

AEROSPACE MICRO-LESSON

learning.

LIVING IN SPACE

Human spaceflight was one of the most singular and defining scientific endeavors of the 20th century, and lengthier human missions in space are vital to future human exploration and discovery. The questions of how we can live in space – how we can create suitable environments, adapt daily tasks to microgravity environments, and maintain safe and reliable space infrastructure – and the political, social, and cultural implications promise to be defining issues of the 21st century.

Next Generation Science Standards (NGSS):

- Discipline: Engineering and Design
- Crosscutting Concept: Systems and System Models
- Science & Engineering Practice: Constructing Explanations and Designing Solutions

GRADES K-2

[K-2-ETS1-1. Ask questions, make observations, and gather information about a situation people want to change to define a simple problem that can be solved through the development of a new or improved object or tool.](#)

I invite you to expose your students to the idea of human spaceflight, and to encourage them to consider what it means to live in space by asking questions such as: What is space? How do people breathe in space? How would life be if we didn't have gravity? What do astronauts do in space? Encourage students to compare astronauts' lives to their own. Why can't astronauts eat their food from plates? Could they eat their favorite foods or snacks in space? How large is the International Space Station? Scientists on Earth can move their work into a larger lab if they need more room to work. Look at features like the [Bigelow Expandable Activity Module](#) that allow those on the ISS to spread out.

To illustrate how basic gravity is for our lives, you may have your students try to wash their hands while lying on their sides (or being held upside down). Watching the following videos may help them understand how such simple activities are much more difficult in microgravity:

[Wringing out a Water Soaked Washcloth in Space](#)
[How to Wash Your Hands in Space.](#)

You may find the following media links helpful:

[Astronauts Eating Food](#)

GRADES K-2 (continued)

[Looking out the Window of the International Space Station \(ISS\)](#)

[International Space Station Facts and Figures](#)

GRADES 3-5

[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.](#)

In addition to the Grades K-2 activity, I invite you to expand on the idea of space stations. Students should learn about the need for space stations and early space stations such as Skylab and Mir, as well as the International Space Station. Encourage students to think about the challenges of living in space, and how simple tasks become much more complicated (see media links). For example, astronauts exercise two and a half hours every day to stay healthy— otherwise, their bodies start to break down in microgravity.

Also, it may be interesting to do a size comparison of the various space stations. There is an [image that compares the three mentioned](#) above, plus a couple of the Salyut stations. It accompanies an article about Mir that may be useful.

You may find the following media links helpful:

[Fun ISS Facts for Kids](#)

[Skylab Paved the Way for ISS](#)

[Diagrams of Skylab](#)

[Commander Chris Hadfield exercising](#)

[Astronaut Karen Nyberg demonstrates how she washes her hair](#)

GRADES 6-8

[MS-ETS1-1. Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.](#)

I invite you to introduce more detailed aspects of human spaceflight, from either a STEM perspective or a socio-political perspective.

Science: Focus on the various challenges of living in space - muscle atrophy, psychological distress, hygiene, etc. Human beings are not suited to living in space; their bodies and minds can deteriorate rapidly. How can astronauts combat these effects?

History: Examine space stations through the lens of the Space Race - Sixty years ago, people envisioned huge hotels and residences floating in orbit. Why did this

GRADES 6-8 (CONTINUED)

never happen? Why did space technology advance so quickly in the 1960s?

Math: Apply basic math principles to human space habitation. For example, it is imperative that space stations function with as few supplies as possible, as it costs thousands of dollars to launch every pound of cargo into space (the Space Shuttle had a launch cost of \$10,000 per pound). Use math principles to calculate, for example, how much food is required by astronauts aboard the ISS depending on how long each astronaut is in orbit. How much does it cost to fly a day's worth of food to space?

You may find the following media links helpful:

[2001: A Space Odyssey \(Spacecraft approaching a space station\)](#)

[2001: A Space Odyssey \(hostess preparing food\)](#)

GRADES 9-12

[HS-ETS1-3. Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics as well as possible social, cultural, and environmental impacts.](#)

I invite you to explore the concepts outlined in the Grades 6-8 micro-lesson more deeply. Students could delve into the science behind any number of human factors issues, especially looking at the [Twins Study](#) featuring astronauts Scott and Mark Kelly. Or they may choose to consider the political and economic motivations for historic, present, and future space station attempts, as well as the political ramifications of establishing human outposts in space or on other planets. It might also be instructive to compare portrayals of life on a space station from pop culture with the actual conditions on board the ISS.

You may find the following media links helpful (along with the links already provided):

[Mission to Mars – Dance the Night Away](#)

[Sandra Bullock in Gravity](#)

Sixty Years Ago in the Space Race:

March 11, 1960: [Launched on a direct solar orbit trajectory, Pioneer 5 successfully reached heliocentric orbit between Earth and Venus to demonstrate deep space technologies and to provide the first map of the interplanetary magnetic field.](#)