

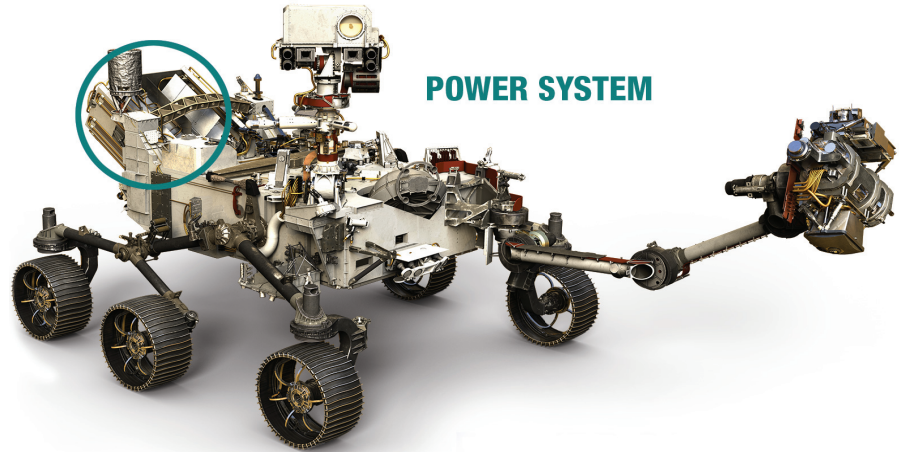


Multi-Mission Radioisotope Thermoelectric Generator (MMRTG) Model Building Instructions

Ages 8 and up

WHAT IS AN MMRTG?

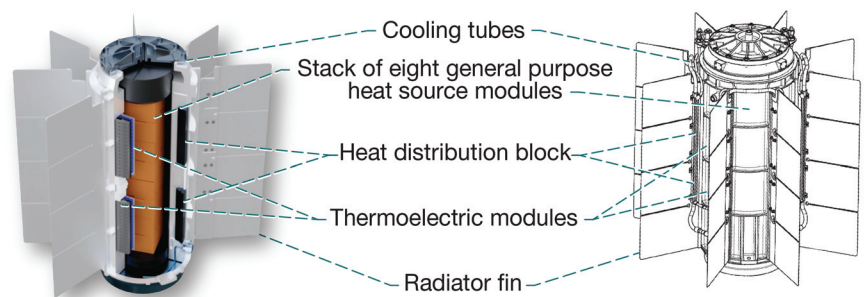
When you see a beautiful image of Pluto, do you ever stop to think about how long it takes to get there and what kind of energy would power a spacecraft to take those pictures? It takes a special kind of power to gather data at the extremes of our solar system. Space exploration missions require safe, reliable, long-lived power systems to provide electricity and heat to spacecraft and their science instruments. One flight-proven source of dependable power is Radioisotope Power Systems (RPS). Similar to a nuclear battery, RPS provide spacecraft with reliable electrical power over long durations. One type of RPS is a Radioisotope Thermoelectric Generator (RTG)—a space nuclear power system that converts heat into electricity using no moving parts.



The Department of Energy (DOE), in support of NASA, has developed several generations of such space nuclear power systems that can be used to supply electricity—and useful excess heat—for a variety of space exploration missions. The current RPS, called a Multi-Mission Radioisotope Thermoelectric Generator (MMRTG), was designed with the flexibility to operate on planetary bodies with atmospheres, such as at Mars, as well as in the vacuum of space.

NASA's first three Mars rovers—Sojourner, Spirit, and Opportunity—used solar panels to provide power to the computers, cameras, other science instruments, mobility systems, and communication systems to teach us about the surface of Mars. The currently active Mars rovers—Curiosity and Perseverance—use radioisotope power systems instead, turning the flow of heat into electricity. Radioisotope power systems let rovers work in the cold dark Martian winter, at night, and even in shadowed areas.

Here are instructions to show you how to build your own model of the power supply for NASA's Mars Curiosity and Perseverance rovers!



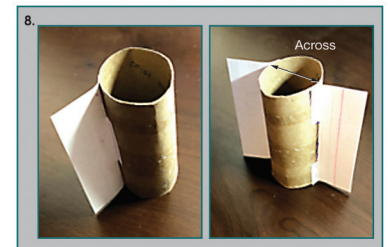
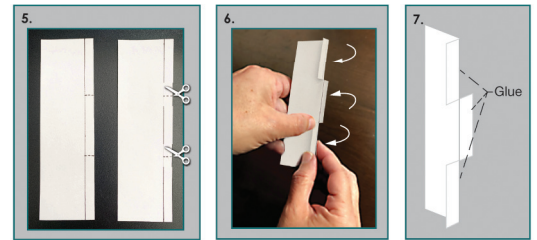
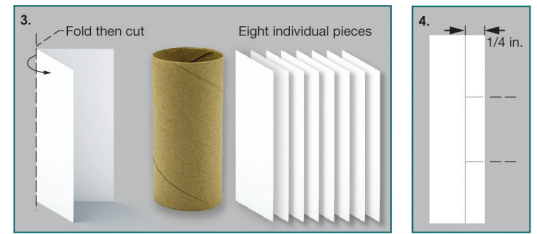
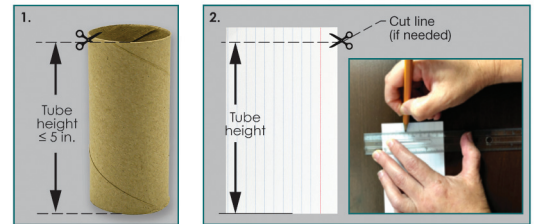
MATERIALS NEEDED

- A cardboard tube
- Four 3 in. by 5 in. index cards (lined or blank)
- Scissors
- Ruler
- Pencil
- Glue stick



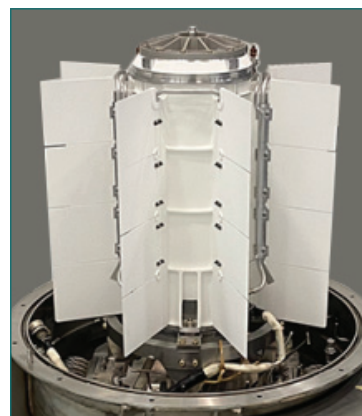
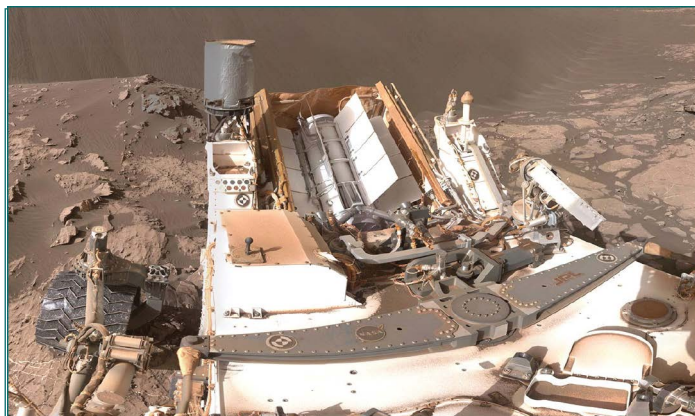
STEP-BY-STEP INSTRUCTIONS

1. Use the ruler to measure the height of the tube. Use a pencil and scissors to mark and cut the tube, making it no taller than 5 inches. Use caution when cutting with scissors.
2. Use the ruler, pencil, and scissors to measure, mark, and cut each card, if needed, to make it as wide as the height of the cardboard tube.
3. Fold each index card in half in the same direction as the tube height (wide edge to wide edge). Then, cut along the fold line of each card. You will now have eight long strips of cardstock that are the same height as the tube.
4. Measure and mark 1/4 inch from the long edge of each card. Then, divide each card into three sections. Mark each section with a short line drawn to the 1/4-inch line.
5. Use the scissors to cut the section lines on each card to create three flaps. Use caution when cutting with scissors.
6. Fold the top and bottom flaps in one direction and the middle flap in the opposite direction.
7. Using the glue stick, put glue on the three small flaps of one card.
8. Attach the card to the tube. Hold the card in place for 10 to 15 seconds, or until the glue is dry. Glue the three flaps of another card and attach it to the tube across from the first card.
9. Repeat these steps until all eight pieces of cardstock are glued on the cardboard tube, in pairs and across from each other.



SHARE YOUR MMRTG MODEL!

Your model looks like the heat-to-electricity converter that powers the Curiosity and Perseverance Mars rovers. Share your MMRTG model with NASA! Snap a picture or video of your model and post it on Facebook, Twitter, and Instagram using the hashtag #NASA-RPS. Be sure to get your parents' or guardians' permission before sharing your snaps online—or ask if they can post it for you.



For more information about the MMRTG on the Perseverance rover, visit <https://mars.nasa.gov/mars2020/spacecraft/rover/electrical-power/>.

For more information on how NASA uses radioisotope power to explore the solar system, visit <https://rps.nasa.gov>.