Level 3 Module 3

Traits

Planning and Preparation Guide

In *PhD Science*™ Level 3, lessons are designed to fill 45 minutes of instructional time. Every lesson has a Launch, Learn, and Land section, and each section serves a specific purpose within the scope and sequence of the lesson. Teachers should always begin the lesson with a Launch to prepare students for the Learn portion of the lesson. The Land generally includes a debrief of the Learn so that students can reflect on their learning and build consensus before moving forward. Teachers who decide to spend more than one class day on a lesson should consider beginning the second day of the lesson with a summary of the previous day's learning.

The purpose of this Planning and Preparation Guide is to summarize the preparation requirements for each lesson. The calendar included in this guide contains the following sections to aid in planning and preparation.

Preparing to Teach: This section describes preparation teachers should complete before a lesson begins.

Materials: This section lists all materials necessary for the lesson. For more information, refer to the module-specific materials lists in the *PhD Science* Teacher Resource Pack.

Module Resources: This section lists all module resources necessary for the lesson.

Alternative Pacing: This section provides pacing suggestions for classrooms with less than 45 minutes of instructional time for science.

Advance Preparation: This section describes preparation teachers should complete a specified number of days before an upcoming lesson.

Instructional Routines

The following instructional routines are recommended for use in this module. For specific information about each routine, refer to the *PhD Science* Implementation Guide.

- Gallery Walk
- Inside–Outside Circles
- Jigsaw
- Mix and Mingle
- Question Corners
- Quick Write
- Stop and Jot
- Think–Pair–Share
- Vote–Discuss–Revote

Module at a Glance

Anchor Phenomenon: Individual Variation in Humpback Whales *Essential Question: What makes an individual humpback whale unique?*
Concept 1: Describing Organisms *Focus Question: How can we identify individuals?*
Concept 2: Growth, Development, and Environmental Influences *Focus Question: How do individuals change over time?*
Application of Concepts: Science Challenge, Part I
Concept 3: Inherited Traits *Focus Question: How do individuals get their traits?*
Application of Concepts: Science Challenge, Part II
Concept 4: Advantages of Traits *Focus Question: How do individuals' traits affect their lives?*
Application of Concepts: Socratic Seminar and End-of-Module Assessment

Calendar

Concept 1: Describing Organisms (Lessons 1–6)

Focus Question: How can we identify individuals?

Lessons 1–3

Phenomenon Question: How do we know if an organism is a humpback whale?

Lesson 1 Ask questions based on observations of humpback whales.	**Preparing to Teach** ☐ Identify a large, open area (such as a gym or sports field) to take students to during the Lesson 1 Launch. Before the lesson, use a tape measure to measure a length of 15 meters in this area and mark the start point and endpoint with pieces of masking tape or other objects (e.g., cones). ☐ Print a copy of Whale Photographs and Typical Adult Lengths (Lesson 1 Resource A). ☐ Cue whale videos: http:/phdsci.link/1267, http:/phdsci.link/1268, and http:/phdsci.link/1269. **Materials** ☐ Science Logbook (Lesson 1 Activity Guide, Module Question Log) ☐ 30-meter tape measure

	☐ Masking tape or other objects (e.g., cones) to mark distances ☐ *Here Come the Humpbacks!* by April Pulley Sayre (2013) **Module Resources** ▪ Lesson 1 Resource A: Whale Photographs and Typical Adult Lengths ▪ Lesson 1 Resource B: "For Humpback Whales in Sanctuaries, Public Involvement Counts" (Wilken 2017) ▪ Lesson 1 Resource C: Four Whale Photographs **Alternative Pacing** Day 1: Launch through Read about Humpback Whales Day 2: Observe Whales through Land **Advance Preparation for Lesson 4** ☐ 5 to 6 Days Before Lesson 4: Prepare Fast Plants (Lesson 4 Resource A).
Lesson 2 Classify organisms of the same species based on their characteristics.	**Preparing to Teach** ☐ Gather a set of at least 10 classroom objects that have noticeable similarities and differences; some of the objects should be the same kind but have small differences (e.g., two bottles of glue in different sizes or with different labels, two glue sticks in different sizes or colors, two paper clips made of different materials or in different sizes or colors, two rolls of tape made of different materials or in different colors, and two pairs of scissors in different sizes or colors). If enough materials are available, prepare a set of objects for each group. ☐ Prepare whale cards (Lesson 2 Resource A). ☐ Prepare species cards (Lesson 2 Resource B). **Materials** ☐ Science Logbook (Lesson 2 Activity Guide) ☐ Whale cards (1 set per student pair) ☐ Species cards (1 set per student pair) ☐ *Here Come the Humpbacks!* **Module Resources** ▪ Lesson 1 Resource B: "For Humpback Whales in Sanctuaries, Public Involvement Counts" ▪ Lesson 2 Resource A: Whale Cards ▪ Lesson 2 Resource B: Species Cards **Alternative Pacing** Day 1: Launch through Sort Other Organisms by Species Day 2: Identify Humpback Whale Characteristics through Land

Lesson 3 Ask questions about the traits of individual humpback whales.	**Preparing to Teach** ☐ Select and print photographs of at least six school staff members (e.g., principal, other teachers, and coaches). Select one of these staff members to be the snack bringer. If school staff photographs are not available, use photographs of famous people instead. Label each photograph with the name of the person shown. ☐ Print a copy of Humpback Whale Count Photographs (Lesson 3 Resource B) for each student pair. **Materials** ☐ Science Logbook (Lesson 1 Activity Guide, Module Question Log) ☐ Science Logbook (Lesson 3 Activity Guide) ☐ Humpback Whale Count Photographs (1 per student pair) ☐ Photographs of six school staff members (or six famous people) ☐ Humpback whale characteristics diagram from Lesson 2 **Module Resources** ▪ Lesson 3 Resource A: Suggestions for Discussing Human Traits, Growth and Development, and Inheritance ▪ Lesson 3 Resource B: Humpback Whale Count Photographs ▪ Lesson 3 Resource C: Individual Humpback Whale Photographs ▪ Lesson 3 Resource D: Migaloo and Beluga Whale Photographs **Alternative Pacing** Day 1: Launch through Describe Individual Humpback Whales Day 2: Develop Anchor Evidence Organizer through Land
Lessons 4–6 *Phenomenon Question: How can we describe differences between individuals of the same species?*	
Lesson 4 Analyze data to describe the relationship between characteristics and traits.	**Preparing to Teach** ☐ Set up Species Stations (Lesson 4 Resource C). **Materials** ☐ Science Logbook (Lesson 4 Activity Guide) ☐ 2 to 5 tomatoes with noticeable differences (e.g., small yellow cherry tomato, medium plum tomato, large beefsteak tomato) ☐ Fast Plant Station: 16 Fast Plants (8 Non-Purple Stem, Hairless and 8 Yellow-Green Leaf), 6 metric rulers, station procedure sheet ☐ Peruvian Scallop Station: 18 Peruvian scallop shells in various colors and sizes, 6 paper plates, 6 metric rulers, station procedure sheet

	☐ Humpback Whale Station: at least 3 computers, station procedure sheet, Whale Flukes Photographs (Lesson 4 Resource E) (optional) ☐ Northern Leopard Frog Station: at least 3 computers, station procedure sheet, Northern Leopard Frog Photographs (Lesson 4 Resource F) (optional) **Module Resources** ▪ Lesson 4 Resource A: Fast Plants Planting and Growing Instructions ▪ Lesson 4 Resource B: Tomato Photographs ▪ Lesson 4 Resource C: Species Stations Setup Instructions ▪ Lesson 4 Resource D: Species Stations Procedure Sheets ▪ Lesson 4 Resource E: Whale Flukes Photographs ▪ Lesson 4 Resource F: Northern Leopard Frog Photographs **Alternative Pacing** Day 1: Launch through Prepare to Visit Species Stations Day 2: Observe Traits at Species Stations through Land
Lesson 5 Support a claim that individuals of the same species have the same characteristics but can have different traits.	**Preparing to Teach** ☐ Set up Species Stations (Lesson 4 Resource C). ☐ Cue "Humpback Whales Work Together to Feed Using Bubble Net Technique" video (WDC 2017), "Trap-Feeding—a Novel Humpback Feeding Strategy (Compilation of Footage)" video (MERS 2018), and "Humpback Whales Kick-Feeding" video (WDC 2016): http:/phdsci.link/1274, http:/phdsci.link/1275, and http:/phdsci.link/1276. **Materials** ☐ Science Logbook (Lesson 4 Activity Guide) ☐ Science Logbook (Lesson 5 Activity Guide) ☐ Fast Plant Station: 16 Fast Plants (8 Non-Purple Stem, Hairless and 8 Yellow-Green Leaf), 6 metric rulers, station procedure sheet ☐ Peruvian Scallop Station: 18 Peruvian scallop shells in various colors and sizes, 6 paper plates, 6 metric rulers, station procedure sheet ☐ Humpback Whale Station: at least 3 computers, station procedure sheet, Whale Flukes Photographs (Lesson 4 Resource E) (optional) ☐ Northern Leopard Frog Station: at least 3 computers, station procedure sheet, Northern Leopard Frog Photographs (Lesson 4 Resource F) (optional) ☐ *Here Come the Humpbacks!* **Module Resources** ▪ Lesson 5 Resource: Humpback Whale Feeding Style Diagrams

	Alternative Pacing Day 1: Launch through Observe and Discuss Traits at Species Stations Day 2: Observe Behavioral Traits through Land
Lesson 6 Describe differences between individuals of the same species.	**Preparing to Teach** ☐ Cue "Raw: Rare White Humpback Whale Sighted" video (AP 2015): http:/phdsci.link/1277. **Materials** ☐ Science Logbook (Lesson 6 Activity Guides A and B) **Module Resources** ▪ Lesson 6 Resource A: Mystery Whale Flukes Photograph ▪ Lesson 6 Resource B: Individual Humpback Whale Profiles ▪ Lesson 6 Resource C: Humpback Whale Photographs for Anchor Evidence Organizer ▪ Lesson 6 Resource D: Conceptual Checkpoint Scenario **Alternative Pacing** Day 1: Launch through Describe Individual Humpback Whales Day 2: Update Anchor Evidence Organizer through Land
Concept 2: Growth, Development, and Environmental Influences (Lessons 7–11) *Focus Question: How do individuals change over time?*	
Lessons 7–8 *Phenomenon Question: How do individuals change throughout their lives?*	
Lesson 7 Describe patterns in the processes that all individuals go through during their lives.	**Preparing to Teach** ☐ Ask four school staff members for a baby photograph and a present-day photograph. Consider asking the same staff members whose photographs were used in the Lesson 3 Launch. Alternatively, find and print baby photographs and present-day photographs of four famous people. Label the baby photographs as A, B, C, and D. ☐ Prepare monarch butterfly sequence cards (Lesson 7 Resource A). ☐ Prepare organism sequence cards (Lesson 7 Resource B). **Materials** ☐ Organism sequence cards (3 sets per group) ☐ Science Logbook (Lesson 7 Activity Guide) ☐ Baby and present-day photographs of four school staff members (or four famous people) ☐ Monarch butterfly sequence cards

	Module Resources ▪ Lesson 7 Resource A: Monarch Butterfly Sequence Cards ▪ Lesson 7 Resource B: Organism Sequence Cards ▪ Lesson 7 Resource C: Life Span Table **Alternative Pacing** Day 1: Launch through Sequence Organism Cards Day 2: Compare Organism Card Sequences through Land
Lesson 8 Analyze data to describe how growth and development affect the traits of individuals.	**Preparing to Teach** ☐ Print a copy of Timeline Instructions (Lesson 8 Resource B), Rabbit Timeline Photographs (Lesson 8 Resource C), and Chicken Timeline Photographs (Lesson 8 Resource E) for each group. ☐ Cut string or yarn to create two 4-foot pieces for each group. **Materials** ☐ Observe Growth and Development of Rabbits and Chickens (1 per group): yardstick or ruler with imperial units, scissors, marker, two 4-foot pieces of string or yarn, 15 paper clips, Timeline Instructions, Rabbit Timeline Photographs, Chicken Timeline Photographs ☐ Science Logbook (Lesson 8 Activity Guide) ☐ Class life of an individual model from Lesson 7 **Module Resources** ▪ Lesson 8 Resource A: Cassowary Chick and Adult Bird Photographs ▪ Lesson 8 Resource B: Timeline Instructions ▪ Lesson 8 Resource C: Rabbit Timeline Photographs ▪ Lesson 8 Resource D: Adult Rabbit Photograph ▪ Lesson 8 Resource E: Chicken Timeline Photographs ▪ Lesson 8 Resource F: Adult Chicken Photograph **Alternative Pacing** Day 1: Launch through Observe Rabbits' Growth and Development Day 2: Observe Chickens' Growth and Development through Land
Lessons 9–11 *Phenomenon Question: What can influence the development of traits?*	
Lesson 9 Model changes in an individual's traits.	**Preparing to Teach** ☐ Set up Trait Influence Stations (Lesson 9 Resource B). **Materials** ☐ Science Logbook (Lesson 9 Activity Guide)

	☐ Body Weight Station (2 per class): 2 plastic cups, 46 14-millimeter diameter wooden beads, 2 containers for wooden beads, 2 sheets of green paper, 2 sheets of blue paper, scale, marker, station procedure sheet ☐ Feeding Style Station (1 per class): 2 folders, 8 plastic cups, 2 6-quart plastic containers, 2 timers, 60 14-millimeter diameter wooden beads, 8 craft sticks, 2 containers for craft sticks, 2 containers for wooden beads, marker, water, feeding style diagrams, station procedure sheet ☐ Coloration Station (2 per class): 3 plastic cups, 9 index cards, bottle of red food coloring, plastic gloves (1 pair per student), plastic spoon, timer, pitcher, marker, water, paper towels, American flamingo photographs, station procedure sheet **Module Resources** ▪ Lesson 9 Resource A: Radish Plant Photographs ▪ Lesson 9 Resource B: Trait Influence Stations Setup Instructions ▪ Lesson 9 Resource C: Trait Influence Stations Procedure Sheets ▪ Lesson 9 Resource D: Trait Influence Stations Text Resources ▪ Lesson 9 Resource E: Trait Influence Stations Diagrams and Photographs **Alternative Pacing** Day 1: Launch through Prepare to Visit Trait Influence Stations (complete Feeding Style Station preparation) Day 2: Prepare to Visit Trait Influence Stations (complete Coloration Station preparation) through Land
Lesson 10 Explain how interactions between an individual and its environment can influence the individual's traits.	**Preparing to Teach** ☐ Set up Trait Influence Stations (Lesson 9 Resource B). **Materials** ☐ Science Logbook (Lesson 9 Activity Guide) ☐ Body Weight Station (2 per class): 2 plastic cups, 46 14-millimeter diameter wooden beads, 2 containers for wooden beads, 2 sheets of green paper, 2 sheets of blue paper, scale, marker, station procedure sheet ☐ Feeding Style Station (1 per class): 2 folders, 8 plastic cups, 2 6-quart plastic containers, 2 timers, 60 14-millimeter diameter wooden beads, 8 craft sticks, 2 containers for craft sticks, 2 containers for wooden beads, marker, water, feeding style diagrams, station procedure sheet ☐ Coloration Station (2 per class): 3 plastic cups, 9 index cards, bottle of red food coloring, plastic gloves (1 pair per student), plastic spoon, timer, pitcher, marker, water, paper towels, American flamingo photographs, station procedure sheet ☐ Class trait influence chart from Lesson 9

	Alternative Pacing Day 1: Launch through Visit Trait Influence Stations Day 2: Debrief Trait Influence Stations through Land
Lesson 11 Identify and describe traits influenced by growth and development and by interactions between an individual and its environment.	**Preparing to Teach** None **Materials** ☐ Science Logbook (Lesson 11 Activity Guides A and B) ☐ *Here Come the Humpbacks!* **Module Resources** ▪ Lesson 11 Resource: Conceptual Checkpoint Scenario **Alternative Pacing** Day 1: Launch through Update Anchor Evidence Organizer Day 2: Conceptual Checkpoint through Land
Application of Concepts (Lessons 12–13): Science Challenge, Part I	
Lessons 12–13 *Phenomenon Question: How does the water in a plant's environment influence the plant's traits?*	
Lesson 12 Plan a fair test to determine how different water conditions influence a plant's traits.	**Preparing to Teach** None **Materials** ☐ Science Logbook (Lesson 12 Activity Guides A and B) ☐ 3 Fast Plants (1 Non-Purple Stem, Hairless; 1 Yellow-Green Leaf; 1 F1 Non-Purple Stem, Yellow-Green Leaf) for students to observe **Module Resources** ▪ Lesson 12 Resource: Salt Truck Photograph **Alternative Pacing** Day 1: Launch through Develop Fair Test Guidelines Day 2: Discuss Investigation Ideas through Land **Advance Preparation for Lesson 13** ☐ Prepare Fast Plants for Science Challenge (Lesson 13 Resource).

Lesson 13 Set up and conduct an investigation to determine how different water conditions influence a plant's traits.	**Preparing to Teach** None **Materials** ☐ Science Logbook (Lesson 12 Activity Guides A and B) ☐ Science Challenge (1 per group for Groups 1 and 2): 2 Non-Purple Stem, Hairless Fast Plants without wicks; metric ruler; marker; masking tape; graduated cylinder; access to water and grow light ☐ Science Challenge (1 per group for Groups 3 and 4): 2 Yellow-Green Leaf Fast Plants without wicks; metric ruler; marker; masking tape; graduated cylinder; access to water and grow light ☐ Science Challenge (1 per group for Groups 5 and 6): 2 F1 Non-Purple Stem, Yellow-Green Leaf Fast Plants without wicks; approx. 10 grams of salt; metric ruler; marker; masking tape; graduated cylinder; scale; access to water and grow light ☐ Class fair test guidelines chart from Lesson 12 ☐ 12 Fast Plants (4 Non-Purple Stem, Hairless; 4 Yellow-Green Leaf; 4 F1 Non-Purple Stem, Yellow-Green Leaf) growing under grow light with wicks intact for students to observe ☐ Class trait influence chart from Lesson 9 **Module Resources** ▪ Lesson 13 Resource: Science Challenge: Fast Plant Preparation Instructions **Alternative Pacing** Day 1: Launch through Set Up Investigations Day 2: Observe and Record Data: Day 1 through Land

Concept 3: Inherited Traits (Lessons 14–18)

Focus Question: How do individuals get their traits?

Lessons 14–15

Phenomenon Question: Why do offspring look like their parents?

Lesson 14 Make a claim that offspring inherit traits from both parents.	**Preparing to Teach** ☐ Prepare Gouldian finch family posters (Lesson 14 Resource C). **Materials** ☐ Science Logbook (Lesson 14 Activity Guide) ☐ Prepare Gouldian Finch Family Posters: 4 pieces of 11'' × 17'' (or larger) paper, 1 color copy of each photograph in Lesson 14 Resource C, scissors, permanent marker, glue

	Module Resources ▪ Lesson 14 Resource A: Rabbit Parent and Offspring Photographs ▪ Lesson 14 Resource B: Gouldian Finch Photographs ▪ Lesson 14 Resource C: Prepare Gouldian Finch Family Posters ▪ Lesson 14 Resource D: Gouldian Finch Parent Photographs **Alternative Pacing** Day 1: Launch through Observe Finch Family Traits Day 2: Analyze Traits through Land
Lesson 15 Collect evidence to determine whether plant offspring inherit traits from both parents.	**Preparing to Teach** ☐ Prepare the 12 Fast Plants not used in the science challenge for student observation. Label each Non-Purple Stem, Hairless plant as Parent A; label each Yellow-Green Leaf plant as Parent B; and label each F1 Non-Purple Stem, Yellow-Green Leaf plant as Offspring. Divide the plants into 4 sets so that each set has 1 plant labeled Parent A, 1 plant labeled Parent B, and 1 plant labeled Offspring. **Materials** ☐ Science Logbook (Lesson 14 Activity Guide) ☐ Observe Plant Parents and Offspring (1 per group): 3 Fast Plants (1 Non-Purple Stem, Hairless; 1 Yellow-Green Leaf; and 1 F1 Non-Purple Stem, Yellow-Green Leaf) labeled as Plant A, Plant B, and Offspring ☐ Science Logbook (Lesson 15 Activity Guides A and B) ☐ Class trait influence chart from Lesson 9 **Module Resources** ▪ Lesson 15 Resource A: Fast Plant Family Tree Diagram ▪ Lesson 15 Resource B: Fast Plant Photographs **Alternative Pacing** Day 1: Launch through Observe Plant Parents and Offspring Day 2: Reevaluate Claim through Land
Lessons 16–18 *Phenomenon Question: What causes differences between siblings?*	
Lesson 16 Analyze data to explain that siblings inherit different combinations of traits from their parents.	**Preparing to Teach** ☐ Print a color copy of the Finch Family Tree Diagram (Lesson 16 Resource B) for each student pair. **Materials** ☐ Finch Family Tree Diagram (1 per student pair) ☐ Science Logbook (Lesson 16 Activity Guide)

	Module Resources ▪ Lesson 16 Resource A: Finch Nest Photograph ▪ Lesson 16 Resource B: Finch Family Tree Diagram **Alternative Pacing** Day 1: Launch through Record Traits of Finch Families Day 2: Analyze Similarities and Differences between Siblings through Land
Lesson 17 Use evidence to support an argument in which an individual's family members are identified based on patterns of inherited traits.	**Preparing to Teach** ☐ Identify four corners or areas of the classroom to use for a Question Corners routine. Print a color copy of each frog family image (Lesson 17 Resource C). Post one image in each corner. Then print a color copy of the mystery frog image (Lesson 17 Resource B) for each student or student pair. Alternatively, print four color copies of the mystery frog image, and post one in each corner alongside the frog family images. If using this approach, be sure to label the mystery frog image clearly and separate it from the frog family images. **Materials** ☐ Mystery Frog Image (1 per student or student pair) ☐ Science Logbook (Lesson 17 Activity Guide) **Module Resources** ▪ Lesson 17 Resource A: Finch Flock Photograph ▪ Lesson 17 Resource B: Mystery Frog Image ▪ Lesson 17 Resource C: Frog Family Images **Alternative Pacing** Day 1: Launch through Examine Frog Families Day 2: Engage in Argument from Evidence through Land
Lesson 18 Identify inherited traits and explain how inheritance contributes to variation within a species.	**Preparing to Teach** ☐ Cue humpback whale mother and calf videos: http:/phdsci.link/1295 and http:/phdsci.link/1296. **Materials** ☐ Science Logbook (Lesson 18 Activity Guide) ☐ Class trait influence chart from Lesson 9 **Module Resources** ▪ Lesson 18 Resource A: Young Rabbits Photograph ▪ Lesson 18 Resource B: Conceptual Checkpoint Scenario ▪ Lesson 18 Resource C: Humpback Whale Mother and Calf Photographs ▪ Lesson 18 Resource D: Humpback Whale Mother and White Calf Photograph

	Alternative Pacing Day 1: Launch through Conceptual Checkpoint Day 2: Update Anchor Evidence Organizer through Land
Application of Concepts (Lessons 19–20): Science Challenge, Part II	
Lessons 19–20 *Phenomenon Question: How does the water in a plant's environment influence the plant's traits?*	
Lesson 19 Analyze data to draw conclusions about how different water conditions influence a plant's traits.	**Preparing to Teach** None **Materials** ☐ Science Logbook (Lesson 12 Activity Guides A and B) ☐ Science Logbook (Lesson 19 Activity Guide) ☐ Class trait influence chart from Lesson 9 **Module Resources** ▪ Lesson 19 Resource: Fast Plant Investigation Photographs (optional) **Alternative Pacing** Day 1: Launch through Analyze Investigation Data Day 2: Compare Investigation Results through Land
Lesson 20 Support a claim with evidence that a plant's inherited traits can be influenced by the plant's environment.	**Preparing to Teach** None **Materials** ☐ Science Logbook (Lesson 12 Activity Guides A and B) ☐ Science Logbook (Lesson 20 Activity Guide) **Module Resources** ▪ Lesson 20 Resource: Bruegel the Elder and Brueghel the Younger Paintings **Alternative Pacing** Day 1: Launch through Gather Evidence to Support or Refute a Claim Day 2: Evaluate a Claim through Land

Concept 4: Advantages of Traits (Lessons 21–25)

Focus Question: How do individuals' traits affect their lives?

Lessons 21–22

Phenomenon Question: How do the traits of different individuals function differently?

Lesson 21

Identify traits that provide an individual with an advantage.

Preparing to Teach

- ☐ Set up Trait Function Stations (Lesson 21 Resource A).

Materials

- ☐ Science Logbook (Lesson 21 Activity Guide)
- ☐ Brown Pelican Station (2 per class): 60 14-millimeter diameter wooden beads, 2 plastic cups, 6-quart plastic container, 1-tablespoon measuring spoon, $\frac{1}{2}$ teaspoon measuring spoon, timer, water, station procedure sheet 2
- ☐ Ruby-Throated Hummingbird Station (2 per class): 20 test tubes (each at least 4.5 inches long), 2 plastic straws, 2 plastic cups, test tube rack (at least 20 tube capacity), scissors, timer, water, permanent marker, ruler, station procedure sheet
- ☐ Prickly Pear Cactus Station (2 per class): 0.75 pound of modeling clay, 120 toothpicks, 2 medium binder clips ($\frac{5}{8}$ inch capacity), station procedure sheet

Module Resources

- Lesson 21 Resource A: Trait Function Stations Setup Instructions
- Lesson 21 Resource B: Trait Function Stations Photographs
- Lesson 21 Resource C: Trait Function Stations Procedure Sheets

Alternative Pacing

Day 1: Launch through Visit Trait Function Stations (visit one station)

Day 2: Visit Trait Function Stations (visit two stations) through Land

Lesson 22

Explain how an advantageous trait can affect an individual's survival.

Preparing to Teach

- ☐ Prepare the materials for the predator and prey model by cutting sheets of black paper and sheets of white paper into 1-inch squares. Place 15 1-inch black paper squares and 15 1-inch white paper squares into a paper bag for each student. Set the timer aside to use during the lesson.

Materials

- ☐ Model Predator and Prey (1 per student pair): 2 paper bags each filled with 15 1-inch white paper squares and 15 1-inch black paper squares, 2 plastic cups, 1 sheet of black paper, 1 sheet of white paper
- ☐ Science Logbook (Lesson 22 Activity Guide)

	☐ Prepare to Model Predator and Prey: several sheets of black paper, several sheets of white paper, paper bags (1 per student), timer ☐ Class trait function chart from Lesson 21 **Module Resources** ▪ Lesson 22 Resource A: Rock Pocket Mice Photographs ▪ Lesson 22 Resource B: Desert Environments Photographs **Alternative Pacing** Day 1: Launch through Model Predator and Prey Day 2: Discuss Results through Land
Lessons 23–25 *Phenomenon Question: How can an individual's traits affect its ability to reproduce?*	
Lesson 23 Explain how having an advantageous trait can affect an individual's ability to reproduce.	**Preparing to Teach** ☐ Print a copy of Life of an Individual Model (Lesson 23 Resource B) for each student. ☐ Prepare the rock pocket mouse cards (Lesson 23 Resource C). ☐ Determine how to display the rock pocket mouse life events (Lesson 23 Resource A). The events should be covered at the beginning of the lesson and uncovered one at a time during the Model Rock Pocket Mouse Life Cycle activity. Consider posting the resource on a whiteboard and taping over each event with a separate piece of paper. **Materials** ☐ Model Rock Pocket Mouse Life Cycle: Life of an Individual Model, rock pocket mouse card ☐ Science Logbook (Lesson 23 Activity Guide) **Module Resources** ▪ Lesson 22 Resource A: Rock Pocket Mice Photographs ▪ Lesson 23 Resource A: Life of an Individual Model ▪ Lesson 23 Resource B: Dark Rocky Desert Environment Photograph ▪ Lesson 23 Resource C: Rock Pocket Mouse Cards ▪ Lesson 23 Resource D: Rock Pocket Mouse Life Events ▪ Lesson 23 Resource E: Red Sandy Environment Photograph ▪ Lesson 23 Resource F: Mammoth Museum Exhibit Photograph **Alternative Pacing** Day 1: Launch through Model Rock Pocket Mouse Life Cycle Day 2: Share Results through Land

Lesson 24 Analyze evidence to explain that certain traits can provide an individual with an advantage in finding a mate.	**Preparing to Teach** ☐ Set up Reproductive Success Stations (Lesson 24 Resource B). ☐ Cue "Vicious Elephant Seal Battle on South Georgia" video (Sidey 2010) and long-tailed widowbird flying video: http:/phdsci.link/1298 and http:/phdsci.link/1299. **Materials** ☐ Science Logbook (Lesson 24 Activity Guide) ☐ Southern Elephant Seal Station: 6 metric rulers, 6 copies of the southern elephant seal station text, 6 sets of elephant seal cutouts, scissors, station procedure sheet ☐ Long-Tailed Widowbird Station: 6 metric tape measures, 6 copies of the long-tailed widowbird station text, 6 sets of widowbird cutouts, 8.5 meters of ribbon or string, scissors, tape or staples, station procedure sheet **Module Resources** ▪ Lesson 24 Resource A: Two Gouldian Finches Photograph ▪ Lesson 24 Resource B: Reproductive Success Stations Setup Instructions ▪ Lesson 24 Resource C: Reproductive Success Stations Text Resources ▪ Lesson 24 Resource D: Reproductive Success Stations Printable Materials ▪ Lesson 24 Resource E: Reproductive Success Stations Procedure Sheets **Alternative Pacing** Day 1: Launch through Visit Reproductive Success Stations (visit one station) Day 2: Visit Reproductive Success Stations (visit one station) through Land
Lesson 25 Construct an explanation for how different traits can provide individuals with advantages in surviving, finding mates, and reproducing.	**Preparing to Teach** None **Materials** ☐ Science Logbook (Lesson 25 Activity Guides A and B) ☐ *Here Come the Humpbacks!* **Module Resources** ▪ Lesson 25 Resource A: Humpback Whale Group Illustration ▪ Lesson 25 Resource B: Humpback Whale Group Data Tables ▪ Lesson 25 Resource C: Conceptual Checkpoint Scenario **Alternative Pacing** Day 1: Launch through Examine Humpback Whale Data Day 2: Update Anchor Chart and Anchor Evidence Organizer through Land

Application of Concepts (Lessons 26–28): Socratic Seminar and End-of-Module Assessment

Lessons 26–28

Phenomenon Question: What makes an individual humpback whale unique?

Lesson 26 Describe factors that influence traits and explain how traits affect an individual's life. (Socratic Seminar)	**Preparing to Teach** None **Materials** ☐ Science Logbook (Lesson 26 Activity Guides A, B, and C) **Alternative Pacing** Day 1: Launch through Prepare for Socratic Seminar Day 2: Engage in Socratic Seminar through Land
Lesson 27 Describe factors that influence traits and explain how traits affect an individual's life. (End-of-Module Assessment)	**Preparing to Teach** None **Materials** ☐ End-of-Module Assessment **Alternative Pacing** Day 1: Launch through Complete the End-of-Module Assessment (begin assessment) Day 2: Complete the End-of-Module Assessment (complete assessment) through Land
Lesson 28 Describe factors that influence traits and explain how traits affect an individual's life. (End-of-Module Assessment Debrief)	**Preparing to Teach** ☐ Score End-of-Module Assessments and write individual feedback. ☐ Select End-of-Module Assessment responses to share with students. ☐ Prepare visual for student connections between module concept statements and Systems Crosscutting Concepts (Lesson 28 Resources A and B). **Materials** ☐ End-of-Module Assessment Rubric ☐ Sample of End-of-Module Assessment responses that meet expectations (either sample responses from Teacher Edition or sample from class) **Module Resources** ▪ Lesson 28 Resource A: Module Concept Statements ▪ Lesson 28 Resource B: Systems Crosscutting Concepts **Alternative Pacing** Day 1: Launch through Debrief the End-of-Module Assessment Day 2: Revise End-of-Module Assessment Responses through Land

Works Cited

Associated Press (AP). 2015. "Raw: Rare White Humpback Whale Sighted." Video, 0:52, posted August 10, 2015, https://www.youtube.com/watch?v=R1iE1ppZuGg.

Marine Education and Research Society (MERS). 2018. "Trap-Feeding—a Novel Humpback Feeding Strategy (Compilation of Footage)." YouTube video, 3:42, posted November 27, 2018, https://www.youtube.com/watch?v=STZDtHn39QI.

Sayre, April Pulley. 2013. *Here Come the Humpbacks!* Watertown, MA: Charlesbridge. [All references to *Here Come the Humpbacks!* are from this source.]

Sidey, Richard. 2010. "Vicious Elephant Seal Battle on South Georgia." YouTube video, 1:45, posted January 17, 2010, https://www.youtube.com/watch?v=DU4xW79ASsg.

Whale and Dolphin Conservation (WDC). 2016. "Humpback Whales Kick-Feeding." YouTube video, 1:06, posted November 4, 2016, https://www.youtube.com/watch?v=bgbJLAmJf24.

Whale and Dolphin Conservation (WDC). 2017. "Humpback Whales Work Together to Feed Using Bubble Net Technique." YouTube video, 0:36, posted November 22, 2017, https://www.youtube.com/watch?v=8hp5wdgwZCY.

Wilken, Rebecca. 2017. "For Humpback Whales in Sanctuaries, Public Involvement Counts." April 2017, National Oceanic and Atmospheric Administration (NOAA), National Marine Sanctuaries, https://sanctuaries.noaa.gov/news/apr17/for-humpback-whales-in-sanctuaries-public-involvement-counts.html.

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