



NGSS Standard: MS-LS1-7



Adventure Description:

In this adventure, you will think like a bioengineer and which materials are best to produce biofuel.

Activity

Step 1: Introduction to Bioengineers and Fuel (5 minutes)

- Show [Video: Alternative Energy](#).
- As a class, discuss how bioengineers use living things to produce fuel. For example, yeast is a living thing that can be used to make fuel. Yeast loves to eat sugar (kind of like most middle school students). The yeast can find sugar to eat in plants. For example, the yeast eats the sugar found in wheat when bread is being made. When the yeast eats sugar, it breaks the sugar molecules down into smaller pieces. Then, it rearranges those smaller pieces and builds new materials of ethyl alcohol and carbon dioxide. The ethyl alcohol (also called ethanol) holds a lot of energy and can be used as a fuel source.
- This process is a chemical reaction. In a chemical reaction, you start with one material and make a new material. Yeast takes the sugar in the plant and makes alcohol and carbon dioxide gas.
- Plants have to be broken down so that the yeast can get to the sugar to make the alcohol. They can't just "eat" the plant the way it is. This is why when someone is making bread, they will use wheat flour (ground up wheat plants) instead of just using the wheat plant whole.

Step 2: Experiment Set Up (10-15 minutes)

- Explain to students that they will be doing an experiment to make fuel using different materials.
- Show [Handout: Experiment Steps](#).
- Divide students into groups of 2-4.

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- Provide each group with the following materials:
 - 5 zipper plastic bags
 - Sharpie
 - 5 teaspoons of yeast
 - Measuring spoons
 - Warm water
 - 1 Tablespoon of sugar
 - 1 Tablespoon of syrup
 - 1 Tablespoon of milk
 - 1 Tablespoon of chopped up plant (like grass)
 - Timer
- Have students complete step 1.

Teacher Notes:

- After adding water, you can set baggies up right making it easier to “squeeze” extra air out and seal baggie then lay it flat, use fingers to mix ingredients.
- All of the baggies will have some pockets of air left in them after you seal them, make sure this is part of first observation.

Step 3: Making Observations (25 minutes)

- Provide groups with [Handout: Table for Observations](#).
- Explain to students that they will now complete step 2. They will write their observations down in the chart every 3 minutes.
- As students are working, ask the following questions:
- What is happening to some of the bags and why do you think it is happening? Discuss how the sugar and syrup bags are inflating because the yeast is making gas.

Teacher Notes:

- After the first 3 minutes, you can tell sugar and syrup pockets of air are getting bigger. Some students might think the air pockets in the other bags are getting bigger, but they have not changed, it's just the air from the original set up. As time goes on it will be clear that its just the sugar and syrup that are puffing up. This is because the yeast can eat the “simple” sugar that makes sugar and syrup. They cannot eat the sugar that is “tied up” in the milk or in the plant.
- (Optional) Have students add lactase to the milk bag. This will cause gas to form like in the sugar and syrup bags, the lactase breaks down the milk into a simple sugar that the yeast can eat.

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Step 4: Reflection (5 minutes)

- Ask students to look at their tables and decide which materials allowed yeast to make fuel (gas). Discuss how the sugar and syrup allowed yeast to make fuel because their bags inflated to produce gas.
- Ask students what would need to happen to other materials so yeast could make gas. Explain that yeast cannot eat plants or milk because they are not simple sugar. You would need to break the plants and the milk down into sugar so the yeast can eat it to make fuel. A cow ate plants and broke the plants down to make milk, but that's still not good enough. But, if you add lactase to milk, the milk breaks down even more to make sugar. Then, yeast can eat the sugar and make fuel. This is because yeast is a very simple living thing and can only eat very simple sugar.
- If time permits, discuss problems that could arise from using sugar or syrup to make gas (e.g., it would take a ton of sugar or syrup to produce enough gas for a car to move).

Materials List

Provided online:

- Video: Alternative Energy
- Handout: Experiment Steps
- Handout: Table for Observations
- Handout: Tips for Teachers

Not Provided online (each student or group needs):

- Measuring spoons
- 1 tablespoon of sugar
- 1 tablespoon of syrup (corn syrup or maple syrup)
- 1 tablespoon of milk (any kind as long as it's not lactose free)
- 1 tablespoon of chopped up plant (grass or leaves will work)
- 5 zipper plastic bags
- sharpie
- 5 teaspoons of dry yeast
- 1 $\frac{1}{4}$ cups of very warm tap water
- Timer
- (Optional) Lactase

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