PhD SCIENCE® TIPS FOR FAMILIES

Overview for Families

What is *PhD Science*?

PhD Science® is a knowledge-building, phenomenon-driven curriculum. Each year comprises four units of study called modules. Each module provides students with a real-world context for their learning by focusing on an observable event that can be explained or predicted: the anchor phenomenon. Students explore these compelling phenomena through observing, questioning, modeling, and investigating. Woven throughout each module is a coherent storyline of science concepts that helps students make sense of the phenomena they are exploring.

What will my student do in class?

Students will be working, thinking, and experimenting just like real scientists. Science 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, find evidence, generate new ideas, and devise solutions.

Throughout each module, the questions students generate about the anchor phenomenon will be recorded on the *driving question board*—a chart the class will use to organize questions and guide student learning. The class also creates an anchor model and chart to visually express students' ideas. These tools help students see how different concepts fit together and how understanding of the phenomenon is deepening.

Each module offers opportunities for students to use the engineering design process, apply what they have learned to solve real-world problems, and present their ideas. For example, in a module on survival, students draw inspiration from animals with protective body parts such as shells and scales, and they design a covering that protects scientists from prickly pond plants that can scratch their legs.

Discussion and debate will be part of many lessons, as students will make claims, defend them with evidence, and ask questions about the claims of their classmates. At the end of each module, students will participate in a Socratic Seminar that stimulates discussion. During the seminar, students respond to fundamental questions about the anchor phenomenon and broader scientific concepts by thinking critically and applying their learning from the module.

What will be different?

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. In class, they read high-quality, age-appropriate texts that spark curiosity, introduce phenomena, and support the development of scientific understandings. Along the way, students document their learning in a Science Logbook that allows them to review and reflect on how they built their knowledge.

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 social studies so students can practice approaching real-world tasks from an interdisciplinary perspective. For example, in a module on celestial objects, students observe patterns in the movements of the Sun, stars, and the Moon. They notice that the number of daytime hours increases throughout the first half of each year and decreases throughout the second half of each year. They also use cardinal directions to describe the locations of these celestial objects. In addition to cross-curricular connections, all modules include 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—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.

Is there homework?

PhD Science modules have optional, 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. When applicable, students are encouraged to share their work with the class.

How are students assessed?

Student learning is assessed in informal and formal ways. Throughout each module, students will be informally assessed through questions and classwork. Toward the end of each module, students apply their new knowledge in a science or engineering challenge, an End-of-Module assessment, and the Socratic Seminar, all of which allow for formal evaluation of learning. The balance of ongoing and cumulative assessment allows instruction to be adjusted throughout the module to ensure that students are progressing.

What will my student study in Level 1?

Module	Title	Anchor Phenomenon
1	Survival	Life at a Pond
2	Light	Wayang Shadow Puppetry
3	Sound	The Recycled Orchestra of Cateura
4	Sky	Polynesian Navigation

Level 1 Module 1: Survival

CONTENT OVERVIEW

ANCHOR PHENOMENON: Life at a Pond

Essential Question: How do pond plants and pond animals survive in their environment?

By exploring life in a pond, we learn that plants and animals have body parts that function in ways that help the plants and animals survive in their environment.

CONCEPT 1: Body Parts

Focus Question: How do plants and animals use their body parts to survive in their environment?

Using models of plants and animals helps us identify the functions of different body parts and see how the body parts help plants and animals survive.

APPLICATION OF CONCEPTS: Protecting Scientists

Using the engineering design process and our observations of plant and animal body parts, we design a protective covering for scientists studying a pond.

CONCEPT 2: Sense and Response

Focus Question: How do plants and animals respond to their environment?

Analyzing how plants and animals sense information helps us understand how they can respond and communicate in ways that help them survive.

CONCEPT 3: Parents and Offspring

Focus Question: How do parents help their offspring survive?

Observing parents and their offspring helps us identify ways in which offspring are similar to their parents and ways in which parents help their offspring survive.

SUPPORTING YOUR YOUNG SCIENTIST AT HOME

ONGOING CONVERSATIONS

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

- Talk about the different plants and animals in your local area.
- Talk about plant and animal body parts and how they help different plants and animals survive. For example, birds' wings help them fly away from danger, and fish have gills that allow them to breathe underwater.
- Point out different human-made objects that mimic the functions of plant and animal body parts. Talk about how engineers might get ideas from observing how plants and animals use their body parts.

ACTIVITIES

These activities support and extend classroom learning:

- Sketch or take photos of different plants and animals that live near your home. Discuss how their different body parts might help the plants or animals survive.
- Check out field guides from the library to help identify local plants and animals.
- Visit a pond or other natural area to observe the plants and animals that live there. Talk about the ways the plants and animals use their body parts to survive.

BOOKS

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

- *Creature Features: 25 Animals Explain Why They Look the Way They Do* by Steve Jenkins and Robin Page
- *Where in the Wild? Camouflaged Creatures Concealed ... and Revealed* by David M. Schwartz and Yael Schy
- *Song of the Water Boatman and Other Pond Poems* by Joyce Sidman

Level 1 Module 2: Light

CONTENT OVERVIEW

ANCHOR PHENOMENON: Wayang Shadow Puppetry

Essential Question: How do puppeteers use light to tell stories during wayang shows?

By studying how light interacts with the parts of a wayang show, we can understand that the way light interacts with objects affects what people see.

CONCEPT 1: Sight

Focus Question: Why do we need light to see objects?

Observing models of a bedroom and a basement helps us understand that objects are visible when light illuminates the objects or when the objects give off their own light.

CONCEPT 2: Interactions with Light

Focus Question: How does light interact with different objects?

Observing interactions between objects, surfaces, and light sources helps us understand how shadows form and how light can be redirected.

APPLICATION OF CONCEPTS: Wayang Screen Materials

Investigating how light interacts with different materials helps us identify the kinds of materials that work well as wayang screens.

SUPPORTING YOUR YOUNG SCIENTIST AT HOME

ONGOING CONVERSATIONS

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

- Point out different light sources inside and outside the home, such as lamps, sunlight, and small lights on appliances.
- Look for shadows and discuss the objects, surfaces, and light sources that interact to form the shadows.
- Compare materials, such as different fabrics, and discuss how much light travels through each material.

ACTIVITIES

These activities support and extend classroom learning:

- Form shadows by using a light source, such as a penlight or flashlight.
- Turn lights on and off a few times at different times of the day and observe how well objects can be seen.
- Go for a walk or drive with your student at different times of the day to observe shadows. If it is dark outside, look for light sources too.
- Use your hands or other objects to put on a shadow puppet show. Check your local library for resources on shadow puppets.

BOOKS

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

- *The Astronaut Who Painted the Moon: The True Story of Alan Bean* by Dean Robbins
- *Hello Lighthouse* by Sophie Blackall
- *Flicker Flash* by Joan Bransfield Graham

Level 1 Module 3: Sound

CONTENT OVERVIEW

ANCHOR PHENOMENON: The Recycled Orchestra of Cateura

Essential Question: How does the Recycled Orchestra make music?

By studying how the Recycled Orchestra of Cateura uses discarded objects to make music, we can understand that sound is caused by vibrating objects and sound can cause objects to vibrate.

CONCEPT 1: Making Sound

Focus Question: What causes sound?

Investigating how a variety of instruments and common objects make sound helps us understand that sound is caused by vibrating objects.

CONCEPT 2: Effects of Sound

Focus Question: What are the effects of sound?

Exploring the effects of sound from vibrating objects helps us understand that sound can cause objects to vibrate, including the eardrum, which is how animals sense sound.

APPLICATION OF CONCEPTS: Using Instruments to Send a Message

Using the engineering design process and our knowledge of sound, we design and build a device that uses sound to help a teacher whose megaphone has broken communicate with students during recess.

SUPPORTING YOUR YOUNG SCIENTIST AT HOME

ONGOING CONVERSATIONS

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

- Listen to music with your student and identify the different sounds in the music. Talk about how people make the different sounds.
- Point out different sounds inside and outside of your home and discuss what caused each sound.
- Point out devices that use sound, light, and color to communicate, such as a crosswalk signal that uses sound, light, and color signals to inform people when it is safe or unsafe to cross a street.

ACTIVITIES

These activities support and extend classroom learning:

- Use common objects around the home to create sound. Have your student explain what caused the sound.
- Use objects around the home to build a simple recycled instrument.
- Play a game in which one person makes a sound in a room and another person in a different room guesses how the person created the sound.

BOOKS

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

- *The Sound of All Things* by Myron Uhlberg
- *Dark Was the Night: Blind Willie Johnson's Journey to the Stars* by Gary Golio
- *The Bell in the Bridge* by Ted Kooser

WEBSITES

Keep the learning about sound going by exploring this internet resource:

- Visit The Kennedy Center website (https://www.kennedy-center.org/video/education/music-world/the-cateura-orchestra-of-recycled-instruments/) to watch a video of the Recycled Orchestra of Cateura.

Level 1 Module 4: Sky

CONTENT OVERVIEW

ANCHOR PHENOMENON: Polynesian Navigation

Essential Question: How did the Polynesians use observations of the Sun, stars, and the Moon to navigate from island to island?

By studying Polynesian navigation, we can understand that people can see the Sun, stars, and the Moon in the sky in predictable locations and at predictable times.

CONCEPT 1: The Sun

Focus Question: What changes in our observations of the Sun throughout the day?

Observing the location of the Sun in the sky throughout the day helps us determine that the Sun follows a similar path across the sky each day.

APPLICATION OF CONCEPTS: Strawberry Plants and Daytime Length

Investigating how different kinds of strawberry plants grow flowers during months with different daytime lengths helps us understand that daytime length changes in the same way each year.

CONCEPT 2: Stars

Focus Question: What changes in our observations of stars throughout the night?

Observing the locations of stars in the sky at different times of night helps us recognize that stars move across the sky each night in a predictable way.

CONCEPT 3: The Moon

Focus Question: What changes in our observations of the Moon throughout the day or night?

Observing the Moon at daytime and nighttime on different dates and at different times helps us recognize that the Moon moves across the sky in a predictable way.

SUPPORTING YOUR YOUNG SCIENTIST AT HOME

ONGOING CONVERSATIONS

Support science learning at home by having conversations about patterns in the movement of the Sun, stars, and the Moon in the sky. Here are some suggestions to get you started:

- Point out familiar places or areas that are north, east, south, and west of your home.
- Observe the day sky at different times and discuss how the Sun appears to move across the sky.
- Observe the night sky at different times and discuss how the Moon and stars appear to move across the sky.
- Point out how daytime length changes throughout the year by discussing sunrise and sunset times relative to daily activities that occur at the same time, such as eating dinner, waking up, or going to sleep.

ACTIVITIES

These activities support and extend classroom learning:

- Encourage your student to use drawings, words, or photographs to record the path of a star or the Moon in a night sky journal.
- If you travel with your student, compare observations of the night sky from distant locations.
- Play a game with your student in which you take turns using the cardinal directions (i.e., north, east, south, and west) to direct each other to different rooms in your home.

BOOKS

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

- *Seeking an Aurora* by Elizabeth Pulford
- *Summer Sun Risin'* by W. Nikola-Lisa
- *Look Up with Me: Neil deGrasse Tyson: A Life Among the Stars* by Jennifer Berne

WEBSITES

Keep the learning about the Sun, stars, and the Moon going by exploring this internet resource:

- Visit the NASA Science Space Place website (https://spaceplace.nasa.gov/) to learn more about the Sun, stars, and the Moon in space.