Supporting Educators in Improving Practice Through Instructional Materials

Can curriculum and instructional materials be developed to not only support students in building knowledge and skills, but also support educators in honing their practice? Educative curriculum materials help teachers acquire new content and pedagogical knowledge, typically through embedded notes, annotations, and models of practice. The presence of educative features in a curriculum has been shown to improve teachers' instructional planning and curriculum implementation as well as student learning.

Defining Educative Curriculum Materials

In 1996, Ball and Cohen introduced the concept of educative curriculum materials in their seminal paper, which suggested that curriculum resources themselves had the potential to support not only students' learning but teachers' learning as well. This idea differentiated educative curriculum materials from those that mainly focus on instruction without developing teachers' own content and pedagogical knowledge.

For example, teachers using highly educative mathematics curriculum materials are more likely to identify the big ideas in a curricular program while planning collaboratively and are more likely to maintain cognitive demand and elicit student thinking during a lesson (Stein and Kaufman 2010). Research also suggests that teachers who use educative curriculum materials show increases in pedagogical content knowledge and use a greater number of strategies to support student learning (Schuchardt et al. 2017).

In 2005, researchers Elizabeth A. Davis and Joseph S. Kracjik—who was also a Next Generation Science Standards writing team leader—offered five design principles to help guide the development of educative curriculum materials, stating that educative resources should do the following:

- Support teachers' learning of subject matter.
- Help teachers anticipate what learners might say or do in response to activities.
- Help teachers consider how to relate units throughout the year.
- Make curriculum developers' pedagogical judgments visible.
- Promote a teacher's capacity to make pedagogical adaptations for learners.

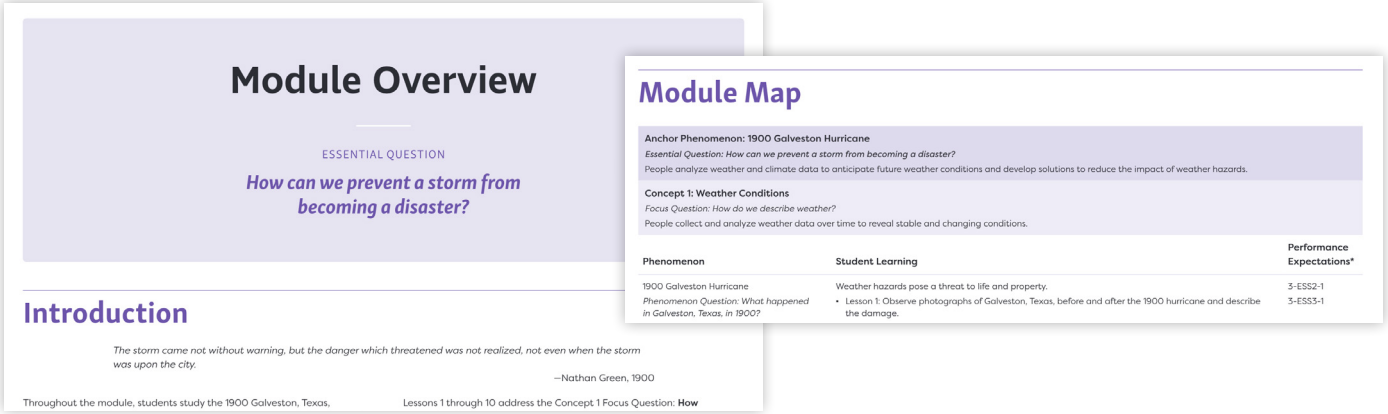
All Great Minds® curricula were intentionally and uniquely designed to contain educative elements because we believe in empowering teachers to not only deliver a high-quality curriculum, but also to effectively adapt it to meet the unique needs of the students in their classroom. Unlike a scripted curriculum where content is provided to educators with little to no guidance or rationale, our educative curricula help teachers improve their practice while enabling all students to achieve greatness.

Five Educative Features Embedded in *PhD Science*®

The *PhD Science*® Teacher Edition is one of the core resources that teachers use to plan for and deliver instruction. Crafted by our team of teacher–writers, the Teacher Edition includes five educative features that support teachers' own learning and help them achieve flexible, high-quality science instruction for all students.

1 **Module Overviews.** Each module's Teacher Edition begins with an overview that contains an introduction to the anchor phenomenon and a description of how students make sense of that complex phenomenon over the course of the module. The overview also provides the module scope and sequence and crucial insights into the standards students interact with. Finally, each overview contains key terms, information about the preparation of materials, safety considerations, and additional reading for teachers.

> ***"Dig into it. Know that it will be hard at first for kids with no background in how to draw models. Don't expect perfection. Don't use it as a script, but make it your own so that it works for you and your kids."***
>
> —Meg Johnson, Teacher, Lincoln Parish Schools



Module Overview

ESSENTIAL QUESTION

How can we prevent a storm from becoming a disaster?

Introduction

The storm came not without warning, but the danger which threatened was not realized, not even when the storm was upon the city.

—Nathan Green, 1900

Throughout the module, students study the 1900 Galveston, Texas,

Lessons 1 through 10 address the Concept 1 Focus Question: **How**

Module Map

Anchor Phenomenon: 1900 Galveston Hurricane

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

People analyze weather and climate data to anticipate future weather conditions and develop solutions to reduce the impact of weather hazards.

Concept 1: Weather Conditions

Focus Question: How do we describe weather?

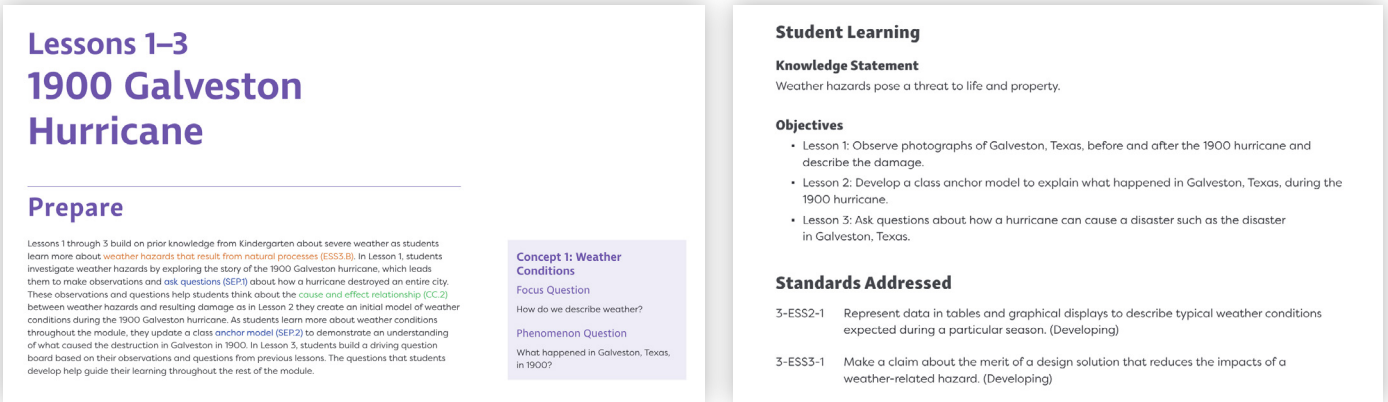
People collect and analyze weather data over time to reveal stable and changing conditions.

Phenomenon	Student Learning	Performance Expectations*
1900 Galveston Hurricane *Phenomenon Question: What happened in Galveston, Texas, in 1900?*	Weather hazards pose a threat to life and property. • Lesson 1: Observe photographs of Galveston, Texas, before and after the 1900 hurricane and describe the damage.	3-ESS2-1 3-ESS3-1

2 **Lesson Preparation.** Each module contains 25 to 30 lessons organized into concepts that help students make sense of an anchor phenomenon. All lesson sets for a given concept have a Prepare section that includes the following information to help teachers get ready for instruction:

> ***"The work [with* PhD Science*] allows elementary teachers, who usually aren't trained as subject matter specialists, to learn alongside their students."***
>
> —Melissa Parfait, Curriculum Specialist, St. Charles Parish Public Schools

- A brief introduction to the lesson set and its three-dimensional learning, including how the lesson material connects to previous and upcoming content.
- A clear picture of intended objectives, learning outcomes, and Performance Expectation(s) to be addressed through the lessons.



Lessons 1–3
1900 Galveston Hurricane

Prepare

Lessons 1 through 3 build on prior knowledge from Kindergarten about severe weather as students learn more about weather hazards that result from natural processes (ESS3.B). In Lesson 1, students investigate weather hazards by exploring the story of the 1900 Galveston hurricane, which leads them to make observations and ask questions (SEP.1) about how a hurricane destroyed an entire city. These observations and questions help students think about the cause and effect relationship (CC.2) between weather hazards and resulting damage as in Lesson 2 they create an initial model of weather conditions during the 1900 Galveston hurricane. As students learn more about weather conditions throughout the module, they update a class anchor model (SEP.2) to demonstrate an understanding of what caused the destruction in Galveston in 1900. In Lesson 3, students build a driving question board based on their observations and questions from previous lessons. The questions that students develop help guide their learning throughout the rest of the module.

Concept 1: Weather Conditions

Focus Question

How do we describe weather?

Phenomenon Question

What happened in Galveston, Texas, in 1900?

Student Learning

Knowledge Statement

Weather hazards pose a threat to life and property.

Objectives

- Lesson 1: Observe photographs of Galveston, Texas, before and after the 1900 hurricane and describe the damage.
- Lesson 2: Develop a class anchor model to explain what happened in Galveston, Texas, during the 1900 hurricane.
- Lesson 3: Ask questions about how a hurricane can cause a disaster such as the disaster in Galveston, Texas.

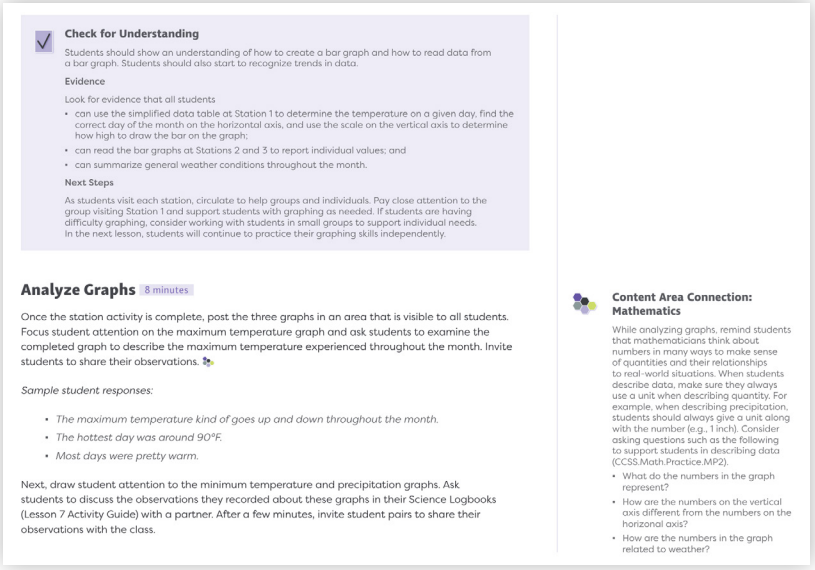
Standards Addressed

3-ESS2-1 Represent data in tables and graphical displays to describe typical weather conditions expected during a particular season. (Developing)

3-ESS3-1 Make a claim about the merit of a design solution that reduces the impacts of a weather-related hazard. (Developing)

3 **Margin Notes.** Each lesson also contains embedded instructional supports and sidebar notes with additional information for teachers. These notes help teachers deepen their knowledge of science content, pedagogy, and the progression of student learning.

- **Teacher Notes** communicate information that helps with lesson implementation. For example, they may enhance scientific understanding, explain pedagogical choices, give background information, or help teachers identify common misconceptions.



Check for Understanding

Students should show an understanding of how to create a bar graph and how to read data from a bar graph. Students should also start to recognize trends in data.

Evidence

Look for evidence that all students

- can use the simplified data table at Station 1 to determine the temperature on a given day, find the correct day of the month on the horizontal axis, and use the scale on the vertical axis to determine how high to draw the bar on the graph;
- can read the bar graphs at Stations 2 and 3 to report individual values; and
- can summarize general weather conditions throughout the month.

Next Steps

As students visit each station, circulate to help groups and individuals. Pay close attention to the group visiting Station 1 and support students with graphing as needed. If students are having difficulty graphing, consider working with students in small groups to support individual needs. In the next lesson, students will continue to practice their graphing skills independently.

Analyze Graphs 8 minutes

Once the station activity is complete, post the three graphs in an area that is visible to all students. Focus student attention on the maximum temperature graph and ask students to examine the completed graph to describe the maximum temperature experienced throughout the month. Invite students to share their observations.

Sample student responses:

- *The maximum temperature kind of goes up and down throughout the month.*
- *The hottest day was around 90°F.*
- *Most days were pretty warm.*

Next, draw student attention to the minimum temperature and precipitation graphs. Ask students to discuss the observations they recorded about these graphs in their Science Logbooks (Lesson 7 Activity Guide) with a partner. After a few minutes, invite student pairs to share their observations with the class.

Content Area Connection: Mathematics

While analyzing graphs, remind students that mathematicians think about numbers in many ways to make sense of quantities and their relationships to real-world situations. When students describe data, make sure they always use a unit when describing quantity. For example, when describing precipitation, students should always give a unit along with the number (e.g., 1 inch). Consider asking questions such as the following to support students in describing data (CCSS.Math.Practice.MP2).

- What do the numbers in the graph represent?
- How are the numbers on the vertical axis different from the numbers on the horizonal axis?
- How are the numbers in the graph related to weather?

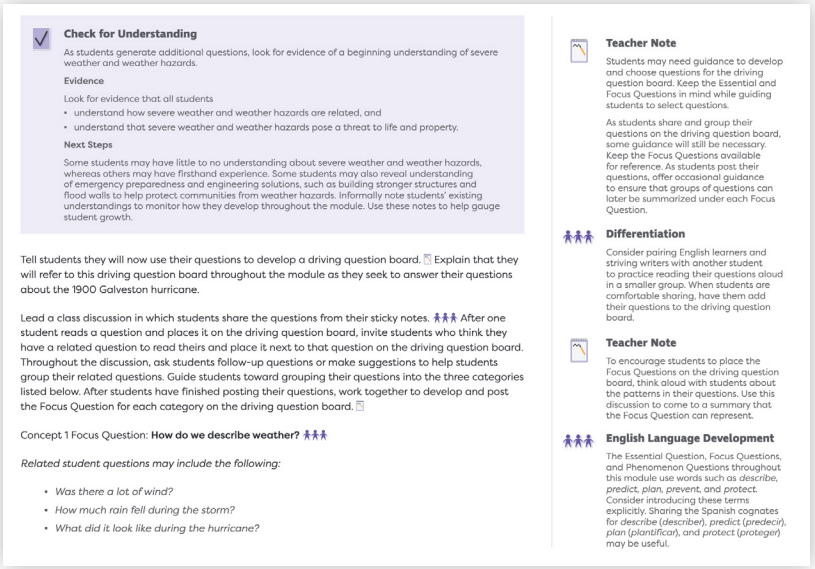
- **Spotlights on Three-Dimensional Integration** explain how a lesson activity develops specific Science and Engineering Practices, Disciplinary Core Ideas, and/or Crosscutting Concepts.

- **Content Area Connections** signal opportunities for students to practice grade-appropriate skills from other subject areas and allow teachers to confidently integrate and reinforce science instruction with English language arts (ELA), mathematics, and more. These notes provide cross-curricular connections, instructional strategies, or additional activities that align with standards for ELA and math as well as connections to history and art.

- **Check for Understanding** and **Conceptual Checkpoints** provide examples of evidence teachers should look for to gauge student learning as well as instructional next steps to support all students in reaching proficiency.

- **Differentiation Suggestions** offer in-the-moment examples of how teachers may customize instruction to support students of various backgrounds and abilities.

- **English Language Development Notes** build teachers' capacity to support English language development. These notes provide strategies that benefit multilingual learners, such as explicit introduction to new terms and Spanish cognates when applicable. They also provide targeted scaffolds for key moments that can benefit students of all backgrounds.



Check for Understanding

As students generate additional questions, look for evidence of a beginning understanding of severe weather and weather hazards.

Evidence

Look for evidence that all students

- understand how severe weather and weather hazards are related, and
- understand that severe weather and weather hazards pose a threat to life and property.

Next Steps

Some students may have little to no understanding about severe weather and weather hazards, whereas others may have firsthand experience. Some students may also reveal understanding of emergency preparedness and engineering solutions, such as building stronger structures and flood walls to help protect communities from weather hazards. Informally note students' existing understandings to monitor how they develop throughout the module. Use these notes to help gauge student growth.

Tell students they will now use their questions to develop a driving question board. Explain that they will refer to this driving question board throughout the module as they seek to answer their questions about the 1900 Galveston hurricane.

Lead a class discussion in which students share the questions from their sticky notes. After one student reads a question and places it on the driving question board, invite students who think they have a related question to read theirs and place it next to that question on the driving question board. Throughout the discussion, ask students follow-up questions or make suggestions to help students group their related questions. Guide students toward grouping their questions into the three categories listed below. After students have finished posting their questions, work together to develop and post the Focus Question for each category on the driving question board.

Concept 1 Focus Question: **How do we describe weather?**

Related student questions may include the following:

- *Was there a lot of wind?*
- *How much rain fell during the storm?*
- *What did it look like during the hurricane?*

Teacher Note

Students may need guidance to develop and choose questions for the driving question board. Keep the Essential and Focus Questions in mind while guiding students to select questions.

As students share and group their questions on the driving question board, some guidance will still be necessary. Keep the Focus Questions available for reference. As students post their questions, offer occasional guidance to ensure that groups of questions can later be summarized under each Focus Question.

Differentiation

Consider pairing English learners and striving writers with another student to practice reading their questions aloud in a smaller group. When students are comfortable sharing, have them add their questions to the driving question board.

Teacher Note

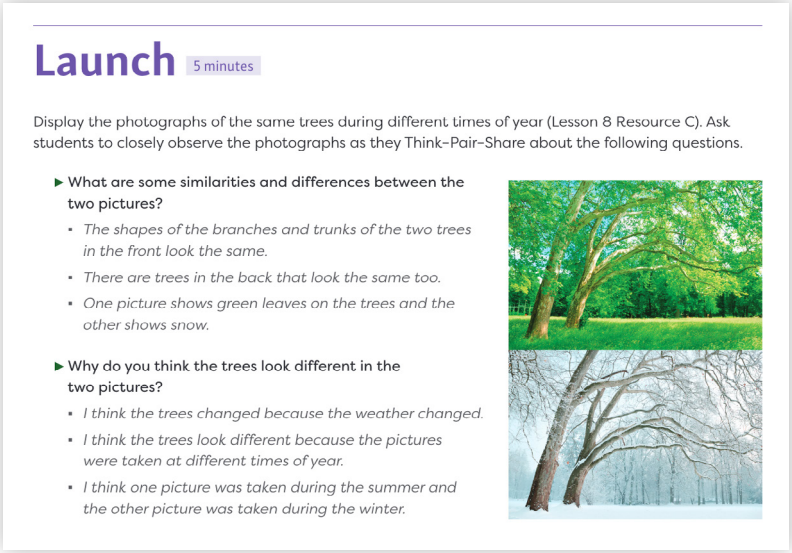
To encourage students to place the Focus Questions on the driving question board, think aloud with students about the patterns in their questions. Use this discussion to come to a summary that the Focus Question can represent.

English Language Development

The Essential Question, Focus Questions, and Phenomenon Questions throughout this module use words such as *describe*, *predict*, *plan*, *prevent*, and *protect*. Consider introducing these terms explicitly. Sharing the Spanish cognates for *describe* (*describir*), *predict* (*predecir*), *plan* (*plantificar*), and *protect* (*proteger*) may be useful.

- **Extension Activities** provide additional learning opportunities related to the lesson topic that extend beyond the time allotted for the lesson.

4 **Sample Responses.** Lessons include sample teacher questions as well as sample student responses. These sample discussions demonstrate for teachers what a classroom discussion might sound like. They are an educative component—not a script—that illustrate a possible trajectory of questions and possible student responses, but teachers are also encouraged to accept accurate responses, reasonable explanations, and equivalent answers for student work even if they differ from the sample.



Launch 5 minutes

Display the photographs of the same trees during different times of year (Lesson 8 Resource C). Ask students to closely observe the photographs as they Think–Pair–Share about the following questions.

- ▸ What are some similarities and differences between the two pictures?
  - *The shapes of the branches and trunks of the two trees in the front look the same.*
  - *There are trees in the back that look the same too.*
  - *One picture shows green leaves on the trees and the other shows snow.*
- ▸ Why do you think the trees look different in the two pictures?
  - *I think the trees changed because the weather changed.*
  - *I think the trees look different because the pictures were taken at different times of year.*
  - *I think one picture was taken during the summer and the other picture was taken during the winter.*

5 **Supplementary Resources.** At the end of each module's Teacher Edition, appendices provide support for teachers before and during instruction. These resources include the following:

> ***"When you get the materials, go straight to Appendix B. It's all there, showing where kids should be at the end of each lesson."***
>
> —Hannah Hyatt, Teacher, Lincoln Parish Schools

- **Appendix A—Module Resources** includes a set of lesson-specific resources to aid instruction such as full-size photographs, informational texts, investigation procedure sheets, and materials preparation information.
- **Appendix B—Module Storyline** provides a more detailed version of the Module Map section found in the Module Overview that summarizes the progression of concepts in the module and describes how students make sense of the anchor phenomenon.
- **Appendix C—Module Glossary** offers level-appropriate definitions for new terms in the module and the lesson in which the definition appears.
- **Appendix D—Domain-Specific Words, General Academic Words, and Spanish Cognates** contains a list of key terms in the module and their Spanish cognates to support English language development.

One of the great strengths of *PhD Science* is its educative nature and its usefulness as point-of-use professional development with these embedded supports. Of course, ***PhD Science* professional learning** is available in many forms, including professional development sessions, coaching, implementation services, and a variety of digital resources. Providing teachers with ongoing, curriculum-based professional learning is key to unlocking the potential of high-quality instructional materials.

Works Cited

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