

MARS ROVER CHALLENGE

Challenge Goal: To build and test a cardboard rover using the engineering design process. Learn more about NASA's Mars Exploration Program.

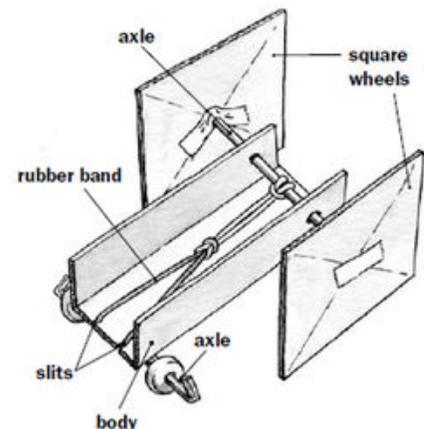
Materials:

- cardboard: cut into one 6-inch square, and two 5-inch squares
- sharpened pencil
- 2 rubber bands
- 2 pieces of hard round candy with a hole in the middle (or a similar object!)
- 1 plastic straw
- Ruler
- Tape
- Scissors
- Missing some of the materials? Get creative! Substitute materials with what you have on hand.

Instructions:

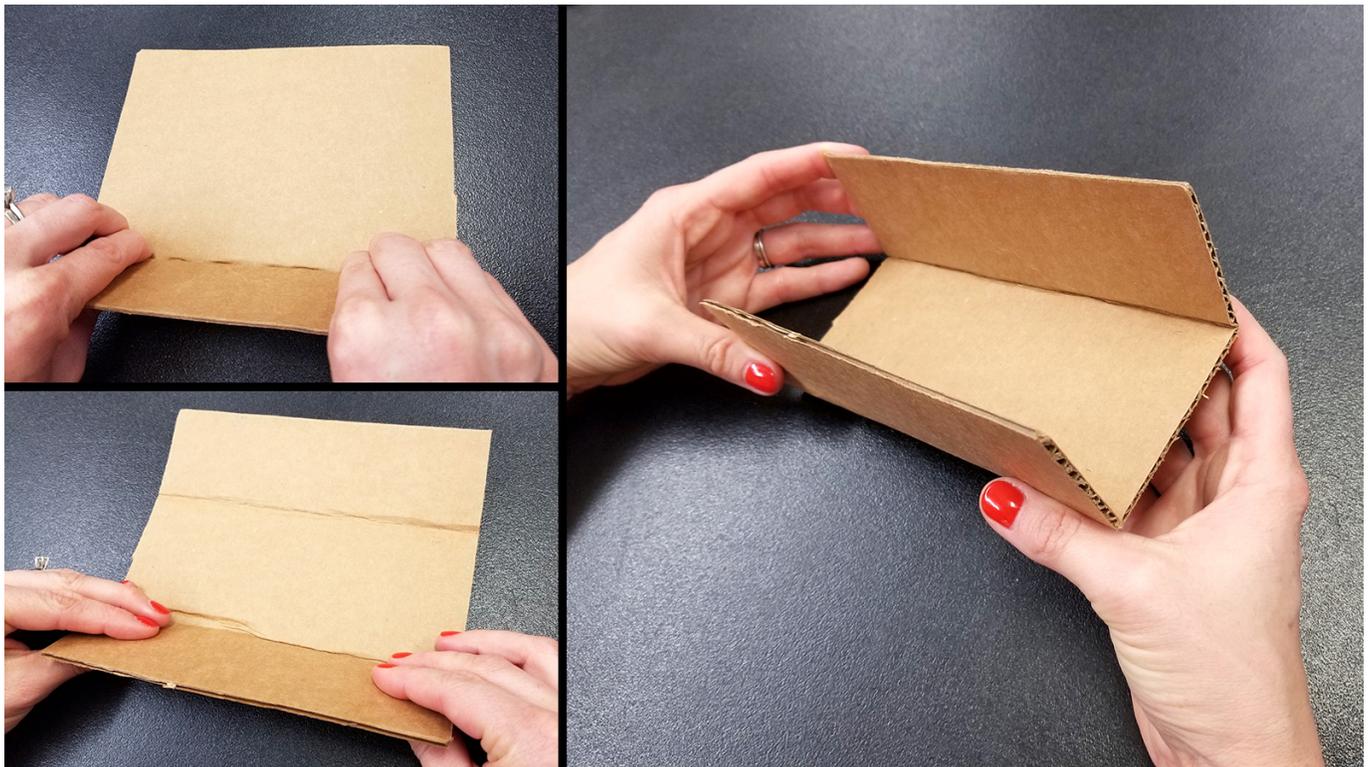
1. Brainstorm:

Check out this prototype of a rover like the one you are going to build. Prototypes are used in engineering to give a basic design to build, test and evaluate. After testing, the design can be improved. This is all part of the engineering design process.



Ask yourself these questions:

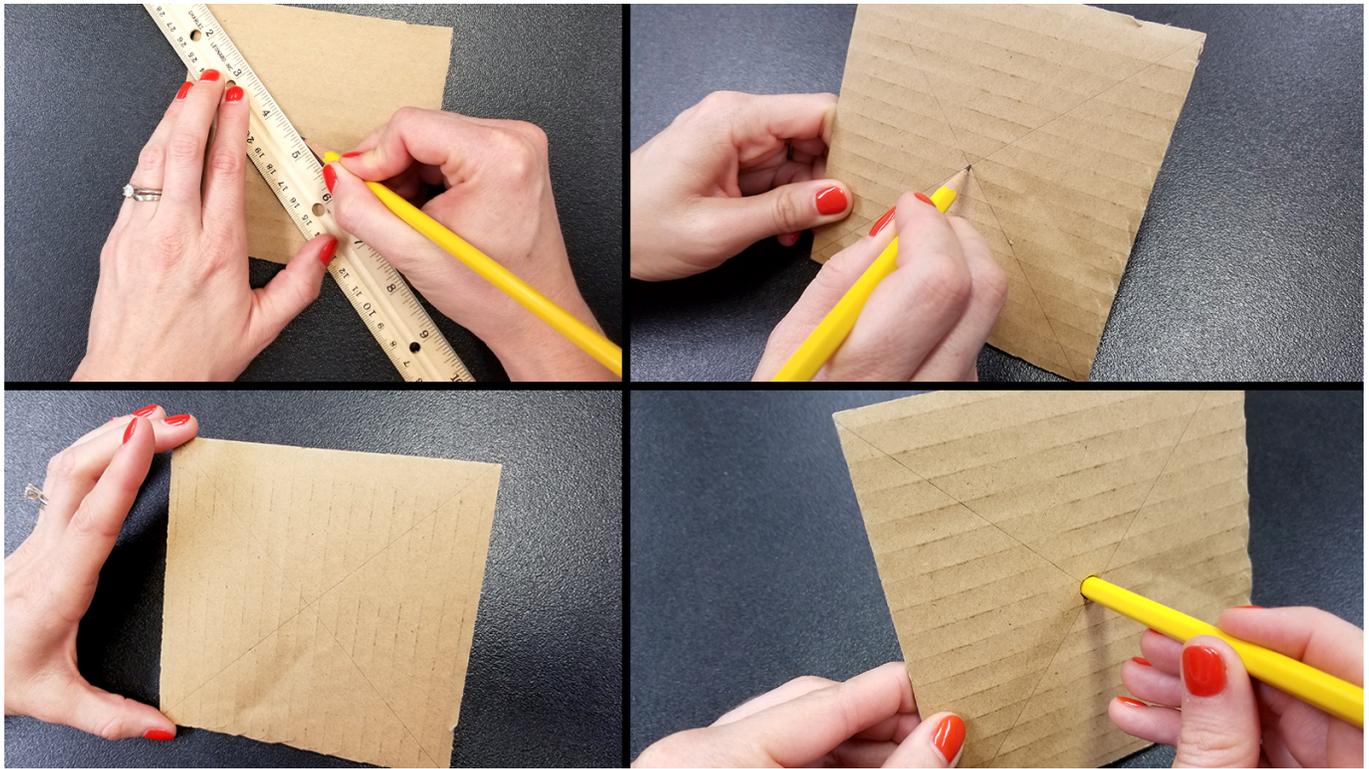
- What do you have to do to make the rover move?
- How do you think square wheels affect how the rover moves across the floor?
- How can you make improvements to the wheel?



2. Make the rover body

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



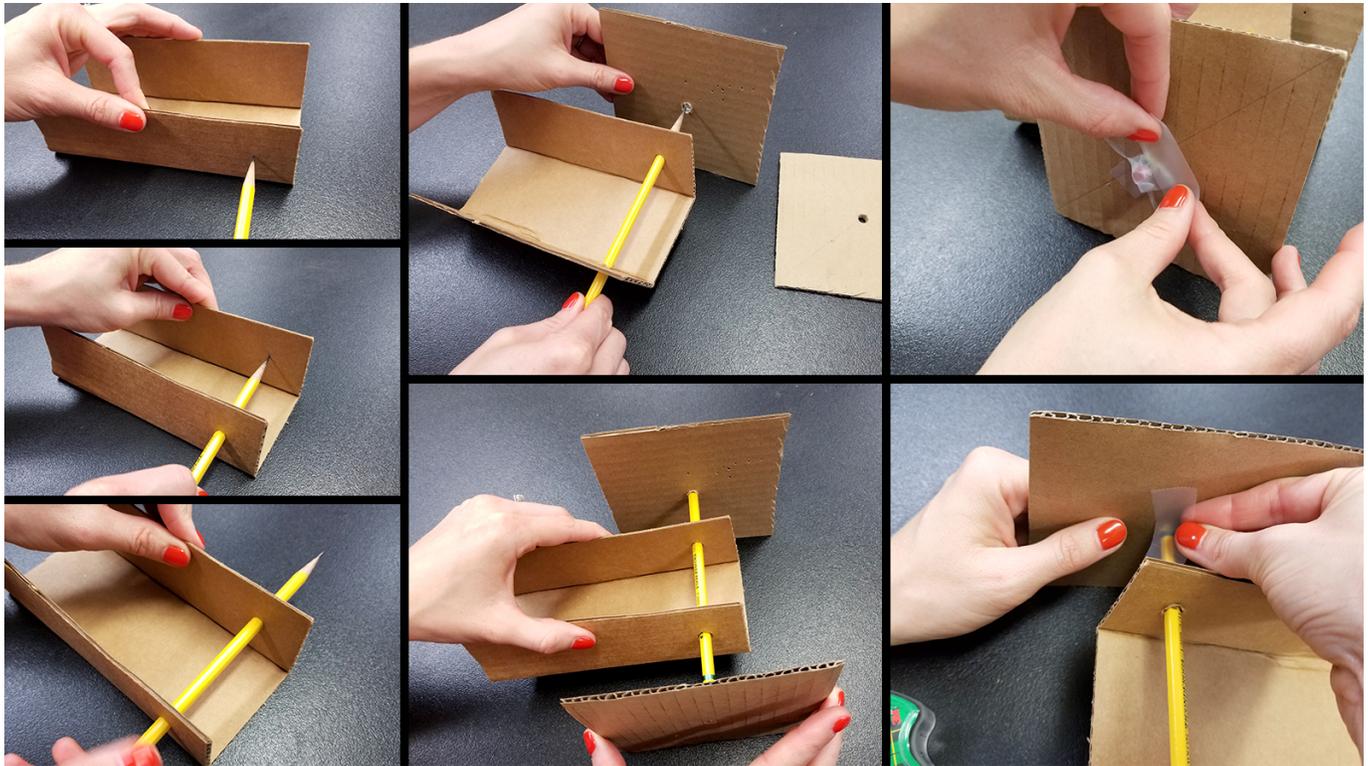


3. Make the front wheels

On the two 5-inch 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.

Be careful not to accidentally poke yourself with the pencil! Keep your hands away from where the pencil will go through the cardboard





4. 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. 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 hole. Carefully slide the cardboard wheels onto each end of the pencil and secure them with tape.

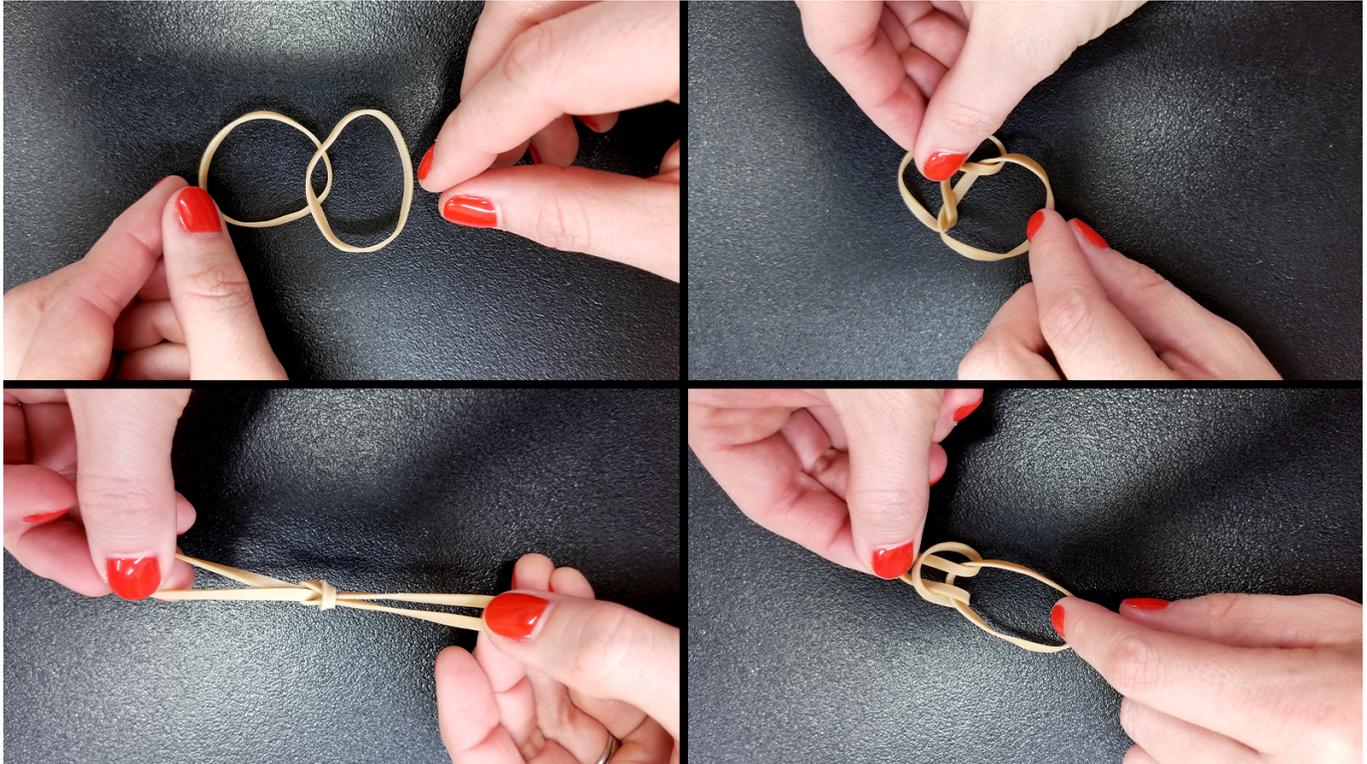




5. Make the front axle and wheels

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.





6. Make a rubber band chain

Create a chain with two rubber bands as shown in the image above.

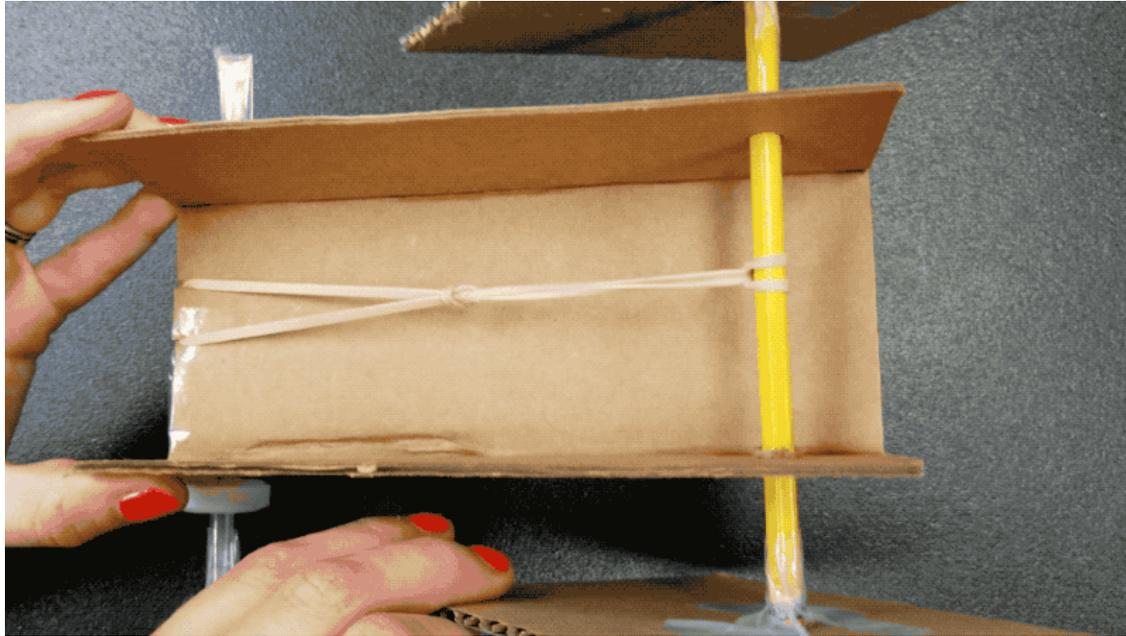




7. Attach the rubber band

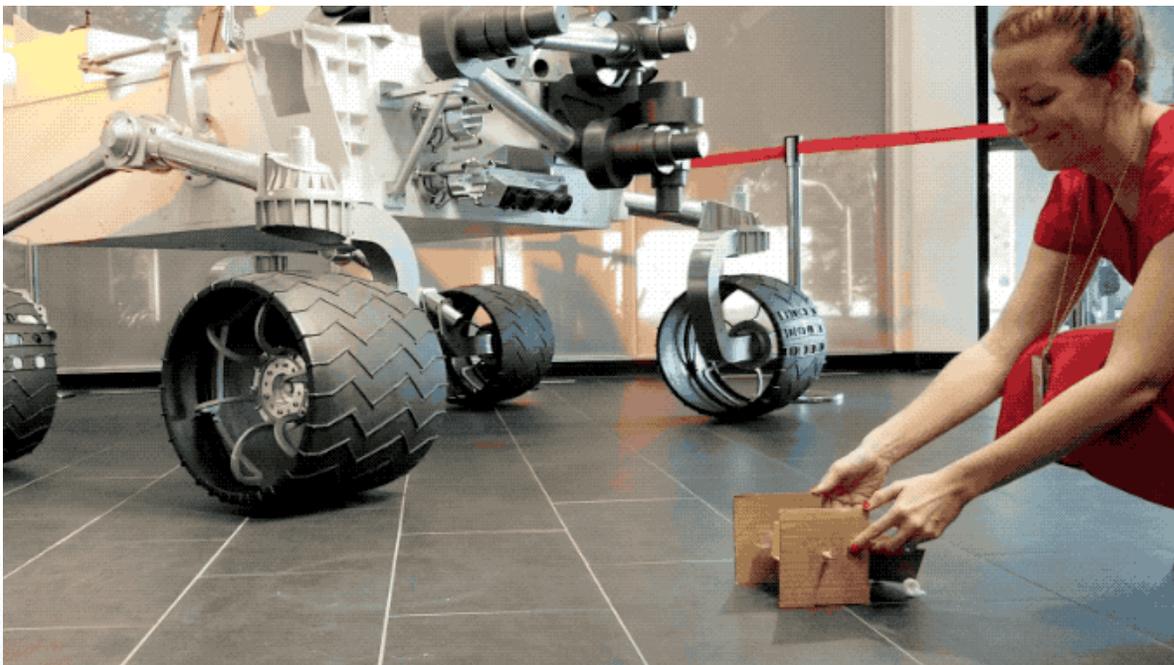
Loop one end of the rubber band chain around the pencil, as shown in the image. Cut small slits into the front end of the rover body. Slide the free end of the rubber band chain into the slits.





8. Ready, set...GO!

Turn the back wheel to wind the rubber band around the axle and power up your rover. With the rover on the floor, let go! Observe what the rover does. Measure the distance it traveled.



EVALUATE & REDESIGN

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?

After evaluating your rover, make changes to improve its performance. After you've made changes, test your rover to see if the improvements worked!

HELPFUL HINTS

Wheels won't turn?

Make sure they are firmly attached to the axles and are parallel to the sides. Make sure the holes in the cardboard body are directly across from one another and large enough for the pencil to turn.

Won't travel in a straight line?

Make sure the axles are straight and the front wheels are the same size.

Doesn't go far?

Wind up the wheels even more! Try larger wheels.

Wheels spin out?

Wheels spin in place when a rubber band delivers too much power at once or there's not enough friction between the wheels and the ground. Add weight over the wheels or add more wheels to increase friction.



LANDING ON MARS: PERSEVERANCE

NASA's Mars 2020 Perseverance rover will land on Mars on February 18, 2021. Perseverance is the most sophisticated rover NASA has ever sent to the Red Planet, with a name that embodies NASA's passion, and our nation's capability, to take on and overcome challenges. It will collect carefully selected and documented rock and sediment samples for future return to Earth, search for signs of ancient microbial life, characterize the planet's geology and climate, and pave the way for human exploration beyond the Moon.

Perseverance is also ferrying several cutting-edge technologies to the surface of Mars – including a helicopter named Ingenuity, the first aircraft to attempt powered, controlled flight on another planet.



You can also follow Perseverance's adventure on social media via @NASAPersevere and @NASAMars on Twitter and Facebook, and the hashtag #CountdownToMars.

