Life Beyond Our World

Pages 1-3 Life Beyond Our World with Christina Koch

Watch the Video Here

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

Pages 3-6 Life Beyond Our World with Bobak Ferdowski

Watch the Video Here

Materials Required for This Lesson/Activity	
Quantity	**Description**
Per team	1 balloon (student choice)
Per team	2 modeling balloons
Per team	4 straws
Per team	2 binder clips
Per team	One inch cardboard ring (cut from paper towel tube)
Per team	Scissors
	Tape

Per team	Meter Stick/ measuring tape
Per class	1 spool of Fishing line

Life Beyond Our World with Christina Koch

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: ● 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 access 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
For questions, please contact info@usasciencefestival.org

Life Beyond Our World with Bobak Ferdowsi

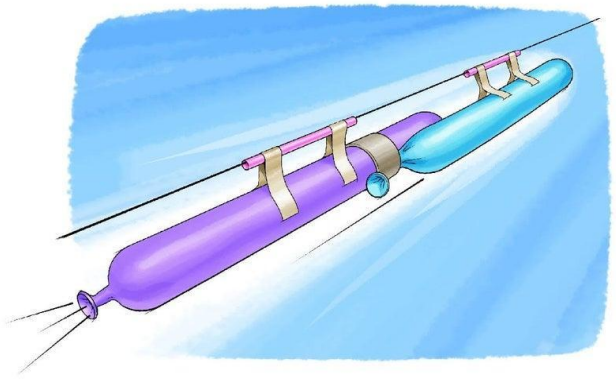
Grade/ Grade Band 6-12	**Topic:** Physics	
Brief Lesson Description: Spacecraft Engineer Bobak Ferdowsi explains how NASA makes the journey to Mars. The first thing you need is a rocket. In this lesson students create rockets that will travel a distance of at least 2.5 meters.		
Performance Expectation(s): **MS-PS2-2**. Plan an investigation to provide evidence that the change in an object's motion depends on the sum of the forces on the object and the mass of the object. **MS-ETS1-3**. Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success.		
Specific Learning Outcomes: Students will demonstrate Newton's 3rd law of motion. Students will use engineering design to build a two-stage rocket that will travel 2.5 meters.		
Narrative / Background Information		
Prior Student Knowledge: Students can explain Newton's laws of motion.		
Science & Engineering Practices: **Asking Questions and Defining Problems.** Plan an investigation individually and collaboratively, and in the design: identify independent and dependent variables and controls, what tools are needed to support a claim. (MS-PS2-2) **Analyzing and Interpreting Data.** Analyze and interpret data to determine similarities and differences in findings. (MS-ETS1-3)	**Disciplinary Core Ideas:** **PS2.A: Forces and Motion.** The motion of an object is determined by the sum of the forces acting on it; if the total force on the object is not zero, its motion will change. The greater the mass of the object, the greater the force needed to achieve the same change in motion. For any given object, a larger force causes a larger change in motion. (MS-PS2-2) **ETS1.B: Developing Possible Solutions.** Sometimes parts of different solutions can be combined to create a solution that is better than any of its predecessors.(MS-ETS1-3)	**Crosscutting Concepts:** **Cause and Effect.** Cause and effect relationships may be used to predict phenomena in natural or designed systems. (MS-ETS2-3)
Possible Preconceptions/Misconceptions: Many students believe that all forces must be equal, Newton's third law is applied when the forces are paired.		
LESSON PLAN – 5-E Model		
ENGAGE: Opening Activity – Access Prior Learning / Stimulate Interest / Generate Questions: Prior to the lesson gather the following materials: Assortment of balloons Modeling Balloons (long balloons for making animals) Straws Binder Clips Paper towel tubes Fishing line tape Give students the following: assortment of balloons, a straw, 6 strips of tape, 3 meters of fishing line, and a meter stick. Tell students to use the materials to create a model rocket that will travel at least 1 meter. Ask them to sketch their design in advance of building it. After the students build their rockets, they will test to see how far it travels.		
EXPLORE: Lesson Description – Materials Needed / Probing or Clarifying Questions: Discuss with students how the rocket performed during the tests. Ask the following questions to prompt discussion: how far did your rocket travel, which features in the design of the rocket helped it to travel, which features hindered the rocket's flight, what changes or additions would you make to the design to improve it? Now view Life Beyond Our World featuring Bobak Ferdowsi. Students should record notes about how Bobak Ferdowsi designs rockets.		

EXPLAIN: Concepts Explained and Vocabulary Defined:
Explain to students that according to Newton's third law of motion, for every action there is an equal and opposite reaction, means that the straw in the balloon rocket is pushed forward along the fishing line as the air is expelled out of the balloon. The friction between the fishing line and the straw acts opposite the direction of motion of the balloon rocket. According to Newton's second law, F = ma, the rocket balloon's acceleration depends on the mass and the sum of the forces acting on it. Adding a second balloon to the rocket increases the amount of energy used to propel the rocket forward.
Vocabulary:
Newton's third law of motion- for every action there is an equal and opposite reaction.

ELABORATE: Applications and Extensions:
Prior to starting the elaboration section of this lesson, you will need to gather the following materials (per team):
Student teams will need the following materials:

- Modeling balloons (2)
- Binder clips (2)
- Straws (2)
- ½ - ¾ inch cardboard ring
- 4 strips of tape
- Fishing line (from the engage stage)

Explain to students that to assemble the 2-stage balloon rocket they will need to delay the expulsion of air from the main balloon. Ask students to plan out their designs focusing their attention on how they will delay the release of air from the main rocket (use the cardboard ring to connect the two balloons such that when the first balloon deflates it provides space for the second balloon to open and expel air), how to ensure the rocket stays straight (don't inflate balloon more than ¾ full).
It can be tricky and frustrating to construct the rocket. Consider sharing the following image from a 2017 Scientific American article:



Once students have assembled their balloon rockets, they will test to see how far it can travel. They should make modifications and record them and the results. Bring the class together for a discussion. Use the following questions to prompt the discussion:

- What changes made the biggest impact on how far the rocket traveled?
- Which changes did not make a difference on how far the rocket traveled?
- What was surprising about your rocket?
- What do you think would happen if there was a third stage/balloon?

EVALUATE:

Formative Monitoring (Questioning / Discussion): The design plans for the rockets and student responses to the discussion in the lesson.

Summative Assessment (Quiz / Project / Report): Students write a report comparing the performance of their single stage rocket to their two-stage rocket and explain how Newtons Laws of Motions are exhibited.

Elaborate Further / Reflect: Enrichment: Students explore changing the direction of the travel from horizontal to vertical. How high will the rocket go? What changes need to be made to the rocket to propel it vertical and why?

SOCIAL EMOTIONAL LEARNING ACTIVITY

CASEL Competency: Responsible Decision Making
Responsible decision-making is the ability to make caring and constructive choices about one's personal behavior and social interactions across diverse situations.
In this activity, students will be strengthening their creative thinking and decision-making skills. Tell students they are stranded on a desert island. They may only choose 3 of the following objects to survive:

- A Swiss army knife

- A fishing net
- A bag of fruit and vegetable seeds
- A 100 ft rope
- A large bucket
- 2 gallons of kerosene
- A flashlight
- Sunscreen
- A first aid kit
- A waterproof bed sheet
- A wool blanket

Give students 2-5 minutes to write out which 3 items they would select and why. Then ask students to select a partner. Next, students should compare the items they selected and the reasons why, before looking for another pair to partner with. This team of four should share the items they selected and discuss their chances for survival. Lead a class discussion asking students how they decided to create the partnerships and why they think their team will survive. Consider asking students how the items they selected play to their strengths, or did they consider their weaknesses when making the decisions to partner with classmates?

INTERDISCIPLINARY CONNECTIONS/IDEAS

With this lesson students are writing a report as well as creating their own diagrams and models. RST.6-8.7 *Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually*

Materials Required for This Lesson/Activity

Quantity	Description
Per team	1 balloon (student choice)
Per team	2 modeling balloons
Per team	4 straws
Per team	2 binder clips
Per team	One inch cardboard ring (cut from paper towel tube)
Per team	Scissors
	Tape
Per team	Meter Stick/ measuring tape
Per class	1 spool of Fishing line

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