Sponsored Educational Materials

SCHOLASTIC

HIGH-SPEED TECH

Engineering, Math, and Science Make a Car Go!

Grades 3–5

Get your students revved up to explore the science, math, engineering, and history behind racecars, inspired by Disney•Pixar's *CARS 3* and created by Scholastic. Students will investigate the topics of ***ENGINEERING, DESIGN, FRICTION,*** and ***SPEED*** with the help of world champion racer Lightning McQueen. Then they will shift gears to research and learn about four prominent figures in the ***HISTORY*** of racing.

Disney • PIXAR Cars 3

JUNE 16
IN 3D AND REAL D 3D

With support from NASCAR

NASCAR

Classroom Poster and Teaching Guide

Created by Scholastic, these hands-on lessons are easy-to-implement and support science standards for grades 3–5.

MORE ONLINE: Visit **scholastic.com/highspeedtech** for additional activities for grades 5–6.

Disney.com/Cars

 Note: Each lesson requires one class period.

LESSON 1:
NEXT GEN RACERS

Goal: In this lesson, students will learn firsthand about auto parts and the engineering process through designing and building their own model racecars. They'll hypothesize and test ways to make their racecars light, sturdy, and aerodynamic.

Materials: Student Worksheet A: Next Gen Racers, materials for building racecars (cardboard, straws, bottle caps, pipe cleaners, scissors, tape, glue, etc.), textbooks, 3-foot-long piece of cardboard, tape, and stopwatch.

Before you begin: Set up a test track on a flat, uncarpeted surface. Stack up several books so they measure about 1-foot high. Tape one end of a 3-foot-long piece of cardboard to the top of the stack and the other end to the floor. Use a piece of tape to mark the "finish line" 3 feet from the end of the cardboard ramp.

1. Divide students into groups. Hand out the Student Worksheet A: Next Gen Racers to each student. In this activity students will be taking on the role of engineers—people trained in design and construction who use science and math to solve problems. Students will have to work together to find ways to make a speedy racer, like Lightning McQueen.

2. Read the worksheet's introduction and directions. Explain that, like an engineer, students will need to follow a process to solve the problem presented. Review the **Ask**, **Research**, **Imagine**, **Plan**, **Create**, **Experiment**, and **Improve** steps together (provided in the worksheet).

3. Introduce parts of a car: Autoshop 101. Have students brainstorm some of the features that might affect how fast a racecar goes. Some examples include the car's weight, the size of its wheels, and its overall shape. Review NASCAR's Resource Sheet (scholastic.com/nascarspeed/pdfs/ThreeDsResourceA.pdf) on the various parts of a racecar and how each part contributes to its speedy design.

4. Provide students with materials to create their own model racecar. Then have them complete the steps on the worksheet to **Ask**, **Research**, **Imagine**, **Plan**, **Create**, **Experiment**, and **Improve** their racecars.

5. Guide groups to take turns testing their racecars by releasing them from the top of the ramp you set up and timing how long the cars take to cross the finish line. Tell students to record their results on the worksheet. (Note: Save students' racecars, as well as the racetrack. They'll be used again in later activities.)

GRADE 6 EXTENSION

Explain to students that, in addition to engineering improvements that make cars faster, new technology can also make cars friendlier to the environment. Split up students into groups to research new environmental technologies for cars using key terms such as *green technology* and *cleaner fuel options*. Ask students to draw a design of their car based on their research.

LESSON 2:
GRAPHING VICTORY

Goal: Students will calculate speed and display their data visually using a line graph.

Materials: Student Worksheet B: Graphing Victory, interactive whiteboard or computer and projector; Grade 6 Extension: cardboard track and racecars from Activity 1, textbooks, ruler, stopwatch or watch with a minute hand, pencil, and paper.

Before you begin: For the Grade 6 Extension, set up the racetrack from Activity 1.

1. Show students the trailer for Disney • Pixar's *CARS 3* **(scholastic.com/highspeedtech).** Discuss as a class.

2. Hand out Student Worksheet B: Graphing Victory. Read the introduction out loud. Ask: How could Lightning McQueen's trainer track whether his speed is improving?

3. What is speed? How would you determine speed? What is the formula for finding speed? Explain that speed is the distance an object travels over a given time. Review the formula to find speed given in Step 1 of the worksheet with your class. Then have students complete this section of the worksheet in pairs.

4. Explain that a line graph is used to show how something changes over time. It's one way to compare how something, like Lightning McQueen's speed, changes over time. Draw a table for a line graph on the board and instruct students to copy the graph on a sheet of paper. State that a line graph has an *x*-axis running horizontally. The *x*-axis shows the numbers for a time period. A line graph also has a *y*-axis running vertically. Explain that they should label the graph's *y*-axis as "speed." Each speed value for a given time period should be marked as a dot on the graph.

5. Have students add points to the graph for the rest of the speed values they calculated. Then explain how they should connect the points to show how the values compare to one another over time. Point out that their graph needs a title that explains what is shown on the graph's *y*-axis versus its *x*-axis. For example, "Distance Over Time." When done graphing, have students answer the questions that follow. Remind students that there are other ways to display data, such as bar graphs and pie charts. Explore how to decide which is the best format for your data.

GRADE 6 EXTENSION

1. Divide students into the same groups as in Activity 1. Explain that they will again use the racetrack and measure the speed of their model racecars. But this time they will change one **variable**, or factor—the height of the racetrack's starting ramp.

2. Have students measure and record the starting height of the ramp and the distance from the base of the ramp to the finish line. Then have them release their cars and time how long it takes for them to cross the finish line.

3. Add a book to raise up the starting height of the track. Have students measure the new height and time their cars again. Repeat this step with one more textbook added.

4. Have students use the track length and race times to calculate the speed of their racecars. Then have students use the speed data to create a graph that best represents their data. Discuss how the ramp's height affected their racecars' speeds.

LESSON 3:
FRICTION FIGHTERS

Friction can work against racecar drivers by slowing them down. But it also helps racecars' tires better grip the track to avoid accidents like Lightning McQueen's.

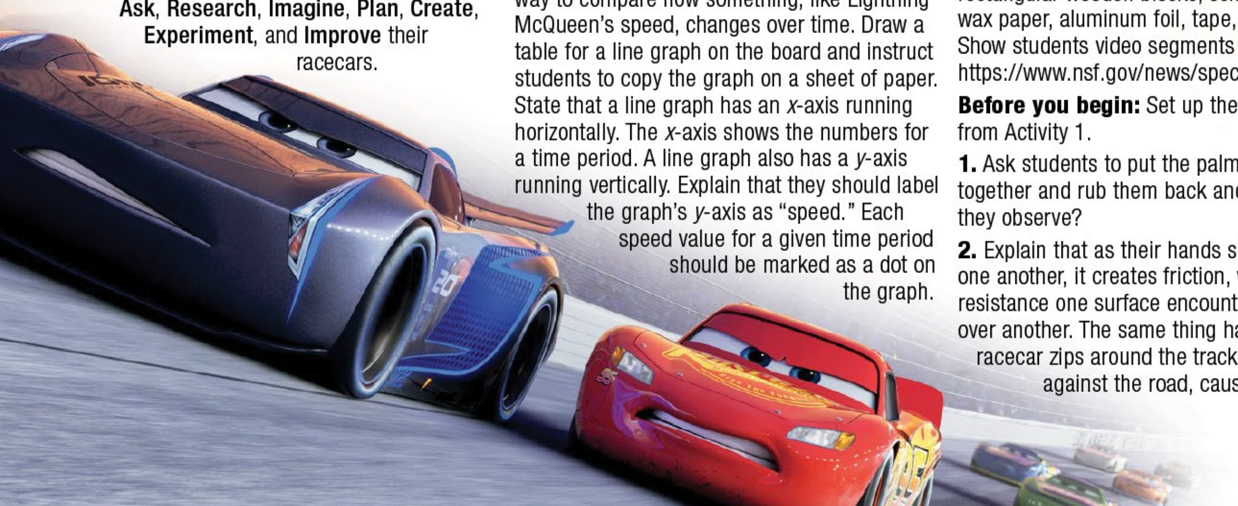
Goal: In this lesson, students will conduct an experiment to see how friction can slow down racecars.

Materials: Student Worksheet C: Friction Fighters, cardboard track from Activity 1, rectangular wooden blocks, scissors, sandpaper, wax paper, aluminum foil, tape, and stopwatch. Show students video segments from: https://www.nsf.gov/news/special_reports/sos.

Before you begin: Set up the racetrack from Activity 1.

1. Ask students to put the palms of their hands together and rub them back and forth. What do they observe?

2. Explain that as their hands slide against one another, it creates friction, which is the resistance one surface encounters when moving over another. The same thing happens when a racecar zips around the track. The tires rub against the road, causing friction.



ACTIVITY INSTRUCTIONS

Note: Each lesson requires one class period.

Some friction is needed to push a car forward but too much can slow a car down.

3. Divide your class into groups and hand out **Student Worksheet C: Friction Fighters** to each student. Review the introduction and directions. Explain that some surfaces are rougher or smoother than others. This can affect how much friction an object rubbing against the surface feels.

4. Ask: How might a road's surface affect how fast a racecar goes? Have students complete the worksheet to find out. (For Step 3, you will need to line the track with each new material—wax paper, sandpaper, and foil—and tape them securely in place.)

5. Discuss the results of the experiment and the groups' worksheet responses as a class. Pose a follow-up critical-thinking question to your class: Since less friction makes a car go faster, why might driving on a road that creates too little friction with a car's wheels be dangerous during a high-speed race? How does rain affect the road?

GRADE 6 EXTENSION

What do you know about car tires? What functions do tires serve on a car? (Examples: Tires connect the car to the road, increase friction, provide more traction or grip, etc.) What might make a tire on a racecar different from a tire on a commercial car?

Have students research the different kinds of tires. What is the difference between a tire used for off-roading, street driving, and racing? What is a "slick" tire? Create a tire comparison chart. What are the pros and cons of each type of tire? How do technology and innovation play into tire development? What are the latest advancements?

Have students consider what they've learned about friction and tires to answer the following writing prompt: How might slick tires improve a racecar driver's performance on the track? What tire advancements do you think would be helpful for drivers?

LESSON 4: POWERFUL PERSONALITIES

Goal: Students will be able to define and differentiate between a fact and an opinion. They will analyze resources and conclude why someone becomes a historic figure. Introduce students to some of the legendary personalities in racing and research how history has depicted them.

Materials: **Student Worksheet D: Powerful Personalities**, access to a computer, an assortment of newspapers, magazines, and journals.

1. Brainstorm with students the difference between a fact and an opinion. Explain that a **fact** is a statement that *can* be proven true, while an **opinion** is a belief or judgment or personal viewpoint that *cannot* be proven true.

2. Engage students in a class discussion. What does it mean to be a historic figure? (Someone important in history whose words, actions, or discoveries had a significant and lasting impact on society.) Encourage students to consider what a person would need to accomplish in order to become a historic figure. Where might you find information about historic figures? How can you differentiate between facts and opinions about that person?

3. Ask students to identify people whom they would consider historic figures. Why are they historic? (Some examples: Abraham Lincoln, Martin Luther King Jr., Mahatma Gandhi, Maya Angelou, Marie Curie, Billie Holiday, Malala Yousafzai, etc.)

4. Remind students that much of what we know about engineering, including engineering safe and speedy racecars, is due to historic people who experimented and pushed boundaries. Hand out **Student Worksheet D: Powerful Personalities**.

GRADE 6 EXTENSION

Engage students in a class discussion about the differences between a historic figure and someone who is famous. (Create a Venn diagram with the students to identify what historic figures and famous people have in common and where they differ.) Who do they consider to be famous and who do they consider to be historic? Share with students that someone who is historic has had a great and lasting impact on society, while someone who is famous is known by many people. What does it mean for someone to be infamous? How might you report differently on someone who has done something historic versus someone who is known by a lot of people? Is it possible for society to overlook someone who should be recognized for their accomplishments? If so, why and how might you research and report on that person? Instruct students to choose one of the four people from the worksheet to research or find another historic figure in the racecar world to report on. Students will then write a fact-based article on the contributions that person made to the racing world.

Find more great STEM activities and learn more about why Wendell Scott is a racing legend at wendellscott.org.

STANDARDS CHART Grades 3-6

Skills supporting key state and national standards for science and engineering and English language arts.

NGSS****	A) Next-Gen Racers	B) Graphing Victory	C) Friction Fighters	D) Powerful Personalities
Engineering Design				
Define a simple design problem	3-5-ETS-1		3-5-ETS1.1	
Generate and compare multiple possible solutions	3-5-ETS-2	3-5ETS1-2	3-5-ETS1.2	
Plan and carry out fair tests	3-5-ETS-3		3-5-ETS1.3	
Define and delimit engineering problems	ETS1.A			
Develop possible solutions	ETS1.B			
Optimize the design solutions	ETS1.C		ETS1.C	
Evaluate competing design solutions	MS-ETS1-2			
Crosscut concepts	MS-ETS1-1			3-5-ETS-1 & 2
Analyze data from test	MS-ETS1-3	MS-ETS1-3	MS-ETS1-3	
Energy				
Use evidence to construct an explanation		4-PS3-1 (Gr. 4)		
Make observations to provide evidence		4-PS3-2 (Gr. 4)	4-PS3-2	
Ask questions and predict outcomes		4-PS3-3 (Gr. 4)		
Apply scientific ideas to design, test, and refine		4-PS3-4 (Gr. 4)		
Construct and interpret graphical displays		MS-PS3-1		
Plan and investigate			MS-PS3-4	
Motion and Stability: Forces and Interactions				
Plan and conduct investigations			3-PS2-1	
Crosscut – Cause & Effect				

Common Core Language Arts	A) Next-Gen Racers	B) Graphing Victory	C) Friction Fighters	D) Powerful Personalities
Reading Standards for Informational Text				
Key ideas and details	RI1, RI2 (Gr. 3-5) RI1, RI2, RI3 (Gr. 6)		RI1, RI2, RI3 (Gr. 6)	RI1, RI2, RI3 (Gr. 3-5) RI1, RI2, RI3 (Gr. 6)
Craft & structure				RI5 & R16 (Gr. 3-5)
Integration of knowledge and ideas	RI7 (Gr. 3-5) RI7 (Gr. 6)		RI7, RI8, RI9 (Gr. 6)	RI7, RI8, RI9 (Gr. 3-5) RI7, RI8, RI9 (Gr. 6)
Speaking and Listening				
Comprehension and collaborations			SL1&3 (Gr. 3-5)	
Presentation of knowledge and ideas			SL4 (Gr. 3-5)	
Writing Standards				
Text types and purpose				W2 (Gr. 3-5), W2 (Gr. 6)
Production and distribution of writing			W4 & W6 (Gr. 6)	W6 (Gr. 3-5), W4 (Gr. 6)
Research to build present knowledge			W7 & W8 (Gr. 6)	W7 & W9 (Gr. 6)
Common Core Mathematics				
Measurement and Data	3.MD.A.1 (Gr. 3)			
Solve problems involving measurement and estimation				
Represent and interpret data		3.MD.3, 4.MD.4, 5.MD.2		
Use the four operations				
Write and interpret expressions				
Expressions and Equations				
Algebraic expressions		6.EE.2c		
Operations and Algebraic Thinking				
Represent and solve problems		3.OA.1		
Use the four operations		4.OA.2		
Write and interpret expressions		5.OA.1&2		

Common Core State Standards and skills taken from Common Core State Standards Initiative, www.corestandards.org Next Generation Science Standards and skills taken from nextgenscience.org.

NEXT GEN RACERS

STUDENT WORKSHEET A

Name: ______________________________

Lightning McQueen has long been a champion racer. But now he's up against new, high-tech competition. JACKSON STORM has been specially engineered for speed. See what it takes to design winning racers like Lightning McQueen and Jackson Storm.

DIRECTIONS: Follow the steps below to design, build, and improve your own model racecar.

1. **RESEARCH:** What do the fastest racecars have in common?
2. **IMAGINE:** Draw some ideas for your racecar design. Its body should be 6 inches long and 4 inches wide. Think about what materials you will need to build it.

3. **CREATE A MODEL:** Choose your group's best design and build it.
4. **EXPERIMENT:** Release your finished racecar from the top of the racetrack's ramp. Record how long it takes to cross the finish line. ______________________________
5. **ANALYZE YOUR RESULTS:** Which group's racecar was the fastest? ______________________________

   Why do you think that was? ______________________________

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6. **IMPROVE YOUR DESIGN:** How could you change your racecar's design to make it faster?

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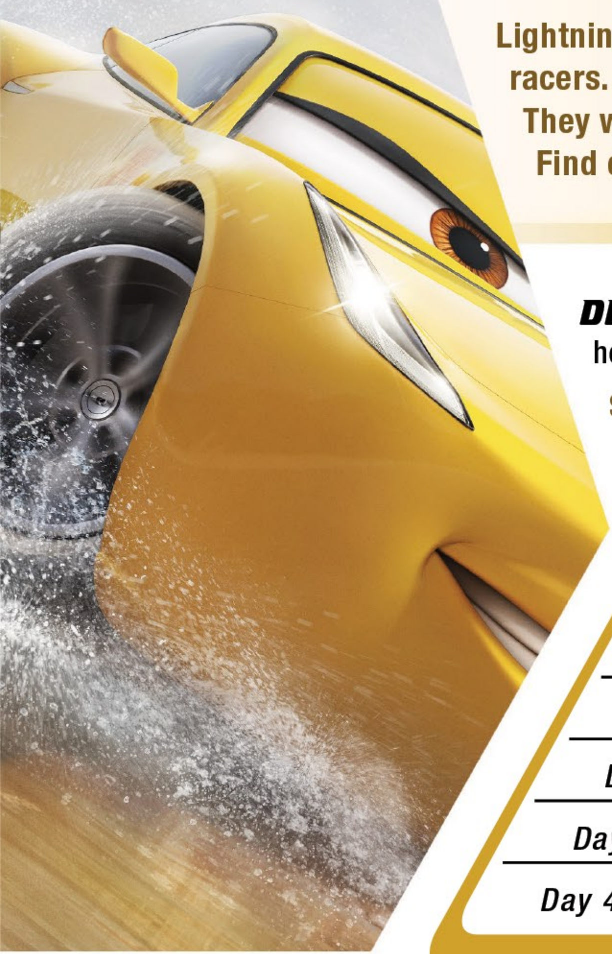
GRAPHING VICTORY

STUDENT WORKSHEET B

Name: ______________________________



Lightning McQueen has trouble keeping up with newer and faster racers. After a crash, he teams up with trainer CRUZ RAMIREZ. They work together to get Lightning McQueen back up to speed. Find out if the training paid off.

DIRECTIONS: Find Lightning McQueen's speed for each day he trains. Then graph Lightning McQueen's speed over time.

STEP 1: FIND THE SPEED

Use the formula below: **Speed = Distance Driven ÷ Time**. Write your answers in the table.

LIGHTNING MCQUEEN'S TRAINING RECORD

TRAINING DAY	DISTANCE DRIVEN	RACE TIME	SPEED (mph)
Day 1	100 miles	1 hour	
Day 2	500 miles	4 hours	
Day 3	300 miles	2 hours	
Day 4	400 miles	2 hours	

STEP 2: MAKE A GRAPH

Use the speeds you found for each day of Lightning McQueen's training to create your own graph. Should you create a line graph or a bar graph? Explain why your choice is the best format for the data:

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STEP 3: DRAW CONCLUSIONS

1. What was Lightning McQueen's fastest training speed? ______________________________

2. Did Lightning McQueen's speed improve over time? ______________________________

FRICTION FIGHTERS

STUDENT WORKSHEET C

Name: ______________________________

Lightning McQueen is one of the fastest racers around. Racers like him can reach speeds of more than 200 miles per hour! But there's a force working against him. It's called FRICTION. It can slow down even the fastest racers.

DIRECTIONS: Complete the experiment below.

WHAT WILL HAPPEN? Over which surface will a wooden block travel faster: cardboard, sandpaper, wax paper, or aluminum foil?

WHAT TO DO:

1. Your teacher has set up a cardboard racetrack. The wooden block will be your "car." Set it at the top of the racetrack's ramp. Release the block so it slides down the track.

2. Time how long it takes for your car to reach the end of the ramp on each surface. Record your results on the chart.

SURFACE	*TIME*
Cardboard	
Wax Paper	
Sandpaper	
Foil	

WHAT'S YOUR CONCLUSION?

1. On which surface did your car go the fastest? ______________________________

2. Which surface caused the most friction? ______________________________

3. Why do you think some amount of friction would be useful to racecar drivers?

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4. Was your "What Will Happen?" prediction for the experiment correct? How will this affect your thinking when making future predictions? ______________________________

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Name: ______________________________

Powerful PERSONALITIES

STUDENT WORKSHEET D

DIRECTIONS: Now that you've learned about some of the science, mathematics, and engineering of racecar driving, research one of the four racing legends below who contributed to the sport as we know it. Write a short, informational, fact-based essay on what you've learned about that person.

Louise Smith	***Wendell Scott***
Junior Johnson	***Smokey Yunick***

QUESTIONS TO CONSIDER WHEN RESEARCHING:

- **Why do you think this article was published?**
- **Does this article or book address: Who? What? Where? When? Why? How?**
- **Are the main points of the story based on facts or opinions? How can you determine if they are fact?**
- **Are there multiple sources being referenced, and are they reliable?**

PARAGRAPH ONE: Who did you choose to research, and what is he or she most well-known for?

PARAGRAPH TWO: Using one to two sources, briefly describe what he or she had to overcome to achieve his or her accomplishments.

PARAGRAPH THREE: Using one to two additional sources, describe and give examples of what his or her accomplishments are and how he or she has changed the world of racecar driving.

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A CRASH COURSE IN COLLISIONS

FAMILY ACTIVITY

Your child has been learning about energy, force, and motion with the help of Lightning McQueen—the world champion racer of Disney • Pixar's *CARS 3*. Continue exploring the science behind racecars together with this fun activity.

You'll Need: Several books, 3-foot-long piece of cardboard, tape, small ball, a variety of small toys or household objects the ball can crash into, ruler, pen or pencil.

Set It Up: In Disney • Pixar's *CARS 3*, Lightning McQueen experiences a crash. If one car bumps another during a high-speed race, its energy is transferred to the other car. That can send one or both cars spinning out of control. Follow the steps below to see the science of what happens when objects collide.

1. In an open, preferably uncarpeted area, stack several books to 1 foot high. Tape one end of the piece of cardboard to the top of the stack and the other end to the floor. This is your racetrack.
2. Use the table below to set up different crash scenarios with toys or household objects.
3. Release the "car" ball from the top of the ramp. Have your child write down what happened when the car struck the objects. Fill in the table below and discuss.

TYPE OF CRASH	OBSERVATIONS	MEASUREMENTS
1 object at the base of the ramp		
1 object placed 1 foot from the base of the ramp		
2 objects in a row at the base of the ramp		
1 object at the base of the ramp whose height has been raised a few more inches		

POTENTIAL ENERGY
HIDDEN ENERGY

TIME REQUIRED: 1 hour
MATERIALS: Small marble, large marble, Ping-Pong ball, golf ball, large pan, flour, yardstick
ACTIVITY AND RESOURCE SHEET: Potential Energy Activity Sheet

THINK

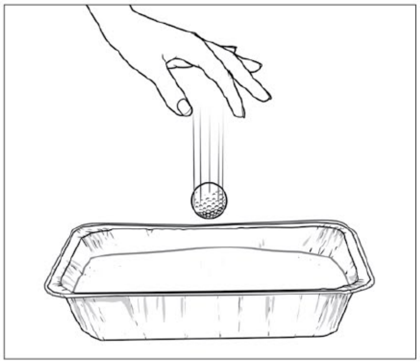
Central question:
What is potential energy?

1. Introduce the concept of potential energy—energy that is stored due to an object's position or condition. Explain that the word "potential" means having the ability to do something. Therefore, potential energy is energy that has not yet been used.
2. To illustrate the concept of potential energy, ask students to imagine a racecar sitting on the top of a steep banking. (See the Build section of Lesson 2: Kinetic Energy for a description of racetrack bankings.) Tell students that in this position the car is loaded with a specific type of potential energy, called gravitational potential energy. Explain that when an object, like a racecar, is far above the ground, a force called gravity pulls it downward toward Earth's surface.

MOVE

Central question:
What affects the amount of potential energy an object has?

1. Explain that the potential energy of an object is measured by its ability to exert a specific amount of force for a particular distance. There are three factors that determine how much gravitational potential energy an object has: gravity, height, and mass. Gravity is constant, but differences in an object's mass and height can increase or decrease the amount of potential energy the object has.
2. To demonstrate, set a small marble on the floor of your classroom. Ask students if the marble has potential energy in its current state. (No, because there's no distance for gravity to pull it toward Earth.) Raise the marble about one foot in the air. Ask whether the ball now has any potential energy. (Yes.)



3. Drop the marble into a large pan filled with a few inches of flour. Gently remove it from the pan, and have a volunteer measure the width of the impact crater left in the flour. Climb on a chair and drop the marble from a height of about seven feet. Measure the new impact crater. Repeat the experiment with the large marble, the Ping-Pong ball, and the golf ball. Have students take notes throughout the experiment. After the demonstration is complete, ask them to draw conclusions about how mass and height impact the amount of potential energy an object has.

BUILD

Central question:
What types of potential energy exist?

1. Hand out Potential Energy Activity Sheet A. Tell students that gravitational potential energy is just one type of potential energy. Have them complete the activity to learn about three other forms.
2. Now that students understand potential energy's different forms, have them imagine a racecar sitting in position on the starting grid before the start of a race. Ask: What forms of potential energy might the car have before it starts moving?
3. Explain that cars use electric potential energy to operate. When a driver starts the car, the battery releases a jolt of electricity to power parts inside the car. The fuel in the car'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 around the track. Batteries are unique because they hold energy in chemical form, but they release electric energy!
4. Describe how a racecar also has a suspension system between its wheels and its base. This system contains flexible springs that store elastic potential energy. This type of energy—also called mechanical energy—is energy stored in an object due to its tension. When the car hits a bump in the road, the springs absorb the impact by compressing. Then they stretch to release the stored energy, pushing the tire back against the road. This helps prevent the car's wheels from losing their grip on the track.

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NAME

POTENTIAL ALL AROUND US

DIRECTIONS: Read about four types of potential energy in the chart below. Then write down as many examples of each that you can think of. One is already done for you.

GRAVITATIONAL: energy stored in an object due to its height.

UNITS OF MEASURE: joules

Examples: a racecar coming off a bank,

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CHEMICAL: energy stored in chemicals.

UNITS OF MEASURE: calories (food), joules, horsepower-hours (vehicles)

Examples: burning fuel inside a racecar's engine, ______________________________

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ELASTIC: energy stored in an object that can be stretched or squeezed.

UNITS OF MEASURE: joules

Examples: the springs that make up a racecar's suspension system,

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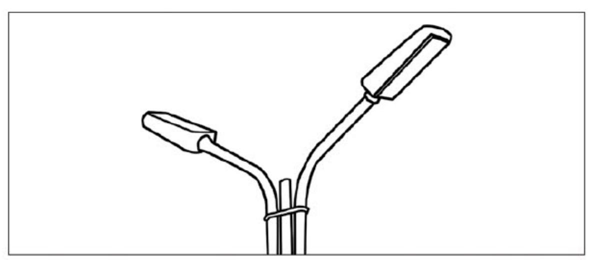
ELECTRIC: energy stored as electricity.



UNITS OF MEASURE: volts

Examples: the wires in a lamppost,

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KINETIC ENERGY
ENERGY IN MOTION

TIME REQUIRED: 1 hour
MATERIALS: String, heavy and light objects (such as a pencil and a pack of index cards), paper cup, masking tape, ruler, textbooks, cardboard
ACTIVITY SHEET: Kinetic Energy Activity Sheet

THINK

Central question:
What is kinetic energy?

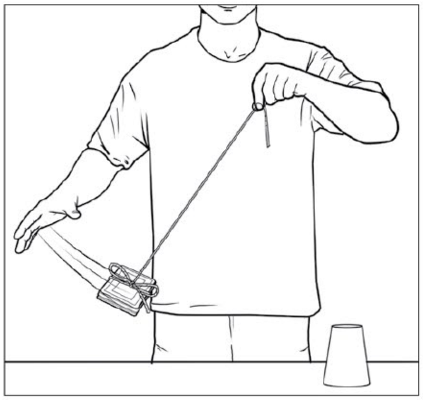
Have students consider what happens to potential energy when it's released from its stored state. Explain that energy can't be created or destroyed, but it does change from one form to another. Potential energy is often converted into another type of energy called kinetic energy. Kinetic energy is the energy of motion. Kinetic energy can also transform back into potential energy. For example, you'd use kinetic energy to lift a ball to the top of a ramp. That energy would be stored in the ball as potential energy.

MOVE

Central question:
What factors affect kinetic energy?

1. Explain that there are two factors that affect how much kinetic energy a moving object will have: mass and speed. Have students complete this demonstration to learn how mass influences an object's kinetic energy.

2. Select a light object (such as a pencil) and a heavy object (such as a pack of index cards). Tie a string around each object, leaving a three-foot-long piece attached. Have a student volunteer hold the light object in his or her right hand three feet above the ground. He or she should hold the other end of the string in his or her left hand so it is stretched horizontally. Have another student place a paper cup on the floor just under the first student's left hand, and mark the spot on the floor with a piece of masking tape. Tell the first student to let go of the object so it swings and collides with the paper cup (this may take a few tries to hit the cup). Have your other volunteer measure the distance the paper cup



moved after the swinging object struck it.

3. Repeat the process with the heavier object. Students will observe that the heavier object made more of an impact than the lighter one, moving the cup farther away. This is because the heavier object had a greater kinetic energy.

BUILD

Central question:
How can potential energy become kinetic energy?

1. Reveal that racecars don't just go forward and side to side as they pass each other on the racetrack, they also go up! Racetracks aren't completely flat. On turns, the tracks are actually tilted. The highest racetrack banking is tilted a steep 33 degrees at the Talladega Super Superspeedway.

2. Racetrack bankings help drivers maintain grip as they whip around corners. The steeper bankings also create more potential energy in the racecars because the cars are raised higher in the air. When drivers come off a banking and onto the flat portion of the track, they have more speed as the potential energy transforms into kinetic energy.

3. Explain that engineers consider the height of a racetrack's banking when considering how cars will perform. Remind students that three factors affect how much gravitational potential energy the racecar has at the top of a racetrack's banking: the height of the banking, the car's mass, and the force of gravity. Given the fact that mass impacts kinetic energy, all racecars must weigh 3,300 pounds (without a driver). Having identical masses makes sure the cars are competitively equal. NASCAR enforces these rules by inspecting each car before and after each race.

4. Tell students they will team up to test how potential energy turns into kinetic energy. Hand out the Kinetic Energy Activity Sheet and the experiment materials. After groups have completed the experiment, have them present their results and discuss as a class.

TEAM UP

Central question:
How does kinetic energy influence NASCAR engineers' choices?

Explain that engineers spend a lot of time thinking about kinetic energy for both racecar performance and safety. Divide students into teams, and tell them to put on their make-believe "engineer caps." They'll need to imagine all the parts of a race from start to finish—that includes designing cars and tracks, installing safety protections for drivers and fans, understanding how vehicles will perform while racing and when making pit stops, and even things that could possibly go wrong during a competition. Have students create a list of the roles kinetic energy plays in each stage of racing.

KINETIC ENERGY ACTIVITY SHEET

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NAME

RAMP IT UP

DIRECTIONS:

Try this experiment to see how changing a car's potential energy changes its kinetic energy.

GATHER YOUR MATERIALS:

Books, cardboard, toy car, tape, ruler

PREDICT: Will a car racing down a ramp travel a shorter or greater distance if you raise the ramp's height?

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PROCEDURE:

1. Use books and cardboard to make a ramp. Use tape to secure both ends of the ramp to the books and floor.
2. Measure the height of the ramp. Record the height under "Run 1" in the table below.
3. Place your car at the top of the ramp. Release the car. Once it stops moving, use the ruler to measure how far it rolled from the end of the ramp.
4. Add two textbooks to raise the height of your ramp. Then repeat steps two and three.

DATA:

	Ramp Height	*Distance Car Rolled*
Run 1		
Run 2		

CONCLUSIONS:

Answer these questions on a separate sheet of paper.

1. What happened when you raised the height of the ramp? Was your prediction correct?
2. Did raising the ramp's height give the car more or less potential energy? Explain your answer.
3. Did the car in Run 1 or 2 end up with more kinetic energy? How could you tell?

WHAT MAKES CARS SO SPEEDY?

FORCE A push or pull on an object that causes or changes motion.

FRICTION

Friction is a force that resists motion when two objects move against one another.

ENERGY Allows an object to do work; energy can be changed from one form to another.

TOP SPEED

195

STORED ENERGY

Objects have stored energy when at rest.

MOTION ENERGY

Objects have motion energy when moving.

Disney · PIXAR Cars 3

JUNE 16
IN 3D AND REAL D 3D