MUSEUM OF NATURAL HISTORY
UNIVERSITY OF MICHIGAN

DETROIT RIVER STORY LAB

Biomass

Plankton, Fossil Fuels and the Carbon Cycle

By Heather Vingsness and Melissa Duhaime, PhD

Museum Program Type	Science for Tomorrow
Content Area	Biology
Grade Level	Middle School, Grades 6-8
Big Idea/Unit	Dead plankton turns into fossil fuels over a long period of time
Pre-Existing Knowledge	
Time Required	20 minute demonstration
Cost (for a group of 30)	$
Safety	

The formation of coal is explained in relation to aquatic plants. Students will create a model out of bread and M&Ms to simulate the creation of fossil fuels. They will view local coal and peat samples from the museum collection, diatomaceous earth, and a tank of phytoplankton to view its diversity. Students will use the Detroit River Story Lab carbon data to discuss how combusting carbon affects the Detroit river.

BACKGROUND INFORMATION

Vocabulary:

Pre-Required Knowledge:

MATERIALS

Presentation **Duhaime Lesson Biomass**
Fish tank
Plant from fish store
Nutrients
Grow light
Pipette
Diatomaceous Earth
Loaf of white bread
Loaf of wheat bread
M&Ms
Wood
Sandwich Baggies
C-Clamp
Knife

SET UP

Three Weeks Before
Buy plant from fish store
Place it in tank with water
Add nutrients according to package
Let it grow under a bright light, preferably set to a timer to provide 15 hours of light a day.
Aerate the tank on a regular basis with a pipette.

CONDUCTING THE LESSON

Engage

Slide 2

Place a slice of bread, some M&Ms on the bread, another slice of bread on top of that, more M&Ms, a third slice of bread (optionally one more layer of gummies and bread). Place in an OPEN sandwich baggie between two pieces of wood. Clamp with a C-Clamp and tighten. *It's good to use different kinds of bread, e.g., rye, whole wheat, white, to more easily see the different layers later.*

Slide 3

Plants gain energy from the sun. They take in carbon dioxide, water, and minerals, and use that to make oxygen and sugar. This is called photosynthesis.

Slide 4

Slide 5

Slide 6

Slide 7

Most atmospheric carbon is created in the northern latitudes and absorbed in the south pole by phytoplankton.

Slide 8

Slide 9

Cyanobacteria are a type of bacteria that get their energy from photosynthesis.
Cyanobacteria blooms can turn water a bright green.
Dinoflagellate blooms can turn water a bright red.
Both of these phytoplankton can release toxins that make the water deadly for drinking and can kill fish.

Explore

Slide 10
Ask: What types of phytoplankton are in this tank?

Slide 11
Algae floating inside
Cyanobacteria and dinoflagellates floating
Diatoms on the walls and bottom

Slide 12
When phytoplankton get enough light and nutrients, they can “bloom”, or grow in huge numbers. Here’s what a bloom looks like before

Slide 13
Here’s what a bloom can look like after. Blooms can be big enough to be visible from space.

Slide 14
Phytoplankton are really important to the ocean food chain, and to fighting climate change. Phytoplankton transfer over 10 gigatons (the weight of a billion elephants) of carbon from air to ocean every year.

Slide 15
Professor Melissa Duhaime is studying the phytoplankton in the South Pole to help us fight climate change. All of the stars represent places where she’s studied phytoplankton.

Explain

Slide 16
Ask: How do phytoplankton turn into oil, coal, and natural gas?
Show the sandwich

Slide 17
This is a simulated fossil. There are three layers of bread with M&Ms in between.

Ask: What do the books (or in your case, the C-Clamp) represent?
Answer: The weight (or pressure) from all the stuff above, including more mud, rock, and sand.
Ask: What do the M&Ms candies represent?
Answer: Dead plants or animals.
Ask: What do the slices of bread represent?
Answer: Layers of sediment—sand, silt, mud, etc.

Slide 18
Ask: What do you notice about the sandwich?
Answer: Everything's very squished!
That's what happens when things are under a lot of pressure.
Ask: What do you think the inside looks like?
Have students use a plastic knife to cut the "sediment sandwich" in half. Allow students to examine all the layers, which gives them a good idea of what sedimentary rock looks like.
Ask: Have you ever seen a steep hill (or butte) or a road that was cut through some rock, exposing the sedimentary layers?

Slide 19
Ask: What do you notice about the inside?
Have the students gently peel apart the bread. The layers really stick together, so this has to be done very slowly and carefully to avoid tearing the bread.
Answer: The plant or animal (M&Ms) left an impression in the bread.
This impression is one type of fossil!
Answer: The impression in the bread looks a bit oily. It might also have some of the color from the M&Ms.
This is similar to how we get oil from ancient plants and animals that have undergone a lot of pressure (and, often, heat). Most of the oil—from which we also get gasoline—that is pumped out of the ground comes from microscopic organisms called plankton. It took millions of years for all the plants and animals that got buried under layers of rock to make fuels such as oil. Because it would take so long to replenish these fuels, we refer to them as non-renewable resources.

Elaborate

Slide 20
Phytoplankton becomes oil when it dies and sinks to the bottom of the sea.
They become covered with a layer of mud.
Over time, more sediment creates pressure, compressing it into oil.
The oil moves up through porous rocks and eventually forms a reservoir.
Show peat sample
Here's what it looks like before
Show coal sample

Slide 21
Coal is formed when dead plant matter is submerged in swampy environments. It starts as moist, low-carbon peat, and is eventually buried and transformed into coal after hundreds of millions of years of heat and pressure. Coal is an energy- and carbon-dense black or brownish-black sedimentary rock.

Evaluate

When I visited your school a few weeks ago, I went to your local river and collected a water sample. I have kept it here at the museum and grown it for you. divided it into three parts. Here are three flasks of phytoplankton.
Slide 11Show the three flasks of phytoplankton
One flask had lights and nutrients, one just had light, and one had neither light nor nutrients. Which is which?
Answer: The greenest flask is light/nutrients. The least green is no light/no nutrients.

Slide 11
The flask with the most light and the most nutrients is the greenest.
Ask: Why do you think it grew the best?

Slide 12

This flask grew the best because phytoplankton need light and nutrients to grow in, just like plants. If it is sunny and the water has nutrients, phytoplankton will thrive and spread.
Light - The phytoplankton are adapted to lots of light because the ocean doesn't have any shady areas.
Nutrients - Phytoplankton need nutrients just like people need vitamins

Elaborate

Slide 13
Some of the highest concentrations of phytoplankton are in the Antarctic. Phytoplankton can grow under the polar ice. Melt pond "skylights" allow light to shine through.

Slide 14
Ask: Where do Antarctic phytoplankton get their nutrients?

Slide 15
Answer: Poop from penguins, fish, whales, zooplankton, and other arctic animals
Penguins poop every 20 minutes and can poop so hard that it flies 4 feet away! It's pink because of all the krill they eat. The bright pink penguin poop helps us spot it from satellites and discover new colonies of penguins.

Slide 16
Phytoplankton might increase in population and fight against climate change if they are allowed to grow with exposure to light and nutrients

CLEAN UP

CONCLUSION

COMMON QUESTIONS

TIPS AND TROUBLESHOOTING

EXTENSIONS

SCALING

REFERENCES

Bobrowsky, Matt. Q: Where do Fossil Fuels Come From? Science & Children, October 2019. Pp 63-65. Accessed from <https://www.nsta.org/science-scope/science-scope-october-2019/where-do-fossil-fuels-come>

SUPPLEMENTAL FILES

NEXT GENERATION SCIENCE STANDARDS

MS-ESS3: Earth and Human Activity
https://www.nextgenscience.org/dci-arrangement/ms-ess3-earth-and-human-activity

The chart below makes one set of connections between the instruction outlined in this lesson and the NGSS. Other valid connections are likely; however, space restrictions prevent us from listing all possibilities. The materials, lessons, and activities outlined in the article are just one step toward reaching the performance expectations listed below.

Dimensions	Classroom Connections
Science and Engineering Practices	

Constructing Explanations and Designing Solutions Construct a scientific explanation based on valid and reliable evidence obtained from sources (including the students' own experiments) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future.	• Students will explain how fossils are created through phases of sedimentation
Disciplinary Core Ideas	
ESS3.D: Global Climate Change Human activities, such as the release of greenhouse gasses from burning fossil fuels, are major factors in the current rise in Earth's mean surface temperature (global warming). Reducing the level of climate change and reducing human vulnerability to whatever climate changes do occur depend on the understanding of climate science, engineering capabilities, and other kinds of knowledge, such as understanding of human behavior and on applying that knowledge wisely in decisions and activities.	• Students will understand that their behavior affects the current rise in Earth's mean surface temperature (global warming)
Crosscutting Concepts	
Stability and Change Stability might be disturbed either by sudden events or gradual changes that accumulate over time.	• Students will identify that the sudden removal of fossil fuels from the ground combats the centuries it takes to create them

Performance Expectation

MS-ESS3-1.
Construct a scientific explanation based on evidence for how the uneven distributions of Earth's mineral, energy, and groundwater resources are the result of past and current geoscience processes. [Clarification Statement: Emphasis is on how these resources are limited and typically non-renewable, and how their distributions are significantly changing as a result of removal by humans. Examples of uneven distributions of resources as a result of past processes include but are not limited to petroleum (locations of the burial of organic marine sediments and subsequent geologic traps), metal ores (locations of past volcanic and hydrothermal activity associated with subduction zones), and soil (locations of active weathering and/or deposition of rock).]

CREDITS

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