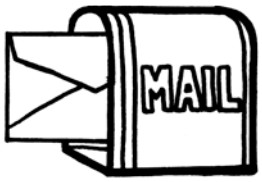
Create a Space Glove

Overview: Kids will *plan*, *create,* and test their model space gloves in one of three Mission Simulations to see how well the gloves protect against the hazards of space.

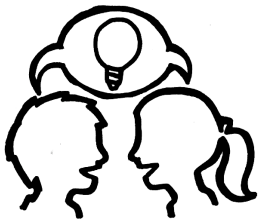
Note to Educator: Be sure that the sponges are dry so that tape will adhere to them.

Be sure to save the *Testing Results* chart, Testing Stations, and groups' model space gloves for Adventure 6.

Duo Update (5 min)

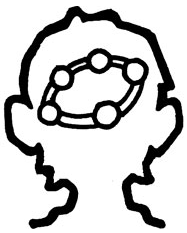


Set the Stage (7 min)



Activity (28 min)

Reflect (5 min)



Materials

For the entire group:

- ☐ *Message from the Duo*, track 8 or Engineering Journal, p. 20
- ☐ *Engineering Design Process* poster
- ☐ *Testing Results* chart
- ☐ Optional: 1 box food-safe gloves

Materials Table:

- ☐ 4 rolls of masking tape
- ☐ 20 sheets of craft foam
- ☐ 20 sheets of felt
- ☐ 20 sheets of foil, 8.5" x 11"
- ☐ 20 sheets of transparency
- ☐ 20 sponges
- ☐ 40 pieces of cheesecloth, 8.5" x 11"
- ☐ 150 cotton balls
- ☐ 150 straws

Mission Simulation:

- ☐ *Mission Profile Images,* pp. 73–77 in this guide
- ☐ 2 calculators
- ☐ 2 Cold Testing Stations from Adventure 2
- ☐ 2 Dust Testing Stations from Adventure 4
- ☐ 2 Impact Testing Stations from Adventure 3
- ☐ 2 jars with lids
- ☐ 2 pieces of paper, 2" x 3"
- ☐ 2 resealable plastic bags, gallon size

For each pair:

- ☐ 1 pair of scissors
- ☐ 1 vinyl glove

For each kid:

- ☐ Engineering Journal

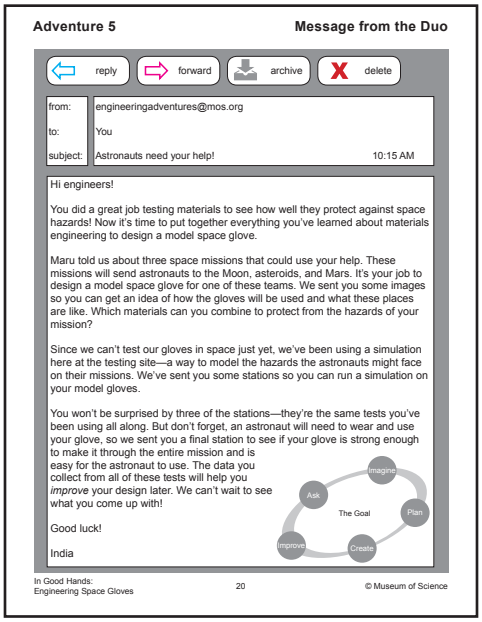
Preparation

Time Required: 30 minutes

1. Post the *Engineering Design Process* poster and *Testing Results* chart.
2. Have the *Message from the Duo* ready to share.
3. Set up a Materials Table with the materials listed above.
4. Prepare the Mission Simulations by copying the *Mission Profile Images,* pp. 73–77 in this guide, and following the directions on *Mission Simulation Set Up*, p. 63 in this guide.

Journal Pages for Adventure 5

Message from the Duo, p.20



Adventure 5 — Message from the Duo

reply | forward | archive | delete

from: engineeringadventures@mos.org
to: You
subject: Astronauts need your help! 10:15 AM

Hi engineers!

You did a great job testing materials to see how well they protect against space hazards! Now it's time to put together everything you've learned about materials engineering to design a model space glove.

Maru told us about three space missions that could use your help. These missions will send astronauts to the Moon, asteroids, and Mars. It's your job to design a model space glove for one of these teams. We sent you some images so you can get an idea of how the gloves will be used and what these places are like. Which materials can you combine to protect from the hazards of your mission?

Since we can't test our gloves in space just yet, we've been using a simulation here at the testing site—a way to model the hazards the astronauts might face on their missions. We've sent you some stations so you can run a simulation on your model gloves.

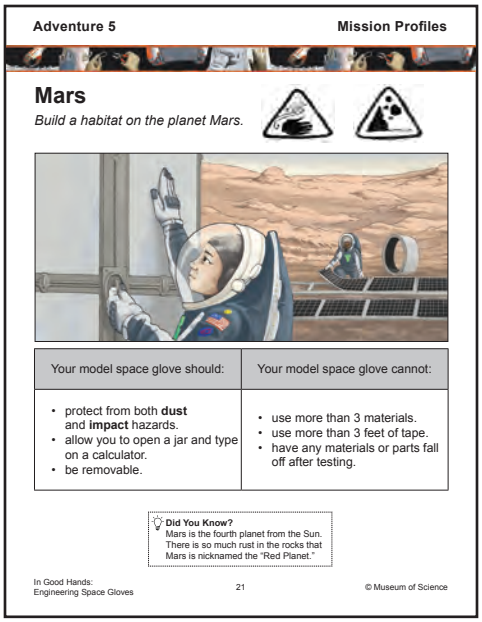
You won't be surprised by three of the stations—they're the same tests you've been using all along. But don't forget, an astronaut will need to wear and use your glove, so we sent you a final station to see if your glove is strong enough to make it through the entire mission and is easy for the astronaut to use. The data you collect from all of these tests will help you *improve* your design later. We can't wait to see what you come up with!

Good luck!

India

In Good Hands: Engineering Space Gloves 20 © Museum of Science

Mission Profiles, pp. 21–23



Adventure 5 — Mission Profiles

Mars

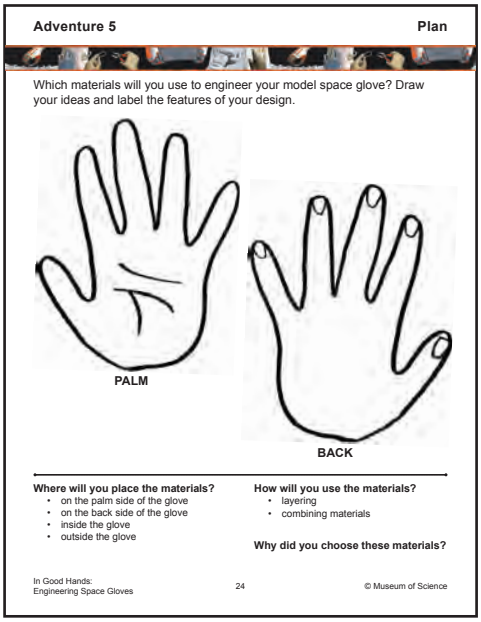
Build a habitat on the planet Mars.

Your model space glove should:	Your model space glove cannot:
• protect from both **dust** and **impact** hazards. • allow you to open a jar and type on a calculator. • be removable.	• use more than 3 materials. • use more than 3 feet of tape. • have any materials or parts fall off after testing.

Did You Know?
Mars is the fourth planet from the Sun. There is so much rust in the rocks that Mars is nicknamed the "Red Planet."

In Good Hands: Engineering Space Gloves 21 © Museum of Science

Plan, p. 24



Adventure 5 — Plan

Which materials will you use to engineer your model space glove? Draw your ideas and label the features of your design.

PALM

BACK

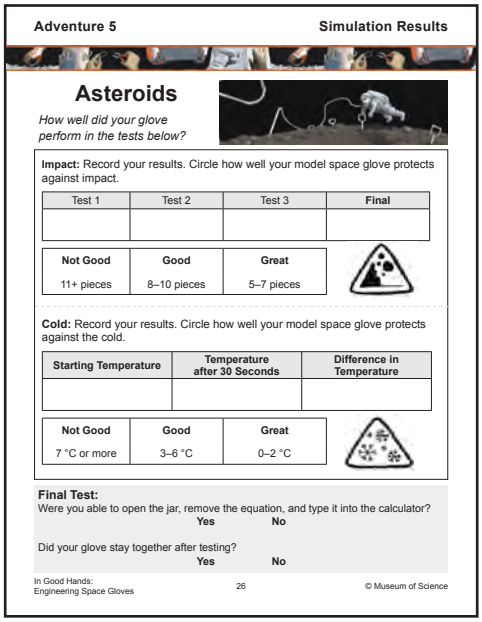
Where will you place the materials?
- on the palm side of the glove
- on the back side of the glove
- inside the glove
- outside the glove

How will you use the materials?
- layering
- combining materials

Why did you choose these materials?

In Good Hands: Engineering Space Gloves 24 © Museum of Science

Simulation Results, pp. 25–27



Adventure 5 — Simulation Results

Asteroids

How well did your glove perform in the tests below?

Impact: Record your results. Circle how well your model space glove protects against impact.

Test 1	Test 2	Test 3	Final

Not Good	Good	Great
11+ pieces	8–10 pieces	5–7 pieces

Cold: Record your results. Circle how well your model space glove protects against the cold.

Starting Temperature	Temperature after 30 Seconds	Difference in Temperature

Not Good	Good	Great
7 °C or more	3–6 °C	0–2 °C

Final Test:
Were you able to open the jar, remove the equation, and type it into the calculator?
Yes **No**

Did your glove stay together after testing?
Yes **No**

In Good Hands: Engineering Space Gloves 26 © Museum of Science

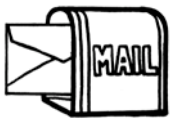
Pre-Preparation for Adventure 6

Time required: 15 minutes

Prepare to have 12 cups of ice ready for the Cold Test Station in Adventure 6.

Create a Space Glove

Kids will learn:
- Engineers *create* models to test technologies.
- They can apply what they have learned about materials and the Engineering Design Process to design a model space glove.



Message from the Duo (5 min)

1. Tell kids that India has sent another message.
2. Have kids turn to *Message from the Duo*, p. 20 in their Engineering Journals, to follow along. Play track 8.
3. To check for understanding, ask:
   - **What is India asking us to do?** *Work together to engineer a model glove that can protect from the space hazards on a particular mission.*

Set the Stage (7 min)

1. Review the *Testing Results* chart together as a full group. Ask:
   - **What do you notice about the materials when we look at all 3 tests together?** *Accept all answers. For example, some materials are great at protecting from impact but bad at protecting from dust.*
2. Organize kids into pairs.
3. Tell groups that today they will put together everything they have learned about the materials to design a model space glove for one of three missions.
4. Let kids know that they will have the opportunity to share their model space glove designs at an Engineering Showcase. During the Showcase, they will explain the mission that their group chose and present their model space gloves to an audience of their peers, staff, family, and community members.
5. Have groups turn to *Mission Profiles*, pp. 21–23 in their Engineering Journals, read each description, and choose a mission. Ask groups to share:
   - **Which mission did you choose?**
   - **What will your glove need to do on that mission?**
6. Show kids the materials they can use to design their gloves. Remind groups that they can use up to 3 materials. Let them know they can also use scissors and up to 3 feet of tape.
7. Show kids the 4 Testing Stations. Explain that there is 1 station for each of the hazards—cold temperatures, impact, and dust. The last station, or final test, will determine how strong the glove is after completing the mission and how easy it was for the astronaut to use.
8. Review the tests at each station so kids can keep them in mind as they design.

Tip: If kids need more context around the missions, show them the *Mission Profile Images,* pp. 73–77 in this guide and/or play some videos from NASA's website.

Plan and Create (28 min)

1. Give pairs a few minutes to *plan* their glove on *Plan*, p. 24 in their Engineering Journals.
2. Once pairs have *planned*, give them 25 minutes to collect their materials and *create* their designs.
3. As pairs finish *creating* their gloves, encourage them to take turns testing their glove, and recording the results on *Simulation Results*, pp. 25–27 in their Engineering Journals. Ask:
   - **What about your model space glove is working well? Why do you think so?**
   - **How can you *improve* your design?**
   - **Did you successfully complete the final test?**
4. After about 25 minutes, have kids stop working and let them know they will have an opportunity to *improve* their model space gloves in the next adventure.

Tip: If groups are interested, allow them to try using a food-safe glove as a base instead of the vinyl glove.

Reflect (5 min)

1. Gather the group together and ask:
   - **Which materials did you use for your model space glove? Why did you choose those materials?** *Accept all answers.*
   - **What happened when you tested your design?** *Accept all answers.*
   - **How could you *improve* your glove so that it is more successful at meeting all of your mission criteria?** *Accept all answers.*
2. Show kids the *Engineering Design Process* poster. Ask:
   - **Which steps of the Engineering Design Process were the most helpful to you today?** *Accept all answers, but encourage kids to think about how they* planned, created, *and* improved *their designs*.
3. Congratulate kids on using the Engineering Design Process and sharing their materials engineering ideas.
4. Give kids time to finish recording the data they collected on *Simulation Results*, pp. 25–27 in their Engineering Journals. Having kids record their ideas will help them remember what they learned and apply it in the next adventure.
5. Save the gloves that the groups *created* in a safe location so they can be *improved* in the next adventure and displayed in the Showcase.

Message from the Duo

reply | forward | archive | delete

from:	engineeringadventures@mos.org
to:	You
subject:	Astronauts need your help!

10:15 AM

Hi engineers!

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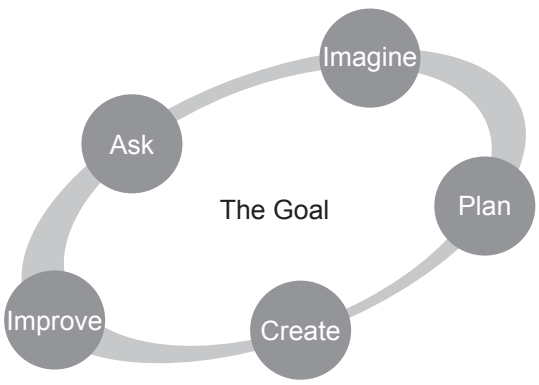


Good luck!
India

Mission Profile Images

Have color copies of *Mission Profile Images*, pp. 73–77 in this guide, available for groups to reference as they design a model space glove.

Cold Test Stations

1. Trim the model hands so they fit inside the palm area of a vinyl glove.
2. Use the directions for Preparation steps 8–9 on p, 33 in this guide to set up 2 Cold Testing Stations for groups to share.
3. Place *Cold Test Directions,* p. 65 in this guide, on the table for kids to reference.

Impact Test Stations

1. Use the directions for Preparation steps 5 and 7 on p. 45 in this guide to set up 2 Impact Testing Stations for groups to share.
2. Place *Impact Test Directions,* p. 67 in this guide, on the table for kids to reference.

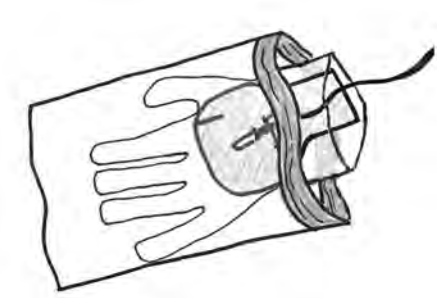
Dust Test Stations

1. Use the directions on p. 56 in this guide to set up 2 Dust Testing Stations for groups to share.
2. Place *Dust Test Directions,* p. 69 in this guide, on the table for kids to reference.

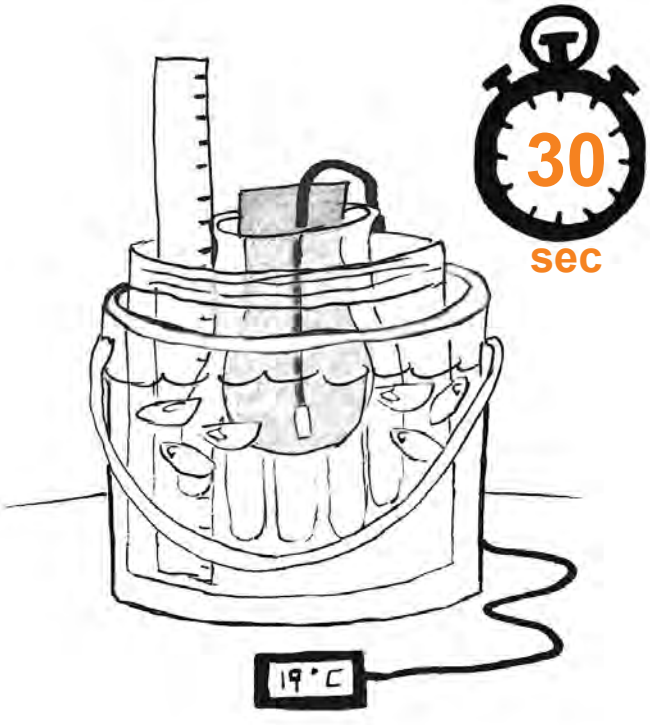
Final Test Stations

1. Prepare 2 Testing Stations for groups to share.
   - Write a simple equation on 2 slips of paper and put them in 2 jars. Tighten the lid on each jar.
   - Set out 2 calculators.
2. Place *Final Test Directions,* p. 71 in this guide, on the table for kids to reference.
3. Kids will test how easy the gloves are to use and look for any damage to the gloves from completing the other tests.

COLD TEST STATION



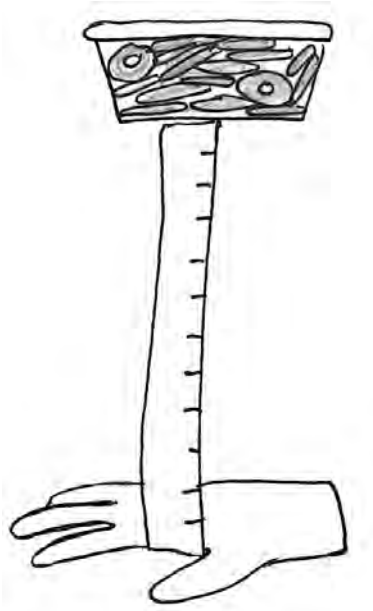
1. Put the model hand with attached thermometer into your glove.
2. Place the model space glove inside the plastic bag.
3. Place the ruler into the corner of the plastic bag.
4. Record the starting temperature in your Engineering Journal.
5. Place the glove straight down into the ice water and start the timer. Use the ruler to keep the glove under water.
6. Record the temperature after **30 seconds.**
7. Subtract to find the difference in temperature.
8. Record your results. How well does your glove protect against the cold?

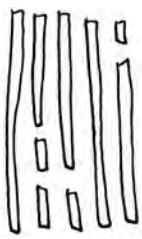


Not Good	Good	Great
7 °C or more	3–6 °C	0–2 °C

IMPACT TEST STATION

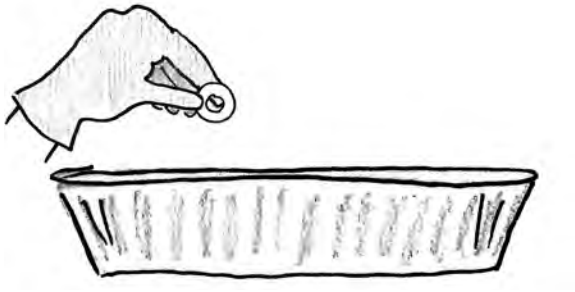
1. Put 1 piece of pasta in each finger of your glove. Snap off any extra pasta that may be sticking out from the wrist.
2. Place your glove in the aluminum tray. Make sure that the “fingers” are resting on the wooden skewer.
3. Lift the weight 1 foot above the center of your glove. Make sure the entire weight is above the ruler.
4. Drop the weight.
5. Carefully empty the pasta out of the glove and count the number of pieces.
6. Record your results.
7. Repeat 2 more times for a total of 3 tests.
8. Record the highest number in the “Final” column. How well does your glove protect against impact?



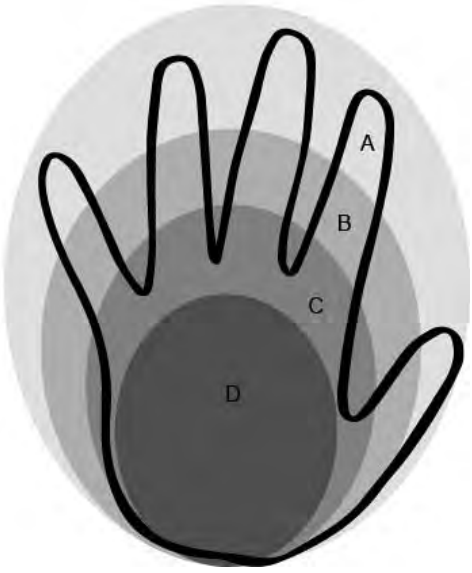
Not Good	Good	Great
11+ pieces	8–10 pieces	5–7 pieces
		

DUST TEST STATION

1. Open the plastic bag.
2. Use your glove to dig through the dust and find the 5 metal washers.
3. Use your glove to place the 5 washers into the plastic bag.



4. Use a paper towel to wipe off any extra dust from your glove.
5. Look at the palm side of your glove with a hand lens and black light to find the places that glow. How many areas have glowing dust?
6. Record your results in your Engineering Journal.



Not Good	Good	Great
4 areas	2–3 areas	0–1 area

7. Reset the station for the next group: bury the 5 washers back in the sand and mix the sand using the craft stick.

FINAL TEST STATION

Part 1: How easy is it to use your glove?

1. Put on your glove.

2. Unscrew the jar and remove the paper.

3. Use your glove to type the equation on the paper into the calculator.

4. Put the equation back in the jar and tighten the lid.

5. Were you able to type the correct equation and get the answer? Record your results in your Engineering Journal.

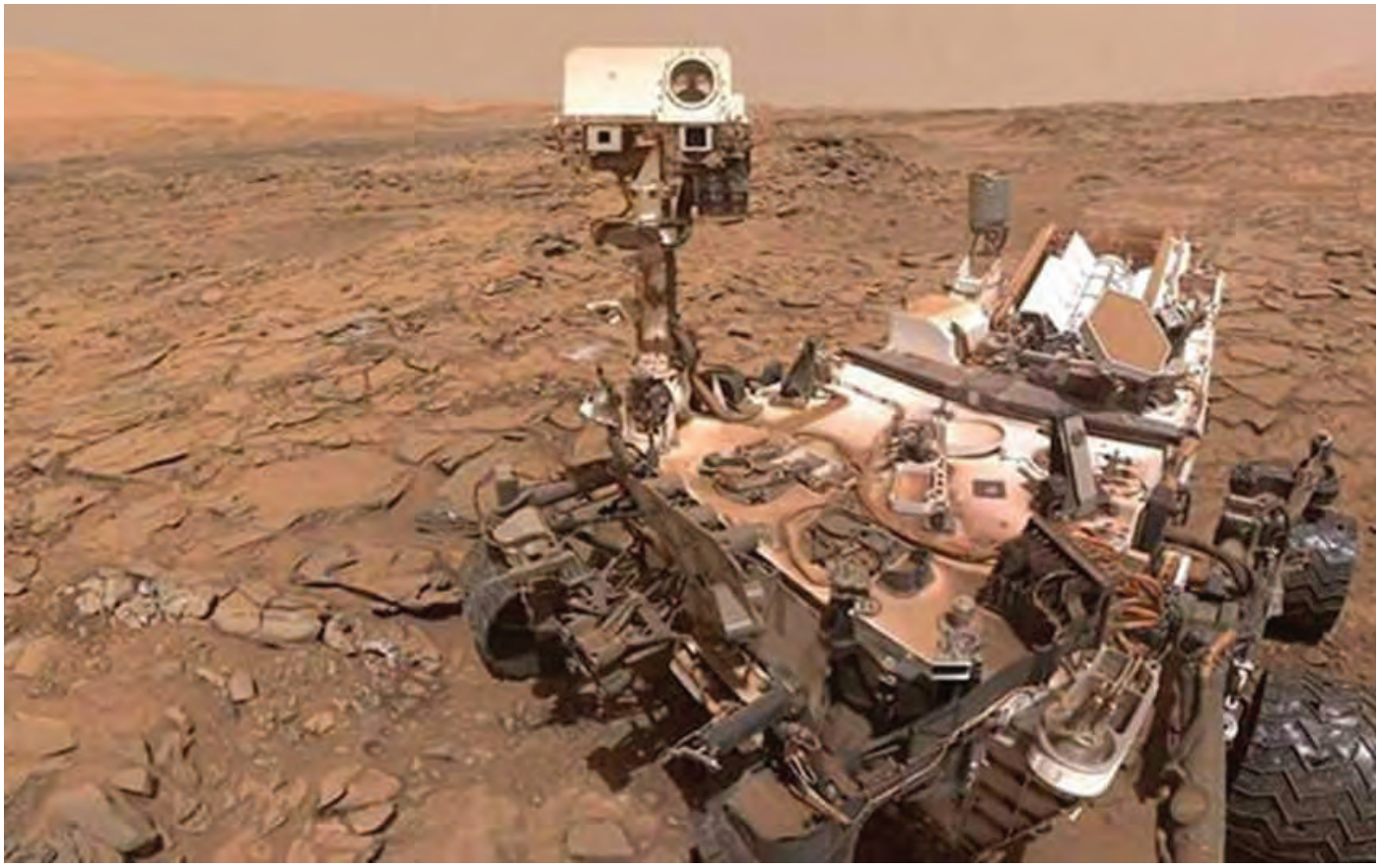
Part 2: How strong is your glove?

1. Take your glove off.

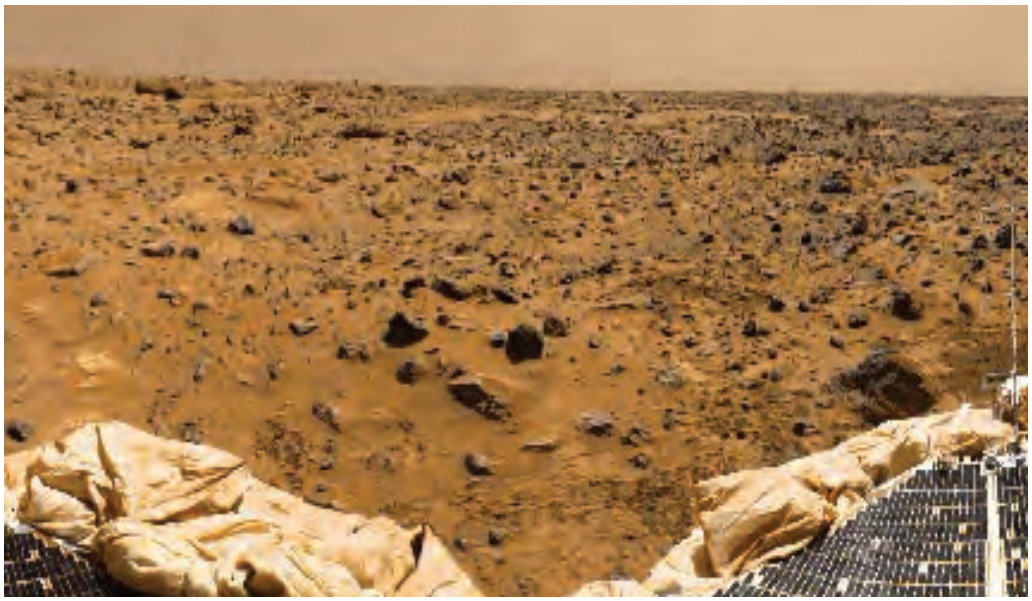
2. Take a close look at your glove. Did it stay together? Did it get damaged in any way?

3. Record your results in your Engineering Journal.

Mars



Curiosity rover exploring Mars. Photo courtesy of NASA.

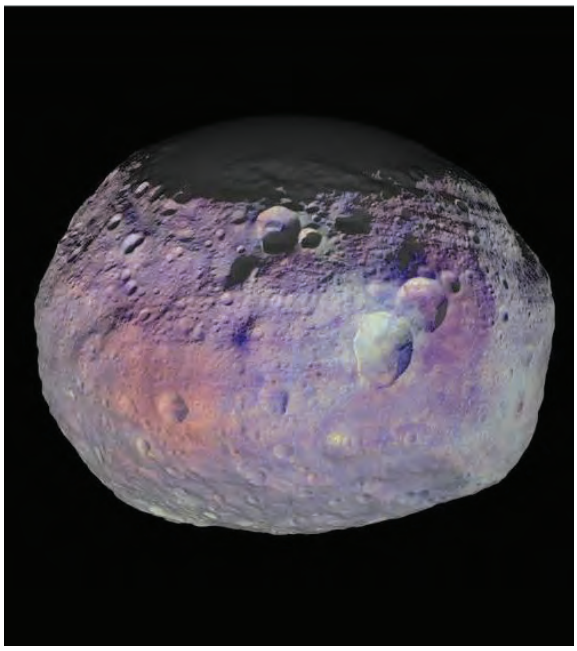


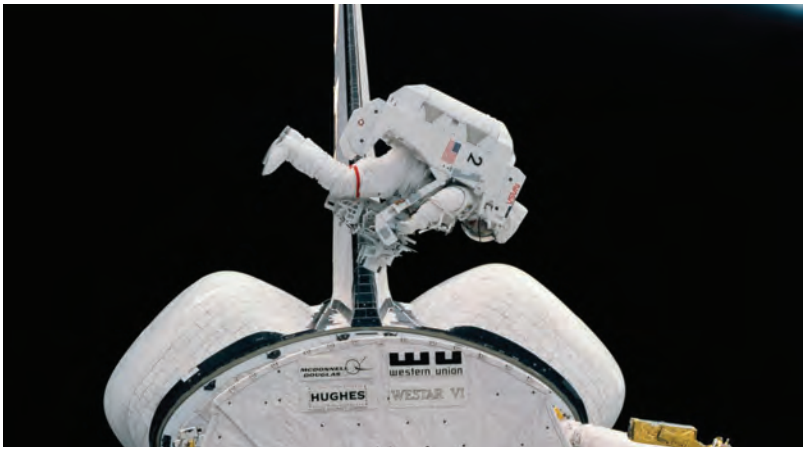
The rocky surface of Mars, from the Mars Pathfinder lander. Photo courtesy of NASA.

An idea for the type of suit astronauts would use on Mars. Photo courtesy of NASA.

Asteroid

A spacecraft collecting a sample from a near-Earth asteroid. Photo courtesy of NASA.





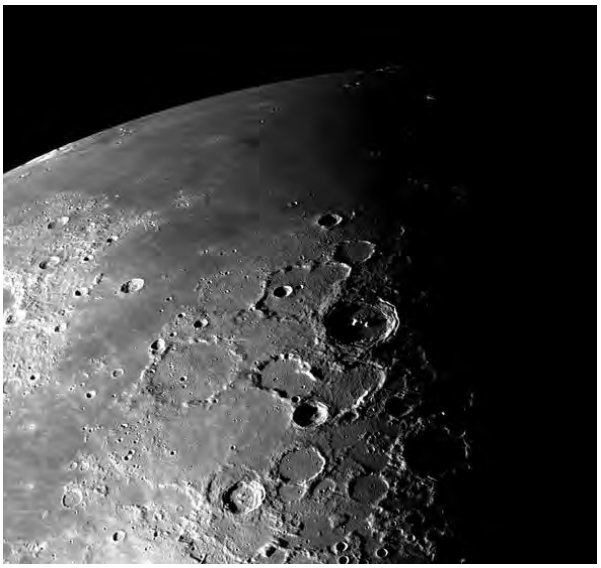
Above: An astronaut testing equipment in space. Photo courtesy of NASA.

Left: Minerals on the asteroid Vesta are represented using different colors. Photo courtesy of NASA.

Moon

An astronaut on the Moon. Photo courtesy of NASA.

Moondust can cause a lot of damage to suits and equipment. Photo courtesy of NASA.



The shaded side of the Moon is much colder than the sunlit side.
Photo courtesy of NASA.