Engineering Adventures®

In Good Hands: Engineering Space Gloves

Materials Engineering for Out-of-School Time • Grades 3–5

Written by the EiE® Team
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and the EiE Team®

EiE

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Pilot Sites for In Good Hands:

This unit would not be possible without the valuable feedback from our pilot sites!

A.C. Whelan Elementary School Revere, MA
Beeman Memorial School Gloucester, MA
Boys and Girls Club of Dorchester Dorchester, MA
Boys and Girls Club of Flagstaff Flagstaff, AZ
Boys and Girls Club of Greater Salem Salem, MA
Bridges After-School Program Carmichael, CA
Cambridge Camping Association Cambridge, MA
East Prairie Middle School Tuscola, IL
Flagstaff Family YMCA Flagstaff, AZ
Flagstaff Junior Academy Flagstaff, AZ
FUSD FACTS Camp Iwannago Flagstaff, AZ
Gregg Neighborhood House Lynn, MA
Havelock Elementary School Havelock, NC
JerseySTEM South Orange, NJ
Killip Elementary School Flagstaff, AZ
Knoles Elementary School Flagstaff, AZ
Leupp Public School Flagstaff, AZ
Magnolia School Orlando, FL
Museum at Prairiefire Overland Park, KS
Project Access Charter Court Apartments San Jose, CA
Project Access Villa Monterey Apartments San Jose, CA
QRSD Fun Frontier Hubbardston, MA
Reformation Lutheran Church Philadelphia, PA

PLANETS

Planetary Learning that Advances the Nexus of Engineering, Technology, and Science (*PLANETS*) is an interdisciplinary and cross-institutional partnership that integrates planetary science, education, technology, and engineering (NASA #NNX16AC53A).

The Center for Science Teaching and Learning at Northern Arizona University (NAU), the U.S. Geological Survey (USGS) Astrogeology Science Center, and the Museum of Science, Boston have partnered to develop, pilot, and research the impact of three curriculum units and related professional development resources (http://planets-stem.org).

The purpose of *PLANETS* is to increase public awareness and use of NASA resources by highlighting the relationship between science, technology, engineering, and mathematics in the context of planetary science in out-of-school time settings.

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Unit Map

Here is an overview of the adventures in this unit and how they all fit together.

Prep Adventure 1: Tower Power

Kids will engineer an index card tower that can support a stuffed animal.

Prep Adventure 2: Hands-On Technology

Kids will discuss the definition of technology and engineer a solution to solve a problem.

Adventure 1: Everyday Gloves

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.

Adventure 2: Chilling Out

Kids will test and compare different materials to see which ones work best to protect against cold temperatures.

Adventure 3: Ready for Impact

Kids will test and compare how well different materials protect against impact hazards, specifically damage from heavy moving objects.

Adventure 4: Dangerous Dust

Kids will test and compare how dust resistant different materials are.

Adventure 5: Create a Space Glove

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.

Adventure 6: Improve a Space Glove

Kids will *improve* their model space gloves and test them in a final Mission Simulation.

Adventure 7: Engineering Showcase

Kids will present their designs and share how they used the Engineering Design Process to engineer model space gloves suited for their chosen mission.

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Introduction

Adventures

About EiE®

EiE is a program of the Museum of Science, Boston. Its mission is to create the next generation of problem solvers. EiE curricula are designed to encourage all children, including those from underrepresented groups, to envision themselves as engineers.

The EiE team creates and supports a range of curricula. Each curriculum product has been created using rigorous, research-based design principles. In addition to introducing children to the excitement of engineering, EiE units foster valuable cognitive skills such as critical thinking, collaboration, communication, creativity, flexibility, persistence, and learning from failure.

The table below provides an overview of EiE's curriculum products.

Curriculum Product	Classroom Type	Grade Level
WeeEngineer®	Preschool and Pre-K classrooms	Ages 3-5
EiE® for Kindergarten	Kindergarten classrooms	Kindergarten
Engineering is Elementary®	Elementary school classrooms	Grades 1-5
Engineering Adventures®	Afterschool and Out-of-school settings	Grades 3-5
Engineering Everywhere®	Afterschool and Out-of-school settings	Grades 6-8

For more information about EiE, visit: eie.org.

About the Museum of Science, Boston

The Museum of Science, Boston is the nation's only science museum with a comprehensive strategy and infrastructure to foster engineering and technological literacy in both science museums and schools. The museum develops exhibits, programs, and curricula that empower children to become lifelong STEM learners and passionate problem solvers. Through the advocacy efforts of the NCTL, we inspire to transform STEM education both nationally and internationally. Our engineering curricula (preK-12), resources, and teacher professional development are designed to innovate for the reality of today's educational landscape, combining the best in theory, research, teaching practice, and thought leadership.

About Engineering Adventures

The mission of Engineering Adventures is to create exciting out-of-school-time activities and experiences that allow *all* 3rd–5th grade learners to act as engineers and engage in the Engineering Design Process. Our goal is to positively impact children's attitudes about their ability to engineer by providing materials uniquely appropriate for the varied landscapes of out-of-school-time settings.

The main ideas that guide the developers are listed below.

We believe kids will best learn engineering when they:

- engage in activities that are fun, exciting, and connect to the world in which they live.
- choose their path through open-ended challenges that have multiple solutions.
- have the opportunity to succeed in engineering challenges.
- communicate and collaborate in innovative, active problem solving.

Through each unit, kids will learn that:

- they can use the Engineering Design Process to help solve problems.
- engineers design technologies to help people and solve problems.
- they have talent and potential for designing and *improving* technologies.
- they, too, are engineers.

As kids work through their engineering design challenges, they will have the opportunity to build problem-solving, teamwork, communication, and creative thinking skills. Most importantly, this curriculum is designed to provide a fun learning opportunity for kids!

For more information on Engineering Adventures, please visit: www.engineeringadventures.org.

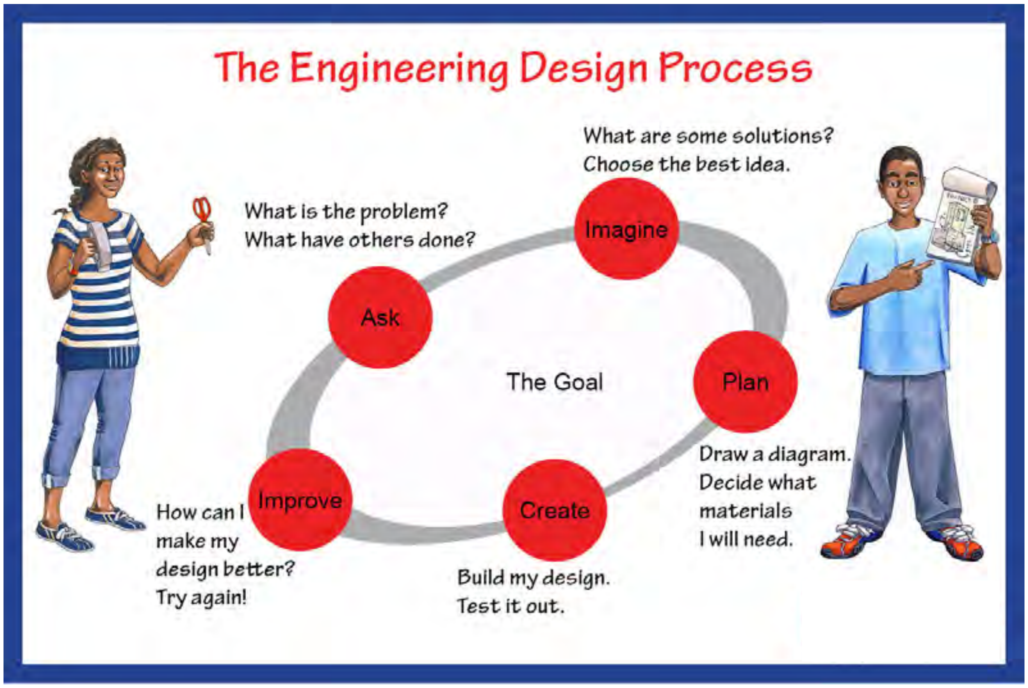
The Engineering Design Process

The Engineering Adventures Engineering Design Process (EDP) is the backbone of each Engineering Adventures unit. It is a five-step process that guides kids in solving engineering challenges. Our goal for each EA unit is for kids to understand the EDP can help them solve problems not only in engineering but also in other areas of their lives.

While there are many other versions of the EDP that are used in academic and professional settings, the EiE team developed a five-step process that is accessible for elementary school kids. India and Jacob, a fictional world-traveling brother and sister duo, introduce and guide kids through the EDP in each unit. There are also questions for the educator to ask and sections in the Engineering Journal to provide an opportunity for kids to reflect on and discuss the process.

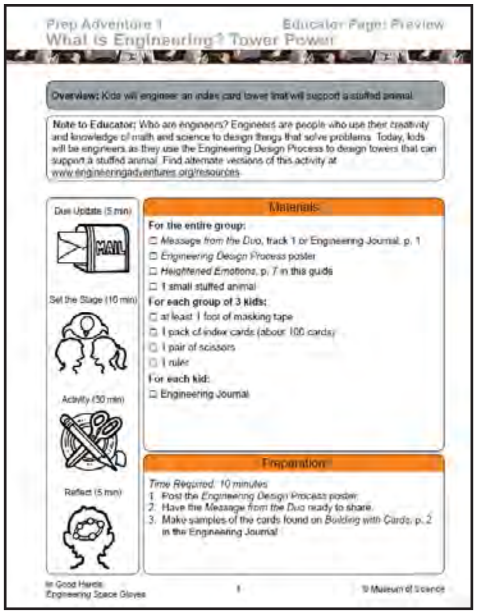
The EDP begins with the goal: the engineering challenge kids are asked to solve. The process is cyclical and flexible; kids can start a challenge at any step and may jump around to steps as they are engineering. For example, it is very common for kids to begin *creating* their technology, but then *ask* questions about materials and *imagine* new ways to *improve* their design. In Enginering Adventures units, kids generally start with the *ask* step, then have time to *imagine* and *plan* their designs, and *create* and *improve* their technologies.

To further highlight the EDP throughout the unit, the steps are italicized in this guide. Below is the EDP used in Engineering Adventures units.



Each Engineering Adventure Includes

Preview pages with relevant background information, materials list, preparatory instructions, and a preview of the journal pages needed.



Prep Adventure 1 — Educator Page: Preview
What is Engineering? Tower Power

Overview: Kids will engineer an index card tower that will support a stuffed animal.

Note to Educator: Who are engineers? Engineers are people who use their creativity and knowledge of math and science to design things that solve problems. Today, kids will be engineers as they use the Engineering Design Process to design towers that can support a stuffed animal. Find alternate versions of this activity at www.engineeringadventures.org/resources.

Duo Update (5 min)
Set the Stage (10 min)
Activity (30 min)
Reflect (5 min)

Materials

For the entire group:
- ☐ *Message from the Duo*, track 1 or Engineering Journal, p. 1
- ☐ *Engineering Design Process* poster
- ☐ *Heightened Emotions*, p. 7 in this guide
- ☐ 1 small stuffed animal

For each group of 3 kids:
- ☐ at least 1 foot of masking tape
- ☐ 1 pack of index cards (about 100 cards)
- ☐ 1 pair of scissors
- ☐ 1 ruler

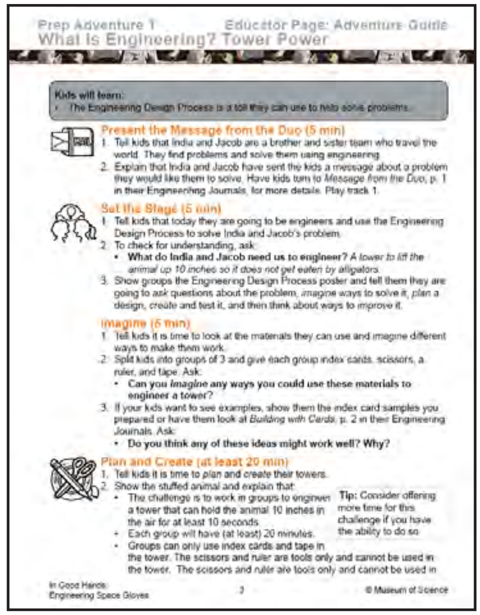
For each kid:
- ☐ Engineering Journal

Preparation

Time Required: 10 minutes
1. Post the *Engineering Design Process* poster.
2. Have the *Message from the Duo* ready to share.
3. Make samples of the cards found on *Building with Cards*, p. 2 in the Engineering Journal.

In Good Hands: Engineering Space Gloves — 1 — © Museum of Science

An **Adventure Guide** with step-by-step instructions, including discussion questions, extension ideas, and tips.



Prep Adventure 1 — Educator Page: Adventure Guide
What is Engineering? Tower Power

Kids will learn:
- The Engineering Design Process is a tool they can use to help solve problems.

Present the Message from the Duo (5 min)
1. Tell kids that India and Jacob are a brother and sister team who travel the world. They find problems and solve them using engineering.
2. Explain that India and Jacob have sent the kids a message about a problem they would like them to solve. Have kids turn to *Message from the Duo*, p. 1 in their Engineering Journals, for more details. Play track 1.

Set the Stage (5 min)
1. Tell kids that today they are going to be engineers and use the Engineering Design Process to solve India and Jacob's problem.
2. To check for understanding, ask:
   - **What do India and Jacob need us to engineer?** *A tower to lift the animal up 10 inches so it does not get eaten by alligators.*
3. Show groups the Engineering Design Process poster and tell them they are going to *ask* questions about the problem, *imagine* ways to solve it, *plan* a design, *create* and test it, and then think about ways to *improve* it.

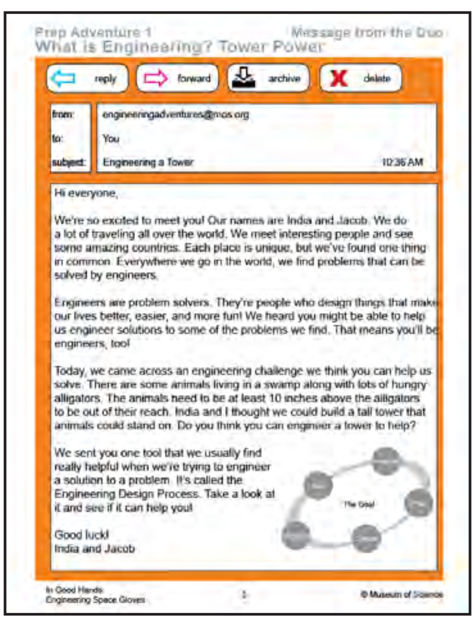
Imagine (5 min)
1. Tell kids it is time to look at the materials they can use and imagine different ways to make them work.
2. Split kids into groups of 3 and give each group index cards, scissors, a ruler, and tape. Ask:
   - **Can you *imagine* any ways you could use these materials to engineer a tower?**
3. If your kids want to see examples, show them the index card samples you prepared or have them look at *Building with Cards*, p. 2 in their Engineering Journals. Ask:
   - **Do you think any of these ideas might work well? Why?**

Plan and Create (at least 20 min)
1. Tell kids it is time to plan and create their towers.
2. Show the stuffed animal and explain that:
   - The challenge is to work in groups to engineer a tower that can hold the animal 10 inches in the air for at least 10 seconds.
   - Each group will have (at least) 20 minutes.
   - Groups can only use index cards and tape in the tower. The scissors and ruler are tools only and cannot be used in the tower.

Tip: Consider offering more time for this challenge if you have the ability to do so.

In Good Hands: Engineering Space Gloves — 2 — © Museum of Science

A **Message from the Duo**, India and Jacob, with information about the day's activity.



Prep Adventure 1 — Message from the Duo
What is Engineering? Tower Power

reply | forward | archive | delete

from: engineeringadventures@mos.org
to: You
subject: Engineering a Tower — 10:36 AM

Hi everyone,

We're so excited to meet you! Our names are India and Jacob. We do a lot of traveling all over the world. We meet interesting people and see some amazing countries. Each place is unique, but we've found one thing in common. Everywhere we go in the world, we find problems that can be solved by engineers.

Engineers are problem solvers. They're people who design things that make our lives better, easier, and more fun! We heard you might be able to help us engineer solutions to some of the problems we find. That means you'll be engineers, too!

Today, we came across an engineering challenge we think you can help us solve. There are some animals living in a swamp along with lots of hungry alligators. The animals need to be at least 10 inches above the alligators to be out of their reach. India and I thought we could build a tall tower that animals could stand on. Do you think you can engineer a tower to help?

We sent you one tool that we usually find really helpful when we're trying to engineer a solution to a problem. It's called the Engineering Design Process. Take a look at it and see if it can help you!

Good luck!
India and Jacob

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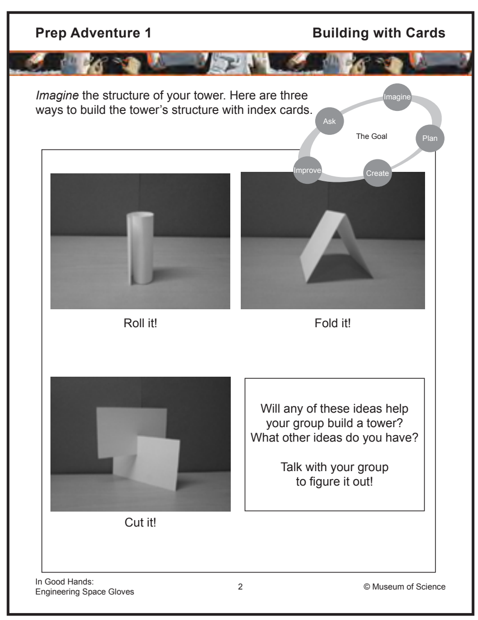
Engineering Journal pages that allow kids to record their findings and reflect on their learning.



Prep Adventure 1 — Building with Cards

Imagine the structure of your tower. Here are three ways to build the tower's structure with index cards.

Ask — Imagine — Plan — Create — Improve — The Goal

Roll it! — Fold it! — Cut it!

Will any of these ideas help your group build a tower? What other ideas do you have?

Talk with your group to figure it out!

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The Sections of the Adventures

Messages from the Duo

Messages from India and Jacob, a fictional world-traveling sister and brother duo, are provided as a quick, exciting way to present the real-world context for the unit's engineering challenge. Providing a context helps kids to understand the challenge and motivates them to find solutions. If you have access to a CD player, MP3 player, or iOS device, we strongly suggest using the audio recordings, although reading the emails aloud will convey the same information.

Set the Stage (Ask)

The Set the Stage (or Ask) part of each adventure provides important information and questions that prepare kids for the main activity. During this section, you might ask questions prompting kids to share their prior knowledge, have them predict what they will find, or remind them of criteria that will help them as they engineer. This sets your kids up to succeed and feel confident in their ability to engineer.

Activities

The activities are designed to get kids thinking and working together to solve the unit's engineering design challenge. As the educator, it is your role to guide kids through these activities by encouraging them to pursue and communicate their own ideas, even if you think they may not work. In engineering, there are no right or wrong answers! Every problem has many possible solutions and multiple ways to reach them.

Reflect

Each adventure includes 5–10 minutes at the end for kids to communicate with their peers by sharing their work. This gives kids the chance to discuss new ideas, think about their own work and the work of others, and reflect on what was learned. Group reflection can help reduce competition by encouraging kids to support each other as they move through the Engineering Design Process. For more individual reflection, each adventure also includes time for kids to record thoughts and ideas in their Engineering Journals.

Engineering Journals

Make a copy of the Engineering Journal for each kid as you begin working on this unit. The Engineering Journal is a central location for kids to record their thoughts and ideas as they move through the unit. It includes recording pages that will guide kids through the Engineering Design Process, poses questions, and prompts kids to reflect on their learning. The 5-10 minutes kids spend with their journals during each adventure will allow them to create a personalized record of their engineering learning.

There are a few ways you can use the Engineering Journal. You may want to have groups share one Engineering Journal as a central recording spot for all group data and findings. This allows group members who enjoy writing and recording to do so. You may also encourage groups to share the responsibility by having group members rotate who records for each adventure.

The back page of each Engineering Journal is a passport page from the location in which the unit takes place. Kids are encouraged to stamp the passport page when they finish a unit and collect the pages from all of the units they have completed.

Alternate Prep Adventures

The two prep adventures, “What is Engineering?” and “What is Technology?,” introduce kids to engineering and technology. “What is Engineering?” gives kids the chance to collaborate, experience a mini hands-on engineering challenge, share their designs, and learn about the Engineering Design Process. This adventure sets the stage for what kids can expect in the rest of the unit.

“What is Technology?” has kids interact with technologies, working with the definition that a technology is anything designed by humans to help solve a problem. Most kids think of technology as things that can be plugged into the wall. They do not realize that the items that they interact with every day—including pencils, paper, and water bottles—are also technologies. This adventure introduces the definition of technology that the kids will refer to as they engineer their own technologies to solve the problem presented in the unit.

There are alternate activities for both of these adventures available online in the Resources section at www.engineeringadventures.org/resources. If kids complete multiple units, you may want to use an alternate activity to refresh the concepts in these activities. There may also be an activity that is more active or would be a better fit for the kids in your program. If you have questions about these activities, please email engineeringadventures@mos.org.

What You Need to Know Before Teaching the Unit

Engineering is Fun

The EiE team hears this from many educators and kids. Engineering is a way of problem solving—a way of thinking about the world—that is very fun and creative. Any time you design something to solve a problem in order to reach a goal, you are engineering.

There Are No Right or Wrong Answers

There are often many great ways to solve the same problem. Not only is this a good engineering lesson, it is a good life lesson for the kids in your program.

It Is Okay to Try It Out

It can be very helpful to try out the engineering challenge yourself—either beforehand or right alongside the kids in your program as they work through the adventures. This can help you understand the challenges the kids might face.

Scheduling the Adventures

Each adventure requires 45–60 minutes of teaching time. We recommend that you budget at least 8–9 hours in order to complete this unit, as some adventures may go longer than expected.

You can schedule this unit in several ways: once a week, several times a week, or daily. It is also possible to group certain adventures together. The chart below shows which adventures are easily taught together. Use this chart to help you plan your schedule.

Prep Adventure 1: What is Engineering? Prep Adventure 2: What is Technology?	2–3 hours
Adventure 1: Everyday Gloves	1 hour
Adventure 2: Chilling Out Adventure 3: Ready for Impact	2 3 hours
Adventure 4: Dangerous Dust	1 hour
Adventure 5: Create a Space Glove Adventure 6: Improve a Space Glove	2–3 hours
Adventure 7: Engineering Showcase	1 hour

Tips and Tricks for Teaching the Unit

Post a Daily Agenda

Giving kids a sense of the day's adventure will help them to plan ahead and manage their time during the activity.

Facilitate Teamwork

Being able to work well in teams is an important skill for any engineer. You may want to assign team roles to help kids who struggle with teamwork. Possible roles include: the recorder, the materials gatherer, the tester, and the presenter.

Timing

As groups are working, call out regular time intervals so kids know how much time they have left to complete their task. This is especially helpful if kids have more than 20 minutes to work on a task. Letting them know when 5-minute increments have passed will allow them to budget their time and reassess where they are in their design.

Invite Others to the Engineering Showcase

The Showcase, the last adventure in the unit, is a big deal! This is a chance for kids to highlight the engineering they have done and share their accomplishments with others. Consider inviting families, program staff, and other kids to come to the Showcase.

Mobile Apps

Mobile apps can be a fun way to engage kids in out-of-school-time environments. The Engineering Adventures team has created iOS apps (compatible with most iPhones, iPod Touches, and iPads) that are designed to supplement the hands-on engineering experiences that your program provides.

You can download the Engineering Adventures apps onto your personal device or the devices that belong to your site. You may also choose to encourage kids to download the apps onto their devices so they may continue to practice their engineering skills on their own time. Encourage them to receive permission from their parents before doing so.

Technology Flashcards

The Technology Flashcards app is designed to be used in conjunction with Prep Adventure 2. The app features a flashcard game that reinforces the idea that a technology is anything designed by a human to help solve a problem. The game allows kids to learn from their misconceptions in real time by providing them with instant feedback on why selected items are classified as technologies or not.

Search for “Technology Flashcards” in the App Store or visit: www.tinyurl.com/flashcardsapp.

Messages from the Duo

The Messages from the Duo app is a new way for kids to listen to the audio communications from India and Jacob at the beginning of each adventure. Kids can use the scanner function in the app to scan the QR code at the top of each Message from the Duo page in the Engineering Journal. The audio of the message will play automatically as if India and Jacob are communicating directly to the kids over a walkie-talkie! The app gives kids an opportunity to listen to the messages on their own for enhanced comprehension or to share them with others. Educators may also choose to use the app as an alternative to a CD player or to reading the messages aloud.

Search for “Messages from the Duo” in the App Store or visit: www.tinyurl.com/MFTDapp.

Background

Materials Engineering

Materials engineering is an interdisciplinary field that draws upon physics, chemistry, and engineering to understand how materials behave. Materials engineers may combine existing materials such as metals, ceramics, and textiles to see how they perform under different conditions or design entirely new materials to meet the growing technological needs of society. All materials have distinct properties, such as strength, flexibility, and resistance to hot or cold temperatures, that can help determine how they can be used in a specific technology, from snowboards to spaceships.

Space Hazards

Astronauts are exposed to some of the most extreme conditions in space, including high levels of radiation and changes in pressure, oxygen, and gravity. In this unit, groups focus on protecting against three space hazards in their glove designs: cold temperatures, impact, and dangerous dust.

- To protect against cold temperatures, materials engineers use thermal insulators materials that slow the transfer of heat from one place to another. These materials are designed to prevent heat from moving from warm to cold areas.
- In addition to the hazards posed by working with heavy machinery, astronauts also need to avoid collisions with heavy, moving space debris. NASA estimates that there are over 500,000 pieces of space debris, such as nonfunctioning satellites and fragments of other spacecraft, currently being tracked as they orbit Earth at up to 17,500 miles per hour. The growing volume of space debris increases the chances of impact and damage.
- In space exploration, dust can be dangerous. It is abrasive to materials, gets stuck in the joints of spacesuits, and compromises sterile environments. Astronauts work hard to keep dust out of their equipment and spacecraft.

Analog Sites

Analog sites are research facilities that are similar in some way to the environmental conditions found on other planets or moons. Testing at analog sites helps astronauts prepare for space missions in a safe but realistic environment before they leave Earth.

Educator Resources

For a list of online resources about space gloves and materials engineering, visit: http://www.engineeringadventures.org.

Vocabulary

Dust: A mixture of different ingredients, such as grains of sand, dead skin cells, tiny hairs and threads, animal dander, pollen, human-made pollutants, dust mites, and even minerals from outer space.

Dust resistant: A quality or treatment of a material that prevents dust from sticking to it.

Engineer: Someone who uses creativity and knowledge of math and science to design things that solve problems.

Engineering Design Process: The steps that engineers use to design something to solve a problem.

Hazard: A source of danger.

Impact: The act of one thing hitting another.

Insulator: A material that does not allow heat to move through it quickly.

Material: What something is made of.

Materials engineer: A person who uses creativity and knowledge of science and math to solve problems related to materials and their specific properties.

Simulation: An imitation of a real situation or process for the purpose of learning.

Space debris: Scattered natural and human-made debris, such as broken bits of meteorites, old satellites, and pieces of spacecraft.

Technology: Any thing designed by humans to help solve a problem.

Temperature: A measurement of how hot or cold something is.

Materials List

This kit is prepared for 12 groups of 2 kids.

Quantity	Part Description
Non-Consumable Items	
1	*Engineering Design Process* poster
1	*Messages from the Duo* audio file or access to a computer
1	measuring cup, 2 cups
1	permanent marker
1	tablespoon measure
2	black lights, handheld, *AA batteries included*
2	buckets, 5 liters
2	calculators
2 pairs	dish gloves
2 pairs	garden gloves
2	hand lenses
2 pairs	oven mitts
2	plastic bags, resealable, gallon size
2	skewers
2	stuffed animals
2	thermometers, digital
2 pairs	winter gloves
4	cups, plastic, 16 oz.
4	jars, with twist lids, 12 oz.
6	aluminum trays, 12” x 10” x 2.5”
8	stopwatches
12	rulers
60	beads
160	paper clips
210	metal washers, 1 1/4” in diameter
Consumable Items	
1 roll	aluminum foil
1 bottle	dish soap
1 box	food-safe gloves, adult, 100 count
1 bottle	UV glow powder, white, 4 oz.
1 box	vinyl gloves, adult, 100 count*
2 sheets	cardboard, thin, 8.5” x 11”
2 cups	gravel

2 boxes	spaghetti†
6	deli containers, round, with lids, 16 oz.
6 cups	sand
12 rolls	tape, masking
24	plastic bags, resealable, quart size
30 sheets	felt, 8.5” x 11”
30 sheets	transparency, 8.5” x 11”
32 sheets	craft foam, green, 8.5” x 11”
36	sponges
50 sq. ft.	cheesecloth, 8.5” x 11”
125	pipe cleaners
300	cotton balls
350	straws, regular
1200	index cards
NOT INCLUDED IN KIT	
1 pad	chart paper
1	clock/timepiece for scheduling
1 sheet	copy paper
1	device to play mp3 files
1 roll	duct tape
2	craft sticks, jumbo
2 rolls	paper towels
8	pens or pencils
12 pairs	scissors
24	Engineering Journals
36 cups	ice cubes‡
	access to water

* The vinyl glove should be at least 3 mil thickness to prevent tearing during glove construction.

† The spaghetti used in Adventure 3 should be standard, No. 5 size, spaghetti. Using thin spaghetti or angel hair pasta will be too fragile for this activity.

‡ You will need 36 cups of ice cubes for 3 activities. Please ensure that you have access to a freezer.

National Education Standards

Engineering Adventures units are written with the goal of teaching engineering skills and critical thinking practices. Many Engineering Adventures units also touch upon a variety of science topics and principles. The engineering standards taught in this unit and the science topic links in this unit are noted below.

		Prep Adventure 1: What is Engineering?	Prep Adventure 2: What is Technology?	Adventure 1: Everyday Gloves	Adventure 2: Chilling Out	Adventure 3: Ready for Impact	Adventure 4: Dangerous Dust	Adventure 5: Create a Space Glove	Adventure 6: Improve a Space Glove	Adventure 7: Engineering Showcase
National Science Education Standards	Science as Inquiry	✓		✓	✓	✓	✓	✓	✓	✓
	Physical Science			✓	✓	✓	✓	✓	✓	
	Life Science									
	Earth and Space Science			✓	✓	✓	✓	✓	✓	✓
	Science and Technology	✓	✓					✓	✓	✓
	Science in Personal and Social Perspectives			✓	✓	✓	✓	✓	✓	
	History and Nature of Science									
ITEEA	The Nature of Technology		✓	✓	✓	✓	✓	✓	✓	✓
	Technology and Society		✓							
	Design	✓					✓	✓	✓	✓
	Abilities for a Technological World	✓					✓	✓	✓	✓
	The Designed World			✓	✓	✓	✓			

		Prep Adventure 1: What is Engineering?	Prep Adventure 2: What is Technology?	Adventure 1: Everyday Gloves	Adventure 2: Chilling Out	Adventure 3: Ready for Impact	Adventure 4: Dangerous Dust	Adventure 5: Create a Space Glove	Adventure 6: Improve a Space Glove	Adventure 7: Engineering Showcase
	3-ESS3-1. Make a claim about the merit of a design solution that reduces the impacts of a weather-related hazard.							✓	✓	
Next Generation Science Standards	4-PS3-2. Make observations to provide evidence that energy can be transferred from place to place by sound, light, heat, and electric currents.				✓			✓	✓	
	4-PS3-3. Ask questions and predict outcomes about the changes in energy that occur when objects collide.					✓		✓	✓	
	5-PS1-3. Make observations and measurements to identify materials based on their properties.			✓	✓	✓	✓	✓	✓	
	3-5-ETS1-1. Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.	✓	✓					✓	✓	✓
	3-5-ETS1-2. Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.	✓						✓	✓	✓
	3-5-ETS1-3. Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.	✓	✓	✓				✓	✓	✓

How to Recognize Success Rubric

How do you know if you are leading an Engineering Adventures activity successfully? This tool will help you keep track of your kids' successful moments and will ask you to identify how your own actions enabled your kids to succeed.

Elements of success	What does this look like?	How does the guide help me facilitate this?
Kids are engaged and challenged by the activity. They persist through difficulties.	• Kids are on task. • Kids are trying out their ideas. • Kids identify what is working well in their designs. • Kids troubleshoot their own work. • Kids *improve* their designs.	• Use the Message from the Duo to **set a real-world context** that will engage kids in the activity. • Use the bold prompts to **ask open-ended questions** to help kids troubleshoot their work. • Use the bold prompts to **ask kids about what they think is working well** in their designs and what they would like to *improve*. This will help kids feel more confident about their problem-solving abilities.
Kids do most of the talking, sharing their ideas with each other during the entire activity.	• Kids bring their own ideas to the activity and are comfortable sharing them. • Kids brainstorm and debate within their groups. • Kids share their designs with others. • Kids talk about how their ideas are changing over time.	• Use the bold prompts in the guide to **encourage kids to share and explain their thinking**. • Have kids **work in groups** so they can brainstorm and *create* a design together. • Use the bold prompts in the Reflect section to **help kids share their new ideas about designs.**
Kids value their engineering work as a process, not just as the end result.	• Kids go beyond talking about their design to talking about how they thought of it and why they designed it. • Kids use the Engineering Design Process to describe their actions.	• Use the bold prompts in the guide to **ask kids how they use the Engineering Design Process.** Spending time talking and thinking about their process will help kids see the value in it. • Use the bold prompts to **ask kids about *improving*** their designs, even if their designs are working well. • **Encourage kids to reflect individually** in their Engineering Journals to give them time for their experiences to sink in and be remembered.

How to Recognize Success Rubric Template

How do you know if you are leading an Engineering Adventures activity successfully? This tool will help you keep track of your kids' successful moments and will ask you to identify how your own actions enabled your kids to succeed.

Date: Adventure:

Elements of success	Evidence: Did I see this during the activity?	What was my role in making this happen?
Kids are engaged and challenged by the activity. They persist through difficulties.		
Kids do most of the talking, sharing their ideas with each other during the entire activity.		
Kids value their engineering work as a process, not just as the end result.		

Dear Family, Date: ________________

We are beginning an engineering unit called *In Good Hands: Engineering Space Gloves*, which is part of the Engineering Adventures curriculum developed by the Museum of Science, Boston. Engineering Adventures is a curricular program that introduces kids to engineering and the Engineering Design Process. Throughout this unit, kids will learn about materials engineering and work to engineer a model space glove that protects against the hazards of space. There are many reasons to introduce kids to engineering:

- **Engineering projects reinforce topics children are learning in school.** Engaging kids in hands-on, real-world engineering experiences can enliven math, science, and other content areas.
- **Engineering fosters problem-solving skills**, including problem formulation, creativity, planning, and testing alternative solutions.
- **Kids are fascinated with building and with taking things apart to see how they work.** By encouraging these explorations, we can keep these interests alive. Describing their activities as "engineering" when kids are engaged in the natural design process can help them develop positive associations with engineering, and increase their desire to pursue such activities in the future.
- **Engineering and technological literacy are necessary for the 21st century.** As our society increasingly depends on engineering and technology, our citizens need to understand these fields.

Because engineering projects are hands-on, materials are often required. Several materials necessary to this unit are listed below. If you have any of these materials available, please consider donating them to us. If you have expertise about materials engineering, space exploration, or have any general questions or comments about the engineering and design unit we are about to begin, please let me know.

Sincerely,

If you have any of the following materials available and would like to donate them, I would greatly appreciate having them by the following date: ______________________ . Thank you!

____________________________ ____________________________

____________________________ ____________________________

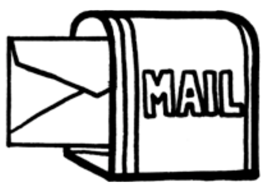
____________________________ ____________________________

What is Engineering? Tower Power

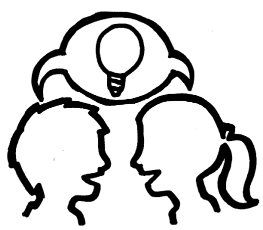
Overview: Kids will engineer an index card tower that can support a stuffed animal.

Note to Educator: Who are engineers? Engineers are people who use their creativity and knowledge of math and science to design things that solve problems. Today, kids will be engineers as they use the Engineering Design Process to design towers that can support a stuffed animal. Find alternate versions of this activity at www.engineeringadventures.org/resources.

Duo Update (5 min)

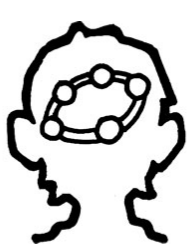


Set the Stage (10 min)



Activity (30 min)

Reflect (5 min)



Materials

For the entire group:

- ☐ *Message from the Duo,* track 1 or Engineering Journal, p. 1
- ☐ *Engineering Design Process* poster
- ☐ *Field of View,* p. 7 in this guide or Engineering Journal, p. 3
- ☐ 1 small stuffed animal

For each group of 3 kids:

- ☐ at least 1 foot of masking tape
- ☐ 1 pack of index cards (about 100 cards)
- ☐ 1 pair of scissors
- ☐ 1 ruler

For each kid:

- ☐ Engineering Journal

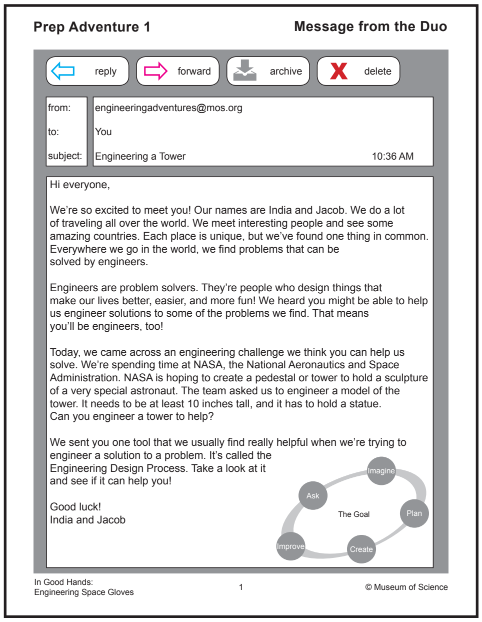
Preparation

Time Required: 10 minutes

1. Post the *Engineering Design Process* poster.
2. Have the *Message from the Duo* ready to share.
3. Make samples of the cards found on *Building with Cards*, p. 2 in the Engineering Journal.

Journal Pages for Prep Adventure 1

Message from the Duo, p. 1



Prep Adventure 1 — Message from the Duo

reply | forward | archive | delete

from: engineeringadventures@mos.org
to: You
subject: Engineering a Tower — 10:36 AM

Hi everyone,

We're so excited to meet you! Our names are India and Jacob. We do a lot of traveling all over the world. We meet interesting people and see some amazing countries. Each place is unique, but we've found one thing in common. Everywhere we go in the world, we find problems that can be solved by engineers.

Engineers are problem solvers. They're people who design things that make our lives better, easier, and more fun! We heard you might be able to help us engineer solutions to some of the problems we find. That means you'll be engineers, too!

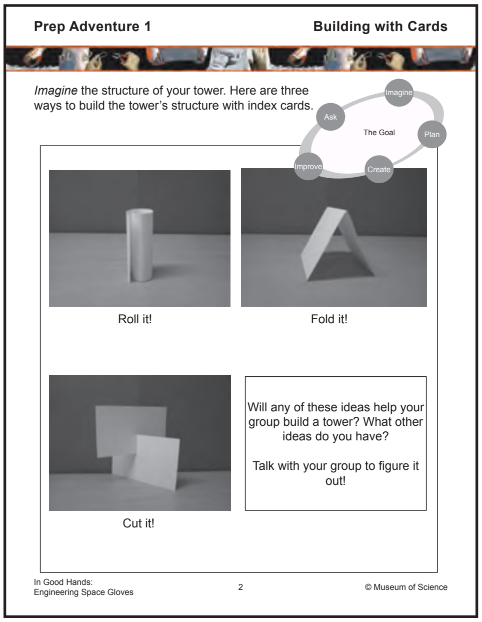
Today, we came across an engineering challenge we think you can help us solve. We're spending time at NASA, the National Aeronautics and Space Administration. NASA is hoping to create a pedestal or tower to hold a sculpture of a very special astronaut. The team asked us to engineer a model of the tower. It needs to be at least 10 inches tall, and it has to hold a statue. Can you engineer a tower to help?

We sent you one tool that we usually find really helpful when we're trying to engineer a solution to a problem. It's called the Engineering Design Process. Take a look at it and see if it can help you!

Good luck!
India and Jacob

In Good Hands: Engineering Space Gloves — 1 — © Museum of Science

Building with Cards, p. 2



Prep Adventure 1 — Building with Cards

Imagine the structure of your tower. Here are three ways to build the tower's structure with index cards.

Roll it!

Fold it!

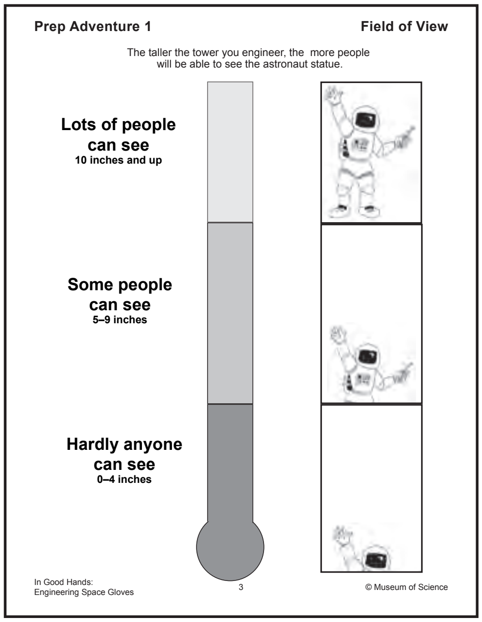
Cut it!

Will any of these ideas help your group build a tower? What other ideas do you have?

Talk with your group to figure it out!

In Good Hands: Engineering Space Gloves — 2 — © Museum of Science

Field of View, p. 3



Prep Adventure 1 — Field of View

The taller the tower you engineer, the more people will be able to see the astronaut statue.

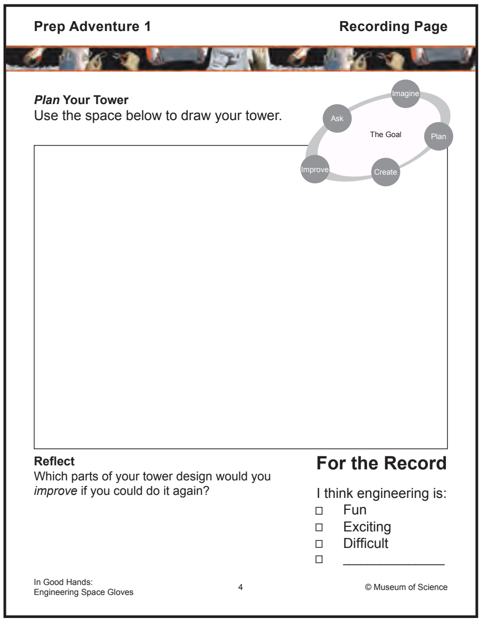
Lots of people can see
10 inches and up

Some people can see
5–9 inches

Hardly anyone can see
0–4 inches

In Good Hands: Engineering Space Gloves — 3 — © Museum of Science

Recording Page, p. 4



Prep Adventure 1 — Recording Page

***Plan* Your Tower**
Use the space below to draw your tower.

Reflect
Which parts of your tower design would you *improve* if you could do it again?

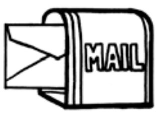
For the Record
I think engineering is:
- ☐ Fun
- ☐ Exciting
- ☐ Difficult
- ☐ ________

In Good Hands: Engineering Space Gloves — 4 — © Museum of Science

What is Engineering? Tower Power

Kids will learn:

- The Engineering Design Process is a tool they can use to help solve problems.



Present the Message from the Duo (5 min)

1. Tell kids that India and Jacob are a sister and brother team who travel the world. They find problems and solve them using engineering.
2. Explain that India and Jacob have sent the kids a message about a problem they would like them to solve. Have kids turn to *Message from the Duo*, p. 1 in their Engineering Journals, to follow along. Play track 1.

Set the Stage (5 min)

1. Tell kids that today they are going to be engineers and use the Engineering Design Process to solve India and Jacob's problem.
2. To check for understanding, ask:
   - **What do India and Jacob need us to engineer?** *A model tower that is at least 10 inches tall and can hold a statue.*
3. Hold up the stuffed animal and explain that it will represent the astronaut statue.
4. Show kids the *Engineering Design Process* poster and tell them they are going to *ask* questions about the problem, *imagine* ways to solve it, *plan* a design, *create* and test it, and then think about ways to *improve* it.

Imagine (5 min)

1. Tell kids that it is time to look at the materials they can use and *imagine* different ways to make them work.
2. Explain that a pack of index cards and a roll of tape will be the only materials they will receive to build their towers. Scissors and a ruler will also be provided, but they can be used only as tools.
3. Ask:
   - **Can you *imagine* any ways you could use these materials and tools to engineer a tower?**
4. If kids want to see examples, show them the index card samples you prepared or have them look at *Building with Cards*, p. 2 in their Engineering Journals. Ask:
   - **Do you think any of these ideas for structuring your tower might work? Why or why not?**

Plan and Create (at least 20 min)

1. Organize kids into groups of 3 and give each group a pack of index cards, scissors, a ruler, and tape.
2. Have groups turn to *Recording Page*, p. 4 in the Engineering Journal. Tell them that p. 4 is where they can *plan*.

3. Tell groups that they may use *Field of View*, p. 3 in their Engineering Journals, to gauge the progress of the tower's height.
4. Show groups the stuffed animal and review the engineering challenge:
   - Groups will engineer a tower that can hold the stuffed animal 10 inches in the air for 10 seconds.
   - Each group will have (at least) 20 minutes to *plan* and *create* their towers. Kids can test their towers with the stuffed animal after 20 minutes are up.
5. Have groups begin.
6. As groups work, circulate around the room. Ask questions like:
   - **Why do you think your design will work well?**
   - **Which step of the Engineering Design Process are you using right now? How do you know?**

> **Tip:** You may choose to offer unlimited tape or challenge groups by limiting the tape to 1 or 2 feet.

> **Tip:** Consider offering more time for this challenge if you are able to do so.

Tower Showcase (10 min)

1. Have each group present their tower. Ask each group questions like:
   - **Can you tell me about your design?**
   - **Which steps of the Engineering Design Process did you use?**
2. Use a ruler to measure each group's tower. Compare the measurement to the diagram on *Field of View,* p. 3 in their Engineering Journals. Give one kid from the group the stuffed animal to place on top of their tower. Count to 10 and observe what happens. Whether or not their tower stands, ask:
   - **What parts would you *improve* if you could design your tower again? Why?**

Reflect (5 min)

1. Go through the *Engineering Design Process* poster with kids and ask:
   - **How did you use the steps of the Engineering Design Process to solve the problem?** *We* asked *about the challenge; we* imagined *ways to build with cards; we* planned *when we decided what design to use; and we* created *and* improved *when we built and fixed the tower.*
   - **Why do you think it is important to use these steps?** *It helps us keep track of our ideas and make sure we are meeting our goal.*
   - **Do you think you are an engineer?**
2. Tell kids that they have just used the same steps that engineers use to solve problems. This means that they are engineers, too! They will have the opportunity to engineer solutions to even bigger problems with India and Jacob later on.

What is Engineering? Tower Power

reply | forward | archive | delete

from: engineeringadventures@mos.org

to: You

subject: Engineering a Tower

10:36 AM

Hi everyone,

We're so excited to meet you! Our names are India and Jacob. We do a lot of traveling all over the world. We meet interesting people and see some amazing countries. Each place is unique, but we've found one thing in common. Everywhere we go in the world, we find problems that can be solved by engineers.

Engineers are problem solvers. They're people who design things that make our lives better, easier, and more fun! We heard you might be able to help us engineer solutions to some of the problems we find. That means you'll be engineers, too!

Today, we came across an engineering challenge we think you can help us solve. We're spending time at NASA, the National Aeronautics and Space Administration. NASA is hoping to create a pedestal or tower to hold a sculpture of a very special astronaut. The team asked us to engineer a model of the tower. It needs to be at least 10 inches tall, and it has to hold a statue. Can you engineer a tower to help?

We sent you one tool that we usually find really helpful when we're trying to engineer a solution to a problem. It's called the Engineering Design Process. Take a look at it and see if it can help you!

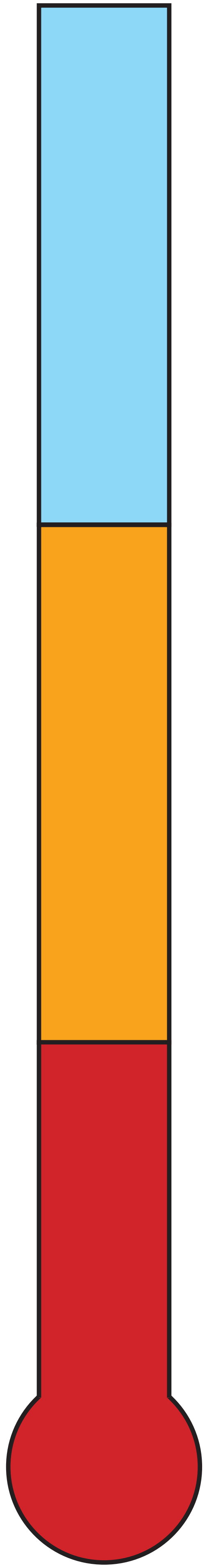
Good luck!
India and Jacob

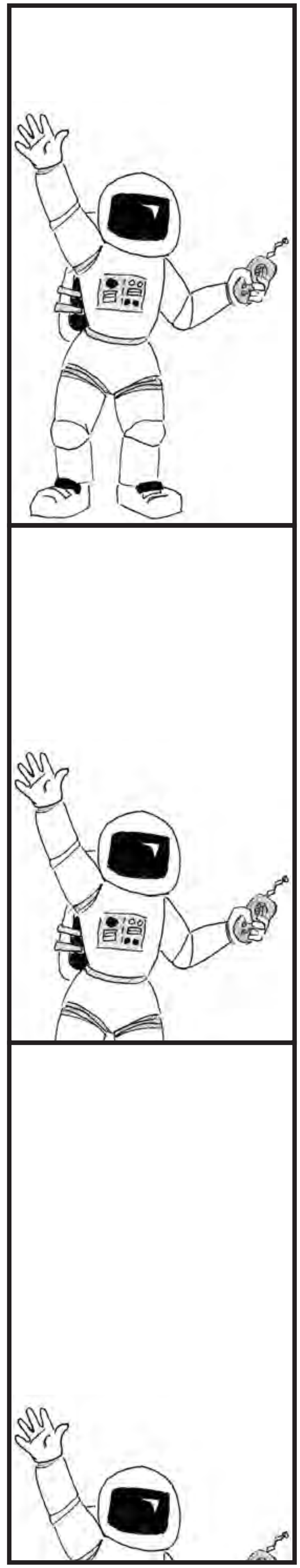
The taller the tower you engineer, the more people will be able to see the astronaut statue.

Lots of people can see
10 inches and up

Some people can see
5–9 inches

Hardly anyone can see
0–4 inches



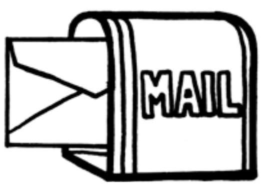


What is Technology? Hands-On Technology

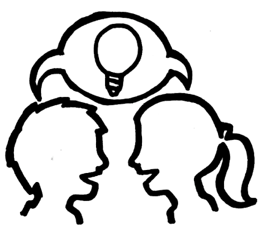
Overview: Kids will discuss the definition of technology and engineer a solution to solve a problem.

Note to Educator: Many people think of technologies only as things that are electronic or things that are "high-tech." Technology is actually anything designed by humans to help solve a problem. Find alternate versions of this activity at www.engineeringadventures.org/resources.

Duo Update (5 min)

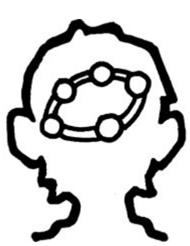


Set the Stage (10 min)



Activity (25 min)

Reflect (5 min)



Materials

For the entire group:

☐ *Message from the Duo*, track 2 or Engineering Journal, p. 5
☐ *Engineering Design Process* poster

Materials Table:

☐ 1 roll of paper towels
☐ 1 tablespoon measure
☐ 1 tablespoon of sand
☐ 2 aluminum trays, 12" X 10"
☐ 2 sheets of green foam
☐ 2 stuffed animals
☐ 4 deli containers, 16 oz.
☐ 4 rolls of masking tape
☐ 8 pens or pencils
☐ 50 straws
☐ optional: 1 roll of duct tape

For each group of 3 kids:

☐ 1 pair of scissors
☐ 1 ruler
☐ 50 index cards

For each kid:

☐ Engineering Journal

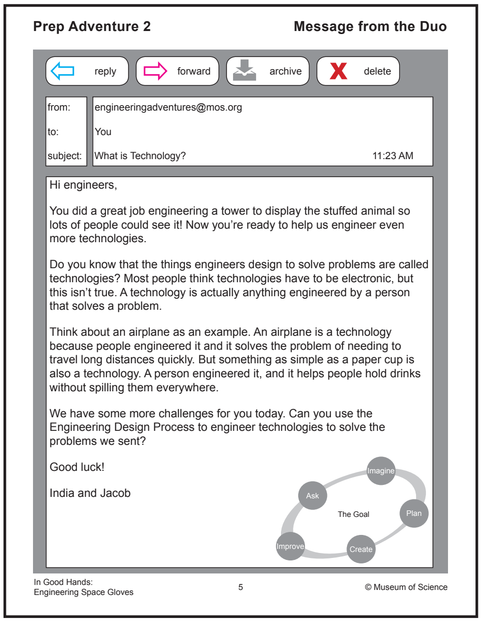
Preparation

Time Required: 20 minutes

1. Post the *Engineering Design Process* poster.
2. Have the *Message from the Duo* ready to share.
3. Fill 2 deli containers with water.
4. Set up the remaining materials at the Materials Table.
5. Measure out 15 feet of testing space for the group(s) who choose the *Send a Message* problem.
6. Create 2 model plants out of green craft foam. See p. 10 in this guide for an example. Place each model plant in an empty deli container. Tape the model plants down.
7. Optional: Preview a video about life on the ISS to share with kids before *Set the Stage*.

Journal Pages for Prep Adventure 2

Message from the Duo, p. 5



Prep Adventure 2 **Message from the Duo**

reply | forward | archive | delete

from: engineeringadventures@mos.org
to: You
subject: What is Technology? 11:23 AM

Hi engineers,

You did a great job engineering a tower to display the stuffed animal so lots of people could see it! Now you're ready to help us engineer even more technologies.

Do you know that the things engineers design to solve problems are called technologies? Most people think technologies have to be electronic, but this isn't true. A technology is actually anything engineered by a person that solves a problem.

Think about an airplane as an example. An airplane is a technology because people engineered it and it solves the problem of needing to travel long distances quickly. But something as simple as a paper cup is also a technology. A person engineered it, and it helps people hold drinks without spilling them everywhere.

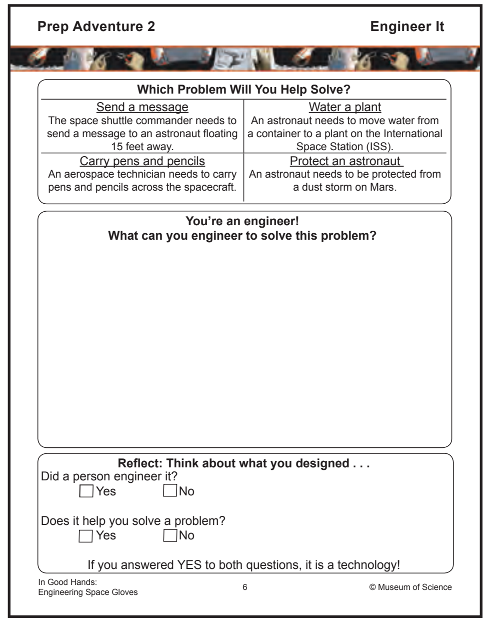
We have some more challenges for you today. Can you use the Engineering Design Process to engineer technologies to solve the problems we sent?

Good luck!

India and Jacob

In Good Hands: Engineering Space Gloves 5 © Museum of Science

Engineer It, p. 6



Prep Adventure 2 **Engineer It**

Which Problem Will You Help Solve?

Send a message The space shuttle commander needs to send a message to an astronaut floating 15 feet away.	Water a plant An astronaut needs to move water from a container to a plant on the International Space Station (ISS).
Carry pens and pencils An aerospace technician needs to carry pens and pencils across the spacecraft.	Protect an astronaut An astronaut needs to be protected from a dust storm on Mars.

You're an engineer!
What can you engineer to solve this problem?

Reflect: Think about what you designed . . .

Did a person engineer it?
☐Yes ☐No

Does it help you solve a problem?
☐Yes ☐No

If you answered YES to both questions, it is a technology!

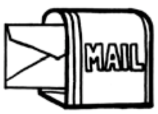
In Good Hands: Engineering Space Gloves 6 © Museum of Science

Model Plant Example

What is Technology? Hands-On Technology

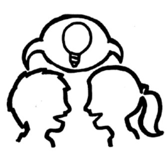
Kids will learn:

- Technology is anything designed by humans to help solve a problem.
- Engineers are people who design and *improve* technologies.



Present the Message from the Duo (5 min)

1. Tell kids that India and Jacob sent them a message with more information about what engineers do. Have kids turn to *Message from the Duo*, p. 5 in their Engineering Journals, to see the message. Play track 2.
2. To check for understanding, ask:
   - **India and Jacob told us that a technology is anything designed by people to solve a problem. What are some technologies you can think of?** *Accept all answers.*
3. Give kids 1 minute to list examples of technologies. If kids name only electronic items, remind them that India and Jacob mentioned that things like paper cups are also technologies.
4. To check further understanding of the definition of technology, ask:
   - **Can you find anything that is not a technology?** *Encourage kids to look around the room or out the windows to see if they can find anything that is not a technology. If kids see rocks, trees, soil, or any natural materials, then they have found something that is not a technology.*



Set the Stage (10 min)

1. Explain to kids that now they get the chance to *create* technologies to solve specific problems. These challenges are (1) send a message, (2) water a plant, (3) carry pens and pencils, and (4) protect an astronaut.
2. Have kids turn to *Engineer It*, p. 6 in their Engineering Journals, to read the descriptions of the 4 problems, or read them aloud.
3. Let groups know that they will have 5 minutes to *imagine* and *plan*, then 20 minutes to *create* and test a technology to solve the problem. Then, groups will share their technology with the whole group.
4. Explain that each group will have 50 index cards, straws, and tape to make their technologies. Scissors and rulers will also be available to use as tools, but cannot be used in their designs.
5. Let groups know they should test their designs as they *create* to determine if their technologies solve their problems. Groups that have the *Protect an Astronaut* problem should test by sprinkling sand over their design placed in the aluminum tray and then checking to see if the stuffed animal was protected from the sand.

> **Tip:** Problems #1 and #2 are the most difficult. Problem #3 is the easiest.

> **Tip:** If groups have many ideas, they can *create* and test more than one technology and choose one to share with the group.

Hands-On Technology (25 min)

1. Organize kids into groups of 3.
2. Assign 1 problem to each group to ensure each problem is chosen, or have groups choose. Have kids circle the problem they will solve in their journals.
3. Give groups about 5 minutes to brainstorm as many technologies as they can to solve their problem. Groups can use the middle box on *Engineer It*, p. 6 in their Engineering Journals, to draw or write their ideas. If groups are having trouble coming up with ideas, ask:
   - **What already exists that would help solve this problem?**
4. When groups have had a few minutes to *plan*, allow them to collect their materials from the Materials Table and spend 20 minutes designing and testing their technologies. As groups are working, circulate around the room and ask questions like:
   - **How are you using the materials to make technologies that solve your problem?**
   - **Are your designs working like you thought they would?**
   - **What other materials might help you solve this problem?**
5. Let groups know when 15, 10, and 5 minutes are left. Make sure all groups have tested their designs.

Tip: You may choose to offer unlimited tape or to challenge groups by limiting the tape to 1 or 2 feet.

Reflect (5 min)

1. Have groups choose 1 of their technologies to share. Ask each group:
   - **What problem was your technology designed to solve?**
   - **Can you tell us about your design?**
   - **How might you *improve* your technology?**
2. Then, have kids look at the bottom of *Engineer It*, p. 6 in their Engineering Journals, and check the boxes that apply to all the designs they just made. Ask:
   - **Were all the designs you made technologies? Why or why not?** *Yes, because we engineered them and they help solve a problem.*
   - **Who designs technologies?** *Engineers*.
   - **Are you an engineer?** *Yes!*
3. Remind kids of the definition of technology that India and Jacob sent: a technology is anything engineered by a person that solves a problem.
4. Tell kids that in this unit they will be working in groups to engineer technologies that help astronauts solve problems in space.

What is Technology? Hands-On Technology

reply | forward | archive | delete

from:	engineeringadventures@mos.org
to:	You
subject:	What is Technology? 11:23 AM

Hi engineers,

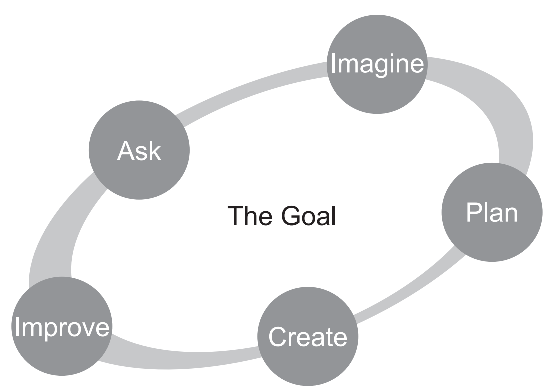
You did a great job engineering a tower to display the stuffed animal so lots of people could see it! Now you're ready to help us engineer even more technologies.

Do you know that the things engineers design to solve problems are called technologies? Most people think technologies have to be electronic, but this isn't true. A technology is actually anything engineered by a person that solves a problem.

Think about an airplane as an example. An airplane is a technology because people engineered it and it solves the problem of needing to travel long distances quickly. But something as simple as a paper cup is also a technology. A person engineered it, and it helps people hold drinks without spilling them everywhere.

We have some more challenges for you today. Can you use the Engineering Design Process to engineer technologies to solve the problems we sent?

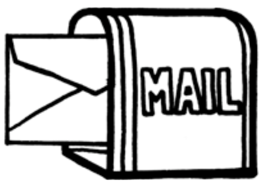
Good luck!
India and Jacob



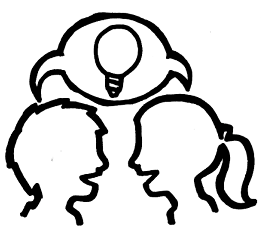
Overview: Kids will explore the features of different gloves and how they perform in a series of challenges. Kids then are introduced to the concept of space hazards and spacesuit design.

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)

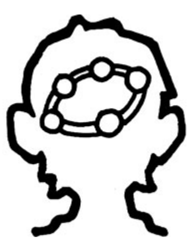


Set the Stage (5 min)



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

<u>*Glove Challenges:*</u>

- ☐ 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

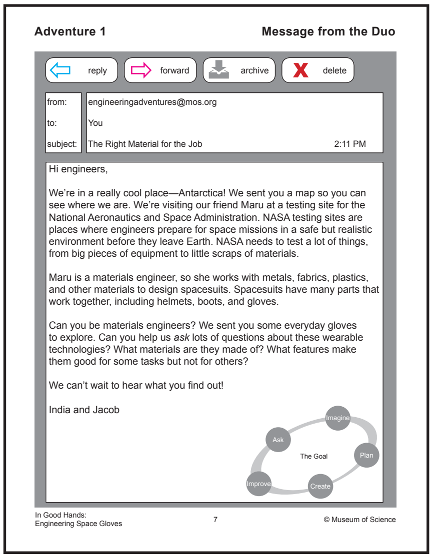
Time Required: 40 minutes

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.

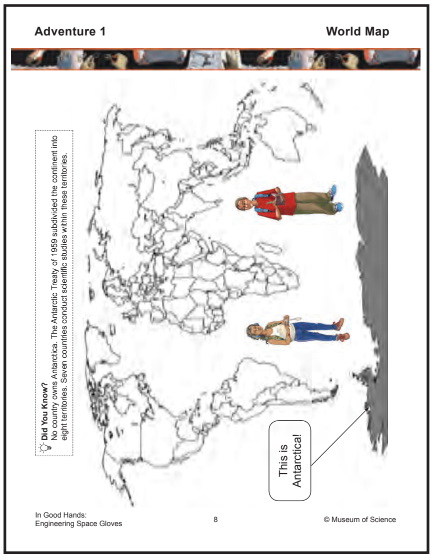
Can you be materials engineers? We sent you some everyday gloves to explore. Can you help us *ask* lots of questions about these wearable technologies? What materials are they made of? What features make them good for some tasks but not for others?

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

India and Jacob

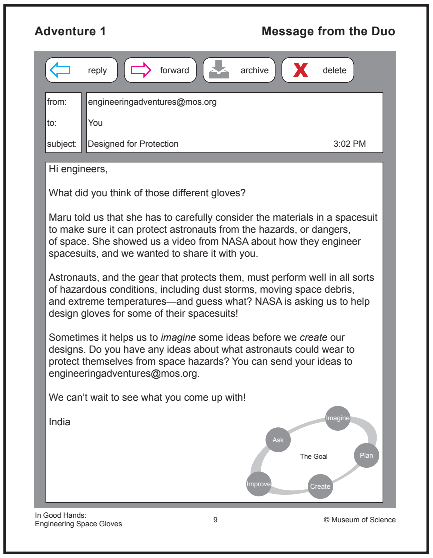
In Good Hands: Engineering Space Gloves 7 © Museum of Science

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!

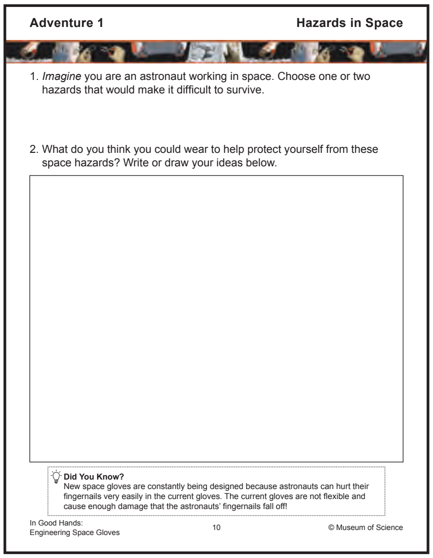
Sometimes it helps us to *imagine* some ideas before we *create* our designs. Do you have any ideas about what astronauts could wear to protect themselves from space hazards? You can send your ideas to engineeringadventures@mos.org.

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

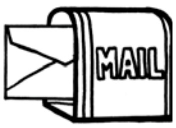
Ice and Sponge Preparation for Other Adventures

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.

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

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.*

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

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.

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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India and Jacob

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?

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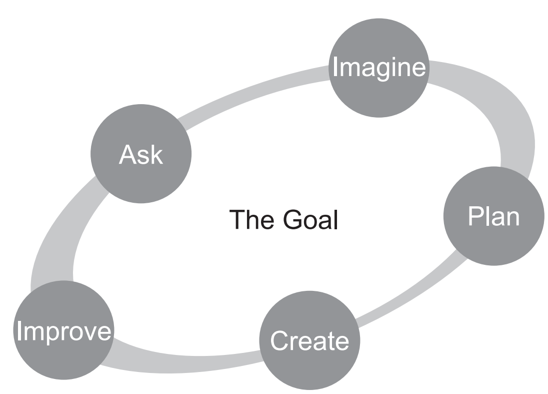
India



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

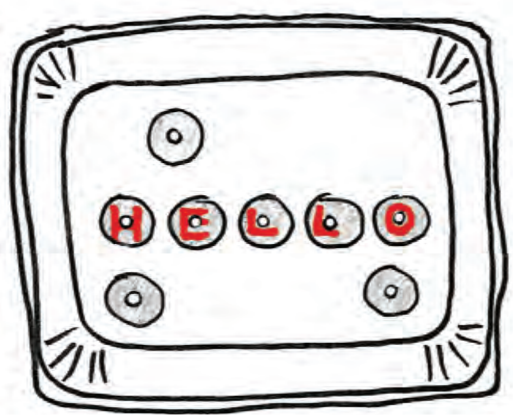
Glove Type	Number of Paper Clips
dish 	
food-safe 	
garden 	
oven[1] 	
vinyl 	
winter 	

[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 <u>hands</u> 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

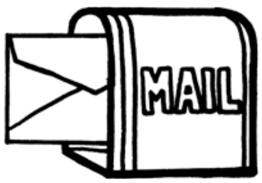
Chilling Out

Overview: Kids will test and compare different materials to see which ones work best to protect against cold temperatures.

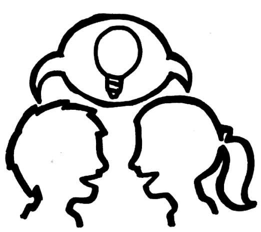
Note to Educator: In this adventure, kids use materials to make a mitt so they can gain experience testing a material prior to developing glove-construction skills. Be sure that the sponges are dry before testing them in the mitt.

Save the *Testing Results* chart for use in later adventures. Save the Testing Stations, including the model hands and thermometers, for use in Adventures 5 and 6.

Duo Update (5 min)

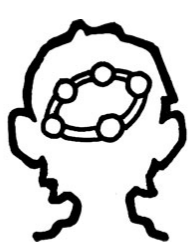


Set the Stage (10 min)



Activity (20 min)

Reflect (10 min)



Materials

For the entire group:

- ☐ *Message from the Duo*, track 5 or Engineering Journal, p. 11
- ☐ *Engineering Design Process* poster
- ☐ chart paper and markers
- ☐ 1 roll of masking tape
- ☐ 1 roll of paper towels

Testing Stations:

- ☐ 1 measuring cup
- ☐ 2 buckets, 5 liters
- ☐ 2 digital thermometers
- ☐ 2 rulers
- ☐ 2 sheets of thin cardboard
- ☐ 2 stopwatches
- ☐ 12 cups of ice cubes
- ☐ 20 cups of water

Materials Table:

- ☐ 1 piece of cheesecloth, approx. 8.5” x 11”
- ☐ 1 sheet of craft foam
- ☐ 1 sheet of felt
- ☐ 1 sheet of foil, approx. 8.5” x 11”
- ☐ 1 sheet of transparency
- ☐ 5 sponges, dry
- ☐ 40 cotton balls
- ☐ 50 straws

For each pair of kids:

- ☐ 1 pair of scissors
- ☐ 2 resealable plastic bags, quart size

For each kid:

- ☐ Engineering Journal

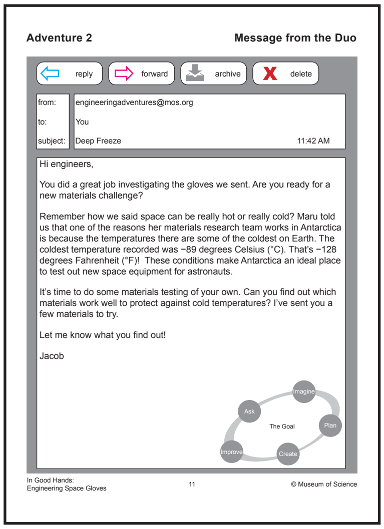
Preparation

Time Required: 30 minutes

1. Post the *Engineering Design Process* poster.
2. Have the *Message from the Duo* ready to share.
3. Copy the *Testing Results* chart, p. 34 in this guide, onto chart paper.
4. Set up a Materials Table with the materials listed above.
5. Cut 2 model hands out of thin cardboard, using the *Model Hand Template*, p. 41 in this guide.
6. Set aside 1 pair of resealable bags to use for the demonstration mitt.
7. Review *Cold Test Procedure*, p. 40 in this guide.
8. Set up 2 Testing Stations by filling each bucket with 6 cups of ice and 10 cups of water. Arrange them on a table with digital thermometers, rulers, stopwatches, and 1 roll of paper towels.
9. Optional: Make copies of *Celsius and Fahrenheit Table*, p. 43 in this guide, for each pair of kids.

Journal Pages for Adventure 2

Message from the Duo, p. 11



Adventure 2 — **Message from the Duo**

reply | forward | archive | delete

from: engineeringadventures@mos.org
to: You
subject: Deep Freeze — 11:42 AM

Hi engineers,

You did a great job investigating the gloves we sent. Are you ready for a new materials challenge?

Remember how we said space can be really hot or really cold? Maru told us that one of the reasons her materials research team works in Antarctica is because the temperatures there are some of the coldest on Earth. The coldest temperature recorded was −89 degrees Celsius (°C). That's −128 degrees Fahrenheit (°F)! These conditions make Antarctica an ideal place to test out new space equipment for astronauts.

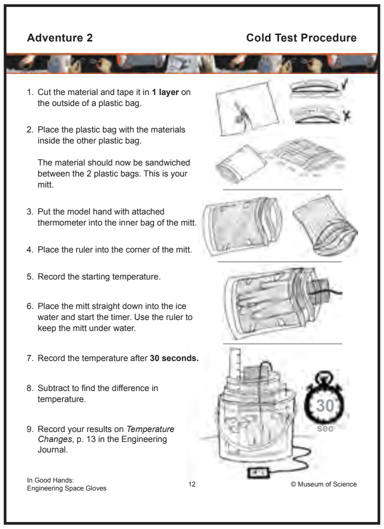
It's time to do some materials testing of your own. Can you find out which materials work well to protect against cold temperatures? I've sent you a few materials to try.

Let me know what you find out!

Jacob

In Good Hands: Engineering Space Gloves — 11 — © Museum of Science

Cold Test Procedure, p. 12



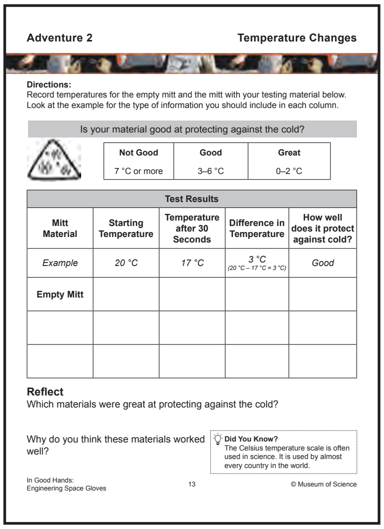
Adventure 2 — **Cold Test Procedure**

1. Cut the material and tape it in **1 layer** on the outside of a plastic bag.
2. Place the plastic bag with the materials inside the other plastic bag.

   The material should now be sandwiched between the 2 plastic bags. This is your mitt.
3. Put the model hand with attached thermometer into the inner bag of the mitt.
4. Place the ruler into the corner of the mitt.
5. Record the starting temperature.
6. Place the mitt straight down into the ice water and start the timer. Use the ruler to keep the mitt under water.
7. Record the temperature after **30 seconds.**
8. Subtract to find the difference in temperature.
9. Record your results on *Temperature Changes*, p. 13 in the Engineering Journal.

In Good Hands: Engineering Space Gloves — 12 — © Museum of Science

Temperature Changes, p. 13



Adventure 2 — **Temperature Changes**

Directions:
Record temperatures for the empty mitt and the mitt with your testing material below. Look at the example for the type of information you should include in each column.

Is your material good at protecting against the cold?

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

Test Results				
Mitt Material	**Starting Temperature**	**Temperature after 30 Seconds**	**Difference in Temperature**	**How well does it protect against cold?**
Example	*20 °C*	*17 °C*	*3 °C (20 °C – 17 °C = 3 °C)*	*Good*
Empty Mitt				

Reflect
Which materials were great at protecting against the cold?

Why do you think these materials worked well?

Did You Know?
The Celsius temperature scale is often used in science. It is used by almost every country in the world.

In Good Hands: Engineering Space Gloves — 13 — © Museum of Science

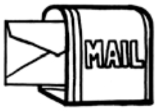
Chart for Adventure 2

Testing Results			
Material	**Cold**		
cheesecloth			
cotton balls			
craft foam			
felt			
foil			
sponges			
straws			
transparency			

Tip: Draw in 2 additional columns in the chart, but leave the headings blank until kids are ready to record their "Impact" and "Dust" data in Adventures 3 and 4.

Kids will learn:

- A space glove must protect astronauts from extreme temperatures in space.
- Some materials are better than others at protecting against the cold.



Present the Message from the Duo (5 min)

1. Tell kids that Jacob sent another message. Have kids turn to *Message from the Duo*, p. 11 in their Engineering Journals, to follow along. Play track 5.
2. To check for understanding, ask:
   - **What did Jacob ask you to investigate today?** *Materials that protect against cold temperatures.*

Set the Stage (10 min)

1. Let kids know that they will line mitts with different materials and test them to find out which materials are better at protecting against the cold.
2. Assemble an empty mitt by placing 1 resealable bag inside another. Hold up the empty mitt with your hand in the inner bag. Ask:
   - **Do you think this mitt will be good at protecting against cold temperatures? Why or why not?** *Accept all answers.*
3. Gather kids at the testing area. Explain that they will take 2 temperature readings. Demonstrate the steps using *Cold Testing Procedure*, p. 40 in this guide or p. 12 in the Engineering Journal, with the empty mitt.
4. Have kids record the data on *Temperature Changes*, p. 13 in their Engineering Journals. Ask:
   - **Do you think this mitt is good at protecting against the cold? Why or why not?** *Accept all answers.*
5. Explain that if the temperature changes a lot (7 degrees or more) in 30 seconds, it means the heat is moving quickly out of the mitt, and the material is “not good” at protecting against the cold.
6. Tell kids if the temperature changes only a little (2 degrees or less) in 30 seconds, the heat is moving slowly out of the mitt, and the material is “great” at protecting against the cold.
7. Show kids the Materials Table with the cheesecloth, cotton balls, felt, craft foam, foil, sponges, straws, and transparency. Ask:
   - **Which materials do you think will be great at protecting against the cold? Why?** *Accept all answers.*

Note: The thermometer takes a little time to adjust, so when the mitt is inserted in the ice water, the temperature may go up slightly before it starts to go down.

Tip: If kids are interested, explain that materials that do not allow heat to move through them quickly are called insulators.

Ask: Which Material Is Best? (20 min)

1. Organize kids into pairs.
2. Assign each pair 1 or 2 materials to test so that all materials are tested.
3. Allow pairs to visit the Materials Table and begin assembling their mitts.
4. As groups are ready, have them move to a Testing Station.
5. Have pairs record their results on *Temperature Changes*, p. 13 in their Engineering Journals, and in the “Cold” column of the *Testing Results* chart by writing whether the material was “not good,” “good,” or “great” at protecting against the cold.

Tip: Kids may ask about empty space between materials in the mitt. Because of the different properties of the materials, 1 layer of material may have more empty space in some mitts than others.

Reflect (10 min)

1. Gather kids near the *Testing Results* chart to share their observations. Ask:
   - **Which materials were great at protecting against the cold? Why do you think they worked well?**
2. Encourage kids to make connections between the properties of the materials and their results. If there are different results for the same material, consider testing it again to decide how to categorize it. Ask:
   - **Which materials were not good at protecting against cold temperatures? Why not?**
   - **Which material do you think would be good to use in a space glove? Why do you think so?** *Accept all answers.*
3. Have kids gather around the *Engineering Design Process* poster. Ask:
   - **What step of the Engineering Design Process did you use today?** *We* asked *questions about materials that protect against cold temperatures.*
4. Let kids know that next time, they will *ask* questions about how well certain materials protect against impact, or damage from heavy moving objects.
5. Save the *Testing Results* chart for use in the next adventure. Save the Testing Stations, model hands, and thermometers for use in Adventures 5 and 6. If the sponges are wet, set them out to dry so that tape will stick to them in the next activity.

Tip: To standardize the test results, wave the paper hand in the air between tests to bring the temperature back up to 20–22 °C.

Tip: If kids are unfamiliar with Celsius, make and distribute copies of the *Celsius and Fahrenheit Table*, p. 43 in this guide, so they can compare the 2 temperature scales.

Tip: Help kids make connections from their results to everyday objects that protect against the cold, like a styrofoam coffee cup, or the lining of a winter coat.

Extension (10 minutes)

To deepen kids' understanding of materials properties and how cheesecloth can protect against the cold, kids will explore what happens when a second layer of cheesecloth is added to the mitt.

1. Bring out another piece of cheesecloth, approximately 8.5" x 11".
2. Ask the kids who tested cheesecloth to cut and tape the second piece of cheesecloth onto their mitt in a second layer.
3. Have the pair test the new two-layer mitt at a Testing Station.
4. Add another row to the *Testing Results* chart labeled "cheesecloth–2 layers"
5. Have a volunteer record the results on the "cheesecloth - 2 layers" row of the *Testing Results* chart by writing whether the material was "not good," "good," or "great" at protecting against the cold.
6. Ask:
   - **Which was better at protecting against the cold, one layer of cheesecloth or two layers?** *Two layers of cheesecloth.*
   - **Did the results surprise you?** *Accept all answers.*
   - **What do you think would happen if you added a second layer of a different material to another mitt?** *Accept all answers.*
   - **Which do you think would be better to use in a space glove—one layer or two layers? Why do you think so?** *Accept all answers.*

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from: engineeringadventures@mos.org

to: You

subject: Deep Freeze

11:42 AM

Hi engineers,

You did a great job investigating the gloves we sent. Are you ready for a new materials challenge?

Remember how we said space can be really hot or really cold? Maru told us that one of the reasons her materials research team works in Antarctica is because the temperatures there are some of the coldest on Earth. The coldest temperature recorded was −89 degrees Celsius (°C). That's −128 degrees Fahrenheit (°F)! These conditions make Antarctica an ideal place to test out new space equipment for astronauts.

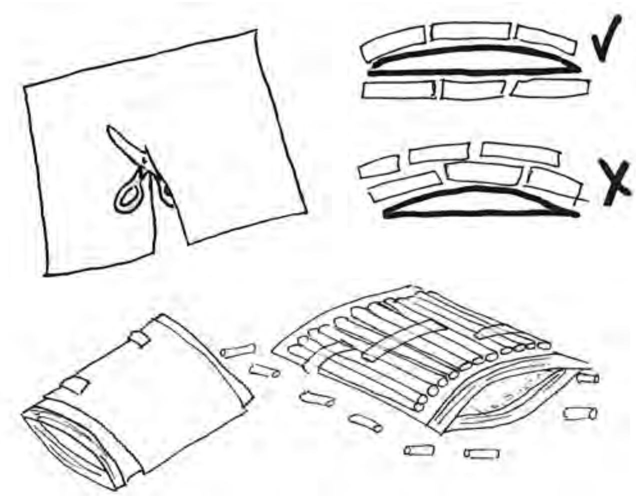
It's time to do some materials testing of your own. Can you find out which materials work well to protect against cold temperatures? I've sent you a few materials to try.

Let me know what you find out!

Jacob

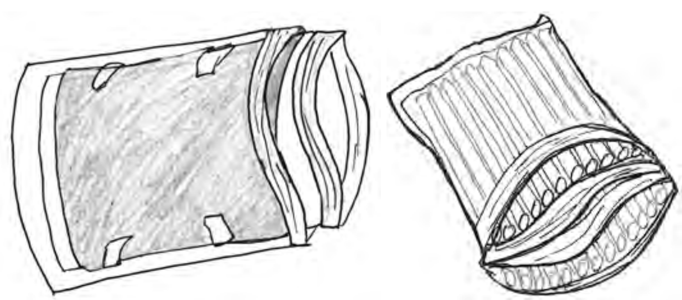
Cold Test Procedure

1. Cut the material and tape it in 1 layer on the outside of a plastic bag.



2. Place the plastic bag with the materials inside the other plastic bag.

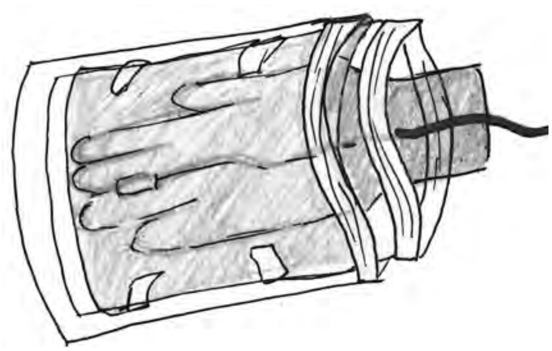
   The material should now be sandwiched between the 2 plastic bags. This is your mitt.



3. Put the model hand with attached thermometer into the inner bag of the mitt.

4. Place the ruler into the corner of the mitt.

5. Record the starting temperature.

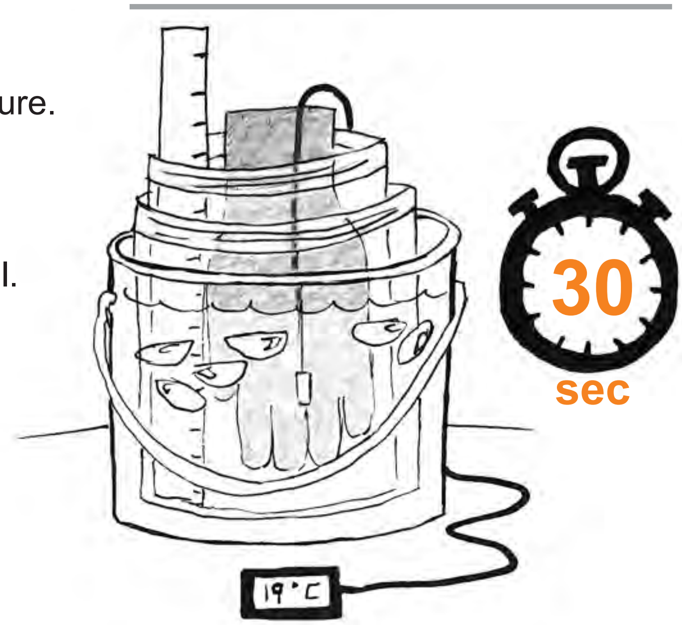


6. Place the mitt straight down into the ice water and start the timer. Use the ruler to keep the mitt under water.

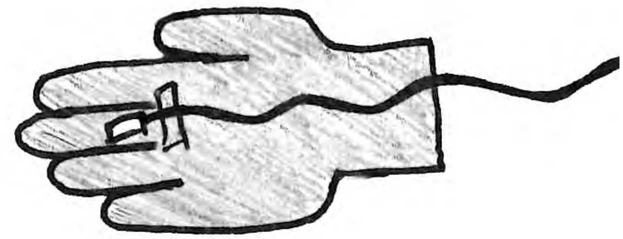
7. Record the temperature after **30 seconds.**

8. Subtract to find the difference in temperature.

9. Record your results on *Temperature Changes*, p. 13 in the Engineering Journal.



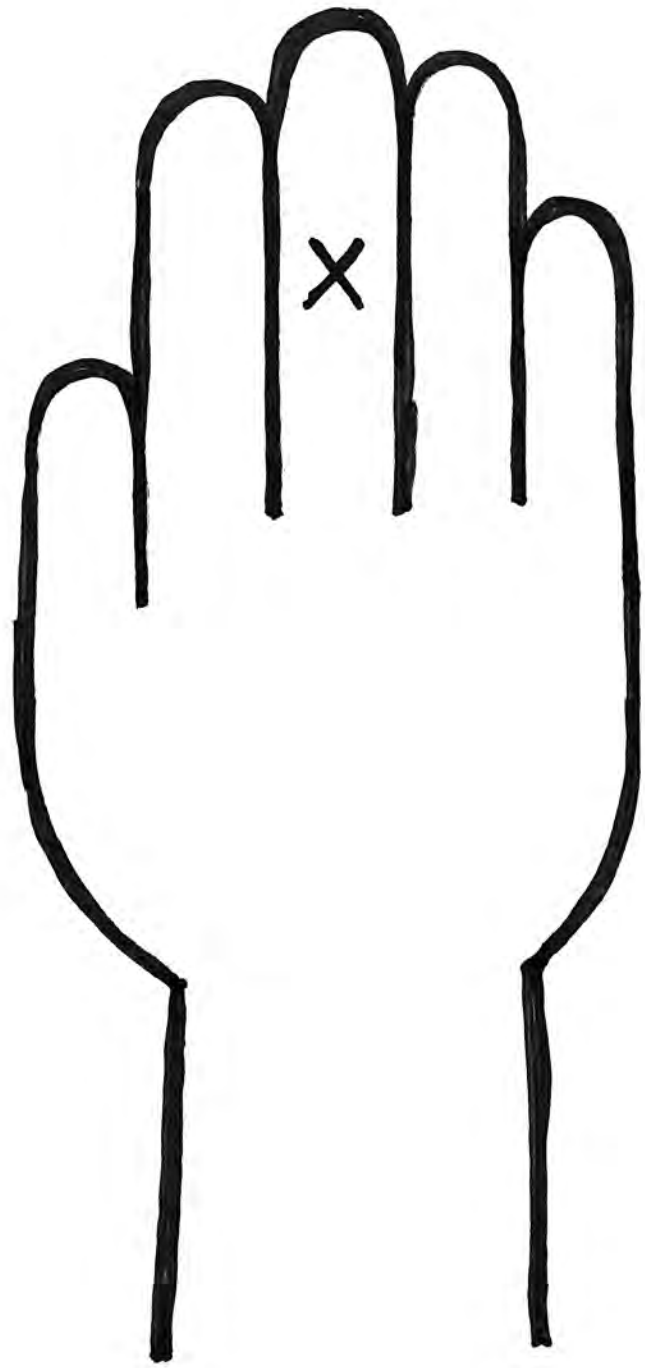
How to Make the Model Hand



Prepare a model hand for each of the 2 Testing Stations.

1. Cut out the hand below.
2. Trace the hand onto thin cardboard and cut it out.
3. Attach the thermometer with masking tape.

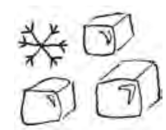
   Make sure the metal probe is positioned over the X. Be careful not to tape over the probe itself.
4. Place 1 model hand with the digital thermometer attached at each Testing Station.



Celsius and Fahrenheit Table

Celsius (°C)	Fahrenheit (°F)
–20 **°C**	–4 **°F**
–10 **°C**	14 **°F**
0 **°C**	32 **°F**
10 **°C**	50 **°F**
20 **°C**	68 **°F**
30 **°C**	86 **°F**
40 **°C**	104 **°F**
50 **°C**	122 **°F**
60 **°C**	140 **°F**
70 **°C**	158 **°F**
80 **°C**	176 **°F**
90 **°C**	194 **°F**
100 **°C**	212 **°F**

32 °F → water freezes



68 °F → room temperature

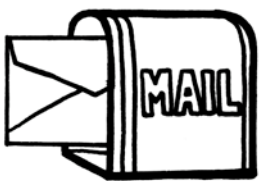
212 °F → water boils

Overview: Kids will test and compare how well different materials protect against impact hazards, specifically damage from heavy moving objects.

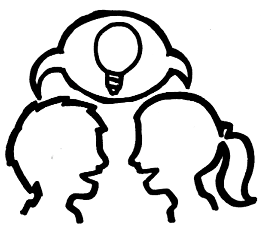
Note to Educator: In this adventure, kids attach materials to 1 side of a vinyl glove to develop glove-construction skills while testing materials. This approach enables kids to start thinking about building for a wearable design.

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

Duo Update (5 min)

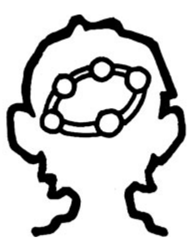


Set the Stage (10 min)



Activity (25 min)

Reflect (10 min)



Materials

For the entire group:

- ☐ *Message from the Duo*, track 6 or Engineering Journal, p. 14
- ☐ *Engineering Design Process* poster
- ☐ *Testing Results* chart and marker
- ☐ 1 glove, vinyl, large

Testing Station:

- ☐ 1 box of spaghetti
- ☐ 2 aluminum trays
- ☐ 2 deli containers, round, with lids, 16 oz.
- ☐ 2 rulers
- ☐ 2 skewers, wooden
- ☐ 200 metal washers, 1 1/4”

Materials Table:

- ☐ 1 piece of cheesecloth, 8.5” x 11”
- ☐ 1 sheet of craft foam, 8.5” x 11”
- ☐ 1 sheet of felt, 8.5” x 11”
- ☐ 1 sheet of foil, 8.5” x 11”
- ☐ 1 sheet of transparency
- ☐ 2 sponges
- ☐ 4 rolls of masking tape
- ☐ 20 straws
- ☐ 30 cotton balls

For each pair of kids:

- ☐ 1 pair of scissors
- ☐ 1 vinyl glove

For each kid:

- ☐ Engineering Journal

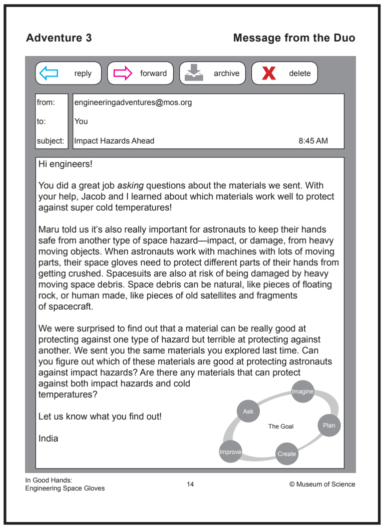
Preparation

Time Required: 25 minutes

1. Post the *Engineering Design Process* poster.
2. Have the *Message from the Duo* ready to share.
3. Post the *Testing Results* chart from Adventure 2 and add “Impact” as the title of the next column, as shown on p. 46 in this guide.
4. Set up a Materials Table with the materials listed above.
5. Prepare the testing weights. Fill each of the 2 containers with 100 washers and seal lids with masking tape.
6. Prepare a demonstration glove by placing 1 piece of pasta in each finger of a vinyl glove.
7. Set up 2 Testing Stations. Tape a skewer to the bottom of each aluminum tray, as shown on *Impact Test Procedure,* p. 50 in this guide.

Journal Pages for Adventure 3

Message from the Duo, p. 14



Adventure 3 **Message from the Duo**

reply | forward | archive | delete

from: engineeringadventures@mos.org
to: You
subject: Impact Hazards Ahead 8:45 AM

Hi engineers!

You did a great job *asking* questions about the materials we sent. With your help, Jacob and I learned about which materials work well to protect against super cold temperatures!

Maru told us it's also really important for astronauts to keep their hands safe from another type of space hazard—impact, or damage, from heavy moving objects. When astronauts work with machines with lots of moving parts, their space gloves need to protect different parts of their hands from getting crushed. Spacesuits are also at risk of being damaged by heavy moving space debris. Space debris can be natural, like pieces of floating rock, or human made, like pieces of old satellites and fragments of spacecraft.

We were surprised to find out that a material can be really good at protecting against one type of hazard but terrible at protecting against another. We sent you the same materials you explored last time. Can you figure out which of these materials are good at protecting astronauts against impact hazards? Are there any materials that can protect against both impact hazards and cold temperatures?

Let us know what you find out!

India

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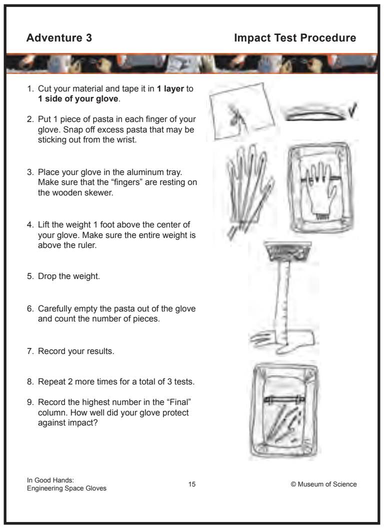
Impact Test Procedure, p. 15

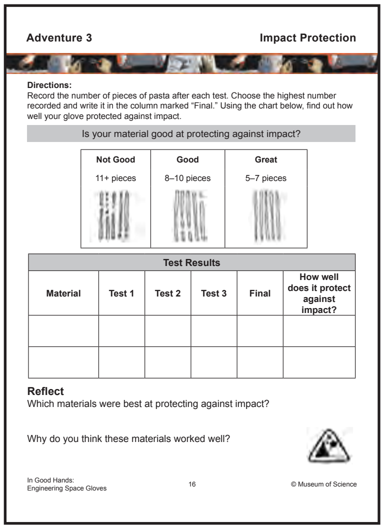


Adventure 3 **Impact Test Procedure**

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

In Good Hands: Engineering Space Gloves 15 © Museum of Science

Impact Protection, p. 16



Adventure 3 **Impact Protection**

Directions:
Record the number of pieces of pasta after each test. Choose the highest number recorded and write it in the column marked "Final." Using the chart below, find out how well your glove protected against impact.

Is your material good at protecting against impact?

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

Test Results					
Material	**Test 1**	**Test 2**	**Test 3**	**Final**	**How well does it protect against impact?**

Reflect
Which materials were best at protecting against impact?

Why do you think these materials worked well?

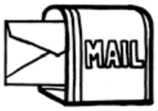
In Good Hands: Engineering Space Gloves 16 © Museum of Science

Chart for Adventure 3

Testing Results			
Material	**Cold**	**Impact**	
cheesecloth	*Cold Results from Adventure 2*		
cotton balls			
craft foam			
felt			
foil			
sponges			
straws			
transparency			

Kids will learn:

- A space glove must protect against impact hazards.
- Some materials are better than others at protecting against heavy moving objects.



Present the Message from the Duo (5 min)

1. Tell kids that India has sent them more information about their model space gloves. Have kids turn to *Message from the Duo*, p. 14 in their Engineering Journals, to follow along. Play track 6.
2. To check for understanding, ask:
   - **What kinds of things did India say that astronauts need to protect their hands against in space?** *Astronauts need to protect themselves against impact hazards like heavy moving equipment and space debris.*
   - **What does India want us to do?** *Test different materials to find out how well they protect against impact hazards.*

Tip: Help kids make connections to everyday objects that protect against impact, such as a bike helmet, a hard hat, knee pads, an airbag, or packing materials.

Set the Stage (10 min)

1. Gather kids at a Testing Station with their Engineering Journals. Show them the demonstration glove and the weight they will use to model an impact hazard in space. Explain that the pasta pieces are a model for the finger bones in a hand. The skewer at the bottom of the tray represents a tool the glove will "hold" during testing.
2. Turn to *Impact Test Procedure,* p. 50 in this guide. Kids may turn to p.15 in the Engineering Journal. Demonstrate steps 2–4 of the impact test, but do not drop the weight. Ask:
   - **What do you think will happen when we drop this weight on the glove?** *The pasta will break.*
3. Let kids know they will test their material 3 times and record their results on *Impact Protection*, p. 16 in their Engineering Journals. They will write the highest number out of the 3 tests in the "Final" column.
4. Point out all of the materials on the Materials Table, and let kids know they will work in pairs to test 1 of the materials. Ask:
   - **Do you think any of these materials will protect the model fingers against impact? Why?** *Accept all answers.*

Tip: If kids have advanced math skills, have them determine the average number of breaks out of 3 tests and round up.

Ask: Which Material Is Best? (25 min)

1. Organize kids into pairs.
2. Have kids turn to *Impact Test Procedure,* p. 15 in their Engineering Journals.
3. Assign pairs a different material than the one they tested in Adventure 2. Have groups retrieve their materials from the Materials Table and begin working.
4. Have groups record their results on *Impact Protection*, p. 16 in their Engineering Journals, and in the "Impact" column on the *Testing Results* chart by writing whether the material was "not good," "good," or "great" at protecting against impact for the material they tested.
5. After kids test and record their results and if time permits, encourage them to continue investigating by testing a different material or combining materials.
6. Let groups know when time is winding down.

Tip: If kids need help attaching material to their glove, tell them to cut long strips of masking tape, make loops with the sticky side out, and place the loop on **1 side** of the glove.

Reflect (10 min)

1. Gather groups around the *Testing Results* chart to share their findings. Ask:
   - **Which materials were great at protecting against impact hazards? Why do you think they worked well?**
2. Encourage kids to make connections between the properties of the materials and their results from the *Testing Results* chart. For example, the softer materials like craft foam and sponges provided padding for the pasta and prevented it from breaking. Ask:
   - **Which materials were not good at protecting against impact hazards? Why do you think they did not work well?** *The thin, flexible materials like foil did not provide enough padding for the pasta.*
   - **Which materials are good at protecting against both impact and cold temperatures?**
3. Show kids the *Engineering Design Process* poster. Ask:
   - **Which step of the Engineering Design Process helped you most today?** *We* asked *which materials were best at protecting against impact.*
4. Give kids time to reflect using the bottom of *Impact Protection*, p. 16 in their Engineering Journals, so they can apply what they learned in this adventure to their final design challenge.
5. Let kids know that next time they will find out about one more hazard before they design a space glove to protect against multiple space hazards.
6. Save the Impact Testing Stations and materials for Adventures 5 and 6.

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from: engineeringadventures@mos.org

to: You

subject: Impact Hazards Ahead

8:45 AM

Hi engineers,

You did a great job *asking* questions about the materials we sent. With your help, Jacob and I learned about which materials work well to protect against super cold temperatures!

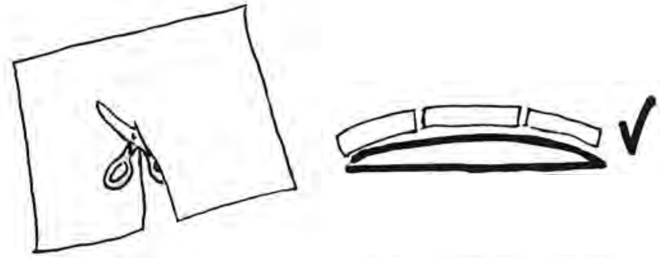
Maru told us it's also really important for astronauts to keep their hands safe from another type of space hazard—impact, or damage, from heavy moving objects. When astronauts work with machines with lots of moving parts, their space gloves need to protect different parts of their hands from getting crushed. Spacesuits are also at risk of being damaged by heavy moving space debris. Space debris can be natural, like pieces of floating rock, or human made, like pieces of old satellites and fragments of spacecraft.

We were surprised to find out that a material can be really good at protecting against one type of hazard but terrible at protecting against another. We sent you the same materials you explored last time. Can you figure out which of these materials are good at protecting astronauts against impact hazards? Are there any materials that can protect against both impact hazards and cold temperatures?

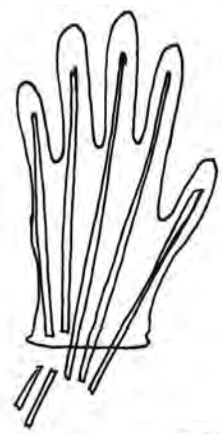
Let us know what you find out!

India

1. Cut your material and tape it in **1 layer** to **1 side of your glove**.

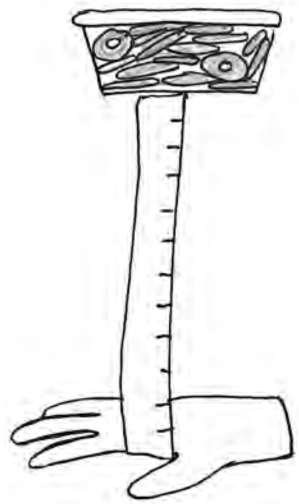


2. Put 1 piece of pasta in each finger of your glove. Snap off excess pasta that may be sticking out from the wrist.

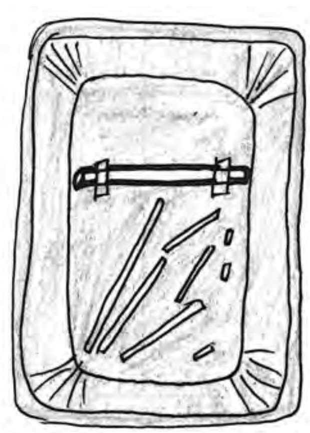


3. Place your glove in the aluminum tray. Make sure that the “fingers” are resting on the wooden skewer.

4. Lift the weight 1 foot above the center of your glove. Make sure the entire weight is above the ruler.



5. Drop the weight.
6. Carefully empty the pasta out of the glove and count the number of pieces.



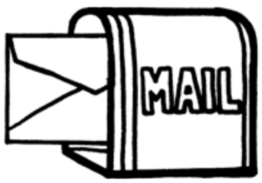
7. Record your results.
8. Repeat 2 more times for a total of 3 tests.
9. Record the highest number in the “Final” column. How well did your glove protect against impact?

Overview: Kids will test and compare how dust resistant different materials are.

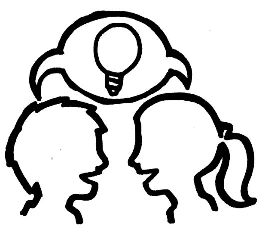
Note to Educator: In this adventure, kids attach materials to both sides of a vinyl glove to further develop glove-construction skills while testing materials. Be sure that the sponges are dry so that tape will adhere to them.

Save the materials, *Testing Results* chart, and Testing Stations for Adventures 5 and 6.

Duo Update (5 min)

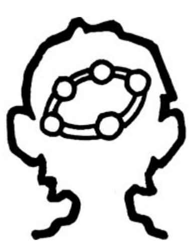


Set the Stage (5 min)



Activity (30 min)

Reflect (5 min)



Materials

For the entire group:

- ☐ *Message from the Duo*, track 7 or Engineering Journal, p. 17
- ☐ *Engineering Design Process* poster
- ☐ *Testing Results* chart and marker

Materials Table:

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

Testing Stations:

- ☐ 1 container of UV glow powder
- ☐ 1 roll of paper towels
- ☐ 1 tablespoon measure
- ☐ 2 aluminum trays, 12” x 10”
- ☐ 2 black lights, handheld
- ☐ 2 craft sticks
- ☐ 2 cups of gravel
- ☐ 2 hand lenses
- ☐ 6 cups of sand
- ☐ 8 resealable plastic bags, quart size
- ☐ 10 washers, 1 1/4”

For each pair of kids:

- ☐ 1 pair of scissors
- ☐ 1 vinyl glove

For each kid:

- ☐ Engineering Journal

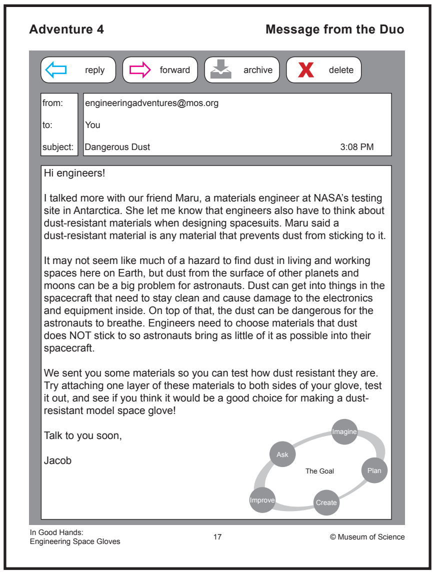
Preparation

Time Required: 30 minutes

1. Post the *Engineering Design Process* poster.
2. Have the *Message from the Duo* ready to share.
3. Update the *Testing Results* chart from Adventure 3 by adding “Dust” as the title of the next column, as shown on p. 52 in this guide. Post the updated chart.
4. Set up a Materials Table with the materials listed above.
5. Prepare 2 Testing Stations by following the instructions on *Dust Testing Station*, p. 56 in this guide.

Journal Pages for Adventure 4

Message from the Duo, p. 17



Adventure 4 — Message from the Duo

from: engineeringadventures@mos.org
to: You
subject: Dangerous Dust 3:08 PM

Hi engineers!

I talked more with our friend Maru, a materials engineer at NASA's testing site in Antarctica. She let me know that engineers also have to think about dust-resistant materials when designing spacesuits. Maru said a dust-resistant material is any material that prevents dust from sticking to it.

It may not seem like much of a hazard to find dust in living and working spaces here on Earth, but dust from the surface of other planets and moons can be a big problem for astronauts. Dust can get into things in the spacecraft that need to stay clean and cause damage to the electronics and equipment inside. On top of that, the dust can be dangerous for the astronauts to breathe. Engineers need to choose materials that dust does NOT stick to so astronauts bring as little of it as possible into their spacecraft.

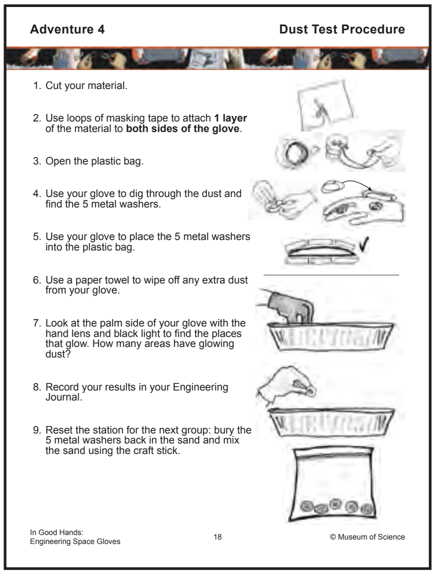
We sent you some materials so you can test how dust resistant they are. Try attaching one layer of these materials to both sides of your glove, test it out, and see if you think it would be a good choice for making a dust-resistant model space glove!

Talk to you soon,

Jacob

In Good Hands: Engineering Space Gloves 17 © Museum of Science

Dust Test Procedure, p.18

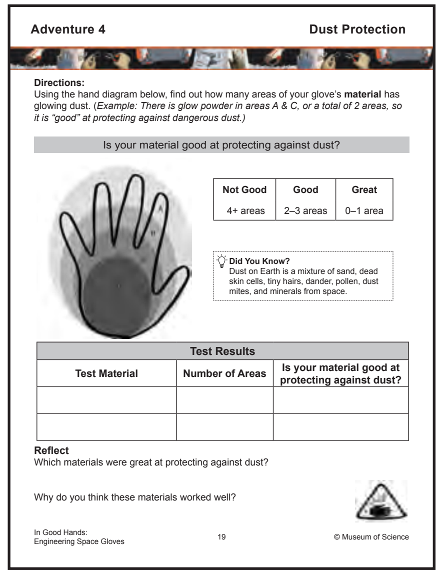


Adventure 4 — Dust Test Procedure

1. Cut your material.
2. Use loops of masking tape to attach **1 layer** of the material to **both sides of the glove**.
3. Open the plastic bag.
4. Use your glove to dig through the dust and find the 5 metal washers.
5. Use your glove to place the 5 metal washers into the plastic bag.
6. Use a paper towel to wipe off any extra dust from your glove.
7. Look at the palm side of your glove with the hand lens and black light to find the places that glow. How many areas have glowing dust?
8. Record your results in your Engineering Journal.
9. Reset the station for the next group: bury the 5 metal washers back in the sand and mix the sand using the craft stick.

In Good Hands: Engineering Space Gloves 18 © Museum of Science

Dust Protection, p. 19



Adventure 4 — Dust Protection

Directions:
Using the hand diagram below, find out how many areas of your glove's **material** has glowing dust. (*Example: There is glow powder in areas A & C, or a total of 2 areas, so it is "good" at protecting against dangerous dust.)*

Is your material good at protecting against dust?

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

Did You Know? Dust on Earth is a mixture of sand, dead skin cells, tiny hairs, dander, pollen, dust mites, and minerals from space.

Test Results		
Test Material	Number of Areas	Is your material good at protecting against dust?

Reflect
Which materials were great at protecting against dust?

Why do you think these materials worked well?

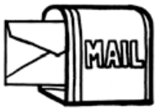
In Good Hands: Engineering Space Gloves 19 © Museum of Science

Chart for Adventure 4

Testing Results			
Material	**Cold**	**Impact**	**Dust**
cheesecloth	*Cold Results from Adventure 2*	*Impact Results from Adventure 3*	
cotton balls			
craft foam			
felt			
foil			
sponges			
straws			
transparency			

Kids will learn:

- Dust contamination can be a hazard for astronauts and equipment in space.
- Some materials prevent dust from sticking to them better than others.



Message from the Duo (5 min)

1. Tell kids that Jacob sent them another message about space gloves.
2. Have kids turn to *Message from the Duo*, p. 17 in their Engineering Journals, to follow along. Play track 7.
3. To check for understanding, ask:
   - **Why is dust a hazard for astronauts in space?** *Dust can damage things inside the spacecraft that astronauts depend on. It can also be dangerous for astronauts to breathe.*
   - **What does it mean if a material is "dust resistant"?** *A dust-resistant material is a material that prevents dust from sticking to it.*
   - **What does Jacob want us to do?** *Test different materials to see which ones are the most dust resistant.*

Set the Stage (5 min)

1. Gather kids at the Testing Station. Have kids *imagine* that they are astronauts working on another planet. They are repairing their spacecraft and dropped some parts on the ground.
2. Turn on the black light and pass it over the trays. Ask:
   - **What do you think the glowing powder represents?** *Areas where there is dangerous dust.*
3. Show kids the testing materials and ask:
   - **Do you think the dangerous dust will stick to these materials? Why or why not?**
4. Explain that each group will be given another glove and assigned a different material to test. This time, groups will use the material to design both sides of the glove.
5. Turn to *Dust Test Procedure*, p. 56 in this guide. Have kids turn to *Dust Test Procedure*, p. 18 in their Engineering Journals. Review each step of the dust test.
6. Show kids the "Dust" column on the *Testing Results* chart. Let them know they will record their results on the chart after they test their material.

> **Tip:** If kids have difficulty seeing the UV glow powder under the black light, try turning off the overhead lights in the room.

Ask: Which Material Is Best? (30 min)

1. Organize kids into pairs.
2. Provide a glove and assign a material to each group.

> **Tip:** If there are fewer than 8 groups, assign some groups 2 materials so all materials are tested.

3. Have groups collect their materials from the Materials Table and begin working. Remind them that during glove construction, their fingers must be able to move to complete the final task.
4. Circulate around the room and ask:
   - **Do you think this material will pick up a lot of dust? Why or why not?**
5. Have groups record their results on *Dust Protection*, p. 19 in their Engineering Journals, and on the *Testing Results* chart by writing "not good," "good," or "great" based on the number of areas the glow powder was identified.

Tip: Have groups use a hand lens to examine the parts of their glove that picked up the most dust. Encourage them to look closely at their material to see how the dust gets trapped in the creases and fibers.

Tip: Add 1/2 tablespoon of glow powder between tests.

Reflect (5 min)

1. Gather groups together in front of the *Testing Results* chart to share their observations. Ask:
   - **Which materials picked up a lot of dust? What do these materials have in common?** *Some have similar textures. Some are porous or fuzzy and caught dust in their creases and fibers.*
   - **Which materials were the most dust resistant? What do these materials have in common?** *They are smooth so dust shakes off easily. There are not a lot of fibers or rough texture in the material for dust to get stuck in.*
   - **Which materials are good at protecting from cold, impact, and dust hazards in space?**
   - **How easy was it to complete the task? Why might this be important for engineers to consider?** *The materials we choose should protect from dust without getting in the way of astronauts' work. Comfort and usability are important for engineers to keep in mind.*
2. Have kids gather around the *Engineering Design Process* poster. Ask:
   - **What step of the Engineering Design Process did we focus on today?** *We* asked *questions about dust-resistant materials.*
3. Let kids know that next time they will learn about the different missions that Maru and her friends at NASA need their help with. They will get to design a model space glove that can protect astronauts from the many hazards of space.
4. Save any leftover materials, the Testing Stations, and the *Testing Results* chart for use in Adventures 5 and 6.

reply | forward | archive | delete

from: engineeringadventures@mos.org

to: You

subject: Dangerous Dust

3:08 PM

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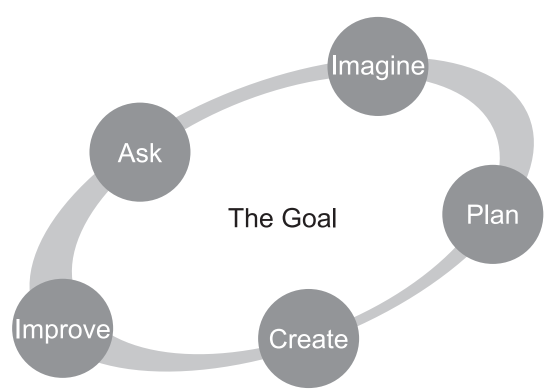
We sent you some materials so you can test how dust resistant they are. Try attaching one layer of these materials to both sides of your glove, test it out, and see if you think it would be a good choice for making a dust-resistant model space glove!

Talk to you soon,

Jacob



Dust Testing Station Set Up

1. Prepare 2 Testing Stations for groups of 2 to share.

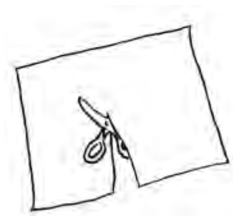
2. For each Testing Station, combine 1 cup of gravel, 3 cups of sand, and 1 tbsp. of glow powder in a 12” x 10” aluminum tray.

3. Mix thoroughly using a craft stick.

4. Bury 5 washers in each tray. The tester wearing the glove will need to uncover them to complete the task.

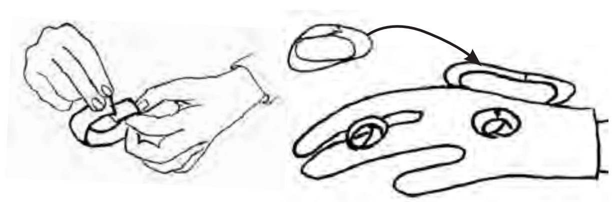
5. Place a black light, a craft stick, 4 resealable plastic bags, and a few paper towels near each tray.

Dust Test Procedure



1. Cut your material.

2. Use loops of masking tape to attach **1 layer** of the material to **both sides of the glove**.

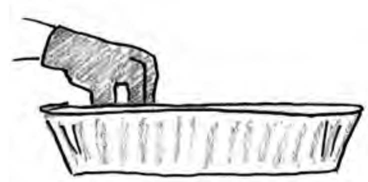


3. Open the plastic bag.

4. Use your glove to dig through the dust and find the 5 metal washers.

5. Use your glove to place the 5 metal washers into the plastic bag.

6. Use a paper towel to wipe off any extra dust from your glove.



7. Look at the palm side of your glove with the hand lens and black light to find the places that glow. How many areas have glowing dust?

8. Record your results in your Engineering Journal.

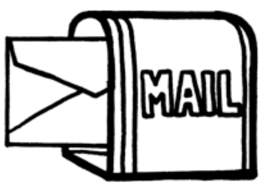
9. Reset the station for the next group: bury the 5 metal washers back in the sand and mix the sand using the craft stick.

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.

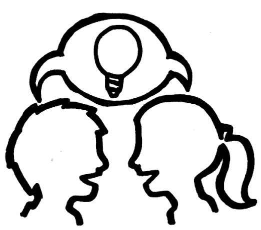
Note to Educator: Be sure that the sponges are dry so that tape will adhere to them.

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

Duo Update (5 min)

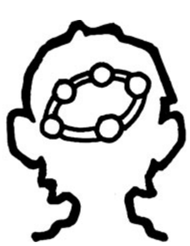


Set the Stage (7 min)



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

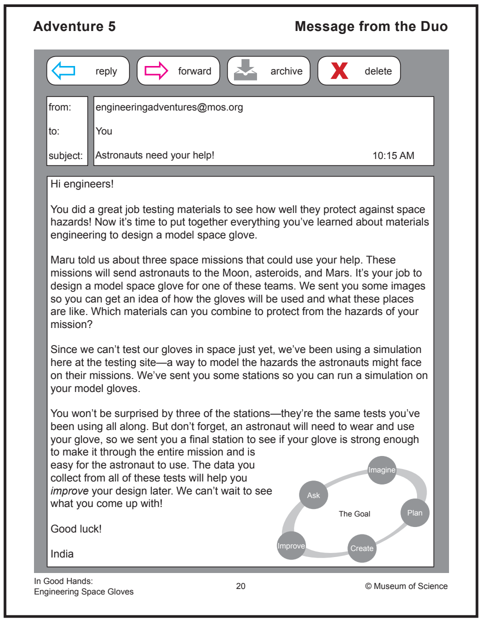
Preparation

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

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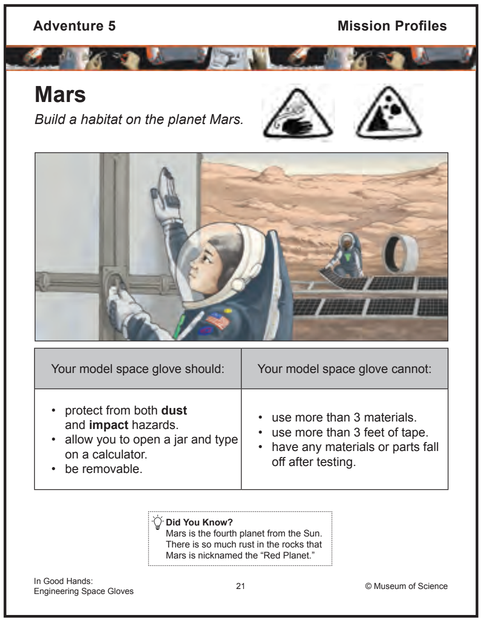
Mission Profiles, pp. 21–23



Adventure 5 Mission Profiles

Mars

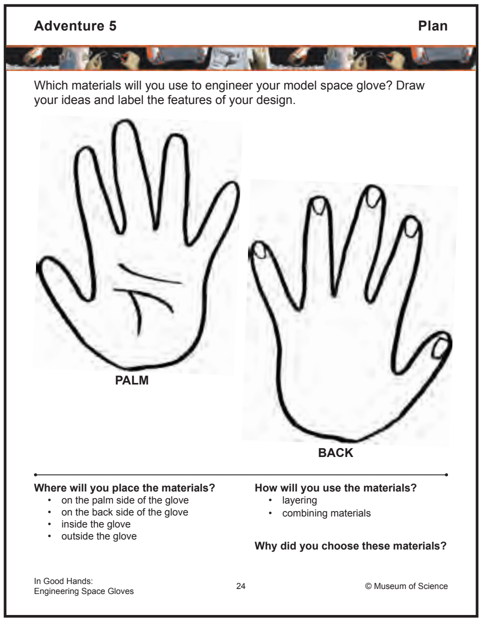
Build a habitat on the planet Mars.

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

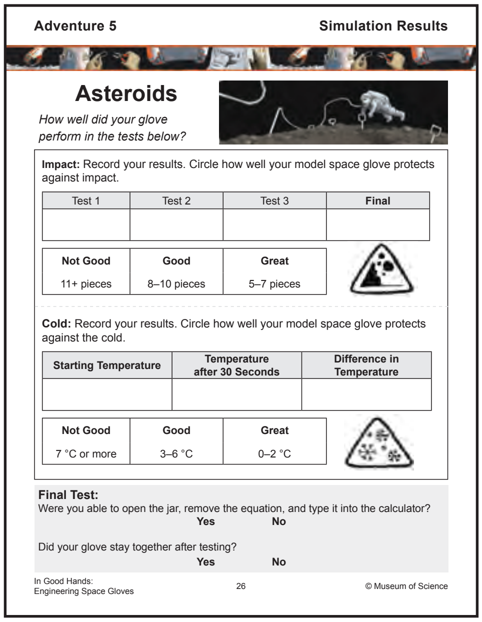
Where will you place the materials?
- on the palm side of the glove
- on the back side of the glove
- inside the glove
- outside the glove

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

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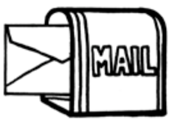
Pre-Preparation for Adventure 6

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?**

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

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.

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.

reply | forward | archive | delete

from: engineeringadventures@mos.org

to: You

subject: Astronauts need your help!

10:15 AM

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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

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.

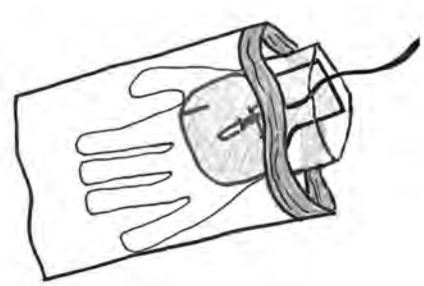
Dust Test Stations

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.

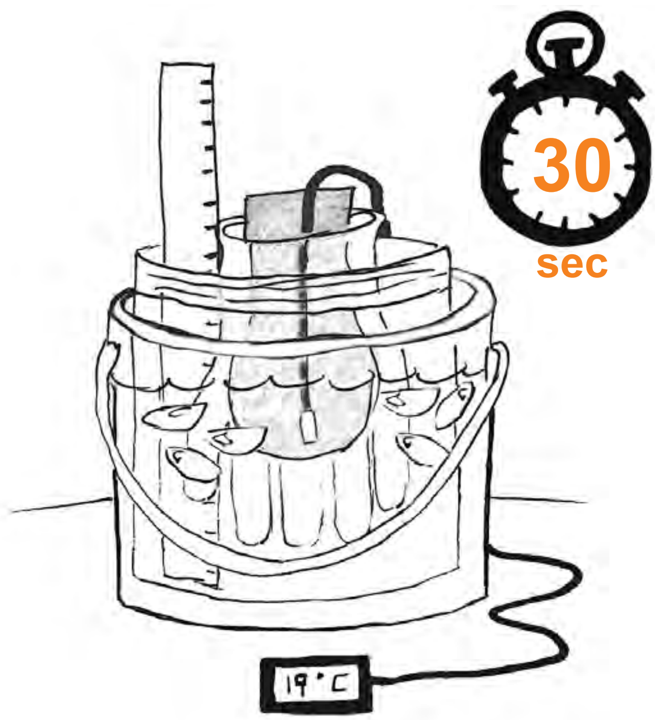
Final Test Stations

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

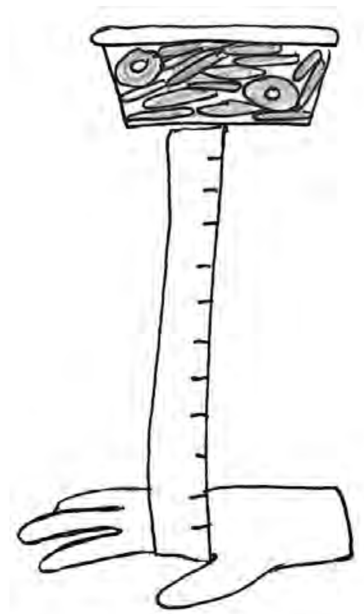


1. Put the model hand with attached thermometer into your glove.
2. Place the model space glove inside the plastic bag.
3. Place the ruler into the corner of the plastic bag.
4. Record the starting temperature in your Engineering Journal.
5. Place the glove straight down into the ice water and start 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?

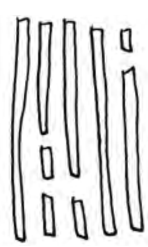
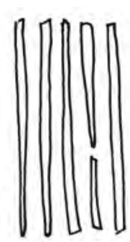


Not Good	Good	Great
7 °C or more	3–6 °C	0–2 °C

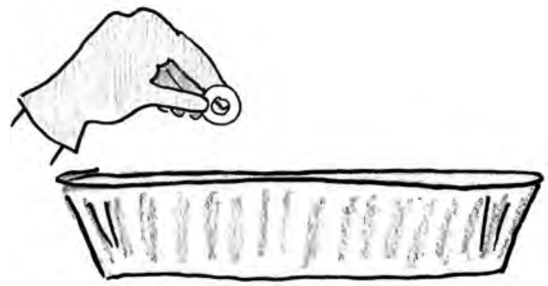
IMPACT TEST STATION



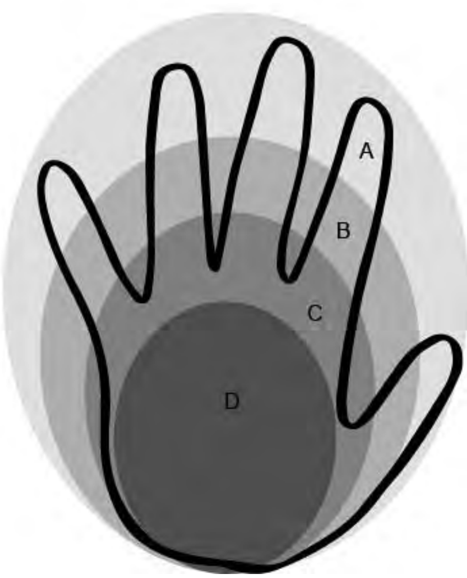
1. Put 1 piece of pasta in each finger of your glove. Snap off any extra pasta that may be sticking out from the wrist.
2. Place your glove in the aluminum tray. Make sure that the “fingers” are resting on the wooden skewer.
3. Lift the weight 1 foot above the center of your glove. Make sure the entire 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?

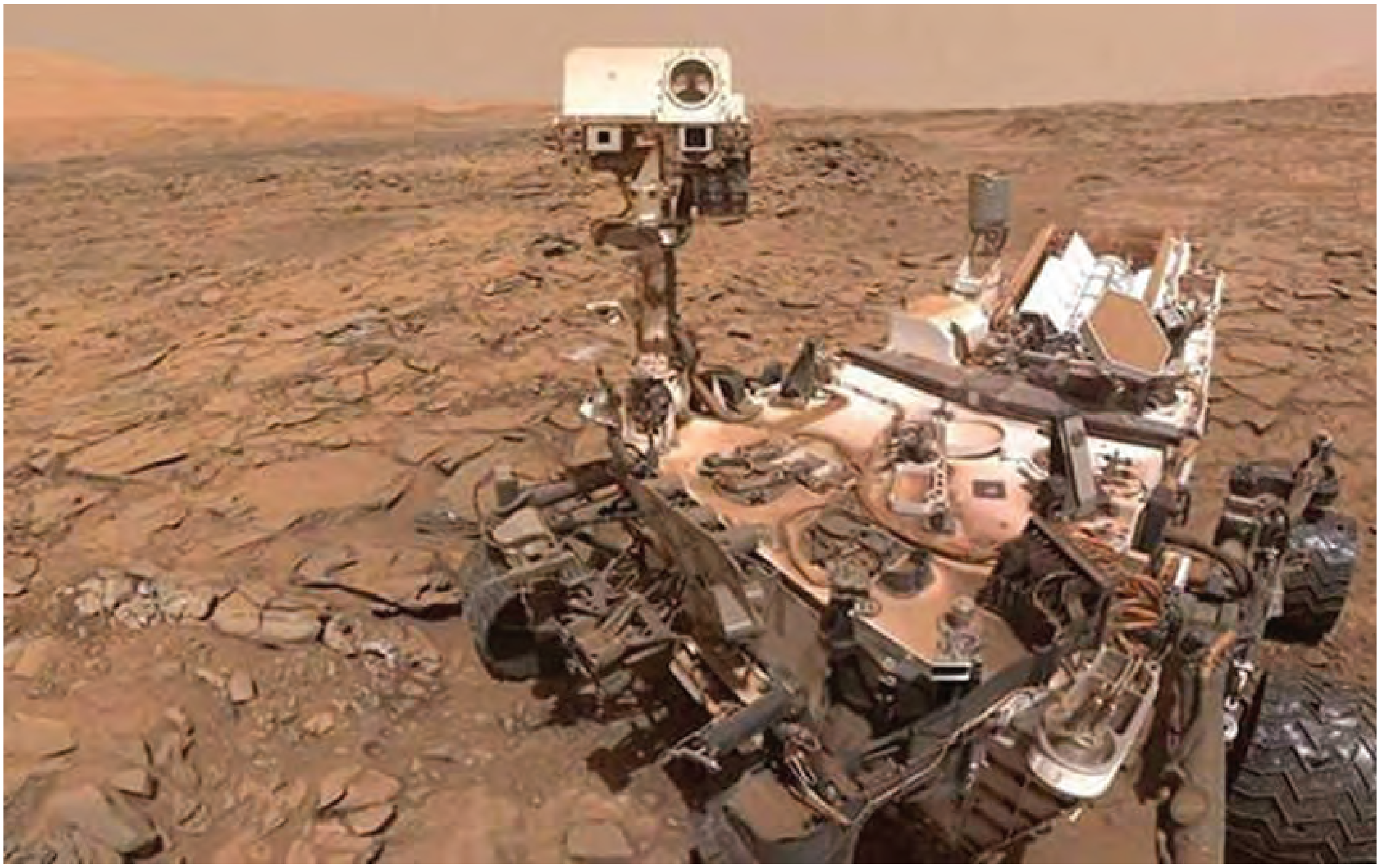
1. Take your glove off.

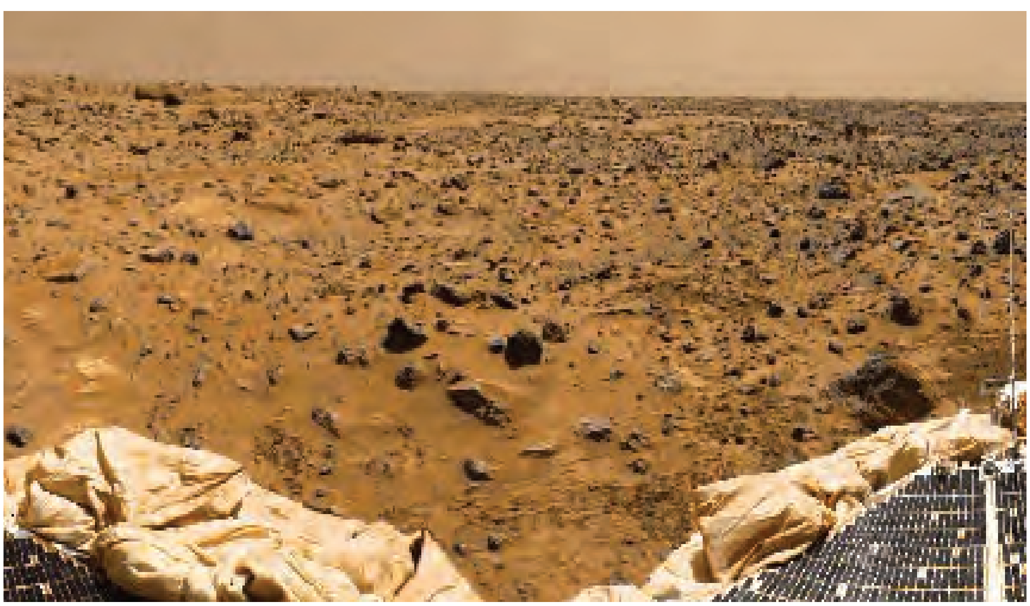
2. Take a close look at your glove. Did it stay together? Did it get damaged in any way?

3. Record your results in your Engineering Journal.

Mars

Curiosity rover exploring Mars. Photo courtesy of NASA.



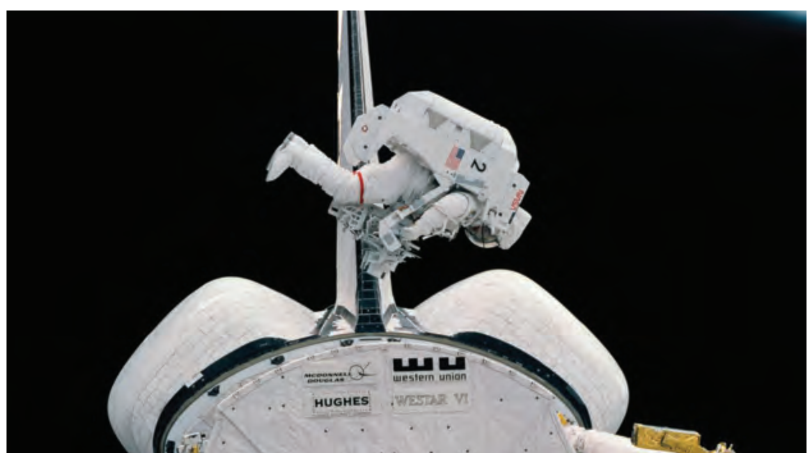


The rocky surface of Mars, from the Mars Pathfinder lander. Photo courtesy of NASA.

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.

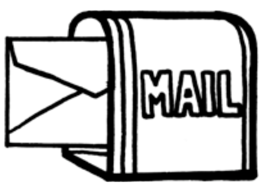
The shaded side of the Moon is much colder than the sunlit side. Photo courtesy of NASA.

Improve a Space Glove

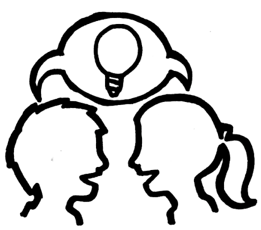
Overview: Kids will *improve* their model space gloves and test them in a final Mission Simulation.

Note to Educator: Remind kids that they should work to *improve* their model space gloves and complete the final Mission Simulation during this adventure. Be sure to save all the model space gloves that groups design for Adventure 7, the Engineering Showcase, and invite staff, family, and community members to attend.

Duo Update (5 min)

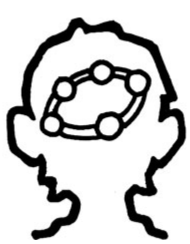


Set the Stage (2 min)



Activity (35 min)

Reflect (3 min)



Materials

For the entire group:

- ☐ *Message from the Duo*, track 9 or Engineering Journal, p. 28
- ☐ *Engineering Design Process* poster
- ☐ *Testing Results* chart
- ☐ chart paper and markers

Materials Table:

- ☐ leftover materials from Adventure 5

Mission Simulation:

- ☐ Testing Stations from Adventure 5
- ☐ *Mission Simulation Set Up*, p. 63 in this guide
- ☐ *Mission Profile Images,* pp. 73–77 in this guide

For each group of 3 kids:

- ☐ model space glove designs from Adventure 5
- ☐ 1 pair of scissors

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 6

Message from the Duo, p. 28

Adventure 6 **Message from the Duo**

reply | forward | archive | delete

from: engineeringadventures@mos.org
to: You
subject: Mission Ready? 3:12 PM

Hi engineers,

We can tell you've been working really hard on the model space gloves you've been designing for the different missions!

Your model space gloves should combine materials to help protect from different hazards and pass the final test to make sure your gloves are strong enough to last the entire mission and are easy for astronauts to use. Maru explained that engineers have to choose materials wisely to make sure they meet all of their goals as best as they can. That means engineers are always testing and *improving* their technologies. Share your ideas with each other and see if you can *improve* your model space gloves to make them even better!

Next time, you'll get to share your model space gloves with an audience in the Engineering Showcase. To help you prepare, you can work on any improvements you need to make and do a final Mission Simulation to make sure your designs are mission ready before you show them off. We can't wait to see your final designs!

India and Jacob

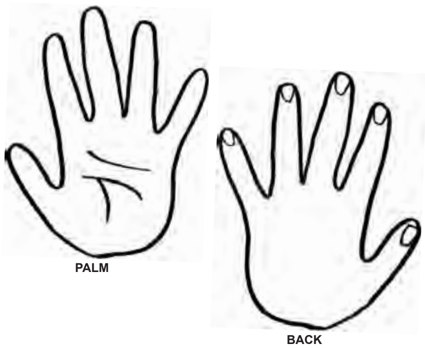
Imagine · Plan · Create · Improve · Ask · The Goal

In Good Hands: Engineering Space Gloves 28 © Museum of Science

Improved Plan, p. 29

Adventure 6 **Improved Plan**

How can you improve your model space glove to make it even better? Draw your ideas and label the changes to your design.



Will you change where you place the materials?

Will you change the materials?

Why will you make these changes?

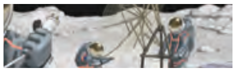
In Good Hands: Engineering Space Gloves 29 © Museum of Science

Simulation Results: Improve, pp. 30–32

Adventure 6 **Simulation Results: Improve**

Moon

How well did your glove perform in the tests below?



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

Dust: Circle how well your model space glove protects against dust.

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

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

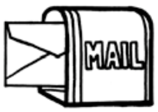
Did your glove stay together after testing?
Yes **No**

Did You Know?
Other than Earth, the Moon is the only place in the solar system where humans have set foot.

In Good Hands: Engineering Space Gloves 32 © Museum of Science

Kids will learn:

- They can choose materials that work together to meet multiple criteria.
- Designs do not always work the first time, and they can learn from failure.
- Using the *improve* step can help them refine their design after testing.



Present the Message from the Duo (5 min)

1. Tell kids that India and Jacob sent them another message about their model space gloves. Have kids turn to *Message from the Duo*, p. 28 in their Engineering Journals, to follow along. Play track 9.
2. To check for understanding, ask:
   - **What are India and Jacob asking you to do?** *To* improve *our model space gloves so they can protect astronauts from multiple hazards on one of the missions.*

Set the Stage (2 min)

1. Remind kids that next time they will have the opportunity to share their model space glove designs at the 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, families, and community members.
2. Explain that today they will have time to continue *creating* their model gloves and make their final improvements to prepare for the Showcase.

Improve (35 min)

1. Have groups revisit the results of their first Mission Simulation on *Simulation Results*, pp. 25–27 in their Engineering Journals. Ask:
   - **How can you *improve* your design to make it even better?**
2. Have groups record their ideas on *Improved Plan*, p. 29 in their Engineering Journals.
3. When groups are ready, have them *improve* their model space gloves.
4. Some gloves may have been damaged during testing and this is okay. Let kids know that if this happens, they will need to repair or *create* a new model space glove to test and display in the Showcase.
5. Remind groups that they can use up to 3 materials to design their gloves, as well as scissors and up to 3 feet of tape.
6. As groups *improve* their designs, circulate around the room and ask:
   - **What parts of your design are you *improving*?**
   - **How are the materials working together in your glove design?**

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

- **How do you think your *improved* glove will protect from each of the hazards the astronauts will encounter on their mission?**

7. When groups are ready, have them move to the Testing Stations to test their *improved* designs in a final Mission Simulation.
8. Have kids record the results of their test on *Simulation Results: Improve*, pp. 30–32 in their Engineering Journals.

> **Tip:** Groups may want to use their first model space glove and *improved* glove in the Engineering Showcase to show how their ideas changed, so encourage groups to save both designs.

9. After all groups have tested their *improved* model space gloves in the final Mission Simulation, collect groups' model space gloves and store them in a safe place so they can be used in the Engineering Showcase.

Reflect (3 min)

1. Gather kids together near the *Engineering Design Process* poster. Ask:
   - **How did you use the Engineering Design Process today?** *We used the* create *step to keep building and testing our gloves. We used the* plan *and* improve *steps to decide how we could make our designs better.*
2. Remind kids that in the next adventure they will get to share their designs with an audience. They will present what they learned about materials, space hazards, and how they used the Engineering Design Process to engineer their model space gloves.
3. If possible, encourage kids to invite their families and friends to the Showcase.
4. Congratulate kids on their excellent engineering work!

reply | forward | archive | delete

from:	engineeringadventures@mos.org
to:	You
subject:	Mission Ready?

3:12 PM

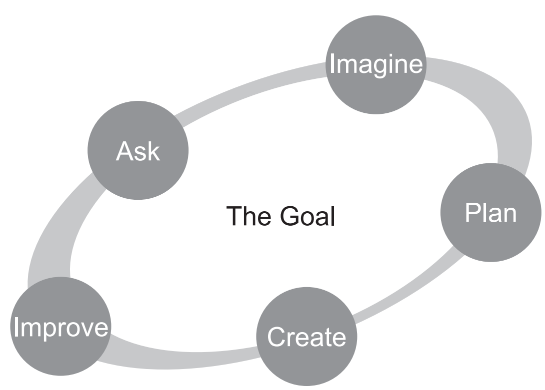
Hi engineers,

We can tell you've been working really hard on the model space gloves you've been designing for the different missions!

Your model space gloves should combine materials to help protect from different hazards and pass the final test to make sure your gloves are strong enough to last the entire mission and are easy for astronauts to use. Maru explained that engineers have to choose materials wisely to make sure they meet all of their goals as best as they can. That means engineers are always testing and *improving* their technologies. Share your ideas with each other and see if you can *improve* your model space gloves to make them even better!

Next time, you'll get to share your model space gloves with an audience in the Engineering Showcase. To help you prepare, you can work on any improvements you need to make and do a final Mission Simulation to make sure your designs are mission ready before you show them off. We can't wait to see your final designs!

India and Jacob

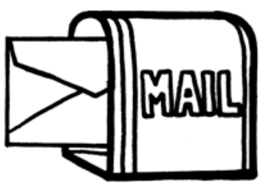


Engineering Showcase: In Good Hands

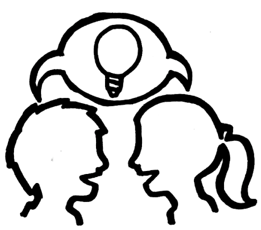
Overview: Kids will present their designs and share how they used the Engineering Design Process to engineer model space gloves suited for their chosen mission.

Note to Educator: The Engineering Showcase is a chance for groups to share their technologies with staff members, families, and friends! Encourage kids to invite guests. This will help kids take ownership of their designs and the Engineering Design Process they used. Consider setting up the Testing Stations for the Showcase if kids want to share the Mission Simulations.

Duo Update (5 min)

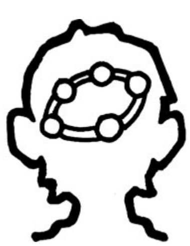


Set the Stage (15 min)



Activity (20 min)

Reflect (5 min)



Materials

For the entire group:

- ☐ *Message from the Duo*, track 10 or Engineering Journal, p. 33
- ☐ *Engineering Design Process* poster

For each group of 3 kids:

- ☐ final model space glove designs from Adventure 6
- ☐ Optional: previous model space glove designs from Adventure 5
- ☐ Optional: 10 pipe cleaners

For each kid:

- ☐ Engineering Journal

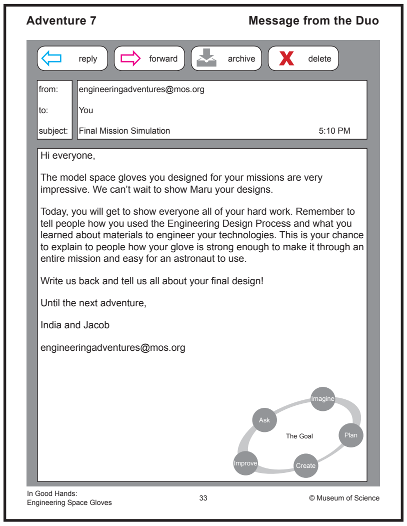
Preparation

Time Required: 5 minutes

1. Post the *Engineering Design Process* poster.
2. Have the *Message from the Duo* ready to share.
3. Optional: Preview 1 or 2 videos that teach kids how to give a successful presentation. Plan to show and discuss the video with groups after the *Message from the Duo* and just before groups begin to prepare their presentations.

Journal Pages for Prep Adventure 7

Message from the Duo, p. 33


Adventure 7 Message from the Duo

reply forward archive delete

from: engineeringadventures@mos.org
to: You
subject: Final Mission Simulation 5:10 PM

Hi everyone,

The model space gloves you designed for your missions are very impressive. We can't wait to show Maru your designs.

Today, you will get to show everyone all of your hard work. Remember to tell people how you used the Engineering Design Process and what you learned about materials to engineer your technologies. This is your chance to explain to people how your glove is strong enough to make it through an entire mission and easy for an astronaut to use.

Write us back and tell us all about your final design!

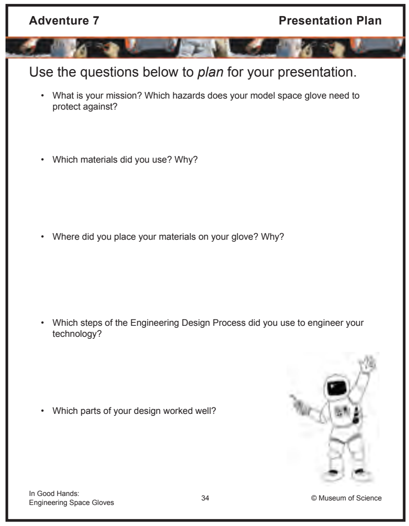
Until the next adventure,

India and Jacob

engineeringadventures@mos.org

In Good Hands: Engineering Space Gloves 33 © Museum of Science

Presentation Plan, p. 34

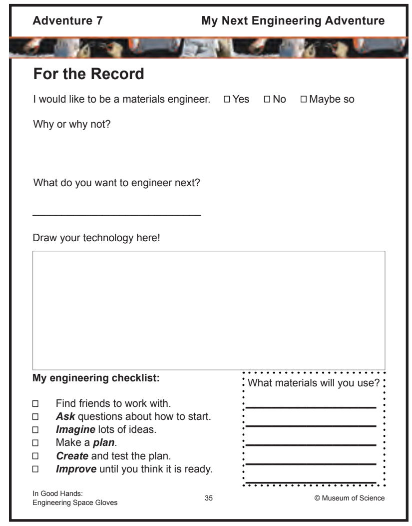

Adventure 7 Presentation Plan

Use the questions below to *plan* for your presentation.

- What is your mission? Which hazards does your model space glove need to protect against?
- Which materials did you use? Why?
- Where did you place your materials on your glove? Why?
- Which steps of the Engineering Design Process did you use to engineer your technology?
- Which parts of your design worked well?

In Good Hands: Engineering Space Gloves 34 © Museum of Science

My Next Engineering Adventure, p. 35


Adventure 7 My Next Engineering Adventure

For the Record

I would like to be a materials engineer. ☐ Yes ☐ No ☐ Maybe so

Why or why not?

What do you want to engineer next?

Draw your technology here!

My engineering checklist:

- ☐ Find friends to work with.
- ☐ ***Ask*** questions about how to start.
- ☐ ***Imagine*** lots of ideas.
- ☐ Make a ***plan***.
- ☐ ***Create*** and test the plan.
- ☐ ***Improve*** until you think it is ready.

What materials will you use?

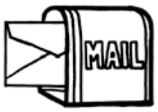
In Good Hands: Engineering Space Gloves 35 © Museum of Science

Example Glove Display

Engineering Showcase: In Good Hands

Kids will learn:

- They used all the steps of the Engineering Design Process to engineer a model space glove.
- Everyone can engineer!



Present the Message from the Duo (5 min)

1. Explain to kids that it is important for engineers to share the technologies they *create* with other people. Let kids know that today they will be presenting their model space gloves to a real audience. India and Jacob sent a message to tell them more.
2. Have kids turn to *Message from the Duo*, p. 33 in their Engineering Journals, to follow along. Play track 10.
3. To check for understanding, ask:
   - **What are India and Jacob asking us to do?** *Share how we used the Engineering Design Process and present our model space gloves.*

Prepare (15 min)

1. Explain that groups will have 15 minutes to fix any parts of their designs that may have been damaged during their final test in the previous adventure. They can also spend this time deciding what they would like to say as they present their designs.
2. Have groups turn to *Presentation Plan*, p. 34 in their Engineering Journals, to see the questions they will be asked. Encourage groups to take notes if they would like.
3. Give groups 15 minutes to prepare their model space gloves and presentations. As groups are working, check in and make sure they are ready to present.

Tip: If groups are interested, have them display both their model gloves from Adventure 5 and their final model gloves from Adventure 6, and have them explain how they *improved* their designs.

Tip: Have groups use 10 pipe cleaners to create a stand to display their model glove(s). See p. 84 in this guide for an example.

Engineering Showcase (20 min)

1. To begin the Showcase, have a volunteer explain the challenge to the audience, including the different missions.
2. Have groups take turns presenting their model space gloves. Ask questions like:
   - **What is your mission?**
   - **Which hazards does your model space glove need to protect from?**
   - **Which materials did you use? Why?**

- **Where did you place your materials on your glove? Why?**
- **Which steps of the Engineering Design Process did you use to engineer your technology?**
- **Which parts of your design worked well?**

3. After each group has had an opportunity to share, give the audience time to circulate among the groups and ask them questions about how they would *improve* their designs.

Reflect (5 min)

1. Once the Showcase is complete, gather kids around the *Engineering Design Process* poster and ask:
   - **What did you learn about space hazards and materials engineering?**
   - **Which step of the Engineering Design Process helped you most as you were engineering your model space gloves?**
   - **Do you think you will use the Engineering Design Process again?**
   - **What does engineering mean to you?**
2. Congratulate kids on all of their great materials engineering work! Have them make their final entry on *My Next Engineering Adventure*, p. 35 in their Engineering Journals.

Extension (30 min)

In this extension activity, kids use what they have learned in the unit to create a new mission with specific criteria and constraints. Then they compare the results from their new mission with the first mission's data. By doing so, kids learn not only how engineers design technology but also how they figure out the most effective way to test it.

1. Revisit *Mission Profiles*, pp. 21–23, in the Engineering Journal.
2. Using the mission profiles as a guide, have groups plan a new mission with specific criteria and constraints.
3. Explain to groups that they will have the same tests for cold temperature, dust, and impact.
4. Have groups test their model space gloves using the new mission's criteria and constraints.
5. Have groups compare results from their new mission with the first mission's data.
6. Discuss how engineers not only design technology, but also must figure out the most effective way to test it.

Engineering Showcase: In Good Hands

reply forward archive delete

from:	engineeringadventures@mos.org	
to:	You	
subject:	Final Mission Simulation	5:10 PM

Hi everyone,

The model space gloves you designed for your missions are very impressive. We can't wait to show Maru your designs.

Today, you will get to show everyone all of your hard work. Remember to tell people how you used the Engineering Design Process and what you learned about materials to engineer your technologies. This is your chance to explain to people how your glove is strong enough to make it through an entire mission and easy for an astronaut to use.

Write us back and tell us all about your final design!

Until the next adventure,
India and Jacob

engineeringadventures@mos.org