HANDS ON AT THE SPACE STATION

OBJECTIVE – Students will be able to understand how astronauts cope with engineering problems while wearing bulky, protective space suits, specifically space gloves.

Image from https://www.nasa.gov/image-feature/international-space-station-43

NATIONAL STANDARDS –

Next Generation Science Standards (www.nextgenscience.org):

Disciplinary Core Idea Progressions

Life Science Progression

- LS1.D: Information processing
- LS4.C: Adaptation

Crosscutting Concepts

- Systems and system models
- Structure and function

Science and Engineering Practices

1. Asking questions (for science) and defining problems (for engineering)
2. Developing and using models
3. Planning and carrying out investigations
4. Analyzing and interpreting data
6. Constructing explanations (for science) and designing solutions (for engineering)

Activity 11: Hands on at the Space Station

BACKGROUND – "Special" flight suits have been around since the 1920s when pioneering aviators needed protection and supplemental oxygen while attempting high altitude records. Long before that, deep sea divers used bulky suits to explore sunken ships and other ocean treasures. Space suits came into prominence during the 1950s when test pilots like A. Scott Crossfield were routinely flying aircraft, like the X-15, to the edge of our atmosphere.

Like the rest of the body, the hands have to be protected from the hostile environment of space. To do this, bulky gloves are required, and these restrict movement of the wrist and fingers. When a simple task can't be performed, students are used to just removing their gloves; however, it comes as quite a surprise when they realize that, in space, you can't remove the gloves due to the harsh environment of the International Space Station.

In this activity, ski gloves are used to simulate "space gloves." Students are asked to perform simple timed tasks like picking up coins and stacking them in a wrapper or constructing a figure with Legos™. After completing the tasks without gloves and recording the amount of time it took to complete the task, the students are then asked to complete it again, this time slipping on a common pair of ski gloves which simulate wearing the "space gloves." The once simple task soon becomes quite difficult and complicated. This is a fun activity that can be easily performed during one class period.

Additional videos to provide background information on the International Space Station:

- Everything About Living in Space by NASA Johnson (https://youtu.be/ouDKD9G9jOE)
- Take a Tour of the Space Station by SciShow Kids (https://youtu.be/SOCixRhRGDw)
- International Space Station: Facts for Kids by Kids Love Learning (https://youtu.be/x-64L3httIM)
- NASA's Tour of the International Space Station by NASA's Marshall Space FlightCenter (https://youtu.be/nJj4K4WdRuk)

MATERIALS (One set of materials per team)

a. Student Data Sheet per student (attached at the end of the lesson)
b. One pair of ski gloves (one pair per team)

Task materials (can have for each team or set up a rotation for teams to go to stations):

c. Coin wrapper and coins (pennies work well)
d. One ballpoint pen
e. A piece of heavy string
f. A toy construction set like Lego™, Erector™, or Tinker Toy™
g. A bolt, two washers, and a nut that fits the bolt

PROCEDURE

1. Show students a pair of winter gloves and ask them to discuss when we wear these gloves. Ask if they know how gloves are related to astronauts. Use the background information to have a discussion related to why astronauts wear gloves in space.

2. Inform the students that they are going to do an experiment today to help understand why astronauts have to practice tasks wearing gloves.

3. Pass out the Student Data Sheet.

4. Introduce the five tasks that are listed on the Student Data Sheet.
- **a.** Pick up 10 coins and place in a wrapper.
- **b.** Loop string through a washer and tie it.
- **c.** Write name, address, and phone number with pen.
- **d.** Assemble the bolt, washer, and nut, securing with 5 turns.
- **e.** Construct an object following directions (using a construction set like Lego™).

5. Explain to the students that they are going to work in pairs and complete these tasks with their bare hands. One student will be the timer while the other student completes the task. The time will be recorded and then the roles will be switched, and the activity will be repeated so that each student will have his/her own time on his/her own data sheet.

6. After each student has had a turn completing the task and recording the time, give each group of students a pair of "Space Gloves" and have them repeat the activity, taking turns timing and completing the different tasks.

7. When the pairs have finished recording all of the times, instruct them to find the difference between the recorded times it took to do the task without gloves compared to how long it took with gloves. Use scaffolding, if needed, and instruct students to subtract the time it took without gloves from the time it took with gloves to get the difference.

8. Have the students fill out the questions at the end of the Student Data Sheet.

9. Once everyone is finished, facilitate a class discussion on the results of the experiment. Make sure to discuss the last question regarding why astronauts practice so much while wearing the gloves before working in space.

DISCUSSION (RECOMMENDATION) - There is a NASA publication called *Spacesuit Guidebook*, which is located online through the NASA Technical Reports Server at https://ntrs.nasa.gov/citations/19910009290. This has a wealth of information about all of the components that are built into an astronaut's protective clothing. The *Guidebook* explains the inside workings of the spacesuit and its various components.

EXTRA RESOURCES:

- "Space Educator's Handbook – The Spacesuit" can be found at https://er.jsc.nasa.gov/seh/seh.html or https://er.jsc.nasa.gov/SEH/suitnasa.html
- StarChild "Wardrobe for Space" – Get more information on spacesuits at https://starchild.gsfc.nasa.gov/docs/StarChild/space_level1/wardrobe.html or https://starchild.gsfc.nasa.gov/docs/StarChild/space_level2/wardrobe.html
- NASA Suited for Spacewalking is a great activity guide for upper elementary students. https://www.nasa.gov/pdf/143159main_Suited_for_Spacewalking.pdf

CREDITS: Based on an original lesson created by middle school teacher, Lauren Allwein.

HANDS ON AT THE SPACE STATION STUDENT DATA SHEET

Name _____ Date _____

1. Describe the overall challenge in your own words.

2. Choose one of the tasks below and predict how you think it will be different to complete it while wearing the "Space Gloves".

3. Perform all the tasks without gloves and record your times on the data chart below. Put on the "Space Gloves" and perform the tasks again, making sure to record the time. Finally, calculate the difference in the amount of time the task took without gloves compared to the amount of time with gloves.

Task	Time without gloves	Time with "Space Gloves"	Difference (in time)
Pick up 10 coins and place them in the wrapper.			
Loop string through a washer and tie it.			
Write name, address, and phone number with a pen.			
Assemble the bolt, washer, and nut, securing with 5 turns.			
Construct an object following directions (using a construction set like Lego™).			

4. Explain which task took the longest time wearing "Space Gloves" compared to using your bare hands and give your reasons as to why it was more complicated with the gloves.

5. Why do you think it is important for astronauts to practice tasks while wearing space gloves?