How to build a balloon-powered car

By Ben Finio, Scientific American on 12.19.19
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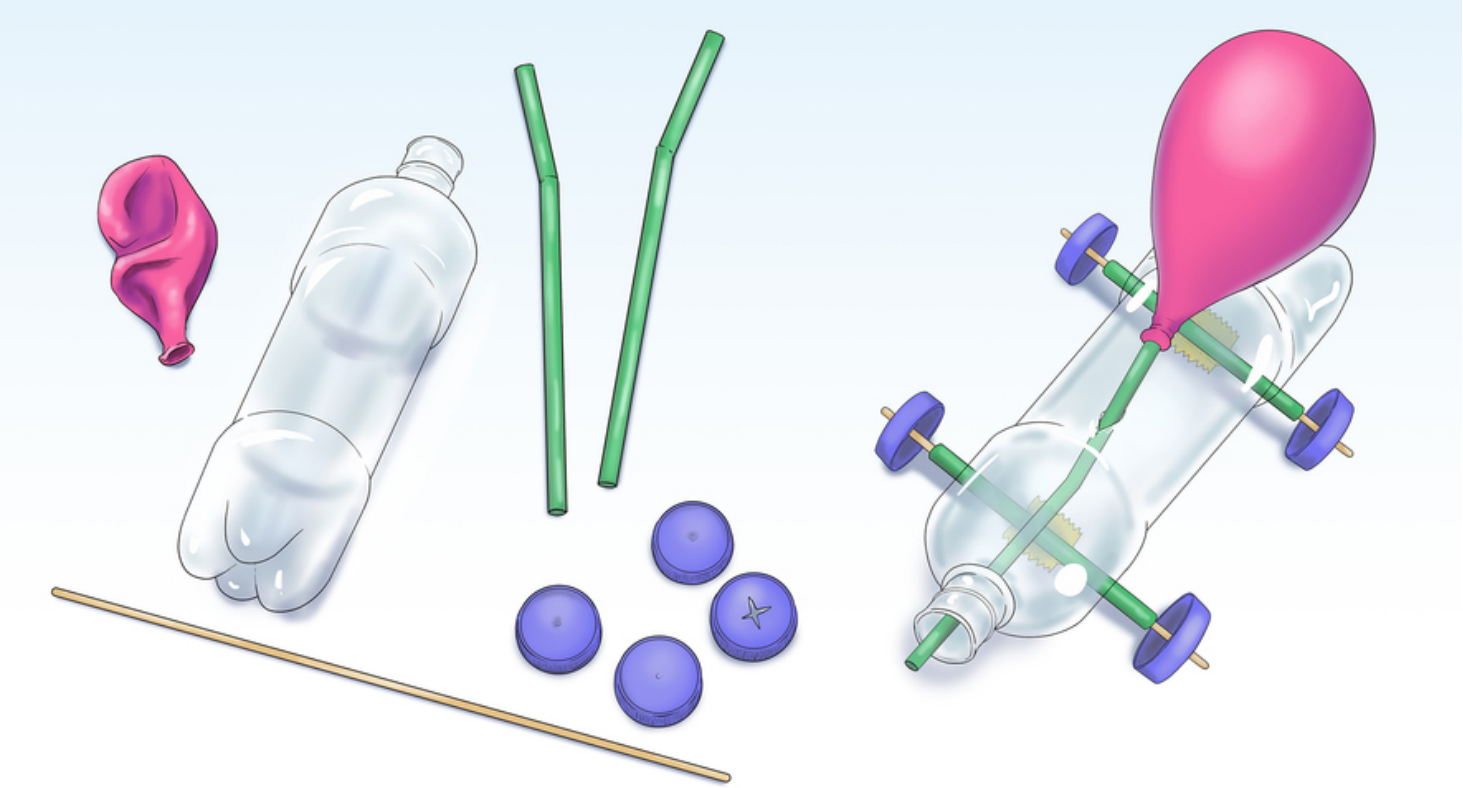


Image 1. In this activity, you will make a balloon-powered car. This illustration shows the car and the materials required to construct it. You will need a balloon, plastic bottle, two straws, four bottle caps and a wooden skewer. Illustrated by Newsela staff

Turn a pile of trash into a toy car — and watch it go! In this activity you will learn some physics concepts and use recycled materials to build a toy car that is propelled by a balloon. You can even find a friend, build two cars and race them against each other. Whose car will go the fastest?

Background

It might not seem like it at first, but a simple balloon car is loaded with physics and engineering concepts! When you inflate a balloon, it stores potential energy in the form of stretched rubber and the compressed air inside. When you release the balloon, this energy is converted to kinetic energy — the energy of motion — as the balloon zooms around the room. Some of the energy is also converted to heat due to friction. According to the law of conservation of energy, the total amount of energy is conserved. Energy never "disappears" — it just changes to another form.

Another way to think about the balloon's movement is to use Newton's third law of motion: For every action there is an equal and opposite reaction. When you inflate a balloon and then release the nozzle, the rubber contracts and pushes the air out the nozzle. This means that there must be

an equal and opposite reaction — the air pushes back on the rubber, propelling the balloon forward. This principle is used in real rockets and jets that shoot a high-speed stream of gases out the back of their engines, propelling the vehicle forward. In this project you will use this principle to build a toy car that is propelled forward by the stream of air escaping a balloon as it deflates.

The car also contains a simple machine: the wheel and axle. This invention has been around so long, we take it for granted — and many of us ride in wheeled vehicles every day. You will see, however, getting your wheel and axle to spin smoothly is a critical part of getting your balloon car to work!

Key Concepts

Physics

Kinetic energy

Potential energy

Conservation of energy

Newton's laws of motion

Materials

Plastic bottle

Four plastic bottle caps

Wooden skewer

Two straws

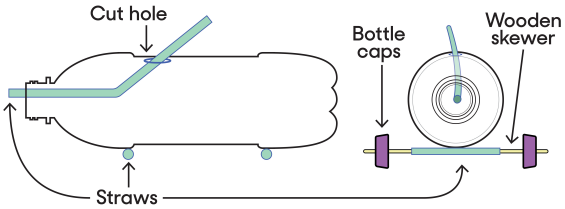
Balloon

Tape

Scissors or sharp knife (Have an adult use or supervise your use of this tool.)

An adult helper

Preparation



1. Cut one of the straws in half.

2. Tape both pieces of the straw to one side of the water bottle.

3. Cut the wooden skewer in half and push each piece through one of the straws. These will form your axles. (Have an adult help.)

4. Have an adult help use the scissors to poke a "+"-shaped hole directly in the center of each plastic bottle cap.

5. Press each bottle cap onto the ends of the wooden skewers. These will form your wheels.

Procedure

1. Put your car down on a flat surface and give it a good push. Make sure the car rolls easily and coasts for a bit before stopping. If your car gets stuck or does not roll smoothly make sure: your axles are parallel to each other; the hole in each bottle cap is centered; and the straws are securely taped to the water bottle and do not wobble. You can add some glue if tape is not sufficient.

2. Tape the neck of the balloon around one end of the other straw. Wrap the tape very tightly so the connection is airtight.

3. Cut a small hole in the top of the water bottle, just big enough to push the straw through.

4. Push the free end of the straw through the hole and out the mouth of the bottle.

5. Use tape to secure the straw to the bottle.

6. Blow through the straw to inflate the balloon, then put your finger over the tip of the straw to trap the air. What do you think will happen when you put the car down and release your finger?

7. Put the car down on a flat surface and release your finger. What happens?

8. See what adjustments you can do to make the car go farther. What happens if you inflate the balloon more? What happens if you adjust the direction the straw is aimed? Does it work best if the straw is aimed straight back?

Extra: There are many different ways to build a balloon car. Turn this into an engineering design project and try building your car with different materials. For example: What happens if you use a cardboard box instead of a plastic bottle for the body? What happens if you use different diameter straws? What about different materials for the wheels and axles? Get some friends and try building different cars and racing them against one another. What materials work the best?

Observations And Results

When you inflate a balloon and let it go, it zips randomly around the room. When you tape the balloon to a straw and attach it to the body of your car, however, you can control the direction of the escaping air. When the end of the straw is aimed backward, the air pushes your car forward, as described by Newton's third law of motion. Your design will be most efficient if the straw is pointed straight back and not downward or to the side. The more you inflate the balloon the more potential energy it stores, which in turn is converted to more kinetic energy, according to the law of conservation of energy — so the car will go faster.

You may find your car does not work perfectly on the first try, particularly if its axles are not parallel or the wheels wobble. Too much friction can cause the wheels to get stuck, and the balloon will not be powerful enough to push the car forward. Test your car to make sure the wheels spin freely and, when you give it a push, the car rolls easily. If not, you might need to make some adjustments to your design. You should also make sure no air escapes the balloon where it is taped to the straw, and re-tape it more tightly if necessary.

Quiz

1 The author includes information about kinetic energy first.

Why does the author choose to provide information about Newton's third law of motion next?

(A) to introduce a comparison between the energy that moves a balloon-powered car and a real car

(B) to illustrate the way that study and understanding of motion and friction have changed over time

(C) to elaborate on ways to think about how energy interacts inside and outside a balloon to create motion

(D) to emphasize the contrast between Newton's ideas about motion and others' ideas about kinetic energy

2 What is the MAIN reason the author includes the section "Observations And Results"?

(A) to argue that over-inflating the balloon will reduce control of the car

(B) to explore the differences in speed caused by friction on the car's wheels

(C) to provide explanations of potential problems and tips for solving them

(D) to refine the idea that the size and shape of the car affects its motion

3 Which answer choice accurately compares and contrasts how each image affects the reader's understanding of the balloon-powered car?

(A) Image 1 illustrates what the car looks like from above, while Image 2 shows what the car will look like from beneath.

(B) Image 1 illustrates the importance of the balloon for motion, while Image 2 shows that the wheels are more important.

(C) Image 1 shows the different materials required to build the car, while Image 2 indicates how physics provides motion.

(D) Image 1 shows what the parts of the car look like before and after it is built, while Image 2 illustrates how to build it.

4 Which conclusion is BEST supported by both Image 2 and the information in the section “Procedure”?

(A) Whatever materials you use to construct your car, it is essential to have a strong and symmetrical base.

(B) When choosing materials to construct your car, they must be heavy enough to move quickly down a slope.

(C) To inflate the balloon, you must make sure all the parts of your car have been sealed tightly with glue.

(D) The more you inflate the balloon, the more tape it will take to hold the pieces of the car together.