# PhD SCIENCE™ TIPS FOR FAMILIES

## Overview for Families

### What is *PhD Science*?

*PhD Science*™ is a knowledge-building, phenomenon-driven curriculum. By using an observable event that can be explained or predicted—the anchor phenomenon—students have a real-world context for their learning. Students explore these compelling phenomena through observation, questioning, modeling, and investigation. The year will be divided into four units of study called modules. Each module weaves a coherent storyline of science concepts that helps students make sense of the phenomena they are exploring. Students then apply their new knowledge to an authentic situation or problem.

### What will my student do in class?

Students will be working, thinking, and experimenting just like real scientists. Science will not be about memorizing facts or reading from a textbook. Instead, the science curriculum will involve hands-on investigations that allow students to develop a deep understanding of science concepts. As students uncover information about the anchor phenomenon, they will ask questions, discover evidence, generate new ideas, and come up with solutions.

Throughout the module, students generate questions about the phenomenon that will be recorded on the *driving question board*. The driving question board is a chart we will use to organize our questions and guide our learning. We will also create an anchor model and chart to visually express our ideas. These tools help us see how different concepts fit together and how our understanding of the phenomena is deepening.

Each module has opportunities for students to use the engineering design process, apply what they learned to solve real-world problems, and present their ideas. For example, in a module on weather and climate, students design a model seawall to reduce the effects of storm-related coastal flooding.

Discussion and debate will be part of many lessons, as students will state and defend their claims with evidence and ask questions about others' claims. At the end of each module, students will participate in a Socratic Seminar that focuses on the importance of questioning. During the seminar, students will be presented with a rigorous question that encourages them to think critically and apply their learning from the module.

## What will be different?

If you stop by the classroom during science instruction, you won't see students answering questions from a textbook or listening to a lecture. Instead, you'll find students in small groups discussing ideas, doing experiments, or reporting their findings. *PhD Science* lessons are designed to allow students to drive their own learning. Students uncover key concepts by actively engaging in science and engineering practices. They read high-quality, age-appropriate books in class that spark curiosity, introduce phenomena, and support the development of scientific understandings. Further, students document their learning in a Science Logbook that allows them to reflect, review, and track how their knowledge has progressed.

## How is science connected to other disciplines?

All *PhD Science* modules make connections across science fields and academic disciplines. The curriculum highlights connections to math, literacy, and history so students can practice using the interdisciplinary approach necessary for real-world tasks. For example, in a module on weather and climate, students practice math skills such as graphing and measuring while analyzing weather data, and they connect this knowledge to history and geography as they learn about the 1900 Galveston hurricane. In addition to cross-curricular connections, all modules have lessons devoted to the application of concepts. In these lessons, students apply science and engineering practices to solve an authentic problem.

## How can I help?

With each module you will receive a Family Tip Sheet that outlines the module concepts and includes ideas on how you can support your student at home. The goal of these suggestions is to help students see science everywhere and not just at school. Talking about science, watching science videos, or visiting a museum, park, or zoo are all ways to support your student's learning. For more information about what you can do to help facilitate your student's understanding of science, visit *NSTA Science Matters: Tips for Busy Parents* at https://www.nsta.org/sciencematters/tips.aspx.

## Is there homework?

*PhD Science* modules have informal homework assignments to reinforce learning and connect students' understandings to their everyday lives. These assignments often include ideas to discuss with family members or questions that prompt a simple exploration. Students are encouraged to report their findings to the class.

## How are students assessed?

Student learning is assessed in informal and formal ways. Through questions and classwork, students will be informally assessed. At the end of the module, tasks to measure learning include a science or engineering challenge, an End-of-Module Assessment, and the Socratic Seminar. The balance of ongoing and cumulative assessments allows instruction to be adjusted throughout the module to ensure that students are progressing.

## What will my student study in Level 3?

| Module | Title | Anchor Phenomenon |
|---|---|---|
| **1** | Weather and Climate | 1900 Galveston Hurricane |
| **2** | Survival | Butterfly Survival |
| **3** | Traits | Individual Variation in Humpback Whales |
| **4** | Forces and Motion | Motion in Space |

# Level 3 Module 1: Weather and Climate

## CONTENT OVERVIEW

**ANCHOR PHENOMENON:** 1900 Galveston Hurricane

***Essential Question:*** **How can we prevent a storm from becoming a disaster?**

Exploring firsthand accounts and photos of the devastating 1900 Galveston, Texas, hurricane brings to life the importance of studying weather and reducing the damage caused by weather disasters.

**CONCEPT 1:** Weather Conditions

***Focus Question:*** **How do we describe weather?**

Recording and graphing weather data helps us recognize weather patterns as well as how weather changes over time.

**CONCEPT 2:** Climate

***Focus Question:*** **How do people know what weather to expect?**

Analyzing weather data from different places shows us how weather typically follows a pattern called climate. Understanding climate helps us make reasonable weather predictions.

**CONCEPT 3:** Weather Hazards

***Focus Question:*** **How can we plan for severe weather?**

Predicting and preparing for severe weather helps us reduce damage caused by hazardous weather events.

**APPLICATION OF CONCEPTS:** Designing a Seawall

Using the engineering design process, we will design solutions to reduce the impact of coastal storm flooding.

## SUPPORTING OUR CLASSROOM

If you have any of the items listed, please consider donating them to our class to use in our science investigations.

- Paper cups (3-ounce)
- Empty plastic bottles with lids (16.9-ounce and 0.5-liter)

## SUPPORTING YOUR YOUNG SCIENTIST AT HOME

### ONGOING CONVERSATIONS

Support science learning at home by having conversations about weather and climate topics. Here are some suggestions to get you started:

- Talk about how weather affects daily life and plans for the year.
- Explore the weather and climate in other locations of interest including where relatives live, previous places you have lived, and places you visit.
- Talk about how weather patterns have changed in your area over the last 5–10 years, such as whether it is drier, wetter, hotter, or colder.
- Discuss family plans for or find out about community resources related to severe weather events.

### ACTIVITIES

These activities support and extend the learning going on in the classroom:

- Help your student keep a weather journal at home by recording local weather conditions or the weather conditions of a favorite place.
- With your student, research weather records for your area such as high and low temperatures or rainfall amounts. Students will enjoy searching for outlier information like the record for the warmest day in January!
- Look for signs of the season on walks or drives. For an extra challenge, work with your student to incorporate these signs into a poem.

### BOOKS

Local libraries are a great resource for fiction and nonfiction books related to weather and climate. Browse the library catalog or start with these suggestions:

- *Hurricanes* by Seymour Simon
- *Tornadoes!* by Gail Gibbons
- *Red Sky at Night* by Elly MacKay

## WEBSITES

Keep the learning going about weather and climate by exploring these internet resources:

- Visit the NASA Climate Kids website at https://climatekids.nasa.gov/ to see how weather impacts different aspects of life, including food and food production.
- Visit the National Weather Service website https://www.weather.gov/owlie/, and click on the Weird Weather link to learn all about interesting weather events.

# Level 3 Module 2: Survival

## CONTENT OVERVIEW

**ANCHOR PHENOMENON:** Butterfly Survival

***Essential Question:*** **How do butterflies survive over time in a changing environment?**

Clues about long ago environments including fossil evidence help us understand how butterflies responded to changes and survived. We can apply this understanding to other plants and animals that have survived and those that have become extinct.

**CONCEPT 1:** Fossil Evidence

***Focus Question:*** **What do fossils reveal about the past?**

Studying butterfly fossils helps us gather information about butterflies and their environment in the past.

**CONCEPT 2:** Suitability to Environment

***Focus Question:*** **How do organisms get what they need to survive?**

Observing caterpillars in an artificial habitat helps us understand what organisms need from their habitats to survive and what characteristics help organisms survive.

**CONCEPT 3:** Effects of Environmental Change

***Focus Question:*** **What happens to organisms when the environment changes?**

Learning about seasonal changes and long-term changes helps us understand how these changes affect organisms. Some organisms survive, some move, and some die.

**APPLICATION OF CONCEPTS:** Helping Monarchs Survive Changing Environments

After learning about threats specific to monarch butterflies, we will design solutions to protect butterflies and write letters explaining the merits of these solutions.

## SUPPORTING OUR CLASSROOM

If you have any of the items listed, please consider donating them to our class to use in our science investigations.

- 9-ounce plastic cups
- Paper plates

## SUPPORTING YOUR YOUNG SCIENTIST AT HOME

### ONGOING CONVERSATIONS

Support science learning at home by having conversations about survival topics. Here are some suggestions to get you started:

- Observe and discuss the different plants and animals you notice in your community. Talk about how the animals and plants are suited for and have adapted to different habitats.
- Notice or remember seasonal changes in your community and what happens to the plants and animals during different seasons of the year.
- Talk about or research changes in your community and their impact on animal habitats.

### ACTIVITIES

These activities support and extend the learning going on in the classroom:

- Help your student keep a nature journal of animals noticed around your home. This data could be graphed and compared over the course of a few days or weeks.
- Plant a butterfly bush (Buddleia) or another plant that attracts butterflies at your home or in a nearby community garden. Observe the visitors to these plants.
- Visit a natural history museum to explore fossils and timelines of Earth's past.
- Visit a nearby nature park or wildlife sanctuary to learn more about local flora and fauna. Take notes or draw sketches to record what you observe.

### BOOKS

Local libraries are a great resource for fiction and nonfiction books related to survival. Browse the library catalog or start with these suggestions:

- *A Butterfly Is Patient*, Dianna Hutts Aston and Sylvia Long
- *Marvelous Mattie: How Margaret E. Knight Became an Inventor*, Emily Arnold McCully
- *Amos & Boris*, William Steig

## WEBSITES

Keep the learning going about survival by exploring these internet resources:

- Visit https://journeynorth.org/monarchs to learn more about monarch butterfly migrations in real time. You can even sign up to report your own sightings of monarch butterflies.
- Visit https://www.nps.gov/flfo/learn/index.htm to learn more about the Florissant Fossil Beds National Monument.

# Level 3 Module 3: Traits

## CONTENT OVERVIEW

**ANCHOR PHENOMENON:** Individual Variation in Humpback Whales

***Essential Question:*** **What makes an individual humpback whale unique?**

By studying humpback whales, we learn that inherited traits and environmental conditions result in variation within the same species. We also learn how traits affect an individual's ability to survive.

**CONCEPT 1:** Describing Organisms

***Focus Question:*** **How can we identify individuals?**

By observing pictures and videos of humpback whales and other animals, we learn that individuals of the same species can have the same characteristics but different traits.

**CONCEPT 2:** Growth, Development, and Environmental Influences

***Focus Question:*** **How do individuals change over time?**

Studying different species shows how individuals' traits are influenced by different factors.

**APPLICATION OF CONCEPTS:** Water Conditions and Environmental Influences

We see how environmental factors influence traits by designing investigations to collect data about the traits of plants grown in different water conditions.

**CONCEPT 3:** Inherited Traits

***Focus Question:*** **How do individuals get their traits?**

Observing plant and animal families shows us that individuals inherit different combinations of traits from both parents.

**CONCEPT 4:** Advantages of Traits

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

Modeling how different traits are helpful shows us how those traits provide individuals with advantages.

## SUPPORTING OUR CLASSROOM

If you have any of the items listed, please consider donating them to our class to use in our science investigations.

- 9-ounce plastic cups
- Potting soil

## SUPPORTING YOUR YOUNG SCIENTIST AT HOME

### ONGOING CONVERSATIONS

Support science learning at home by having conversations about traits. Here are some suggestions to get you started:

- Talk about the characteristics and traits of the different plants and animals near your home. Extend the conversation by talking about the advantages of these characteristics and traits.
- Compare the traits of a species in different places that you have visited or might want to visit.
- Look for trait similarities and differences in families such as eye color or handedness. Discuss whether these might be inherited traits or traits influenced by the environment.

### ACTIVITIES

These activities support and extend the learning going on in the classroom:

- Take photos of or examine different pictures of individuals from the same species to look for variation among individuals.
- Visit a zoo to observe different characteristics and traits of the animals.
- Observe plants in your environment. If the plants are the same species, look for shared traits. If they are different species, look for shared characteristics.

### BOOKS

Local libraries are a great resource for fiction and nonfiction books related to traits. Browse the library catalog or start with these suggestions:

- *Here Come the Humpbacks!* by April Pulley Sayre
- *Creature Features: Twenty-Five Animals Explain Why They Look the Way They Do* by Steve Jenkins and Robin Page
- *Amazing Animals: Elephants* by Kate Riggs

## WEBSITES

Keep the learning going by exploring these internet resources:

- Visit the Marine Education and Research Society (https://mersociety.org/humpback) to learn more about humpback whales.
- Observe organisms and look for characteristics of species and traits of individuals of the same species at https://www.inaturalist.org.

# Level 3 Module 4: Forces and Motion

## CONTENT OVERVIEW

**ANCHOR PHENOMENON:** Motion in Space

***Essential Question:*** **Why do objects move differently in space than they do on Earth?**

By investigating how objects move differently in space and on Earth, we develop an understanding that forces can cause changes in the motion of objects and that we can observe, measure, describe, and predict an object's motion.

**CONCEPT 1:** Motion

***Focus Question:*** **How can we describe and predict an object's motion?**

Observing and describing the motion of a soccer ball on Earth and in space helps us understand the patterns of an object's motion and make predictions about how an object will move.

**CONCEPT 2:** Forces

***Focus Question:*** **What can cause the motion of an object to change?**

Observing pushes and pulls and investigating the many forces acting on an object, such as gravity and friction, help us recognize how forces can affect motion.

**CONCEPT 3:** Magnetic and Electric Forces

***Focus Question:*** **How can an object move without being touched?**

By investigating magnetic and electric forces, we learn about non-touching forces and how magnets can be used to solve problems.

**APPLICATION OF CONCEPTS:** Designing an Astronaut's Toolbox

We apply our understanding of forces and motion in an engineering challenge in which we develop a solution to a problem experienced by astronauts outside the International Space Station.

## SUPPORTING OUR CLASSROOM

If you have any of the items listed, please consider donating them to our class to use in our science investigations.

- Pennies
- Large metal paper clips

## SUPPORTING YOUR YOUNG SCIENTIST AT HOME

### ONGOING CONVERSATIONS

Support science learning at home by having conversations about forces and motion topics. Here are some suggestions to get you started:

- Have discussions about forces and motion in everyday life. Ask: Why is it easier to pull a wagon on a smooth sidewalk than on rough grass? Why does a bike speed up when it is going downhill?
- Talk about different sports that are played with balls and a striking force. Consider how forces affect the motion of the ball in sports such as baseball, tennis, ping pong, golf, basketball, and soccer.
- Draw attention to your daily activities and imagine how an activity such as taking a bath, brushing teeth, or making a bed might be different on the International Space Station.

### ACTIVITIES

These activities support and extend the learning going on in the classroom:

- Go on a magnet hunt around the house to discover how magnets are used in everyday objects (e.g., refrigerator magnets, cabinet latches, toys, appliance doors).
- Watch a sporting event and encourage your student to use vocabulary such as *balanced*, *unbalanced*, *direction*, *speed*, *friction*, *push*, and *pull* to describe the forces and motion they observe.
- Invite your student to find examples of objects that move in ways similar to the objects in their Motion Station Investigation, such as those that swing, bounce, roll, spin, slide, and curve.

## BOOKS

Local libraries are a great resource for fiction and nonfiction books related to space and forces and motion. Browse the library catalog or start with these suggestions:

- *Moonshot: The Flight of Apollo 11* by Brian Floca
- *Team Moon: How 400,000 People Landed Apollo 11 on the Moon* by Catherine Thimmesh
- *Footprints on the Moon* by Alexandra Siy

## WEBSITES

Keep the learning going about forces and motion by exploring these internet resources:

- Visit the NASA website for students (https://solc.gsfc.nasa.gov/modules/newkz3/index.html) and select Living on ISS to see videos of some creative solutions for living and working in space.

- Find out how crew members on the International Space Station live. Visit this NASA website: https://www.nasa.gov/audience/forstudents/k-4/more_to_explore/Living-Working-In-Space.html.