



## Curiosity Guide #301

### Wheel and Axle

Accompanies Curious Crew, Season 3, Episode 1 (#301)

#### Rubber-Band-Powered Wheel-and-Axle Car

STEM Challenge

##### Description

Build and test a rubber-band car, then improve the design to make the car go faster or travel further!

##### Materials

- 2 CD's per car
- CD inserts or poster putty
- Corrugated cardboard
- Rubber bands in various lengths and thicknesses
- Wooden skewer
- Hot glue
- Duct tape
- Ruler
- Scissors
- Craft sticks

##### Procedure 1: Making the chassis and wheels

- 1) Measure and cut 5-inch-square pieces of cardboard.
- 2) Orient the direction of the corrugation, then center and cut a 2-inch notch across one end of the corrugation. The cut should be 1 and  $\frac{1}{2}$  inches deep and 2 inches wide.
- 3) Discard the cut-out piece.

- 4) Slide the wooden skewer so that the skewer penetrates through the corrugation of the cardboard, spans the notch, and continues out the other side.
- 5) Center the skewer so that the same amount sticks out on both sides.
- 6) Cut a small piece of duct tape and secure it as a flap around the center of the skewer in the notched area.
- 7) Reinforce the slender cardboard sides with wooden craft sticks. Tape the craft sticks in place.
- 8) Use either CD inserts by snapping the inserts into the center of the CD's, or put a dab of hot glue around the center of one side of the CD. Then firmly attach a metal washer.
- 9) Tear a piece of poster putty and form a flat seal over the center of the inside of each CD wheel.
- 10) Slide a wheel on each end of the axles so that the skewer slides through the putty. Press the putty tightly around the axle to keep the axle and wheel together. Check to make sure that the wheel is still straight.
- 11) Apply a bead of hot glue on the skewer and washer on the outside of the wheels.
- 12) Select the preferred rubber band. Center the rubber band near the solid front end of the chassis. Tape one end of the rubber band down.

#### Procedure 2: Testing the car

- 1) To power the car, wrap the loose end of the rubber band around the tape flap on the chassis and rotate the axle to wind the rubber band up. Winding the wheels could loosen them, so grip the axle instead.
- 2) Place the car on the floor and let it go.
- 3) How could you improve the design? What other materials could you make the wheels out of? Does the size of the wheel matter?

## My Results

### Explanation

The rubber-band-powered car is a good example of a wheel and axle that uses a speed multiplier. When a force is applied to an axle, the wheel itself travels more quickly because the wheel has so much more distance to cover in one rotation than the axle does. When the rubber band is wound up, it stores potential energy. When the rubber band is released, the energy is changed into kinetic energy. The car begins to move as the rubber band spins the axle and unwinds.

### **Investigate further:**

On the internet, find some photos of rubber-band cars, spinning automobile wheels, and monster-wheel vehicles.

Then think about this: Our cars used the power of rubber bands to make them go, but cars work in a similar way. The energy from the engine makes the axle turn. Because the wheels are bigger than the axle, the wheels turn faster. The speed is multiplied. So if the wheel is 6 times bigger than the axle, it is also rolling six times faster. If an average tire has a circumference of about  $6\frac{1}{2}$  feet, the tire will rotate 812 times every mile. And if you're going 60 miles per hour, that means the tire spins  $13\frac{1}{2}$  times each second! Just imagine how quickly the wheels must be turning on really large, wheeled vehicles. Wow!

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