Pacing Guide

Level 3 Module 3

Forces and Motion with Spotlight Lessons on the Solar System

Each *PhD Science® TEKS Edition* Level 3 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.

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.

Module at a Glance

This module contains 30 lessons and 7 spotlight lessons on the Solar System. Even with lesson splits, this module should take no more than 45 days to complete. This maximum number of days ensures the implementation of all Level 3 modules within a school year that has 150 days of science instruction.

Forces and Motion

Anchor Phenomenon: Motion in Space **Essential Question: Why do objects move differently in space than they do on Earth?**	**Recommended Number of Days**	**TEKS and ELPS Alignment**
Concept 1 (Lessons 1–9): Motion **Focus Question:** How can we describe and predict an object's motion? Patterns of an object's motion can be observed and described in order to make predictions.	9–12 days	3.2A, 3.2B, 3.2C, 3.2D, 3.2E, 3.2F, 3.3A, 3.3B, 3.3C, 3.4, 3.6A, 3.6B, 3.6C ELPS: 2E, 2F, 3D, 3G, 3H
Concept 2 (Lessons 10–18): Forces **Focus Question:** What can cause the motion of an object to change? Multiple forces can act on an object. If the forces are balanced, the object's motion does not change. If the forces are unbalanced, the object's motion changes.	9–13 days	3.2A, 3.2B, 3.2C, 3.2D, 3.2E, 3.2F, 3.3A, 3.3B, 3.3C, 3.4, 3.6B, 3.6C ELPS: 1C, 1F, 3E, 3F, 3G, 3J, 5G
Concept 3 (Lessons 19–22): Magnetic and Electric Forces **Focus Question:** How can an object move without being touched? Magnetic and electric forces can be exerted between objects with certain properties even when the objects are not in contact.	4 days	3.2A, 3.2B, 3.2D, 3.2F, 3.3A, 3.4, 3.5A, 3.6B, 3.6C ELPS: 2C, 2F, 3F, 4D, 4E
Application of Concepts (Lessons 23–27): Engineering Challenge **Phenomenon Question:** How can we use magnets to design a solution to help astronauts in space? Problems can be solved by applying scientific ideas about magnets.	5 days	3.2A, 3.2B, 3.2E, 3.2F, 3.3B, 3.3C, 3.5A, 3.6A ELPS: 2E, 3E, 5F
Application of Concepts (Lessons 28–30): End-of-Module Socratic Seminar, Assessment, and Debrief **Essential Question:** Why do objects move differently in space than they do on Earth? The forces acting on an object may affect its motion (speed and direction). Forces that are balanced do not change an object's motion, but forces that are unbalanced change an object's motion.	3 days	3.2A, 3.2C, 3.2D, 3.2F, 3.3A, 3.3B, 3.5A, 3.6A, 3.6B, 3.6C ELPS: 3F

Spotlight Lessons on Solar System

Lesson Sets	Recommended Number of Days	TEKS and ELPS Alignment
Lessons 1–3: Solar Eclipses **Phenomenon Question: What do we observe during a solar eclipse?:** The Sun provides light and thermal energy, and people us light, thermal, and sound energy every day.	3 days	3.2A, 3.2B, 3.2D, 3.2F, 3.3B, 3.6A, 3.8B ELPS: 1C, 3H
Lesson 4: Stars **Phenomenon Question:** Why does the Sun look different from other stars? The Sun is a star made of gases that is closer to Earth than other stars.	1–2 days	3.2D, 3.4, 3.8B ELPS: 3E
Lessons 5–7: The Planets and the Moon **Phenomenon Question:** What objects can cause a solar eclipse? Earth and other planets in the solar system orbit the Sun, and the Moon orbits Earth.	3 days	3.3B, 3.4, 3.8C, 3.8D ELPS: 2E, 3H

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				

Module 3: Forces and Motion

Concept 1: How can we describe and predict an object's motion? 9–12 days

Focus Standards

3.6A Explore different forms of energy, including mechanical, light, sound, and thermal in everyday life.

3.6B Demonstrate and observe how position and motion can be changed by pushing and pulling objects such as swings, balls, and wagon.

3.6C Observe forces such as magnetism and gravity acting on objects.

Lessons 1–3: Motion in Space			**Lessons 4–6: Describing Motion**
Lesson 1: Observe the motion of objects in space.	**Lesson 2:** Observe a soccer ball on Earth, and compare its motion with the motion of a soccer ball in space.	**Lesson 3:** Ask questions about the motion of objects in space and on Earth.	**Lesson 4:** Observe and measure the motion of a variety of objects.
Day 1: Launch through Read *Moonshot: The Flight of Apollo 11* (Floca 2019) **Day 2:** Observe Motion in Space through Land	Use Teacher Note in Explore with a Soccer Ball.	Use inline Teacher Note in Build Driving Question Board.	Use English Language Development note in Launch. Use third Teacher Note in Prepare to Visit Motion Stations.

Concept 1: How can we describe and predict an object's motion? (continued)

Lessons 4–6: Describing Motion		Lessons 7–9: Predicting Motion	
Lesson 5: Analyze data to determine that motion can be described in terms of speed, direction, and rest.	**Lesson 6:** Identify patterns that can be used to describe and classify the motion of objects.	**Lesson 7:** Design an investigation to test how changing a variable affects the motion of an object.	**Lesson 8:** Conduct a fair test investigation to explain how changing a variable affects the motion of an object.
Day 1: Launch through Analyze Observations **Day 2:** Define Speed through Land Use second Differentiation Note in Analyze Observations.	**Day 1:** Launch through Identify Patterns of Motion **Day 2:** Classify Motion through Land Think aloud ball pattern sketch and description in Launch. Use an alternative collaborative conversation routine in Classify Motion.	Use first sidebar Teacher Note in Explore Motion of Pendulum and Toy Car.	Use second Teacher Note to assign roles in Investigate Patterns of Motion. Use Differentiation note in Analyze Data.

Lessons 7–9: Predicting Motion
Lesson 9: Predict an object's motion based on observed patterns.
Conceptual Checkpoint

Concept 2: What can cause the motion of an object to change? 9–13 days

Focus Standards

3.6B Demonstrate and observe how position and motion can be changed by pushing and pulling objects such as swings, balls, and wagon.

3.6C Observe forces such as magnetism and gravity acting on objects.

Lessons 10–11: Forces and Motion		Lessons 12–14: Multiple Forces	
Lesson 10: Explore pushes and pulls on an object in order to describe force.	**Lesson 11:** Explore how a force acting on an object can cause the object's motion to change.	**Lesson 12:** Make observations to describe the effect of multiple forces acting on an object.	**Lesson 13:** Observe and describe the effect of gravity on an object.
Use inline Teacher Note in Explore Changes in Motion. Use a timer to pace scooter board stations in Explore Changes in Motion. Use fourth sidebar Teacher Note in Explore Changes in Motion.	**Day 1:** Launch through Explore Atwood Machines **Day 2:** Develop Force Models through Land Use second Teacher Note in Explore Atwood Machines.	Use an alternative instructional routine in Explore Forces in Two Directions.	**Day 1:** Launch through Explore Gravity **Day 2:** Explore Forces on Classroom Objects through Land

Concept 2: What can cause the motion of an object to change? (continued)

Lessons 12–14: Multiple Forces	Lessons 15–16: Slowing Motion		Lessons 17–18: Objects at Rest
Lesson 14: Evaluate a claim about the effect of multiple forces acting on an object.	**Lesson 15:** Plan and conduct an investigation to gather evidence of a force that can cause a moving object to slow down and stop.	**Lesson 16:** Analyze and interpret data to explain that friction can cause a moving object to slow down and stop.	**Lesson 17:** Explore forces acting on an object at rest.
Day 1: Launch through Describe Forces as Balanced and Unbalanced **Day 2:** Evaluate a Claim through Land Think aloud bucket model in Launch.	**Day 1:** Launch through Develop an Investigation Plan **Day 2:** Conduct an Investigation through Land Use Differentiation note in Develop an Investigation Plan.		Use an alternative collaborative conversation routine in Model Friction. Think aloud revision of force models in Model Friction.
Lessons 17–18: Objects at Rest			
Lesson 18: Explain how forces can cause the motion of an object to change.			
Conceptual Checkpoint			

Concept 3: How can an object move without being touched? 4 days

Focus Standards

3.5A Measure, test, and record physical properties of matter, including temperature, mass, magnetism, and the ability to sink or float.

3.6B Demonstrate and observe how position and motion can be changed by pushing and pulling objects such as swings, balls, and wagon.

3.6C Observe forces such as magnetism and gravity acting on objects.

Lessons 19–21: Magnetic and Electric Forces			**Lesson 22: Uses of Magnets**
Lesson 19: Observe interactions between objects to gather evidence of magnetic force.	**Lesson 20:** Use observations as evidence to explain that magnets can exert a force on other objects.	**Lesson 21:** Use observations as evidence to explain that certain objects can exert an electric force on other objects.	**Lesson 22:** Obtain information about the use of magnets to solve problems.
Use Differentiation note in Ask Questions About Magnets.	Use Differentiation note in Analyze Cause and Effect Relationships. Use video in first Teacher Note in Land.	**Conceptual Checkpoint**	Complete Launch and read aloud "So Repulsive, It's Attractive!" (D'Alto 2009) before the lesson. Use Differentiation Note in Obtain Information About Uses of Magnets.

Engineering Challenge: How can we use magnets to design a solution to help astronauts in space? — 5 days

Focus Standards

3.5A Measure, test, and record physical properties of matter, including temperature, mass, magnetism, and the ability to sink or float.

3.6C Observe forces such as magnetism and gravity acting on objects.

Lessons 23–27: Engineering Challenge

Lesson 23: Apply the engineering design process to construct and refine a prototype to secure objects in space.	**Lesson 24:** Apply the engineering design process to construct and refine a prototype to secure objects in space.	**Lesson 25:** Apply the engineering design process to construct and refine a prototype to secure objects in space.	**Lesson 26:** Apply the engineering design process to construct and refine a prototype to secure objects in space.
Use Differentiation note in Ask About an Engineering Problem.	Use a timer to pace rotations in Provide Peer Feedback. Use Differentiation note in Create a Solution. Use second sidebar Teacher Note in Create a Solution.	**Engineering Challenge**	Use English Language Development note in Test a Solution.
			Engineering Challenge
Engineering Challenge	**Engineering Challenge**		

Lessons 23–27: Engineering Challenge

Lesson 27: Apply the engineering design process to construct and refine a prototype to secure objects in space.
Engineering Challenge

Application of Concepts: Why do objects move differently in space than they do on Earth? — 3 days

Focus Standards

3.5A Measure, test, and record physical properties of matter, including temperature, mass, magnetism, and the ability to sink or float.

3.6A Explore different forms of energy, including mechanical, light, sound, and thermal in everyday life.

3.6B Demonstrate and observe how position and motion can be changed by pushing and pulling objects such as swings, balls, and wagon.

3.6C Observe forces such as magnetism and gravity acting on objects.

Lessons 28–30: Motion in Space		
Lesson 28: Explain how the forces exerted on an object affect the object's motion.	**Lesson 29:** Explain how the forces exerted on an object affect the object's motion.	**Lesson 30:** Explain how the forces exerted on an object affect the object's motion.
 Use English Language Development note in Engage in Socratic Seminar.	**End-of-Module Assessment**	**End-of-Module Debrief**
Socratic Seminar		

Spotlight Lessons: Solar System

Focus Standards: 7–8 days

3.6A Explore different forms of energy, including mechanical, light, sound, and thermal in everyday life.

3.8B Describe and illustrate the Sun as a star composed of gases that provides light and thermal energy.

3.8C Construct models that demonstrate the relationship of the Sun, Earth, and Moon, including orbits and positions.

3.8D Identify the planets in Earth's solar system and their position in relation to the Sun.

Lessons 1–3: Solar Eclipses			**Lesson 4: Stars**
Lesson 1: Create a model to show the decrease in light energy reaching Earth during a solar eclipse.	**Lesson 2:** Investigate temperature changes to identify the Sun as a source of thermal energy.	**Lesson 3:** Observe how the sounds some animals make may change during a solar eclipse, and explore how people make use of sound energy in everyday life.	**Lesson 4:** Describe the Sun as a star composed of gases that is closer to Earth than other stars.
	Use second Teacher Note in Investigate Temperature.		**Day 1:** Launch through Compare the Sun and Alpha Centauri A **Day 2:** Investigate Distance and Appearance through Land
Lessons 5–7: The Planets and the Moon			
Lesson 5: Arrange the planets in order by their distance from the Sun.	**Lesson 6:** Construct a model of the Sun-Earth-Moon system.	**Lesson 7:** Investigate whether the Moon can block the Sun and cause a solar eclipse.	
	Use inline Teacher Note in Create a Model.		

Texas Essential Knowledge and Skills (TEKS)

Focus Standards	
3.5	Matter and energy. The student knows that matter has measurable physical properties and those properties determine how matter is classified, changed, and used. The student is expected to
3.5A	measure, test, and record physical properties of matter, including temperature, mass, magnetism, and the ability to sink or float.
3.6	Force, motion, and energy. The student knows that forces cause change and that energy exists in many forms. The student is expected to
3.6A	explore different forms of energy, including mechanical, light, sound, and thermal in everyday life;
3.6B	demonstrate and observe how position and motion can be changed by pushing and pulling objects such as swings, balls, and wagons; and
3.6C	observe forces such as magnetism and gravity acting on objects.
3.8	Earth and space. The student knows there are recognizable patterns in the natural world and among objects in the sky. The student is expected to
3.8B	describe and illustrate the Sun as a star composed of gases that provides light and thermal energy;
3.8C	construct models that demonstrate the relationship of the Sun, Earth, and Moon, including orbits and positions; and
3.8D	identify the planets in Earth's solar system and their position in relation to the Sun.

Investigation and Reasoning Standards	
3.1	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
	3.1A demonstrate safe practices as described in Texas Education Agency–approved safety standards during classroom and outdoor investigations using safety equipment as appropriate, including safety goggles or chemical splash goggles, as appropriate, and gloves; and
	3.1B make informed choices in the use and conservation of natural resources by recycling or reusing materials such as paper, aluminum cans, and plastics.
3.2	Scientific investigation and reasoning. The student uses scientific practices during laboratory and outdoor investigations. The student is expected to
	3.2A plan and implement descriptive investigations, including asking and answering questions, making inferences, and selecting and using equipment or technology needed, to solve a specific problem in the natural world;
	3.2B collect and record data by observing and measuring using the metric system and recognize differences between observed and measured data;
	3.2C construct maps, graphic organizers, simple tables, charts, and bar graphs using tools and current technology to organize, examine, and evaluate measured data;
	3.2D analyze and interpret patterns in data to construct reasonable explanations based on evidence from investigations;
	3.2E demonstrate that repeated investigations may increase the reliability of results; and
	3.2F communicate valid conclusions supported by data in writing, by drawing pictures, and through verbal discussion.
3.3	Scientific investigation and reasoning. The student knows that information, critical thinking, scientific problem solving, and the contributions of scientists are used in making decisions. The student is expected to
	3.3A analyze, evaluate, and critique scientific explanations by using evidence, logical reasoning, and experimental and observational testing;
	3.3B represent the natural world using models such as volcanoes or the Sun, Earth, and Moon system and identify their limitations, including size, properties, and materials; and
	3.3C connect grade-level appropriate science concepts with the history of science, science careers, and contributions of scientists.
3.4	Scientific investigation and reasoning. The student knows how to use a variety of tools and methods to conduct science inquiry. The student is expected to
	3.4 collect, record, and analyze information using tools, including cameras, computers, hand lenses, metric rulers, Celsius thermometers, wind vanes, rain gauges, pan balances, graduated cylinders, beakers, spring scales, hot plates, meter sticks, magnets, collecting nets, notebooks, and Sun, Earth, and Moon system models; timing devices; and materials to support observation of habitats of organisms such as terrariums and aquariums.