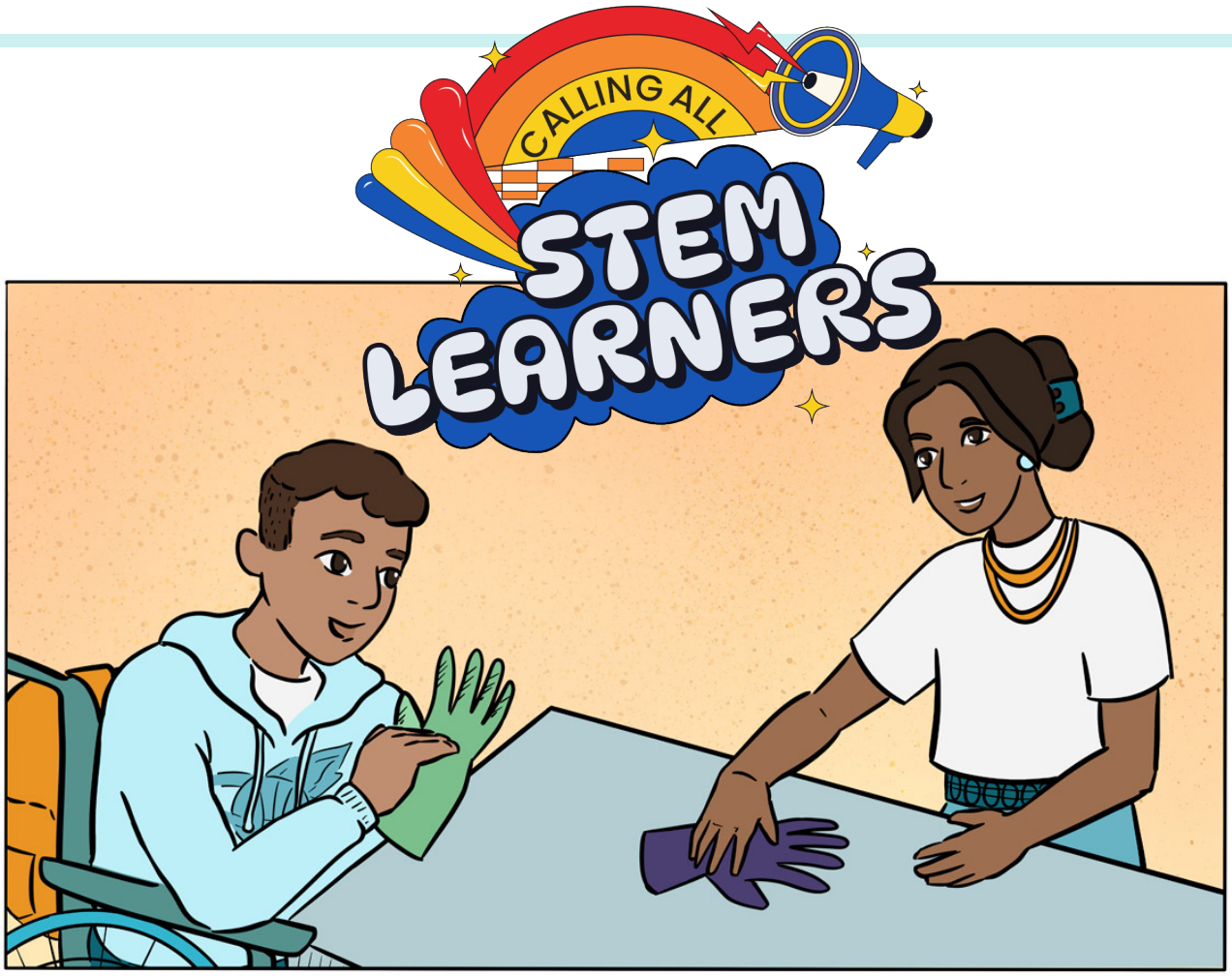


Your PLANETS
Engineering Notebook

for:

Space Hazards: Engineering Space Gloves

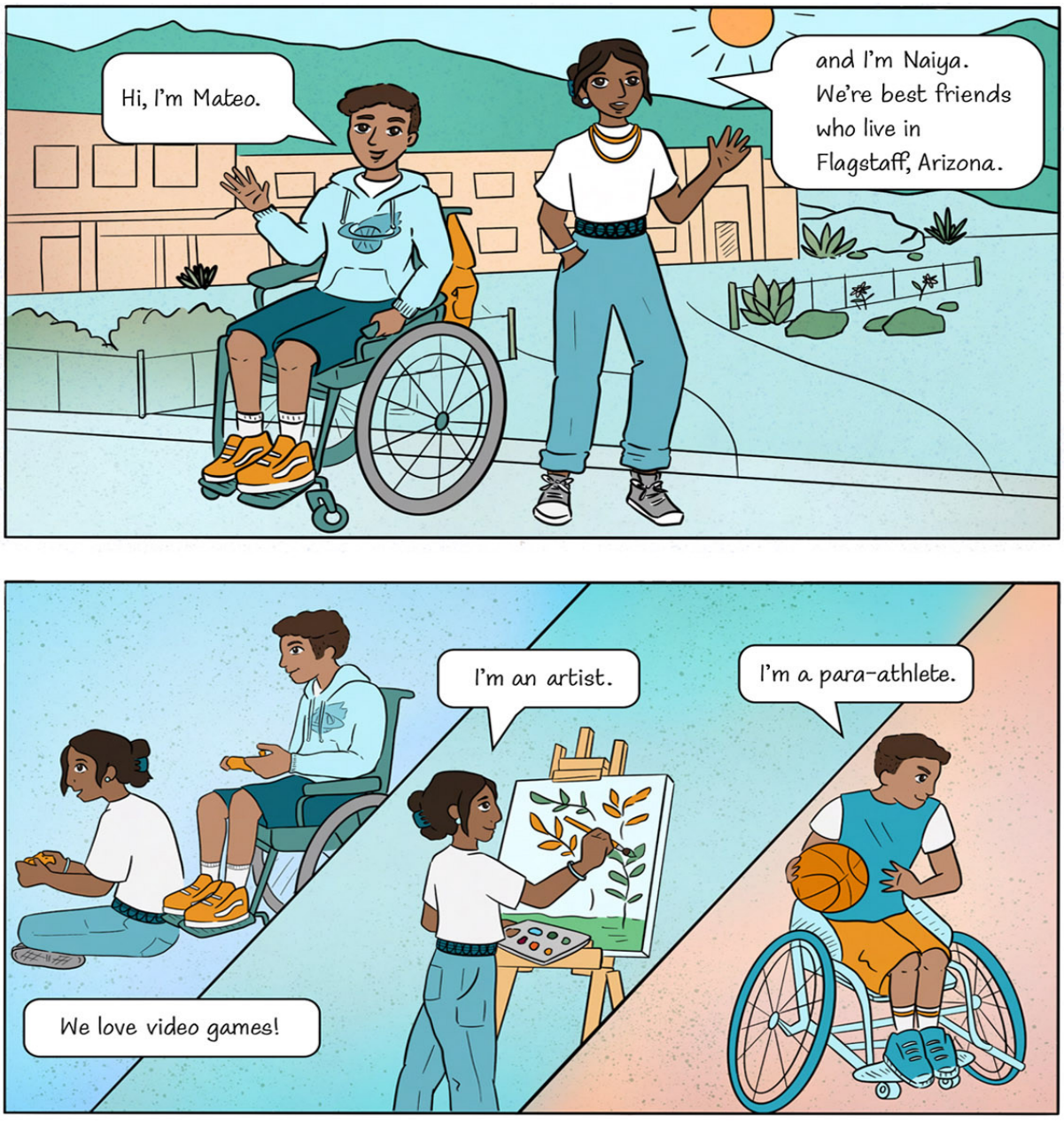
Name: _____

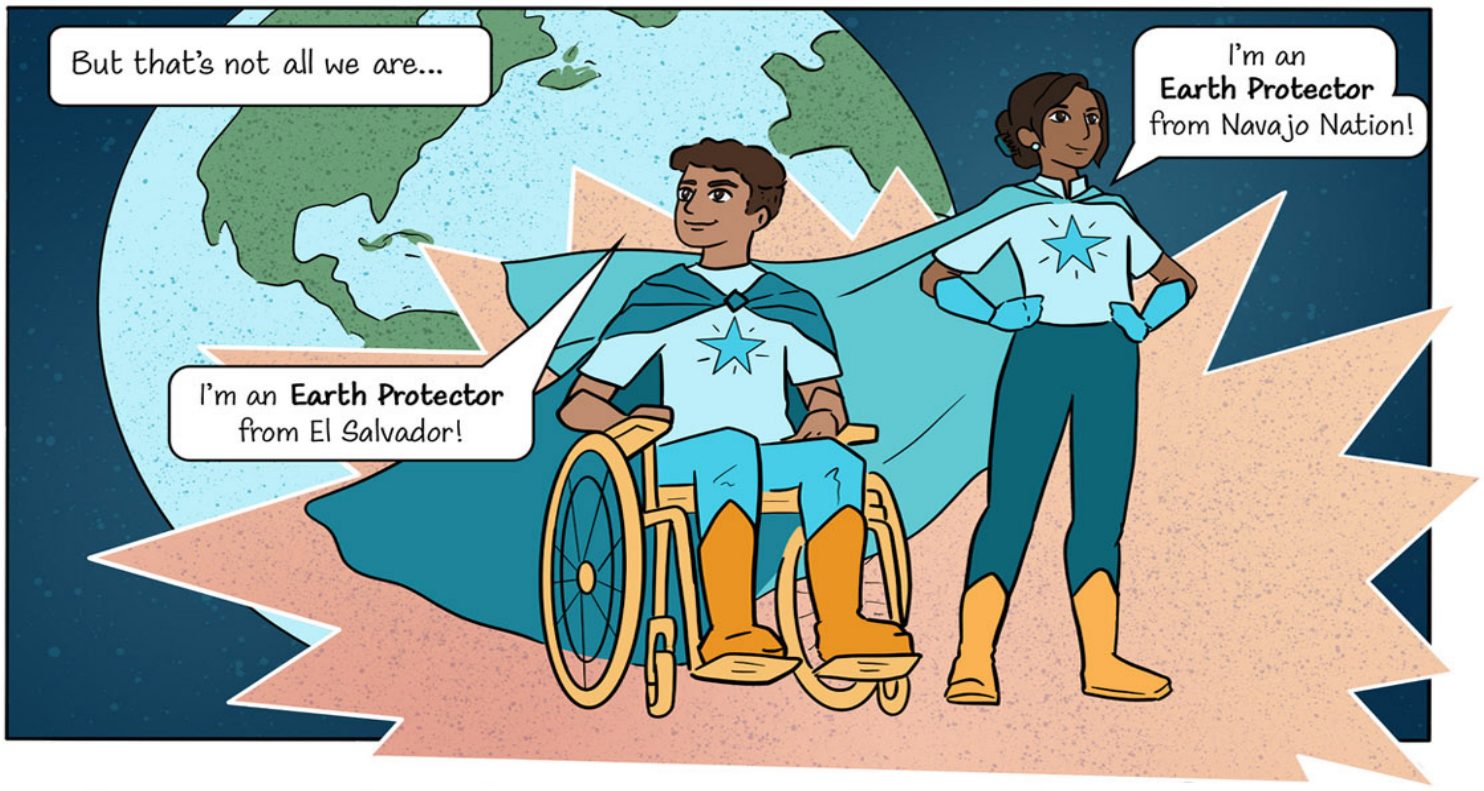
Ready, S.E.T., Go!

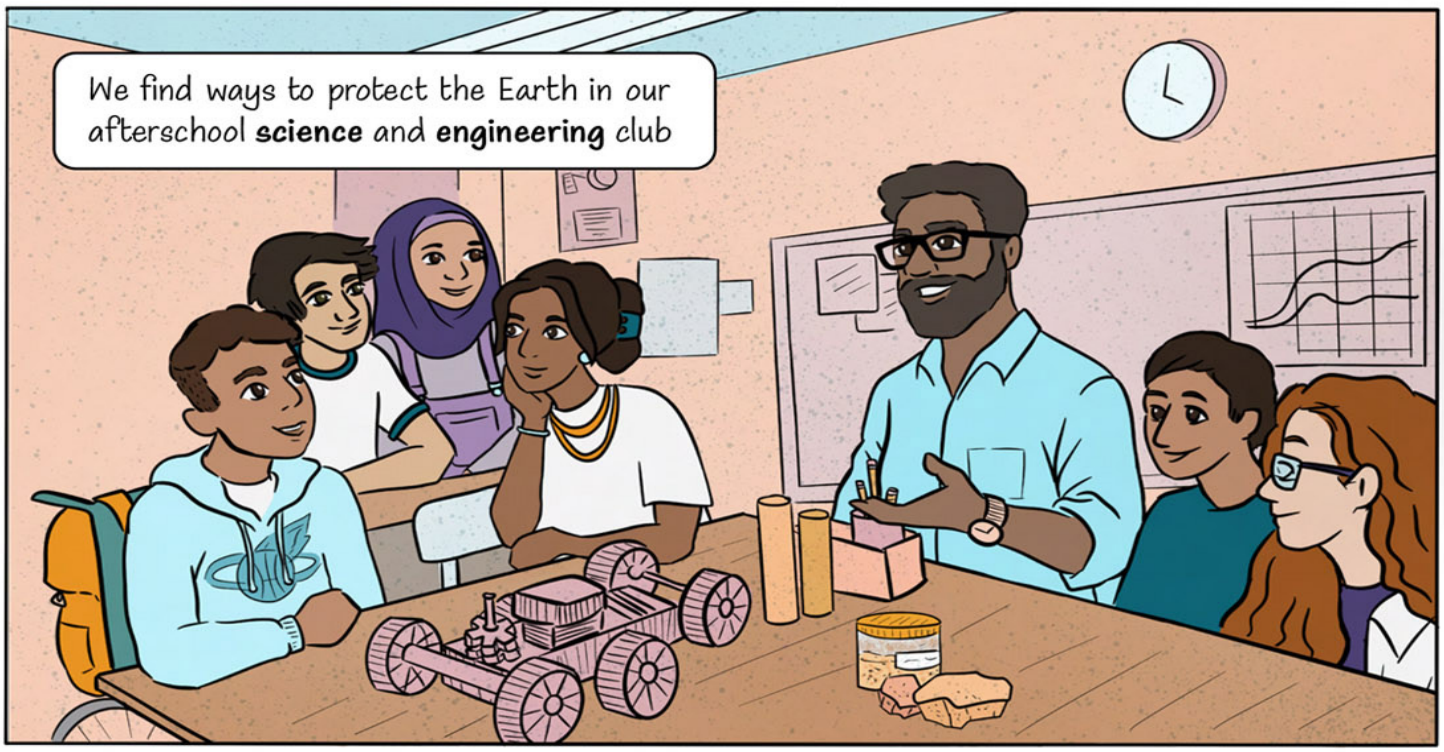
Science
Engineering
Technology

How can we learn about space trash and design ways to protect against it?

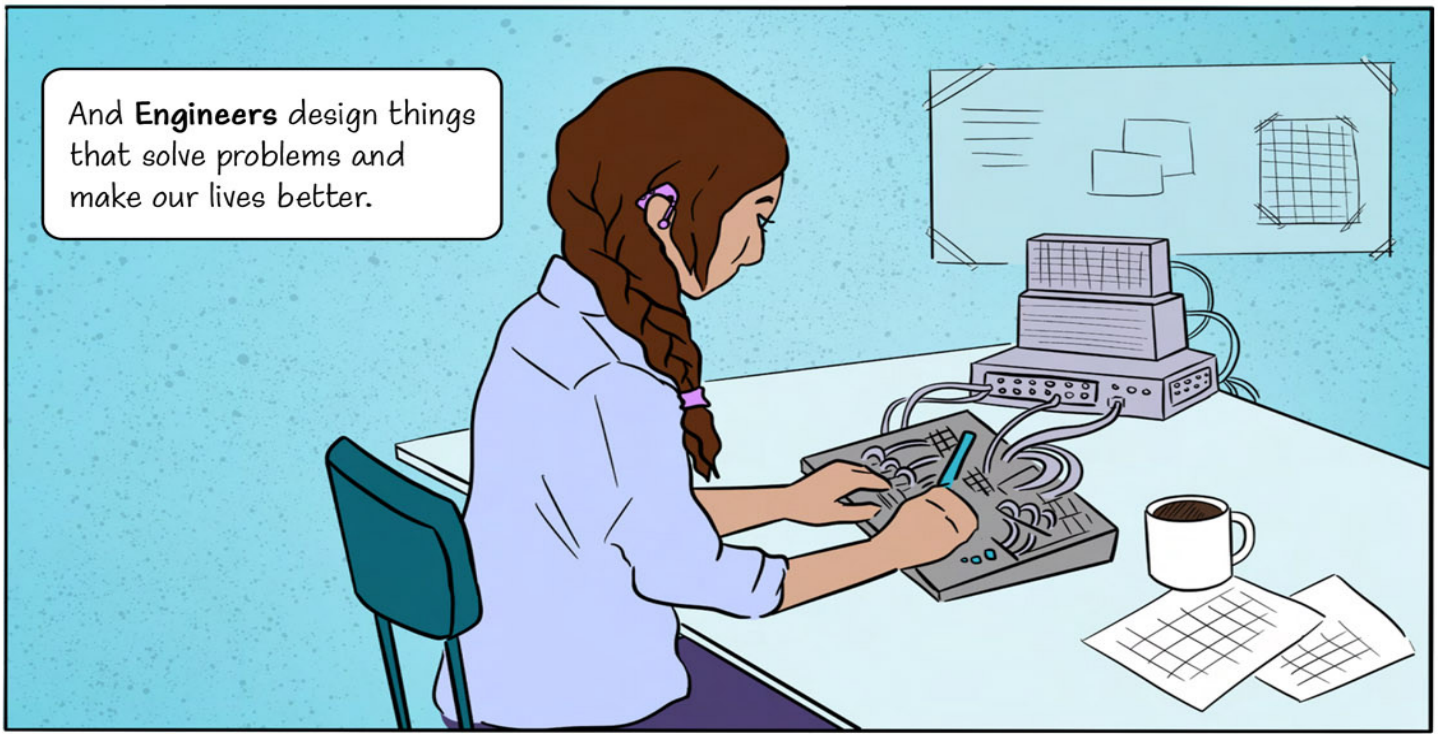
Ready, S.E.T., Go! Comic

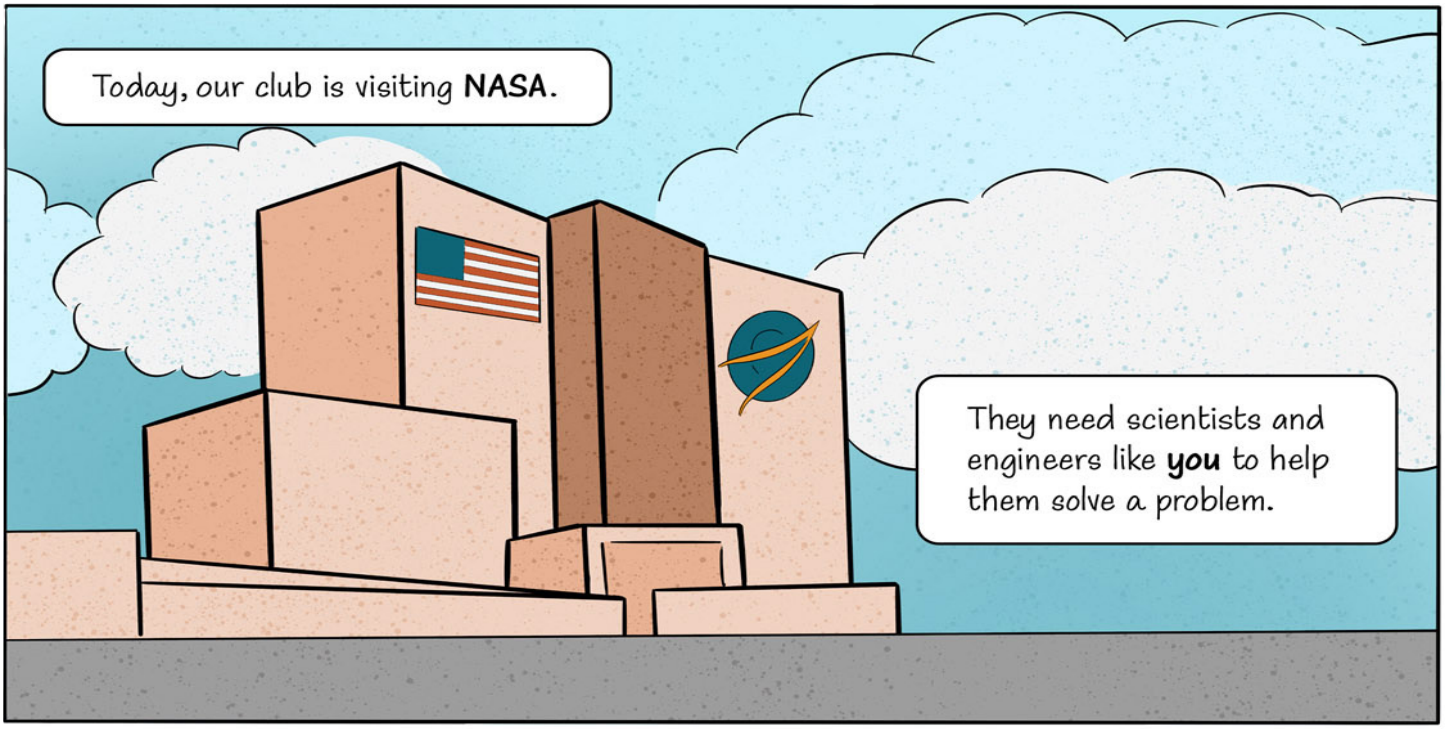



But that's not all we are...
I'm an **Earth Protector** from Navajo Nation!
I'm an **Earth Protector** from El Salvador!

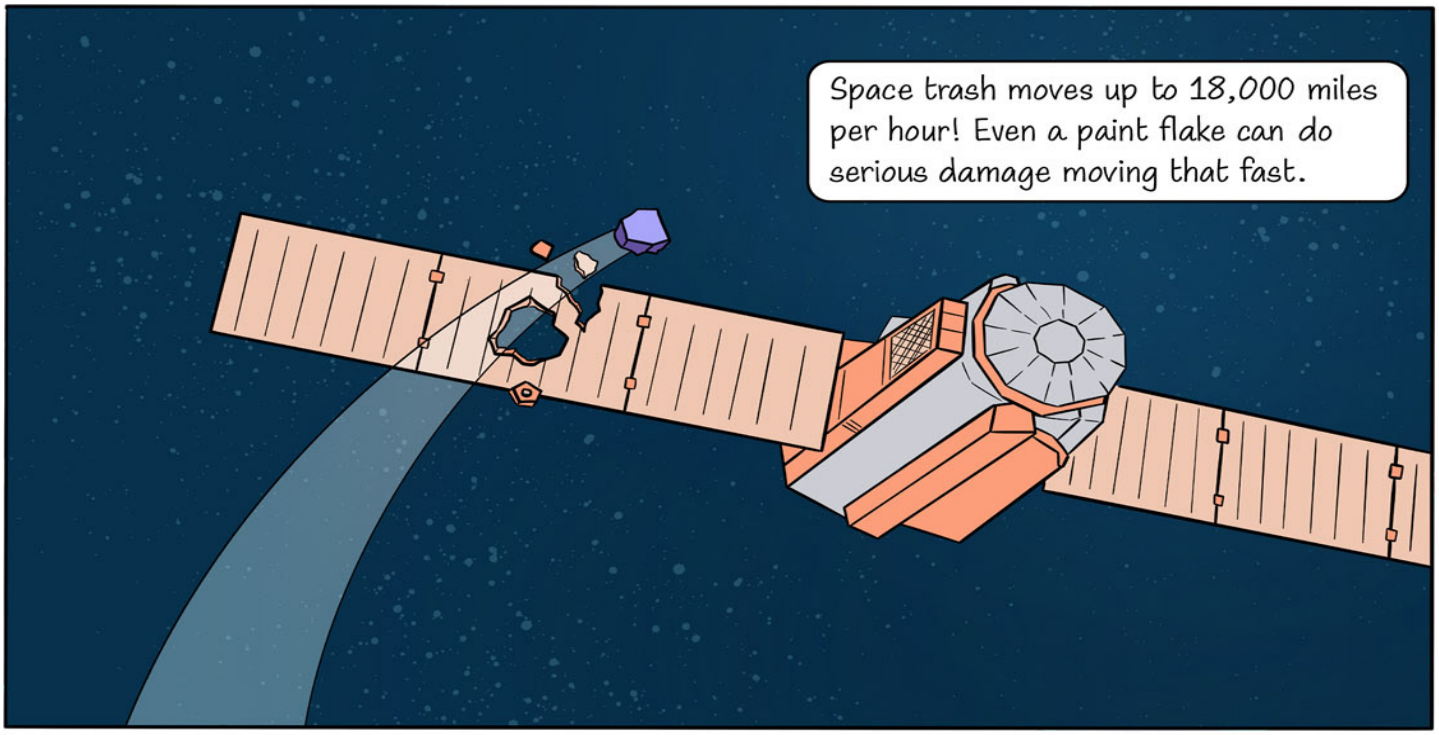

We find ways to protect the Earth in our afterschool **science** and **engineering** club


Scientists ask questions and gather evidence to try to answer them.


And **Engineers** design things that solve problems and make our lives better.


Today, our club is visiting **NASA**.
They need scientists and engineers like **you** to help them solve a problem.


The problem?
SPACE TRASH!


Space trash moves up to 18,000 miles per hour! Even a paint flake can do serious damage moving that fast.


Let's learn about space trash and design ways to protect against it!
Thanks for your help!

Investigate It!

1. Make predictions about how much damage 1, 2, 3, or 4 washers will do when dropped from 1 or 2 feet onto the tray. Write your predictions in the table. Then test by dropping the washers. Write the actual results in the table.

A = A little damage B = Some damage C = A lot of damage

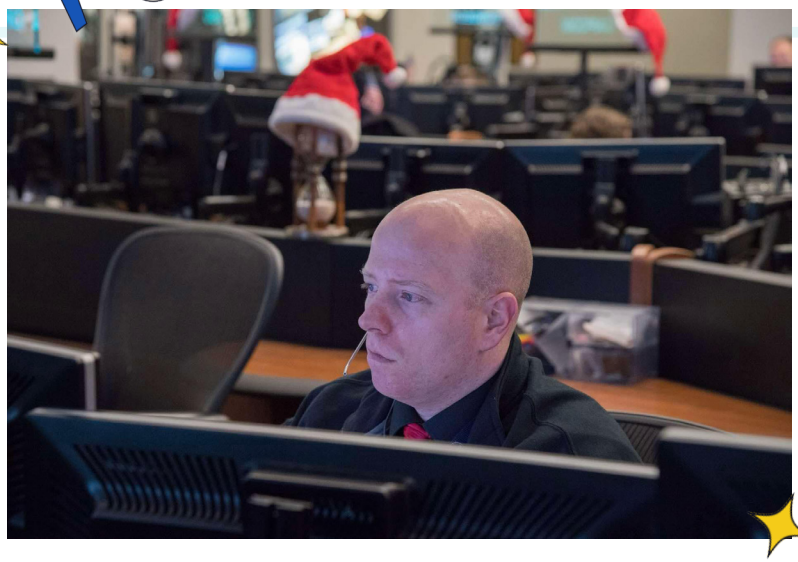
Number of Washers Dropped	1 foot height (prediction)	2 foot height (prediction)	1 foot height (actual)	2 foot height (actual)
1				
2				
3				
4				

2. Next, you will protect the tray with different materials. First make predictions about how much damage 4 washers will do when dropped from 2 feet onto each material. Write your predictions below. Test, and write the actual results below.

Material	Prediction	Actual
cheesecloth		
felt		
foam		
foil		
index card		

Our Engineering Design Process

NASA Career Spotlight



Daniel Sturber

My job at NASA is to work with astronauts and other engineers to make sure spaceships work the way astronauts need them to work.

Engineering Adventure 1: Safety Stories: Sharing Experiences

Why is it important to make hazards safer?

My Safety Story

Think of a story about a time you made a hazard safer in your home, town, or school.

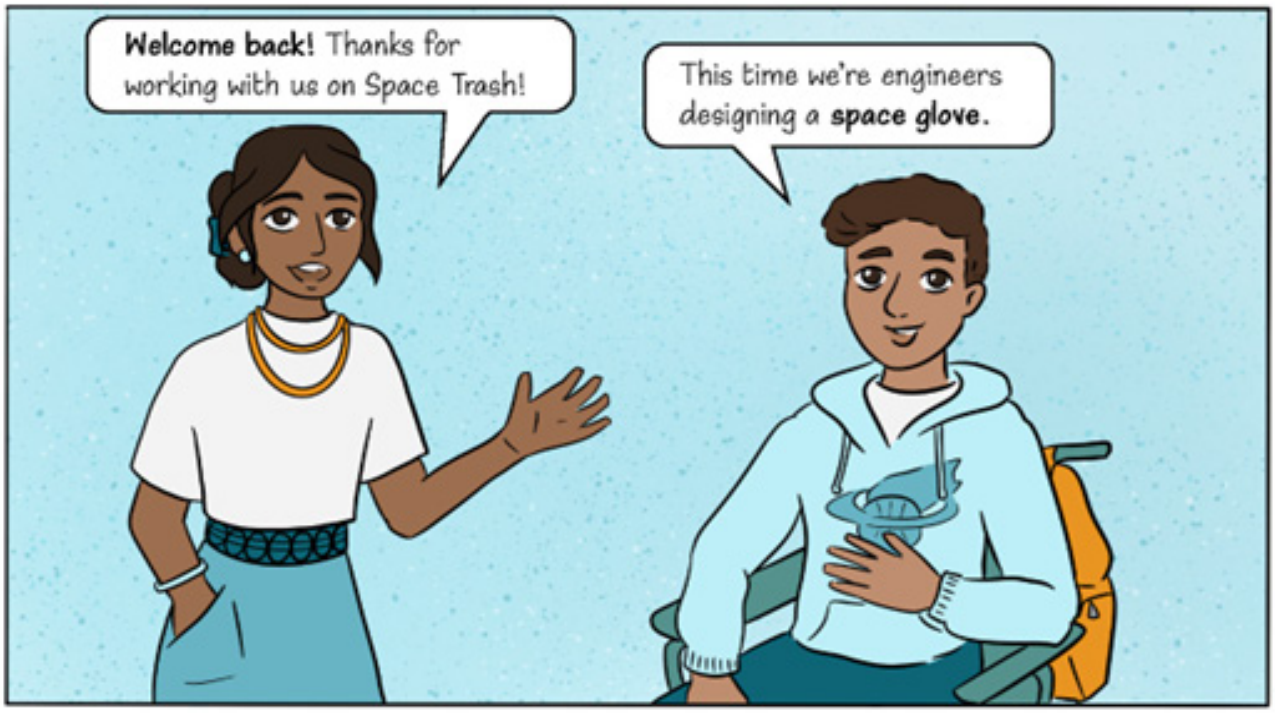
Then

- write or draw your story on this page, or
- build something to demonstrate it.

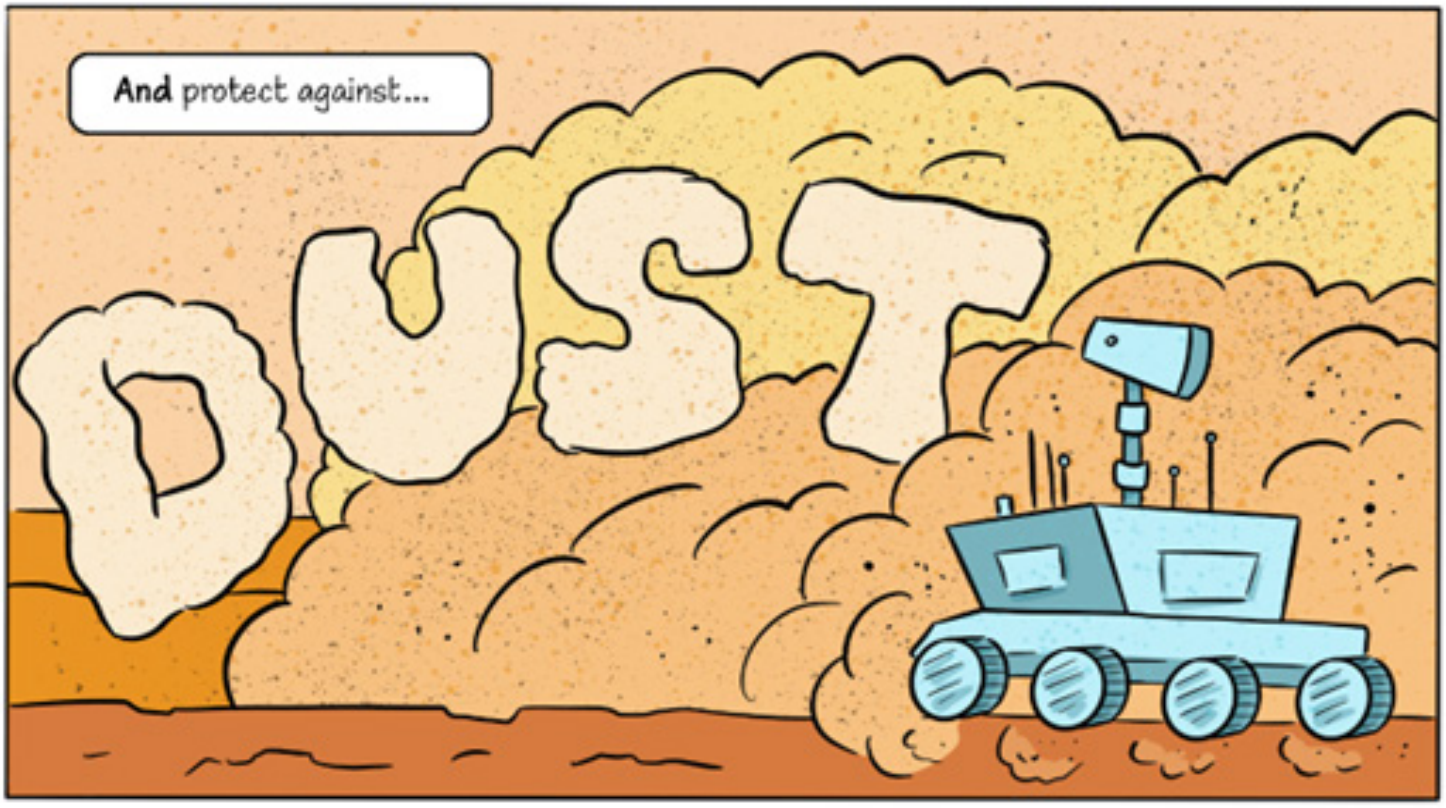
Engineering Adventure 2: Everyday Gloves: Exploring Glove Uses

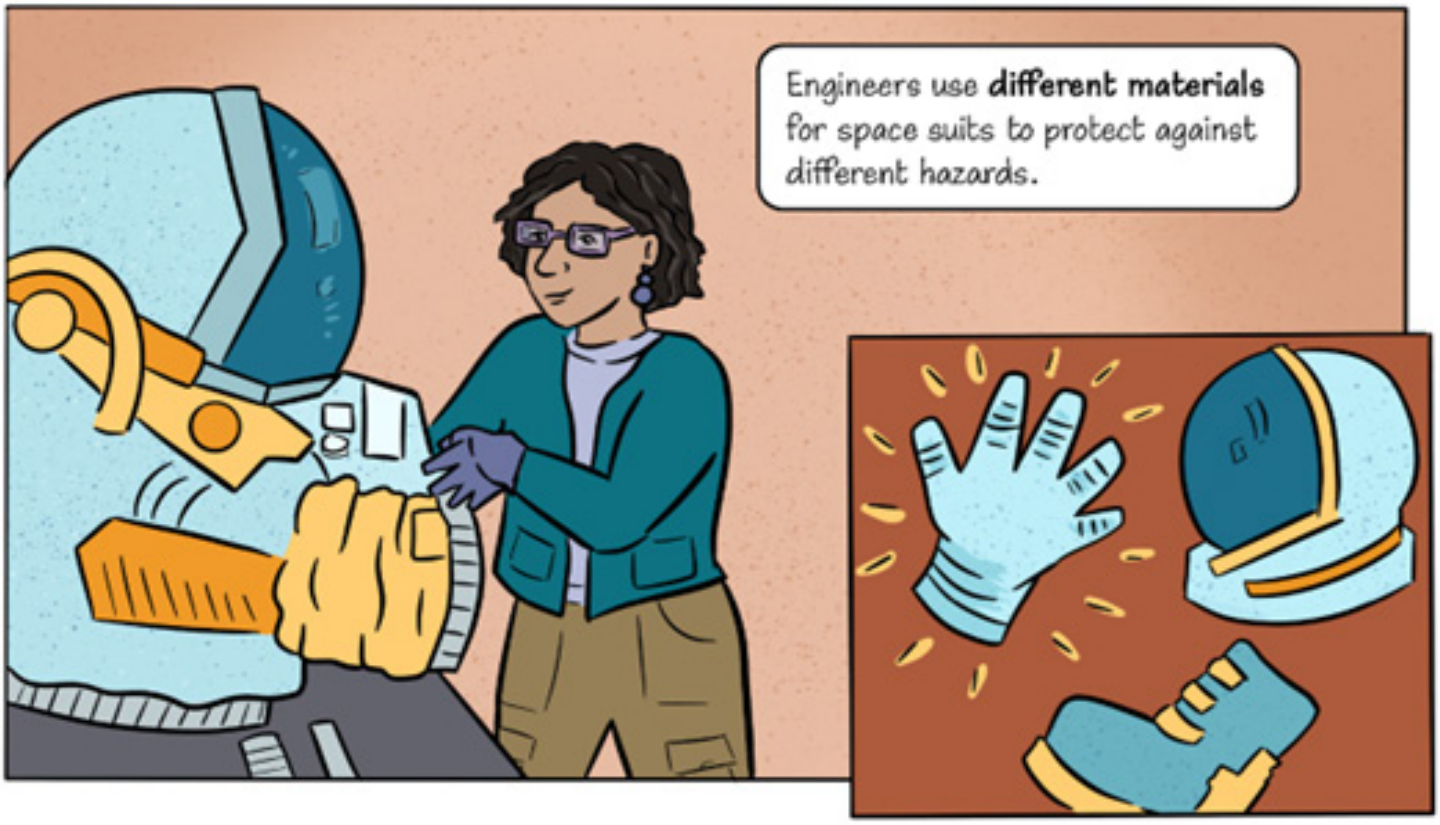
Which gloves work best for everyday tasks?

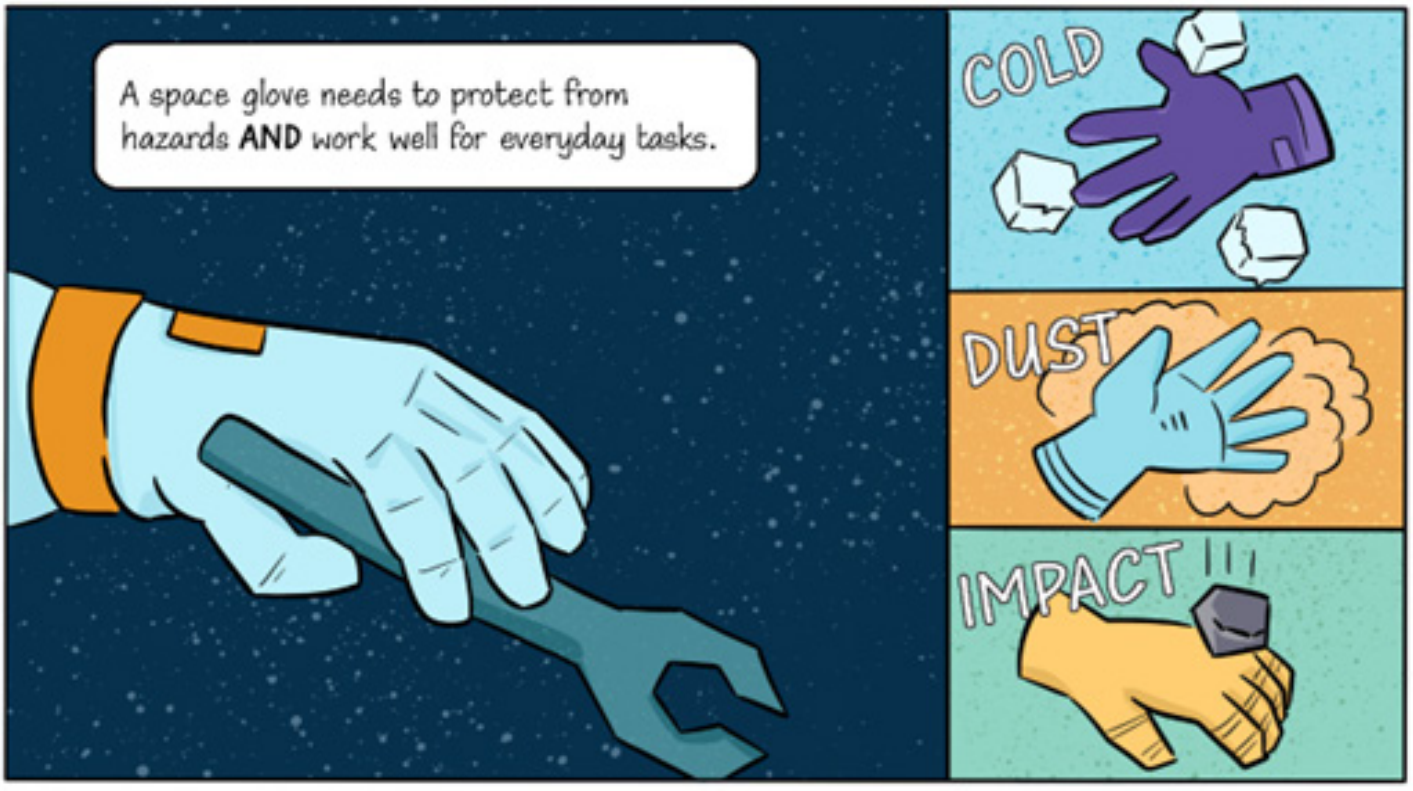
Engineering Comic




And protect against...
COLD


And protect against...
DUST


Engineers use **different materials** for space suits to protect against different hazards.


A space glove needs to protect from hazards **AND** work well for everyday tasks.
COLD
DUST
IMPACT


Let's get started!
What would **you** design a glove for?

Engineering Adventure 3: Chilling Out: Protecting Against Cold

Which materials are good at protecting against cold?

Temperature Changes

Directions

Record temperatures below for the empty mitt. Add a material to your mitt, take the temperatures, and record them 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**: difference of 7°C or more
- **Good**: difference of 3–6°C
- **Great**: difference of 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				

Engineering Adventure 4: Ready for Impact: Protecting Against Impact

Which materials are good at protecting against damage from heavy moving objects?

Impact Protection

Directions

Record the results from the empty glove test. Then add a material to your glove and test it 3 times. 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 information below, find out how well your glove protected against impact.

Is your material good at protecting against impact?

- **Not Good**: 11+ pieces
- **Good**: 8–10 pieces
- **Great**: 5–7 pieces

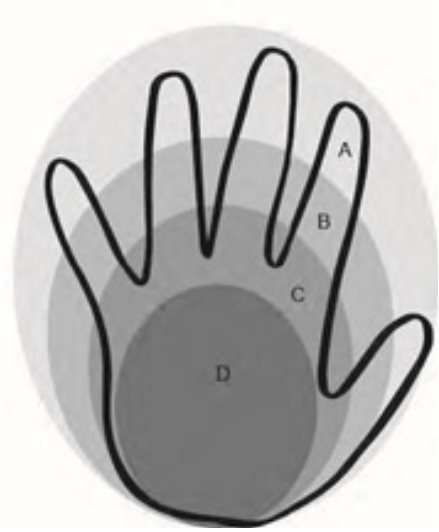
Test Results

Material	Test 1	Test 2	Test 3	Final	How well does it protect against impact?
Example	9	7	10	10	Good
Empty Glove					

Engineering Adventure 5: Dangerous Dust: Protecting Against Dust

Which materials are good at resisting dust?

Dust Protection



Directions

Record the results for the plain glove. Then add a material to your glove and test it. Use the hand diagram below to figure out how many areas of your glove have glowing dust.

Is your material good at protecting against dust?

- **Not Good**: 4 areas
- **Good**: 2–3 areas
- **Great**: 0–1 area

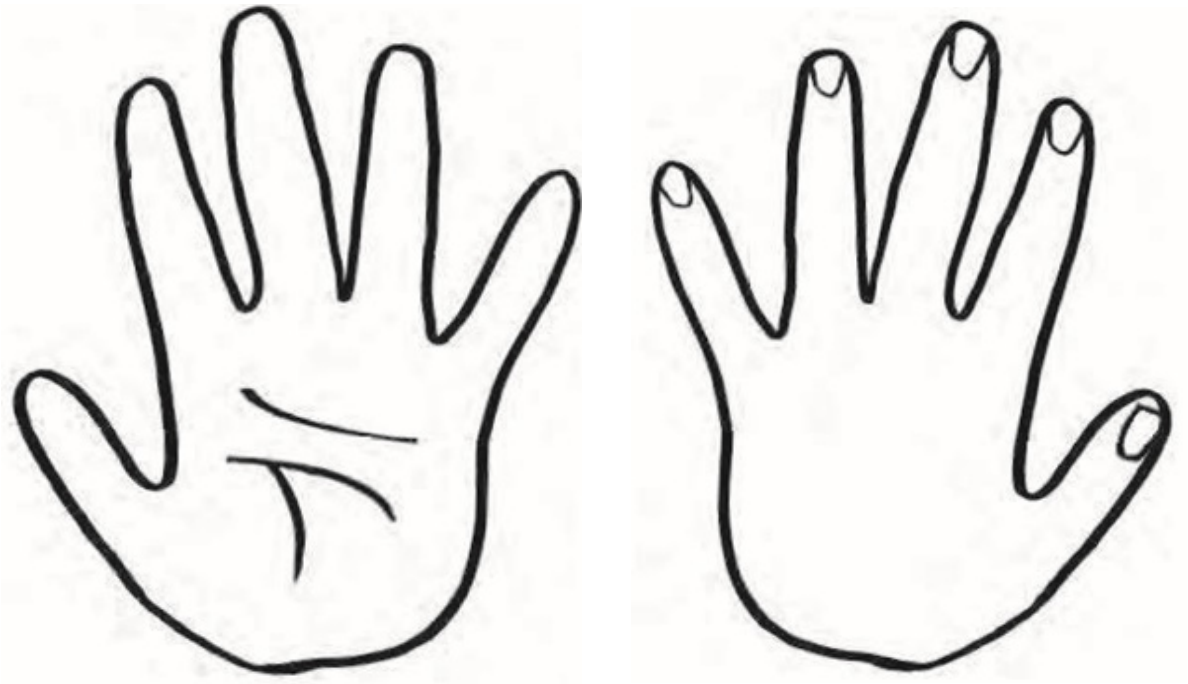
Test Results

Test Material	Number of Areas	Good at Protecting against Dust?
Example	2 (A and C)	Good
Plain Glove		

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

How can we create a space glove that protects against cold, impact, and dust?

Plan



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

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

NASA Career Spotlight

Phyllis Friello

My job at NASA is to work with my space medicine team to develop and provide what we need to keep our astronaut crews on moon and Mars missions healthy and safe.

Test Results

Location

Circle your mission location.

Mars Asteroids Moon

Dust (Mars and Moon)

Circle the number of areas on your glove with dust.

Dust on 4 areas (not good) 2–3 areas (good) 0–1 area (great)

Impact (Mars and Asteroids)

Record number of pieces for each test. Circle the highest number.

Test 1: _____ Test 2: _____ Test 3: _____

11+ pieces (not good) 8–10 pieces (good) 5–7 pieces (great)

Cold (Asteroids and Moon)

Record temperatures. Circle the difference in temperatures.

Starting Temp: ____°C Temp after 30 Seconds: ____°C

Difference of 7°C+ (not good) 3–6°C (good) 0–2°C (great)

Final Test

Were you able to complete the test? ☐ Yes ☐ No

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

Remember that design failure is natural in engineering! Engineers gain information from failed designs and use it to make future designs better.

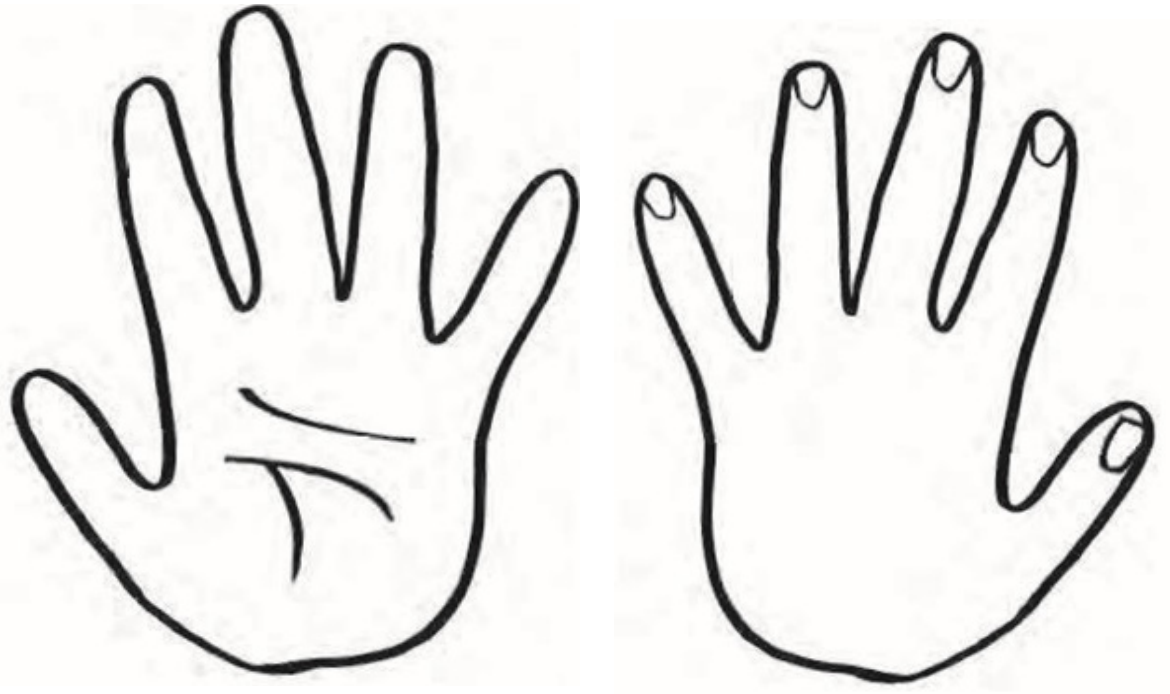
Humans have never been to a planetary body beyond the Moon, so it's important to make sure astronauts have good equipment before they travel to Mars, asteroids, and beyond.

Engineering Adventure 7: The Final Test: Improving a Space Glove

How can we improve our space gloves to make them stronger or more protective while still allowing us to complete the tasks?

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?

☐ Yes ☐ No

Will you change the materials?

☐ Yes ☐ No

Test Results: Improve

Location

Circle your mission location.

Mars Asteroids Moon

Dust (Mars and Moon)

Circle the number of areas on your glove with dust.

Dust on 4 areas (not good) 2–3 areas (good) 0–1 area (great)

Impact (Mars and Asteroids)

Record number of pieces for each test. Circle the highest number.

Test 1: _____ Test 2: _____ Test 3: _____

11+ pieces (not good) 8–10 pieces (good) 5–7 pieces (great)

Cold (Asteroids and Moon)

Record temperatures. Circle the difference in temperatures.

Starting Temp: ____°C Temp after 30 Seconds: ____°C

Difference of 7°C+ (not good) 3–6°C (good) 0–2°C (great)

Final Test

Were you able to complete the test? ☐ Yes ☐ No

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

Engineering Adventure 8: Spread the Word: Preparing for the Engineering Share-Out

How can we share our space glove designs with others?

Communicate

Think About It

What have you learned that you can now use to help your family and the communities you belong to?

NASA Career Spotlights

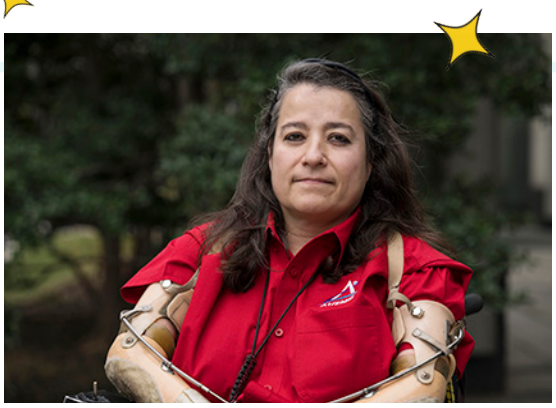


Photo Credit: Aubrey Gemignani/NASA

Dana Bolles

My job at NASA is to ensure all users can enjoy our science websites.