RUBBER BAND POWERED CAR

Introduction

Build a car powered by stored energy. In this activity, you will design and construct a vehicle that moves using the energy stored in a stretched rubber band. Engineers use similar design processes when creating vehicles, machines, and robots.

Learning Objectives

- Build a working rubber band powered car.
- Explore how energy can be stored and transferred.
- Investigate the effects of friction and traction.
- Practice engineering design and problem solving skills.

How Does It Work?

When you pull the car backward, the rubber band stretches and stores energy.

When released, the stored energy causes the axle and wheels to rotate. As the wheels push against the ground, the car moves forward.

Key Engineering Concepts

Energy Transformation
Your Muscles → Stored Elastic Energy → Motion Energy
Elastic Potential Energy: Energy stored when an object is stretched or compressed.
Kinetic Energy: The energy of motion.
Friction: A force that resists movement between two surfaces.
Traction: The grip between the wheels and the ground that helps the car move forward.

Did You Know?

- The first rubber bands were patented in 1845.
- Engineers often build small prototypes before creating full-sized vehicles.
- Tire traction is important for race cars, bicycles, and airplanes.

Challenge

Once your car is complete, try improving its performance!

Challenge 1: Distance
- Can you make your car travel farther?

Challenge 2: Speed
- Can you make your car reach the finish line faster? Race your friends!

Challenge 3: Accuracy
- Can you make your car stop as close as possible to a target?

Challenge 4: Cargo Transport
- Can your car carry three coins or other objects while still moving?

Think Like and Engineer

1. Why does the rubber band help the car move?
2. What role does friction play?
3. What improvements would you make if you built a second version?
4. What engineering challenges did you encounter during construction?

Real-World Connections

The same engineering principles used in this activity are applied in:
- Automobiles
- Robotics
- Aerospace systems

Careers Related to This Activity:
- Mechanical Engineer
- Automotive Engineer
- Robotics Engineer
- Aerospace Engineer

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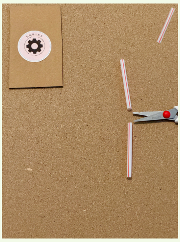
Materials

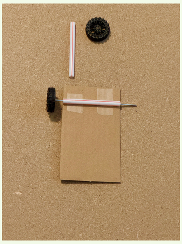
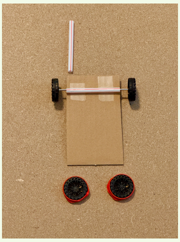
- 1 cardboard base
- 1 Straw
- 4 Wheels + 2 Axles
- 2 Thick rubber bands
- 1 Thin rubber band
- paperclip
- tape
- scissors

Instructions

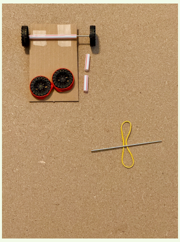
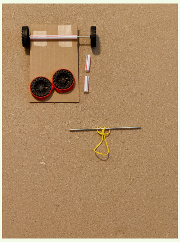
1. Decorate your piece of **cardboard** however you like and give your car a team name!
2. Take 1 straw and cut off the **short ridged** section. Cut the **remaining straight** section in half to create **2** equal pieces.
3. Place one straw half on the back of the cardboard about **½ inch** from the **top edge** (the undecorated side). **Tape** each end with a 1-inch piece of tape. Make sure the straw is **parallel** to the **short side** of the cardboard.

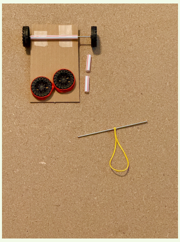
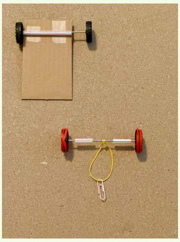
4. Slide a **wheel** onto a metal axle, push the rod through the straw, and attach a **second** wheel to the other end. Make sure both wheels spin freely **without** touching the cardboard.
5. Take **2 more wheels** and wrap a t**hick rubber** band around **each** wheel **twice** to improve **traction**.

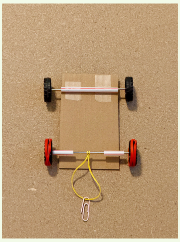
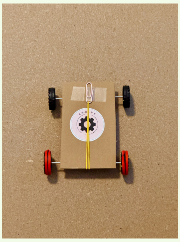
6. Cut the **second** straw half into **3 equal** pieces and **keep 2** of the pieces.
7. Lay a **thin** rubber band **under** an axle rod. Push down on the **center** of the rod so the rubber band forms **two loops**. Insert your **thumb** and **pointer** finger through **one loop** from **underneath**, grab the **opposite** loop, and pull it **back through** the **first** loop in the same direction your fingers **entered**. Pull both ends tightly to **secure** the knot around the rod, then **attach** a **paper clip** to the loose end of the rubber band. Use provided YouTube tutorial if needed.

8. Slide the **two small straw** pieces onto the rod, one on **each side** of the rubber band knot, then attach the **two rubber-band-covered** wheels to the ends of the rod.
9. Place this **back axle assembly** on the back of the cardboard about **½ inch** from the **bottom** edge. The **thin rubber band** should point **downward**, and the **horizontal** part of the knot should **rest against** the **cardboard**. **Tape** each straw spacer to the cardboard with a 1-inch piece of tape, making sure the new back axle stays **parallel** to the front axle.

10. Pull the **paper clip down** and **over** the **bottom** of the car, then **tape** it near the **top edge** of the cardboard on the front side. The rubber band should run **across your design,** and the **top** of the paper clip should line up with the **top** of the car.
11. To use the car, place it on the ground, apply pressure, pull it **backward**, and **release** to watch it race!

SIMPLE CIRCUIT ART

Introduction

Create a light-up card or artwork using a simple electrical circuit. In this activity, you will learn how electricity flows through a circuit by connecting a battery, copper tape, and an LED. Engineers use simple circuits in everything from toys and flashlights to computers and medical devices.

Learning Objectives

- Build a working paper circuit.
- Understand how electricity flows in a closed circuit.
- Learn the function of a battery, LED, and conductive materials.

How Does It Work?

When the battery is connected to the copper tape, electrical energy flows through the circuit. If the positive and negative sides of the LED are connected correctly, the LED lights up. The light only works when the circuit forms a complete loop.

Key Engineering Concepts

Circuit: A complete path that allows electricity to flow.
Electrical Current: The movement of electric charge through a conductor.
Conductor: A material, such as copper tape, that allows electricity to flow easily.
Insulator: A material, such as paper or plastic, that blocks electricity.
Polarity: LEDs only work when connected in the correct direction. The longer leg connects to the positive (+) side of the battery.

Did You Know?

• Copper has been used in electrical wiring for over 100 years.
• LEDs use much less energy than traditional light bulbs.

Challenge

Once your circuit is complete, try improving your design!

Challenge 1: Creativity
Can you design a unique greeting card or picture?
Challenge 2: Brightness
Can you make your LED shine more consistently?
Challenge 3: Multiple Lights
Can you add a second LED to your circuit?
Challenge 4: Switch Design
Can you create a paper switch to turn the light on and off?

Think Like and Engineer

1. Why does the LED only light when the circuit is complete?
2. What happens if you flip the LED around?
3. Why is copper tape used instead of regular tape?
4. What improvements would you make to your design?

Real-World Connections

The same engineering principles used in this activity are applied in:

- Consumer Electronics
- Robotics
- Computer Systems

Careers Related to This Activity:

- Electrical Engineer
- Electronics Engineer
- Computer Engineer
- Robotics Engineer

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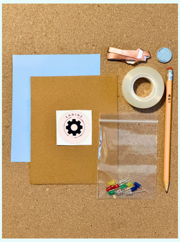
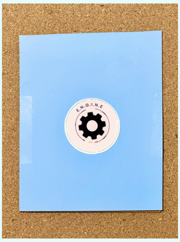
Materials

- 1 cardboard base
- 1 coin cell battery
- 1 LED
- Copper tape
- Clear Tape
- Colored markers
- Pencil/Pen
- scissors

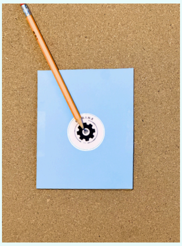
Instructions

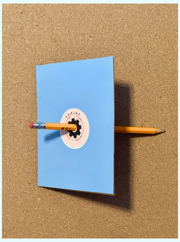
1. **Decorate** the front of your cardstock. Decide where you would like your LED to light up.
2. Carefully poke **one small hole** with a sharpened pencil using a twisting motion where you want the LED to be placed.



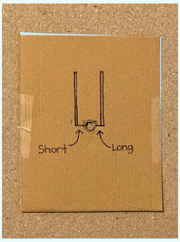


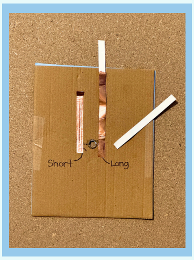
3. On the back of the cardstock, **draw two short horizontal lines** coming out from the puncture holes. Then **draw two longer lines** extending straight up from the ends of the short lines. Label one side of your circuit "Short" and the other "Long."
4. Cut a strip of copper tape and apply it along the **Short side**. The tape should stop at the edge of the cardboard and should not extend past it.



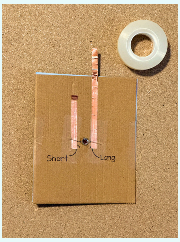


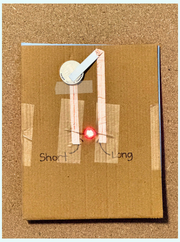
5. Cut a second strip of copper tape that is **longer than the first**. Peel back only enough of the backing to attach the tape along your line to the edge of the cardboard, leaving the remaining backing on the extra length. Apply the tape along the Long side so the extra length extends past the edge of the cardboard. (**See blue image**)
6. **Insert the LED** through the two holes from the front of the cardstock. Make sure the longer leg lays across the Long side and the shorter leg lays across the Short side.



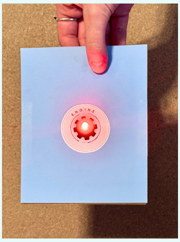


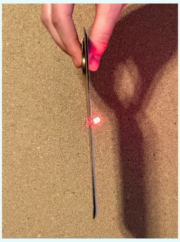
7. **Bend both LED legs** flat against the back of the cardstock. Use two small pieces of **tape** to secure the legs in place so they line up with the copper tape. (The tape should be placed **vertically**)
8. Place the **coin cell battery** face up on top of the end of the **Short** copper tape. Secure only half of the battery with one piece of tape horizontally so the other half is uncovered. (See image below to **identify the top of the battery**)



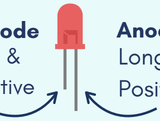


9. Fold the extra length of the Long copper tape diagonally so the **exposed copper touches the top of the battery**. Press the copper tape against the battery to complete the circuit. The LED should light up.
10. **If the LED does not light up**, check that the battery is facing the correct direction, the LED's long and short legs are in the correct positions, and the copper tape is making good contact with both the LED legs and the battery.





Cathode
Short &
Negative



Anode
Long &
Positive

Face Up (+) Face Down (-)

RUBBER BAND HELICOPTER

Introduction

Build a helicopter powered by stored energy. In this activity, you will design and construct a flying model that launches using the energy stored in a twisted rubber band. Engineers use similar design principles when developing helicopters, drones, and other aircraft.

Learning Objectives

- Build a working rubber band helicopter.
- Explore how energy can be stored and transferred.
- Investigate how spinning blades generate lift.
- Practice engineering design and problem solving skills.

How Does It Work?

When you twist the rubber band, it stores energy. When released, the rubber band quickly untwists, causing the propeller to spin.

As the blades push air downward, an upward force called lift is created, allowing the helicopter to fly into the air.

Key Engineering Concepts

Energy Transformation
Your Muscles → Stored Elastic Energy → Motion Energy
Elastic Potential Energy: Energy stored when an object is twisted or stretched.
Lift: The upward force produced by spinning blades moving air downward.
Rotation: Circular motion around a central axis.
Gravity: The force that pulls the helicopter back toward Earth.

Did You Know?

- The first successful helicopters were tested as small prototypes.
- Many toy helicopters use the same rubber band mechanism.

Challenge

Once your helicopter is complete, try improving its performance!

Challenge 1: Height
Can you make your helicopter fly higher?
Challenge 2: Flight Time
Can you make it stay in the air longer?
Challenge 3: Efficiency
How many twists give the best flight?
Challenge 4: Blade Design
Can you redesign the blades to improve performance?

Think Like and Engineer

1. Why does twisting the rubber band make the helicopter fly?
2. How do the blades create lift?
3. What changes could make the helicopter fly higher?
4. What engineering challenges did you encounter during construction?

Real-World Connections

The same engineering principles used in this activity are applied in:

- Helicopters/Drones
- Aerospace Systems
- Aviation Technology

Careers Related to This Activity:

- Aerospace Engineer
- Mechanical Engineer
- Aviation Engineer
- Robotics Engineer

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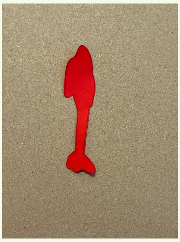
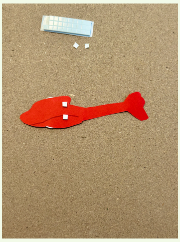
Materials

- 1 helicopter template
- 1 Propeller
- 4 Wheels + 2 Axles
- 2 Thick rubber bands
- 1 Thin rubber band
- paperclip
- tape
- scissors

Instructions

1. Fit the plastic hook and the propeller onto opposite ends of the stick. Make sure both hooks are **facing the same direction.**
2. Loop the rubber band through both **hooks** so it is securely attached.
3. **Trace** the helicopter template onto the colored paper using the provided cutout.
4. **Color and decorate** the helicopter however you like before cutting it out.
5. Carefully **cut** out the helicopter shape along the outline.
6. Place **two white foam stickers** on the stick about half an inch apart.
7. **Attach** the paper helicopter to the foam stickers so it is securely attached to the stick.
8. Hold the stick firmly and **rotate the propeller clockwise** to wind the rubber band. Keep turning until the rubber band forms a **Supercoil***, where it twists over itself into two layers of coils.
9. Once the rubber band is fully wound, let go of the helicopter and watch it fly.
10. If the helicopter does not fly well, **check that the propeller, hooks, and rubber band are attached correctly**, then try winding it again.





*SuperCoil