




Preparation Guide


Level 1 Module 1

PUSHES AND PULLS

with Spotlight Lessons on Weather Conditions

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.

Pushes and Pulls | Advance Preparation

An activity in this module requires advance preparation. This guide identifies the 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 |
|--------|-----------------|-----------------------|---|
| 18 | 1 day† | Engineering Challenge | Prepare dock cushion testing stations, and prepare to demonstrate the testing station classroom procedure for students. |

Pushes and Pulls | Lesson Preparation

Lesson 1

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| Materials | Kit Items <ul style="list-style-type: none"><input type="checkbox"/> Binder rings, 1" (24)<input type="checkbox"/> Knowledge Deck™ poster, New York Harbor (1) School-Supplied Items <ul style="list-style-type: none"><input type="checkbox"/> Classroom object, large (e.g., reading table, rolling bookcase) (1) Item Reuse <ul style="list-style-type: none"><input type="checkbox"/> Lesson 3 requires the New York Harbor Knowledge Deck poster. |
| Resources | <ul style="list-style-type: none"><input type="checkbox"/> <i>Tugboat</i> (Garland 2014) |
| Preparation | None |

Lesson 2

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| Materials | <p>Kit Items</p> <ul style="list-style-type: none"> <input type="checkbox"/> Blocks, wooden, 3 cm × 5 cm × 1.5 cm (6) <input type="checkbox"/> Blocks, wooden, 5 cm × 15 cm × 2 cm (6) <input type="checkbox"/> Chenille stem pieces, 4" (6) <input type="checkbox"/> Harbor maps (<i>PhD Science</i>® exclusive) (7) <input type="checkbox"/> Hooks, screw-in, vinyl-coated, $\frac{3}{4}$" (24) <input type="checkbox"/> Ruler (1, optional) <p>School-Supplied Items</p> <ul style="list-style-type: none"> <input type="checkbox"/> Scissors (1) <input type="checkbox"/> Tape, masking (partial roll) <input type="checkbox"/> White glue (1 bottle) <p>Item Reuse</p> <ul style="list-style-type: none"> <input type="checkbox"/> Lesson 10 requires 1 of the harbor maps, 1 of the prepared chenille stem pieces, 1 of the prepared wooden block cargo ships, and 2 of the prepared wooden block tugboats. One harbor map should remain displayed throughout the module as part of the anchor model. Save all the harbor maps, chenille stem pieces, wooden block cargo ships, and wooden block tugboats for Lesson 11. <input type="checkbox"/> Lesson 12 requires the prepared anchor model cargo ship cutouts and tugboat cutouts. |
| Resources | <ul style="list-style-type: none"> <input type="checkbox"/> Lesson 2 Resource A: Staten Island and New York Harbor Map  <input type="checkbox"/> Lesson 2 Resource B: Cargo Ship Cutouts and Tugboat Cutouts <input type="checkbox"/> Lesson 2 Resource C: Map Model Setup Instructions <input type="checkbox"/> Lesson 2 Resource D: Guide for Creating Harbor Maps |
| Preparation | <ul style="list-style-type: none"> <input type="checkbox"/> Prepare cargo ship cutouts and tugboat cutouts. (See Lesson 2 Resource B.) <input type="checkbox"/> Prepare map models. (See Lesson 2 Resource C.) <input type="checkbox"/> If the class is not using the Module 1 kit, prepare harbor map sketches as alternatives to the harbor maps. (See Lesson 2 Resource D.) |



Lesson 3

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| Materials | <p>Kit Items</p> <ul style="list-style-type: none"> <input type="checkbox"/> Knowledge Deck poster, New York Harbor (1) <p>School-Supplied Items</p> <ul style="list-style-type: none"> <input type="checkbox"/> Tape, masking (partial roll) <p>Item Reuse</p> <ul style="list-style-type: none"> <input type="checkbox"/> Lesson 22 requires the New York Harbor Knowledge Deck poster. |
| Resources | <ul style="list-style-type: none"> <input type="checkbox"/> <i>Tugboat</i> (Garland 2014) |
| Preparation | None |

Lesson 4

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| Materials | <p>Kit Items</p> <ul style="list-style-type: none"> <input type="checkbox"/> Pucks, plastic (6) <input type="checkbox"/> Sticky hands (6) <input type="checkbox"/> Table tennis balls (6) <input type="checkbox"/> Tape, painter's (partial roll) <input type="checkbox"/> Toy cars (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 5 requires the prepared push and pull chart. <input type="checkbox"/> Lesson 7 requires the table tennis balls. <input type="checkbox"/> Lesson 9 requires 1 each of the pucks, sticky hands, and toy cars. |
| Resources | <ul style="list-style-type: none"> <input type="checkbox"/> Lesson 4 Resource A: Push and Pull Chart Header Symbols <input type="checkbox"/> Lesson 4 Resource B: Toy Icon Cards |
| Preparation | <ul style="list-style-type: none"> <input type="checkbox"/> Prepare push and pull chart header symbols. (See Lesson 4 Resource A.) <input type="checkbox"/> Prepare toy icon cards. (See Lesson 4 Resource B.) |


Lesson 5

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| Materials | <p>Kit Items</p> <ul style="list-style-type: none"> <input type="checkbox"/> Sentence strips (2) <input type="checkbox"/> Tape, painter's (partial roll) <p>School-Supplied Items</p> <ul style="list-style-type: none"> <input type="checkbox"/> Pocket chart (1) <input type="checkbox"/> Scissors (1) <p>Prepared Items from Previous Lessons</p> <ul style="list-style-type: none"> <input type="checkbox"/> Push and pull chart started in Lesson 4 (1) <p>Item Reuse</p> <ul style="list-style-type: none"> <input type="checkbox"/> Lesson 6 requires the prepared push cutouts and pull cutouts. <input type="checkbox"/> Lesson 9 requires the prepared push and pull chart. |
| Resources | <ul style="list-style-type: none"> <input type="checkbox"/> Lesson 5 Resource A: Toy Stroller Photograph  <input type="checkbox"/> Lesson 5 Resource B: Toy Stroller Icon Card <input type="checkbox"/> Lesson 5 Resource C: Push Cutouts and Pull Cutouts |
| Preparation | <ul style="list-style-type: none"> <input type="checkbox"/> Prepare toy stroller icon card. (See Lesson 5 Resource B.) <input type="checkbox"/> Cue video “The Royal Ballet Performance of <i>Alice’s Adventures in Wonderland</i>” (Royal Opera House 2015) (http://phdsci.link/1576).  <input type="checkbox"/> Prepare push cutouts and pull cutouts. (See Lesson 5 Resource C.) |


Lesson 6

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| <p>Materials</p> | <p>Kit Items</p> <ul style="list-style-type: none"> <input type="checkbox"/> Bin, clear plastic, 34" × 16" × 6" (1) <input type="checkbox"/> Block, wooden, 5 cm × 15 cm × 2 cm (1) <input type="checkbox"/> Chenille stem, 12" (1) <input type="checkbox"/> Hooks, screw-in, vinyl-coated, $\frac{3}{4}$" (2) <input type="checkbox"/> Safety goggles, student (24) <input type="checkbox"/> Safety goggles, teacher (1) <input type="checkbox"/> Screw eyes, 1.5" length (4) <input type="checkbox"/> Screwdriver, Phillips <input type="checkbox"/> Tape, painter's (partial roll) <input type="checkbox"/> Toy tugboats, plastic (2) <p>School-Supplied Items</p> <ul style="list-style-type: none"> <input type="checkbox"/> Paper towels (partial roll) <input type="checkbox"/> Water (access) <p>Prepared Items from Previous Lessons</p> <ul style="list-style-type: none"> <input type="checkbox"/> Push cutouts and pull cutouts from Lesson 5 <p>Item Reuse</p> <ul style="list-style-type: none"> <input type="checkbox"/> Lesson 8 requires the prepared water model. |
| <p>Resources</p> | <ul style="list-style-type: none"> <input type="checkbox"/> Lesson 5 Resource C: Push Cutouts and Pull Cutouts <input type="checkbox"/> Lesson 6 Resource: Water Model Setup Instructions <input type="checkbox"/> <i>Tugboat</i> (Garland 2014) |
| <p>Preparation</p> | <ul style="list-style-type: none"> <input type="checkbox"/> Prepare water model. (See Lesson 6 Resource.) |




Lesson 7

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| Materials | <p>Kit Items</p> <ul style="list-style-type: none"> <input type="checkbox"/> Craft sticks, jumbo (24) <input type="checkbox"/> Table tennis balls (12) <p>School-Supplied Items</p> <ul style="list-style-type: none"> <input type="checkbox"/> Glue sticks (24) <input type="checkbox"/> Scissors (1) <p>Item Reuse</p> <ul style="list-style-type: none"> <input type="checkbox"/> Lesson 8 requires the prepared stronger and weaker push and pull cutouts from the third page of Lesson 7 Resource. <input type="checkbox"/> Lesson 9 requires 1 of the table tennis balls. <input type="checkbox"/> Lesson 19 requires 4 of the craft sticks. Save all the craft sticks for Lesson 20. |
| Resources | <ul style="list-style-type: none"> <input type="checkbox"/> Lesson 7 Resource: Stronger and Weaker Push and Pull Cutouts |
| Preparation | <ul style="list-style-type: none"> <input type="checkbox"/> Cue video of a tugboat pushing a cargo ship (http://phdsci.link/1577).  <input type="checkbox"/> Prepare stronger and weaker push and pull cutouts. (See Lesson 7 Resource.) |


Lesson 8

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| Materials | <p>Kit Items</p> <ul style="list-style-type: none"> <input type="checkbox"/> Sentence strips (2) <p>School-Supplied Items</p> <ul style="list-style-type: none"> <input type="checkbox"/> Paper towels (partial roll) <p>Prepared Items from Previous Lessons</p> <ul style="list-style-type: none"> <input type="checkbox"/> Stronger and weaker push and pull cutouts from Lesson 7 <input type="checkbox"/> Water model from Lesson 6 (1) <p>Item Reuse</p> <ul style="list-style-type: none"> <input type="checkbox"/> Lesson 12 requires the prepared stronger and weaker push and pull cutouts and the prepared water model. |
| Resources | <p>None</p> |
| Preparation | <ul style="list-style-type: none"> <input type="checkbox"/> Cue video of a tugboat pushing a cargo ship (http://phdsci.link/1577).  |

Lesson 9

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| Materials | <p>Kit Items</p> <ul style="list-style-type: none"> <input type="checkbox"/> Puck, plastic (1) <input type="checkbox"/> Sticky hand (1) <input type="checkbox"/> Table tennis ball (1) <input type="checkbox"/> Toy car (1) <p>School-Supplied Items</p> <p>None</p> <p>Prepared Items from Previous Lessons</p> <ul style="list-style-type: none"> <input type="checkbox"/> Push and pull chart started in Lesson 5 (1) <p>Item Reuse</p> <ul style="list-style-type: none"> <input type="checkbox"/> Lesson 12 requires the table tennis ball. |
| Resources | <ul style="list-style-type: none"> <input type="checkbox"/> Lesson 9 Resource A: Skateboard Race Photograph  <input type="checkbox"/> Lesson 9 Resource B: Skateboard Race Diagram  <input type="checkbox"/> Lesson 9 Resource C: Conceptual Checkpoint  |
| Preparation | <ul style="list-style-type: none"> <input type="checkbox"/> Prepare to distribute a copy of Lesson 9 Resource C to each student. |

Lesson 10

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| Materials | <p>Kit Items</p> <ul style="list-style-type: none"> <input type="checkbox"/> Harbor map (1) <p>School-Supplied Items</p> <ul style="list-style-type: none"> <input type="checkbox"/> Glue sticks (24) <input type="checkbox"/> Scissors (1) <p>Prepared Items from Previous Lessons</p> <ul style="list-style-type: none"> <input type="checkbox"/> Chenille stem piece from Lesson 2 (1) <input type="checkbox"/> Wooden block cargo ship from Lesson 2 (1) <input type="checkbox"/> Wooden block tugboats from Lesson 2 (2) <p>Item Reuse</p> <ul style="list-style-type: none"> <input type="checkbox"/> Lesson 11 requires the harbor map, prepared chenille stem piece, prepared wooden block cargo ship, and prepared wooden block tugboats. <input type="checkbox"/> Lesson 11 requires the small tugboat cutouts, small push cutouts, and small pull cutouts. |
| Resources | <ul style="list-style-type: none"> <input type="checkbox"/> Lesson 10 Resource A: Two Tugboats Photograph  <input type="checkbox"/> Lesson 10 Resource B: Small Tugboat Cutouts, Small Push Cutouts, and Small Pull Cutouts |
| Preparation | <ul style="list-style-type: none"> <input type="checkbox"/> Prepare small tugboat cutouts, small push cutouts, and small pull cutouts. (See Lesson 10 Resource B.) |


Lesson 11

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| Materials | <p>Kit Items</p> <ul style="list-style-type: none"> <input type="checkbox"/> Harbor maps (6) <p>School-Supplied Items</p> <ul style="list-style-type: none"> <input type="checkbox"/> Glue sticks (6) <p>Prepared Items from Previous Lessons</p> <ul style="list-style-type: none"> <input type="checkbox"/> Chenille stem pieces from Lesson 2 (12) <input type="checkbox"/> Small tugboat cutouts, small push cutouts, and small pull cutouts from Lesson 10 (48 each) <input type="checkbox"/> Wooden block cargo ships from Lesson 2 (6) <input type="checkbox"/> Wooden block tugboats from Lesson 2 (12) <p>Item Reuse</p> <ul style="list-style-type: none"> <input type="checkbox"/> Lesson 13 requires 1 of the harbor maps and 1 of the prepared wooden block cargo ships. Save all the harbor maps and prepared wooden block cargo ships for Lesson 14. <input type="checkbox"/> Lesson 14 requires the prepared chenille stem pieces and wooden block tugboats. |
| Resources | <ul style="list-style-type: none"> <input type="checkbox"/> Lesson 2 Resource C: Map Model Setup Instructions |
| Preparation | <ul style="list-style-type: none"> <input type="checkbox"/> Prepare additional chenille stem pieces and wooden block tugboats as needed for direction investigation. (See Lesson 2 Resource C.) Also, if needed, gather harbor map, prepared wooden block cargo ship, and prepared wooden block tugboats from direction demonstration for reuse by a group of students in direction investigation. |

Lesson 12

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| Materials | <p>Kit Items</p> <ul style="list-style-type: none"> <input type="checkbox"/> Table tennis ball (1) <input type="checkbox"/> Sentence strips (2) <p>School-Supplied Items</p> <ul style="list-style-type: none"> <input type="checkbox"/> Paper towels (partial roll) <input type="checkbox"/> Tape, masking (partial roll) <p>Prepared Items from Previous Lessons</p> <ul style="list-style-type: none"> <input type="checkbox"/> Anchor model cargo ship cutouts and tugboat cutouts from Lesson 2 <input type="checkbox"/> Stronger and weaker push and pull cutouts from Lesson 7 <input type="checkbox"/> Water model from Lesson 8 with an additional chenille stem piece and an additional plastic toy tugboat from Lesson 6 (1) <p>Item Reuse</p> <ul style="list-style-type: none"> <input type="checkbox"/> Lesson 13 requires the prepared water model with the wooden block cargo ship. <input type="checkbox"/> Lesson 14 requires the prepared stronger and weaker push and pull cutouts. |
| Resources | <ul style="list-style-type: none"> <input type="checkbox"/> Lesson 6 Resource: Water Model Setup Instructions |
| Preparation | <ul style="list-style-type: none"> <input type="checkbox"/> Prepare second plastic toy tugboat. (See Lesson 6 Resource.) |

Lesson 13

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|---------------------------|--|
| <p>Materials</p> | <p>Kit Items</p> <ul style="list-style-type: none"> <input type="checkbox"/> Harbor map (1) <p>School-Supplied Items</p> <ul style="list-style-type: none"> <input type="checkbox"/> Glue sticks (24) <input type="checkbox"/> Paper towels (partial roll) <p>Prepared Items from Previous Lessons</p> <ul style="list-style-type: none"> <input type="checkbox"/> Small tugboat cutouts, small push cutouts, and small pull cutouts from Lesson 10 (24 each) <input type="checkbox"/> Water model with wooden block cargo ship from Lesson 6 (1) <input type="checkbox"/> Wooden block cargo ship from Lesson 2 (i.e., wooden block with glued-on cargo ship cutout) (1) <p>Item Reuse</p> <ul style="list-style-type: none"> <input type="checkbox"/> Lesson 14 requires the harbor map, prepared water model with wooden block cargo ship, and prepared wooden block cargo ship. |
| <p>Resources</p> | <p>None</p> |
| <p>Preparation</p> | <ul style="list-style-type: none"> <input type="checkbox"/> Cue video “Milano Bridge Accident” (Li 2020) (http://phdsci.link/1587)  and mute sound. <input type="checkbox"/> Prepare for model comparison demonstration by setting up a harbor map next to the water model and placing a wooden block cargo ship from a map model onto the map. <input type="checkbox"/> Prepare enough small tugboat cutouts, small push cutouts, and small pull cutouts for every student to have one of each. (See Lesson 10 Resource B.) |




Lesson 14

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| Materials | <p>Kit Items</p> <ul style="list-style-type: none"> <input type="checkbox"/> Harbor maps (6) <input type="checkbox"/> Knowledge Deck cards, New York Harbor (24) <p>School-Supplied Items</p> <ul style="list-style-type: none"> <input type="checkbox"/> Paper towels (partial roll) <input type="checkbox"/> Scissors (1) <input type="checkbox"/> Tape, masking (partial roll) <p>Prepared Items from Previous Lessons</p> <ul style="list-style-type: none"> <input type="checkbox"/> Blue tugboat cutout (1) and cargo ship cutout (1) from Lesson 2 <input type="checkbox"/> Stronger and weaker push and pull cutouts from Lesson 7 (1 of each) <input type="checkbox"/> Water model with wooden block cargo ship, plastic tugboat, and chenille stem piece from Lesson 6 (1) <input type="checkbox"/> Wooden block cargo ships, wooden block tugboats, and chenille stem pieces from Lesson 2 (12 of each) <p>Item Reuse</p> <ul style="list-style-type: none"> <input type="checkbox"/> Lesson 15 requires the water model with wooden block cargo ship. <input type="checkbox"/> Lesson 18 requires 1 of the harbor maps and 1 of the prepared wooden block tugboats. |
| Resources | <ul style="list-style-type: none"> <input type="checkbox"/> Lesson 14 Resource: Stop Sign Cutout |
| Preparation | <ul style="list-style-type: none"> <input type="checkbox"/> Prepare additional wooden block cargo ships as needed for slowing down and stopping investigation. (See Lesson 2 Resource C.) Also, if needed, gather harbor map and map model wooden block cargo ship from model comparison demonstration for a group of students to reuse during slowing down and stopping investigation. <input type="checkbox"/> Prepare stop sign cutout. (See Lesson 14 Resource.) |



Lesson 15

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| Materials | <p>Kit Items</p> <ul style="list-style-type: none"> <input type="checkbox"/> Hall's car (1) <input type="checkbox"/> Sentence strips (2) <p>School-Supplied Items</p> <ul style="list-style-type: none"> <input type="checkbox"/> Paper towels (partial roll) <p>Prepared Items from Previous Lessons</p> <ul style="list-style-type: none"> <input type="checkbox"/> Water model with wooden block cargo ship from Lesson 6 (1) <p>Item Reuse</p> <ul style="list-style-type: none"> <input type="checkbox"/> Lesson 18 requires the Hall's car. |
| Resources | None |
| Preparation | None |

Lesson 16





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| Materials | <p>Kit Items None</p> <p>School-Supplied Items <input type="checkbox"/> Glue sticks (24)</p> <p>Prepared Items from Previous Lessons <input type="checkbox"/> Small push cutouts and small pull cutouts from Lesson 10 (48 each)</p> |
| Resources | <input type="checkbox"/> Lesson 16 Resource: Conceptual Checkpoint  |
| Preparation | <p><input type="checkbox"/> Cue children playing soccer video (http://phdsci.link/1588)  and two soccer players video (http://phdsci.link/1589). </p> <p><input type="checkbox"/> Prepare to distribute a copy of Lesson 16 Resource to each student.</p> <p><input type="checkbox"/> Prepare enough small push cutouts and small pull cutouts for every student to have two of each. (See Lesson 10 Resource B.)</p> |

Lesson 17


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| Materials | <p>Kit Items <input type="checkbox"/> Safety goggles, student (24) <input type="checkbox"/> Safety goggles, teacher (1) <input type="checkbox"/> Spray bottles (7)</p> <p>School-Supplied Items <input type="checkbox"/> Scissors (1) <input type="checkbox"/> Water (access)</p> |
| Resources | <p><input type="checkbox"/> Lesson 17 Resource A: Historical Bicycle Photographs </p> <p><input type="checkbox"/> Lesson 17 Resource B: Draisienne Bicycle Illustration </p> <p><input type="checkbox"/> Lesson 17 Resource C: Bicycle Cards</p> |
| Preparation | <p><input type="checkbox"/> Prepare bicycle cards. (See Lesson 17 Resource C.)</p> <p><input type="checkbox"/> Prepare the nonfunctioning spray bottle. Take apart the spray bottle and cut the straw about halfway up. Add water to the spray bottle, leaving a gap between the end of the straw and the top of the water.</p> <p>Advance Preparation for Lesson 18</p> <p><input type="checkbox"/> Prepare dock cushion testing stations, and prepare to demonstrate the testing station classroom procedure for students. (See Lesson 18 Resource G.)</p> |





Lesson 18

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| <p>Materials</p> | <p>Kit Items</p> <ul style="list-style-type: none"> <input type="checkbox"/> Bins with lids, clear plastic, 6 qt (4) <input type="checkbox"/> Blocks, wooden, 5 cm × 15 cm × 2 cm (8) <input type="checkbox"/> Clipboards, smooth (4) <input type="checkbox"/> Hall's cars (4) <input type="checkbox"/> Harbor map (1) <input type="checkbox"/> Rulers, plastic (12) <p>School-Supplied Items</p> <ul style="list-style-type: none"> <input type="checkbox"/> Books or other weights (20 lb) <input type="checkbox"/> Magnet (1, optional) <input type="checkbox"/> Scissors (1) <input type="checkbox"/> Tape, masking (partial roll) <p>Prepared Items from Previous Lessons</p> <ul style="list-style-type: none"> <input type="checkbox"/> Wooden block tugboat from Lesson 2 (1) <p>Item Reuse</p> <ul style="list-style-type: none"> <input type="checkbox"/> Lesson 19 requires the prepared dock cushion testing stations. |
| <p>Resources</p> | <ul style="list-style-type: none"> <input type="checkbox"/> Lesson 18 Resource A: Engineering Challenge Rubric <input type="checkbox"/> Lesson 18 Resource B: Tugboat in New York Harbor Photograph  <input type="checkbox"/> Lesson 18 Resource C: Engineering Design Process Visual  <input type="checkbox"/> Lesson 18 Resource D: Tugboat at a Dock Photograph  <input type="checkbox"/> Lesson 18 Resource E: Dock System Photograph  <input type="checkbox"/> Lesson 18 Resource F: Measurement Paper <input type="checkbox"/> Lesson 18 Resource G: Engineering Challenge Setup Instructions and Classroom Procedure <input type="checkbox"/> Lesson 18 Resource H: Tugboat Cutouts for Engineering Challenge <input type="checkbox"/> <i>Tugboat</i> (Garland 2014) |
| <p>Preparation</p> | <ul style="list-style-type: none"> <input type="checkbox"/> Consider affixing a tugboat cutout to each Hall's car. (See Lesson 18 Resource H.) <input type="checkbox"/> Prepare for wooden block tugboat demonstration. Place a harbor map face down on a flat surface and adjacent to a weighted-down plastic bin from one of the testing stations. (Make sure to use the side of the bin that is not facing the ramp.) Practice pushing a wooden block tugboat across the map with enough force for the tugboat to bump into the bin and bounce back at least a couple of inches. |



Lesson 19

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| <p>Materials</p> | <p>Kit Items</p> <ul style="list-style-type: none"> <input type="checkbox"/> Bags, resealable plastic, snack (8) <input type="checkbox"/> Clay, modeling, nonhardening ($\frac{1}{4}$ lb) <input type="checkbox"/> Cotton balls (30) <input type="checkbox"/> Craft sticks, jumbo (4) <input type="checkbox"/> Erasers, wedge, medium (6) <input type="checkbox"/> Rope, braided cotton (2$\frac{1}{2}$ ft) <input type="checkbox"/> Sponges (2) <p>School-Supplied Items</p> <ul style="list-style-type: none"> <input type="checkbox"/> Crayons (8 sets) <input type="checkbox"/> Glue sticks (24) <input type="checkbox"/> Magnet (1, optional) <input type="checkbox"/> Markers, green, red, yellow (9 of each color) <input type="checkbox"/> Scissors (1) <input type="checkbox"/> Tape, masking (partial roll) <p>Prepared Items from Previous Lessons</p> <ul style="list-style-type: none"> <input type="checkbox"/> Small tugboat cutouts from Lesson 10 (24) <input type="checkbox"/> Dock cushion testing stations from Lesson 18 (4) <p>Item Reuse</p> <ul style="list-style-type: none"> <input type="checkbox"/> Lesson 20 requires the clay, cotton balls, craft sticks, erasers, sponges, rope, and the prepared dock cushion testing stations. |
| <p>Resources</p> | <ul style="list-style-type: none"> <input type="checkbox"/> Lesson 18 Resource C: Engineering Design Process Visual  <input type="checkbox"/> Lesson 18 Resource F: Measurement Paper  <input type="checkbox"/> Lesson 18 Resource G: Engineering Challenge Setup Instructions and Classroom Procedure <input type="checkbox"/> Lesson 19 Resource: Results Chart Header Illustrations |
| <p>Preparation</p> | <ul style="list-style-type: none"> <input type="checkbox"/> Prepare Imagine stage testing bags. (See Lesson 18 Resource G.) <input type="checkbox"/> Prepare results chart header illustrations. (See Lesson 19 Resource.) <input type="checkbox"/> Prepare enough small tugboat cutouts for every student to have one. (See Lesson 10 Resource B.) |

Lesson 20

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| Materials | <p>Kit Items</p> <ul style="list-style-type: none"> <input type="checkbox"/> Bags, resealable plastic, snack (8) <input type="checkbox"/> Clay, modeling, nonhardening (2 lb) <input type="checkbox"/> Cotton balls (120) <input type="checkbox"/> Craft sticks, jumbo (32) <input type="checkbox"/> Erasers, wedge, medium (48) <input type="checkbox"/> Rope, braided cotton (20 ft) <input type="checkbox"/> Sponges (8) <p>School-Supplied Items</p> <ul style="list-style-type: none"> <input type="checkbox"/> Magnet (1, optional) <input type="checkbox"/> Scissors (1) <input type="checkbox"/> Scissors, blunt tip (8) <input type="checkbox"/> Tape, masking (8 rolls) <p>Prepared Items from Previous Lessons</p> <ul style="list-style-type: none"> <input type="checkbox"/> Dock cushion testing stations from Lesson 18 (4) <p>Item Reuse</p> <ul style="list-style-type: none"> <input type="checkbox"/> Lesson 21 requires the final dock cushions created by students. |
| Resources | <ul style="list-style-type: none"> <input type="checkbox"/> Lesson 18 Resource C: Engineering Design Process Visual  <input type="checkbox"/> Lesson 18 Resource G: Engineering Challenge Setup Instructions and Classroom Procedure <input type="checkbox"/> Lesson 20 Resource: Lined Measurement Paper  |
| Preparation | <ul style="list-style-type: none"> <input type="checkbox"/> Prepare Create stage materials. (See Lesson 18 Resource G.) |








Lesson 21

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| Materials | <p>Kit Items</p> <p>None</p> <p>School-Supplied Items</p> <ul style="list-style-type: none"> <input type="checkbox"/> Magnet (1, optional) <input type="checkbox"/> Tape, masking (partial roll) <p>Prepared Items from Previous Lessons</p> <ul style="list-style-type: none"> <input type="checkbox"/> Final dock cushions from Lesson 20 (8) |
| Resources | <ul style="list-style-type: none"> <input type="checkbox"/> Lesson 18 Resource C: Engineering Design Process Visual  <input type="checkbox"/> Lesson 21 Resource: Dock Cushion Photographs  |
| Preparation | <p>None</p> |




Lesson 22

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|--------------------|---|
| Materials | <p>Kit Items</p> <ul style="list-style-type: none"> <input type="checkbox"/> Knowledge Deck poster, New York Harbor (1) <p>School-Supplied Items</p> <ul style="list-style-type: none"> <input type="checkbox"/> Scissors (1) |
| Resources | <ul style="list-style-type: none"> <input type="checkbox"/> Lesson 22 Resource: Key Term Cards |
| Preparation | <ul style="list-style-type: none"> <input type="checkbox"/> Prepare key term cards. (See Lesson 22 Resource.) |

Lesson 23



| | |
|--------------------|--|
| 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 23 Resource: Carnival Game Photographs  |
| Preparation | <ul style="list-style-type: none"> <input type="checkbox"/> Cue duck-catching game video (http://phdsci.link/1593)  and balloon dart game video (http://phdsci.link/1594).  <input type="checkbox"/> Cue golf ball stopping video (http://phdsci.link/1614)  and golf ball changing direction video (http://phdsci.link/1615).  <input type="checkbox"/> Cue SKEE-BALL® game video (http://phdsci.link/2366)  and Bowler Roller game video (http://phdsci.link/2367).  <input type="checkbox"/> Prepare to distribute a copy of the End-of-Module Assessment to each student. |

Lesson 24

| | |
|--------------------|---|
| Materials | <p>Kit Items</p> <p>None</p> <p>School-Supplied Items</p> <ul style="list-style-type: none"> <input type="checkbox"/> Scissors (1) |
| Resources | <ul style="list-style-type: none"> <input type="checkbox"/> Lesson 24 Resource: Recurring Themes and Concepts Cards  |
| Preparation | <ul style="list-style-type: none"> <input type="checkbox"/> Cue duck-catching game video (http://phdsci.link/1593)  and balloon dart game video (http://phdsci.link/1594).  <input type="checkbox"/> Score End-of-Module Assessment and write individual feedback. <input type="checkbox"/> Select at least one End-of-Module Assessment item for the class to debrief, and prepare a sample response for that item to share with students. <input type="checkbox"/> Prepare recurring themes and concepts cards. (See Lesson 24 Resource.) |

Weather Conditions | Lesson Preparation

Lesson 1

| | |
|--------------------|---|
| Materials | Kit Items <ul style="list-style-type: none"> <input type="checkbox"/> Clothespins (6) <input type="checkbox"/> Fan, table, two-speed (1) <input type="checkbox"/> Flagging tape, 1" wide ($4\frac{1}{2}$ ft) <input type="checkbox"/> Rulers, plastic (6) <input type="checkbox"/> Sunglasses (1 pair) School-Supplied Items <ul style="list-style-type: none"> <input type="checkbox"/> Scissors (1) Item Reuse <ul style="list-style-type: none"> <input type="checkbox"/> Lesson 2 requires 6 wind observation tools. |
| Resources | <ul style="list-style-type: none"> <input type="checkbox"/> Lesson 1 Resource A: People in Rain Photograph  <input type="checkbox"/> Lesson 1 Resource B: Wind Observation Tool Instructions <input type="checkbox"/> Lesson 1 Resource C: Cloud Cover Cards |
| Preparation | <ul style="list-style-type: none"> <input type="checkbox"/> Cue kite flying video (http://phdsci.link/2331).  <input type="checkbox"/> Prepare wind observation tools. (See Lesson 1 Resource B.) <input type="checkbox"/> Prepare cloud cover cards. (See Lesson 1 Resource C.) |



Lesson 2

| | |
|--------------------|---|
| Materials | Kit Items <ul style="list-style-type: none"> <input type="checkbox"/> Thermometers, Fahrenheit, plastic-backed (12) <input type="checkbox"/> Safety goggles, student (24) <input type="checkbox"/> Safety goggles, teacher (1) School-Supplied Items <ul style="list-style-type: none"> <input type="checkbox"/> Scissors (1) <input type="checkbox"/> Stapler (1) <input type="checkbox"/> Tape, packing, clear, 2" wide (1 roll) or laminating machine (access) Prepared Items from Previous Lessons <ul style="list-style-type: none"> <input type="checkbox"/> Wind observation tools from Lesson 1 (6) Item Reuse <ul style="list-style-type: none"> <input type="checkbox"/> Lesson 7 requires 1 thermometer. |
| Resources | <ul style="list-style-type: none"> <input type="checkbox"/> Lesson 2 Resource: Thermometer Setup Instructions |
| Preparation | <ul style="list-style-type: none"> <input type="checkbox"/> Prepare thermometers. (See Lesson 2 Resource.) |



Lesson 3

| | |
|--------------------|---|
| Materials | <p>Kit Items None</p> <p>School-Supplied Items <input type="checkbox"/> Scissors (1)</p> |
| Resources | <p><input type="checkbox"/> Lesson 3 Resource A: Weather, Clothing, and Activity Cards</p> <p><input type="checkbox"/> Lesson 3 Resource B: Weather Display Cards</p> <p><input type="checkbox"/> <i>Pond</i> (LaMarche 2016)</p> |
| Preparation | <p><input type="checkbox"/> Prepare weather, clothing, and activity cards. (See Lesson 3 Resource A.)</p> <p><input type="checkbox"/> Prepare weather display cards. (See Lesson 3 Resource B.)</p> |





Lesson 4

| | |
|--------------------|---|
| Materials | <p>Kit Items None</p> <p>School-Supplied Items None</p> <p>Item Reuse <input type="checkbox"/> Lesson 5 requires the class seasons chart.</p> |
| Resources | <p><input type="checkbox"/> Lesson 4 Resource A: Sunflower Trail Photograph </p> <p><input type="checkbox"/> Lesson 4 Resource B: Amarillo, Texas, 2017–2018 Weather Data </p> <p><input type="checkbox"/> <i>Pond</i> (LaMarche 2016)</p> |
| Preparation | None |



Lesson 5

| | |
|--------------------|---|
| Materials | <p>Kit Items None</p> <p>School-Supplied Items</p> <ul style="list-style-type: none"> <input type="checkbox"/> Glue or tape <input type="checkbox"/> Markers or pencils, brown, green (24 of each) <input type="checkbox"/> Scissors (1) <p>Prepared Items from Previous Lessons</p> <ul style="list-style-type: none"> <input type="checkbox"/> Class seasons chart started in Lesson 4. <p>Item Reuse</p> <ul style="list-style-type: none"> <input type="checkbox"/> Lesson 6 requires the class seasons chart. |
| Resources | <ul style="list-style-type: none"> <input type="checkbox"/> Lesson 5 Resource A: Seasonal Tree Cards <input type="checkbox"/> Lesson 5 Resource B: Fall Photograph  <input type="checkbox"/> <i>Pond</i> (LaMarche 2016) |
| Preparation | <ul style="list-style-type: none"> <input type="checkbox"/> Cue forest time-lapse video (http://phdsci.link/2347).  <input type="checkbox"/> Prepare seasonal tree cards. (See Lesson 5 Resource A.) |

Lesson 6

| | |
|--------------------|---|
| Materials | <p>Kit Items None</p> <p>School-Supplied Items</p> <ul style="list-style-type: none"> <input type="checkbox"/> Glue sticks (24) <input type="checkbox"/> Scissors (1) <p>Prepared Items from Previous Lessons</p> <ul style="list-style-type: none"> <input type="checkbox"/> Class seasons chart started in Lesson 4 |
| Resources | <ul style="list-style-type: none"> <input type="checkbox"/> Lesson 6 Resource A: Term Cards <input type="checkbox"/> Lesson 6 Resource B: Cherry Blossom Trees Photograph  <input type="checkbox"/> Lesson 6 Resource C: National Cherry Blossom Festival Photograph  <input type="checkbox"/> Lesson 6 Resource D: Cherry Blossom Tree Peak Bloom Table  <input type="checkbox"/> Lesson 6 Resource E: Seasons Cards <input type="checkbox"/> <i>Pond</i> (LaMarche 2016) |
| Preparation | <ul style="list-style-type: none"> <input type="checkbox"/> Prepare term cards. (See Lesson 6 Resource A.) <input type="checkbox"/> Cue cherry blossom time-lapse video (http://phdsci.link/2480).  <input type="checkbox"/> Prepare seasons cards. (See Lesson 6 Resource E.) <input type="checkbox"/> Prepare to distribute a copy of the End-of-Spotlight Assessment to each student. |

Lesson 7

| | |
|--------------------|---|
| Materials | Kit Items None School-Supplied Items <input type="checkbox"/> Scissors (1) Prepared Items from Previous Lessons <input type="checkbox"/> Prepared thermometer from Lesson 2 (1) |
| Resources | <input type="checkbox"/> Lesson 7 Resource A: Washington, DC, Yearly Temperature Data  <input type="checkbox"/> Lesson 7 Resource B: Recurring Themes and Concepts Cards  |
| Preparation | <input type="checkbox"/> Score End-of-Spotlight Assessment and write individual feedback. <input type="checkbox"/> Select at least one End-of-Spotlight Assessment item for the class debrief, and prepare a sample response for that item to share with students. <input type="checkbox"/> Prepare recurring themes and concepts cards. (See Lesson 7 Resource B.) |

Pushes and Pulls | Works Cited

Garland, Michael. 2014. *Tugboat*. New York: Holiday House. (All references to *Tugboat* are from this source.)

Li, Martina. 2020. "High Speed and Compromised Maneuvering Caused *Milano Bridge* Accident." *Container News*. Video, 1:30, posted May 7, 2020. <https://container-news.com/high-speed-and-compromised-manoeuving-caused-milano-bridge-accident/>.

Royal Opera House. 2015. "Knave of Hearts." Pas de deux from The Royal Ballet Performance of *Alice's Adventures in Wonderland*. Video, 3:31, posted February 13, 2015. <https://www.youtube.com/watch?v=e1BuBdGunC8>.

Weather Conditions | Works Cited

LaMarche, Jim. 2016. *Pond*. New York: Simon & Schuster Books for Young Readers. (All references to *Pond* are from this source.)