

Sustainable Solutions in Outer Space

Companion Lesson to X-STEM All Access Episode “[Life Beyond Our World](#)”

Grade/ Grade Band 6-12	Topic: Food Science	
Brief Lesson Description: Astronaut Christina Koch lived on the International Space Station for Expedition for a total of 328 days! She served as the flight engineer on the International Space Station where the mission is to enable long-term exploration of space and provide benefits to people on Earth. Food is one thing everyone needs. In this lesson, students will investigate dehydrating food.		
Performance Expectation(s): MS-ESS3-3- Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.		
Specific Learning Outcomes: Students will describe how to dehydrate food and how important dehydrated foods are for surviving in various situations, such as outer space, by providing a consistent food source.		
Narrative / Background Information		
Prior Student Knowledge: Students should be able to distinguish between osmosis, diffusion, and active transport		
Science & Engineering Practices: Constructing Explanations and Designing Solutions Constructing explanations and designing solutions in 6-8 builds on K-5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific ideas, principles, and theories. -Apply scientific ideas or principles to design an object, tool, process, or systems (MS-ES3-3)	Disciplinary Core Ideas: Human Impacts on Earth Systems Typically, as human populations and per-capita consumption of natural resources increase, so do the negative impacts on Earth unless the activities and technologies involved are engineered otherwise. (MS-ES3-3)	Crosscutting Concepts: Influence of Science, Engineering, and Technology on Society and the Natural World The uses of technologies and any limitations on their use are driven by individual or societal needs, desires, and values; by the findings of scientific research; and by differences in such factors as climate, natural resources, and economic conditions. Thus, technology use varies from region to region and over time. (MS-ES3-3)
Possible Preconceptions/Misconceptions: Students tend to believe that osmosis is limited to liquids. Students also may believe that osmosis requires an attractive force that pulls water out of things.		
LESSON PLAN – 5-E Model		
ENGAGE: Opening Activity – Access Prior Learning / Stimulate Interest / Generate Questions: Prior to the lesson gather your materials. Ask students what they think are some differences between living in Outer Space and here on Earth? Share the Life Beyond Our World video featuring Christina Koch and ask students to record facts about Christina’s journey to living on the International Space Station. Discuss with students the differences between Christina Koch’s experiences and what they imagined living in outer space would be like.		
EXPLORE: Lesson Description – Materials Needed / Probing or Clarifying Questions: Gather the following materials prior to the lesson: <ul style="list-style-type: none"> ● Pre-packaged dehydrated food ● Fresh apples, bananas, zucchini, grapes, carrots ● Aluminum foil ● Parchment paper ● Ziplock bags ● Salt ● Sugar ● Heat resistant cups or bowls ● Knife (plastic, disposable) 		

- Graduated cylinder
- Scale/balance
- Access to hot water
- Access to oven or food dehydrator (optional)

Prepare cups of the pre-packaged dehydrated foods for the students to observe (suggestion: divide one pack into 3 containers so students can add 100 ml of water to rehydrate). Ask students to create a general description for dehydrated foods. Have students attempt to rehydrate the food with water and make observations. Then ask students to revise their descriptions. Have students answer the following questions:

1. What was in your cup? Name the dish.
2. What changes did you notice when you added water?
3. Would you eat this dish? Why or why not?
4. Why do you think people dehydrate food?
5. How do you think food is dehydrated?

EXPLAIN: Concepts Explained and Vocabulary Defined:

Explain to student that dehydrating food is a process of removing the water in foods, which makes them last longer, makes them more convenient to package and store, and alter for a desirable feature such as flavor, crispiness, and chewiness. Discuss with students how using dehydrated foods for space travel gives astronauts access to more solid foods and a better, more nutritious, overall diet. Using dehydrated foods and drinks also allow for a significant weight reduction during space travel. Display and explain the various fruits and vegetables students will be using in this investigation.

[How to dehydrate foods.](#)

There are several methods used to dehydrate food: sun drying, air drying, solar drying, oven drying, and electric dehydrators. Sun drying is one of the oldest and simplest methods of preserving food. It involves laying foods on a sheet in a sunny area with low humidity at a temperature of 30°C or higher (86°F +). Remember to cover the food to prevent pests and insects. This method may take several days. Air drying is simple like sun drying however the food is not place in direct sunlight. It's a good option for dehydrating leafy green vegetables, herbal teas, and spices. You may consider using a fan to expedite the process. Solar drying uses a greenhouse like device powered by the sun. An oven is the easiest and fastest way to dehydrate food. Keep the temperature very low, around 60°C or 140°F. You can purchase an electric dehydrator that's sole purpose is to dehydrate food. It is the most efficient method and can cost between \$50 and \$1,000.

Vocabulary:

Dehydration: is the removal of water by evaporation from a solid or liquid food to create a solid edible product

Rehydratable Food: food that has had water removed to make them easier to store.

ELABORATE: Applications and Extensions:

Prior to starting the elaboration section of this lesson, you will need to gather the following materials (per team):

- Fresh apples, bananas, zucchini, grapes, carrots
- Aluminum foil
- Parchment paper
- Ziplock bags
- Salt
- Sugar
- Heat resistant cups or bowls
- Knife (plastic, disposable)
- Graduated cylinder
- Scale/balance
- Access to oven or food dehydrator (optional)

Explain to students they are going to naturally dehydrate 2 of the foods listed above using the sun as the main source for dehydration. Have students to design their dehydrator using the materials (foil, parchment paper, Ziplock bags, sugar, or salt). Once they've built their dehydrators, direct students to slice their food into smaller pieces and measure and record the weight before placing in their dehydrating device. Ask students the following:

- What foods did your team select and why?
- Describe the process the team is using to dehydrate food.
- Why do they need to cut the fruits/vegetables into smaller pieces?
- Why did they need to weigh the food before starting the dehydration process?

Students should measure their foods daily and record observations. After 3 days the taste testing can begin. Students submit a written report explain how well the dehydrator worked based on the data collected and the answers to the questions listed above.

EVALUATE:

Formative Monitoring (Questioning / Discussion): As students are completing the investigation, use the questions to assess their

understanding.

Summative Assessment (Quiz / Project / Report): Students written report.

Elaborate Further / Reflect: Enrichment: Students create [fruit leather](#) to improve the flavor profiles or chewiness ([recipe](#) using the sun).

SOCIAL EMOTIONAL LEARNING ACTIVITY

CASEL Competency: Social Awareness

The ability to understand the perspective of and empathize with others is social awareness. Today's activity is a twist on the guessing game Charades. Students will act out various emotions and situations while the students will act out a response before guessing the word or phrase.

Sample words: happiness, anger, sadness, surprise, disgust, fear, jealousy, regret, shame

Sample situations: anticipating good news, trusting a friend, lost a friend, upset that you missed the event, encountering a hostile situation, embarrassed by your dad's jokes, enjoying a good meal

Then discuss the scenes acted out and how students interpreted the emotions. Here are a few questions to prompt the discussion: Which emotions were easiest to identify, what does the body language look like when responding to those emotions, which emotion did you respond with and why, which emotions were challenging to recognize and what made it difficult, were there any surprises, and what were the surprises?

Explain to students that people can display their emotions differently and they are working on understanding the perspective of others.

INTERDISCIPLINARY CONNECTIONS/IDEAS

WHST.6-8.7 - Conduct short research projects to answer a question (including a self-generated question), drawing on several sources and generating additional related, focused questions that allow for multiple avenues of exploration.

Materials Required for This Lesson/Activity

Quantity	Description
2-3 packs per class	Pre-packaged dehydrated foods
2-3 per class of each	Fruits: bananas, apples, grapes Vegetables: carrots, zucchini,
	Aluminum foil
	Parchment paper
	Ziplock baggies
	Salt
	Sugar
	Cups/bowls
	Knife
	Scale/balance
	Graduated cylinder
	Hot water



Lesson Created by Stacy Douglas
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