Curiosity Guide #210
Mechanical Energy

Accompanies Curious Crew, Season 2, Episode 10 (#210)

Making a Kinetic Car

STEM Challenge

Description

Engineer a car that runs without a motor!

Materials, per team

- Tall open-top boxes with flaps cut off
- 4 CDs or solid foam discs
- 3 wooden dowels, $\frac{1}{4}$ inch in diameter
- 3 straws
- Tape
- Hot glue gun
- Marker
- Scratch awl
- 50 to 100 metal washers
- String or ribbon
- Large paper clips
- Ruler
- Scissors

Procedure #1, getting ready for assembly

1) Select what size wheels the car is to have. Front and back wheel size can differ.
2) Start with the bottom of the "car body" facing up. This will make assembling and attaching the axles and wheels easier.

3) On the rear of the box, cut a rectangular opening several inches wide by several inches long, centered where the rear axle will be.
4) Measure the width of the body.
5) Cut one straw so that it is an inch wider than the body. This will hold the front axle.
6) Measure and cut a second straw in two pieces to hold the back axle so that there are straw sleeves on each side of the cut rectangle.

Procedure #2, assembling the wheels

1) Tape each straw onto the bottom of the box so that they are a half-inch in from the front and back edge.
2) Slide the wooden dowels through the straws. Verify that the dowels are parallel and stick out at least an inch on either end.
3) Find the exact center of each foam disc and mark it.
4) Make a pilot hole in the foam disc with a scratch awl.
5) Slide the dowel onto the foam disc and hot glue in place.
6) Repeat with the other wheels.
7) Turn the car over so that it is standing on its wheels.

Procedure #3, adding power and testing the car

1) Slide the third dowel through a straw.
2) Lay the dowel across the top of the box. Place the dowel parallel to the axles but centered on the top of the car.
3) Tape the ends of the dowel in place. Make sure that the straw can spin freely on the dowel.
4) Cut a length of ribbon so that it is 3 times the height of the box.
5) Secure one end of the ribbon to the back axle with tape and fish it through the cut rectangular hole.
6) Wind the wheels in reverse to take in the ribbon slack.
7) The ribbon should be wound enough so that the loose end of the ribbon drapes over the top straw support.
8) Make a large hook out of a paper clip.

9) On the loose end of the ribbon, tie the large hook.
10) Load the hook with metal washers. This can be secured with string.
11) Try releasing the weights. Does the car move?

My Results

Explanation

When the washers are hoisted up, they hold **gravitational potential energy** because gravity is pulling down on them. As the washers begin to fall, they pull the ribbon, which slides over the top dowel like a pulley system. At the same time, the ribbon pulls on the rear axle. This causes the wheels to spin and makes the car move forward. The potential energy of the washers changes into **kinetic energy**, or energy in motion. Because the falling washers make the wheels turn, it is an example of **mechanical energy**.

Would you like to modify your kinetic car? Variations to consider include the height of the box, the size of the wheels, the number of weights used, and the floor surface. The greater the mass of the car, the greater the friction and floor resistance, so the harder it is to move.

More to investigate: Cars that run on gravitational potential energy come in all sizes and designs. Some of the most interesting are Soap Box cars that carry passengers. Imagine building a car with no engine and placing it at the top of a hill with other Soap Box cars to see which one will coast down a hill the fastest. Each year, in Akron, Ohio, people compete to win the Soap Box Derby. On your mark, get set, GO!

If you would like to learn more, search for "soap box derby" on the internet. If you click Images, you can see some of the cars that people have designed.

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