Lessons 6–7
Effect of Energy on Speed

Prepare

In previous lessons, students developed a description of energy and identified indicators of its presence. In Lesson 6, students make a prediction about the relationship between energy and speed. They then explore this relationship with a range of classroom objects. In Lesson 7, students design a fair test investigation to manipulate the energy input of a system and take quantitative measurements to observe the cause and effect relationship between energy and speed.

Student Learning

Knowledge Statement

The speed of an object is related to the energy of the object.

Objectives

- Lesson 6: Describe the relationship between energy and speed.
- Lesson 7: Interpret data showing that greater energy input enables greater speed.

Concept 2: Energy Transfer

Focus Question

How does energy transfer from place to place?

Phenomenon Question

What is the relationship between energy and speed?

Texas Essential Knowledge and Skills Addressed

5.2A **Describe, plan, and implement simple experimental investigations** testing one variable. (Addressed)

5.2B **Ask well defined questions**, formulate testable hypotheses, **and select and use appropriate equipment and technology**. (Addressed)

5.2C **Collect and record information using detailed observations and accurate measuring**. (Addressed)

5.2G **Construct** appropriate simple graphs, tables, maps, and **charts** using technology, including computers, **to organize, examine, and evaluate information**. (Addressed)

5.2D **Analyze and interpret information to construct reasonable explanations from direct (observable) and indirect (inferred) evidence**. (Addressed)

5.2F **Communicate valid conclusions** in both written and verbal forms. (Addressed)

5.3A **Analyze, evaluate, and critique scientific explanations by using evidence, logical reasoning, and experimental and observational testing**. (Addressed)

5.3B **Draw or develop a model that represents how something** that cannot be seen such as the Sun, Earth, and Moon system and formation of sedimentary rock **works** or looks. (Addressed)

5.4 **Collect, record, and analyze information using tools, including** calculators, microscopes, cameras, computers, hand lenses, metric rulers, Celsius thermometers, prisms, mirrors, balances, spring scales, 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. (Addressed)

5.6A **Explore the uses of energy**, including mechanical, light, thermal, electrical, and sound energy. (Addressed)

English Language Proficiency Standards Addressed

3B Expand and internalize initial English vocabulary by learning and using high-frequency English words necessary for identifying and describing people, places, and objects, by retelling simple stories and basic information represented or supported by pictures, and by learning and using routine language needed for classroom communication.

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.

5F Write using a variety of grade-appropriate sentence lengths, patterns, and connecting words to combine phrases, clauses, and sentences in increasingly accurate ways as more English is acquired.

Materials

		Lesson 6	Lesson 7
Student	Science Logbook (Lesson 6 Activity Guide)	●	
	Science Logbook (Lesson 7 Activity Guide)		●
	Speed Investigation (per group): textbook (at least 1" thick; the same type or size for each group), ruler, 1" ball bearing, stopwatch, tape, meter stick		●
Teacher	Speed Station (2 per class): pull back cars; Snap Circuits® Green kit windmill (assembled); soccer ball, kickball, or another object based on class suggestion	●	
Preparation	Ensure that all stopwatches work properly.		●

Lesson 6

Objective: Describe the relationship between energy and speed.

Agenda

Launch (10 minutes)

Learn (25 minutes)

- Investigate Energy (20 minutes)
- Draw Initial Conclusions (5 minutes)

Land (10 minutes)

Launch 10 minutes

Pose the following scenario to the class, and allow students to share and discuss their responses.

▶ **Cars usually move at a speed of 60 miles per hour on the highway, but race cars move at speeds up to 200 miles per hour. So a trip that would take 20 minutes in a regular car might take only 6 minutes in a race car. Do you think this statement is correct?**

- *That would only happen if the race car were on a track with no stoplights or traffic.*
- *The race car is moving a lot faster, so I think that's correct. The trip would take less time for the race car.*

Have students write the Phenomenon Question at the top of the Lesson 6 Activity Guide to frame the investigation for this lesson: **What is the relationship between energy and speed?** Review student understanding of energy from previous lessons.

▶ **What do we know so far about energy?**

- *Energy helps make things happen.*
- *Energy can look different and do different things. Sometimes it is movement, a light shining, or even music playing.*

Ask students to work with a partner to make a prediction about the relationship between speed and energy and write it on a sticky note or individual whiteboard to share with the class.

Differentiation

Students may benefit from a discussion of the word *relationship* in other contexts to help them apply it to energy and speed. Have students practice describing the relationships between other pairs of words, such as *predator* and *prey*, *parent* and *child*, or *temperature* and *weather* (3B).

Have students who struggle with written language draw a picture to illustrate the relationship between energy and speed.

Sample student responses:

- *If I throw something hard, it will fly really fast and go really far.*
- *The more energy I give something, the faster it will move.*
- *An object that moves quickly has more energy than an object that moves slowly.*

Use student responses to record a class prediction on the board. Keep this prediction posted to revisit later in the lesson, and ask students to record it in their Science Logbooks.

Sample class prediction:

When we give an object more energy, it will move faster.

▶ How do you know when an object has more energy or less energy?

- *When I'm running around really fast, my mom says I have too much energy. Is that the same?*
- *I think we have to do more of something to give more energy to an object. Like at the hand-crank flashlight Energy Station, I had to spin the crank really fast to make the light brighter. I felt like I was doing a lot of work.*

Ask students to think about ways they could test the class prediction with the materials available to the class. Encourage students to consider the materials they used in previous lessons as well as other materials available to them inside the classroom. As a class, brainstorm a list of possible objects to test and write the ideas on the board. Work with students to select three objects they can use to test the class prediction, and then develop a class investigation plan. Have students record the investigation plan and which objects they will test in their Science Logbooks.

Teacher Note

In this lesson, students should deepen their understanding of how the amount of energy put into a system affects the speed of components in the system. Students may respond that faster-moving objects possess more energy. While these responses are valid, highlight those that focus on greater energy causing an object to move with more speed. The reverse relationship is studied in more detail in later levels.

Spotlight on Knowledge and Skills

At this point in the module, students may think that energy is "given" to an object. In Lesson 8, students clarify this understanding as they investigate transfer of energy. Students learn that energy moves by moving objects or through sound, light, heat, and electric currents.

Teacher Note

As students share ideas of objects to test, keep quantity in mind. Depending on class size, at least two sets of materials for each test (e.g., two sets of pull back cars, two windmills, and two soccer balls) may be required.

Sample investigation table:

Investigation Plan *Use a small amount of energy or a lot of energy to make the objects move and see how fast they go.*		
Object 1 *Pull back car*	**Object 2** *Windmill*	**Object 3** *Soccer ball*
Prediction *When we put more energy into the pull back cars by pulling them back more, they will move faster.*	**Prediction** *When we put more energy into the windmill by blowing more, the windmill blades will spin faster.*	**Prediction** *When we put more energy into the soccer ball by kicking it harder, it will move faster.*
Observations	**Observations**	**Observations**

Learn 25 minutes

Investigate Energy 20 minutes

Set up stations to test the chosen objects, and then divide students into groups for the investigation. Explain the importance of each member having a turn to conduct each test. Students then work in their groups to test the class predictions and determine whether there is a relationship between energy and speed. Have students fill out the Observations columns in their Science Logbooks as they investigate at each station.

Teacher Note

Ensure that the number of stations are adequate for each group to visit each station once in 15 minutes.

For example, in a class with 30 students, divide students into six groups of five and set up two stations for each test (e.g., two pull back car stations, two windmill stations, two soccer ball stations). Allow students to spend about 5 minutes at each station.

Content Area Connection: English

As students record observations, reinforce the skill of taking notes to help recall relevant information. Students can write phrases or complete sentences and should use precise language to objectively describe their observations.

Sample investigation plan:

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Prediction *When we put more energy into the pull back cars by pulling them back more, they will move faster.*	**Prediction** *When we put more energy into the windmill by blowing more, the windmill blades will spin faster.*	**Prediction** *When we put more energy into the soccer ball by kicking it harder, it will move faster.*
Observations *When we pull the car back more, it goes faster (more speed). When we pull it back less, it moves slowly (less speed). When we pull the car back more, we are giving it more energy because we are using our muscles to pull it back.*	**Observations** *When we blow softly, the windmill blades spin slowly (less speed). When we blow harder, the windmill blades spin faster (more speed). When we blow more, we are giving the windmill blades more energy and working harder to make them spin faster.*	**Observations** *When we kick the ball hard, it goes faster (more speed). When we kick it softly, it rolls pretty slowly (less speed). When we kick the ball hard, we are giving it more energy because we are working harder to make it go.*

Draw Initial Conclusions 5 minutes

Ask students to work with their groups to write a response to the Phenomenon Question **What is the relationship between energy and speed?** in their Science Logbooks (Lesson 6 Activity Guide) by using their observations as evidence. Debrief students' initial conclusions as a class.

Sample student responses:

- *When something is given more energy, it moves faster. It took more of my energy to make the soccer ball move faster, but the harder I kicked it, the more energy I put in and the faster the ball moved.*

Teacher Note

Students may not use the term *speed* at this point in the lesson set. Instead, they may describe how fast or slowly something moves. In the next lesson, students study this term in more detail and learn that speed describes the distance an object travels over a specific time (5F).

Spotlight on Knowledge and Skills

The goal of this lesson is for students to describe the relationship between energy and speed. Students may suggest that energy of motion (kinetic energy) is a type of energy, so moving faster indicates more energy of motion. If necessary, facilitate a discussion to explore cause and effect. Note that, based on what students observed in the investigation, putting more energy into a system causes the objects in the system to move faster.

- *Our group found that the more energy we added to try to move an object, the faster the object seemed to move. At the pull back car station, when we put in more energy by pulling the cars back farther, they moved faster.*

Check for Understanding

Review students' responses to the Phenomenon Question to check for understanding of the connection between energy and speed.

Evidence

Look for evidence that all students

- explain that more energy put into a system results in greater speed of the object, and
- cite relevant evidence from observations.

Next Steps

If students do not draw a connection between energy input and speed, repeat the investigations in a small group or one-on-one. Ask students how they can make the objects move quickly or make them move slowly. Point out the relationship between how much energy they give to an object and how quickly it moves.

Land 10 minutes

Begin the Land by working with students to clarify where energy comes from.

▶ Where do you think the energy came from at the stations?

- *At each station, the energy came from us. We pulled the cars back, our breath made wind, and we kicked the soccer ball.*
- *The energy came from us because we used our energy to move the objects at each station.*

▶ If the energy comes from us, where do we get the energy?

- *The energy that we give the objects comes from our muscles.*
- *Our bodies get energy from the food we eat.*

Teacher Note

To avoid a common misconception about conservation of energy, it is important to discuss that the energy possessed by something is neither created nor destroyed (e.g., a windmill does not create energy or destroy it). If needed, expand on this idea by leading a discussion about energy in humans. The question can be asked as a follow-up to student responses or as a new question. To check for understanding that energy is neither created nor destroyed, listen for students to acknowledge that humans do not *make* their own energy; rather, they get energy from sources such as food (3B).

After students share, revisit the class prediction about the relationship between energy and speed.

- **Were your results what you expected? What evidence did you gather to evaluate our prediction?**
  - *Yes, the evidence we gathered agrees with our prediction because we saw the same result at every station. Giving an object more energy made it move faster.*

Explain that scientists must design fair tests and be very precise in testing a prediction and collecting data as evidence.

- **Why might the tests you conducted not be fair? Did each group test the objects in the same way?**
  - *Some groups rolled the ball while others kicked it hard. So, maybe it wasn't fair.*
  - *Some groups had the pull back cars travel across the classroom, and others had them travel just across the desk.*

Tell students that in the next lesson they will design a fair test investigation to further test the class prediction and answer the Phenomenon Question with more confidence.

Optional Homework

Challenge students to think about the connections among wind, speed, and windmills by deciding on a good location for a windmill in their area. Students may be aware of areas in their town that are particularly windy, which could be a good location for a windmill. Ask them to make a list of other factors they might need to consider.

Extension

While many factors influence the placement of windmills, students should be able to make a connection between areas with high wind speeds and the location of windmills. Students may also want to research the locations of windmills near them. Challenge them to think about why these locations were chosen.