Part I -- Build a Rover

Rovers are a kind of carlike spacecraft that NASA uses to explore the surfaces of other worlds! So far, rovers have gone to Mars and the Moon – and one day, they might go even farther.

Your Challenge: Build your own rubber-band-powered rover that can scramble across the room. This activity is divided into two parts.

**Part 1** -- Build your rover out of cardboard and figure out how to use rubber bands to spin the wheels.

**Part 2** -- Use the engineering design process to improve your rover based on testing results.


NASA’s Artemis program plans to land astronauts on the Moon by 2024. These astronauts could use rovers to drive across the Moon’s surface, carry supplies, and explore the area. NASA will then use knowledge gained from exploring the lunar surface to take the next giant leap--sending humans to Mars.

Learn about NASA’s Artemis Program [www.nasa.gov/specials/artemis/](http://www.nasa.gov/specials/artemis/)
Materials

- 1 - 6-in. cardboard square for the rover body
- 2 - 5-in. cardboard square for the wheels
- 1 - sharpened cylindrical pencil
- 2 - rubber bands
- 2 - pieces of round hard candy with a hole in the middle
- 1 - plastic drinking straw
- Ruler
- Tape
- Scissors

*Don’t worry if you don’t have all of the materials. Get creative and substitute materials with what you have! It’s all part of the design process.

Brainstorm

Take a close look at this prototype of a rover like the one you are going to build. Prototypes are used all the time in engineering. They give you a basic design from which to build, test and evaluate. Improving a design based on testing is part of the engineering design process.

DID YOU KNOW?

NASA is sending a rover to hunt for water on the Moon.

https://www.youtube.com/watch?v=ROWPoRXLvo4
Ask yourself these questions:
• What do you have to do to make the rover move?
• How do you think square wheels affect how the rover moves across the floor?
• How can you make improvements to the wheels?

Make the rover body
Fold the cardboard into thirds along – not across – the corrugation (the open veins inside the piece of cardboard), pushing up the sides of the rover body to form a trench. Each section will be about 2 inches (5 cm) across.

Make the front wheels
On the two 5-inch (13-cm) cardboard squares, draw diagonal lines from each of the corners, forming an “X”. Poke a small hole in the center with a pencil, where the lines cross.

Important! Avoid accidentally poking yourself with the pencil. Keep your hands away from where the pencil will go through the cardboard.
Attach the rear axle and wheels
Use a pencil to carefully poke a hole near the top of each of the two outermost sections on the rover body. **Again, keep your hands away from where the pencil will go through the cardboard.** Make sure the holes are directly across from each other and are big enough for the pencil to spin freely. This is where your axle will go.

Slide the pencil through the axle holes. Carefully slide the cardboard wheels onto each end of the pencil and secure them with tape.

Make the front axle and wheels
Tape the straw across the bottom of the rover body on the opposite side from the pencil. Slip a candy onto each end of the straw. Bend and tape the ends of the axle to stop the candies from coming off.

https://mars.nasa.gov/mars2020/multimedia/videos/?v=462
Make a rubber-band chain
Create a chain with the two rubber bands as shown in the image above.

Attach the rubber band
Loop one end of the rubber band chain around the pencil, as shown in the image. Cut small slits into the front end of the rover body. Slide the free end of the rubber band chain into the slits.

Seeking Signs of Life in Ancient Martian Rocks
mars.nasa.gov/mars2020/multimedia/videos/?v=438
Ready, set …
Turn the back wheels to wind the rubber band around the axle and power up your rover.

Put your rover to the test
With the rover on the floor, let go! Observe what the rover does. Measure the distance it traveled.

Evaluate the design
Think about how your rover performed and what could be improved. Ask yourself these questions:
Did the wheels turn freely?
Did the rover travel in a straight line?
How far did it go?
Did the wheels spin out without the rover moving much, or did they have traction on the ground and cause the rover to move?

Redesign and test it again
Make changes to your rover to improve its performance. After you’ve made changes, test your rover to see if the improvements worked!

Share it!
Share your design with NASA!
Snap a picture or video of your spacecraft and post it on Facebook, Twitter and Instagram using the hashtag #VirtualMoonshot. Be sure to get your parents’ or guardians’ permission before sharing your snaps online – or ask if they can post it for you.