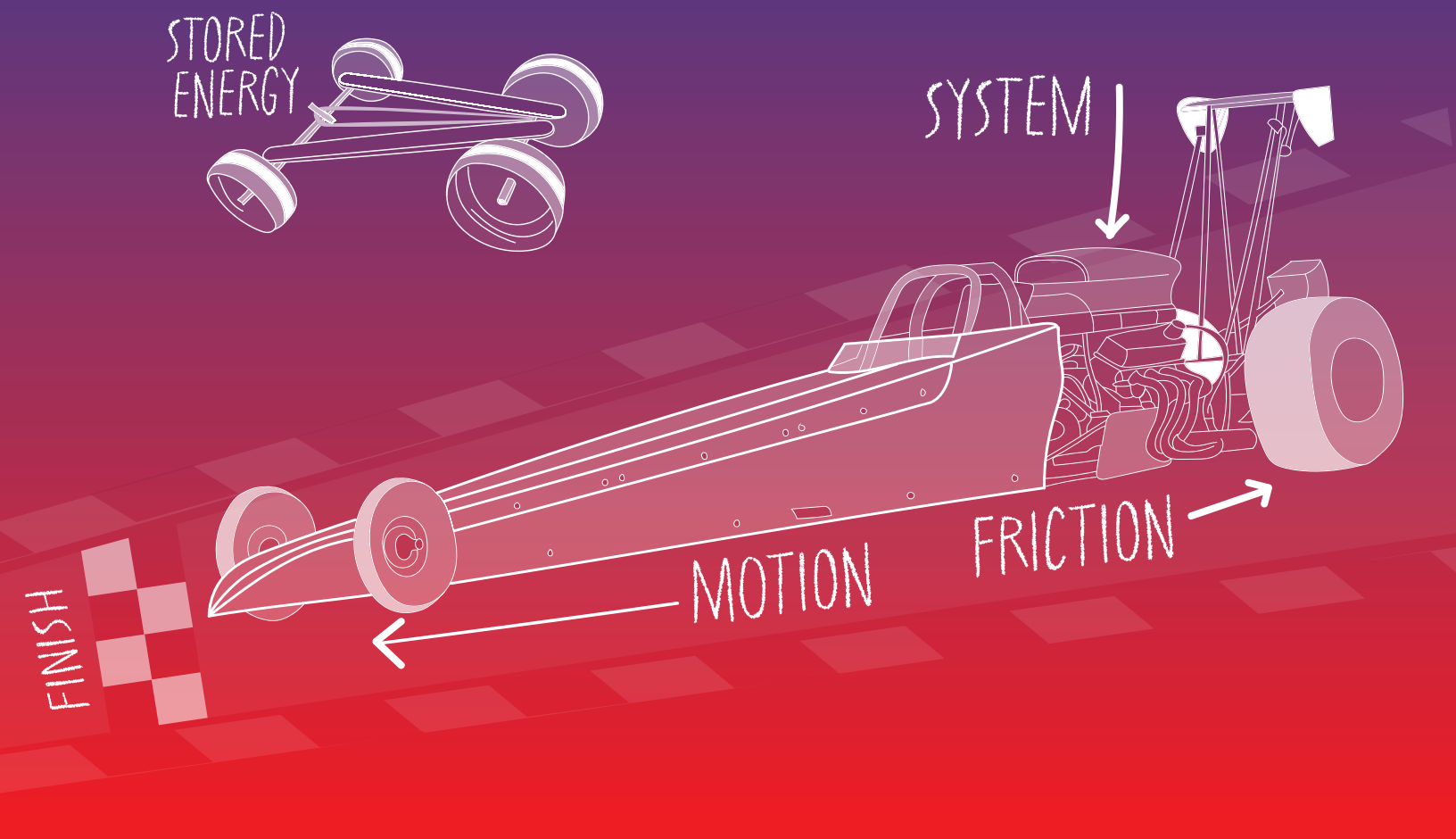
DREAM. BUILD. BECOME.

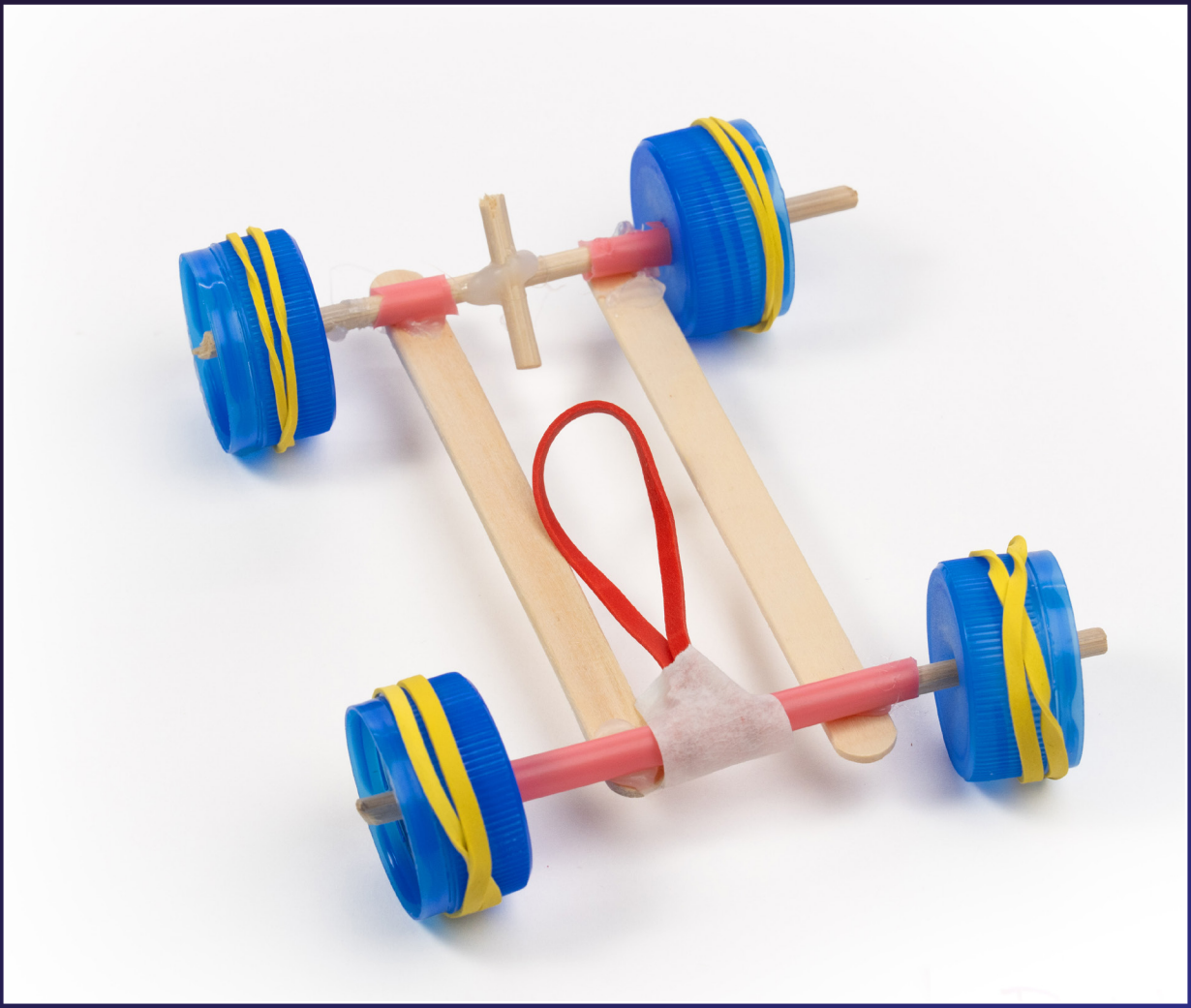
ACE METAL FOUNDATIONS

By IACMI

Rubber Band Powered Car



Rubber Band-Powered Car



Prior Knowledge

To help ensure student success, students should possess some fundamental knowledge about cars and motion. It is helpful for students to understand that the wheels on a vehicle spin freely, and that the axles they are attached to also turn with the wheels.

Rubber Band-Powered Car

Lesson Overview

In this activity, students will build and test a rubber band-powered car to explore how stored energy can be used to create motion. Working with familiar, hands-on materials, students will investigate how different parts, such as wheels, axles, and rubber bands, work together as a system that makes the car move.

Students will observe what happens when the rubber band is wound and released and connect this action to the movement of the car. As students test their cars, they may notice that come cars move smoothly, while others struggle or do not move at all. These moments allow students to practice troubleshooting by identifying where motion is being slowed or stopped.

During this activity, students will be introduced to the idea that not all forces help motion. When parts rub together, or are misaligned, friction can slow the system down and prevent the car from moving effectively.

Students will put their newly obtained knowledge of stored energy, also known as potential energy, to the test as they gain real-life exposure to using this force to set their car into motion. As this stored energy is released, students will gain a tangible understanding of how stored energy can be converted into kinetic energy, the energy of movement!

Vocabulary

System: A group of parts that work together to do a job

Stored Energy: Energy that is saved up and ready to use. Also known as "potential energy"

Motion: When something moves

Friction: A force that slows things down when surfaces rub together

Figure 1: The internal systems of a car, including the power, electrical, cooling and stability systems.

Figure 2: A race car in motion using friction to slow down in a corner.

Rubber Band-Powered Car

The Foundations of Motion

Motion is how and why things move. Objects do not move on their own, they only move when something makes them move, such as a push, a pull, or a force stored in a solid material.

In this activity, motion comes from a rubber band that has been twisted. This causes energy in the rubber band to accumulate as stored energy. When the rubber band is released, it unwinds and causes the wheels and axles of the car to turn. These parts work together as a system to change stored energy into kinetic energy, the energy of motion.

Not all motion happens smoothly. When parts rub against each other, motion can slow down or stop. This slowing force is called friction. Understanding motion means paying attention to how parts are connected, how freely they can move, and how forces travel through a system.

Scientists and engineers study motion to understand how things move, why they sometimes don't, and how designs can be adjusted to work better. By building and testing a rubber band-powered car, you will be able to explore the foundations of motion by observing cause and effect in a real, working system.

Materials

Materials Supplied in Kit

Per Student

- 1 straw
- 1 wooden skewer
- 2 craft sticks
- 4 bottle caps
- 3 rubber bands

Shared

- 1 hot glue gun

Rubber Band-Powered Car

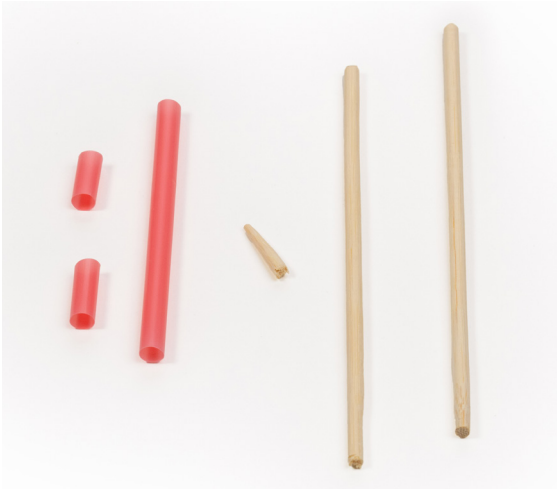
Activity Directions

Step 1: Preparing the wheels

- Using the pointed edge of the skewer, poke a hole in the middle of each of the four bottle caps. Press the bottle cap against the table while you do this, as pictured.
- Make the hole large enough for the skewer to slide through the bottle cap.

Step 2: Prepare the axle housings

- Using scissors, cut the straw into three pieces.
  - Cut two short pieces that are about ½ inch long (or the width of a craft stick)
  - Cut one long piece that is about 2 ½ inches long (or about ½ the length of a craft stick)



Step 3: Prepare the axles

- Using scissors (with help, if needed), cut the skewer into three pieces, making sure to hold onto the end of the skewer that isn't being cut
  - Cut one short piece that is about 1 inch long (or slightly longer than the width of a craft stick)
  - Cut the rest of the skewer in half

Rubber Band-Powered Car

Activity Directions Continued

Step 4: Hot glue the axle housings to the craft sticks

- Using the hot glue gun (caution: hot) glue the straws across the craft sticks so that they make a plus (+) shape

Step 5: Start your front wheel and axle assembly

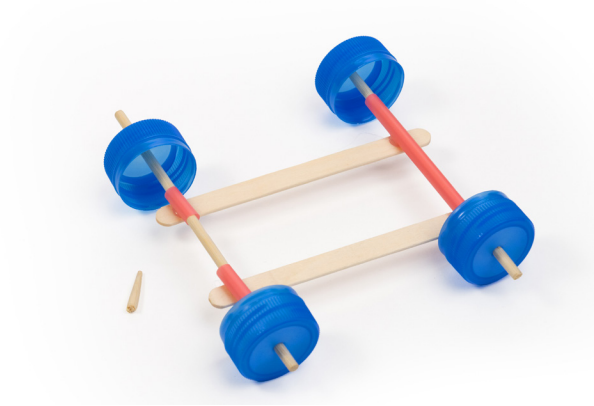
- Push one long skewer into the bottle cap to make a wheel and axel assembly, then slide the skewer through the long straw

Step 6: Start your rear wheel and axle assembly

- Push one long skewer into the bottle cap to make a wheel and axel assembly, then slide the skewer through the long straw

Step 7: Finish your wheel and axle assemblies

- Place the last two bottle caps onto the open ends of each skewer. These are the wheels to your car



Rubber Band-Powered Car

Activity Directions Continued

Step 8: Wrap your tires for traction

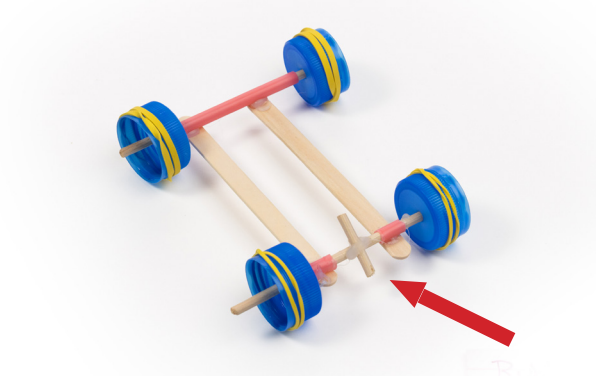
- Wrap one rubber band around each wheel that was connected to the skewer that was inserted into the short straws.

Step 9: Test your car

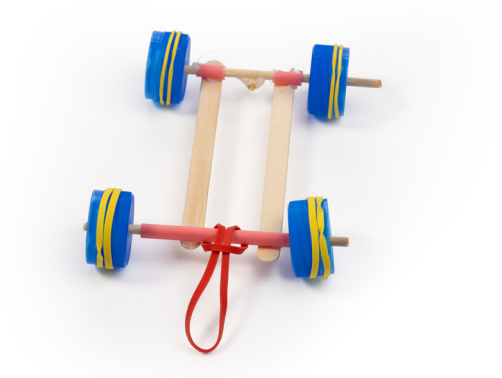
- Test your car to make sure that it can roll smoothly. Place it on a flat surface and give the car a push. If the car does not freely roll, friction may be slowing it down. Friction happens when parts rub together and take energy away from motion. If the wheels are crooked or the axle rubs too greatly against the axle housing, make small adjustments to help reduce the friction.

Step 10: Add your rubber band anchor

- Using hot glue, glue the short skewer piece in the middle of the skewer that goes through the two short straws



Step 11: Loop your rubber band

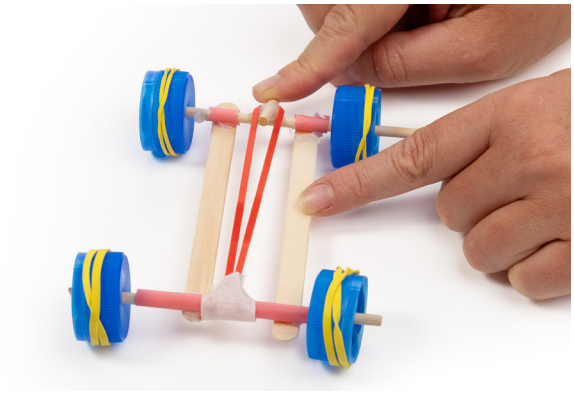


- Loop your last rubber band through itself around the middle of the long straw
- Then tape the rubber band to the straw to hold it in place so that it does not slide off. As the skewer rotates, the rubber band should rotate with it

Rubber Band-Powered Car

Activity Directions Continued

Step 12: Hook your rubber band onto your anchor



- Hook the loose end of the rubber band onto the short skewer

Step 13: Wind up and release

- Wind up the axle that that has the anchor attached to is. Hold onto the rubber band if it begins to slip. By winding the axle, you will be building up stored energy
- Place your car down on the floor and release to convert the stored energy into motion

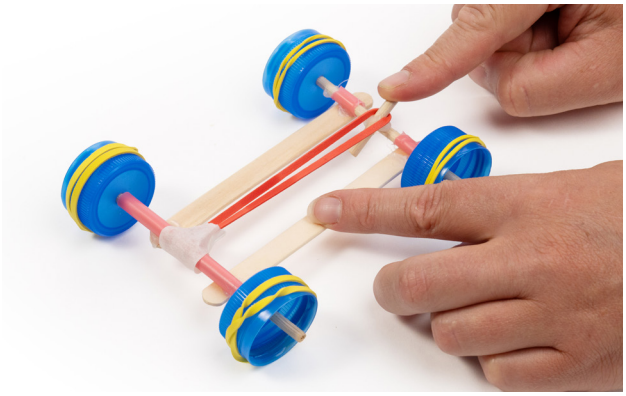


Figure 3: Race cars turning a corner during a race.

Rubber Band-Powered Car

Discussion Prompts or Reflection

- What parts of the car are working together in this car? In other words, which parts are working as a system?
- What could happen if one part isn't lined up correctly?
- Which parts do you think are most important for helping the car roll?
- What changes when the rubber band is twisted?

Variations and Enrichment

- This activity uses a standardized design to ensure success. To increase rigor, students can be encouraged to create their own design after understanding the basic function
- To decrease rigor, a teacher demonstration of the rubber band mechanism can help reduce uncertainty about the most failure-prone step
- Ask students to identify potential controlled variables and test how they impact the rubber band-powered cars. For example, how might the number of times the rubber band is wound affect how far the car travels?

Foundation Exploration

- **Mechanical engineers** design things that move, such as cars, bikes, elevators, and machines. It's important that they understand how energy is stored and released, how parts work together as a system, and how to reduce friction so things move smoothly.
- **Toy designers** crate moving toys like pull-back cars, wind-up toys, and launchers.
- **Race car engineers** focus on making cars move as fast and as smoothly as possible. They work to reduce friction, improve energy transfer, and make sure every part of a system is aligned and working together.