Set a Table for the ISS Crew

Subject/Grade Level:	Space and the Solar System / Middle School (Grades 6-8)
Lesson Objective(s):	Students learn how they can survive on the International Space Station.
Materials:	• ISS-ABOVE hardware and software (set up and ready). • Velcro, double sided sticky squares, sticky tape. • Foldable tables or stiff cardboards with room for 2-4 place settings. • Table cloth (optional). • Utensils (plastic or metal). Metal utensils will need magnets (not used on the ISS), so plastic utensils and Velcro are better. • Plastic (reusable) plates, cups/glasses. • Free-dried food packages, for example https://www.amazon.com/Harmony-House-Foods-Vegetable-Emergency/dp/B0039QW1HM/ref=sr_1_17_a_it?ie=UTF8&qid=1513924982&sr=8-17&keywords=dehydrated%2Bfood&th=1 (you can use these for Unit 6: lesson 2 also) OR Ziplocs filled with dry food items, with as little air in the bag as possible). • Highlighters (for Part 2 of the Student Worksheet).
NGSS Essential Standards and Clarifying Objectives:	*MS-ESS1.B* Objects are held in orbit around the sun by the gravitational pull upon them. **Science and Engineering Practices:** • Develop and use a model to describe phenomena. Analyze and interpret data to determine similarities and differences in findings. **Disciplinary Core Ideas:** • Objects, including satellites and the objects and people within them, are held in orbit around the Earth by its gravitational pull on them. Gravity gets weaker, the further from a body you are. **Crosscutting Concepts** • Science assumes that objects and events in natural systems occur in consistent patterns that are understandable through measurement and observation
Differentiation strategies to meet diverse learner needs:	• Think-pair-share, for students that learn best when engaging with classmates. • Multisensory learning, to accommodate students that are auditory learners and visual learners, as well as encourage students to engage their senses in the learning process. • Awareness of social and cultural backgrounds of students to reinforce the real-life application of what they are learning.
Student Worksheet	Worksheet for students' dinner place settings, with room for observations. Article on food in space.
Skills Needed	Students will solve problems that occur on the ISS due to microgravity (resulting in the apparent weightlessness of people and objects).

ENGAGEMENT

Set a Table for Dinner on the ISS

The students will examine how microgravity affects everyday life on the ISS. In this lesson the focus is on eating and food.

> **TASK:** Ask students to share with a partner how they set their table for dinner at home. What do they use to eat dinner? What plates, utensils, drinkware? How do they set them out? Where do they sit?

Hand out the Student Worksheet**.**

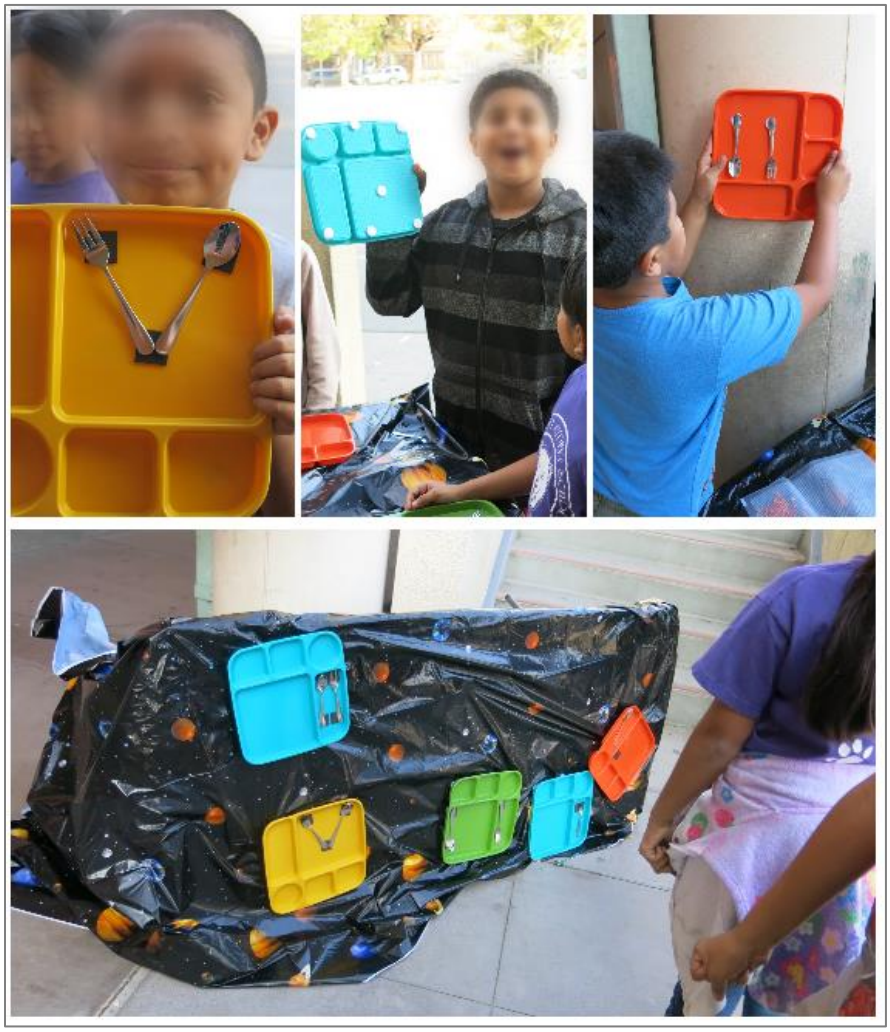
> **TASK:** Students should draw a sketch of their place setting on the first side of their worksheet and complete the questions about how they eat dinner at home.

Explain that students will be setting the table for a dinner on the ISS. Students should think about their Earth-based configurations and components and consider what would happen in a microgravity environment.

FYI: Information on microgravity is here: https://www.nasa.gov/audience/forstudents/5-8/features/nasa-knows/what-is-microgravity-58.html

Class discussion on the difference that microgravity (objects appearing weightless) might make to a table set on Earth and one on the Space Station.

EXPLORATION



Activity: In groups, students construct a table layout such that none of the items 'float away'. This includes a table of large card, trays, food, utensils, tablecloth etc. Provide Velcro, magnets, 2-sided sticky squares, or have students get creative with materials you have around the classroom.

Once their initial setup is ready, test their 'table' by flipping it over. If everything stays attached, an award is in order!

An example is shown in the photos.

Students should add observations about how their table layout is different for the ISS to Part 1 of their Worksheet.

EXPLANATION

Ask the students for their thoughts on the following questions.

1. Does It matter whether a 'table' on the ISS is on the 'floor" or on the 'walls' or 'ceiling'?
2. When you tip <u>your</u> table upside down, what happens if the items aren't attached properly? What would happen on the ISS if any objects weren't attached properly?
3. What would be different about a table on the ISS compare with a table on Earth?
4. Do you think astronauts 'wash the dishes'?
5. How would you redesign an eating area for astronauts so that it would be a little more like eating on Earth?

Space food must be carefully contained so it doesn't float around in the microgravity environment. Even something as simple as a few crumbs can become deadly in low gravity. Condiments like ketchup, mustard and mayonnaise have their own packaging. Salt and pepper are stored in liquid form so that the crystals or granules don't float away. Salt is dissolved in water while pepper is suspended in oil.

The food must be light, well packaged, fast to serve and require minimal cleaning up.

(foods that tend to leave crumbs, for example, are ill-suited for space). Finally, foods require a minimum of energy expenditure throughout their use; they must store well, open easily and leave little waste behind.

EXTENSION – Now for the food

This section is a good lead-in to Unit 6: Lesson 2, which deals with food, exercise and sleep on the ISS.

Option 1: **Warning**: Video has slightly racy language (e.g. 'crap'). There's also a flyout that references sex in space, so be prepared! The students will love the video, though.

> ***What do astronauts eat on the ISS? A short history of food and space travel*** (3:30min).
>
> **https://youtu.be/mxavDn270to**

OR Option 2: **No warning needed!**

> ***Chris Hadfield shows how to make a space sandwich***. Video 2:30min:
>
> **https://www.youtube.com/watch?v=AZx0RIV0wss**
>
> ***The Myth Busters talk to Chris Hadfield and look into food on the Space Station*** Video 10:50min:
>
> **https://youtu.be/f8-UKqGZ_hs**

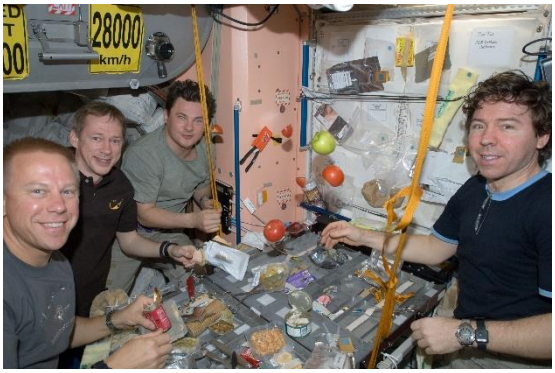
Students should now read the article in Part 2 of their worksheet (which covers a host of matters relating to food in space). Ask students to highlight things that they didn't know or were surprised by.

(Article is edited from **https://science.howstuffworks.com/astronauts-eat-in-space.htm**)

Additional resources:

Start the following video (it's a little dry) at 1:30min to 6:34 min to find out how Astronauts actually eat on the Space Station. Can also continue to the end, which includes vitamin use.

https://youtu.be/_4aWoZPEd2w



Photos of astronauts 'playing with their food' can be printed out and created as a collage:

https://www.space.com/12274-space-food-photos-astronauts-nasa-meals.html

And finally, what do astronauts eat over the holidays? Article from a UK newspaper:

https://www.eveningexpress.co.uk/news/what-do-astronauts-eat-at-christmas-on-the-iss/

EVALUATION

What did students notice about food, nutrition and eating habits on the ISS compared to Earth?

Prompt students to write a few paragraphs or bullet points summarizing similarities and differences between:

- The table they set at home and what they set on the ISS.
- How food is prepared at home and on the ISS.
- What meal time is like.

Student Worksheet – Dinner on the ISS

Part 1: Sketch your place setting or table layout at home for dinner.
Make sure you have plates, utensils, drinking vessels. What else might you have on the table?

What is dinner like in your home? Where do you sit? What do you most like to eat? Does everyone eat together?

Eating a Meal in Zero G

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After you have constructed your ISS table settings, note below what's different about the ISS table and your table at home:

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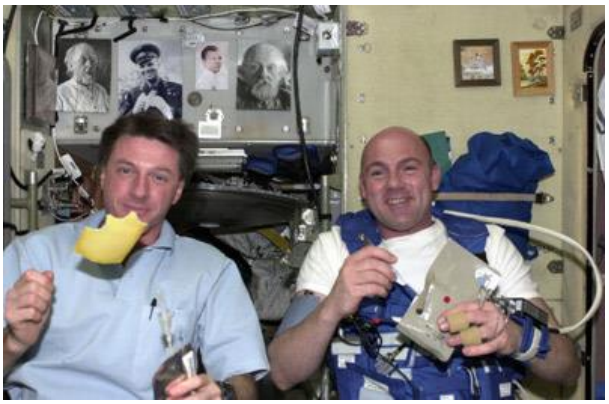
Part 2: Read the article below and highlight the things that surprise you.



European Space Agency astronaut Andre Kuipers (R) and his NASA colleague Michael Foale eat Dutch cheese for breakfast on the International Space Station.

If you asked the question, "How do astronauts eat in space?" about fifty years ago, the answer would be quite different than it is today. In space travel's early years, astronauts used straws to suck dehydrated, paste-like food out of tubes. Today, astronauts eat food in much the same way as they do here on Earth.

In a low-gravity environment, food and drinks would simply float away if they weren't handled correctly. To combat this problem, food and drinks are packaged as dehydrated powders.

Foods are either partially or completely dehydrated to prevent them from spoiling. Meats are exposed to radiation before they are put onboard the shuttle to give them a longer shelf life.

Astronauts eat three meals a day (plus periodic snacks), just as they do on Earth. Meals are organized by the order in which astronauts are going to eat them, and stored in locker trays held by a net so they won't float away. When mealtime rolls around, astronauts go into the galley area in the shuttle's middeck. There they add water to freeze-dried foods and dehydrated drinks from a rehydration station that dispenses both hot and cold water. They heat foods in a forced-air convection oven that's kept between 160 and 170 degrees Fahrenheit. It takes about 20 to 30 minutes to rehydrate and heat an average meal.

Astronauts attach their individual food containers to a food tray with fabric fasteners. The tray itself connects either to the wall or to the astronauts' laps. Astronauts open the food packages with scissors and eat with a knife, fork and spoon.

Each shuttle packs enough food to last the length of the mission, and then some. A **Safe Haven food system** provides every astronaut with an extra three weeks' worth of food -- 2,000 extra calories a day -- just in case the crew encounters an emergency. These foods are typically dehydrated for a longer shelf life.

Astronauts may have plenty of food to eat, but being in space can put a damper on their appetites. Without gravity, food aromas waft away before they make it to the nose. When you can't smell food very well, you can't really taste it, either. And because fluids tend to rise to the top half of astronauts' bodies, the crew members usually have perpetually stuffy noses. Salt, pepper, ketchup, mustard and mayonnaise are available to enhance the flavor of the food, but even then, the condiments are different from their terrestrial counterparts -- salt and pepper are suspended in liquid (water or oil) so the particles don't float away.