Pacing Guide

Level 4 Module 1

Energy with Spotlight Lessons on Matter

Each *PhD Science® TEKS Edition* 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 the needs of their students. Choose one or more options for each lesson. Note that pacing options do not omit parts of lessons.

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.

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

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.

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Module at a Glance

This module contains 30 lessons with 5 spotlight lessons. Even with lesson splits, this module should take no more than 41 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.

Energy

Anchor Phenomenon: Windmills at Work **Essential Question: How do windmills change wind to light?**	**Recommended Number of Days**	**TEKS and ELPS Alignment**
Concept 1 (Lessons 1–5): Energy and Its Classifications **Focus Question:** What is energy? Energy is why things happen. People can observe phenomena that indicate the presence of energy. It can be useful to classify those indicators into categories such as sound, light, heat, electricity, and the motion of objects.	5–8 days	4.2A, 4.2D, 4.2F, 4.3B, 4.3C, 4.6A, 4.6C, 4.6D ELPS: 1E, 3D, 3E, 5G
Concept 2 (Lessons 6–11): Energy Transfer **Focus Question:** How does energy transfer from place to place? Energy can transfer between objects through collisions and from place to place through electric currents, sound, heat, and light.	6–9 days	4.2A, 4.2B, 4.2C, 4.2D, 4.2E, 4.2F, 4.3A, 4.3B, 4.4, 4.6A, 4.6D ELPS: 3B, 3F, 4A, 5F
Concept 3 (Lessons 12–20): Energy Transformation **Focus Question:** How does energy transform? Energy transformation occurs when one phenomenon indicating the presence of energy changes into any other energy phenomenon.	9 days	4.2A, 4.2B, 4.2C, 4.2D, 4.2F, 4.3B, 4.3C, 4.4, 4.6A, 4.6B, 4.6C ELPS: 2E, 3D, 3E, 3F, 3H, 4A
Application of Concepts (Lessons 21–27): Engineering Challenge **Phenomenon Question:** How can we apply our knowledge of energy to solve a problem? The engineering design process can be used to create a device to transfer energy and transform it from an available form into the desired form.	7 days	4.2A, 4.2E, 4.2F, 4.3B, 4.3C, 4.6A, 4.6C ELPS: 3E, 3F
Application of Concepts (Lessons 28–30): End-of-Module Socratic Seminar, Assessment, and Debrief **Essential Question:** How do windmills change wind to light? In a system, specific indicators of energy can be generated through energy transfers and transformations.	3 days	4.2C, 4.2D, 4.2F, 4.3B, 4.6A, 4.6B, 4.6C, 4.6D ELPS: 3G

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Spotlight Lessons on Matter

Lesson Sets	Recommended Number of Days	TEKS and ELPS Alignment
Lessons 1–3: Matter **Phenomenon Question:** How can we use physical properties to describe matter?	3 days	4.2B, 4.4, 4.5A ELPS: 3E
Lessons 4–5: Mixtures **Phenomenon Question:** What happens when you mix matter?	2 days	4.2A, 4.2B, 4.5A, 4.5B ELPS: 4A

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 five days a week.

Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
Module 1			Module 2			Module 3				

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Module 1: Energy

Concept 1: What is energy? 5–8 days

Focus Standards

4.6A Differentiate among forms of energy, including mechanical, sound, electrical, light, and thermal.

4.6C Demonstrate that electricity travels in a closed path, creating an electrical circuit.

4.6D Design a descriptive investigation to explore the effect of force on an object such as a push or pull, gravity, friction, or magnetism.

<table>
<tr><th colspan="3">Lessons 1–3: Windmills at Work</th><th>Lessons 4–5: Energy Indicators</th></tr>
<tr><td>Lesson 1: Make observations to generate questions about how windmills harness the wind.</td><td>Lesson 2: Create a model windmill that generates electricity.</td><td>Lesson 3: Ask questions about energy.</td><td>Lesson 4: Observe indicators of the presence of energy.</td></tr>
<tr><td>Day 1: Launch through Notice and Wonder About Windmills
Day 2: Construct Miniature Windmills through Land</td><td>Day 1: Launch through Introduce and Discuss The Boy Who Harnessed the Wind (Kamkwamba and Mealer 2010)
Day 2: Construct Physical Models through Land</td><td>Day 1: Launch through Develop an Anchor Model
Day 2: Build a Driving Question Board through Land</td><td>Think aloud Station 4: Snap Circuits® windmill in Observe Energy Stations.</td></tr>
<tr><th colspan="1">Lessons 4–5: Energy Indicators</th></tr>
<tr><td>Lesson 5: Classify indicators of the presence of energy.</td></tr>
<tr><td>Conceptual Checkpoint</td></tr>
</table>

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Concept 2: How does energy transfer from place to place? 6–9 days

Focus Standards

4.6A Differentiate among forms of energy, including mechanical, sound, electrical, light, and thermal.

4.6D Design a descriptive investigation to explore the effect of force on an object such as a push or pull, gravity, friction, or magnetism.

Lessons 6–7: Effect of Energy on Speed

Lesson 6: Describe the relationship between energy and speed.

- **Day 1:** Launch through Investigate Energy (groups visit 1 station)
  Day 2: Investigate Energy (groups visit remaining 2 stations) through Land
- Use first Teacher Note in Investigate Energy.
- Think aloud Object 3 during Investigate Energy.

Lesson 7: Interpret data showing that greater energy input enables greater speed.

- **Day 1:** Launch through Design a Fair Test Investigation
  Day 2: Conduct the Investigation through Land
- Use English Language Development note in Analyze and Interpret Data.

Lessons 8–9: Energy Changes During a Collision

Lesson 8: Predict the transfer of motion energy between objects during a collision.

- **Day 1:** Launch through Plan the Investigation
  Day 2: Conduct the Investigation through Land
- Use English Language Development note in Analyze and Interpret Data.

Lesson 9: Explain the transfer of motion energy between objects through forces in a collision.

- Think aloud Model Energy Before a Collision.
- Use first Differentiate Note in Model Energy Before a Collision.

Lessons 10–11: Slowing Motion

Lesson 10: Plan and conduct an investigation to gather evidence of a force that can cause a moving object to slow down and stop.

- Use Differentiation note in Develop an Investigation Plan.

Lesson 11: Analyze and interpret data to explain that friction can cause a moving object to slow down and stop.

Conceptual Checkpoint

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Concept 3: How does energy transform? — 9 days

Focus Standards

4.6A Differentiate among forms of energy, including mechanical, sound, electrical, light, and thermal.

4.6B Differentiate between conductors and insulators of thermal and electrical energy.

4.6C Demonstrate that electricity travels in a closed path, creating an electrical circuit.

Lessons 12–13: Changes in Energy Indicators		**Lessons 14–15: Conductors, Insulators, and Circuits**	
Lesson 12: Observe transformation of energy to produce motion, light, sound, and temperature change.	**Lesson 13:** Explain that energy may transform to produce new phenomena, such as motion, light, sound, and temperature change.	**Lesson 14:** Demonstrate that in an electrical circuit electrical energy must travel in a closed loop.	**Lesson 15:** Differentiate between conductors and insulators of electrical and thermal energy.
	Use sidebar English language development note in Construct Explanations about Energy Transformations and Energy Transfer.	Use Differentiation note in Build an Electrical Circuit.	
Lessons 16–18: Generating Electricity			**Lessons 19–20: Windmills at Work**
Lesson 16: Plan to build generators to transform mechanical energy into electrical energy.	**Lesson 17:** Build generators to transform mechanical energy into electrical energy.	**Lesson 18:** Build generators to transform mechanical energy into electrical energy.	**Lesson 19:** Model how windmills transfer and transform energy.
Set up magnet and nail configuration for students in Prepare and Plan to Build a Generator before the lesson.	Pre-assign student roles in Determine Group Roles. Use Teacher Note in Determine Group Roles.	Use English Language Development note in Form Conclusions About Generating Electricity.	

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Concept 3: How does energy transform? (continued)
Lessons 19–20: Windmills at Work
Lesson 20: Explain that energy makes things happen when it is transferred and transformed.
Complete Revisit *The Boy Who Harnessed the Wind* before the lesson.
Focus on pages 22 and 23 in Revisit *The Boy Who Harnessed the Wind.*
Conceptual Checkpoint

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Engineering Challenge: How can we apply our knowledge of energy to solve a problem? 7 days

Focus Standards

4.6A Differentiate among forms of energy, including mechanical, sound, electrical, light, and thermal.

4.6C Demonstrate that electricity travels in a closed path, creating an electrical circuit.

Lessons 21–27: Engineering Challenge			
Lesson 21: Apply the engineering design process to construct and refine a device that transforms energy.	**Lesson 22:** Apply the engineering design process to construct and refine a device that transforms energy.	**Lesson 23:** Apply the engineering design process to construct and refine a device that transforms energy.	**Lesson 24:** Apply the engineering design process to construct and refine a device that transforms energy.
	Use English Language Development note in Plan a Design Solution.	Use Differentiation note in Create a Design Solution.	Use Differentiation note in Provide Peer Feedback.
Engineering Challenge	**Engineering Challenge**	**Engineering Challenge**	**Engineering Challenge**

Lessons 21–27: Engineering Challenge		
Lesson 25: Apply the engineering design process to construct and refine a device that transforms energy.	**Lesson 26:** Apply the engineering design process to construct and refine a device that transforms energy.	**Lesson 27:** Apply the engineering design process to construct and refine a device that transforms energy.
Engineering Challenge	**Engineering Challenge**	**Engineering Challenge**

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<table>
<tr><td colspan="3">Application of Concepts: How do windmills change wind to light? 3 days
Focus Standards
4.6A Differentiate among forms of energy, including mechanical, sound, electrical, light, and thermal.
4.6B Differentiate between conductors and insulators of thermal and electrical energy.
4.6C Demonstrate that electricity travels in a closed path, creating an electrical circuit.
4.6D Design a descriptive investigation to explore the effect of force on an object such as a push or pull, gravity, friction, or magnetism.</td></tr>
<tr><td colspan="3">Lessons 28–30: Windmills at Work</td></tr>
<tr><td>Lesson 28: Explain changes in a system as the transfer and transformation of energy.</td><td>Lesson 29: Explain changes in a system as the transfer and transformation of energy.</td><td>Lesson 30: Explain changes in a system as the transfer and transformation of energy.</td></tr>
<tr><td>  Use English Language Development note in Engage in Socratic Seminar.</td><td rowspan="2">End-of-Module Assessment</td><td rowspan="2">End-of-Module Debrief</td></tr>
<tr><td>Socratic Seminar</td></tr>
</table>

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Spotlight Lessons: Matter

Focus Standards: 5 days

4.5A Measure, compare, and contrast physical properties of matter, including mass, volume, states (solid, liquid, gas), temperature, magnetism, and the ability to sink or float.

4.5B Compare and contrast a variety of mixtures, including solutions.

Lessons 1–3: Matter			Lessons 4–5: Mixtures
Lesson 1: Observe and describe physical properties of matter.	**Lesson 2:** Measure and record physical properties of matter.	**Lesson 3:** Compare physical properties of matter.	**Lesson 4:** Observe and describe the physical properties of materials before and after mixing.
 Prepare Properties of Matter chart with category headings in Develop List of Properties before the lesson.	 Use first Teacher Note in Measure Properties of Matter.		 Use first Teacher Note in Launch.  Use Differentiation note in Explore Mixtures

Lessons 4–5: Mixtures
Lesson 5: Compare the physical properties of various mixtures
 Think aloud oil and sand mixture in Make Mixtures.

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Texas Essential Knowledge and Skills (TEKS)

Focus Standards	
4.6	Force, motion, and energy. The student knows that energy exists in many forms and can be observed in cycles, patterns, and systems. The student is expected to
	4.6A differentiate among forms of energy, including mechanical, sound, electrical, light, and thermal;
	4.6B differentiate between conductors and insulators of thermal and electrical energy;
	4.6C demonstrate that electricity travels in a closed path, creating an electrical circuit; and
	4.6D design a descriptive investigation to explore the effect of force on an object such as a push or pull, gravity, friction, or magnetism.

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Investigation and Reasoning Standards	
4.1	Scientific investigation and reasoning. The student conducts classroom and outdoor investigations following home and school safety procedures and environmentally appropriate practices. The student is expected to
	4.1A demonstrate safe practices and the use of safety equipment as described in Texas Education Agency–approved safety standards during classroom and outdoor investigations using safety equipment, including safety goggles or chemical splash goggles, as appropriate, and gloves, as appropriate; and
	4.1B make informed choices in the use and conservation of natural resources and reusing and recycling of materials such as paper, aluminum, glass, cans, and plastic.
4.2	Scientific investigation and reasoning. The student uses scientific practices during laboratory and outdoor investigations. The student is expected to
	4.2A plan and implement descriptive investigations, including asking well defined questions, making inferences, and selecting and using appropriate equipment or technology to answer his/her questions;
	4.2B collect and record data by observing and measuring, using the metric system, and using descriptive words and numerals such as labeled drawings, writing, and concept maps;
	4.2C construct simple tables, charts, bar graphs, and maps using tools and current technology to organize, examine, and evaluate data;
	4.2D analyze data and interpret patterns to construct reasonable explanations from data that can be observed and measured;
	4.2E perform repeated investigations to increase the reliability of results; and
	4.2F communicate valid oral and written results supported by data.
4.3	Scientific investigation and reasoning. The student uses critical thinking and scientific problem solving to make informed decisions. The student is expected to
	4.3A analyze, evaluate, and critique scientific explanations by using evidence, logical reasoning, and experimental and observational testing;
	4.3B represent the natural world using models such as the water cycle and stream tables and identify their limitations, including accuracy and size; and
	4.3C connect grade-level appropriate science concepts with the history of science, science careers, and contributions of scientists.
4.4	Scientific investigation and reasoning. The student knows how to use a variety of tools, materials, equipment, and models to conduct science inquiry. The student is expected to
	4.4 collect, record, and analyze information using tools, including calculators, microscopes, cameras, computers, hand lenses, metric rulers, Celsius thermometers, mirrors, spring scales, balances, graduated cylinders, beakers, hot plates, meter sticks, magnets, collecting nets, and notebooks; timing devices; and materials to support observation of habitats of organisms such as terrariums and aquariums.

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Works Cited

Kamkwamba, William, and Bryan Mealer. 2010. *The Boy Who Harnessed the Wind: Creating Currents of Electricity and Hope*. New York: HarperCollins.

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