepared dust bowl investigation containers.	
Resources	<input type="checkbox"/> Lesson 20 Resource A: Drought-Affected Soil Photograph  <input type="checkbox"/> Lesson 20 Resource B: Drought Investigation Setup Instructions and Procedure <input type="checkbox"/> Lesson 20 Resource C: Sample Dust Bowl Investigation Setup Instructions <input type="checkbox"/> Lesson 20 Resource D: Sample Dust Bowl Investigation Plan <input type="checkbox"/> <i>The Buffalo Are Back</i> by Jean Craighead George (2010)	
Preparation	None	

## Lesson 21

<b>Materials</b>	<b>Kit Items</b> None	<b>School Supplied Items</b> None
	<b>Prepared Items from Previous Lessons</b> <input type="checkbox"/> Dust bowl investigation containers from Lesson 20 (12)	
	<b>Item Reuse</b> <input type="checkbox"/> Disassemble the dust bowl investigation containers, and place a piece of tape over the drilled hole in 6 of the containers. Lesson 27 requires the 6 bins with taped holes and the soil.	
<b>Resources</b>	<input type="checkbox"/> Lesson 20 Resource D: Sample Dust Bowl Investigation Plan <input type="checkbox"/> <i>The Buffalo Are Back</i> by Jean Craighead George (2010)	
<b>Preparation</b>	None	




## Lesson 22

<b>Materials</b>	<b>Kit Items</b> None	<b>School Supplied Items</b> <input type="checkbox"/> Scissors (1) <input type="checkbox"/> Tape (partial roll)
	<b>Resources</b> <input type="checkbox"/> Lesson 22 Resource A: Great Plains Food Chain Cards <input type="checkbox"/> Lesson 22 Resource B: “Life in the Food Chain” <input type="checkbox"/> Lesson 22 Resource C: Ecosystem Food Chain Cards <input type="checkbox"/> Module 1 Energy Anchor Chart	
<b>Preparation</b>	<input type="checkbox"/> Cue buffalo video: <a href="http://phdsci.link/2084">http://phdsci.link/2084</a> <input type="checkbox"/> Prepare Great Plains food chain cards. (See Lesson 22 Resource A.) <input type="checkbox"/> Prepare to distribute one copy of the “Life in the Food Chain” text to each student. (See Lesson 22 Resource B.) <input type="checkbox"/> Prepare ecosystem food chain cards. (See Lesson 22 Resource C.)	


## Lesson 23

<b>Materials</b>	<b>Kit Items</b> None	<b>School Supplied Items</b> <input type="checkbox"/> Glue sticks (24) <input type="checkbox"/> Scissors (24)
	<b>Resources</b> <input type="checkbox"/> Lesson 23 Resource A: Grass to Wolf Food Chains <input type="checkbox"/> Lesson 23 Resource B: Organism Cards	
<b>Preparation</b>	<input type="checkbox"/> Prepare to distribute one copy of the Grass to Wolf Food Chains (Lesson 23 Resource A) and two sets of organism cards (Lesson 23 Resource B) to each student pair.	


## Lesson 24

Materials	Kit Items	School Supplied Items
	<input type="checkbox"/> Pony beads, blue, green, red (192 each color)	<input type="checkbox"/> Cups, clear plastic, 9 oz (24)
Resources	<input type="checkbox"/> Lesson 19 Resource B: “The Great Dust Storm” <input type="checkbox"/> Lesson 24 Resource A: 1930–1940 US Migration Map  <input type="checkbox"/> Lesson 24 Resource B: Crop Rotation Model Instructions <input type="checkbox"/> Lesson 24 Resource C: Crop Rotation Model Procedure Sheet <input type="checkbox"/> Lesson 24 Resource D: Kansas Farmland Photographs  <input type="checkbox"/> <i>Cycle of Rice, Cycle of Life</i> (Reynolds 2009)	
Preparation	<input type="checkbox"/> Cue the video of dust storms during the Dust Bowl: <a href="http://phdsci.link/1337">http://phdsci.link/1337</a> .  <input type="checkbox"/> Prepare plant cards and cups for crop rotation model. (See Lesson 24 Resource B.)	



## Lesson 25

Materials	Kit Items	School Supplied Items
	None	None
Resources	<input type="checkbox"/> Lesson 25 Resource: Conceptual Checkpoint  <input type="checkbox"/> <i>Cycle of Rice, Cycle of Life</i> (Reynolds 2009)	
Preparation	<input type="checkbox"/> Prepare for the Chalk Talk routine by writing each of Earth’s systems across the top and down the left side of each of 6 pieces of chart paper.	

## Lesson 26

Materials	Kit Items	School Supplied Items
	None	None
Resources	<input type="checkbox"/> Lesson 26 Resource A: Engineering Design Process  <input type="checkbox"/> Lesson 26 Resource B: World Water Crisis Resources <input type="checkbox"/> <i>Cycle of Rice, Cycle of Life</i> (Reynolds 2009)	
Preparation	<input type="checkbox"/> Curate world water crisis resources and print copies for each group. (See Lesson 26 Resource B.)	

## Lesson 27

<b>Materials</b>	<b>Kit Items</b> <ul style="list-style-type: none"> <li><input type="checkbox"/> Bins, clear plastic, 6 qt (6)</li> <li><input type="checkbox"/> Chenille stems (40)</li> <li><input type="checkbox"/> Clay, modeling, nonhardening (5 lb)</li> <li><input type="checkbox"/> Food coloring, blue (1 oz)</li> </ul>	<b>School Supplied Items</b> <ul style="list-style-type: none"> <li><input type="checkbox"/> Aluminum foil (1 roll)</li> <li><input type="checkbox"/> Containers, cardboard (6–12, optional)</li> <li><input type="checkbox"/> Cotton swabs (78)</li> <li><input type="checkbox"/> Craft sticks (50)</li> <li><input type="checkbox"/> Cups, paper, 3 oz (50)</li> <li><input type="checkbox"/> Paper clips (100)</li> <li><input type="checkbox"/> Plastic wrap (partial roll)</li> <li><input type="checkbox"/> Push pins (6)</li> <li><input type="checkbox"/> Scissors (6)</li> <li><input type="checkbox"/> Soil, potting or locally sourced (28 cups)</li> <li><input type="checkbox"/> Straws, bendable (50)</li> <li><input type="checkbox"/> String (1 spool)</li> <li><input type="checkbox"/> Tape, duct (1 roll)</li> <li><input type="checkbox"/> Tape, electrical (1 roll)</li> <li><input type="checkbox"/> Tape, masking (partial roll)</li> <li><input type="checkbox"/> Toothpicks (250)</li> <li><input type="checkbox"/> Water (1 L)</li> </ul>
	<b>Item Reuse</b> <ul style="list-style-type: none"> <li><input type="checkbox"/> Lesson 28 requires the prepared Engineering Challenge materials.</li> </ul>	
<b>Resources</b>	<ul style="list-style-type: none"> <li><input type="checkbox"/> Lesson 27 Resource A: Fresh Water Use in Indonesia Chart </li> <li><input type="checkbox"/> Lesson 27 Resource B: Sample Irrigation Prototypes</li> <li><input type="checkbox"/> Lesson 27 Resource C: Materials Price List </li> <li><input type="checkbox"/> Lesson 27 Resource D: Engineering Challenge Money Template</li> </ul>	
<b>Preparation</b>	None	


## Lesson 28

<b>Materials</b>	<b>Kit Items</b> <input type="checkbox"/> Gloves, disposable (24 pairs, optional)	<b>School Supplied Items</b> None
	<b>Module 1 Kit</b> <input type="checkbox"/> Safety goggles, student (24, optional) <input type="checkbox"/> Safety goggles, teacher (1, optional)	
	<b>Prepared Items from Previous Lessons</b> <input type="checkbox"/> Engineering Challenge materials from Lesson 27	
	<b>Item Reuse</b> <input type="checkbox"/> Lesson 29 requires the prepared Engineering Challenge materials.	
<b>Resources</b>	None	
<b>Preparation</b>	<input type="checkbox"/> Cut enough cotton swabs in half to provide 12 halves per group.	

## Lesson 29

<b>Materials</b>	<b>Kit Items</b> <input type="checkbox"/> Gloves, disposable (24 pairs, optional)	<b>School Supplied Items</b> None
	<b>Module 1 Kit</b> <input type="checkbox"/> Safety goggles, student (24, optional) <input type="checkbox"/> Safety goggles, teacher (1, optional)	
	<b>Prepared Items from Previous Lessons</b> <input type="checkbox"/> Engineering Challenge materials from Lesson 27	
	<b>Resources</b>	
<b>Preparation</b>	<input type="checkbox"/> Cut enough cotton swabs in half to provide 12 halves per group.	

## Lesson 30

<b>Materials</b>	<b>Kit Items</b> None	<b>School Supplied Items</b> None
<b>Resources</b>	<input type="checkbox"/> Lesson 30 Resource: Irrigation Photographs 	
<b>Preparation</b>	None	



## Lesson 31

No materials, resources, or preparation required.

## Lesson 32

<b>Materials</b>	<b>Kit Items</b> None	<b>School Supplied Items</b> None
<b>Resources</b>	<input type="checkbox"/> <i>Cycle of Rice, Cycle of Life</i> by Jan Reynolds (2009)	
<b>Preparation</b>	<input type="checkbox"/> Identify and mark the following pages in <i>Cycle of Rice, Cycle of Life</i> for End-of Module Assessment question 3b: pages 19, 20, 23, 24, and 29.	

## Lesson 33

<b>Materials</b>	<b>Kit Items</b> None	<b>School Supplied Items</b> None
<b>Resources</b>	<input type="checkbox"/> Lesson 33 Resource: Content Standards	
<b>Preparation</b>	<input type="checkbox"/> Score End-of-Module Assessment and write individual feedback. <input type="checkbox"/> Select End-of-Module Assessment responses to share with students. <input type="checkbox"/> Prepare visual for reflection on content standards. (See Lesson 33 Resource.)	

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## Works Cited

- Burns, Ken, director. 2012. "Woody Guthrie: The Great Dust Storm." *The Dust Bowl*, episode 2, Introduction. Florentine Films and WETA, Washington, DC, and the Dust Bowl Film Project LLC. Video, 2:17, Aired November 18, 2012. <https://www.pbs.org/video/dust-bowl-woody-guthrie-great-dust-storm/>.
- Fernleaf Interactive. n.d. "Watersheds." Accessed May 28, 2019. <http://watersheds.fernleafinteractive.com/>.
- Fusion. 2016. "Sinking City: Mexico City's Water Crisis." Video, 4:08, posted February 29, 2016. [https://www.youtube.com/watch?v=sra\\_-ykV7c](https://www.youtube.com/watch?v=sra_-ykV7c).
- George, Jean Craighead. 2010. *The Buffalo Are Back*. London: Dutton Books for Young Readers. [All references to *The Buffalo Are Back* are from this source.]
- Google. 2019. "Google Earth™ Mapping Service." Accessed May 28, 2019. <https://www.google.com/earth/>.
- Guthrie, Woody. (1960) 1963. "The Great Dust Storm." Words and music by Woody Guthrie. [https://www.woodyguthrie.org/Lyrics/Dust\\_Storm\\_Disaster.htm](https://www.woodyguthrie.org/Lyrics/Dust_Storm_Disaster.htm).
- NASA Earth Observatory (NEO). 2019. "Water Vapor & Cloud Fraction." Accessed May 28, 2019. [https://earthobservatory.nasa.gov/global-maps/MYDAL2\\_M\\_SKY\\_WV/MODAL2\\_M\\_CLD\\_FR](https://earthobservatory.nasa.gov/global-maps/MYDAL2_M_SKY_WV/MODAL2_M_CLD_FR).
- NASA/Goddard Space Flight Center Scientific Visualization Studio. 2010. "NCCS Hyperwall Show: GEOS-5 Modeled Clouds at 5-km Resolution (Flat Map)." June 18, 2010. <https://svs.gsfc.nasa.gov/3723>.
- Reynolds, Jan. 2009. *Cycle of Rice, Cycle of Life*. New York: Lee & Low Books. [All references to *Cycle of Rice, Cycle of Life* are from this source.]
- Roop, Peter. 2012. "Covered in Dust." *Cobblestone—The Perfect Storm: When Weather Made History*. March 2012, 26–28.
- Voices of Music. 2019. "Bach: Partita No. 3 in E Major BWV 1006." Performed by Alana Youssefian, baroque violin. Video, 5:09, posted February 4, 2019. <https://www.youtube.com/watch?v=zWcKlKwV2Jk>.
- Voices of Music. 2016. "Handel: Hornpipe from the *Water Music*." Performed by FestspielOrchester Göttingen, Laurence Cummings, director. Video, 3:08, posted August 29, 2016. <https://www.youtube.com/watch?v=1h4mAceHmrl>.

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