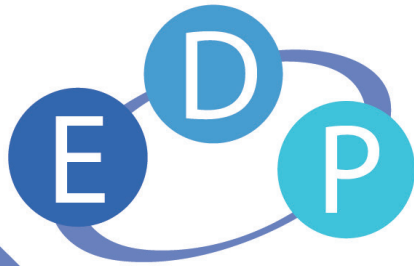
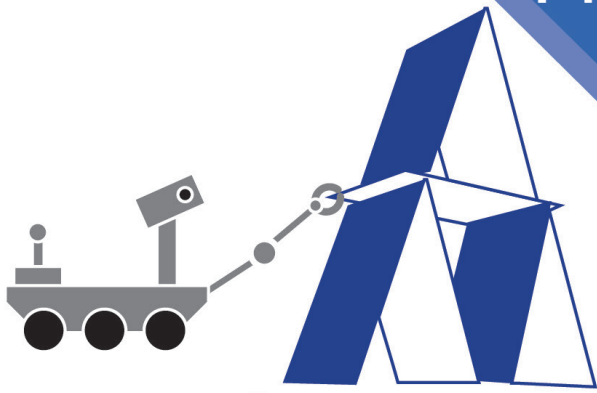
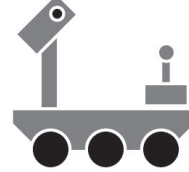


P1



What is Engineering?
Create a Tower

P2



+



+



What is Technology?
Create a Technology

A1



Everyday Gloves
Test Gloves for Different Uses

A2



Chilling Out
Test Materials for Cold

P1 Purpose:

Youth engage in an engineering design challenge using an Engineering Design Process (EDP).

EDP Step:

Ask
Imagine
Plan
Create

Activity Timing

Duo Update: 5 min
Set the Stage: 10 min
Activity: 30 min
Reflect: 5 min

Total 50 min

Quick Tips:

- Find Audio Duo messages online at planets-stem.org/space-hazards
- Alternatively, print messages and hide under someone's chair
- In wrap up, identify each step of the EDP used

Prep Corner

- Post EDP Poster
- Get the Duo message ready
- Make Card samples (p. 2, Engineering Journal)

10 min • Guide pg. 1

Did you know?

Use duct tape much? You probably engineer more than you think. Anytime you design a makeshift tool because you don't have exactly what you need, you are engineering.

Key Terms:

• **Material:** What something is made of
• **Engineering Design Process:** The steps that engineers use to design something to solve a problem.

P2 Purpose:

Youth consider the definition of technology as any thing or process humans (engineers) design to solve a problem.

EDP Step:

Ask
Imagine
Plan
Create

Activity Timing

Duo Update: 5 min
Set the Stage: 10 min
Activity: 25 min
Reflect: 5 min

Total 45 min

Quick Tips:

- Alternate versions of this activity at www.engineeringadventures.org/resources
- Problems #1 and #2 are the most difficult. Problem #3 is the easiest
- In wrap up, identify each step of the EDP used

Prep Corner

- Post EDP Poster
- Get the Duo message ready
- Fill 2 deli containers with water
- Set up materials table
- Measure out 15 ft for Send a Message
- Create 2 model plants (p. 10 in guide)
- Preview a video about life on the ISS to show

20 min • Guide pg. 9

Did you know?

Engineers designed pens for astronauts that can write in extreme temperatures, zero gravity, and under water. Normal pens rely on gravity for the ink to flow and pencil lead breaks into tiny sharp pieces that float around.

Key Terms:

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

A1 Purpose:

Youth investigate multiple glove types to determine which are better for certain tasks.

EDP Step:

Ask

Activity Timing

Duo Update: 5 min
Set the Stage: 5 min
Activity: 15 min
Reflect: 20 min

Total 45 min

Quick Tips:

- Group management strategies:
- Make bold labels for materials table
 - Make bags of materials for each group rather than a materials table
 - Rotate groups through stations
 - Designate a volunteer to help other groups with testing and reset

Prep Corner

- Post EDP Poster
- Get the Duo message ready
- Watch and prepare to play video: www.nasa.gov/feature/nasa-spacesuit-development
- Copy Stations 1-3 (pp. 25-29, guide)
- Set up stations (pp. 22-23, guide)

40 min • Guide pg. 15

Did you know?

Many people wear gloves at work. Surgeons wear latex or nitrile gloves, electrical workers wear fire-resistant gloves, professional athletes even wear gloves, like baseball catcher mitts.

Key Terms:

• **Hazard:** A source of danger

A2 Purpose:

Youth explore how different water filter materials reduce contaminants.

EDP Step:

Ask

Activity Timing

Duo Update: 5 min
Set the Stage: 10 min
Activity: 20 min
Reflect: 10 min

Total 45 min

Quick Tips:

- Group management strategies:
- Make bold labels for materials table
 - Make bags of materials for each group rather than a materials table
 - Rotate groups through stations
 - Designate a volunteer to help other groups with testing and reset

Prep Corner

- Post EDP Poster
- Get the Duo message ready
- Transcribe Testing Results (p. 34, guide) to chart paper
- Set up the Materials Table
- Cut two model hands (p. 41, guide)
- Set aside 2 bags for demo
- Review Cold Test Procedure (p. 40, guide)
- Set up Testing Stations (6 cups ice, 10 cups water, digital thermometers, cardboard hands, stop watches)

30 min • Guide pg. 33

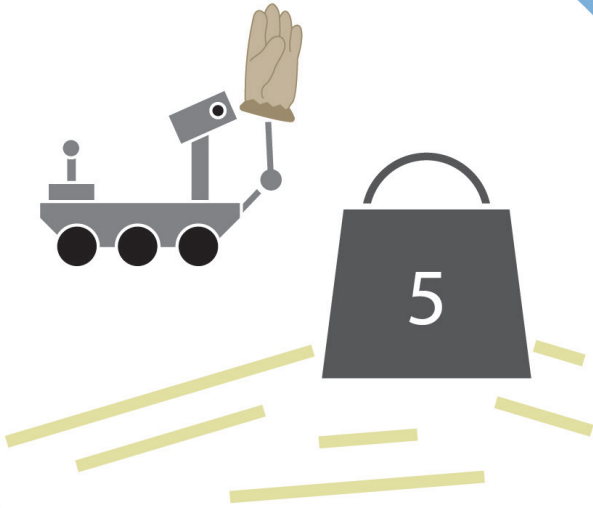
Did you know?

Outside the space station temperatures are 120°C (250°F) in the sun and -155°C (-250°F) in the shade. Space suits have water circulating through to help with the extreme temperatures.

Key Terms:

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

A3



Ready for Impact
Test Materials for Impact

A4



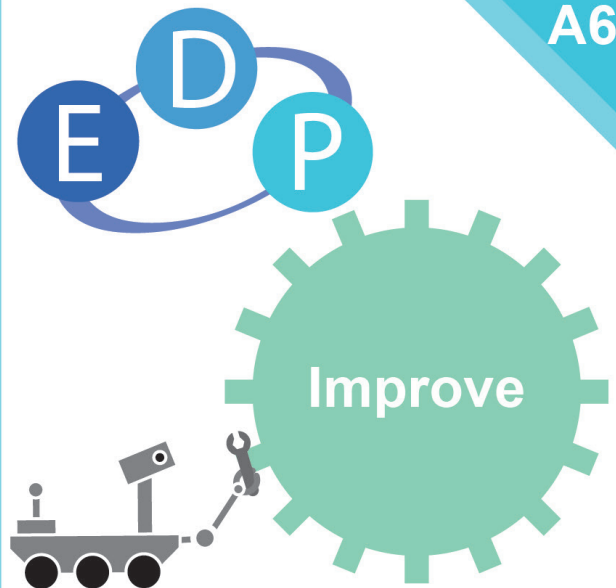
Dangerous Dust
Test Materials for Dust

A5



Create a Space Glove
Plan, Create, Test

A6



Improve a Space Glove
Improve a Technology

A3 Purpose:

Youth explore how well different materials protect against impact.

EDP Step:

Ask

Activity Timing

Duo Update: 5 min
Set the Stage: 10 min
Activity: 25 min
Reflect: 10 min

Total 50 min

Quick Tips:

- For ELL, pair youth purposefully to encourage the best possible environment for collaboration
- Emphasize the analogies:
 - The spaghetti are bones in a hand
 - The skewer represents a tool
 - The washer container is a falling rock

Prep Corner

- Post EDP Poster
- Get the Duo message ready
- Post Testing Results chart paper, add Impact column (p. 46, guide)
- Set up Materials Table
- Fill two containers with 100 washers and tape lids
- Prepare demo glove with 5 spaghetti pieces
- Set up Testing Stations (skewer taped to aluminum tray, spaghetti, testing weights, ruler)

25 min · Guide pg. 45

Did you know?

Some construction gloves have rubber tread like a shoe to protect workers from impacts with falling tools, construction materials, and the moving parts of their equipment.

Key Terms:

• **Impact:** The act of one thing hitting another

A4 Purpose:

Youth explore how different materials resist or collect dust.

EDP Step:

Ask

Activity Timing

Duo Update: 5 min
Set the Stage: 5 min
Activity: 30 min
Reflect: 5 min

Total 45 min

Quick Tips:

- If glow powder is not available, non-borax box laundry detergent can be substituted
- Consider showing Video 3 Dangerous Dust at: www.planets-stem.org/space-hazards

Prep Corner

- Post EDP Poster
- Get the Duo message ready
- Post Testing Results chart paper, add Dust column (p. 52, guide)
- Set up Materials Table
- Set up Testing Stations (sand, gravel, glow powder, washers, aluminum trays, blacklight) (p. 56, guide)

30 min · Guide pg. 51

Did you know?

Did you know dust on the Moon is sharp like tiny pieces of glass? There is no water or wind to erode the particles. When wind and water move particles on Earth, they collide with each other and the sharp edges get knocked off.

Key Terms:

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

A5 Purpose:

Youth apply what they learned in prior adventures to plan, create, and test a space glove designed for a space mission and its associated hazards.

EDP Step:

Plan
Create
Test

Activity Timing

Duo Update: 5 min
Set the Stage: 7 min
Activity: 28 min
Reflect: 5 min

Total 45 min

Quick Tips:

- Set up the Materials Table or "store" so that each material has a display placeholder in order to track anything that runs out
- For youth who are struggling, return to the Testing Results Chart

Prep Corner

- Post EDP Poster and Testing Results chart paper
- Get the Duo message ready
- Set up Materials Table
- Copy Mission Profile Images (pp. 73-77, guide)
- Prepare Mission Simulations (p. 63, guide)

30 min · Guide pp. 57

Did you know?

NASA held a competition in 2009 for engineers to design a better space glove and the prize was \$350,000. The problem was that gloves must be pressurized against the vacuum of space, which made them very hard to move.

Key Terms:

• **Simulation:** An imitation of a real situation for the purpose of learning

A6 Purpose:

Youth improve their glove for more agility, strength, or to better protect against the hazards of their space environment.

EDP Step:

Improve

Activity Timing

Duo Update: 5 min
Set the Stage: 2 min
Activity: 35 min
Reflect: 3 min

Total 45 min

Quick Tips:

- Build on youth successes and failures, both are useful learning tools

Prep Corner

- Post EDP Poster & Testing Results chart
- Get the Duo message ready
- Set up Materials Table
- Copy Mission Profile Images (pp. 73-77, guide)
- Prepare Mission Simulations (p. 63, guide)

30 min · Guide pg. 79

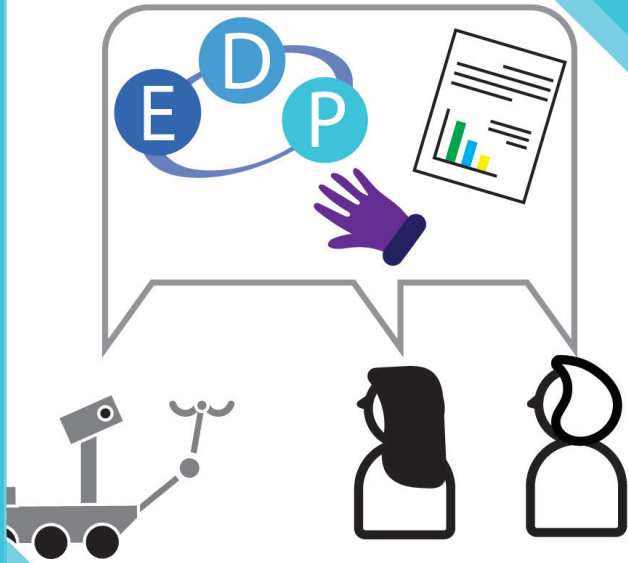
Did you know?

Failure is a big part of the engineering design process. Engineers sometimes make mistakes on purpose so they can learn how to avoid them later when it's more crucial to get it right.

Key Terms:

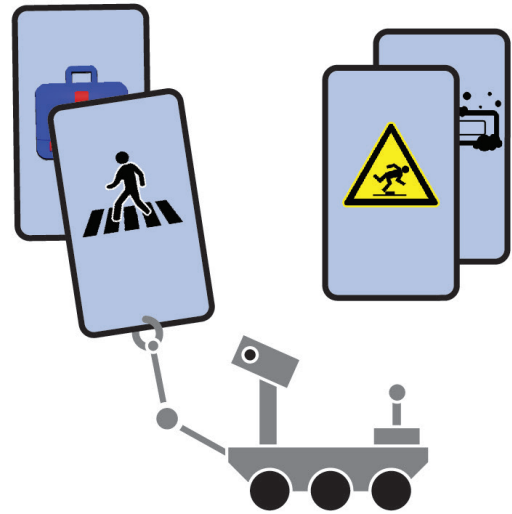
• **Improve (in engineering):** To make better than the first build. Examples from this activity include easier to move, holds together better, or better at protection

A7



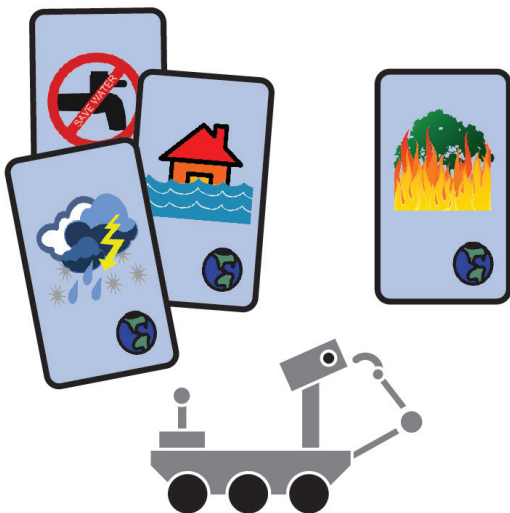
Engineering Showcase
Communicate Results

S1



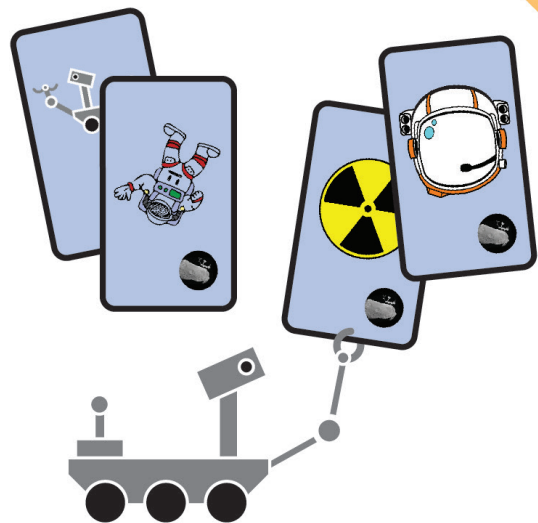
Everyday Hazards
Everyday Hazards Card Game

S2



Hazards on Earth
Earth Hazards Card Game

S3



Hazards in Space
Space Hazards Card Game

A7 Purpose:

Youth prepare presentations to communicate their space glove design to others.

EDP Step:

Communicate

Activity Timing

Duo Update: 5 min
Set the Stage: 15 min
Activity: 20 min
Reflect: 5 min

Quick Tips:

- Consider showing videos of presentation techniques
- Consider filming each group and posting on social media

Total 45 min

Prep Corner

- Post EDP Poster & Testing Results chart
- Get the Duo message ready
- Consider previewing videos on presentation methods

5 min • Guide pg. 85

Did you know?

NASA astronauts sometimes wear space suits designed by other countries for specific tasks, like the Russian Sokol launch and entry suit. In order to find the best design, space agencies collaborate.

Key Terms:

• Communicate (in engineering): To share information, data, or ideas. When engineers communicate, designs can be improved. When scientists communicate, data and ideas can be used to discover new things.

S1 Purpose:

Youth are introduced to the concepts of hazards as dangers and mitigation as a way to lessen the danger through a matching card game.

Activity Timing

Intro to Hazards: 30 min
Define Mitigate: 10 min
Reflect: 2 min

Quick Tips:

- Define both "hazard" and "mitigate" as a group
- Pay extra attention to the group that is dealt the hazard card for *Tripping* and make sure youth are planning on acting it out in a safe way

Total 42 min

Prep Corner

- Read through the guide
- Print Science Notebook for each group
- Print Safety Hazards playmat and cards (Deck A)
- Tape the playmat together
- Cut cards with paper cutter or scissors

1-1.5 hrs • Guide pg. 35

Did you know?

Many industries have Health and Safety Officers (HSOs). In construction, the HSO must write a plan that identifies all known hazards and how to mitigate them. These often include hazards like frost bite or bee stings.

Key Terms:

- Hazard: A source of danger
- Mitigate: To make less severe, serious, or painful.

S2 Purpose:

Youth are introduced natural hazards on Earth and mitigations through a card matching game.

Activity Timing

Intro: 5 min
Know the Cards: 10 min
Card Game: 25 min
Reflect: 5 min

Quick Tips:

- Don't skip the actions; youth might respond better to kinesthetic and sensory learning than visual and auditory methods
- If groups finish early, remove two "good" chance cards and four mitigation cards from the deck and restart game play

Total 45 min

Prep Corner

- Print and tape together Mitigate Hazards playmat*
- Print cards (Decks B&C) for each group of 4
- Cut cards
- Post the Hazards Game Rules (p. 46, guide)

*consider skipping this step if the previous activity sufficiently scaffolded game set-up for your group.

40 min • Guide pg. 41

Did you know?

Some natural disasters cause other natural disasters. For instance, an earthquake can trigger a landslide, or a volcano could set off a wildfire.

Key Terms:

• Natural hazard: An extreme event that occurs naturally and can cause harm to humans or property.

S3 Purpose:

Youth explore different hazards and mitigations in space and learn that some are the same as they are on Earth.

Activity Timing

Intro: 5 min
Know the Cards: 10 min
Card Game: 20 min
Reflect: 10 min

Quick Tips:

- If groups finish early, remove two "good" chance cards and four mitigation cards from the deck and restart game play

Total 45 min

Cheat Sheet for Potential Answers

- Reuse Mitigate Hazards Playmats
- Sort out Deck C from last activity
- Print cards (Decks D) for each group of 4
- Combine Decks C&D for each group
- Cut cards
- Post the Hazards Game Rules (p. 46, guide)
- Have the educator background (pp. 18-28, guide) on hand

30 min • Guide pg. 49

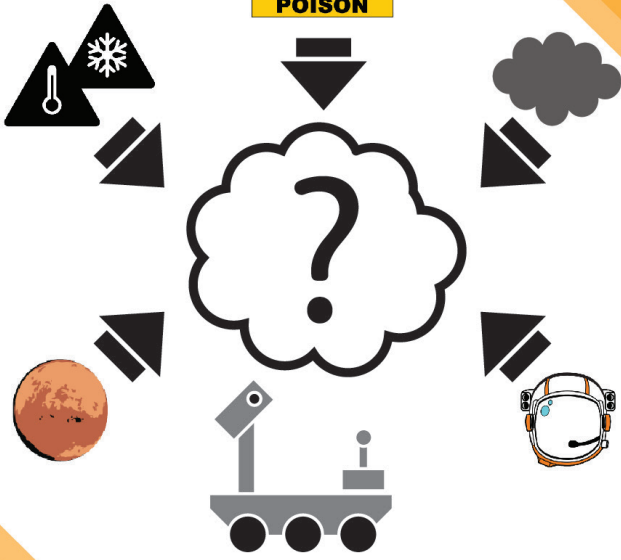
Did you know?

Finding ways to mitigate hazards in space can improve life on Earth. Example: scientists studying bone loss prevention in space can help prevent bone loss for people with osteoporosis on Earth.

Key Terms:

- Gravity: A force that attracts 2 objects toward each other, such as the earth and all objects around it.
- Radiation: energy in the form of light waves or particles

S4



Mitigate Hazards
For Your Mission

S4 Purpose:

Youth investigate the hazards and mitigations that apply to a specific mission and learn that hazards and mitigations differ for human versus robotic missions.

Activity Timing

Intro:	5 min
Assign	
Mission:	10 min
ID Hazards:	10 min
Presentation	
Prep:	15 min
Share Out:	25 min
Reflect	5 min
Total	70 min

Quick Tips:

- This activity can be split: Part 1 (Intro, Assign Mission, ID hazards) & Part 2 (Presentation Prep, Share out, Reflect)
- Many cards apply to each mission. Youth can choose which to focus on

Cheat Sheet for Potential Answers

- Combine decks B,C,&D for each group
- Have educator background (pp. 18-28, guide) on hand

10 min • Guide pg. 55

Did you know?

NASA designs suits differently for some missions. For the the Moon, space gloves have adjustable pressure to make manipulation easier. Engineers are designing a space glove to control a drone on Mars.

BONUS Did you know?

NASA has 200 different missions listed on their website! Check them out at:
<https://www.nasa.gov/missions>