Pacing Guide

Level 4 Module 1

EARTH FEATURES

with Spotlight Lessons on Mixtures and Solutions

Each *PhD Science® Texas* Level 4 lesson requires 45 minutes of instructional time. This guide is intended for teachers who are providing in-person instruction. This guide presents lesson objectives and activities by concept and multiple pacing options to allow teachers to maximize instructional time while remaining responsive to student needs. Choose one or more options for each lesson. Note that pacing options do not omit parts of lessons. Teacher choice days are also included in this pacing guide to allow for review, reteaching, assessment, and extension activities.

Pacing Option Key

Lesson Split: This symbol identifies single lessons teachers may split across 2 days.

Cross-Curricular Activity: This symbol identifies parts of lessons teachers may incorporate during instructional time for other content areas, such as English, math, social and emotional learning, and center time. Teachers may implement these parts before or after science instruction; for example, if the class reads a *PhD Science* core text during English instruction, students can discuss the core text during science instruction rather than reading the full text during that time.

Investigation Preparation: This symbol identifies preparation the teacher may do in advance of an investigation. This advance preparation does not interfere with student learning.

Teacher Think Aloud: This symbol identifies activities that are appropriate for a teacher Think Aloud. Suggested primarily for use during station activities, this option allows completion of these activities as a class. During a teacher Think Aloud, the teacher assumes the role of a student and verbalizes the thought process of a student completing the activity to engage students with intentional questioning techniques. The teacher may also ask students to model appropriate procedures and participate in collaborative conversations.

Shared Media Experience: This symbol identifies media (e.g., videos, images) that the teacher may share with the whole class rather than having students view the media individually or in groups. After students observe the media as a class, they complete an activity.

Focal Point: This symbol identifies parts of lessons teachers should emphasize. For example, in an activity with multiple resources (e.g., videos, texts, charts), a focal point identifies the most important resources, thus ensuring the coherence of the lessons.

Instructional Note: This symbol identifies parts of lessons that have instructional notes that describe time-saving strategies. Examples of such instructional notes are Differentiation supports that provide sentence frames for writing assignments and Teacher Notes that suggest alternative activities.

Instructional Routine: This symbol identifies opportunities to use alternative instructional routines. See the Implementation Guide for information on instructional routines.

Module at a Glance

This module contains 28 lessons plus 7 spotlight lessons on Mixtures and Solutions. Even with lesson splits and teacher choice days, this module should take no more than 49 days to complete. This maximum number of days ensures the implementation of all Level 4 modules within a school year that has 150 days of science instruction.

Earth Features

ANCHOR PHENOMENON:

Formation of the Grand Canyon's Features

ESSENTIAL QUESTION:

How did the Grand Canyon's features form?

Concept	Recommended Number of Days	TEKS Alignment	ELPS Alignment
Concept 1 (Lessons 1–6): Rock Layers **Focus Question:** What do Earth's rock layers reveal? Layers of rock and the fossils in those layers provide evidence of changes to Earth's surface over time.	6–9 days	4.1A, 4.1E, 4.1G, 4.2B, 4.3A, 4.3B, 4.5A, 4.10B, 4.12C	3D, 3E, 4A, 4D
Concept 2 (Lessons 7–12): Weathering and Erosion **Focus Question:** How are Earth's rock layers uncovered? The processes of breaking down rock (weathering) and moving sediment (erosion) play a role in shaping the features of Earth's surface.	6–9 days	4.1B, 4.1C, 4.1D, 4.1E, 4.1F, 4.1G, 4.2A, 4.2B, 4.3A, 4.3B, 4.5A, 4.5B, 4.5D, 4.7, 4.10B	2E, 2I, 3D, 4A
Application of Concepts (Lessons 13–18): Engineering Challenge **Phenomenon Question:** How can people reduce damage related to erosion? Designed solutions can reduce the impact of Earth's processes on humans.	6 days	4.1A, 4.1B, 4.1C, 4.1G, 4.2D, 4.3A, 4.3B, 4.3C, 4.4A, 4.5B, 4.5D, 4.10B	3F, 4F
Concept 3 (Lessons 19–25): Human Interactions with Earth **Focus Question:** How do humans interact with Earth's features and processes? Humans harness energy from Earth's features and processes, and the methods used to harness that energy can change Earth's features and processes.	7–12 days	4.1A, 4.1B, 4.1C, 4.1D, 4.1E, 4.1F, 4.1G, 4.2A, 4.2B, 4.3A, 4.3B, 4.4A, 4.5A, 4.5B, 4.5D, 4.5G, 4.8A, 4.10B, 4.11A, 4.11B, 4.11C	1A, 2D, 2E, 4D, 4G
Application of Concepts (Lessons 26–28): End-of-Module Socratic Seminar, Assessment, and Debrief **Essential Question:** How did the Grand Canyon's features form? Earth's surface features continually change as a result of natural processes, sometimes occurring over long periods of time.	3–4 days	4.1E 4.1F, 4.1G, 4.2B, 4.3A, 4.3B, 4.5A, 4.5B, 4.10B, 4.11A, 4.11B, 4.11C, 4.12C	3F

Spotlight Lessons on Mixtures and Solutions

Lesson Sets	Recommended Number of Days	TEKS Alignment	ELPS Alignment
Lessons 1–2: Water Pollution **Phenomenon Question:** What do environmental scientists need to know about water pollution materials before understanding the materials' effects on the environment? Matter is described and classified by using patterns of physical properties.	2 days	4.1A, 4.1C, 4.1E, 4.1F, 4.5A, 4.5B, 4.6A, 4.6B, 4.11B	1A, 3E
Lessons 3–4: Mixtures and Solutions **Phenomenon Question:** What properties can we use to describe mixtures? Mixtures, including solutions, can be compared on the basis of distinguishable properties.	2–3 days	4.1B, 4.1C, 4.1D, 4.1E, 4.1F, 4.1G, 4.5A, 4.5E, 4.6A, 4.6B, 4.6C	3E
Lesson 5: Relative Density **Phenomenon Question:** Why is it safe to swim in the Charles River but unsafe to touch the river bottom? The relative density of a material determines whether it sinks or floats in water.	1 days	4.1B, 4.1C, 4.1D, 4.1E, 4.1F, 4.1G, 4.5A, 4.5E, 4.6A, 4.6B, 4.6C	3D
Lessons 6–7: Cleaning an Oil Spill **Phenomenon Question:** How can environmental scientists clean an oil spill in the Gulf of Mexico? The properties of matter can be observed and used to describe mixtures and solutions.	2–3 days	4.1E, 4.1G, 4.2B, 4.2C, 4.5A, 4.5B, 4.5E, 4.6A, 4.6B, 4.6C	1A

Year at a Glance

This year at a glance chart shows where all three modules fit in a year. To ensure completion of each module, it is recommended to teach science 5 days a week.

Module 1	Module 2	Module 3
August	November	February
September	December	March
October	January	April

MODULE 1

Earth Features

CONCEPT 1

What do Earth's rock layers reveal? 6–9 days

Lessons 1–2: Grand Canyon Features and Patterns

TEKS 4.10B, 4.1A, 4.1E, 4.1G, 4.3B, 4.5A **ELPS** 3D, 3E, 4A

Lessons	Pacing Options
Lesson 1: Ask questions about the Grand Canyon's distinctive features.	Use Teacher Note in Launch. Think Aloud about Powell's 1871 Expedition Team Photographs in Notice and Wonder About Powell's Expedition Team Photographs and Moran's 1873 Expedition Painting.
Lesson 2: Develop a class anchor model of the Grand Canyon's distinctive features.	**Day 1:** Launch through Build a Driving Question Board **Day 2:** Develop an Initial Model of Grand Canyon Features through Land

Lessons 3–6: Rock Layers

TEKS 4.10B, 4.12C, 4.1A, 4.1E, 4.1G, 4.2B, 4.3A, 4.3B, 4.5A **ELPS** 3D, 3E, 4D

Lessons	Pacing Options
Lesson 3: Use fossil evidence to determine that the Grand Canyon rock layers came from distinct environments.	None
Lesson 4: Explain how the relative position of rock layers indicates the order in which they formed.	Use Differentiation note in Model the Order That Rock Layers Formed.
Lesson 5: Explain changes in the canyon landscapes by using evidence from fossils and rocks.	**Day 1:** Launch through Revise Anchor Model **Day 2:** Investigate Texas Landforms through Land Read and discuss *Grand Canyon* by Jason Chin (2017) in Read About the Grand Canyon before the lesson.
Lesson 6: Use fossil evidence to identify past environments and landscapes in Texas.	**Day 1:** Launch through Observe Texas Fossils **Day 2:** Create Anchor Chart through Land **Conceptual Checkpoint**

CONCEPT 2

How are Earth's rock layers uncovered? 6–9 days

Lessons 7–8: Weathering

TEKS 4.7, 4.10B, 4.1B, 4.1C, 4.1E, 4.1G, 4.2B, 4.5A, 4.5B **ELPS** 2E, 4A

Lessons	Pacing Options
Lesson 7: Investigate how natural materials can break rock.	Think Aloud Air Station in Investigate Interactions of Materials.
Lesson 8: Explain how natural materials weather rock.	Use an alternative instructional routine in Explain Weathering.

Lessons 9–12: Erosion

TEKS 4.7, 4.10B, 4.1B, 4.1C, 4.1D, 4.1E, 4.1F, 4.1G, 4.2A, 4.2B, 4.3A, 4.3B, 4.5A, 4.5B, 4.5D **ELPS** 2I, 3D

Lessons	Pacing Options
Lesson 9: Prepare a stream table landscape for investigation.	Measure sand and soil for Prepare Stream Table Landscape before the lesson. Use Differentiation note in Prepare Stream Table Landscape.
Lesson 10: Investigate how sediment is moved.	**Day 1:** Launch through Investigate Causes of Erosion (Investigation 2) **Day 2:** Investigate Causes of Erosion (Investigation 3) through Land Finish Frayer model (Lesson 10 Activity Guide B) in Define Erosion after the lesson.
Lesson 11: Investigate rates of erosion.	**Day 1:** Launch through Plan Investigations About Rates of Erosion **Day 2:** Investigate Rates of Erosion through Land Use Differentiation note in Plan Investigations About Rates of Erosion.
Lesson 12: Explain how rocks in the Grand Canyon have been changed by weathering and moved by erosion.	**Day 1:** Launch through Revise Anchor Model **Day 2:** Conceptual Checkpoint through Land **Conceptual Checkpoint**

ENGINEERING CHALLENGE

How can people reduce damage related to erosion? 6 days

Lessons 13–18: Engineering Challenge

TEKS 4.10B, 4.1A, 4.1B, 4.1C, 4.1G, 4.2D, 4.3A, 4.3B, 4.3C, 4.4A, 4.5B, 4.5D **ELPS** 3F, 4F

Lessons	Pacing Options
Lesson 13: Apply the engineering design process to design a structure to reduce damage related to erosion.	Read *Who Were the Wright Brothers?* by James Buckley Jr. (2014) in Read About the Wright Brothers before the lesson. **Engineering Challenge**
Lesson 14: Apply the engineering design process to design a structure to reduce damage related to erosion.	Use Differentiation note in Ask About an Engineering Problem. **Engineering Challenge**
Lesson 15: Apply the engineering design process to design a structure to reduce damage related to erosion.	**Engineering Challenge**
Lesson 16: Apply the engineering design process to design a structure to reduce damage related to erosion.	**Engineering Challenge**
Lesson 17: Apply the engineering design process to design a structure to reduce damage related to erosion.	**Engineering Challenge**
Lesson 18: Apply the engineering design process to design a structure to reduce damage related to erosion.	**Engineering Challenge**

CONCEPT 3

How do humans interact with Earth's features and processes? 7–12 days

Lessons 19–20: Lake Formation After the Addition of Dams

TEKS 4.1A, 4.1B, 4.1C, 4.1E, 4.1G, 4.2A, 4.3A, 4.3B, 4.5A, 4.5D, 4.5G, 4.10B, 4.11A, 4.11B **ELPS** 2E

Lessons	Pacing Options
Lesson 19: Create a model of the Colorado River.	**Day 1:** Launch through Explore Colorado River System Map **Day 2:** Model the Colorado River through Land
Lesson 20: Identify the effects of dams on the environment.	**Day 1:** Launch through Effects of a Dam on a River Investigation **Day 2:** Construct Explanations through Land Use Differentiation note in Construct Explanations. Think Aloud similarities between the two maps in Compare Colorado River System Maps.

Lessons 21–22: Renewable and Nonrenewable Energy Resource Use

TEKS 4.8A, 4.11A, 4.11B, 4.1A, 4.1E, 4.1F, 4.2B, 4.3B, 4.4A, 4.5B **ELPS** 4D, 4G

Lessons	Pacing Options
Lesson 21: Interpret information to determine uses of dams.	Think Aloud one paragraph of "The Hoover Dam: Controlling Water in the West" (Lusted 2016) in Read About the Hoover Dam. Think Aloud one data table or graph in Analyze Energy Data.
Lesson 22: Describe how the use of renewable and nonrenewable energy resources impacts the environment.	**Day 1:** Launch through Categorize Energy Resources **Day 2:** Discuss Similarities and Differences Among Energy Resources through Land Think Aloud one text excerpt and topic notes in Read About Energy Resources.

Lesson 23: Storage of Earth's Resources

TEKS 4.11C, 4.1B, 4.1C, 4.1D, 4.1E, 4.1G, 4.2B, 4.3A, 4.5A, 4.5D **ELPS** 1A

Lessons	Pacing Options
Lesson 23: Observe the properties of land materials that allow them to store water underground.	**Day 1:** Launch through Observe Water and Land Interactions (Investigation) **Day 2:** Observe Water and Land Interactions (Class Data Analysis) through Land

Lesson 24: Environmental Effects of Resource Use

TEKS 4.11B, 4.1G, 4.2A, 4.3B, 4.5A, 4.5B **ELPS** 4D, 4G

Lessons	Pacing Options
Lesson 24: Use models and text to identify patterns that explain how human actions affect groundwater storage and the environment.	**Day 1:** Launch through Observe a Model **Day 2:** Explore Ways to Conserve Water through Land Use Differentiation note in Explore Ways to Conserve Water.

Lesson 25: Human Impacts on Earth's Features

TEKS 4.11A, 4.11B, 4.11C, 4.1E, 4.2B, 4.3A, 4.5A **ELPS** 2D

Lessons	Pacing Options
Lesson 25: Explain how and why human use of energy resources varies.	**Conceptual Checkpoint**

APPLICATION OF CONCEPTS

How did the Grand Canyon's features form? 3–4 days

Lessons 26–28: End-of-Module Socratic Seminar, Assessment, and Debrief

TEKS 4.10B, 4.11A, 4.11B, 4.11C, 4.12C, 4.1E, 4.1F, 4.1G, 4.2B, 4.3A, 4.3B, 4.5A, 4.5B **ELPS** 3F

Lessons	Pacing Options
Lesson 26: Explain how Earth's processes shape some of Earth's features.	Use English Language Development note in Engage in Socratic Seminar. **Socratic Seminar**
Lesson 27: Explain how Earth's processes shape some of Earth's features.	**End-of-Module Assessment**
Lesson 28: Explain how Earth's processes shape some of Earth's features.	**End-of-Module Assessment Debrief**
Teacher Choice Day	Review, reteach, assess, or complete extension activities.

SPOTLIGHT LESSONS

Mixtures and Solutions 7–9 days

Lessons 1–2: Water Pollution

TEKS 4.6A, 4.6B, 4.11B, 4.1A, 4.1C, 4.1E, 4.1F, 4.5A, 4.5B **ELPS** 1A, 3E

Lessons	Pacing Options
Lesson 1: Observe examples of water pollution to identify that solids, liquids, and gases can pollute water and harm animals living in a water environment.	None
Lesson 2: Describe physical properties of matter and use them to classify solid materials that can pollute water.	Use an alternative written response routine in Review Properties of Matter.

Lessons 3–4: Mixtures and Solutions

TEKS 4.6A, 4.6B, 4.6C, 4.1B, 4.1C, 4.1D, 4.1E, 4.1F, 4.1G, 4.5A, 4.5E **ELPS** 3E

Lessons	Pacing Options
Lesson 3: Develop an investigation plan to compare different mixtures.	None
Lesson 4: Investigate and compare mixtures of water pollution materials to demonstrate that matter is conserved.	**Day 1:** Launch through Investigate Mixtures **Day 2:** Classify Solutions through Land Use Differentiation note in Investigate Mixtures.

Lesson 5: Relative Density

TEKS 4.6A, 4.6B, 4.1C, 4.1E, 4.2B, 4.3A, 4.5A, 4.5B **ELPS** 3D

Lessons	Pacing Options
Lesson 5: Classify materials based on their relative densities to predict the location of pollution materials in a body of water.	Use Differentiation note in Collect Data. Use Differentiation note in Analyze Data.

Lessons 6–7: Cleaning an Oil Spill

TEKS 4.6A, 4.6B, 4.6C, 4.1E, 4.1G, 4.2B, 4.2C, 4.5A, 4.5B, 4.5E **ELPS** 1A

Lessons	Pacing Options
Lesson 6: Explain how mixtures and solutions are described by their properties.	**End-of-Spotlight Assessment**
Lesson 7: Explain how mixtures and solutions are described by their properties.	**End-of-Spotlight Assessment Debrief**
Teacher Choice Day	Review, reteach, assess, or complete extension activities.

Texas Essential Knowledge and Skills (TEKS)

Content Standards

4.6 Matter and energy. The student knows that matter has measurable physical properties that determine how matter is identified, classified, changed, and used. The student is expected to

4 .6A classify and describe matter using observable physical properties, including temperature, mass, magnetism, relative density (the ability to sink or float in water), and physical state (solid, liquid, gas); (Introduced)

4.6B investigate and compare a variety of mixtures, including solutions that are composed of liquids in liquids and solids in liquids. (Introduced) concept maps, Venn diagrams, flow charts or sequence maps, and input-output tables that show cause and effect; and

4.6C demonstrate that matter is conserved when mixtures such as soil and water or oil and water are formed.

4.7 Force, motion, and energy. The student knows the nature of forces and the patterns of their interactions. The student is expected to

4.7 plan and conduct descriptive investigations to explore the patterns of forces such as gravity, friction, or magnetism in contact or at a distance on an object.

4.8 Force, motion, and energy. The student knows that energy is everywhere and can be observed in cycles, patterns, and systems. The student is expected to

4.8A investigate and identify the transfer of energy by objects in motion, waves in water, and sound.

4.10 Earth and space. The student knows that there are processes on Earth that create patterns of change. The student is expected to

4.10B model and describe slow changes to Earth's surface caused by weathering, erosion, and deposition from water, wind, and ice.

4.11 Earth and space. The student understands how natural resources are important and can be managed. The student is expected to

4.11A identify and explain advantages and disadvantages of using Earth's renewable and nonrenewable natural resources such as wind, water, sunlight, plants, animals, coal, oil, and natural gas.

4.11B explain the critical role of energy resources to modern life and how conservation, disposal, and recycling of natural resources impact the environment; and

4.11C determine the physical properties of rocks that allow Earth's natural resources to be stored there.

4.12 Organisms and environments. The student describes patterns, cycles, systems, and relationships within environments. The student is expected to

4.12C identify and describe past environments based on fossil evidence, including common Texas fossils.

Scientific and Engineering Practices

4.1 Scientific and engineering practices. The student asks questions, identifies problems, and plans and safely conducts classroom, laboratory, and field investigations to answer questions, explain phenomena, or design solutions using appropriate tools and models. The student is expected to

- **4.1A** ask questions and define problems based on observations or information from text, phenomena, models, or investigations;
- **4.1B** use scientific practices to plan and conduct descriptive investigations and use engineering practices to design solutions to problems;
- **4.1C** demonstrate safe practices and the use of safety equipment during classroom and field investigations as outlined in Texas Education Agency–approved safety standards;
- **4.1D** use tools, including hand lenses; metric rulers; Celsius thermometers; calculators; laser pointers; mirrors; digital scales; balances; graduated cylinders; beakers; hot plates; meter sticks; magnets; notebooks; timing devices; sieves; materials for building circuits; materials to support observation of habitats of organisms such as terrariums, aquariums, and collecting nets; and materials to support digital data collection such as computers, tablets, and cameras, to observe, measure, test, and analyze information;
- **4.1E** collect observations and measurements as evidence;
- **4.1F** construct appropriate graphic organizers used to collect data, including tables, bar graphs, line graphs, tree maps, concept maps, Venn diagrams, flow charts or sequence maps, and input-output tables that show cause and effect; and
- **4.1G** develop and use models to represent phenomena, objects, and processes or design a prototype for a solution to a problem.

4.2 Scientific and engineering practices. The student analyzes and interprets data to derive meaning, identify features and patterns, and discover relationships or correlations to develop evidence-based arguments or evaluate designs. The student is expected to

- **4.2A** identify advantages and limitations of models such as their size, scale, properties, and materials;
- **4.2B** analyze data by identifying any significant features, patterns, or sources of error;
- **4.2C** use mathematical calculations to compare patterns and relationships; and
- **4.2D** evaluate a design or object using criteria.

4.3 Scientific and engineering practices. The student develops evidence-based explanations and communicates findings, conclusions, and proposed solutions. The student is expected to

- **4.3A** develop explanations and propose solutions supported by data and models;
- **4.3B** communicate explanations and solutions individually and collaboratively in a variety of settings and formats; and
- **4.3C** listen actively to others' explanations to identify relevant evidence and engage respectfully in scientific discussion.

4.4 Scientific and engineering practices. The student knows the contributions of scientists and recognizes the importance of scientific research and innovation for society. The student is expected to

- **4.4A** explain how scientific discoveries and innovative solutions to problems impact science and society.

Recurring Themes and Concepts

4.5 Recurring themes and concepts. The student understands that recurring themes and concepts provide a framework for making connections across disciplines. The student is expected to

- **4.5A** identify and use patterns to explain scientific phenomena or to design solutions;
- **4.5B** identify and investigate cause-and-effect relationships to explain scientific phenomena or analyze problems;
- **4.5D** examine and model the parts of a system and their interdependence in the function of the system;
- **4.5E** investigate how energy flows and matter cycles through systems and how matter is conserved; and
- **4.5G** explain how factors or conditions impact stability and change in objects, organisms, and systems.

English Language Proficiency Standards (ELPS)

1A Use prior knowledge and experiences to understand meanings in English.

2D Monitor understanding of spoken language during classroom instruction and interactions and seek clarification as needed.

2E Use visual, contextual, and linguistic support to enhance and confirm understanding of increasingly complex and elaborated spoken language.

2I Demonstrate listening comprehension of increasingly complex spoken English by following directions, retelling or summarizing spoken messages, responding to questions and requests, collaborating with peers, and taking notes commensurate with content and grade-level needs.

3D Speak using grade-level content area vocabulary in context to internalize new English words and build academic language proficiency.

3E Share information in cooperative learning interactions.

3F Ask and give information ranging from using a very limited bank of high-frequency, high-need, concrete vocabulary, including key words and expressions needed for basic communication in academic and social contexts, to using abstract and content-based vocabulary during extended speaking assignments.

4A Learn relationships between sounds and letters of the English language and decode (sound out) words using a combination of skills such as recognizing sound-letter relationships and identifying cognates, affixes, roots, and base words.

4D Use prereading supports such as graphic organizers, illustrations, and pretaught topic-related vocabulary and other prereading activities to enhance comprehension of written text.

4F Use visual and contextual support and support from peers and teachers to read grade-appropriate content area text, enhance and confirm understanding, and develop vocabulary, grasp of language structures, and background knowledge needed to comprehend increasingly challenging language.

4G Demonstrate comprehension of increasingly complex English by participating in shared reading, retelling or summarizing material, responding to questions, and taking notes commensurate with content area and grade level needs.