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#SeaworthySTEM

Biofuel Jell-O

Grades 3-5

Teacher Guide

Seaworthy STEM™ in a Box Series

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Biofuel Jell-O

Teacher Guide for 3-5

Seaworthy STEM™ in a Box Educator Kit description:

Seaworthy STEM™ in a Box activities are a Navy initiative to provide enhanced Naval-relevant, standards aligned, hands-on activities to K-12 teachers and students. Components of this program include, curated sets of classroom activities that aim to build deep conceptual understanding in Naval-relevant content areas. The kits also includes comprehensive lesson plans, material lists, scientific background information, STEM related literacy books, and student activity sheets. The Seaworthy STEM™ in a Box program is designed to support teachers as they select content, acquire materials, and implement more hands-on STEM activities in their classrooms. Increasing student access to hands-on STEM activities, also increases awareness of STEM career paths, engage students in STEM, and support development of student's abilities in STEM content.

The Seaworthy STEM™ in a Box kits were designed to guide students through the scientific inquiry-based theory and the engineering design process. The content and Naval-relevant activities are aligned with the Next Generation Science Standards. The topics and content covered within the lessons are connected and scaffolded based on distinct grade bands (K-2nd, 3rd-5th, 6th-8th, and 9th-12th).

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Lesson Title: Biofuel Jello

Time:

1 Class period (45-60 minutes)
(This may take 2 separate class periods due to refrigeration involved.)

Student Objectives:

Students will learn about algae and how it is part of the marine food ecosystem. Students will gain knowledge about naval research and development into new biofuel and sustainable energy sources such as algae. Students will create their own "biofuel" using the same ingredients incorporated in Jell-O.

Lesson Overview:

Students will learn about sustainable and biofuel energy sources such as algae. Students will work together to create their own biofuel source. Students will learn how biofuels can be used as an energy source and how the Navy is currently exploring sustainable production of different types of biofuels.

Next Gen Science Standards:

3-LS4-4
3-LS4-3
4-PS3-4
4-ESS3-1
5-PS1-4
5-PS3-1

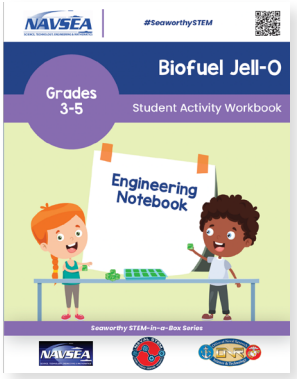
Notes

Materials and Equipment List:

- ☑ 2 packs of instant Jell-O
- ☑ Tonic Water
- ☑ Ice cube trays
- ☑ Black light
- ☑ Fridge
- ☑ Kettle
- ☑ Bowl
- ☑ Mixing spoons
- ☑ Measuring cups
- ☑ Tap Water
- ☑ Black Light

Student Activity Sheets/Handouts:

Biofuel Jell-O Student Activity Workbook

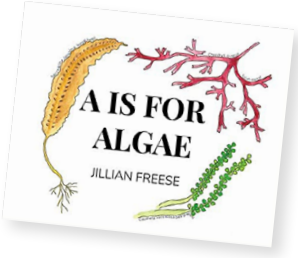


Technology Tools:

- Black light
- Learn about the Navy's Great Green Fleet initiative: https://allhands.navy.mil/Features/GGF/

Suggested STEM Related Literacy Book:

A is for Algae by Jillian Freese



Procedure:

1. Students will receive a brief introduction into sustainable and biofuel energy sources. The teacher will also introduce the research on energy sources such as algae. The teacher can direct a classroom discussion with the following introduction questions.

The teacher can guide students through the following questions:

"What is algae?"

"Why do animals eat algae?"

"If algae is a source of energy for animals, could we use that energy for other sources?"

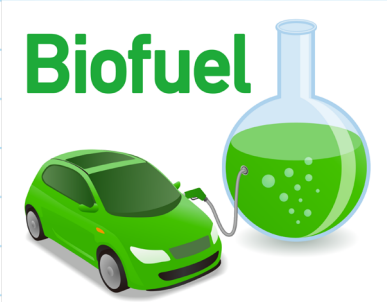
2. The teacher will split students into teams and hand out materials. Based on grade level, teacher may use discretion to have students work in teams or as whole class.

3. The teacher will then demonstrate how students will create the "biofuel Jell-O" using the kitchen ingredients listed in materials.

4. Give students 10-15 minutes to create the instant Jell-O in teams. This mixture will follow the recipe on the Jell-O box with one exception, please use the tonic water instead of regular tap water.

Helpful tip:

Follow the directions on the instant Jell-O package directions. Replace the 2 cups of water with the listed 2 cups of tonic water. The tonic water is crucial to produce the "glowing" trait of the biofuel algae.



5 After making the Jell-O, pour into the ice cube tray and have set in the fridge.

Time for students to do their lesson worksheet!

Helpful tip:

This break would be a great time to read the STEM related literacy book and have students work on the Biofuel lesson worksheet in the engineering notebook.

6 Now that the "Biofuel Jello" has been created, it is suggested that the instructor encourages the students to make predictions and creates 3 additional different mixtures to compare to compare and to contrast. Examples include:

- Tap water with the suggested amount of Jello powder
- Measure more Jello powder and less tap water than the original recipe
- Measure less Jello powder with more tap water than the original recipe

Have the students note their new recipe and record a prediction in their student activity workbook.

7 When the Jell-O is set, give each student a cube of the biofuel Jell-O from the tray.

8 Use the blacklight and turn off the lights to see if it glows. The student will then pass out the second student engineered recipe to gather observations which they can compare and contrast with the Biofuel Jello. The students may then eat both of the samples.

9 Discuss the "Scientific Background" information with the class and guide a discussion focusing on sustainable energy. The teacher can use the whole group discussion questions in the side panel.

The teacher can use these group discussion questions:

"Why is algae a great source for fuel?"

"Does algae have energy?"

"Where does the algae get energy from?"

Vocabulary Terms:

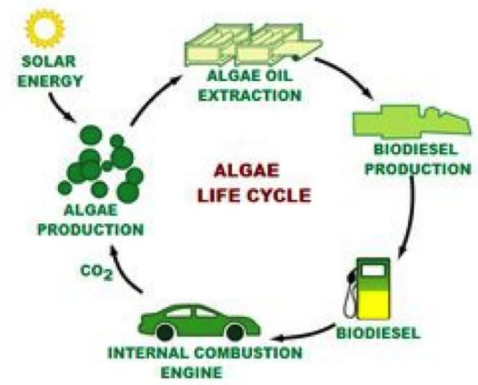
- Algae: a simple, nonflowering, and typically aquatic plant of a large group that includes the seaweeds and many single-celled forms. Algae contain chlorophyll but lack true stems, roots, leaves, and vascular tissue.
- Bioluminescence: the biochemical emission of light by living organisms such as fireflies and deep-sea fishes.
- Colloid: a mixture is two or more substances mixed together but not chemically combined (they can be separated)
- Gas: matter without a fixed shape or volume, but can fill its container.
- Liquid: an object with a fixed volume, but without a fixed shape and can take the shape of its container.
- Mixture: a mixture is when two or more substances are combined, but each substance keeps its physical properties
- Observations: Observation is the process of using one's senses to gather information about the world
- Solid: an object with both a fixed shape and a fixed volume
- Solution: a mixture of two or more substances that stays evenly mixed.

Scientific Background:

Algae is a group of aquatic nucleus-bearing organisms that lack roots, stems, leaves, and other functions that are typical of most plants. Algae is a critical food source in the marine life ecosystem. Animals such as snails, fish, and reptiles graze on algae. Algae is not only a good source of protein for these animals but also has a key role in producing oxygen to maintain a healthy marine ecosystem. In recent developments, research in sustainable energy has discovered that algae can be used as an alternative to liquid fossil fuels. Algae is not only a source of energy for marine life but can also be a source of energy for human transportation. Algae can be turned into biofuel through the extraction of fatty acid contained in lipids. To extract this fatty

Fun Fact!

This diagram is a basic cycle of how algae is developed and then how it is turned into a biofuel source for human transportation such as a car.



Source: https://cla.auburn.edu/ces/energy/algae-as-energy-a-look-to-the-future/

acid it requires removing all the water from the algae. This results in a dry powder or "slurry" substance. For instance the Jell-O packet mix is in a powder green and looks similar to the dehydrated algae. Algae has the potential to yield at least 30 times more energy than land-based crops such as other alternative energy sources like corn and sugarcane. The Navy is exploring the use of algae as a biofuel source. The use of eco-friendly fuels such as algae are generally much better for the environment as compared to fossil fuels like diesel and gasoline.

STEM Related Career:

- Energy Analyst
- Energy Transition Technical Specialist
- Energy Systems Engineer

Reference Photo:

Fun Fact!

This reference photo is an example of the excess growth of algae blooms due to stagnant water combined with the rise of warm temperatures.

The Seaworthy STEM™ in a Box curricula was developed through collaborative efforts of a team of individuals at the Naval Surface Warfare Center Carderock Division and Albert Einstein Distinguished Educator Fellows via an inter-agency agreement with the U.S. Department of Energy for the Albert Einstein Distinguished Educator Fellowship (AEF) Program. We are grateful to the following Content Specialists who contributed their knowledge and expertise by researching and writing on selected topics: Suzanne Otto, Stephanie Klixbull, and Thomas Jenkins. We'd also like to acknowledge the contributions of AEF participant Ms. Deborah Reynolds, the inaugural AEF Educator at Carderock that helped inspire the design of Seaworthy STEM™ in a Box content. With the help of Albert Einstein Fellow, Melissa Thompson, and Carderock Outreach Specialist, Ashlee Floyd, special additions to the curriculum such as career portfolios, workforce trading cards, and in-house short story publications are included that reflect the diversity of NAVSEA Sites.

It is the goal of the SeaWorthy Curriculum to embrace NAVSEA technologies from sites nationwide to empower the youth of our nation to purse STEM-centric career pathways. The views and opinions of the Content Specialists expressed herein do not necessarily state or reflect those of the AEF Program, the U.S. Department of Energy, or the U.S. Government. Reference herein to any specific commercial product, process, or service by trade name, trademark, service mark, manufacturer, or otherwise does not constitute or imply endorsement, recommendation, or favoring by the AEF Program, the U.S. Department of Energy, or the U.S. Government.

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