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 ecosystems, students will research and propose solutions to reduce the impact of invasive species on an ecosystem.

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 about matter, students learn chemistry concepts as they explore the history of changes to the Statue of Liberty. Students also use math in the lessons to help them understand the conservation of matter. 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 5?

Module	Title	Anchor Phenomenon
1	Matter	Changes to the Statue of Liberty's Appearance
2	Ecosystems	Life around a Mangrove Tree
3	Earth Systems	Balinese Rice Farming
4	Orbit and Rotation	Views from Earth and Space

Level 5 Module 1: Matter

CONTENT OVERVIEW

ANCHOR PHENOMENON: Changes to the Statue of Liberty's Appearance

Essential Question: **What caused the Statue of Liberty to change over time?**

Experimenting with changing substances and creating particle models of matter helps us discover why some parts of the Statue of Liberty have changed color.

CONCEPT 1: Properties of Matter

Focus Question: **How do we describe different materials?**

We will learn how materials change over time by studying the materials that make up the statue and its base. Experiments with air help us discover how the air around the statue might contribute to its changes.

CONCEPT 2: Heating and Cooling Substances

Focus Question: **How do temperature changes affect substances?**

Exploring effects of temperature change on substances helps us notice change in states of matter and formation of new substances.

CONCEPT 3: Mixing Substances

Focus Question: **What happens when substances are mixed?**

Through mixing, we will observe how substances can maintain their original properties or new substances can be created.

APPLICATION OF CONCEPTS: Preventing Rust Formation

Using the engineering design process, we will develop solutions to prevent rust buildup inside the Statue of Liberty.

SUPPORTING OUR CLASSROOM

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

- Plastic cups (both 3-ounce and 9-ounce) and spoons
- Resealable plastic bags (quart-sized)

SUPPORTING YOUR YOUNG SCIENTIST AT HOME

ONGOING CONVERSATIONS

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

- Have your student classify different substances at home as solid, liquid, or gas. Try to trick your student with substances like cereal or flour, since they are solids but take the shape of the container that they are in (which is usually the sign of a liquid).
- Talk about the properties of different items found around the house. Look for signs of change such as tarnish on metal or water rings on wood.
- Since we rarely see the gas state of matter, ask your student for evidence that gases are present.
- Talk about safety precautions when using common household chemicals such as cleaners.

ACTIVITIES

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

- Bake with your student. Many books can help you identify the reactions that occur during baking.
- Dissolve sugar in water. Brainstorm ways to test whether the sugar is still present.
- Visit older monuments or older gravestones. Look for ways that air, water, and other weather features have changed them over time.
- Re-create some of the classroom experiments at home by trying out substances such as ketchup, hot sauce, or vinegar to clean dirty pennies. Research why these substances work.

BOOKS

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

- *At Ellis Island: A History in Many Voices* by Louise Peacock
- *Her Right Foot* by Dave Eggers
- *This Is New York* by Miroslav Sasek

WEBSITES

Keep the learning going about the Statue of Liberty by exploring these internet resources:

- Visit the National Park Service Statue of Liberty website (https://www.nps.gov/stli/index.htm) for a virtual tour, live webcams from the torch, and more.
- Explore the Library of Congress archives (https://www.loc.gov/rr/news/topics/liberty.html) to see historic newspaper articles about the Statue of Liberty.

Level 5 Module 2: Ecosystems

CONTENT OVERVIEW

ANCHOR PHENOMENON: Life around a Mangrove Tree

Essential Question: **How can trees support so much life?**

The Mangrove Tree by Susan L. Roth and Cindy Trumbore sets the stage for our study of ecosystems. By learning how plants and animals around the mangrove tree interact with one another, we explore how ecosystems work and come up with ideas to help ecosystems that are out of balance.

CONCEPT 1: Plant Matter

Focus Question: **How do plants grow?**

Through investigating plants in different conditions, we discover what they need to grow. We also examine how plants and animals interact with air.

CONCEPT 2: Life's Matter

Focus Question: **Where does life's matter come from?**

By analyzing grizzly bear data, observing rotting fruit, and investigating soil nutrient levels, we uncover how matter cycles between plants, animals, decomposers, and the environment.

CONCEPT 3: Life's Energy

Focus Question: **Where does life's energy come from?**

Modeling the flow of energy helps us realize energy can be traced from the Sun to plants and then to animals and decomposers.

APPLICATION OF CONCEPTS: Reducing the Impact of Invasive Species

Researching the emerald ash borer, an invasive insect damaging North American forests, helps us develop ways to reduce its impact on ecosystems.

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 towels
- Sticky notes

SUPPORTING YOUR YOUNG SCIENTIST AT HOME

ONGOING CONVERSATIONS

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

- Talk about the plants and animals in your community and how they form an ecosystem.
- Compare the different ecosystems where you have lived or visited.
- Discuss where the energy in your food comes from and how you use the energy. See if you can trace the flow of energy back to the Sun.
- Discuss how humans affect the plant and animal life in your community.

ACTIVITIES

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

- Observe a tree and look for how it supports other organisms around it.
- Go for a walk and search for common decomposers such as mushrooms. Discuss where you found them and why they live there.
- Create a food web featuring local organisms.
- Research invasive species in your area. Look into what local wildlife agencies or conservation groups are doing to reduce invasive species' effects.
- Participate in a park cleanup and talk about why it is important to maintain shared green spaces.

BOOKS

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

- *Seed, Soil, Sun: Earth's Recipe for Food* by Cris Peterson
- *Living Sunlight* by Molly Bang and Penny Chisholm
- *Over and Under the Pond* by Kate Messner

WEBSITES

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

- Visit https://www.nps.gov/ever/learn/nature/mangroves.htm to find out about mangrove ecosystems in Everglades National Park.
- Visit https://ocean.si.edu/ocean-life/plants-algae/mangroves to learn about mangroves' adaptations, the organisms they support, and their distribution across our planet.

Level 5 Module 3: Earth Systems

CONTENT OVERVIEW

ANCHOR PHENOMENON: Balinese Rice Farming

Essential Question: **How has Balinese rice farming endured for 1,000 years?**

By creating models of the sustainable rice farming system on the island of Bali, we uncover how water (hydrosphere), air (atmosphere), life (biosphere), and land (geosphere) interact and how humans can affect these interactions.

CONCEPT 1: Earth's Systems

Focus Question: **Where does fresh water come from?**

After analyzing data to learn about the distribution of water on our planet, we investigate evaporation, condensation, and precipitation to see interactions between the hydrosphere and atmosphere. We also observe ocean webcams to explore ways the biosphere and hydrosphere interact.

CONCEPT 2: Interaction of Earth's Systems

Focus Question: **How do water and land interact?**

By exploring rain shadows, investigating water passing through soil, and constructing coastal models, we discover interactions between the hydrosphere and geosphere.

CONCEPT 3: Changes to Earth's Systems

Focus Question: **How do Earth's systems respond to change?**

By modeling different events, we see how humans can disrupt or stabilize Earth's systems.

APPLICATION OF CONCEPTS: Engineering Challenge

We apply our knowledge of Earth's interacting systems to design and test a sustainable irrigation system.

SUPPORTING OUR CLASSROOM

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

- Chenille stems (pipe cleaners)
- Craft sticks

SUPPORTING YOUR YOUNG SCIENTIST AT HOME

ONGOING CONVERSATIONS

Support science learning at home by having conversations about Earth's systems. Here are some suggestions to get you started:

- Talk about ways to conserve water around the house, such as watering the lawn at cool times of day to reduce evaporation.
- Discuss the impacts of the Dust Bowl and any family stories related to this era.
- Notice ways your community has harnessed interactions between Earth's systems to overcome societal challenges, such as growing food sustainably or programs that convert waste into energy.
- Discuss ways humans have positively or negatively impacted your local environment, and brainstorm ways to solve the negative impacts.

ACTIVITIES

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

- Visit a local farm and discuss how their agricultural practices involve multiple Earth systems.
- Research your local water source and talk about what could affect its amount and quality.
- Gather a soil sample and try to identify the different components. Consider using a hand lens to magnify the particles.
- Take a trip to a beach or a virtual trip online and search for a variety of coastal landforms (e.g. cliffs, sandbars, sea arches, etc.). Discuss processes that could have created the land shapes you find.

BOOKS

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

- *Out of the Dust* by Karen Hesse
- *Seymour Simon's Extreme Oceans* by Seymour Simon
- *Cycle of Rice, Cycle of Life: A Story of Sustainable Farming* by Jan Reynolds

WEBSITES

Keep the learning going about Earth's systems by exploring these internet resources:

- Visit NASA's Earth Observatory (https://earthobservatory.nasa.gov) to explore images and global maps of Earth's systems from NASA satellites.
- Explore the NOAA website about oceans (https://www.noaa.gov/oceans-coasts) to see some of the ways people are working on solutions to disruptions in Earth's systems.

Level 5 Module 4: Orbit and Rotation

CONTENT OVERVIEW

ANCHOR PHENOMENON: Views from Earth and Space

Essential Question: **How can we explain our observations of the Sun, the Moon, and stars from Earth?**

We consider how ancient Polynesians used celestial navigation, and we make our own observations of the apparent motion of the Sun, Moon, and stars. Through modeling the Earth-Sun-Moon-Stars system, we discover that patterns in our observations are due to the motion of the Earth and Moon.

CONCEPT 1: Patterns of the Sun

Focus Question: **How can we explain our observations of the Sun?**

Through investigating shadows and observing satellite images of Earth, we uncover how Earth's rotation causes the Sun to appear to move across our sky and the daily pattern of day and night.

APPLICATION OF CONCEPTS: Science Challenge

We demonstrate how sundials work in different locations on Earth to show how the apparent motion of the Sun can be used to measure time.

CONCEPT 2: Patterns of the Moon

Focus Question: **How can we explain our observations of the Moon?**

Analyzing moonrise and moonset times reveals that the Moon orbits Earth. Through modeling the Moon's orbit, we explore why the Moon appears to change shape based on its position relative to the Sun.

CONCEPT 3: Patterns of the Stars

Focus Question: **How can we explain our observations of stars?**

By observing stars circling the North Star, we explain that the nightly movement of stars is because of Earth's rotation. We use star maps to notice a yearly pattern in star visibility caused by Earth's orbit around the Sun.

SUPPORTING OUR CLASSROOM

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

- Glue sticks
- Metric rulers

SUPPORTING YOUR YOUNG SCIENTIST AT HOME

ONGOING CONVERSATIONS

Support science learning at home by having conversations about the motion of Earth and the Moon. Here are some suggestions to get you started:

- Choose different locations on Earth and discuss observations of the sky that would be the same and observations that would differ from your current location.
- Imagine you are lost without a map. What are some landmarks you could use to get back home?
- Find relatives or family friends who remember the Apollo missions, and talk about their memories.
- Discuss whether you think it is a good idea to explore outer space. What are the advantages and disadvantages?

ACTIVITIES

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

- Go for a walk on a sunny day and observe shadows. Consider what would make the shadows look different.
- Look for moving objects in the night sky and try to identify if they are human-made objects, such as planes or satellites, or natural objects, such as meteors.
- Observe the Moon's shape and location in the sky at the same time for several days, and share ideas about why those changes occur.
- Ask your student to pick a favorite constellation and recreate it on paper or on a ceiling.

BOOKS

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

- *Find the Constellations* by H. A. Rey
- *Next Time You See the Moon* by Emily Morgan
- *Team Moon: How 400,000 People Landed Apollo 11 on the Moon* by Catherine Thimmesh

WEBSITES

Keep the learning going about the motion of Earth and the Moon by exploring these internet resources:

- Explore University of Colorado's Gravity and Orbits simulation (https://phet.colorado.edu/en/simulation/gravity-and-orbits) to visualize orbits.
- Visit NASA's Jet Propulsion Laboratory website (https://www.jpl.nasa.gov/edu/learn/) for do-it-yourself science projects about space.