Engineering Adventure 6: Put It Together: Creating a Space Glove

Educator Preview

Adventure Snapshot

Learners plan and create model space gloves and test them to see how well they protect against space hazards.

Timing | 55 minutes

Get Ready & Team Up	5 min.
Plan & Create	45 min.
Reflect & Wrap Up	5 min.
Total	**55 min.**

Level Up Activities 5–15 min. each

Prep Snapshot*

Prep Time 45 min.

- Set up materials stations.
- Print handouts.
- Prepare ice for Adventure 7, as noted in Materials & Preparation.

**See Materials & Preparation for full info.*

21st Century Skills

Connection

- Creativity

Habits of Mind

- Consider problems in context.
- Consider tradeoffs between criteria and constraints.

Guiding Question

How can we design space gloves that protect astronauts from space hazards on the Moon, Mars, or asteroids?

Learners Will Do

Plan, create, and test space gloves that meet mission criteria.

Learners Will Know

Engineers choose materials for designs based on what they need the design to do.

Connecting Across Adventures

Adventure 5: Protecting Against Dust	Adventure 6: Creating a Space Glove	Adventure 7: Improving a Space Glove
Last time, learners tested how well different materials resist dust.	**Today**, learners plan, create, and test gloves to protect against space hazards.	**Next time**, learners will improve their gloves and test them again.

Activity Resources

Access videos and digital resources using the link or QR code below. More information for teaching this curriculum is available in the Educator Guide Introduction (pgs. iii–xxvi). Access more PLANETS units, research, and pathways at https://planets-stem.org/.

weblink: https://hov.to/f9ad3ecc

Materials and Preparation

Materials

For the whole group

- *Our Ideas* poster (on paper or a shared digital document) Examples | Templates
- 2 calculators
- 2 Cold Testing Stations from Adventure 3
- 2 Impact Testing Stations from Adventure 4
- 2 Dust Testing Stations from Adventure 5
- 2 jars with lids
- 2 pieces of paper, 2" × 3"
- 2 resealable plastic bags, gallon size
- 1 box food-safe gloves (optional)

For each group of 4

- 2 pairs of scissors
- 2 vinyl gloves
- Engineering Adventure 6 Mission Profiles Handout, pg. 84

For each learner

- Engineering Notebook (PDF)

Support Learner Differences

Mechanical calculators are used to test the ability of the gloves to push buttons. However, your learners may benefit from using adaptive calculators instead.

Teaching Tip

If time is short or learners would benefit from a starting point, you can create simple prototype gloves for learners to modify.

For the Materials Table

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

Adventure 6 Materials Preparation (45 min.)

Ahead of Time

1. Review the "In-Use Example" in the Prep & Setup Guide (PDF) to help you think about what to add to the *Our Ideas* poster during the discussions in this adventure.
2. Watch the video How to Design and Test Space Gloves (3:00).
3. Make 1 copy of Engineering Adventure 6 Mission Profiles Handout, pg. 84, for each group of 4.
4. Make a plan to store gloves-in-progress between adventures. For example, you may want to have sturdy boxes to store the gloves so they are not damaged.

In Your Space

5. Place the *Our Ideas* poster in a visible place in your learning setting or prepare to share it digitally.
6. See Mission Test Setup Instructions, pg. 81.
7. Set up a Materials Table. See list above.

Ice Preparation for Other Adventures

8. Be aware that you will need 12 cups of ice for Adventure 7.

Teaching Tips

- If you have space, you can leave the Testing Stations set up exactly as they are at the end of this adventure. They will be reused in Adventure 7.
- Be sure sponges are dry so tape will stick to them. Save the Testing Stations and model space gloves for Adventure 7.

Adventure Guide

Get Ready & Team Up (5 min.)

1. Ask: **If you did the last three activities, what did you do and why?** *(We measured how well different materials protected a glove from cold, impact, and dust.)*
2. Revisit the *Engineering Comic* with learners, focusing on how space gloves need to protect against multiple hazards.
3. Say: **Today you will work on the Imagine, Plan, Create, and Test phases of our engineering design process. You will use everything you learned to design a space glove for a mission.** Point out the Guiding Question at the top of the *Our Ideas* poster and share it aloud: **How can we design space gloves that protect astronauts from space hazards on the Moon, Mars, or asteroids?**
4. Organize learners into groups of 4 and distribute Engineering Notebooks.

Plan and Create (45 min.)

5. Review the Testing Results chart on the *Our Ideas* poster. Ask: **What do you notice?** *(Accept all answers. For example, some materials protect against impact but not dust.)* Say: **You can refer to this chart as you work.**
6. Give each group a copy of Engineering Adventure 6 Mission Profiles Handout, pg. 84. Have them read each description and choose a mission.
7. Say: **Each group will be designing two gloves. For each glove, you can use up to 3 materials, scissors, and up to 3 feet of tape.**
8. Show learners the Testing Stations: cold, impact, dust, and a final test. Review each test. As needed, allow learners to feel the test setups.
9. Give learners a few minutes to discuss and fill out *Plan*, pg. 18 in their Engineering Notebooks.

Support Learner Differences

If new learners are joining you, lead an inclusion activity (pgs. xx-xxi) and use other engagement strategies as necessary (pgs. viii–xviii).

Teaching Tip

It's important to keep the same groups for Engineering Adventures 6, 7, and 8. That way, the same learners are working together on the same gloves each time.

Support Learner Differences

Encourage learners to identify their own strengths and the roles they would like to play during testing, and form groups that can play a variety of roles. For example, at the Final Test Station, a learner who is good at reading can read the equation, and a learner who is good with their hands can enter it into the calculator.

10. Give groups 25 minutes to collect materials and create designs.

Teaching Tip

If time is running short, you can pause the adventure here and test the gloves in another session. You can also have learners perform one test rather than two for each glove.

Support Thinking

- Allow learners to try modifying materials before adding them to the gloves. For example, they may get a sponge wet before attaching it.
- If learners would benefit from an additional visual of the testing procedure, play *How to Design and Test Space Gloves* (from 2:12).
- Learners may say that they have failed. Emphasize that engineers think about designs failing, not about people failing. To help learners persist and learn from failure, treat ineffective designs as an opportunity to gather data and make improvements. Ask: **What did you find out from that test? How will you use it to plan the next design of your gloves?**
- Have learners think about local traditions of making gloves and other clothing items to protect against hazards. Ask: **What materials do you know of that people use to make gloves? Why are these materials useful?**

11. As groups finish, have them test their gloves and record the results on *Test Results*, pg. 20 in their Engineering Notebooks.

Reflect & Wrap Up (5 min.)

12. Revisit the Guiding Question: **How can we design space gloves that protect astronauts from space hazards on the Moon, Mars, or asteroids?** Ask: **Which materials did you use? Why? What happened when you tested? How can you improve your glove?** Allow learners to record ideas on the *Our Ideas* poster.
13. Say: **Next time, you will improve your gloves and retest them.**

After the Adventure

1. Clean up:
   - Keep the *Our Ideas* poster for Adventure 7.
   - Save the gloves and Testing Stations for Adventure 7.
2. Plan for Engineering Adventure 7. See Engineering Adventure 7 Preparation on pg. 94. Note that you will need another 12 cups of ice for the Cold Testing Station. This setup will likely take at least 30 minutes.
3. Take time to reflect on the following educator prompt. **How did you help learners embrace and learn from failure during this adventure?**

Space Hazards Additional Resources

Resources include All Downloads, All Videos, Family Connections, and more.

weblink: https://hov.to/940428f7

Level Up!

- Refer to the Engineering Design Process poster (PDF). Ask: **What phases of the Engineering Design Process did you use today?** *(Responses will vary. Possible responses include the Imagine, Plan, and Create phases.)* (5 min.)
- If you can, show the NASA video clip Spacesuits for the Next Explorers (Full feature) (12:03) to help learners understand that different space missions require different spacesuits. (15 min.)
- NASA often tests components and technology before deciding to use it in a full mission. This is called a "technology demonstration," often shortened to "tech demonstration," and helps NASA learn about what can and can't work in different types of environments. The Mars 2020 helicopter named "Ingenuity" was one such Tech Demonstration, testing whether it was possible to fly a helicopter in the thin atmosphere of Mars. Turns out it's possible; learn more in the article "Ingenuity Passes the Test - NASA" (10 min.)
- Ask one of these story prompts: (1) **Can you tell me a story about building something to solve several problems at the same time?** (2) **Can you tell me a story you know about something in the night sky?** (If you are working with Indigenous learners, be aware that it may not be an appropriate time of year to tell star stories. If you are unsure, use the first story prompt.) Tell learners, if anyone asks what they did today, they can tell them "We designed an astronaut glove!", and then ask them the above story prompts. Consider returning to learners' ideas at the start of the next adventure. (5 min.)

Mission Test Setup Instructions

Set up testing stations for learners to test how well their gloves protect against cold, impact, and dust, as well as how easy they are to use and how durable they are.

Mission Profile Images

1. Make color copies of Engineering Adventure 6 Mission Profiles Handout, pg. 84, for each group.

Cold Test Stations

2. Trim the model hands so they fit inside the palm area of a vinyl glove.
3. Use Cold Test Setup Instructions, pg.50, to set up two Cold Testing Stations.
4. Place Engineering Adventure 3 Cold Test Procedure Handout, pg.53, on the table.

Impact Test Stations

5. Use Impact Test Setup Instructions, pg. 61, to set up two Impact Testing Stations.
6. Place Engineering Adventure 4 Impact Test Procedure Handout, pg. 62 on the table.

Dust Test Stations

7. Use Dust Test Setup Instructions, pg. 71 to set up two Dust Testing Stations.
8. Place Engineering Adventure 5 Dust Test Procedure Handout, pg. 72, on the table.

Final Test Stations

Materials for each setup:

- 1 calculator
- 1 piece of paper, 2" × 3"
- 1 plastic jar with lid

Prepare Test Stations

9. Prepare two Test Stations for groups to share.
   - Write simple equations on 2 slips of paper and put them in 2 jars. Tighten the lids.
   - Set out 2 calculators.
10. Place Final Test Procedure Handout, pg. 83, on the table.

Final Test Procedure

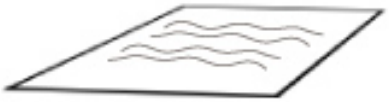
1

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 get the answer?

Record your results in your Engineering Notebook.



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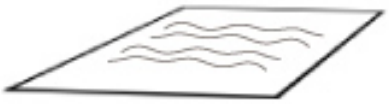
Part 2

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?

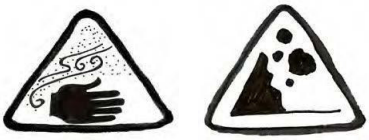
Record your results in your Engineering Notebook.

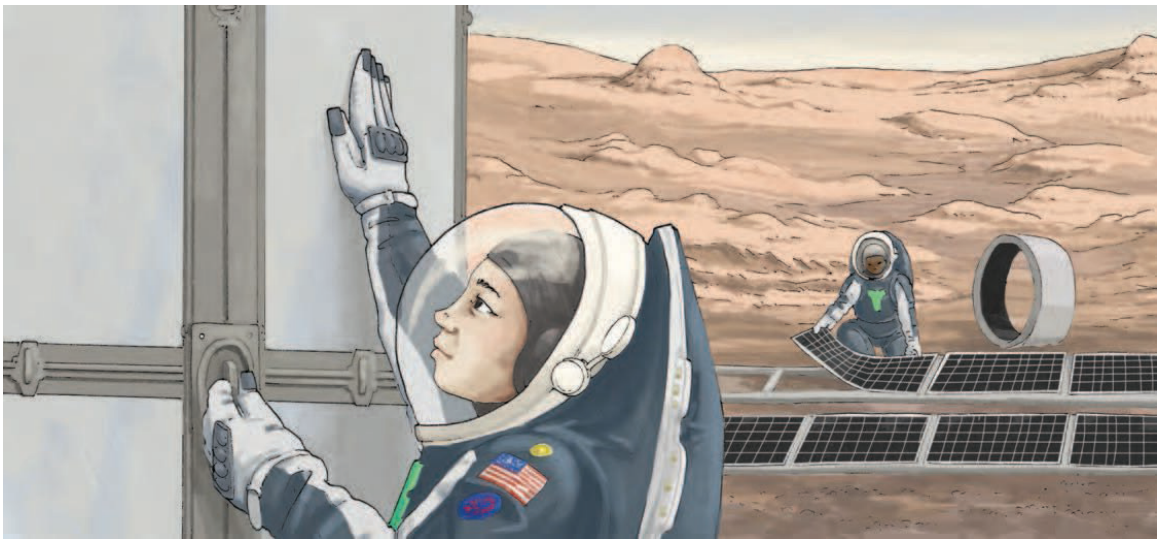


Mission Profiles

Mars

Build a habitat on the planet Mars.





Your model space glove should

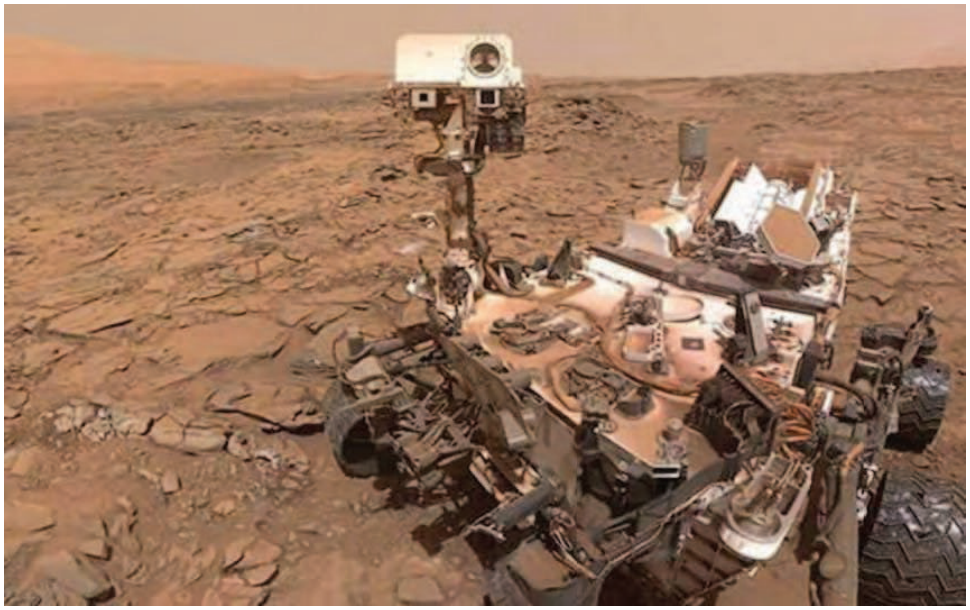
- protect from both **dust** and **impact** hazards.
- allow you to open a jar and type on a calculator.
- be removable.

Your model space glove cannot

- use more than 3 materials.
- use more than 3 feet of tape.
- have any materials or parts fall off after testing.

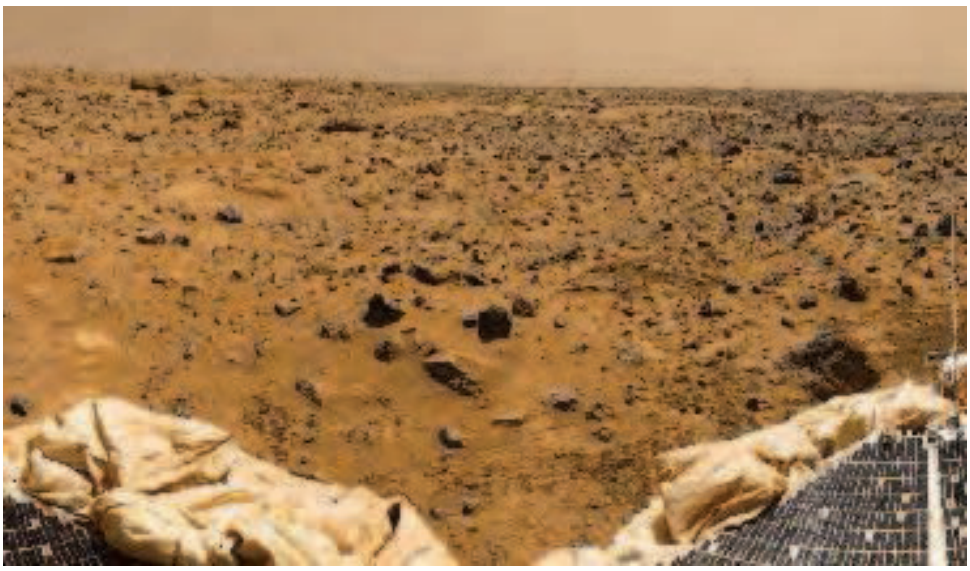
Did You Know?

Mars is the fourth planet from the Sun. There is so much rust in the rocks that Mars is nicknamed the "Red Planet." No humans have visited Mars.



Curiosity rover exploring Mars.

Photo courtesy of NASA.



The rocky surface of Mars, from the Mars Pathfinder lander.

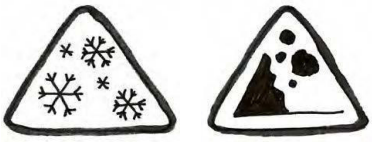
Photo courtesy of NASA.

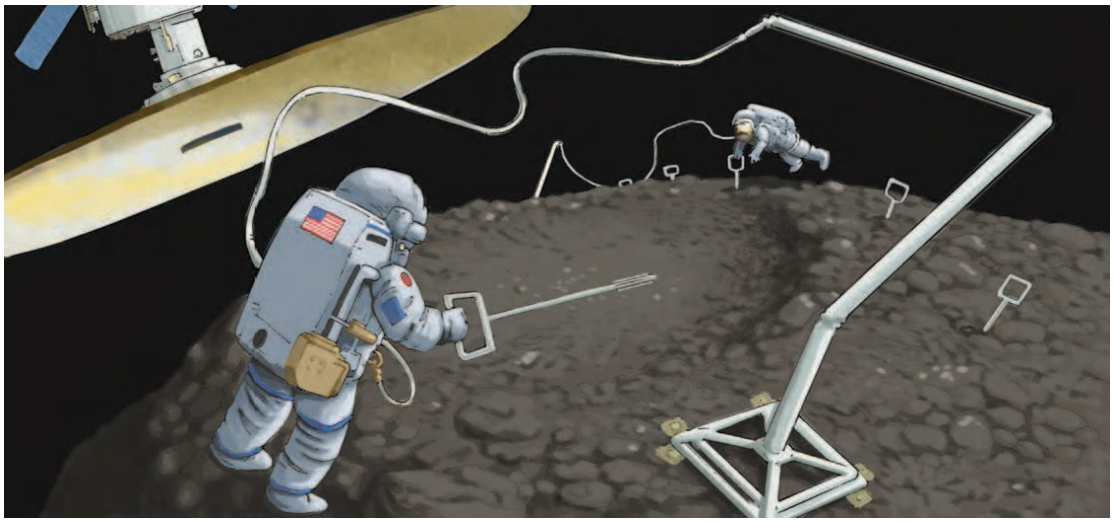
An idea for the type of suit astronauts would use on Mars.

Photo courtesy of NASA.

Asteroids

Mine asteroids for their minerals.





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- protect from both **cold** and **impact** hazards.
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- use more than 3 feet of tape.
- have any materials or parts fall off after testing.

Did You Know?

Asteroids are small, rocky objects that are sometimes called "minor planets." Most asteroids in our solar system are found in the Asteroid Belt between Mars and Jupiter. No humans have visited asteroids.

Some asteroids are made of materials that have been around since the solar system formed 4.5 billion years ago.

A spacecraft collecting a sample from a near-Earth asteroid.

Photo courtesy of NASA.

Minerals on the asteroid Vesta are represented using different colors.

Photo courtesy of NASA.

An astronaut testing equipment in space.

Photo courtesy of NASA.

Moon

Build a radio tower on the far side of Earth's moon.

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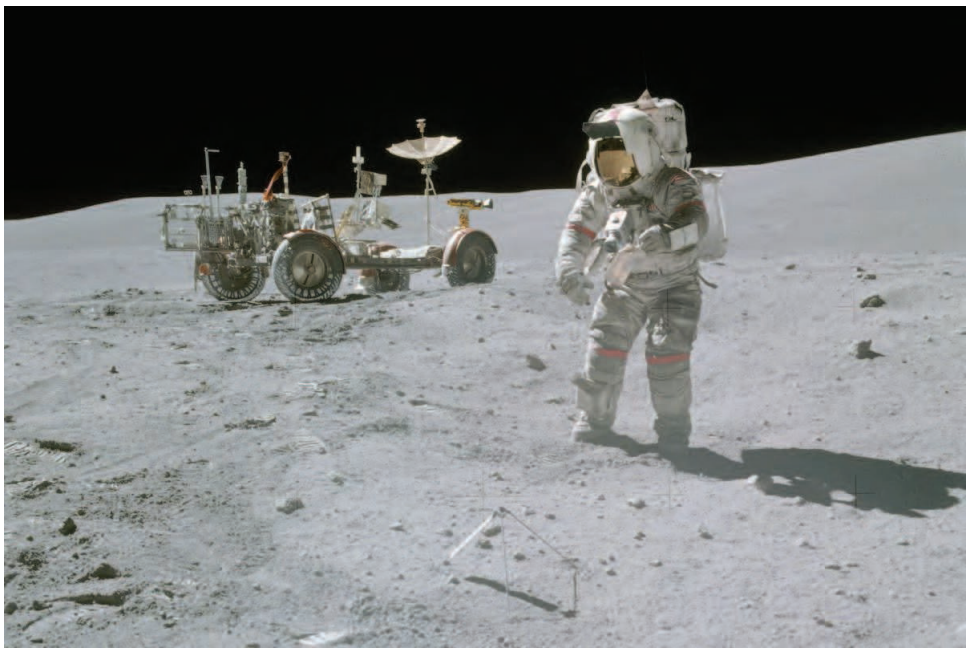
- use more than 3 feet of tape.
- have any materials or parts fall off after testing.

Did You Know?

We always see the same side of the Moon from Earth. This is called the "near side." Sometimes the far side is called the "dark side," but it actually gets the same amount of sunlight as the near side!



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 night side of the Moon is much colder than the day side.

Photo courtesy of NASA.