deSTEMber
SCIENCE ★ TECHNOLOGY ★ ENGINEERING ★ MATH
PRESENTED BY: girlstart

Rubber Band Racers

Off to the races! Observe energy transfer and the exhilarating physics behind Formula 1 as you create and test a rubber band-powered race car.

Materials:

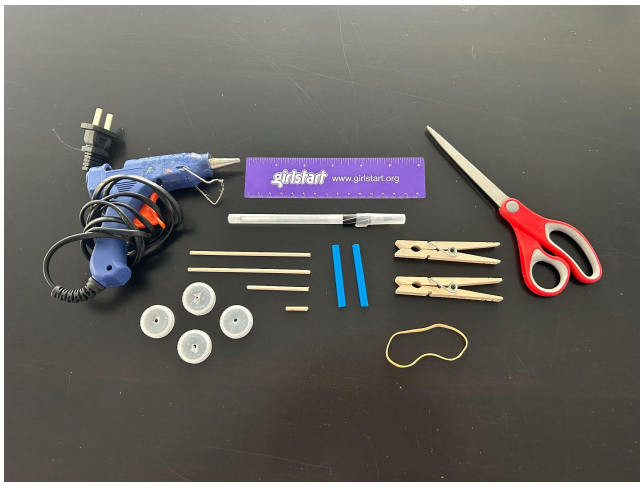
- 2 clothespins
- Hot glue
- Pen
- 4 plastic bottle lids or wheels
- Rubber band
- Ruler
- Scissors
- Straw
- Wooden skewer

TEKS:

SCI 4.7: Force, motion, and energy. The student knows the nature of forces and the patterns of their interactions. The student is expected to plan and conduct descriptive investigations to explore the patterns of forces such as gravity, friction, or magnetism in contact or at a distance on an object.
SCI 4.8.A: The student is expected to investigate and identify the transfer of energy by objects in motion, waves in water, and sound.
SCI 5.7: Force, motion, and energy. The student knows the nature of forces and the patterns of their interactions.
SCI 5.7.A: The student is expected to investigate and explain how equal and unequal forces acting on an object cause patterns of motion and transfer of energy.
SCI 5.7.B: The student is expected to design a simple experimental investigation that tests the effect of force on an object in a system such as a car on a ramp or a balloon rocket on a string.

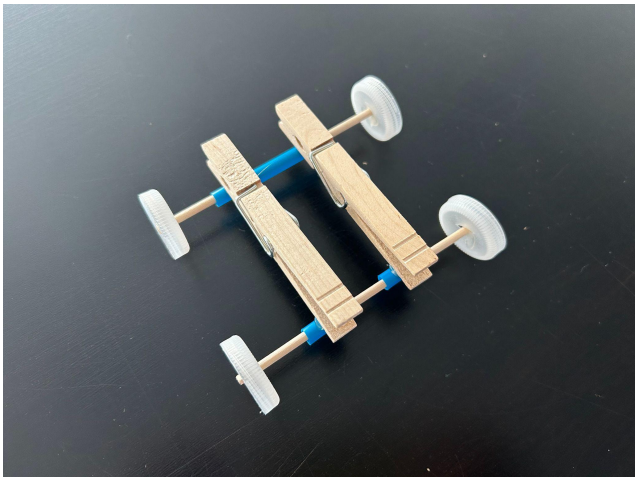
How To:

1. Prepare your materials!
    a. Cut 2 2-inch pieces of straw.
    b. Cut the wooden skewer into 2 4-inch pieces, 1 2-inch piece, and 1 0.5-inch piece.
    c. Use the pen to carefully poke a hole in the center of each plastic bottle cap. *If this is difficult, try twisting the pen through the plastic.*

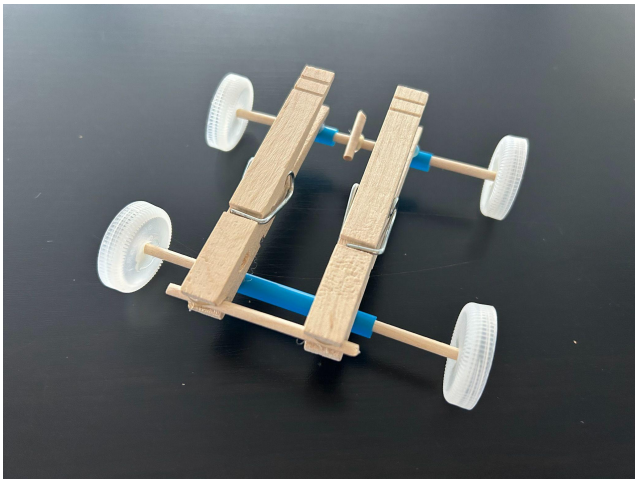


2. Place the 2 clothespins approximately 1 inch apart, parallel to each other. Glue the straw pieces across each end and cut the center out of the straw that's opposite the "mouth" of the clothespins. This is the main body of the car. Safety: An adult should assist when using hot glue.

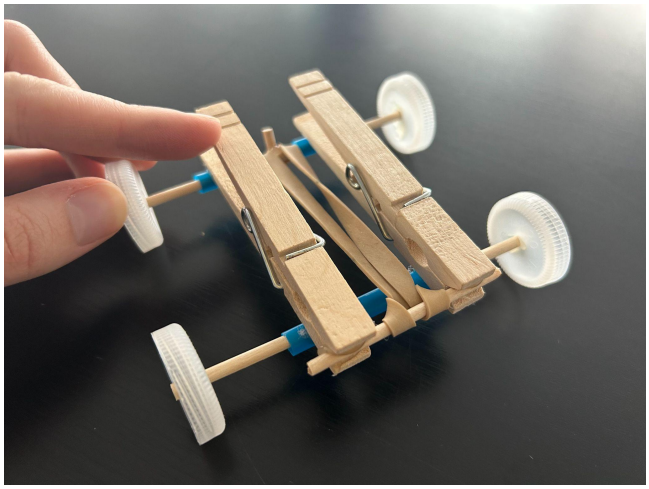
3. Place the end of one 4-inch skewer through the center of a plastic bottle cap. Secure with hot glue. Place the skewer through one of the straws and glue a second bottle cap to the other end. Repeat this process with the other straw. The bottle caps are the car's wheels and the skewers are the axles! Safety: An adult should assist when using hot glue.



4. Glue the 2-inch skewer across the "mouth" of the clothespins and the 0.5-inch skewer to the center of the axle with the cut straw. Safety: An adult should assist when using hot glue.



5. Test the car! Wait 2-5 minutes for the glue to dry. Loop one end of the rubber band around the 2-inch skewer and hook the other end around the 0.5-inch skewer (see photo below). Place the car on the ground, spin the wheels backward to wind the rubber band around the axle, and release!



Troubleshooting Tips:

- Test the rubber band racer on a flat, smooth surface.
- Wind the rubber band around the back axle with all four car wheels on the ground (like a wind-up car!)
- Ensure that all of the wheels are aligned and don't touch the straws as they spin.

Want to improve your rubber band racer? Here are some ideas:

- Wheels: Add rubber bands or tape to the edge of the wheels to increase their grip. Or, use another type of wheel altogether!
- Extra Weight: Tape coins or washers to the top of the car to see how additional weight affects the car's speed.
- Rubber Band: Try a different-sized rubber band to wind the car, or wind the rubber band in the opposite direction to see if the car goes backward!

STEM Explanation:

How does the rubber band power the race car? It's all about physics! A rubber band stores potential energy. The more times you wind the rubber band around the axle, the more potential energy the rubber band stores. When the rubber band is released, all of that potential energy converts to kinetic energy: the energy of motion. The back axle turns, which causes all four wheels to spin, and the car races forward! An object stays in motion until another force acts on it. So… why did your car stop? A force called friction is to blame! Some friction is necessary and helps the wheels grip the surface, but friction eventually slows the racer to a stop.

Many of these same physics principles are used when engineering vehicles that you see on the road… or even a Formula 1 track! Formula 1, or F1, is the world's most prestigious racing competition, with over 20 Grand Prix races across the globe every year. F1 cars use a combination of turbocharged engines, friction, and aerodynamics to achieve speeds of over 200 miles per hour!

A Formula 1 car is engineered with aerodynamics in mind! The car's body is designed to slice through the air with very little air resistance. The air that flows over an F1 car's wings creates **downforce**, a force that increases the friction between the tires and the ground. This allows the cars to take super-fast turns without flying off the track. Behind every competing Formula 1 car is a team of mechanical engineers, aerodynamicists, data analysts, and more, all working together to create a car that can accelerate from 0 to 100 miles per hour in only 4 seconds!

Career:

Aerodynamicists are engineers who study how air flows around objects in motion. In Formula 1, they design and test the car's wings and body to improve performance and generate maximum speed on the track!

Resources:

https://f1chronicle.com/a-beginners-guide-to-formula-1/
https://www.formula1.com/en/page.what-is-f1.html
https://www.scientificamerican.com/article/build-a-rubber-band-powered-car/

