



TRADING SPACES: LIVING AND EATING OFF EARTH



FITNESS AND NUTRITION

MISSION DESCRIPTION

This lesson will introduce students to what life is like on the International Space Station (ISS). Participants can learn about gravity, the effects of microgravity, and what life is like on the ISS. Begin with a discussion of what the participants already know about space and the ISS. Youth can brainstorm ideas about how daily life is changed and what astronauts do in one day on the ISS.

Using the provided information and the links within, present the information to the students (see Resources section).

MISSION PREPARATION

TIMELINE

| Breakdown | Duration |
|------------------------------|-------------------|
| Class discussion | 10 minutes |
| Lesson lecture | 15 minutes |
| Crossword puzzle & questions | 15 minutes |
| Total | 40 minutes |

MATERIALS

- Background
- Videos about living in space from the CSA website (see Resources section)
- Crossword puzzle

Difficulty: **EASY**

Duration: **40 MINUTES**

Materials: **MINIMAL**

GOALS

The participants will increase their knowledge of the International Space Station, the effects of gravity, and what life is like as an astronaut.

OBJECTIVES

- By the end of the lesson, participants will be able to
- Identify at least two criteria for foods sent to the ISS
 - Provide two examples of what astronauts do on the ISS



BACKGROUND

The International Space Station (ISS) is a research laboratory that orbits Earth. Since the year 2000 humans have continuously lived and worked aboard the ISS. Seven Canadian astronauts have completed nine missions aboard the ISS. Living and working in microgravity presents unique challenges, and astronauts must closely monitor their health, what they eat, and how much they exercise.

RESOURCES

1. Gravity

Gravity is the force which attracts a body to the centre of another physical body with mass. Every object has gravity. The Sun's gravity keeps Earth in its orbit, and the Moon's gravitational pull causes the ocean tides.

On the ISS, there is **microgravity**. Gravity at the altitude of the ISS is 90% as strong as it is at Earth's surface, but the objects orbiting Earth are in a state of continuous freefall which results in the feeling of weightlessness.

2. International Space Station

The ISS is a habitable microgravity and space environment research laboratory. Astronauts typically live on the ISS for an average of six months.

Canada contributed robotics expertise to the Station: **Canadarm2**, Dextre, and the Mobile Base System. Because of this contribution, Canada can send science experiments, test new technology, and send Canadian astronauts to the Space Station.

Interesting facts about the ISS:

- It orbits Earth at an altitude of 400 km.
- It moves at 28,000 km/h, 90 times faster than an F1 car.
- It has a permanent crew of three to six people.
- Twenty Canadian experiments have been conducted on board, some of which are still underway.
- It is the second brightest object in the night sky after the Moon.
- It crosses the night sky like a bright star and could easily be mistaken for an airplane, but it moves faster and does not have blinking lights.
- It has living quarters similar to those of a five-bedroom house.
- It circles the globe every 90 minutes.

Further reading at <http://www.asc-csa.gc.ca/eng/iss/about.asp>

3. Life on the International Space Station

EATING

Eating meals and snacks in microgravity is a challenge! Each food package has a Velcro sticker on it for the astronauts to stick to Velcro patches on their clothes or dining table so their food doesn't float away. The food available on the ISS needs to be shelf-stable for a minimum of one year, as there are no refrigerators or freezers for food on the Station. Food on the ISS comes in a variety of forms:

- **FRESH:** Fruits and vegetables are delivered to the ISS on most flights but must be consumed within a few days because of the lack of refrigeration.
- **NATURAL FORM:** These foods do not require rehydration or heating. Examples include nuts and tortillas.
- **DRIED:** Dried foods have the water taken out of them to extend their shelf life. Examples include dried fruit, dried vegetables, and beef jerky.



- **REHYDRATABLE:** These are foods and beverages with the liquid removed before packaging that the astronaut adds water to on the ISS before consuming. Examples include coffee, spinach, and chili.
- **THERMOSTABILIZED:** These foods have been processed with heat and pressure to make them safe for consumption. The items can be in cans or flexible retort (metallic) packages. Examples include minestrone soup and salmon pâté.
- **IRRADIATED:** Irradiated foods are treated with radiation to extend shelf life and are safe to eat. Examples include chicken breast and smoked turkey.

The foods the Canadian Space Agency sends to the ISS must meet certain criteria:

- **Lightweight:** Sending food to the Station is costly.
- **Compact:** Space is very limited on board the ISS.
- **Nutritious:** The food helps keep the astronauts healthy.
- **Tasty:** Food is often spicy or very flavourful because an astronaut's sense of taste may be reduced in microgravity.
- **Not crumbly:** Crumbs can be dangerous on the ISS—they can get into equipment or into an astronaut's eyes.
- **Shelf-stable for one year:** After delivery to the ISS, food must be safe to consume throughout the six-month mission and afterwards.
- **Microbiologically safe:** All products are rigorously tested to make sure they are safe to consume.

Astronauts typically consume between 1900 and 3200 calories per day depending on their height, weight, sex, and activity level.

Astronauts aboard the Station have a lot of foods to choose from! There is a permanent menu on the ISS supplied by NASA, Canadian products supplied by the Canadian Space Agency, European products supplied by the European Space Agency, Russian products supplied by Roscosmos, and Japanese products supplied by the Japan Aerospace Exploration Agency. The astronauts can eat together and share food if they wish!

Further reading & videos at <http://www.asc-csa.gc.ca/eng/astronauts/living-in-space/eating-in-space.asp>

SLEEPING

Astronauts have sleep stations the size of a telephone booth or small closet that contain:

- Sleeping bag with arm holes
- Pillow
- Lamp
- Air vent
- Personal laptop
- Place for personal belongings

To block out noise and light, astronauts often wear earplugs and use sleep masks.

Although astronauts sleep “at night,” the ISS experiences a sunrise every 90 minutes. In total, astronauts witness 16 sunrises and sunsets every 24 hours! The time zone astronauts follow on the ISS is Greenwich Mean Time (GMT).

Further reading & videos at <http://www.asc-csa.gc.ca/eng/astronauts/living-in-space/sleeping-in-space.asp>

PERSONAL HYGIENE

Staying hygienic in space is more difficult than it is on Earth. For example, going to the bathroom on the ISS is very different from how it's done on Earth. For urine, astronauts use a personal urination device which uses an air current to suck the liquid into a waste compartment. For solid waste, astronauts use a specially adapted bag attachment and turn on a vacuum system which mimics the effects of gravity; afterwards they seal the bag and dispose of it in the waste compartment under the toilet. The liquid waste produced on the ISS (moisture, sweat, urine) gets purified and recycled into drinking water.



To wash their hair, astronauts use a no-rinse shampoo with a bag of warm water and a small towel. Astronauts do not have showers in space because water does not flow downward like it does on Earth, but astronauts can clean their body with a washcloth and a no-rinse cleaning solution.

A laundry system would use too much water on the ISS, so astronauts wear their clothes until they are too dirty and then throw them out.

Learn more about hygiene in space here: <http://www.asc-csa.gc.ca/eng/astronauts/living-in-space/personal-hygiene-in-space.asp>

EXERCISING

Physical activity is very important in space. On Earth, gravity provides resistance to our muscles and bones that helps keep them strong enough to support our weight. In microgravity, the bones and muscles are no longer needed to support the weight of the body, so they begin to break down. In order to help stop this process and maintain cardiovascular health, astronauts perform two hours of physical activity per day.

The exercise machines astronauts use in space are adapted to work in weightlessness. Devices include a treadmill, stationary bicycle, and an Advanced Resistive Exercise Device (ARED). ARED allows resistance exercises to be performed to maintain muscle strength and bone density by targeting the major muscle groups. The device works by using vacuum cylinders instead of traditional barbells. The vacuum cylinders can exert up to 272 kg of resistance on a bar or cable. Astronauts can perform heel lifts, squats, deadlifts, and other exercises on this machine.

To read more about exercising on the ISS, visit <http://www.asc-csa.gc.ca/eng/astronauts/living-in-space/physical-activity-in-space.asp>

RELAXING

An astronaut's week on the ISS is similar to a week on Earth—they work five days a week and have two days of rest. A few hours on Saturdays are dedicated to chores.

When astronauts have time to relax, they often head to the Cupola, which is a dome composed of windows to view Earth. In the Cupola, astronauts marvel at Earth and often take photographs.

Although they are orbiting Earth, astronauts can still communicate with their friends and family. They can use email, an Internet phone, ham radio, and videoconference to communicate.

Additionally, astronauts receive personal care packages from their friends and family that often contain sweets, books, magazines, photos, and letters.

Further reading & videos at <http://www.asc-csa.gc.ca/eng/astronauts/living-in-space/relaxing-in-space.asp>



FAQ RESOURCE

How many times a day do astronauts eat?

Astronauts typically eat three meals and one snack throughout the day, so roughly four times each day.

Do astronauts get to choose what they eat?

Yes. Astronauts select their own meals but need to remember to eat a balanced meal in order to receive all the nutrients they require.

Can astronauts have desserts?

Yes! Astronauts can still have their favourite treat every once in a while. The desserts on the Station include chocolate pudding, banana pudding, brownies, cobbler, and cookies.

How come there isn't a refrigerator or freezer for food on the ISS?

Although a food refrigerator was considered for the ISS, it was never provided due to the amount of power that would be required to operate it. Instead, food scientists and nutritionists have developed an extensive menu of foods that can be stored at room temperature. These foods include rehydratable foods and heat-treated foods and ensure that astronauts can meet their nutritional requirements while living in space. Food systems for missions to the Moon and Mars will face the same limitations as the ISS food system. The food will need to be limited in mass and volume due to small volume of the spacecraft and the high cost of launching mass into space.

There is a freezer on the ISS that is used for scientific purposes such as storing blood and urine samples and is set at -80 °C.

Are the nutritional requirements in space different from those on Earth?

Most nutritional requirements stay the same; however, some nutrients help lessen the negative effects of living in microgravity. These include calcium, vitamin D, iron, zinc, vitamin A, and vitamin C.



ANSWER KEY FOR THE SPACE CROSSWORD PUZZLE

ACROSS

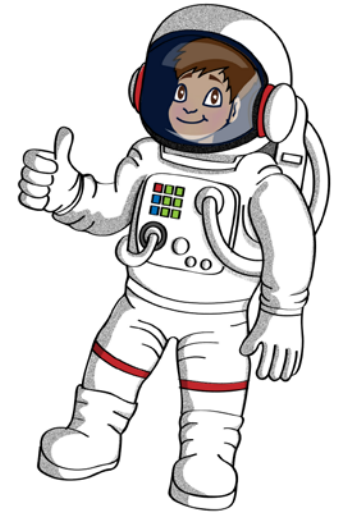
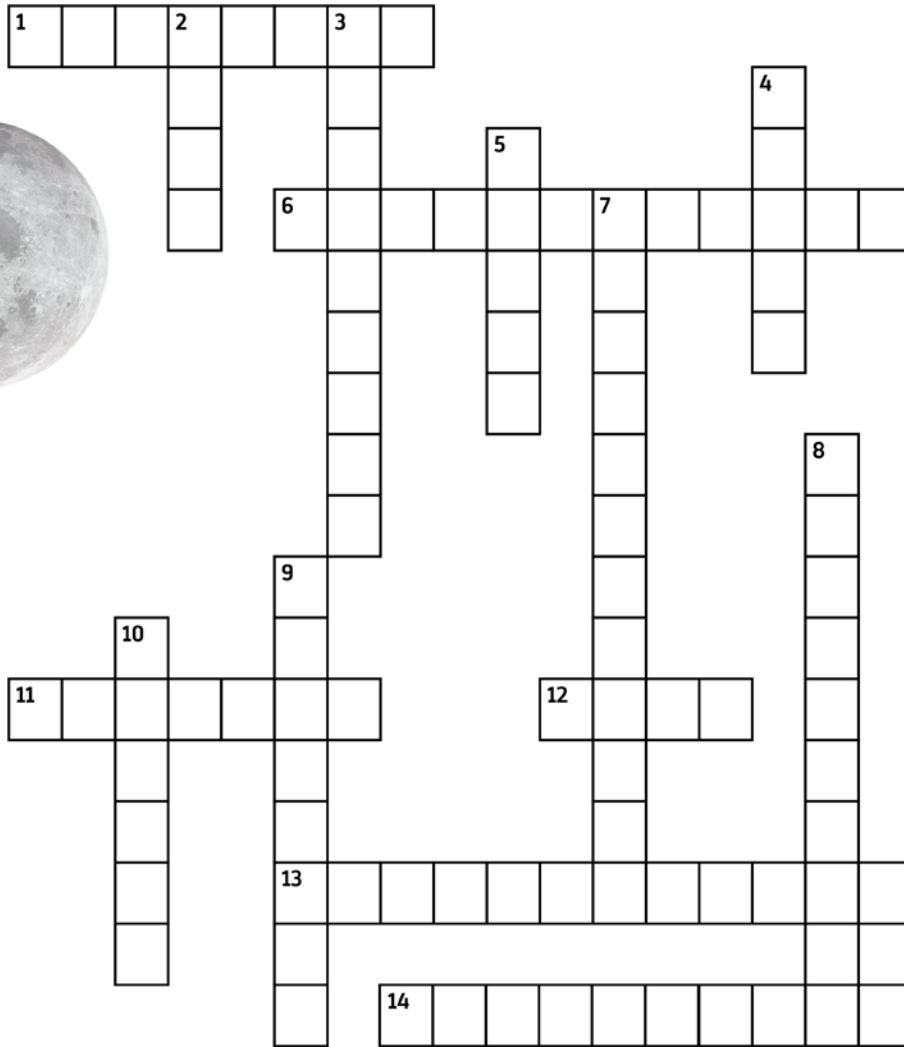
1. Name of the robotic arm on space shuttles and is the ancestor of Canadarm2 of the International Space Station (ISS) **CANADARM**
6. Astronauts float around in the ISS due to **MICROGRAVITY**
11. Canadian astronauts on the ISS perform a lot of **SCIENCE** experiments
12. The red planet **MARS**
13. A requirement of space food **LIGHTWEIGHT**
14. The average amount of time astronauts spend on the ISS **SIXMONTHS**

DOWN

2. Acronym for an exercise device on the ISS which helps protect an astronaut's muscles and bones **ARED**
3. A type of energy which can damage an astronaut's body if there is high exposure **RADIATION**
4. This type of space food is light and does not require rehydration **DRIED**
5. Living in microgravity can affect your **BONES** and muscles
7. A category of space food which is initially dehydrated **REHYDRATABLE**
8. Objects orbiting Earth which help with Earth observation, communications, and navigation **SATELLITES**
9. The majority of the water on the ISS is **RECYCLED**
10. Every **NINETY** minutes astronauts on the ISS experience a sunrise



SPACE CROSSWORD PUZZLE



Across

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