

ANAEROBIC DIGESTION OF ORGANICS

| David Luong | 1 hour + | Grade 5/6



OVERVIEW

Description

Participants will learn about biogas production and the different types of materials that can produce biogas. They will also learn to build small versions of anaerobic digestors to produce their own biogas.

Learning Outcomes

- Sustainable fuel sources
- Biogas and Biogas production
- Organic decomposition of organic material (Foods, agricultural waste)

Outline (with time indications/estimations)

1. Biogas (5 minutes)
 - a. What are the uses of biogas?
 - b. Where does biogas come from?
2. Biogas production (5 minutes)
3. Producing your own biogas (45 minutes build + Couple of days for biogas to produce)

Materials

Item (be <u>very</u> descriptive)	Quantity Per Child (with units)	Quantity Per Camp (with units)
● 750 mL Bottle	● 1	● 20
● Balloon	● 1	● 20
● Organic Materials	● N/A	● N/A
● Marker	● 1	● 20
● Tape	● ~6 inches	● 1-2 Rolls

SAFETY CONSIDERATIONS

- Precautions for Instructor and Participants.
- Please use caution, and explain each safety measure to the participants. Ensure any incidents are reported appropriately.
- Indicate with an 'x' next to the items that apply to this activity.

Material/Chemical Safety	
<input type="checkbox"/>	SDS Required (<i>attach in write up</i>)
<input type="checkbox"/>	Electrical Components
X	Food &/or Potential Allergens
<input type="checkbox"/>	Other:
Equipment Precautions	
<input type="checkbox"/>	Sharp Objects: Scissors/ Staplers/ Scalpel
<input type="checkbox"/>	Burn Risk: Glue Guns/ Hot Plate/ Flame
<input type="checkbox"/>	Tools
<input type="checkbox"/>	Other:

Digital Safety <input type="checkbox"/> Yes <input type="checkbox"/> No	
Special Clean-up Required? (indicate below)	
<input type="checkbox"/>	
Safety Equipment or Protection	
<input type="checkbox"/>	Goggles/ Gloves
<input type="checkbox"/>	Lab Coat
<input type="checkbox"/>	Fire Extinguisher
<input type="checkbox"/>	Other:
Other Safety Precautions? (indicate below)	
<input type="checkbox"/>	

KEY INFORMATION

*Information on the activity topic(s) that is necessary for Instructor to be familiar with.
(Suggested 300 words)*

Biogas: Biogas is an energy-rich gas produced by anaerobic decomposition or thermochemical conversion of biomass. Biogas is composed mainly of methane (CH₄), the same compound in natural gas, and carbon dioxide (CO₂). The methane content of raw (untreated) biogas may vary from 40%–60%, with CO₂ making up most of the remainder along with small amounts of water vapour and other gases. Biogas can be burned directly as a fuel or treated to remove the CO₂ and other gases for use just like natural gas. Treated biogas may be called *renewable natural gas* or *biomethane*.

Biomethane: The term biomethane is used to describe methane that was derived from biomass. Biomethane has comparable properties to natural gas and thus can be transported and stored in the available facilities and infrastructure. Currently available processes to produce biomethane are (1) Anaerobic digestion followed by upgrading and (2) Biomass gasification followed by methanation. In addition, methane can also be produced by combining CO₂ with H₂ in a Power to Methane pathway when using biomass-derived CO₂ (3). All these pathways use different feedstocks and conversion technologies.

LESSON PLAN AND PROCEDURE

- *Should reflect Overview-Outline.*
- *Include any necessary inclusion and/or adaptation information.*
- *Refrain from including additional background information on the topic, instead refer back to the Key Information section, where necessary.*
- *Make note if anything needs to be prepared beforehand.*

Biogas (5 minutes)

1. What is biogas? Biogas is a type of gas that is typically 60%-70% methane and 30%-40% carbon dioxide. If refined and if the carbon dioxide is removed it becomes biomethane or essentially natural gas.
 - a. What are the uses of biogas?
 - i. Biogas can be burned or combusted. Burning the biogas allows someone to use it for cooking, boiling water, or heating. Biogas can be used for many other things but these are some of the main ones. Think of some other uses for biogas with the ones mentioned.
 - b. Where does biogas come from?
 - i. Biogas can be produced from many organic materials. The organic materials will decompose over time and microorganisms will consume the organics.

While this is happening the microorganisms will produce biogas as a by-product.

Biogas production (5 minutes)

2. Biogas can be produced from simple things such as a barrel to more complicated things such as large reactors using the anaerobic digester method.
 - a. Anaerobic digestors make the decomposition of organic materials more efficient than allowing the material to sit in a barrel. It does this by heating, stirring, and retaining microorganisms. Anaerobic digestors are very good at producing biogas but can also be used to treat water that is filled with many organics and turn the dirty water to clean water.
 - b. Most anaerobic digestors are used to treat sewage water or on farms to treat waste. The waste from farms can range from crops that are not wanted or even manure from livestock. The farmer can then use the biogas they produced in their house.

Producing your own biogas (45 minutes build + Couple of days for biogas to produce)

3. Participants will now build their own anaerobic digestors and produce their own biogas.
 - a. Gather some organic materials around your location. Organic materials for this activity can be leaves or anything that can go into the compost bin.
 - b. Take a 750 mL bottle and put a mark $\frac{3}{4}$ of the way up. This will be where the bottle will be filled to.
 - c. Take some organic material and make it into very small pieces. Try to make these as small as possible and if you have a blender you can use that! Place the organic material into the bottle. Fill the bottle approximately a quarter with organic material and then fill it with water to the $\frac{3}{4}$ mark.
 - d. Once filled, place the balloon over the top of the bottle and put some tape at the base of the balloon sealing it. Place it near the window to absorb sunlight. Absorbing the sunlight will warm the contents of the bottle and make digestion faster.
 - e. The digestion of the organics and the production of biogas will take a few days. The balloon will fill with biogas and inflate over time. What is in the balloon is the biogas that was produced from organic material!
 - f. To dispose of the contents in the balloon and in the bottle, it is best to do it outside! The gas will smell a bit. The contents within the bottle is very high in nutrients and is essentially very high-quality fertilizer so it is good for plants.

REFERENCES & RESOURCES

Biogas/Biomethane

- https://www.etipbioenergy.eu/images/ETIP_B_Factsheet_Biomethane.pdf
- <https://www.epa.gov/agstar/how-does-anaerobic-digestion-work#:~:text=Anaerobic%20digestion%20is%20a%20process,in%20the%20absence%20of%20oxygen.>

Produce biogas at home

- <https://www.clearwaycommunitysolar.com/blog/science-center-home-experiments-for-kids/cr-eating-biogas-from-your-pantry/>

DOCUMENT TITLE NAMING CONVENTION

Title

Be concise, but descriptive. The Title *must* reflect the title in the write up document itself, the SuperNOTE, and the camp schedule.