THREE Ds OF SPEED

LESSON PLAN 3: AIRFLOW

TUNNEL TESTING

TIME REQUIRED: 1 hour, plus time for optional extension activity

MATERIALS: Assembled racecars from Lesson 1, small fan, straws, string, scissors, ruler, masking tape, pencil, and paper

ACTIVITY AND RESOURCE SHEETS: *Airflow Activity Sheet*

Download additional sheets as needed at scholastic.com/nascarspeed.

LEXILE SCORE: *1060L*

THINK

Central question:
What are drag and downforce?

Have students recall the two forces they learned about in Lessons 1 and 2: drag and downforce. Call on volunteers to describe these forces for the rest of the class. Review how each force affects a racecar's speed.

- **Drag**, or air resistance, is a force that occurs when air pushes against an object as it moves. Drag slows racecars down.
- **Downforce** is a downward force created when there is high-pressure air above an object and low-pressure air below it. Downforce helps racecars stay on the track.

READ

Central question:
How do engineers test the aerodynamics of racecars?

1. Hand out the *Airflow Activity Sheet*, which contains a reading passage about the use of wind tunnels to test drag and downforce. Read the introduction together as a class. Before students read the passage, discuss what it means to be an "active reader." Explain that reading is more than just following the words on a page. Active readers question, think, make connections, and form opinions about a text. That helps them better understand what they are reading.
2. On your whiteboard or chalkboard write the following questions. Tell students to record their answers to these questions on a separate sheet of paper as they read the passage.
   - What predictions can you make about the story before you begin reading?
   - What questions come to mind as you read?
   - What do you picture in your mind as you read?
   - Does the text make you think about anything you've already learned?
   - Are there any words in the text that you don't know?
3. Instruct students to answer the questions on the sheet to assess their reading comprehension. (*Answers: 1. Something that is not moving. 2. A wind tunnel is a large, narrow room with powerful fans at one end. They blow air over an object, such as a racecar, placed inside the tunnel. 3. Engineers use wind tunnels to study racecars' aerodynamics and improve their performance. 4. NASCAR designers use wind tunnels to learn about different forces and pressures on a car. 5. They might alter the car's body to give it a more aerodynamic shape. Or engineers might change the angle of a car's spoiler to increase downforce.*)
4. After completing the activity sheet, show students a video of a real wind tunnel used to test NASCAR racecars: **accelerationnation.com/fun-and-games/video/three-ds-of-speed/air-tunneling.html**. Prompt students to compare how information is presented visually in the video versus the reading passage. Does the video help them better understand what they just read?

TEAM UP

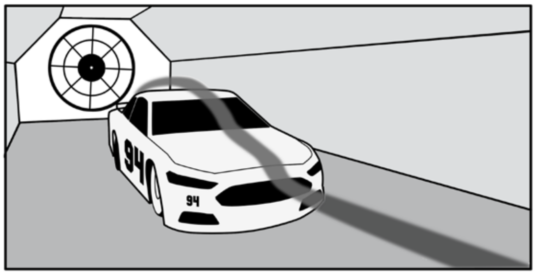
Central question:
How can engineers view airflow in a wind tunnel?

PIT CREW CHALLENGE (OPTIONAL)

1. Explain that streamers are another way engineers determine how air flows around objects in a wind tunnel. Provide pit crews with a straw and a four-inch piece of string. Have groups tape one end of the string to one end of the straw to create their own streamers.
2. Set up a fan on a table and mark a distance two feet away with a piece of masking tape. Have a pit crew place the car the team built in Lesson 1 on the piece of tape facing the fan. Turn the fan to a medium setting and make sure it is positioned so air is blowing at the car. Tell a crew member to hold the straw and place the end of his or her streamer on different points of the car, such as the front, sides, back, and top. The direction in which the string moves shows the direction that air is moving over the car's surface. If the string is straight, the airflow is steady—a sign of an aerodynamic design. The opposite is true if the string whips around wildly.
3. Instruct pit crews to draw a simple sketch of their car and label it with arrows to show which way air is flowing in different spots. Also have them label where the airflow is smooth and where it is turbulent.

NAME

TUNNEL TESTING



A NASCAR racecar goes through extensive testing before it ever hits the track.

Engineers want to know how forces such as drag and downforce will affect a racecar's performance. Read the passage below to find out how engineers study racecar aerodynamics using a **wind tunnel**. Then answer the questions on the right in complete sentences.

ENGINEERING WIND

Engineers study racecars' aerodynamics to improve racecars' speed and safety, but that's not an easy thing to do while a racecar is hurtling more than 200 miles per hour around a track. Engineers need the car to stay put while they gather information on how air flows around it. To do that, engineers place a stationary racecar inside a wind tunnel.

A wind tunnel is a large, narrow room with powerful fans at one end. NASCAR engineers release smoke into the tunnel while the fans blow air over the racecar to make the air movements around the vehicle visible. High-tech sensors collect data about the forces the racecar experiences in the tunnel.

Wind-tunnel tests help engineers identify important changes to build better racecars. They might alter the car's body to give it a more aerodynamic shape, which can reduce drag and boost a car's speed. Or engineers might change the angle of a car's spoiler to increase downforce, which would help a car grip the track better. Both changes would improve the airflow around the racecar and allow it to go faster.

1. Context clues are hints in sentences near an unknown word that can help you define it. Use context clues to define the word *stationary*.

2. In your own words, explain how a wind tunnel works.

3. What is the main idea of this passage?

4. Give one key detail in the second paragraph that supports the passage's main idea.

5. Explain how engineers use the data they collect in a wind tunnel to improve a racecar's design.

ENERGY AND NASCAR

LESSON PLAN 3: ENERGY AND SPEED

UNDER THE HOOD

TIME REQUIRED: 1 hour, plus time for optional extension activity

MATERIALS: Completed racecars from the **Three Ds of Speed** unit, straws, balloons, rubber bands, tape, scissors, index cards

ACTIVITY AND RESOURCE SHEETS: *Energy and Speed Activity Sheet*

Download additional sheets as needed at scholastic.com/nascarspeed.

LEXILE SCORE: *1050L*

THINK

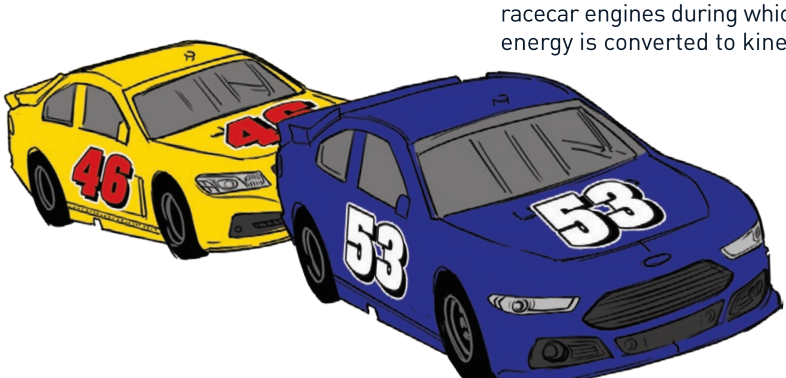
Central question:
How are potential and kinetic energy connected?

1. Read the following description to your class: "My hands tightly grip the steering wheel. My ears are filled with the loud roar from the engine. I feel my body pushed back into my seat. A crowd of people whips past my window." Ask students if they can guess which activity you are describing. (*Driving a racecar.*)
2. Show students a picture of a roller coaster. Ask them to explain what's going on in the image. What clues let them know what's taking place? Have them recall the idea of **potential energy** (stored energy) and **kinetic energy** (energy of motion). Ask them how these concepts relate to what's going on in the picture. (*A roller coaster gains potential energy as it reaches the peak of each track. It's converted to kinetic energy as the roller coaster plunges downward.*)
3. Explain that in these two activities, students practiced making inferences. They used prior knowledge, evidence, and reasoning to make connections and draw conclusions.

READ

Central question:
Why are speed limits important for NASCAR safety?

1. State that making inferences is an important skill to have when reading texts. It helps students "read between the lines" and identify ideas that are not directly stated.
2. Hand out the *Energy and Speed Activity Sheet*, where students will read a passage about NASCAR's safety measures to reduce high-speed crashes. After reading the passage, have them answer the reading comprehension questions on the sheet, which require them to make inferences about the text. They'll also be asked to explain how they came to their conclusions. (*Answers: 1. Fuel. 2. The flow of fuel into the car's engine is reduced. 3. No one has been able to beat Bill Elliott's record speed since restrictor plates were introduced. 4. A high-speed crash in 1987. 5. To ensure that no team has an unfair advantage over another and to make sure the teams do not tamper with the plates to go faster.*)
3. Prompt students to discuss in pairs their responses to the activity sheet's questions. Ask students to share real-world examples other than racecar engines during which potential energy is converted to kinetic energy.



TEAM UP

Central question:
How does limiting potential energy reduce kinetic energy?

PIT CREW CHALLENGE (OPTIONAL)

1. In previous lessons and in the reading passage, students learned that the fuel in a racecar's gas tank holds chemical potential energy. When the fuel burns, it undergoes a chemical reaction that unleashes energy to power the car's engine and propel the vehicle forward.
2. Pass out a straw, balloon, and rubber band to each pit crew. Instruct teams to insert the straw into the mouth of the balloon and wrap a rubber band around the balloon's neck so it makes an airtight seal. Tell pit crews to tape the straw lengthwise to the top of their completed cars from the *Three Ds of Speed* unit. The balloon end of the straw should point toward the front of each car.
3. Place a piece of tape on the floor to act as a starting line. Have students blow into the open end of their straws to inflate their balloons until they measure four inches wide, and then pinch the end of the straw so the air can't escape. Have pit crews place their cars on the line and, on your signal, release the ends of the straws. Discuss what happened as a class. How did the balloon-powered racecars convert potential energy into kinetic energy?
4. Have each crew cut a hole one-eighth of an inch wide in the center of an index card. Fit the neck of the balloon through the hole, then reattach the balloon to the straw and retape it to the car. Have students inflate their balloons to four inches and race their cars again. How did the index card act like a NASCAR restrictor plate? How did it affect how far each car rolled?

NAME

UNDER THE HOOD

NASCAR racecars are superfast—but there's a limiting factor to their speed. For safety reasons, NASCAR officials have reduced just how fast racecars can go. Read the passage below to find out how this happened. Then answer the associated questions.

SPEED LIMIT

In 1987, Bill Elliott set the NASCAR speed record. His racecar reached 212 miles per hour while qualifying for the Winston 500 at the Talladega Superspeedway in Alabama. Why has no other racer topped this feat since?

BILL ELLIOTT

During the actual 1987 Winston 500, the car of another driver named Bobby Allison went airborne and crashed into a fence at 210 mph. After that, NASCAR put safety measures in place to prevent similar high-speed crashes.

In 1988, NASCAR began to require the use of restrictor plates on all racecars during superspeedway races. A restrictor plate is a square piece of aluminum with four holes drilled into it. Each hole is about the size of a quarter. The plate reduces the flow of air and fuel into a car's engine. With less fuel to burn, the cars go slower.

All teams must have identical restrictor plates at the start of a race. NASCAR distributes them before the race and collects them when it is over. Some people believe that without restrictor plates, NASCAR racers could go more than 220 mph. In fact, one car tested at Talladega without a restrictor plate reached a speed of 228 mph, exceeding Bill Elliott's record by 16 mph.

For each question, provide an answer and an explanation of how you arrived at your response.

1. What is the source of potential energy in a racecar's engine?

2. What happens to the source of potential energy when a restrictor plate is added to the racecar?

3. How can you infer that restrictor plates work to slow racecars?

4. What prompted NASCAR to use restrictor plates at superspeedways?

5. Why do NASCAR officials give all teams identical restrictor plates at the start of a race and collect them at the end?