



Preparation Guide

Level 5 Module 3

SUN, EARTH, AND MOON SYSTEM

with Spotlight Lessons and a Capstone Project on Forces, Motion, and Energy

Materials: This section lists the quantity of each material necessary for the lesson. Lesson materials may be from a *PhD Science*® *Texas* materials kit, or the materials may be school-supplied items. In addition to having the listed materials, teachers should have access to the following common classroom items: sticky notes, chart paper, pencils, a whiteboard, and markers.

Resources: This section lists module resources (from the Module Resources section 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, digital slides. A symbol (🖥️) identifies resources that appear in the digital slides. Additional supports and Spanish resources are available in the Implementation Resources and Level Overview sections of the digital platform.

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.







Sun, Earth, and Moon System | Advance 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
1	3 or more days†	Sky Observation	Have students make observations of the sky at the same time and from the same location once a day for 3 consecutive days. Students should choose an area of the sky where the Sun is visible. Warn students not to look directly at the Sun, as this can cause permanent eye damage. Students record their observations in their Science Logbook.
2	1 day†	Force Investigation	Calibrate push spring scales and prepare materials for the force investigation.
5	1 day†	Shadow Observation	Take a picture of a shadow cast from the school building in the early morning before school, and record the time that the photograph was taken. The picture should show the full shadow as well as at least part of the building casting the shadow. If possible, use chalk to record the shadow's position.
17	1 day†	Reflection Investigation	Prepare the light ray boxes and black pencil sleeves for each group.
21	1 day†	Distance and Brightness Investigation	Assemble light intensity comparers.

Sun, Earth, and Moon System | Lesson Preparation


Lesson 1

Materials	Kit Items None School-Supplied Items None
Resources	<input type="checkbox"/> Lesson 1 Resource A: Sky Photographs  (Optional) <input type="checkbox"/> Lesson 1 Resource B: Pacific Ocean Photograph  <input type="checkbox"/> Lesson 1 Resource C: Polynesian Triangle Map  <input type="checkbox"/> Lesson 1 Resource D: Location Mapping Instructions <input type="checkbox"/> Lesson 1 Resource E: “Polynesia’s Genius Navigators” 
Preparation 	<p>Use Google Earth™ mapping service (http://phdsci.link/1310) to bookmark the three locations that make up the corners of the Polynesian Triangle. (See Lesson 1 Resource D.) </p> <p>Advance Preparation for Lesson 1</p> <input type="checkbox"/> 3 or More Days Before: Have students make observations of the sky at the same time and from the same location once a day for 3 consecutive days. Students should choose an area of the sky where the Sun is visible. Warn students not to look directly at the Sun, as this can cause permanent eye damage. Students record their observations in their Science Logbook. If observations in advance are not possible, use the sky photographs in Lesson 1 Resource A.


Lesson 2

Materials	Kit Items None School-Supplied Items None
Resources	<input type="checkbox"/> Lesson 2 Resource: <i>Celestial Navigation</i>  <input type="checkbox"/> <i>Look to the Stars</i> (Aldrin 2009)
Preparation	None


Lesson 3

Materials	<p>Kit Items</p> <ul style="list-style-type: none"> <input type="checkbox"/> Clay, modeling, nonhardening (1 oz) <input type="checkbox"/> Lantern with batteries (1) <p>School-Supplied Items</p> <ul style="list-style-type: none"> <input type="checkbox"/> Pencil, unsharpened (1) <p>Prepared Items from Previous Modules</p> <ul style="list-style-type: none"> <input type="checkbox"/> Fair test criteria chart started in Module 2 <p>Item Reuse</p> <ul style="list-style-type: none"> <input type="checkbox"/> Lesson 4 requires the lantern and unsharpened pencil. <input type="checkbox"/> Lesson 12 requires the prepared class light model.
Resources	<ul style="list-style-type: none"> <input type="checkbox"/> Lesson 3 Resource A: Gateway Arch Photographs  <input type="checkbox"/> Lesson 3 Resource B: Shadow Investigation Setup Photographs
Preparation	None




Lesson 4

Materials	<p>Kit Items</p> <ul style="list-style-type: none"> <input type="checkbox"/> Clay, modeling, nonhardening (6 oz) <input type="checkbox"/> Lanterns with batteries (6) <input type="checkbox"/> Meter sticks (4) <input type="checkbox"/> Protractors (6) <p>Module 1 Kit</p> <ul style="list-style-type: none"> <input type="checkbox"/> Rulers, metric (6) <p>Module 2 Kit</p> <ul style="list-style-type: none"> <input type="checkbox"/> Meter sticks (2) <p>School-Supplied Items</p> <ul style="list-style-type: none"> <input type="checkbox"/> Highlighters or colored pencils (6 sets) <input type="checkbox"/> Pencils, unsharpened (6) <p>Item Reuse</p> <ul style="list-style-type: none"> <input type="checkbox"/> Lesson 6 requires the lanterns. <input type="checkbox"/> Lesson 8 requires the nonhardening modeling clay and unsharpened pencils. <input type="checkbox"/> Lesson 20 requires 1 of the meter sticks. Save all the meter sticks for Lesson 21.
Resources	<ul style="list-style-type: none"> <input type="checkbox"/> Lesson 3 Resource A: Gateway Arch Photographs  <input type="checkbox"/> Lesson 3 Resource B: Shadow Investigation Setup Photographs
Preparation	<p>None</p> <p>Advance Preparation for Lesson 5</p> <ul style="list-style-type: none"> <input type="checkbox"/> 1 Day Before: Take a picture of a shadow cast from the school building in the early morning before school, and record the time that the photograph was taken. The picture should show the full shadow as well as at least part of the building casting the shadow. If possible, use chalk to record the shadow's position.


Lesson 5

Materials	<p>Kit Items</p> <ul style="list-style-type: none"> <input type="checkbox"/> Chalk (1 stick) <input type="checkbox"/> Compasses (12) <p>School-Supplied Items</p> <ul style="list-style-type: none"> <input type="checkbox"/> Camera, digital (1)
Resources	<ul style="list-style-type: none"> <input type="checkbox"/> Lesson 5 Resource A: Shadow Photographs  <input type="checkbox"/> Lesson 5 Resource B: Compass Instructions
Preparation	None



Lesson 6

Materials	<p>Kit Items</p> <ul style="list-style-type: none"> <input type="checkbox"/> Lanterns with batteries (6) <p>School-Supplied Items</p> <ul style="list-style-type: none"> <input type="checkbox"/> Scissors (1) <p>Item Reuse</p> <ul style="list-style-type: none"> <input type="checkbox"/> Lesson 7 requires the lanterns. <input type="checkbox"/> Lesson 14 requires the prepared sets of east and west direction cards.
Resources	<ul style="list-style-type: none"> <input type="checkbox"/> Lesson 6 Resource A: Re and Nut  <input type="checkbox"/> Lesson 6 Resource B: Earth-View Student Model Resources <input type="checkbox"/> Lesson 6 Resource C: Diagram of Earth's Solar System  <input type="checkbox"/> Lesson 6 Resource D: “Galileo and the Moons of Jupiter”
Preparation	<ul style="list-style-type: none"> <input type="checkbox"/> Prepare a set of east and west direction cards (Lesson 6 Resource B, Figure 1) for each group. Consider laminating the cards for future use. <input type="checkbox"/> Cue “One Year on Earth—Seen From 1 Million Miles” (NASA Goddard 2016) video (http://phdsci.link/2403). 


Lesson 7

Materials	<p>Kit Items</p> <ul style="list-style-type: none"> <input type="checkbox"/> Discs, polystyrene foam (6) <input type="checkbox"/> Globes, mini (6) <input type="checkbox"/> Lanterns with batteries (6) <input type="checkbox"/> Sticks, wooden (6) <p>Module 1 Kit</p> <ul style="list-style-type: none"> <input type="checkbox"/> Toothpicks (6) <p>School-Supplied Items</p> <p>None</p> <p>Item Reuse</p> <ul style="list-style-type: none"> <input type="checkbox"/> Lesson 8 requires the lanterns. <input type="checkbox"/> Lesson 9 requires the prepared mini Earth models.
Resources	<ul style="list-style-type: none"> <input type="checkbox"/> Lesson 7 Resource A: Space-View Model Setup Instructions <input type="checkbox"/> Lesson 7 Resource B: World Cities Live Camera Feeds
Preparation	<ul style="list-style-type: none"> <input type="checkbox"/> Cue “One Year on Earth—Seen From 1 Million Miles” (NASA Goddard 2016) video (http://phdsci.link/2403).  <input type="checkbox"/> Cue a live camera feed from a city experiencing nighttime during class. (See Lesson 7 Resource B.)

Lesson 8

Materials	<p>Kit Items</p> <ul style="list-style-type: none"> <input type="checkbox"/> Clay, modeling, nonhardening (6 oz) <input type="checkbox"/> Compasses (6, optional) <input type="checkbox"/> Lanterns with batteries (6) <p>School-Supplied Items</p> <ul style="list-style-type: none"> <input type="checkbox"/> Paper, printer, 8.5" × 11" (6 sheets) <input type="checkbox"/> Pencils, unsharpened (6) <input type="checkbox"/> Scissors (6) <input type="checkbox"/> Tape, clear (partial roll) <p>Item Reuse</p> <ul style="list-style-type: none"> <input type="checkbox"/> Lesson 9 requires the lanterns.
Resources	<ul style="list-style-type: none"> <input type="checkbox"/> Lesson 8 Resource A: Science Challenge Rubric <input type="checkbox"/> Lesson 8 Resource B: Sun Above the Horizon Photograph  <input type="checkbox"/> Lesson 8 Resource C: Ancient Egyptian Sundial Photograph 
Preparation	<ul style="list-style-type: none"> <input type="checkbox"/> Prepare to distribute a copy of the Science Challenge Rubric (Lesson 8 Resource A) to each student.

Lesson 9

Materials	<p>Kit Items</p> <ul style="list-style-type: none"> <input type="checkbox"/> Lanterns with batteries (6) <p>Module 1 Kit</p> <ul style="list-style-type: none"> <input type="checkbox"/> Toothpicks (12) <p>School-Supplied Items</p> <ul style="list-style-type: none"> <input type="checkbox"/> Paper, printer, 8.5" x 11" (1 sheet) <input type="checkbox"/> Scissors (1) <p>Prepared Items from Previous Lessons</p> <ul style="list-style-type: none"> <input type="checkbox"/> Mini Earth models from Lesson 8 (6) <p>Item Reuse</p> <ul style="list-style-type: none"> <input type="checkbox"/> Lesson 10 requires the prepared space-view sundial models. <input type="checkbox"/> Lesson 14 requires the prepared mini Earth models.
Resources	<ul style="list-style-type: none"> <input type="checkbox"/> Lesson 8 Resource A: Science Challenge Rubric <input type="checkbox"/> Lesson 9 Resource: Time Zone Map 
Preparation	<ul style="list-style-type: none"> <input type="checkbox"/> Prepare 2 mini sundials for each group by cutting out paper circles approximately 2 cm in diameter.





Lesson 10

Materials	<p>Kit Items</p> <p>None</p> <p>School-Supplied Items</p> <p>None</p> <p>Prepared Items from Previous Lessons</p> <ul style="list-style-type: none"> <input type="checkbox"/> Space-view sundial models from Lesson 9 (6) <p>Item Reuse</p> <ul style="list-style-type: none"> <input type="checkbox"/> Lesson 11 requires the prepared space-view sundial models.
Resources	<ul style="list-style-type: none"> <input type="checkbox"/> Lesson 8 Resource A: Science Challenge Rubric
Preparation	<p>None</p>





Lesson 11

Materials	<p>Kit Items None</p> <p>School-Supplied Items None</p> <p>Prepared Items from Previous Lessons <input type="checkbox"/> Space-view sundial models from Lesson 9 (6)</p> <p>Item Reuse <input type="checkbox"/> Lesson 12 requires the lanterns.</p>
Resources	None
Preparation	None



Lesson 12

Materials	<p>Kit Items <input type="checkbox"/> Lanterns with batteries (6) <input type="checkbox"/> Spoons, plastic, clear (24)</p> <p>School-Supplied Items <input type="checkbox"/> Scissors (1)</p> <p>Prepared Items from Previous Lessons <input type="checkbox"/> Class light model from Lesson 3</p> <p>Item Reuse <input type="checkbox"/> Lesson 14 requires the lanterns. <input type="checkbox"/> Lesson 17 requires the class light model.</p>
Resources	<p><input type="checkbox"/> Lesson 12 Resource A: Sunrise Data </p> <p><input type="checkbox"/> Lesson 12 Resource B: Cloudy Philippine Sea Photograph </p> <p><input type="checkbox"/> Lesson 12 Resource C: Laser Light Photographs </p>
Preparation	<p><input type="checkbox"/> Cue sunrise video (http://phdsci.link/1902). </p> <p><input type="checkbox"/> Prepare a set of laser light photographs for each group. (See Lesson 12 Resource C.)</p>


Lesson 13

Materials	<p>Kit Items None</p> <p>School-Supplied Items None</p>
Resources	<ul style="list-style-type: none"> <input type="checkbox"/> Lesson 13 Resource A: Sun Photographs  <input type="checkbox"/> Lesson 13 Resource B: Conceptual Checkpoint 
Preparation	<ul style="list-style-type: none"> <input type="checkbox"/> Cue sunrise video (http://phdsci.link/1902).  <input type="checkbox"/> Cue sunset video (http://phdsci.link/2406).  <input type="checkbox"/> Prepare to distribute a copy of Lesson 13 Resource B to each student.


Lesson 14

Materials	<p>Kit Items</p> <ul style="list-style-type: none"> <input type="checkbox"/> Lanterns with batteries (6) <input type="checkbox"/> Balls, polystyrene foam, small (6) <input type="checkbox"/> Discs, polystyrene foam (12) <input type="checkbox"/> Sticks, wooden (6) <p>School-Supplied Items</p> <ul style="list-style-type: none"> <input type="checkbox"/> Scissors (1) <p>Prepared Items from Previous Lessons</p> <ul style="list-style-type: none"> <input type="checkbox"/> East and west direction cards from Lesson 6 (6 sets) <input type="checkbox"/> Mini Earth models from Lesson 7 (6) <p>Item Reuse</p> <ul style="list-style-type: none"> <input type="checkbox"/> Lesson 15 requires the lanterns, prepared mini Earth models, and prepared mini Moon models. <input type="checkbox"/> Lesson 15 requires the prepared sets of east and west direction cards.
Resources	<ul style="list-style-type: none"> <input type="checkbox"/> Lesson 6 Resource B: Earth-View Student Model Resources <input type="checkbox"/> Lesson 14 Resource A: Moon Cards <input type="checkbox"/> Lesson 14 Resource B: Space-View Model Setup Instructions, Figure 1 <input type="checkbox"/> Lesson 14 Resource C: 24-Hour Clock Diagram <input type="checkbox"/> Lesson 14 Resource D: Greek Myth of Selene 
Preparation	<ul style="list-style-type: none"> <input type="checkbox"/> Prepare to distribute a set of the Moon cards to each group. (See Lesson 14 Resource A.) <input type="checkbox"/> Prepare mini Moon models. (See Lesson 14 Resource B.) <input type="checkbox"/> Cue time-lapse video of the Sun and the Moon (http://phdsci.link/1372).  <input type="checkbox"/> Use chart paper to prepare a large version of the 24-hour clock diagram for each group. (See Lesson 14 Resource C.)

Lesson 15




Materials	<p>Kit Items</p> <ul style="list-style-type: none"> <input type="checkbox"/> Lanterns with batteries (6) <p>School-Supplied Items</p> <ul style="list-style-type: none"> <input type="checkbox"/> Scissors (1) <p>Prepared Items from Previous Lessons</p> <ul style="list-style-type: none"> <input type="checkbox"/> East and west direction cards from Lesson 6 (6 sets) <input type="checkbox"/> Mini Earth models from Lesson 7 (6) <input type="checkbox"/> Mini Moon models from Lesson 14 (6) <p>Item Reuse</p> <ul style="list-style-type: none"> <input type="checkbox"/> Lesson 16 requires the lanterns, prepared mini Moon models, and prepared sets of east and west direction cards. <input type="checkbox"/> Lesson 18 requires the mini Earth models.
Resources	<ul style="list-style-type: none"> <input type="checkbox"/> Lesson 14 Resource B: Space-View Model Setup Instructions, Figure 2 <input type="checkbox"/> Lesson 15 Resource A: Moon During the Daytime Photograph  <input type="checkbox"/> Lesson 15 Resource B: Moonrise and Moonset Times
Preparation	<ul style="list-style-type: none"> <input type="checkbox"/> (Optional) Check local moonrise and moonset times to see whether the Moon will be visible from the school's location during class time. <input type="checkbox"/> Prepare to distribute one moonrise and moonset times table and a blank 24-hour timeline to each group. (See Lesson 15 Resource B.)

Lesson 16




Materials	<p>Kit Items</p> <ul style="list-style-type: none"> <input type="checkbox"/> Lanterns with batteries (6) <input type="checkbox"/> Protractors (6, optional) <p>School-Supplied Items</p> <ul style="list-style-type: none"> <input type="checkbox"/> Protractors (18, optional) <p>Prepared Items from Previous Lessons</p> <ul style="list-style-type: none"> <input type="checkbox"/> East and west direction cards from Lesson 6 (6 sets) <input type="checkbox"/> Mini Moon models from Lesson 14 (6) <p>Item Reuse</p> <ul style="list-style-type: none"> <input type="checkbox"/> Lesson 18 requires the lanterns and prepared mini Moon models. <input type="checkbox"/> Lesson 22 requires the prepared sets of east and west direction cards.
Resources	<ul style="list-style-type: none"> <input type="checkbox"/> Lesson 14 Resource C: 24-Hour Clock Diagram <input type="checkbox"/> Lesson 16 Resource: Moonrise and Moonset Data Tables 
Preparation	<ul style="list-style-type: none"> <input type="checkbox"/> Prepare to distribute a set of moonrise and moonset data tables to each group. (See Lesson 16 Resource.) <input type="checkbox"/> Prepare to distribute a copy of the 24-hour clock diagram to each group. (See Lesson 14 Resource C.) <p>Advance Preparation for Lesson 17</p> <ul style="list-style-type: none"> <input type="checkbox"/> 1 Day Before: Prepare the light ray boxes and black pencil sleeves for each group. (See Lesson 17 Resource B.)






Lesson 17

<p>Materials</p>	<p>Kit Items</p> <ul style="list-style-type: none"> <input type="checkbox"/> Boxes with lids, cardboard, 12" × 7" × 4" (6) <input type="checkbox"/> Clay, modeling, nonhardening ($\frac{1}{2}$ lb) <input type="checkbox"/> Flashlights with batteries (6) <input type="checkbox"/> Knife, precision (1) <input type="checkbox"/> Mirror, small (1) <p>Module 1 Kit</p> <ul style="list-style-type: none"> <input type="checkbox"/> Ruler (1) <p>School-Supplied Items</p> <ul style="list-style-type: none"> <input type="checkbox"/> Construction paper, black, 11" × 17" (14 sheets) <input type="checkbox"/> Pencils, wooden, hexagonal, or triangular, sharpened (6) <input type="checkbox"/> Pushpin (1) <input type="checkbox"/> Scissors (1) <input type="checkbox"/> Tape, clear (partial roll) <p>Prepared Items from Previous Lessons</p> <ul style="list-style-type: none"> <input type="checkbox"/> Class light model from Lesson 12
<p>Resources</p>	<ul style="list-style-type: none"> <input type="checkbox"/> Lesson 17 Resource A: Full Moon Photograph  <input type="checkbox"/> Lesson 17 Resource B: Light Ray Box Setup Instructions <input type="checkbox"/> Lesson 17 Resource C: Reflection Demonstration Photographs 
<p>Preparation</p>	<ul style="list-style-type: none"> <input type="checkbox"/> Cue video about black coating which reflects almost no light (http://phdsci.link/2408).  <input type="checkbox"/> Cut enough black construction paper to completely cover the surface of the mirror. (See Lesson 17 Resource C, Figure 3.)




Lesson 18

<p>Materials</p>	<p>Kit Items</p> <ul style="list-style-type: none"> <input type="checkbox"/> Lanterns with batteries (6) <p>School-Supplied Items</p> <ul style="list-style-type: none"> <input type="checkbox"/> Markers, permanent, black (6) <p>Prepared Items from Previous Lessons</p> <ul style="list-style-type: none"> <input type="checkbox"/> Mini Earth models from Lesson 7 (6) <input type="checkbox"/> Mini Moon models from Lesson 14 (6) <p>Item Reuse</p> <ul style="list-style-type: none"> <input type="checkbox"/> Lesson 19 requires the lanterns, markers, mini Earth models, and mini Moon models.
<p>Resources</p>	<ul style="list-style-type: none"> <input type="checkbox"/> Lesson 17 Resource A: Full Moon Photograph  <input type="checkbox"/> Lesson 18 Resource A: Apollo 11 Moon Landing Photograph  <input type="checkbox"/> Lesson 18 Resource B: Space-View Model Setup <input type="checkbox"/> <i>Look to the Stars</i>
<p>Preparation</p>	<ul style="list-style-type: none"> <input type="checkbox"/> Cue NASA animation of Moon's orbit (http://phdsci.link/2409). 


Lesson 19

Materials	<p>Kit Items</p> <ul style="list-style-type: none"> <input type="checkbox"/> Lanterns with batteries (6) <p>School-Supplied Items</p> <ul style="list-style-type: none"> <input type="checkbox"/> Markers, permanent, black (6) <p>Prepared Items from Previous Lessons</p> <ul style="list-style-type: none"> <input type="checkbox"/> Mini Earth models from Lesson 7 (6) <input type="checkbox"/> Mini Moon models from Lesson 14 (6) <p>Item Reuse</p> <ul style="list-style-type: none"> <input type="checkbox"/> Lesson 21 requires the lanterns. <input type="checkbox"/> Lesson 23 requires the mini Earth models.
Resources	<ul style="list-style-type: none"> <input type="checkbox"/> Lesson 19 Resource A: Crescent Moon Photograph  <input type="checkbox"/> Lesson 19 Resource B: Moon Shading Instructions <input type="checkbox"/> Lesson 19 Resource C: Crescent Moon at Night Photograph  <input type="checkbox"/> Lesson 19 Resource D: Conceptual Checkpoint 
Preparation	<ul style="list-style-type: none"> <input type="checkbox"/> Prepare to distribute a copy of Lesson 19 Resource D to each student.




Lesson 20

Materials	<p>Kit Items</p> <ul style="list-style-type: none"> <input type="checkbox"/> Bead, 2-mm (1) <input type="checkbox"/> Meter stick (1) <p>Module 2 Kit</p> <ul style="list-style-type: none"> <input type="checkbox"/> Ball, table tennis (1, optional) <input type="checkbox"/> Ball, tennis (1, optional) <input type="checkbox"/> Marble (1, optional) <p>School-Supplied Items</p> <ul style="list-style-type: none"> <input type="checkbox"/> Basketball, adult size (1) <input type="checkbox"/> Spherical objects (e.g., beach ball, basketball, tennis ball, table tennis ball, marble), different sizes with 2 large and of the same size (at least 4)
Resources	<ul style="list-style-type: none"> <input type="checkbox"/> Lesson 18 Resource A: Apollo 11 Moon Landing Photograph  <input type="checkbox"/> Lesson 20 Resource A: Stars in the Night Sky Photograph  <input type="checkbox"/> Lesson 20 Resource B: “All About Stars” Summary <input type="checkbox"/> Lesson 20 Resource C: Sun Photograph 
Preparation	<ul style="list-style-type: none"> <input type="checkbox"/> Prepare to distribute a copy of “All About Stars” Summary to each student. (See Lesson 20 Resource B.) <p>Advance Preparation for Lesson 21</p> <ul style="list-style-type: none"> <input type="checkbox"/> 1 Day Before: Prepare light intensity comparers. (See Lesson 21 Resource B.)


Lesson 21

Materials	<p>Kit Items</p> <ul style="list-style-type: none"> <input type="checkbox"/> Aluminum foil, 4.5" × 1.13" (6) <input type="checkbox"/> Knife, serrated (1) <input type="checkbox"/> Lanterns with batteries (6) <input type="checkbox"/> Meter sticks (4) <input type="checkbox"/> Paraffin blocks, 4.5" × 2.25" × 0.75" (6) <input type="checkbox"/> Tape, electrical (1 roll) <input type="checkbox"/> Tealights, LED, nonflickering (12) <p>Module 1 Kit</p> <ul style="list-style-type: none"> <input type="checkbox"/> Ruler, metric (1) <p>Module 2 Kit</p> <ul style="list-style-type: none"> <input type="checkbox"/> Meter sticks (2) <p>School-Supplied Items</p> <ul style="list-style-type: none"> <input type="checkbox"/> Scissors (1) <p>Item Reuse</p> <ul style="list-style-type: none"> <input type="checkbox"/> Lesson 22 requires the lanterns.
Resources	<ul style="list-style-type: none"> <input type="checkbox"/> Lesson 21 Resource A: Star Field Image  <input type="checkbox"/> Lesson 21 Resource B: Light Intensity Comparer Setup Instructions and Procedure <input type="checkbox"/> <i>Look Up! Henrietta Leavitt, Pioneering Woman Astronomer</i> (Burleigh and Colón 2013)
Preparation	None

Lesson 22

Materials	<p>Kit Items</p> <ul style="list-style-type: none"> <input type="checkbox"/> Lanterns with batteries (6) <input type="checkbox"/> Star stickers ($\frac{1}{2}$ of total) <p>School-Supplied Items</p> <p>None</p> <p>Prepared Items from Previous Lessons</p> <ul style="list-style-type: none"> <input type="checkbox"/> East and west direction cards from Lesson 7 (6 sets) <p>Item Reuse</p> <ul style="list-style-type: none"> <input type="checkbox"/> Lesson 23 requires the lanterns, prepared east and west direction cards, and star stickers placed on walls.
Resources	None
Preparation	<ul style="list-style-type: none"> <input type="checkbox"/> Set aside half of the vinyl star stickers for use in Lesson 23. <input type="checkbox"/> Cue time-lapse video of Sirius and Orion (http://phdsci.link/1379).  <input type="checkbox"/> Cue time-lapse video of Sirius, Orion, and moonset (http://phdsci.link/1380).  <input type="checkbox"/> Cue time-lapse video of the night sky in the desert (http://phdsci.link/1381). 





Lesson 23

Materials	<p>Kit Items</p> <ul style="list-style-type: none"> <input type="checkbox"/> Lanterns with batteries (6) <input type="checkbox"/> Star stickers ($\frac{1}{2}$ of total) <p>School-Supplied Items</p> <p>None</p> <p>Prepared Items from Previous Lessons</p> <ul style="list-style-type: none"> <input type="checkbox"/> East and west direction cards from Lesson 7 (6 sets) <input type="checkbox"/> Mini Earth models from Lesson 7 (6) <p>Item Reuse</p> <ul style="list-style-type: none"> <input type="checkbox"/> Lesson 25 requires the lanterns, prepared mini Earth models, and star stickers placed on walls.
Resources	<ul style="list-style-type: none"> <input type="checkbox"/> Lesson 23 Resource: Ursa Minor with Outline of Little Dipper
Preparation	<ul style="list-style-type: none"> <input type="checkbox"/> Cue time-lapse video of the night sky in the desert (http://phdsci.link/1381). 

Lesson 24

Materials	<p>Kit Items</p> <p>None</p> <p>School-Supplied Items</p> <p>None</p>
Resources	<ul style="list-style-type: none"> <input type="checkbox"/> Lesson 24 Resource A: Star Map Instructions and Samples <input type="checkbox"/> Lesson 24 Resource B: Star Maps <input type="checkbox"/> Lesson 24 Resource C: Sample Class Data Table
Preparation	<ul style="list-style-type: none"> <input type="checkbox"/> Generate local star maps for two different dates or use provided samples. (See Lesson 24 Resource A.) <input type="checkbox"/> Prepare a copy of Lesson 24 Resource B and provide each group with two star maps: one for a month in 2017 and another for the same month in 2018.



Lesson 25

Materials	<p>Kit Items</p> <ul style="list-style-type: none"> <input type="checkbox"/> Lanterns with batteries (6) <p>School-Supplied Items</p> <ul style="list-style-type: none"> <input type="checkbox"/> Tape (partial roll) <p>Prepared Items from Previous Lessons</p> <ul style="list-style-type: none"> <input type="checkbox"/> Mini Earth models from Lesson 7 (6) <input type="checkbox"/> Star stickers placed in Lessons 22 and 23
Resources	<ul style="list-style-type: none"> <input type="checkbox"/> Lesson 24 Resource C: Sample Class Data Table <input type="checkbox"/> Lesson 25 Resource A: Constellation Images <input type="checkbox"/> Lesson 25 Resource B: Classroom Constellation Map <input type="checkbox"/> Lesson 25 Resource C: Conceptual Checkpoint  <input type="checkbox"/> Lesson 27 Resource: Milepost in Hawaii Photograph 
Preparation	<ul style="list-style-type: none"> <input type="checkbox"/> Prepare month signs and a copy of the constellations for students to post around the classroom. (See Lesson 25 Resources A and B.) <input type="checkbox"/> Cue time-lapse video of a solar eclipse (http://phdsci.link/1382).  <input type="checkbox"/> Cue NASA animation of Moon's orbit (http://phdsci.link/2409).  <input type="checkbox"/> Prepare to distribute a copy of Lesson 25 Resource C to each student.

Lesson 26

Materials	<p>Kit Items</p> <p>None</p> <p>School-Supplied Items</p> <ul style="list-style-type: none"> <input type="checkbox"/> Glue sticks (24) <input type="checkbox"/> Scissors (24)
Resources	None
Preparation	None

Lesson 27

Materials	<p>Kit Items None</p> <p>School-Supplied Items None</p>
Resources	<input type="checkbox"/> Lesson 27 Resource: Milepost in Hawaii Photograph 
Preparation	<input type="checkbox"/> Cue Tracing Moments of Lahaina Noon video (http://phdsci.link/2411).  <input type="checkbox"/> Prepare to distribute a copy of the End-of-Module Assessment to each student.

Lesson 28

Materials	<p>Kit Items None</p> <p>School-Supplied Items</p> <ul style="list-style-type: none"> <input type="checkbox"/> Pencils, 2 different colors (24 of each) <input type="checkbox"/> Scissors (1)
Resources	<ul style="list-style-type: none"> <input type="checkbox"/> Lesson 28 Resource A: Module Concept Statements <input type="checkbox"/> Lesson 28 Resource B: Recurring Themes and Concepts <input type="checkbox"/> End-of-Module Assessment Rubric
Preparation	<ul style="list-style-type: none"> <input type="checkbox"/> Score End-of-Module Assessments and write individual feedback. <input type="checkbox"/> Select End-of-Module Assessment responses to share with students. <input type="checkbox"/> Prepare visual for student connections between module learning and content standards. (See Lesson 28 Resources A and B.)





Forces, Motion, and Energy | Advance Preparation

Some 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
11	1 day†	Design Solution Models	Prepare the train model and train station map model.
12	1 day†	Capstone Project Areas Setup	Prepare the Writing Area, Models and Research Area, Materials Area, and Meeting Area to use throughout the Capstone Project.

Forces, Motion, and Energy | Lesson Preparation



Lesson 1

Materials	<p>Kit Items None</p> <p>School-Supplied Items</p> <ul style="list-style-type: none"> <input type="checkbox"/> Glue stick (1) <input type="checkbox"/> Markers, 3 different colors (1 set) <input type="checkbox"/> Pencils, 3 different colors (24 sets) <input type="checkbox"/> Scissors (1)
Resources	<ul style="list-style-type: none"> <input type="checkbox"/> Lesson 1 Resource A: Crosswalk Photograph  <input type="checkbox"/> Lesson 1 Resource B: Light Rail Train System Diagram 
Preparation	<ul style="list-style-type: none"> <input type="checkbox"/> Prepare anchor model. Print and cut out the diagram from Lesson 1 Resource B. Glue or tape the diagram near the top of a sheet of chart paper. Leave space at the top of the chart paper for a title and space below the diagram for additional models. Have markers in three colors available and use one color to update the model during the lesson. <input type="checkbox"/> Cue the DART Rail introduction video (http://phdsci.link/1989).  <input type="checkbox"/> Cue the DART Rail train leaving station video (http://phdsci.link/1985). 





Lesson 2

<p>Materials</p>	<p>Kit Items</p> <ul style="list-style-type: none"> <input type="checkbox"/> Hall's cars (6) <input type="checkbox"/> Meter sticks (4) <input type="checkbox"/> Spring scales, push, 5 N (6) <input type="checkbox"/> Stopwatches (6) <p>Module 1 Kit</p> <ul style="list-style-type: none"> <input type="checkbox"/> Safety goggles, student (24) <input type="checkbox"/> Safety goggles, teacher (1) <p>Module 2 Kit</p> <ul style="list-style-type: none"> <input type="checkbox"/> Meter sticks (2) <p>School-Supplied Items</p> <ul style="list-style-type: none"> <input type="checkbox"/> Markers, permanent (6) <input type="checkbox"/> Paper, scratch (6 sheets) <input type="checkbox"/> Tape, masking (6 rolls) <p>Item Reuse</p> <ul style="list-style-type: none"> <input type="checkbox"/> Lesson 3 requires the prepared force investigation materials.
<p>Resources</p>	<ul style="list-style-type: none"> <input type="checkbox"/> Lesson 2 Resource A: Spring Scale Calibration Instructions  <input type="checkbox"/> Lesson 2 Resource B: Investigation Materials Setup Instructions <input type="checkbox"/> Lesson 2 Resource C: Sample Force Investigation Testing Procedure
<p>Preparation</p>	<ul style="list-style-type: none"> <input type="checkbox"/> Cue the DART Rail train leaving station video (http://phdsci.link/1985).  <input type="checkbox"/> Calibrate push spring scales. (See Lesson 2 Resource A.) <input type="checkbox"/> Set up materials for the force investigation. (See Lesson 2 Resource B.)




Lesson 3

<p>Materials</p>	<p>Kit Items None</p> <p>Module 1 Kit</p> <ul style="list-style-type: none"> <input type="checkbox"/> Safety goggles, student (24) <input type="checkbox"/> Safety goggles, teacher (1) <p>School-Supplied Items</p> <ul style="list-style-type: none"> <input type="checkbox"/> Paper, scratch (24 sheets) <p>Prepared Items from Previous Lessons</p> <ul style="list-style-type: none"> <input type="checkbox"/> Force investigation materials from Lesson 2 (6 sets) <p>Item Reuse</p> <ul style="list-style-type: none"> <input type="checkbox"/> Lesson 4 requires the Hall's cars, meter sticks, permanent markers, and stopwatches.
<p>Resources</p>	<ul style="list-style-type: none"> <input type="checkbox"/> Lesson 2 Resource A: Spring Scale Calibration Instructions  <input type="checkbox"/> Lesson 2 Resource B: Investigation Materials Setup Instructions <input type="checkbox"/> Lesson 2 Resource C: Sample Force Investigation Testing Procedure
<p>Preparation</p>	<ul style="list-style-type: none"> <input type="checkbox"/> Calibrate push spring scales. (See Lesson 2 Resource A.) <input type="checkbox"/> Set up materials for the force investigation. (See Lesson 2 Resource B.) <input type="checkbox"/> Cue video of passengers boarding a DART Rail train (http://phdsci.link/1986). 






Lesson 4

<p>Materials</p>	<p>Kit Items</p> <ul style="list-style-type: none"> <input type="checkbox"/> Erasers, wedge, medium (30) <input type="checkbox"/> Hall’s cars (6) <input type="checkbox"/> Meter sticks (4) <input type="checkbox"/> Spring scales, push, 5 N (6) <input type="checkbox"/> Stopwatches (6) <p>Module 1 Kit</p> <ul style="list-style-type: none"> <input type="checkbox"/> Safety goggles, student (24) <input type="checkbox"/> Safety goggles, teacher (1) <p>Module 2 Kit</p> <ul style="list-style-type: none"> <input type="checkbox"/> Meter sticks (2) <p>School-Supplied Items</p> <ul style="list-style-type: none"> <input type="checkbox"/> Markers, 3 different colors (1 set) <input type="checkbox"/> Markers, permanent (6) <input type="checkbox"/> Paper, scratch (6 sheets) <input type="checkbox"/> Scissors (1) <input type="checkbox"/> Tape, masking (6 rolls) <p>Item Reuse</p> <ul style="list-style-type: none"> <input type="checkbox"/> Lesson 5 requires the Hall’s cars and spring scales. <input type="checkbox"/> Lesson 7 requires 6 of the erasers.
<p>Resources</p>	<ul style="list-style-type: none"> <input type="checkbox"/> Lesson 2 Resource A: Spring Scale Calibration Instructions  <input type="checkbox"/> Lesson 2 Resource B: Investigation Materials Setup Instructions <input type="checkbox"/> Lesson 4 Resource A: DART Rail Train Interior Photographs  <input type="checkbox"/> Lesson 4 Resource B: Crowded Train Photograph  <input type="checkbox"/> Lesson 4 Resource C: Mass Investigation Procedure <input type="checkbox"/> Lesson 4 Resource D: Traction Motor Diagram 
<p>Preparation</p>	<ul style="list-style-type: none"> <input type="checkbox"/> Calibrate push spring scales. (See Lesson 2 Resource A.) <input type="checkbox"/> Set up materials for the force investigation. (See Lesson 2 Resource B.) <input type="checkbox"/> Prepare to distribute the mass investigation setup and testing procedure sheets to each group. (See Lesson 4 Resource C.)




Lesson 5

<p>Materials</p>	<p>Kit Items</p> <ul style="list-style-type: none"> <input type="checkbox"/> Felt, 9" × 12" (12 sheets) <input type="checkbox"/> Hall's cars (6) <input type="checkbox"/> Hook and loop fastener, 6" strips (12) <input type="checkbox"/> Sandpaper, 9" × 11" (12 sheets) <input type="checkbox"/> Spring scales, push, 5 N (6) <p>Module 1 Kit</p> <ul style="list-style-type: none"> <input type="checkbox"/> Safety goggles, student (24) <input type="checkbox"/> Safety goggles, teacher (1) <p>School-Supplied Items</p> <ul style="list-style-type: none"> <input type="checkbox"/> Markers, 3 different colors (1 set) <input type="checkbox"/> Scissors (1) <input type="checkbox"/> Tape, masking (6 rolls) <p>Item Reuse</p> <ul style="list-style-type: none"> <input type="checkbox"/> Lesson 11 requires 3 of the Hall's cars and 3 of the spring scales.
<p>Resources</p>	<ul style="list-style-type: none"> <input type="checkbox"/> Lesson 2 Resource A: Spring Scale Calibration Instructions  <input type="checkbox"/> Lesson 5 Resource: Magnetic Friction Brake Photograph 
<p>Preparation</p>	<ul style="list-style-type: none"> <input type="checkbox"/> Calibrate push spring scales. (See Lesson 2 Resource A.) <input type="checkbox"/> Prepare hook and loop fasteners for each group. Cut enough strips so that each group receives two 6" strips of the hook side and two 6" strips of the loop side. <input type="checkbox"/> Cue DART Rail train arriving at station video (http://phdsci.link/1991). 


Lesson 6

<p>Materials</p>	<p>Kit Items</p> <ul style="list-style-type: none"> <input type="checkbox"/> Aluminum foil, 8 cm × 30 cm (1) <input type="checkbox"/> Batteries, D (7) <input type="checkbox"/> Battery holders, D (6) <input type="checkbox"/> DC motors (6) <input type="checkbox"/> Flashlight bulb, incandescent (1) <input type="checkbox"/> Tape, copper foil, 1 cm wide (partial roll) <input type="checkbox"/> Tape, electrical (partial roll) <p>Module 1 Kit</p> <ul style="list-style-type: none"> <input type="checkbox"/> Ruler, metric (1) <p>School-Supplied Items</p> <ul style="list-style-type: none"> <input type="checkbox"/> Highlighters (24) <input type="checkbox"/> Scissors (6) <input type="checkbox"/> Tape, masking (6 rolls) <p>Item Reuse</p> <ul style="list-style-type: none"> <input type="checkbox"/> Lesson 7 requires the prepared light rail circuit models. <input type="checkbox"/> Lesson 9 requires the incandescent flashlight bulb.
<p>Resources</p>	<ul style="list-style-type: none"> <input type="checkbox"/> Lesson 6 Resource A: Circuit Troubleshooting Guide (Optional) <input type="checkbox"/> Lesson 6 Resource B: Closed Circuit Demonstration Setup Instructions <input type="checkbox"/> Lesson 6 Resource C: Electric Grid Diagram  <input type="checkbox"/> Lesson 6 Resource D: Light Rail Circuit Diagram  <input type="checkbox"/> Lesson 6 Resource E: Light Rail Circuit Model Setup Instructions
<p>Preparation</p>	<ul style="list-style-type: none"> <input type="checkbox"/> Cue DART Rail train at night video (http://phdsci.link/2066).  <input type="checkbox"/> Prepare the circuit for the closed circuit demonstration. (See Lesson 6 Resource B.) <input type="checkbox"/> Prepare to distribute a copy of the electric grid diagram to each group. (See Lesson 6 Resource C.) <input type="checkbox"/> Prepare to distribute a copy of the light rail circuit diagram to each group. (See Lesson 6 Resource D.) <input type="checkbox"/> Prepare materials for the light rail circuit model investigation. (See Lesson 6 Resource E.) <input type="checkbox"/> Cue pantograph motion video (http://phdsci.link/2064).  <input type="checkbox"/> Cue DART Rail train pantograph video (http://phdsci.link/2065). 

Lesson 7

<p>Materials</p>	<p>Kit Items</p> <ul style="list-style-type: none"> <input type="checkbox"/> Beads, glass, flat (6) <input type="checkbox"/> Cotton balls (6) <input type="checkbox"/> Erasers, wedge, medium (6) <input type="checkbox"/> Nails, steel (6) <input type="checkbox"/> Pencil graphite (6) <input type="checkbox"/> Tape, copper foil, 1 cm wide (partial roll) <p>Module 1 Kit</p> <ul style="list-style-type: none"> <input type="checkbox"/> Ruler, metric (1) <p>Module 2 Kit</p> <ul style="list-style-type: none"> <input type="checkbox"/> Bingo chips (6) <p>School-Supplied Items</p> <ul style="list-style-type: none"> <input type="checkbox"/> Highlighters (24) <input type="checkbox"/> Pennies (6) <input type="checkbox"/> Scissors (6) <p>Prepared Items from Previous Lessons</p> <ul style="list-style-type: none"> <input type="checkbox"/> Light rail circuit models from Lesson 6 (6) <p>Item Reuse</p> <ul style="list-style-type: none"> <input type="checkbox"/> Lesson 8 requires the batteries with holders and 4 of the DC motors.
<p>Resources</p>	<ul style="list-style-type: none"> <input type="checkbox"/> Lesson 6 Resource A: Circuit Troubleshooting Guide <input type="checkbox"/> Lesson 7 Resource A: Pantograph Photograph  <input type="checkbox"/> Lesson 7 Resource B: Pantograph Materials Investigation Photographs <input type="checkbox"/> Lesson 7 Resource C: Pantograph Diagram 
<p>Preparation</p>	<ul style="list-style-type: none"> <input type="checkbox"/> Measure and cut copper foil tape into 10 cm long strips for the pantograph materials investigation. Prepare three strips for each group. <input type="checkbox"/> Cue DART Rail train at the end of the line video (http://phdsci.link/2067). 


Lesson 8

Materials	<p>Kit Items</p> <ul style="list-style-type: none"> <input type="checkbox"/> Alligator clip cords (24) <input type="checkbox"/> Batteries, D (12) <input type="checkbox"/> Battery holders, D (12) <input type="checkbox"/> Buzzers (4) <input type="checkbox"/> DC motors (4) <input type="checkbox"/> Flashlight bulbs, incandescent (4) <input type="checkbox"/> Light bulb holders (4) <p>Module 1 Kit</p> <ul style="list-style-type: none"> <input type="checkbox"/> Safety goggles, student (24) <input type="checkbox"/> Safety goggles, teacher (1) <p>School-Supplied Items</p> <p>None</p> <p>Item Reuse</p> <ul style="list-style-type: none"> <input type="checkbox"/> Lesson 9 requires the alligator clip cords, D batteries with holders, DC motors, and light bulb holders.
Resources	<ul style="list-style-type: none"> <input type="checkbox"/> Lesson 6 Resource A: Circuit Troubleshooting Guide (Optional) <input type="checkbox"/> Lesson 8 Resource: Device Stations Setup Instructions
Preparation	<ul style="list-style-type: none"> <input type="checkbox"/> Cue the DART Train interior video (http://phdsci.link/2097).  <input type="checkbox"/> Prepare the device stations. (See Lesson 8 Resource.)





Lesson 9

Materials	<p>Kit Items</p> <ul style="list-style-type: none"> <input type="checkbox"/> Alligator clip cords (36) <input type="checkbox"/> Batteries, D (12) <input type="checkbox"/> Battery holders, D (12) <input type="checkbox"/> DC motors (6) <input type="checkbox"/> Flashlight bulbs, incandescent (6) <input type="checkbox"/> Light bulb holders (6) <input type="checkbox"/> Switches, knife (12) <p>Module 1 Kit</p> <ul style="list-style-type: none"> <input type="checkbox"/> Safety goggles, student (24) <input type="checkbox"/> Safety goggles, teacher (1) <p>School-Supplied Items</p> <ul style="list-style-type: none"> <input type="checkbox"/> Glue stick (1) <input type="checkbox"/> Markers, 2 different colors (1 set) <input type="checkbox"/> Scissors (1) <p>Item Reuse</p> <ul style="list-style-type: none"> <input type="checkbox"/> Lesson 11 requires 3 of each of the alligator clip cords, D batteries with holders, incandescent flashlight bulbs with holders, and knife switches. <input type="checkbox"/> Lesson 12 requires the batteries with holders.
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Lesson 9 *continued*

Resources	<ul style="list-style-type: none"> <input type="checkbox"/> Lesson 6 Resource A: Circuit Troubleshooting Guide (Optional) <input type="checkbox"/> Lesson 6 Resource D: Light Rail Circuit Diagram <input type="checkbox"/> Lesson 9 Resource A: Circuit with Multiple Devices Investigation Photographs <input type="checkbox"/> Lesson 9 Resource B: Circuit Diagram Key 
Preparation	<ul style="list-style-type: none"> <input type="checkbox"/> Prepare materials for circuits with multiple devices investigation. Place the batteries into the battery holders. Place the incandescent flashlight bulbs into the light bulb holders. <input type="checkbox"/> Prepare anchor model. Print and cut out the diagram from Lesson 6 Resource D. Glue or tape the diagram under the anchor model from Lesson 5. Leave space above the new model for a title and space below the diagram for an additional model.





Lesson 10

Materials	<p>Kit Items None</p> <p>School-Supplied Items None</p>
Resources	<ul style="list-style-type: none"> <input type="checkbox"/> Lesson 6 Resource D: Light Rail Circuit Diagram <input type="checkbox"/> Lesson 10 Resource A: Toaster Photograph and Electric Heating Diagram  <input type="checkbox"/> Lesson 10 Resource B: Cup Photographs  <input type="checkbox"/> Lesson 10 Resource C: Light Rail Train Window Photograph  <input type="checkbox"/> Lesson 10 Resource D: Insulating Window Types <input type="checkbox"/> Lesson 10 Resource E: Evaluating Window Types
<p>Preparation</p> 	<p>None</p> <p>Advance Preparation for Lesson 11</p> <ul style="list-style-type: none"> <input type="checkbox"/> 1 Day Before: Prepare light rail models. (See Lesson 11 Resource C.)


Lesson 11

Materials	Kit Items <ul style="list-style-type: none"><input type="checkbox"/> Alligator clip cords (3)<input type="checkbox"/> Aluminum foil, 2" × 2" (3)<input type="checkbox"/> Batteries, D (3)<input type="checkbox"/> Battery holders, D (3)<input type="checkbox"/> Cardboard, 6" × 7" (3)<input type="checkbox"/> Clay, modeling, nonhardening, 1" balls (3)<input type="checkbox"/> Craft foam sheets, 2" × 2" (3)<input type="checkbox"/> Craft sticks, wax (3)<input type="checkbox"/> Flashlight bulbs, incandescent (3)<input type="checkbox"/> Hall's cars (3)<input type="checkbox"/> Light bulb holders (3)<input type="checkbox"/> Rubber bands (3)<input type="checkbox"/> Spring scales, push, 5 N (3)<input type="checkbox"/> String, 6" piece (3)<input type="checkbox"/> Switches, knife (3)<input type="checkbox"/> Tape, copper foil, 1 cm wide, 3" piece (3)<input type="checkbox"/> Tape, electrical (partial roll)<input type="checkbox"/> Toy cars, small (3) Module 1 Kit <ul style="list-style-type: none"><input type="checkbox"/> Chenille stems (3)<input type="checkbox"/> Craft sticks, jumbo (3)<input type="checkbox"/> Ruler (1) School-Supplied Items <ul style="list-style-type: none"><input type="checkbox"/> Cellophane, colored (3 sheets, optional)<input type="checkbox"/> Computers or tablets with internet access (3)<input type="checkbox"/> Glue stick (1)<input type="checkbox"/> Hole punch, single-hole (1)<input type="checkbox"/> LEDs, colored (3, optional)<input type="checkbox"/> Manila folders (3)<input type="checkbox"/> Paper clips (3)<input type="checkbox"/> Scissors (1)<input type="checkbox"/> Tape, masking (partial roll) Item Reuse <ul style="list-style-type: none"><input type="checkbox"/> Lesson 12 requires the Eliza and Patrick rider stations materials.
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Lesson 11 *continued*

Resources	<ul style="list-style-type: none"><input type="checkbox"/> Lesson 11 Resource A: Capstone Project Rubrics<input type="checkbox"/> Lesson 11 Resource B: Engineering Design Process Visual <input type="checkbox"/> Lesson 11 Resource C: Light Rail Model Setup Instructions<input type="checkbox"/> Lesson 11 Resource D: Rider Stations Setup Instructions<input type="checkbox"/> Lesson 11 Resource E: Rider Cards<input type="checkbox"/> Lesson 11 Resource F: Accessible Design Cards<input type="checkbox"/> Lesson 11 Resource G: Audio Files Transcript Card
Preparation 	<ul style="list-style-type: none"><input type="checkbox"/> Cue the riding DART Rail video (http://phdsci.link/2120). <input type="checkbox"/> Cue train accessibility video (http://phdsci.link/2119). <input type="checkbox"/> Prepare rider stations. (See Lesson 11 Resource D.)<input type="checkbox"/> Prepare to distribute the selected rider card to each student. (See Lesson 11 Resource E.) <p>Advance Preparation for Lesson 12</p> <ul style="list-style-type: none"><input type="checkbox"/> 1 Day Before: Prepare the Writing Area, Models and Research Area, Materials Area, and Meeting Area. (See Lesson 12 Resource B.)



Lesson 12

<p>Materials</p>	<p>Kit Items</p> <ul style="list-style-type: none"> <input type="checkbox"/> Alligator clip cords (36) <input type="checkbox"/> Aluminum foil (partial roll) <input type="checkbox"/> Batteries, D (12) <input type="checkbox"/> Battery holders, D (12) <input type="checkbox"/> Clay, modeling, nonhardening (1 lb) <input type="checkbox"/> Craft foam sheets, 9" × 12" (5) <input type="checkbox"/> Craft sticks, wax (30) <input type="checkbox"/> Flashlight bulbs, incandescent (9) <input type="checkbox"/> Light bulb holders (9) <input type="checkbox"/> Rubber bands (25) <input type="checkbox"/> Spring scales, push, 5 N (3) <input type="checkbox"/> String (partial spool) <input type="checkbox"/> Switches, knife (12) <input type="checkbox"/> Tape, copper foil, 1 cm wide (3 rolls) <input type="checkbox"/> Toy cars, small (3) <p>Module 1 Kit</p> <ul style="list-style-type: none"> <input type="checkbox"/> Chenille stems (30) <input type="checkbox"/> Craft sticks, jumbo (30) <input type="checkbox"/> Safety goggles, student (24) <input type="checkbox"/> Safety goggles, teacher (1) <p>School-Supplied Items</p> <ul style="list-style-type: none"> <input type="checkbox"/> Cellophane, colored (9 sheets, optional) <input type="checkbox"/> Computers or tablets with internet access (3) <input type="checkbox"/> LEDs, colored (20, optional) <input type="checkbox"/> Paper clips (50) <input type="checkbox"/> Scissors (1) <p>Prepared Items from Previous Lessons</p> <ul style="list-style-type: none"> <input type="checkbox"/> Train models for Eliza from Lesson 11 (3) <input type="checkbox"/> Train station map models for Patrick from Lesson 11 (3) <p>Item Reuse</p> <ul style="list-style-type: none"> <input type="checkbox"/> Lesson 13 requires the Models and Research Area materials, Materials Area materials, train models for Eliza and train station map models for Patrick.
<p>Resources</p>	<ul style="list-style-type: none"> <input type="checkbox"/> Lesson 11 Resource A: Capstone Project Rubrics <input type="checkbox"/> Lesson 11 Resource B: Engineering Design Process Visual  <input type="checkbox"/> Lesson 11 Resource C: Light Rail Model Setup Instructions <input type="checkbox"/> Lesson 11 Resource F: Accessible Design Cards <input type="checkbox"/> Lesson 11 Resource G: Audio Files Transcript Card <input type="checkbox"/> Lesson 12 Resource A: Project Proposal Meeting Tool <input type="checkbox"/> Lesson 12 Resource B: Capstone Project Areas Setup Instructions <input type="checkbox"/> Lesson 12 Resource C: Area Cards <input type="checkbox"/> Lesson 12 Resource D: Sample Capstone Project Solutions
<p>Preparation</p>	<p>None</p>


Lesson 13

<p>Materials</p>	<p>Kit Items</p> <ul style="list-style-type: none"> <input type="checkbox"/> Hook and loop fastener, 6" strips (6, optional) <p>Module 1 Kit</p> <ul style="list-style-type: none"> <input type="checkbox"/> Safety goggles, student (24) <input type="checkbox"/> Safety goggles, teacher (1) <p>School-Supplied Items</p> <ul style="list-style-type: none"> <input type="checkbox"/> Glue, liquid, white (6 bottles) <input type="checkbox"/> Glue sticks (6) <input type="checkbox"/> Scissors (6) <input type="checkbox"/> Tape, clear (6 rolls) <input type="checkbox"/> Tape, double-sided (6 rolls, optional) <p>Prepared Items from Previous Lessons</p> <ul style="list-style-type: none"> <input type="checkbox"/> Hook and loop fastener strips from Lesson 5 (6, optional) <input type="checkbox"/> Train models for Eliza from Lesson 11 (3) <input type="checkbox"/> Train station map models for Patrick from Lesson 11 (3) <input type="checkbox"/> Models and Research Area materials from Lesson 12 (1 set) <input type="checkbox"/> Materials Area materials from Lesson 12 (1 set) <p>Item Reuse</p> <ul style="list-style-type: none"> <input type="checkbox"/> Lesson 14 requires the Models and Research Area materials, Materials Area materials, train models for Eliza, train model station map models for Patrick, and Capstone Project building tools.
<p>Resources</p>	<ul style="list-style-type: none"> <input type="checkbox"/> Lesson 11 Resource A: Capstone Project Rubrics <input type="checkbox"/> Lesson 11 Resource B: Engineering Design Process Visual  <input type="checkbox"/> Lesson 11 Resource C: Light Rail Model Setup Instructions <input type="checkbox"/> Lesson 11 Resource F: Accessible Design Cards <input type="checkbox"/> Lesson 11 Resource G: Audio Files Transcript Card <input type="checkbox"/> Lesson 12 Resource A: Project Proposal Meeting Tool  <input type="checkbox"/> Lesson 12 Resource C: Area Cards <input type="checkbox"/> Lesson 12 Resource D: Sample Capstone Project Solutions
<p>Preparation</p>	<ul style="list-style-type: none"> <input type="checkbox"/> Prepare additional light rail models as needed. (See Lesson 11 Resource C.)


Lesson 14

<p>Materials</p>	<p>Kit Items None</p> <p>Module 1 Kit</p> <ul style="list-style-type: none"> <input type="checkbox"/> Safety goggles, student (24) <input type="checkbox"/> Safety goggles, teacher (1) <p>School-Supplied Items None</p> <p>Prepared Items from Previous Lessons</p> <ul style="list-style-type: none"> <input type="checkbox"/> Hook and loop fastener strips from Lesson 5 (6, optional) <input type="checkbox"/> Train models for Eliza from Lesson 11 (3) <input type="checkbox"/> Train station map models for Patrick from Lesson 11 (3) <input type="checkbox"/> Capstone Project building tools from Lesson 13 (6 sets) <input type="checkbox"/> Models and Research Area materials from Lesson 13 (1 set) <input type="checkbox"/> Materials Area materials from Lesson 13 (1 set) <p>Item Reuse</p> <ul style="list-style-type: none"> <input type="checkbox"/> Lesson 15 requires the train models for Eliza and train station map models for Patrick.
<p>Resources</p>	<ul style="list-style-type: none"> <input type="checkbox"/> Lesson 11 Resource A: Capstone Project Rubrics <input type="checkbox"/> Lesson 11 Resource B: Engineering Design Process Visual  <input type="checkbox"/> Lesson 11 Resource F: Accessible Design Cards <input type="checkbox"/> Lesson 11 Resource G: Audio Files Transcript Card <input type="checkbox"/> Lesson 12 Resource A: Project Proposal Meeting Tool  <input type="checkbox"/> Lesson 12 Resource C: Area Cards
<p>Preparation</p>	<ul style="list-style-type: none"> <input type="checkbox"/> Prepare additional light rail models as needed. (See Lesson 11 Resource C.)

Lesson 15

<p>Materials</p>	<p>Kit Items None</p> <p>School-Supplied Items None</p> <p>Prepared Items from Previous Lessons</p> <ul style="list-style-type: none"> <input type="checkbox"/> Train models for Eliza from Lesson 11 (3) <input type="checkbox"/> Train station map models for Patrick from Lesson 11 (3)
<p>Resources</p>	<ul style="list-style-type: none"> <input type="checkbox"/> Lesson 11 Resource A: Capstone Project Rubrics <input type="checkbox"/> Lesson 11 Resource B: Engineering Design Process Visual 
<p>Preparation</p>	<p>None</p>

Lesson 16

Materials	Kit Items None School-Supplied Items <input type="checkbox"/> Glue sticks (24) <input type="checkbox"/> Scissors (24)
Resources	<input type="checkbox"/> Lesson 16 Resource: 3D Printer Process Information Sheet
Preparation	<input type="checkbox"/> Cue time-lapse video of 3D printer (http://phdsci.link/2446).  <input type="checkbox"/> Prepare to distribute a copy of Lesson 16 Resource to each student. <input type="checkbox"/> Prepare to distribute a copy of the End-of-Module Assessment to each student.

Lesson 17

Materials	Kit Items None School-Supplied Items <input type="checkbox"/> Pencils, 3 different colors (24 sets)
Resources	<input type="checkbox"/> Lesson 17 Resource A: Content Standards <input type="checkbox"/> Lesson 17 Resource B: Recurring Themes and Concepts <input type="checkbox"/> End-of-Spotlight Assessment Rubric
Preparation	<input type="checkbox"/> Score End-of-Spotlight Assessment and write individual feedback. <input type="checkbox"/> Select End-of-Spotlight Assessment responses to provide to students for additional support. If selecting student responses, remember to remove identifying information and choose diverse student responses. <input type="checkbox"/> Prepare visual for student connections between content standards and recurring themes and concepts.

Sun, Earth, and Moon System | Works Cited

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