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CHEMISTS CELEBRATE EARTH WEEK

AMERICAN CHEMICAL SOCIETY

The Curious Chemistry of Amazing Algae

CHEMISTS CELEBRATE EARTH WEEK

What are Algae ...

and What is so Amazing about Them?

By Sara Delgado-Rivera

Have you ever seen brown or green goo floating on a river or in the ocean? Or have you noticed how the walls of a fish tank sometimes turn green and slimy? These are all examples of **algae**—but there is a lot more to the algae story!

The word "algae" refers to various organisms that usually live in water. Fun fact: *Algae* is actually the plural form of the word *alga*, which means a single plant-like organism. They are a little like plants—but they are also different. For instance, they make their own food through **photosynthesis**, like plants do, using a chemical called **chlorophyll**. Also like plants, they naturally help in producing oxygen, which we humans need to live. (Read more on page 3.) But unlike plants, algae have no roots, leaves, or flowers.

About our cover

Our cover illustrates some of the incredible stories of algae.

The left side of the cover shows one of the most amazing things about certain algae: they glow in the dark. The phenomenon is called *bioluminescence*, and the blue glow Avi is watching is caused by the behavior of huge groups of *dinoflagellates*, the microscopic algae shown enlarged in the circle. (Read more on page 8.)

On the right side of the cover, it is daytime—and we can see two kinds of algae in the water around the boat. One type is **microalgae**, which can only be seen with a microscope. **Macroalgae**, on the other hand, is big enough to see with your eyes, and examples include the brown seaweeds called sargassum and kelp. Sargassum floats near the water's surface, while kelp is anchored to rocks on the ocean floor. Both of these types of algae feed and give shelter to other marine life, including fish, turtles, crustaceans, otters, and even sharks.

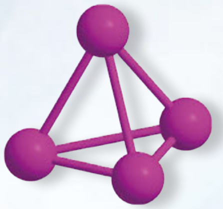
The cover also shows some of the many uses scientists have found for algae, such as:

- The food tray includes some *nori,* an edible red seaweed used to make sushi. (Read more on pages 4 and 5.)
- Milli's water bottle is a *bioplastic*, made with microalgae! It can help reduce pollution caused by single-use plastics. There are some bioplastic bottles you can eat after you drink the water!
- Milli's sunscreen, made with microalgae, blocks UV light … but unlike regular sunscreen, when it washes off into the ocean, it will not harm coral reefs.
- Milli's clothes are made from algae and do not include toxic dyes that can pollute water.
- Avi and Milli's boat, *The Alginator*, runs on **biofuels**, made from living organisms instead of gasoline. Biofuels do not pollute the environment and can be made quickly and easily. (Read more on page 11.)

Dive into algae!

We invite you to continue reading, learning, and having fun exploring the world of amazing, environmentally-friendly algae!

Sara Delgado-Rivera *is Professor of Chemistry at University of Puerto Rico at Río Piedras and University of Sagrado Corazón.*



Algae are Elemental!

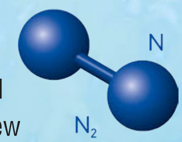
By Susan Hershberger

Take a deep breath: When we inhale, our lungs take in oxygen, a gas that makes up part of the air we breathe. We need to breathe oxygen to stay alive. Where does it come from? You may already know that trees and other land plants help make the oxygen in our environment. But do not forget about algae, which produce over half of the oxygen that you inhale each time you breathe!

Take another deep breath and exhale. When we exhale, we add carbon dioxide (another kind of gas) to the air. When the sun is shining, algae and plants use this carbon dioxide along with water to make their own food through a process called photosynthesis. They also release oxygen into the air as part of this process.

Most types of algae grow in freshwater (lakes, ponds, rivers, streams) or saltwater (oceans, seas, lagoons). Algae provide food, habitat, and oxygen to the organisms that live in water. Algae are the base of many **food webs** and are necessary for a healthy aquatic **ecosystem**. Algae use elements such as carbon, nitrogen, and phosphorus as nutrients for growth. Most healthy bodies of water tend to have enough of these elements to help just the right amount of algae grow.

However, algae can also grow out of control if the water around them contains too many nutrients resulting in **harmful algal blooms (HAB)**. This can happen when fertilizers and animal waste from farms mix with water. The algal growth sometimes covers the whole surface of the water body, and can give off toxins that harm other **aquatic organisms**. During the day, algae can also block sunlight from reaching other algae and animals below the water's surface. When algae eventually die, they decay in water and use up a lot of oxygen from it. This can make the amount of oxygen in the water dangerously low, which can harm other organisms.



People sometimes forget that algae do so many good things for us. There are thousands and thousands of different kinds of algae, and only a few types are harmful. Algae are not just "green goo" … actually, they are "green *good*"! They produce oxygen, capture carbon dioxide (a **greenhouse gas**), and help keep aquatic ecosystems healthy. Is it not amazing what algae do for us and earth?

Susan Hershberger *is Director, Center for Chemistry Education, Miami University in Oxford Ohio.*

Do Science Safely Safety First!

- Ask an adult for permission to do the activity and for help when necessary.
- Read all directions and safety recommendations before starting the activity.
- Wear appropriate personal protective equipment (safety glasses, at a minimum), including during preparation and clean up.
- Tie back long hair and secure loose clothing, such as long sleeves and drawstrings.
- Do not eat or drink food when conducting the activity.
- Clean up and dispose of materials properly when you are finished with the activity.
- Thoroughly wash hands after conducting the activity.

Edible Algae

By Robin Tanke






Which of the following foods contain algae?

Ice Cream • Cherry Pie • Sushi Roll • Spirulina Drink • Icing • Candy

Read this article to find out about these foods and more!

There are basically four types of algae, based on their color: green, blue-green, red, and brown. Green and blue-green algae are found in freshwater as well as saltwater. Red and brown algae are found only in saltwater and are also called seaweed.

Did you know that algae of all four types have been a food source for people for at least 14,000 years? For example, the *Man'yōshū*, a 1,200-year-old collection of poems about everyday life in Japan, describes people gathering seaweed at low tide. The poem also calls seaweed "precious since the age of the gods."

On the other side of the world, the Aztec peoples, who lived in what is now Central Mexico, harvested blue-green algae from the surface of lakes using ropes. They ate dried algae with tortillas and toasted corn and sometimes made sauce with algae. Later, English colonists brought to North America a pudding they prepared by boiling red algae with milk. Today, we find algae in our food, in both ordinary and unexpected places.

Red algae, especially *nori*, are dried and then used as a wrap for making sushi or added to soups, salads, sandwiches, and even baked goods. Although it may appear to be simply a convenient edible cover, *nori* contains protein, fiber, healthy fats, and vitamins (even more than soybeans!). In addition to being used in dried form, products such as *agar* and *carrageenan* are extracted (or taken out) from red algae. These products are used to make gels or thick creamy foods such as pie fillings, cake frostings, sherbets, and custards.

Brown algae, especially kelp, are used to extract another gel-forming product called *algin*. Algin absorbs water to make gels and thick solutions and can be found in ice creams and dry baking mixes.

Blue-green algae, especially spirulina, are an important protein source. In areas where food is not easily available, they are a valuable protein source and contain healthy fats, as well as certain important vitamins and minerals. For people who avoid eating animal products, algae can be an important source of vitamin B12. Additionally, spirulina's lovely color is used to make candy, ice cream, and blue gum.

Algae are used in a variety of ways in making food, from coloring, to wrapping, to gel-forming … and also as sources of healthy nutrients. Next time you eat ice cream, candy, gum, or sushi, you should check to see if it has any algae in it!

And to answer the question at the beginning of this article: Which of the foods above contain algae? *All of them do!*

***Robin Tanke** is Professor of Chemistry, University of Wisconsin-Stevens Point.*

Transforming Gels

By Susan Hershberger

Introduction

Fruit-flavored gel snacks are both delicious and mysterious! When you go to a grocery store, you may notice that some brands are stored in the refrigerator, while other brands are stored on a shelf at room temperature. Why are they not kept in the same place? This activity provides all the clues you need to solve this juicy mystery.

Question to investigate

Why are fruit-flavored gel snacks kept in different places at the grocery store?

Materials

- 2 clear plastic cups (9- or 10-ounce, or about 300 mL)
- Permanent marker
- Plastic wrap
- 2 teaspoons
- 1 pack of individually-portioned fruit-flavored Jell-O, The Treat Life Gelatin Snacks, or other brand found in the refrigerated section of your grocery store
- 1 pack of individually-portioned fruit-flavored Snack Pack, Juicy Gels, Kool-Aid Gels, or other brand gels found on a shelf at your grocery store
- Comfortably warm (100-110 °F or 40-43 °C) tap water from the faucet

Note: Refrigerate both types of snacks for at least one hour before beginning this activity so they are at the same starting temperature.

Procedure

Melting Test

1. Use a permanent marker to label one of the cups "CG" (for Cold Gel, found in the grocery store fridge). Label the other "SSG" (for Shelf-stable Gel, found on a grocery store shelf).
2. Fill both cups about two-thirds full with warm tap water from the kitchen faucet.
3. Place a piece of clear plastic wrap loosely over each cup of warm water so that it rests on the surface of the water.
4. Place 1 tsp of Jell-O on top of the plastic wrap covering the CG cup, and 1 tsp of Snack Pack gel over the SSG cup. Wait 3 to 5 minutes. Which gel melts first? Draw a checkmark in the chart on this page.
5. Discard the plastic wrap with the gels in the trash. Keep the cups, but refill them with fresh warm water for the next test.

Dissolving Test

1. Now add 1 tsp of Jell-O into the water in the CG cup, and add 1 tsp of the Snack Pack gel into the water in the SSG cup.
2. Use different spoons to stir the gel and water in each cup and wait 3-5 minutes. Which gel dissolves first? Record this in the chart.

Squishing Test

1. Rub your hands together to warm the palms of your hands.
2. Have an adult place 1 tsp of the Cold Gel on your right palm and 1 tsp of the Shelf-stable Gel on your left.
3. Close both hands. Slightly squeeze and release your grip repeatedly to squish the gels.
4. After about one minute, open your hands and compare the gels. Which gel breaks apart more? Record your observation in the chart.

Compare the Ingredients

Look for the ingredients list for each of the products. Which pack contains *gelatin* or *carrageenan* as the key ingredient? Record this in the chart.

Safety Suggestions

- ✓ Do not eat the gel or drink the water used in this activity.
- ✓ Ensure that the tap water is less than 110 °F or 43 °C.
- ✓ Dispose of used liquids down the sink. Cups and gels may be placed in the trash.

What did you observe?

Compare the physical properties of two types of fruit-flavored gel snacks		
Type of Gel	**Cold Gel (CG)**	**Shelf-stable Gel (SSG)**
Which brand did you use?		
Melting Test Which gel melts first?		
Dissolving Test Which gel dissolves first?		
Squishing Test Which gel is softer and juicier?		
Ingredients Label Does the gel contain gelatin or carrageenan?		

Why are fruit-flavored gel snacks kept in different places at the grocery store?

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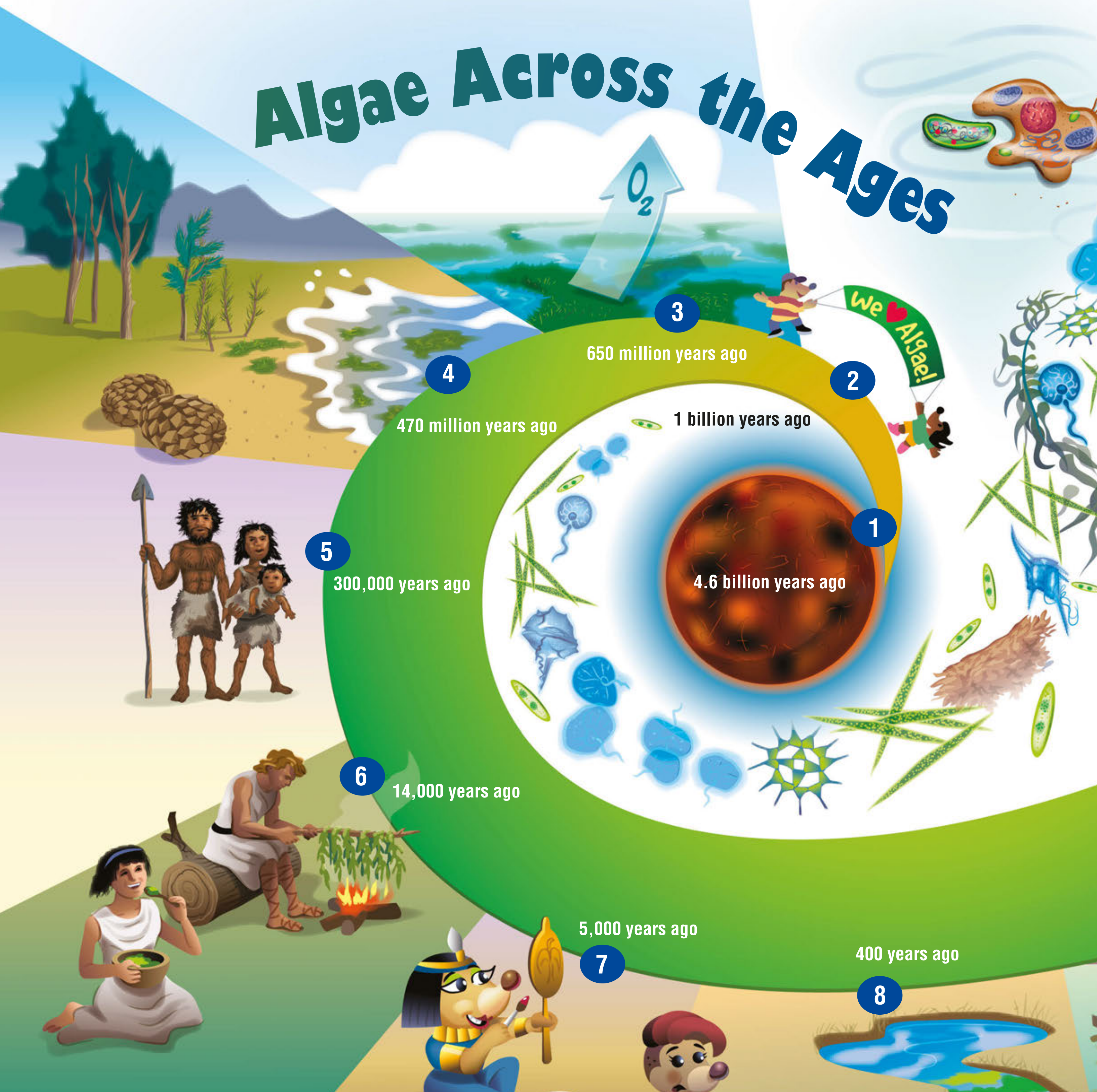
How does it work?

Although the gels are similar products, they have different melting points and dissolve in water at different speeds. Typically, the Cold Gel melts and dissolves faster, while the Shelf-stable Gel breaks up more when squished. Cold Gel contains *gelatin*, while Shelf-stable Gel has *carrageenan*. How does this compare to your observations?

Gelatin is a protein made from cows and pigs. Gelatin-based products become liquid-like at room temperature. When chilled, gelatin-based snacks become a gel. Carrageenan is a long carbohydrate that comes from a red seaweed. Carrageenan-based products act like a gel at room temperature without refrigeration. Since refrigeration is expensive, not having to refrigerate gels saves money. Which type of gelled snack do you prefer? Why?

Susan Hershberger *is Director, Center for Chemistry Education, Miami University in Oxford Ohio.*

Algae Across the Ages



Match each event described below with its position on the timeline on pages 6 and 7 as in the example:

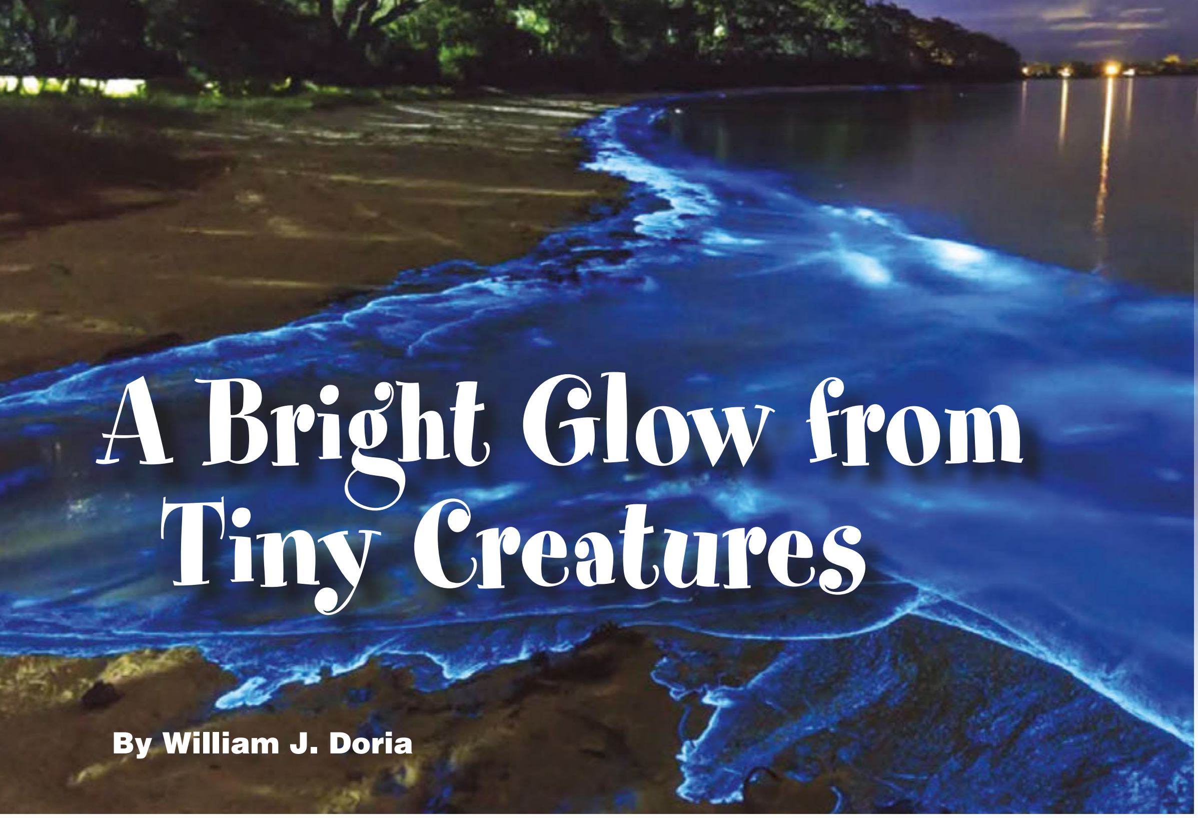
- (5) The first evidence of humans on earth—which means that compared to algae, we humans are newcomers!
- ( ) A scientific journal documents that dogs in Europe were poisoned by a harmful algal bloom.
- ( ) The first alga cell forms when one single-celled organism merges with a cyanobacteria and starts photosynthesizing.
- ( ) The United States bans use of phosphates in laundry detergents to control the growth of harmful algal blooms.
- ( ) Mosses and simple plants with algae ancestors become the first organisms to start living on land.
- ( ) Algae are proposed as an alternative fuel to petroleum.

What does the Future Hold?

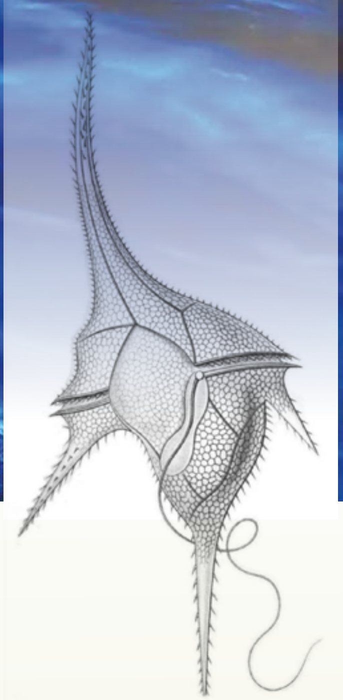
- Women in Northern Africa and the Middle East use algae to color their lips red. In Asia, people use algae as medicine to cure a condition called goiter.
- Algae release enough oxygen into the **atmosphere** to support future life on the planet.
- The newly formed Earth has a lava surface and almost no atmosphere.
- People in South America leave behind chewed and burned bits of algae, which modern archeologists will later find.
- Microalgae are used to deliver drugs, make hormones, treat allergies, fight cancer, and more.
- People farm algae in East Asia. For comparison, humans farmed crops on land at least 9,000 years earlier.

A Bright Glow from Tiny Creatures

By William J. Doria



Bioluminescent algae light up the ocean near a beach.



A close-up drawing of a dinoflagellate. Depending on the species, this tiny creature is between two millimeters and just two thousandths of a millimeter long—too small to see without a microscope!

Imagine yourself swimming in the warm water off the coast of a lovely sandy beach. Suddenly, you are swimming through a beautiful, soft blue glow that seems to come from the water all around you. Could this be real? Believe it or not, this could happen to you if you are in the right place!

It might seem that it is the water itself that is glowing. But instead, the glow is caused by millions of tiny organisms called *dinoflagellates* that live in the water and sometimes make it glow.

Dinoflagellates are a type of single-celled algae, and each of these tiny creatures emits a small amount of light. There are so many dinoflagellates in the sea that when they all light up at once, the whole surface of the sea seems to give off a color and a view that is a feast for the eyes.

How do they work?

The light is caused by a chemical reaction that happens inside the dinoflagellate. A chemical called *luciferin* is responsible for the glow. Luciferin is similar to the green chlorophyll in the leaves of plants. Luciferin reacts with oxygen to produce blue-colored light in the ocean. It happens in the presence of an enzyme called *luciferase*. When the water where dinoflagellates live is disturbed, it triggers a chemical reaction, and they all start to emit blue light.

Each tiny flash of light is really short! It lasts just 0.5 microseconds—only a tiny fraction of a second. But because there are so many blinking on and off at the same time, it brightens the whole surface of the water. We do not notice that the glow is really made up of millions of quick flashes.

Why do dinoflagellates behave in this amazing way?

The reason why dinoflagellates give off bright flashes of light is not clearly understood by scientists, but it is probably the organism's way of defending itself. When a predator swimming close by creates a disturbance in the water, the dinoflagellate reacts by emitting light. One hypothesis is that the flash is enough to scare off the predator and make it stay away.

When a living thing emits light, it is called **bioluminescence**. You may have never seen dinoflagellates giving off light, but you have likely seen bioluminescence from other organisms! For example, fireflies glow—thanks to a different kind of luciferin in their bodies. The next time you see a firefly twinkling on a summer night, remember you are watching a chemical reaction that is similar to the one in dinoflagellates in the ocean!

Fireflies use luciferin, just like dinoflagellates! The kind of light fireflies emit is a yellow-green color instead of blue.

***William J. Doria** is Professor at Rockford University, in Rockford Illinois.*

Know by the Glow

By Susan Hershberger

Safety Suggestions

- ✓ Do not eat or drink the materials used in this activity.
- ✓ Do not shine either flashlight into the eyes of any human or animal.
- ✓ Many common plants are toxic. Receive permission from a knowledgeable adult before using leaves from any plant.
- ✓ Disposable cups, capsules, and plant matter may be placed in the trash.

Introduction

Algae and plants are similar but not quite the same. Their structures are very different, for example: plants have stems, roots, flowers, and fruits, while algae do not. And where plants are always made of many cells, algae may be made from one single cell, or millions.

Plants contain a molecule called chlorophyll that works with energy from the sun, water, and carbon dioxide to make plant food and release oxygen. We also know that algae make their own food. But do they do it the same way plants do, with chlorophyll?

Question to Investigate

Do algae contain chlorophyll, just like plants?

The green leaves of plants contain chlorophyll, which glows under a UV light. Do algae contain chlorophyll? What is your evidence?

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Materials

- Green algal powder, either in a pack or in capsules that contains spirulina, chlorella, or both. (Your adult partner can find these materials at a nutritional supplement store or online.)
- 2 or 3 spinach, kale, or other green plant leaves (be sure to get permission from an adult before using any houseplants for this activity)
- Green food coloring or green paint (watercolor, tempera, or acrylic)
- ¼ teaspoon (about 1.2 mL) measure
- 1 tablespoon (about 15 mL) or medicine cup
- Regular bright flashlight
- 1 sheet of white paper
- Liquid hand sanitizer
- 3 small clear cups
- UV flashlight
- Permanent marker
- Scissors
- 3 spoons

Procedure

1. Use a permanent marker to label three clear plastic cups: COLOR, PLANT, and ALGAE.
2. Add 15 mL (about 1 tablespoon, or 10 squirts) of hand sanitizer to each cup.
3. Arrange all 3 cups on the white paper.
4. For the COLOR cup, add 2 drops of food coloring.
5. For the PLANT cup, use the scissors to cut up spinach, kale, or other green plant leaves into tiny pieces and then place them in the cup.
6. For the ALGAE cup, take about ¼ teaspoon (a tiny pinch) of the green algal powder, either by opening up a capsule or taking it straight from the pack. Stir each of the cups with a clean spoon to mix thoroughly.
7. Now dim the lights in the room and shine a *regular* flashlight straight down into each of the cups. Write the colors you see in the chart below.
8. Next, shine your *UV* flashlight down into each of the three cups. Record the colors and any other observations you notice in the same chart.

Labeled cup	Observations		
	Color	Plant	Algae
Regular flashlight			
UV flashlight			

How does it work?

Anything that appears a certain color, like green for example, means that it absorbs all the colors of the rainbow *except* that color. Instead, that green light is reflected back at us, which allows us to see the object as being "green." Chlorophyll is a molecule that absorbs blue and red parts of visible light. That means mainly green light gets reflected back. This is the reason plants and certain algae appear green to our eyes!

Chlorophyll uses the energy it takes in from the sun to start a set of chemical reactions called photosynthesis, the process plants use to make their own food. In both plants and algae, this important process takes place in tiny, specialized places inside the cell called chloroplasts. Chloroplasts use the absorbed energy from the sun to convert carbon dioxide and water into glucose and oxygen. Glucose is the food that plants and algae make, store, and use as they grow. Oxygen is a byproduct of the chemical reactions and is released into water or atmosphere. We and other living things use this oxygen to breathe!

When you shone the UV flashlight on the algae powder and the plant pieces, you may have observed that some of the light energy was released as a red or pink glow. This is called **fluorescence**. Fluorescence happens when an object or organism absorbs light with high energy, like UV light, and gives off excess energy as lower energy light that they do not absorb. Sometimes, they may give off extra energy as heat.

Chlorophyll fluoresces to release the extra energy as red light. If you observed a pinkish glow, that is what you were seeing! Because the algae powder and the plant leaves fluoresce the same way, we can conclude that the algae in this activity also contain chlorophyll.

Algae are an extremely diverse group of organisms, with many differences in type, size, and other aspects. But there are three features that most algae share: they contain chloroplasts and chlorophyll, and they conduct photosynthesis. This experiment shows that algae, like plants, contain chlorophyll that allows them to make their own food!

***Susan Hershberger** is Director, Center for Chemistry Education, Miami University in Oxford Ohio.*

The Adventures of Meg A. Mole, Future Chemist

Dr. Eduardo J. Caro-Diaz

Assistant Professor, School of Pharmacy

In honor of this year's Chemists Celebrate Earth Week (CCEW) theme, "The Curious Chemistry of Amazing Algae," I traveled all the way to the University of Puerto Rico—Medical Sciences Campus, in San Juan, Puerto Rico. There I met with Dr. Eduardo J. Caro-Diaz, Assistant Professor at the School of Pharmacy.

Dr. Caro-Diaz's research is in medicinal chemistry of natural marine products. "I collect algae in the ocean," he told me, "and bring them back to the lab to find new medicine-like molecules." He said he does most of his work on the computer, inside a laboratory. "In addition, we sometimes visit the ocean to collect samples, or travel to share our work with other scientists."

Dr. Caro-Diaz also works with students, which is what he enjoys most about his work. "Teaching and training science students is a very rewarding experience," he shared. "I also like that I get to do a lot of experiments." He told me that the best thing about being a scientist is "learning everyday about interesting things. Every day is different, with new challenges—and I really enjoy solving problems."

Growing up, Dr. Caro-Diaz was very interested in science. "From a very early age, I really liked math and science. I especially liked learning about nature," he explained. He shared a special memory of an experiment he conducted when he was in 2nd grade that involved growing bean plants in different light conditions, which is when he started to learn about photosynthesis. "I also used to love solving puzzles and riddles," he recalled, "and enjoyed my middle school chemistry laboratory the most."

Dr. Caro-Diaz had great support from his teachers and family. "I had fantastic teachers who were very supportive of my interest in science. My parents also had a big influence (my dad is a mathematician)." He also mentioned to me how thankful he was for his high school chemistry teacher, who "encouraged me to think about studying chemistry, since it was a subject I naturally liked and understood. 'Thanks, Mrs. Maldonado!'" he added with a big smile.

Thank you, Dr. Caro-Diaz for the wonderful tour of your lab and teaching me all about amazing algae. And a huge thank-you to all of the teachers, like Mrs. Maldonado, who inspire children to become chemists!

Fun Facts

- **Favorite pastime/hobby:** Surfing and climbing
- **Favorite color:** All shades of sea blue
- **Very interesting project you were a part of:** Looking for COVID-19 medicines in algae
- **Accomplishment you are proud of:** Building our lab at the University of Puerto Rico

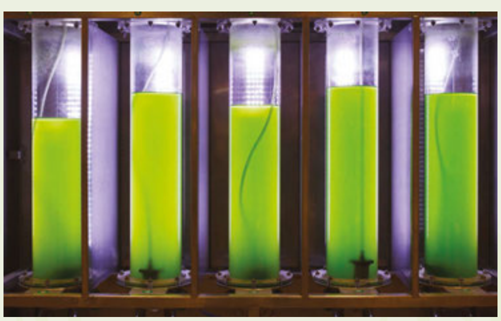
Start Your Engines—with *Algae!*

By Regina M. Malczewski

By now, you may know that our bodies can get energy from algae … but did you know that *cars* can, too?

Around the world, chemists are looking for interesting new ways to make energy that do not depend on petroleum. Biofuels, including from algae and other living things, are one amazing possibility. The world of algae includes *micro*algae (also called **phytoplankton**), which are too small for us to see with our eyes. On the larger end, *macro*algae (seaweed), are not only visible, but can also grow as tall as 200 feet (60m)!

Both types of algae contain oils that can be used as fuel. Because this oil is biodegradable, even if there is an accidental spill, it does not hurt the environment. And even the "waste" from algae fuel production is worth saving. Scientists can use it to feed animals or to help make other important chemicals, like antibiotics. For all these reasons, algae are valuable alternatives to petroleum.



Algae even have advantages over other natural sources of energy, like corn or wood:

- Algae are easy to grow, both on land (even where other crops will not grow) or in water (both fresh and salty). Also, they are not easily damaged by bugs or pests.
- Algae are not fussy, so they can be grown near to the people who will use them for energy. That means they will not need to be moved long distances—saving time, money, and effort!
- Compared with traditional crops, much more algae can be harvested from the same amount of space. In fact, one acre of algae can produce up to 100 times more fuel than one acre of sesame or palm trees. Part of the reason for this is that algae grow very fast. Also, we can develop other types of algae that produce unusually high amounts of oil.

There is still work to be done before people everywhere can use algae to make biofuel. Large amounts of water are needed, costs are currently high, and today's processing methods must be improved. Chemists, engineers, and biologists will continue to work together at this challenge and make more earth-friendly fuels, energized with algae!

Regina M. Malczewski *is a retired biochemist from Dow Corning Corporation.*

Word Search

Try to find the words listed below – they can be horizontal, vertical or diagonal, and read forward or backward!

P	J	B	E	M	A	C	R	O	A	L	G	A	E	O
Q	H	I	C	A	J	H	Z	R	E	L	H	C	R	E
C	U	O	I	T	Q	F	H	A	B	O	P	B	D	C
V	A	L	T	M	N	A	L	G	R	E	M	I	B	O
B	S	U	A	O	R	O	N	E	G	Y	X	O	E	S
E	Y	M	U	S	S	T	R	F	L	O	H	F	W	Y
A	N	I	Q	P	A	Y	L	I	I	D	Y	U	D	S
G	M	N	A	H	F	P	N	D	Z	V	W	E	O	T
L	R	E	G	E	K	E	N	T	R	J	T	L	O	E
A	O	S	K	R	E	O	L	Q	H	L	E	X	F	M
O	S	C	M	E	B	Q	P	H	G	E	A	R	T	H
R	N	E	E	R	L	E	U	R	K	E	S	C	V	E
C	M	N	A	A	E	P	H	I	N	U	Q	I	D	A
I	R	C	S	R	N	Z	D	E	E	W	A	E	S	A
M	O	E	G	C	H	L	O	R	O	P	H	Y	L	L

Aquatic	Earth	Microalgae
Atmosphere	Ecosystem	Nori
Biofuel	Food web	Ocean
Bioluminescence	HAB	Oxygen
Carbon dioxide	Kelp	Photosynthesis
Chlorophyll	Macroalgae	Seaweed

For answers to the word search, please visit **www.acs.org/celebratingchemistry**.

Words to Know

Algae – a group of over 27,000 different aquatic organisms, most of which conduct photosynthesis. Most algae live in either fresh or saltwater, while some live on land in moist environments, such as in the fur of a sloth, in damp soil, or on tree trunks.
Algae (or harmful algal) bloom – an uncontrolled growth of algae caused by too many nutrients, which leaves the water with dangerously low levels of oxygen. This can cause animals such as fish and crustaceans to either move or die.
Atmosphere – the layer of gasses held around a planet by its gravity.
Aquatic organism – an alga, bacteria, plant, or animal that is part of a freshwater or saltwater ecosystem.
Biofuel – a renewable energy resource made from organisms, such as algae, plants, animals, or bacteria or their products. Biofuel can be used to power cars, trucks, and even jets.
Bioluminescence – light emitted by an organism through a chemical reaction between luciferin and oxygen.
Chlorophyll – a type of molecule that allows plants and algae to use sunlight to make their own food.
Ecosystem – an interconnected community of organisms and their physical environment.
Food web – a network of organisms, including what they eat and what eats them.
Fluorescence – the light given off by an object or organism, at a lower energy than was taken in.
Greenhouse gas – a compound in the atmosphere, such as water vapor, methane, or carbon dioxide, that lets sunlight warm the earth but prevents this heat from escaping our atmosphere into space.
Macroalgae – multi-celled red, brown, or green seaweed that range in size from just a few millimeters to more than 50 meters tall. Macroalgae form an important part of aquatic ecosystems.
Microalgae – tiny single-cell algae that are invisible to our eyes. They are found in saltwater or freshwater and are capable of photosynthesis. They live alone or as part of a colony with similar algae.
Photosynthesis – a series of chemical reactions conducted by algae and plants that use energy from the sun to convert water and carbon dioxide into glucose and oxygen.
Phytoplankton – a variety of photosynthetic microalgae that float near the surface of the water and serve as the base for the many aquatic food webs.

About *Celebrating Chemistry*

Celebrating Chemistry is a publication of the ACS Office of Science Outreach in conjunction with the Committee on Community Activities (CCA). The Office of Science Outreach is part of the ACS Division of Education. Chemists Celebrate Earth Week (CCEW) edition of *Celebrating Chemistry* is published annually and is available free of charge online or in print through your local CCEW Coordinator. Visit **www.acs.org/ccew** to learn more.

About the American Chemical Society

The American Chemical Society (ACS) is one of the world's largest scientific organizations. ACS members are chemists, chemical engineers, and other professionals who work in chemistry or chemistry-related jobs. The ACS has over 151,000 members in more than 140 countries around the world. Members of the ACS share ideas with each other and learn about important discoveries in chemistry during scientific meetings held several times a year, through the ACS website, and through the many peer-reviewed scientific journals the ACS publishes. ACS members carry out many programs that help the public learn about chemistry. One of these programs is Chemists Celebrate Earth Week, held annually during the week of Earth Day on April 22. ACS members celebrate by holding events in schools, shopping malls, science museums, libraries, and even virtually online! Activities at these events include carrying out chemistry investigations and participating in contests and games. If you would like more information about these programs, please contact us at **outreach@acs.org**.

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The activities described in this publication are intended for children under the direct supervision of adults. The American Chemical Society cannot be responsible for any accidents or injuries that may result from conducting the activities without proper supervision, from not specifically following directions, or from ignoring the cautions contained in the text.

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