PhD SCIENCE®

Helping Every Student Build Knowledge by *Doing* Science

From a young age, children are observant and curious and begin to informally engage with science to make sense of the world. Research tells us that to help students build enduring science knowledge, curricula must offer rich content and coherently develop students' understanding of scientific concepts and practices.

Science materials should guide students to see science as both a body of knowledge and a process, encouraging them to engage in scientific sense-making, ask questions, and authentically build from their existing knowledge. Science programs often underestimate what elementary students can grasp and offer disparate standalone activities rather than the tools for comprehensive and coherent science instruction.

PhD Science® is a K–5 curriculum that builds students' deep scientific understanding through compelling, authentic phenomena. *PhD Science* transforms classrooms into a place of exploration as students learn to think and act like budding scientists, driven by their own natural curiosity. Students actively engage in the process of knowledge construction by analyzing questions about anchor phenomena, modeling and solving real-world problems, studying informational texts, and performing hands-on investigations.

Because we believe that too few students have access to this coherent, knowledge-building learning early in elementary school, our Levels K–2 are available as a free open educational resource.

PhD Science enables all students to move from *reading* about science to *doing* science, resulting in deep comprehension of scientific concepts and lifelong scientific literacy.

K–5

K–2 Open Educational Resource

GREAT MINDS™

every child is capable of greatness

At the Core of *PhD Science*

> **Our instructional approach is not only three-dimensional; it also gives priority to coherence and student exploration. Students practice the skills and processes that scientists use and apply their content learning through hands-on investigations.**

Coherent Storylines with Authentic Phenomena

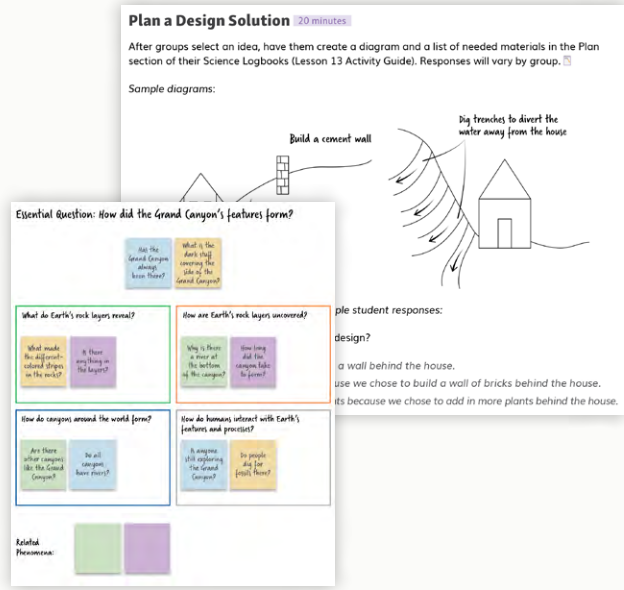
Our instructional design helps students build a deep knowledge of science and our world through authentic phenomena and events, not simulations.

- Instead of fabricated and contrived phenomena, *PhD Science* uses authentic phenomena to guide students' learning. For example, students examine the formation of the Grand Canyon rather than learning about Earth's layers by studying a fictitious place, which would deny students the opportunity to apply their learning to the real world.
- Science and engineering practices are embedded throughout the curriculum, instead of added as an afterthought, to help students build skills in a coherent progression.

Student-Driven Inquiry

Students engage with science the way scientists and engineers do—by asking questions, analyzing and synthesizing information, and applying knowledge to new contexts.

- Anchor visuals help students collect and display evidence of their new knowledge, helping them integrate it with prior knowledge.
- Science Challenges and Engineering Challenges provide students opportunities to apply their conceptual knowledge to solve real-world problems.



Rigorously Engaging through Hands-On Investigations

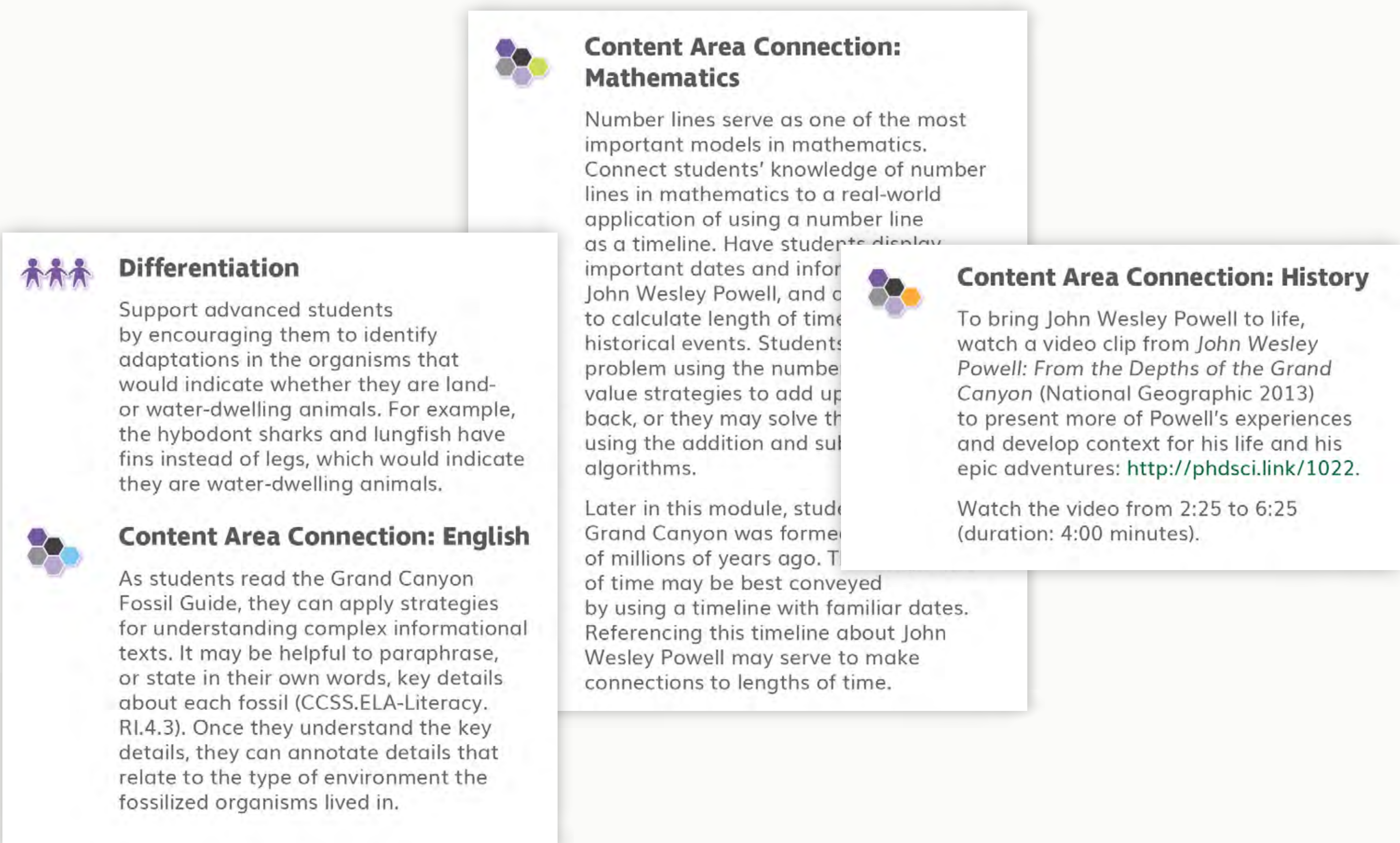
Hands-on experiences give students time to observe, imagine, and reason through their learning while applying their knowledge of scientific processes to understand phenomena.

- Students actively and collaboratively engage in a learning cycle of asking questions and sharing ideas about phenomena, investigating those questions, developing evidence-based explanations, and transferring their knowledge to explain different phenomena.
- Hands-on investigations are exactly that—students work directly with materials and observe how they react to forces in the real world in real time. Students are not led directly to a foregone conclusion or shown simulations that create artificial constraints on students' learning.

Cross-Curricular Connections

While students learn science, lessons present them with multiple opportunities to make connections to other content areas and practice literacy, math, and other skills in a scientific context.

- The Teacher Edition provides sidebar notes that identify content area connections.
- The Core texts allow teachers to present relatable content and inspire student learning.



Content Area Connection: Mathematics

Number lines serve as one of the most important models in mathematics. Connect students' knowledge of number lines in mathematics to a real-world application of using a number line as a timeline. Have students display important dates and infor John Wesley Powell, and c to calculate length of time historical events. Students problem using the numbe value strategies to add up back, or they may solve th using the addition and sul algorithms.

Later in this module, stud Grand Canyon was forme of millions of years ago. T of time may be best conveyed by using a timeline with familiar dates. Referencing this timeline about John Wesley Powell may serve to make connections to lengths of time.

Differentiation

Support advanced students by encouraging them to identify adaptations in the organisms that would indicate whether they are land- or water-dwelling animals. For example, the hybodont sharks and lungfish have fins instead of legs, which would indicate they are water-dwelling animals.

Content Area Connection: English

As students read the Grand Canyon Fossil Guide, they can apply strategies for understanding complex informational texts. It may be helpful to paraphrase, or state in their own words, key details about each fossil (CCSS.ELA-Literacy. RI.4.3). Once they understand the key details, they can annotate details that relate to the type of environment the fossilized organisms lived in.

Content Area Connection: History

To bring John Wesley Powell to life, watch a video clip from *John Wesley Powell: From the Depths of the Grand Canyon* (National Geographic 2013) to present more of Powell's experiences and develop context for his life and his epic adventures: http://phdsci.link/1022.

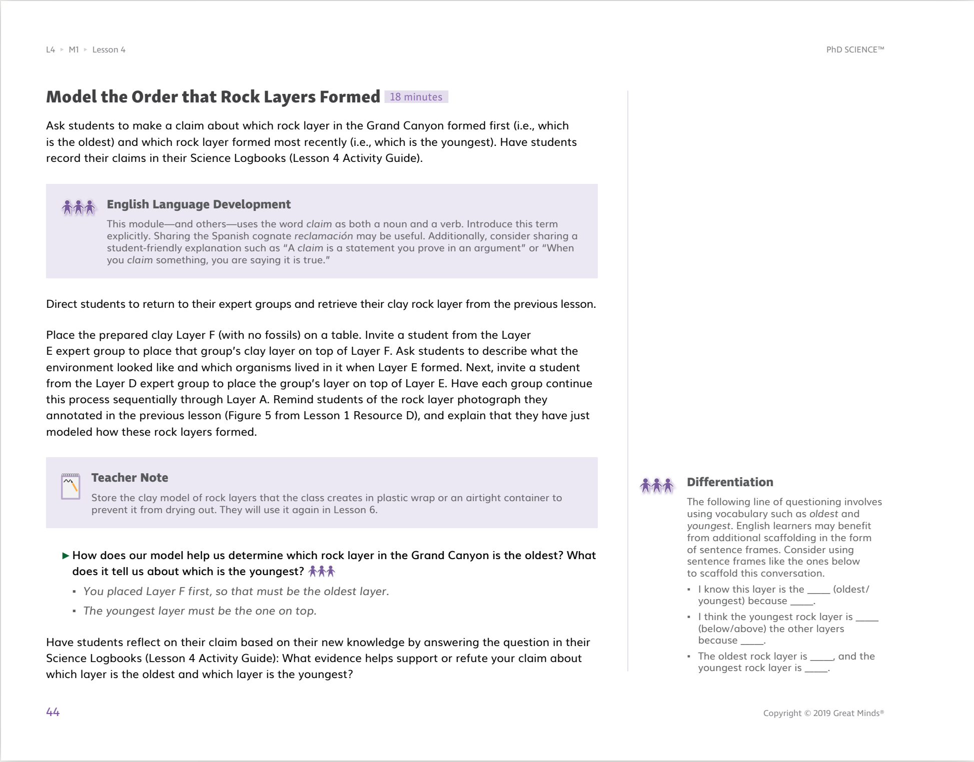
Watch the video from 2:25 to 6:25 (duration: 4:00 minutes).

At the Core of *PhD Science*

Differentiation and Accessibility

The curriculum is designed to ensure that all learners can access science content through a variety of intentionally designed and embedded supports.

- Just-in-time notes throughout the module offer differentiation and English language development strategies and extension opportunities to support all students.
- The curriculum incorporates the three guiding principles of the Universal Design for Learning (UDL) Framework.



L4 • M1 • Lesson 4 PhD SCIENCE™

Model the Order that Rock Layers Formed 18 minutes

Ask students to make a claim about which rock layer in the Grand Canyon formed first (i.e., which is the oldest) and which rock layer formed most recently (i.e., which is the youngest). Have students record their claims in their Science Logbooks (Lesson 4 Activity Guide).

English Language Development

This module—and others—uses the word *claim* as both a noun and a verb. Introduce this term explicitly. Sharing the Spanish cognate *reclamación* may be useful. Additionally, consider sharing a student-friendly explanation such as "A *claim* is a statement you prove in an argument" or "When you *claim* something, you are saying it is true."

Direct students to return to their expert groups and retrieve their clay rock layer from the previous lesson.

Place the prepared clay Layer F (with no fossils) on a table. Invite a student from the Layer E expert group to place that group's clay layer on top of Layer F. Ask students to describe what the environment looked like and which organisms lived in it when Layer E formed. Next, invite a student from the Layer D expert group to place the group's layer on top of Layer E. Have each group continue this process sequentially through Layer A. Remind students of the rock layer photograph they annotated in the previous lesson (Figure 5 from Lesson 1 Resource D), and explain that they have just modeled how these rock layers formed.

Teacher Note

Store the clay model of rock layers that the class creates in plastic wrap or an airtight container to prevent it from drying out. They will use it again in Lesson 6.

▸ How does our model help us determine which rock layer in the Grand Canyon is the oldest? What does it tell us about which is the youngest?

- *You placed Layer F first, so that must be the oldest layer.*
- *The youngest layer must be the one on top.*

Have students reflect on their claim based on their new knowledge by answering the question in their Science Logbooks (Lesson 4 Activity Guide): What evidence helps support or refute your claim about which layer is the oldest and which layer is the youngest?

Differentiation

The following line of questioning involves using vocabulary such as *oldest* and *youngest*. English learners may benefit from additional scaffolding in the form of sentence frames. Consider using sentence frames like the ones below to scaffold this conversation.

- I know this layer is the ____ (oldest/youngest) because ____.
- I think the youngest rock layer is ____ (below/above) the other layers because ____.
- The oldest rock layer is ____, and the youngest rock layer is ____.

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Art

Art is embedded in every module, providing students with powerful opportunities to interact with scientific phenomena in a new and unique context, while creating an additional entry point to the module topic.

- An example is how students are asked what they notice and wonder about a woodcut called *The Rhinoceros* by Albrecht Dürer in Level 3 to begin their exploration of characteristics of organisms and how they survive over time in changing environments.

Educators Pick
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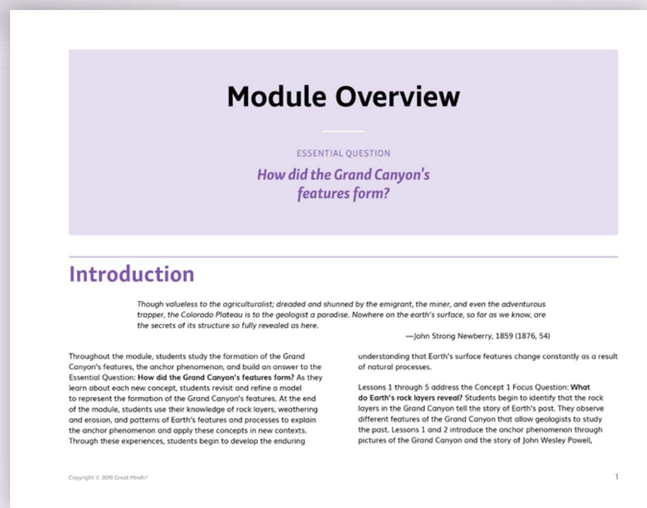
PhD Science Print and Hands-On Resources

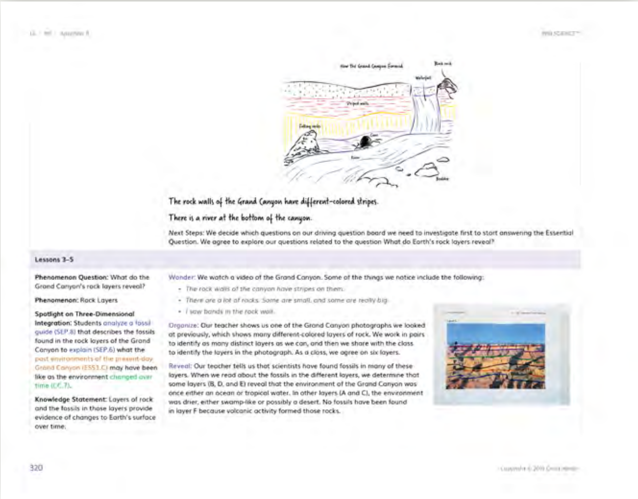
Teacher Edition

Available for each module at each level, the Teacher Edition provides all the instructional guidance educators need to engage in the module learning with students. It includes the following components, among others.



A **Module Overview**, which includes module maps, focus standards, guidance on materials preparation, and how knowledge builds across levels

Embedded instructional supports that include cross-curricular connections, supports for English learners, and strategies to support differentiation for students



Instructional spotlights that identify three-dimensional integration and explain how a lesson activity helps develop student knowledge of specific Science and Engineering Practices (SEPs), Disciplinary Core Ideas (DCIs) and/or Crosscutting Concepts (CCCs)

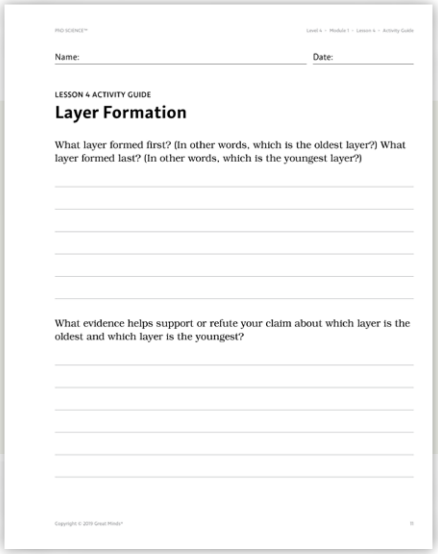
Module appendices that include module-specific resources, storyline, and glossary, as well as domain-specific words, general academic words, and Spanish cognates

PhD Science Print and Hands-On Resources

Science Logbook

This consumable resource allows students to document their learning and record evidence. Students use their logbooks to develop models or record observations, predictions, data analysis, explanations, claims, and other information as they complete scientific tasks.

Layer	Fossils Present	What type of environment do you think the fossilized organisms lived in?	Provide evidence to support your thinking.



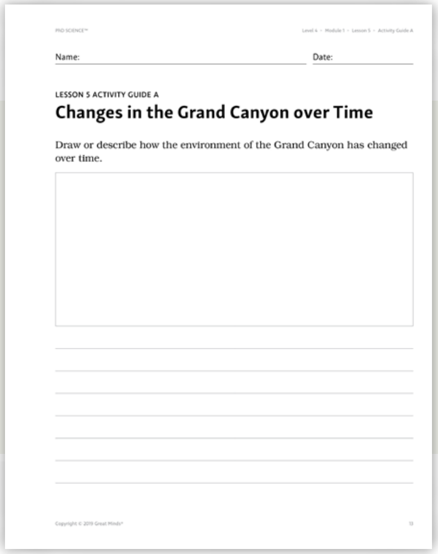
Name: Date:

LESSON 4 ACTIVITY GUIDE

Layer Formation

What layer formed first? (In other words, which is the oldest layer?) What layer formed last? (In other words, which is the youngest layer?)

What evidence helps support or refute your claim about which layer is the oldest and which layer is the youngest?



Name: Date:

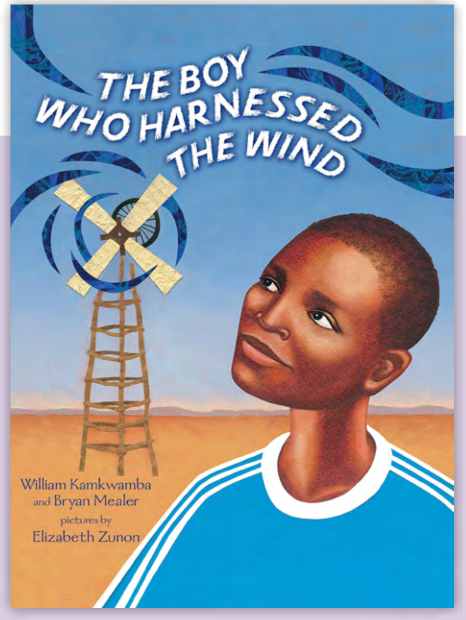
LESSON 5 ACTIVITY GUIDE A

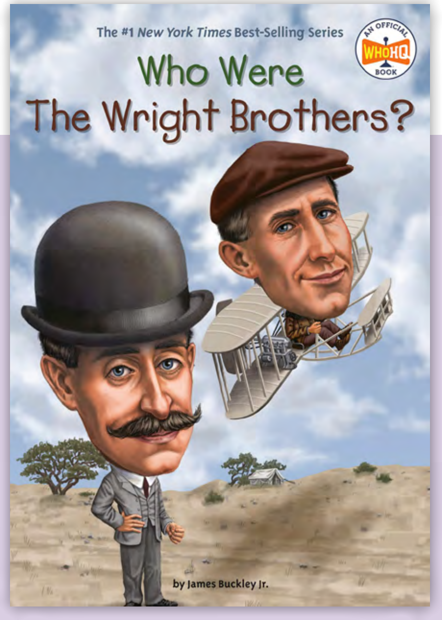
Changes in the Grand Canyon over Time

Draw or describe how the environment of the Grand Canyon has changed over time.

Core Texts

Authentic, content-rich texts used throughout the curriculum help support or explain the science that students are learning. Core texts also provide students with an opportunity to practice and strengthen their literacy skills and make cross-content connections.





Materials Kits

These well-designed kits contain the supplies needed to implement the *PhD Science* hands-on investigations and activities in all four modules of each level.

Student Science Packs and Assessment Packs

These packs of color-printed resources are easy to distribute and are assembled in appropriate quantities for classroom use. The Student Science Pack resources are listed in Appendix A of each Teacher Edition. The Assessment Packs include the End-of-Module Assessments for Levels K–5 and Conceptual Checkpoints for Levels K–2.

Knowledge Deck™ Posters and Cards

Knowledge Deck posters and cards engage K–2 students with accessible, knowledge-building texts that enrich the curriculum experience. Knowledge Deck image types include photographs, illustrations, fine art, historical primary and secondary sources, diagrams, and visual displays of data. The text of both posters and cards is written at a complexity level appropriate for teachers to read aloud to students.

PhD Science Digital Resources

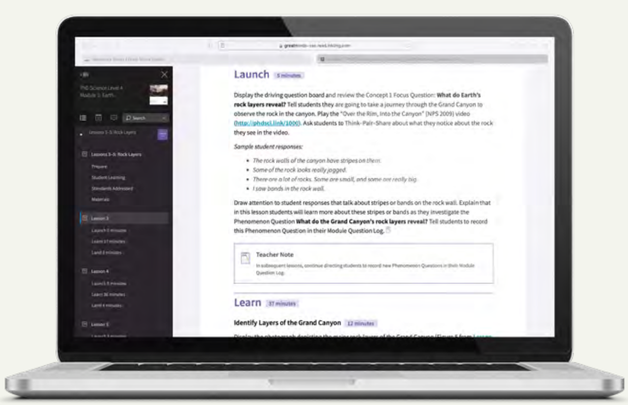
Teacher Resource Pack

This free, comprehensive collection of essential supports for educators includes the Implementation Guide, Module Structure, Pacing Guides, Materials Lists, Preparation Guides, and Family Tip Sheets.

- The Implementation Guide and Module Structure explain the philosophy and design of the curriculum to help teachers succeed in their facilitator role.
- Pacing Guides present an overview of each module along with multiple pacing options so teachers can remain responsive to the needs of their students.
- Materials Lists and Preparation Guides provide a detailed list of materials and outline the advance preparation for each lesson so that investigations proceed efficiently.
- Family Tip Sheets provide families with an overview of each module and provide suggestions for how to discuss and extend students' learning at home.

PhD Science in Sync™

PhD Science in Sync was created for hybrid or distance learning and covers the same topics as our high-quality *PhD Science* curriculum. Adapted to support students anywhere, *PhD Science in Sync* includes daily video lessons and Science Journals that allow students to fill and submit PDFs digitally with interactive annotation tools. Planning and preparation resources for teachers include the Learn Anywhere Plan, with a pacing guide for daily lessons, and PhD Projected slides that provide lesson-specific content for online and in-class instruction.



Digital Teacher Edition

The complete Teacher Edition in digital form allows teachers to explore the overview, lesson sets, resources, and embedded instructional supports for each *PhD Science* module, and annotation features support ease of instructional preparation with the digital resource.

Professional Learning for *PhD Science*

We know that with the proper support for educators, high-quality instructional materials can transform teaching and learning. Great Minds® is the exclusive provider of professional learning created and delivered by the *PhD Science* team of teacher–writers. We offer in-person and virtual professional development and personalized coaching options, with sessions designed for both teachers and leaders, to ensure strong initial implementation and sustained success.