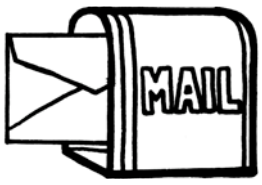
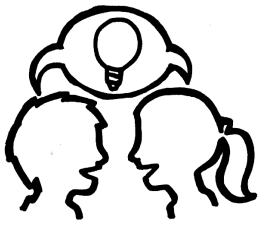
Overview: Kids will explore the features of different gloves and how they perform in a series of challenges. Kids then are introduced to the concept of space hazards and spacesuit design.

Note to Educator: In this adventure, each pair of kids tests one type of glove in a series of challenges. Provide extra groups the food-safe or vinyl gloves, since there are more of these types. If pairs have trouble reusing the food-safe or vinyl gloves, let them know they can get new gloves between each station.

Duo Update (5 min)

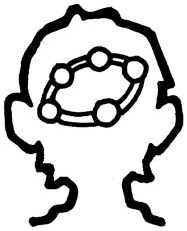


Set the Stage (5 min)



Activity (15 min)

Reflect (20 min)



Materials

For the entire group:

- ☐ *Message from the Duo*, track 3 or Engineering Journal, p. 7
- ☐ *Message from the Duo*, track 4 or Engineering Journal, p. 9
- ☐ *NASA Spacesuit Development* video
- ☐ *Engineering Design Process* poster
- ☐ 1 box of food-safe gloves
- ☐ 1 box of vinyl gloves
- ☐ 1 permanent marker
- ☐ 1 tablespoon measure

Glove Challenges:

- ☐ access to water
- ☐ *Stations 1–3,* pp. 25–29
- ☐ 1 bottle of dish soap
- ☐ 1 roll of masking tape
- ☐ 2 rolls of paper towels
- ☐ 4 jars with twist lids
- ☐ 4 pipe cleaners
- ☐ 4 plastic cups, 16 oz.
- ☐ 6 aluminum trays, 12” x 10”
- ☐ 8 stopwatches
- ☐ 28 washers, 1 1/4"
- ☐ 60 beads
- ☐ 160 paper clips

For each pair of kids:

- ☐ 1 pair of gloves: dish, food-safe, garden, oven mitt, vinyl, or winter

For each kid:

- ☐ Engineering Journal

Preparation

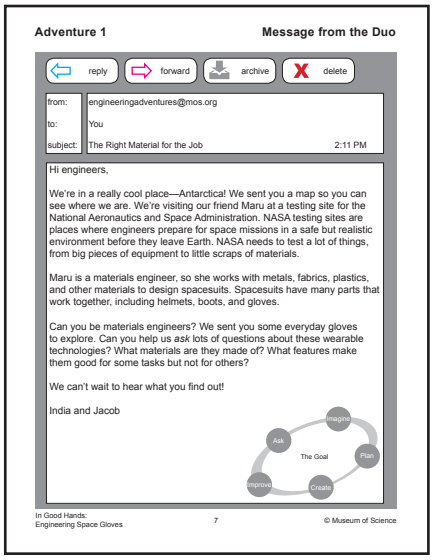
Time Required: 40 minutes

1. Post the *Engineering Design Process* poster.
2. Have the *Messages from the Duo* ready to share.
3. Watch and prepare to play the video *NASA Spacesuit Development* (7:16): www.nasa.gov/feature/nasa-spacesuit-development.
4. Make 1 copy of *Stations 1–3*, pp. 25–29 in this guide.
5. Set up the stations by following the instructions on *Glove Challenge Set Up*, pp. 22–23 in this guide.
6. Optional: Make a copy of *Gloves in Action*, p. 31 in this guide, for each pair of kids.

continued on next page →

Journal Pages for Adventure 1

Message from the Duo, p. 7



Adventure 1 — Message from the Duo

reply | forward | archive | delete

from: engineeringadventures@mos.org
to: You
subject: The Right Material for the Job 2:11 PM

Hi engineers,

We're in a really cool place—Antarctica! We sent you a map so you can see where we are. We're visiting our friend Maru at a testing site for the National Aeronautics and Space Administration. NASA testing sites are places where engineers prepare for space missions in a safe but realistic environment before they leave Earth. NASA needs to test a lot of things, from big pieces of equipment to little scraps of materials.

Maru is a materials engineer, so she works with metals, fabrics, plastics, and other materials to design spacesuits. Spacesuits have many parts that work together, including helmets, boots, and gloves.

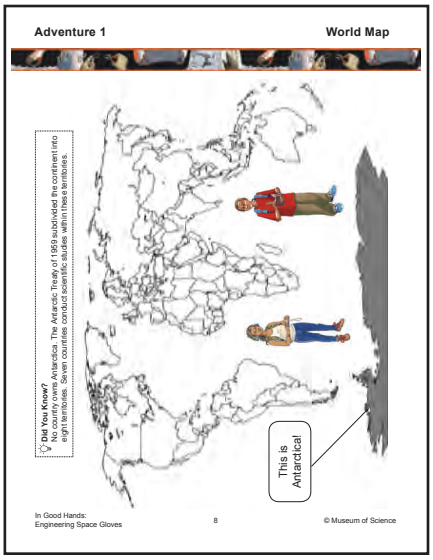
Can you be materials engineers? We sent you some everyday gloves to explore. Can you help us *ask* lots of questions about these wearable technologies? What materials are they made of? What features make them good for some tasks but not for others?

We can't wait to hear what you find out!

India and Jacob

In Good Hands: Engineering Space Gloves 7 © Museum of Science

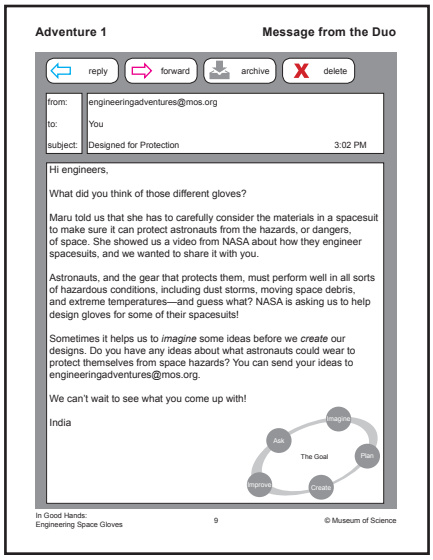
World Map, p. 8



Adventure 1 — World Map

In Good Hands: Engineering Space Gloves 8 © Museum of Science

Message from the Duo, p. 9



Adventure 1 — Message from the Duo

reply | forward | archive | delete

from: engineeringadventures@mos.org
to: You
subject: Designed for Protection 3:02 PM

Hi engineers,

What did you think of those different gloves?

Maru told us that she has to carefully consider the materials in a spacesuit to make sure it can protect astronauts from the hazards, or dangers, of space. She showed us a video from NASA about how they engineer spacesuits, and we wanted to share it with you.

Astronauts, and the gear that protects them, must perform well in all sorts of hazardous conditions, including dust storms, moving space debris, and extreme temperatures—and guess what? NASA is asking us to help design gloves for some of their spacesuits!

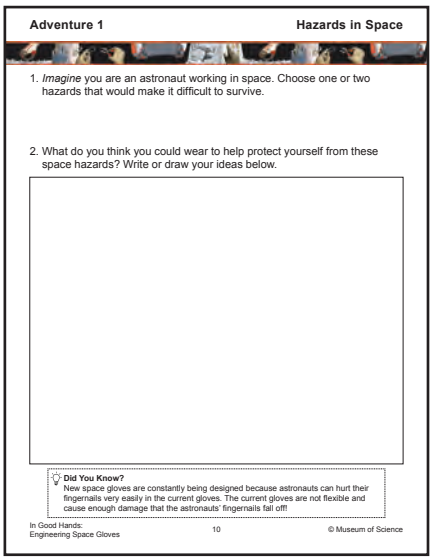
Sometimes it helps us to *imagine* some ideas before we *create* our designs. Do you have any ideas about what astronauts could wear to protect themselves from space hazards? You can send your ideas to engineeringadventures@mos.org.

We can't wait to see what you come up with!

India

In Good Hands: Engineering Space Gloves 9 © Museum of Science

Hazards in Space, p. 10



Adventure 1 — Hazards in Space

1. *Imagine* you are an astronaut working in space. Choose one or two hazards that would make it difficult to survive.

2. What do you think you could wear to help protect yourself from these space hazards? Write or draw your ideas below.

Did You Know?
New space gloves are constantly being designed because astronauts can hurt their fingernails very easily in the current gloves. The current gloves are not flexible and cause enough damage that the astronauts' fingernails fall off!

In Good Hands: Engineering Space Gloves 10 © Museum of Science

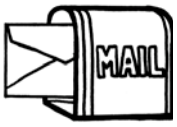
Ice and Sponge Preparation for Other Adventures

Time required: 15 minutes

Prepare 12 cups of ice for each of the following: **Adventures 2, 5, and 6**.

Open the sponge packaging to allow the sponges time to dry out. The sponges need to be dry so that tape will adhere to them. Sponges are used in **Adventures 2, 3, 4, 5, and 6.**

Kids will learn:
- Engineers design technologies that help protect astronauts from space hazards.
- *Asking* questions about materials is part of the Engineering Design Process.



Present the Message from the Duo (5 min)

1. Tell kids that India and Jacob sent a message about the duo's mission. Have kids turn to *Message from the Duo*, p. 7 in their Engineering Journals, to follow along. Play track 3.
2. Let kids know that before launching into space, NASA tests many of their technologies, including spacesuits, at testing sites on Earth, some of which are located in Antarctica. To see where Antarctica is located, have kids look at *World Map*, p. 8 in their Engineering Journals.
3. To check for understanding, ask:
   - **What do India and Jacob want us to do?** *Be materials engineers and explore the features of different gloves.*

Set the Stage: What Do You Know about Gloves? (5 min)

1. Have kids share what they already know about gloves. Ask:
   - **Why do people wear gloves?** *Accept all answers. Common responses include: to be warm, clean, safe, or fashionable.*
2. Tell kids that India and Jacob have sent them 6 types of gloves to examine. Identify each glove and allow kids to feel the gloves, and make observations about the materials with which they were designed. Ask:
   - **How are they similar?** *They all cover your hands.*
   - **How are they different?** *They are different colors, sizes, and materials. Some are made of just one material, and others are made of multiple materials.*
3. Tell kids that they are going to explore how each glove performs in a series of challenges.

Ask: Which Glove Works Best? (15 min)

1. Organize kids into pairs.
2. Review the names of the gloves and assign 1 type of glove to each pair.
3. Show kids the sheet posted at each station that has directions on how to test the gloves and a results chart. Let them know that:
   - First, pairs will read the directions on how to test the gloves.
   - Next, they will complete the glove challenge, with their gloves on.
   - Then, they will record their results in the results chart on the sheet.
   - Finally, kids must reset the stations.
   - Pairs must visit all 3 stations; when they finish 1 station, they can move to any available station.

4. Give kids a brief description of what they will do at each station. Ask:
   - **For each task, which glove do you predict will work the best? The worst?** *Accept all answers.*
5. Have kids move to their first station and begin testing.
6. Let kids know when time is winding down.

Tip: Each station should take no more than 3 minutes. If the *Slippery Jar* station is taking longer, pairs should stop and move on to the next station.

Reflect (20 min)

1. Gather kids together and review the testing results from each station. Ask:
   - **What surprised you about how the gloves did at each station?** *Guide kids to compare their predictions and how well the gloves actually did at each station.*
   - **Which tasks did your gloves do best and worst in? Why do you think so?** *Guide kids to think about how the materials and features of their gloves affected their results.*
2. Let kids know that India has sent another message. Have kids turn to *Message from the Duo*, p. 9 in their Engineering Journals, to follow along. Play track 4.
3. After the message, play the video *NASA Spacesuit Development* (7:16): www.nasa.gov/feature/nasa-spacesuit-development.
4. To check for understanding, ask:
   - **What hazards do engineers consider when designing spacesuits?** *Accept all answers, including: extreme temperatures, dust storms, space debris, vacuum, no oxygen, or trips and falls.*
   - **Why do materials engineers need to know about the hazards when they design spacesuits?** *So they can match the suit to the dangers of the mission.*
5. Help kids make the connection that, just as the gloves they tested perform better for specific tasks, the parts of a spacesuit are designed for the goals of the mission.
6. Gather kids together at the *Engineering Design Process* poster. Ask:
   - **Which step of the Engineering Design Process did you use most today?** *We* asked *which gloves work best for different tasks. We* asked *what engineers need to know when designing a spacesuit.*
7. Let kids know that next time they will *ask* questions about how well different materials can protect against the hazard of cold temperatures.

Tip: Hand out copies of *Gloves in Action*, p. 31 in this guide, to review the function, materials, and features of each glove.

Tip: Have kids record their ideas about spacesuits that protect from space hazards on *Hazards in Space*, p. 10 in their Engineering Journals.

Message from the Duo

reply | forward | archive | delete

from:	engineeringadventures@mos.org
to:	You
subject:	The Right Material for the Job

2:11 PM

Hi engineers,

We're in a really cool place—Antarctica! We sent you a map so you can see where we are. We're visiting our friend Maru at a testing site for the National Aeronautics and Space Administration. NASA testing sites are places where engineers prepare for space missions in a safe but realistic environment before they leave Earth. NASA needs to test a lot of things, from big pieces of equipment to little scraps of materials.

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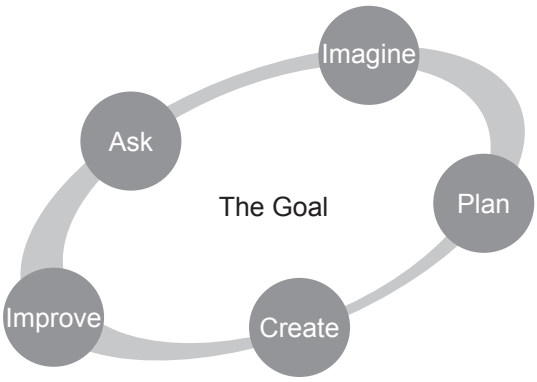

Message from the Duo

reply | forward | archive | delete

from:	engineeringadventures@mos.org
to:	You
subject:	Designed for Protection

3:02 PM

Hi engineers,

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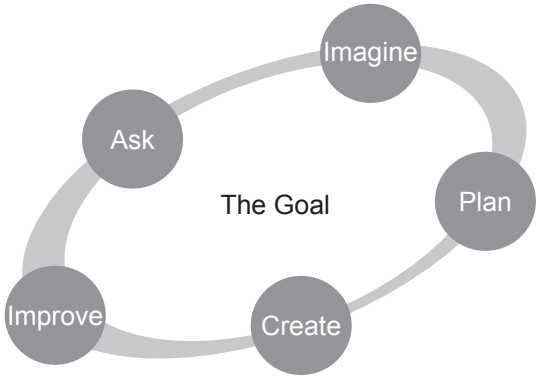
We can't wait to see what you come up with!

India



Arrange the stations on separate tables by following the instructions below.

The instructions ensure that there are 4 setups at each station so that 4 pairs of kids can test simultaneously.

Arrange as many setups per station as needed so that kids in each pair have a place to test their gloves at any given time.

Station 1: Slippery Jar

Materials

- ☐ *Station 1: Slippery Jar*, p. 25 in this guide
- ☐ access to water
- ☐ 1 bottle of dish soap
- ☐ 1 roll of paper towels
- ☐ 1 tablespoon measure
- ☐ 2 aluminum trays, 12” x 10”
- ☐ 4 pipe cleaners
- ☐ 4 plastic jars with twist lids
- ☐ 4 stopwatches
- ☐ 60 beads

This shows 2 setups. For 4 setups, there should be 2 of these per table.

Instructions

1. Place the *Station 1: Slippery Jar* sheet at the station where kids can see it.
2. Place 15 beads in each jar and tighten the lids.
3. Pour 1 cup of water into each aluminum tray and add 2 tablespoons of dish soap.
4. Roll the jars in the soapy water and leave them in the tray.
5. Place 2 pipe cleaners, 2 stopwatches, and a roll of paper towels near each tray.

Station 2: Paper Clip Pick Up

This shows 2 setups. For 4 setups, there should be 2 of these per table.

Materials

- ☐ *Station 2: Paper Clip Pick Up*, p. 27 in this guide
- ☐ 4 plastic cups, 16 oz.
- ☐ 4 stopwatches
- ☐ 160 paper clips

Instructions

1. Place the *Station 2: Paper Clip Pick Up* sheet at the station where kids can see it.
2. Spread the paper clips on the table in a single layer.
3. Place the plastic cups and stopwatches around the paper clips.

Station 3: Find the Message

This shows 2 setups. For 4 setups, there should be 2 of these per table.

Materials

- ☐ *Station 3: Find the Message*, p. 29 in this guide
- ☐ access to water
- ☐ 1 permanent marker
- ☐ 1 roll of paper towels
- ☐ 4 aluminum trays, 12” x 10”
- ☐ 28 washers

Instructions

1. Place the *Station 3: Find the Message* sheet at the station where kids can see it.
2. Fill each tray halfway with water.
3. Choose a word with 5 letters (e.g.,"hello")—this will be the message kids need to find.
4. Use a permanent marker to write 1 letter of the message on each washer. Do this again so you have 4 sets of washers with the same 5 letters written on them.
5. Place 1 message in each tray. Add 2 additional washers to each tray and turn all the washers over to hide the letters.
6. Place a roll of paper towels at this station in case of spills.
7. Optional: Write the message on *Station 3: Find the Message* so kids know what to look for as they complete the task.

Station 1: Slippery Jar

*The maximum amount of time is 3 minutes

Challenge Directions

1. Start the timer.
2. Open 1 jar and take out 3 beads.
3. String each bead onto the pipe cleaner and twist the lid back on the jar.
4. Stop the timer. How long did it take you to complete the task?
5. Record your results.

Reset

1. Put the beads back in the jar and close the lid.
2. Roll the jar in the soapy water.

Use paper towels to dry your gloves before moving to the next station.

Station 1 Results

Glove Type	Time to Complete
dish 	
food-safe 	
garden 	
oven[1] 	
vinyl 	
winter 	

[1] "Baking glove" by Lymantria is licensed under CC BY-SA 3.0
https://commons.wikimedia.org/wiki/File:Baking_glove.jpg

Station 2: Paper Clip Pick Up

Challenge Directions

1. Set the timer for 20 seconds.
2. Pick up paper clips one at a time and drop them in the cup.
3. Stop after 20 seconds. How many paper clips are in the cup?
4. Record your results.

Reset

1. Take the paper clips out of the cup.
2. Spread the paper clips on the table in a single layer.

Station 2 Results

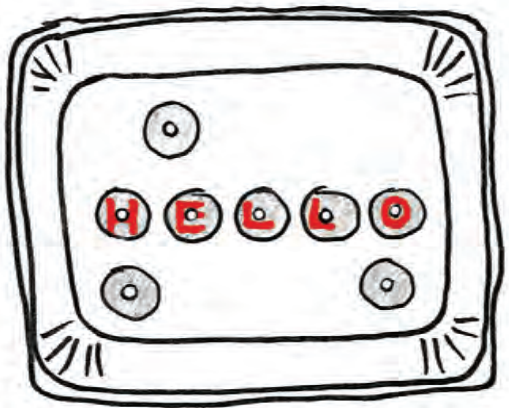
Glove Type	Number of Paper Clips
dish 	
food-safe 	
garden 	
oven[1] 	
vinyl 	
winter 	

[1] "Baking glove" by Lymantria is licensed under CC BY-SA 3.0
https://commons.wikimedia.org/wiki/File:Baking_glove.jpg

Station 3: Find the Message

Challenge Directions

1. Turn over the washers in the water.
2. Arrange the washers to reveal the message.
3. Take the gloves off. Are your hands wet or dry?
4. Record your results.



Reset

1. Turn the washers over so the message is hidden.
2. Mix the washers up so the message is hard to find.

Use paper towels to dry your gloves before moving to the next station.

Station 3 Results

Glove Type	Wet or Dry?
dish 	
food-safe 	
garden 	
oven[1] 	
vinyl 	
winter 	

[1] "Baking glove" by Lymantria is licensed under CC BY-SA 3.0
https://commons.wikimedia.org/wiki/File:Baking_glove.jpg

Glove Type	Function	Material	Features
dish 	Dish gloves protect skin while working with soapy water or chemicals, especially for long periods of time. They are often longer than other gloves, covering up to the elbow.	Thick rubber or rubber-like material	Waterproof Good grip
food-safe 	Food-safe gloves help stop the spread of germs and keep hands clean while serving or preparing food. They are made to be inexpensive and thrown away after use.	Thin plastic	Inexpensive One-time use
garden 	Garden gloves keep your hands clean while digging, planting, or weeding. They can also protect your hands from sharp or scratchy plants.	Cloth	Good grip Washable
oven 	Oven mitts, or baking gloves, are worn in the kitchen to protect your hands from hot objects like baking sheets or pot handles.	Fabric or silicone	Insulated Thick
vinyl 	Vinyl gloves have many uses, including cleaning or preparing food. Vinyl gloves are perfect for many glove changes between tasks. They have a tight fit and are thrown away after use.	Thin plastic	Fitted One-time use
winter 	Winter gloves keep hands warm in cold temperatures.	Cloth	Insulated