UTeach Outreach

College of Natural Sciences
THE UNIVERSITY OF TEXAS AT AUSTIN

Algae and Atomic Worm

Lesson created by: UTeach Outreach
Date of lesson:
Description of the class: 4th-6th grade
Length of lesson: 50-60 minutes
Source of the lesson:
TEKS addressed:

(1) Scientific investigation and reasoning. The student conducts classroom and outdoor investigations following home and school safety procedures and environmentally appropriate and ethical practices. The student is expected to:

(A) demonstrate safe practices and the use of safety equipment as described in the Texas Safety Standards during classroom and outdoor investigations; and
(B) make informed choices in the conservation, disposal, and recycling of materials.

(7) Earth and space. The students know that Earth consists of useful resources and its surface is constantly changing. The student is expected to:

(A) examine properties of soils, including color and texture, capacity to retain water, and ability to support the growth of plants;
(B) observe and identify slow changes to Earth's surface caused by weathering, erosion, and deposition from water, wind, and ice; and
(C) identify and classify Earth's renewable resources, including air, plants, water, and animals; and nonrenewable resources, including coal, oil, and natural gas; and the importance of conservation.

I. Overview

The purpose of this lesson is to introduce students to algae and its importance such as its use as a biofuel. Students will explore the formation of an 'atomic worm' using sodium alginate and a calcium carbonate solution. A discussion will follow suit, as you explore the uses of algae.

II. Objectives

1. Define a polymer/polysaccharide
2. Discuss the importance of algae and its various applications
3. Explain how algae is vital to the global ecosystem

III. Resources, materials and supplies

Per class

- Water
- Clear cup
- Fork
- Calcium carbonate
- 'Algy'/Atomic Worm solution

- examples of sodium alginate use (just need some)
    - brownie mix
    - jello
    - toothpaste
    - gravy mix
    - cookie mix
    - cosmetics

Per group (4-6 students)

- 2 petri dishes
- algae (more than one type, if possible)
- 2-3 toothpicks

IV. Advanced Preparation:

Have foodstuff already displayed. Put algae samples in petri dishes. Make sure to have other materials out and ready to be used.

V. Supplementary worksheets, materials and handouts

Pictures of algae

VI. Background information

College Level Background Information

Sodium alginate is a sugar extract from algae. The molecules are large but small enough to remain liquid and each molecule has a sodium ion associated with it with a +1 charge. The calcium ions dissolved in the solution from the calcium carbonate have a +2 charge and replace the sodium ions, linking the large molecules together into a solid. This solid is a large polysaccharide that is commonly used as a thickening agent in foods like jell-o or gravy.

Elementary Level

The calcium chloride dissolves like table salt into the water. A chemical reaction occurs when the liquid sodium alginate is also added in the water that causes it to form a long worm, going from a liquid to a solid. This solid can be used in foods to make liquids thicker such as in jell-o or gravy.

VII. Possible Misconceptions

There are a lot of different types of algae and different definitions. Some definitions include prokaryotes such as cyanobacteria (blue-green algae) while others do not. All species of algae are not directly descended from the same common ancestor (convergent evolution). The most complex orders of algae include seaweeds and kelp.

VIII. Vocabulary & Definitions:

College Level

Polymer—a chain of repeating, identical monomers (individual molecules)
Polysaccharide—a polymer made entirely of sugar molecules
Phytonutrient—a substance found in certain plants that is believed to be beneficial to health and help prevent various diseases

Elementary Level

Algae—a small, plant-like organism that grows either individual or in clusters in wet environments
Polymer—a chain of repeating, identical monomers (individual molecules)
Biofuel—a renewable fuel derived from organic matter
Phytonutrient—a substance found in certain plants that is believed to be beneficial to health and help prevent various diseases

IX. Safety Considerations:

Keep students away while experiment is being conducted; students may safely touch the atomic worm after it has been suspended in the calcium chloride solution about two minutes

X. Question of the Day

Why is algae important in our daily lives?

Five-E Organization

ENGAGEMENT Time: 10-15 minutes		
What the Teacher Will Do	Probing Questions	Student Responses Potential Misconceptions
Show liquid sodium alginate to students. *This is sodium alginate. It is a sugar derivative from algae. I have a little bit of calcium chloride here, which dissolves in water like normal table salt does.* Pour a little $CaCl_2$ in water, stir with fork until dissolved.	The sodium alginate's a bright yellow liquid right now-- what do you think will happen when I pour a little of it into this solution of calcium chloride?	Solidify, become thicker, change colors
Pour sodium alginate into calcium carbonate solution. Let sit about five seconds and then gently lift the worm out with a fork. Once you show students, lower worm back into solution—it will further solidify. *So let's use our knowledge of chemistry to figure out how this happened.*	So what happened to the sodium alginate that I have? Which do you think has bigger molecules: solids or liquids? So, if solids have bigger	It became a solid Solids

Every little sugar molecule in the liquid has a sodium ion attached to it, which can hold on to one sugar molecule at a time. But when we add it to our solution, which has calcium ions in it, the calcium ions can hold on to two sugar molecules at a time and link them together. When we link a lot of the same type of molecules together like this, it's called a polymer. *When we have a lot of sugar molecules linked together, that has a special name called a polysaccharide. Our alginate polymer is an example of a polysaccharide.*	molecules, how did the small molecules of my liquid sodium alginate become bigger? What is our polymer made of?	They stuck together; chemical reaction Algae sugar molecules
Pull out worm again with fork (it should be more solid than before) and allow students to touch it—warn them not to squeeze too hard. *There's a reason this looks and feels so much like a gummy worm: it is used in many food products like yogurt, cake mix, macaroni and cheese, and toothpaste (point to things on the table). Just like in this experiment, it can be used to thicken liquids. Next time you go to the store, see if you can find the additive "sodium alginate" in the ingredients on boxes of food!*	What does this remind you of?	A gummy worm, a snake

EXPLANATION Time: 10 minutes

What the Teacher Will Do	Probing Questions	Student Responses Potential Misconceptions
Just like there are a lot of different types of plants, there are a lot of different types of algae. The sodium alginate I used is from a different type of algae than you might see in your backyard. *I have a few different types of algae here.* Allow students to use toothpicks to look at algae.	So we now know one use for algae, but what is algae? Where do you typically see it? What do you notice is similar about the types of algae? What is different?	See it in water—lakes, rivers, pools, etc. (misconception: algae is a plant) algae is a grouping of photosynthetic protists that can look like plants and for a long time were thought to be plants Answers will vary based on algae species used in lesson

EXPLANATION Time: 15 minutes		
What the Teacher Will Do	Probing Questions	Student Responses Potential Misconceptions
Algae isn't just used to give our food a better texture. It is also a phytonutrient. Phytonutrients are naturally occurring chemicals in plants. Phytonutrients are not essential to keep a human alive, like certain vitamins and minerals are, but they are useful to help prevent disease and keep your body functioning properly. Eating more plants (or even algae!) with high		

levels of beneficial phytonutrients could be a sustainable way to keep humans healthy, instead of taking pills and getting injections after we are already sick. *Humans aren't the only species that uses algae for food. For example, in the turtle pond on campus, the turtles eat the algae.*	Can you think of other things that might rely on algae? And can you think of anything that relies on [answer to previous question] to survive?	Bugs, fish, water animals, etc. Larger animals higher up the food chain
So this algae that we have seems pretty important to a lot of species.	What do you think would happen if all the algae in an aquatic ecosystem died?	Animals wouldn't have food, animals would die too.
If you recall, I told you that algae photosynthesize like plants. *With so much of the earth covered in water, there is a lot of algae growing. 80% of the world's oxygen comes from algae.*	What does photosynthesis produce? Why is oxygen so important? How would it impact us if all the algae died?	Oxygen We have to breathe There wouldn't be enough oxygen.

ELABORATION		Time: 5-10 minutes
What the Teacher Will Do	Probing Questions	Student Responses Potential Misconceptions

As it turns out, though, there can be a downside to having too much algae in an ecosystem as well. Show students the pictures of algal blooms. *When a lot of algae grows very quickly in an ecosystem, it is called an algal bloom. Most algal blooms are green, but they can be yellow, red, or blue also depending on the species of algae that grows. They can disrupt entire aquatic ecosystems, since the algae grows so dense. For example, it can clog fish gills and suffocate them, it can block out light for any plant populations underwater, and some algae even releases small amounts of toxins that build up in the water when so much algae grows. Typically these blooms are a result of fertilizers that wash into lakes or rivers.*	Can you think of a reason why having too much algae might be bad?	Clog up the water, take over plants' place to grow, block sun for species under the water

EVALUATION		Time: 5-10 minutes
What the Teacher Will Do	Probing Questions	Student Responses Potential Misconceptions
UT is doing a lot of research on algae, since algae is such a versatile organism. For example, the algae program right now is working on improving harvesting and concentrating the algae, finding new uses for algae byproducts, and using algae to grow necessary biological products.	What are some of the uses of algae that we discusses today?	Phytonutrient, oxygen producer, sugars can be used as a food thickener, food source, etc.