



The Curious Chemistry of Amazing **Algae**



AMERICAN CHEMICAL SOCIETY



Open for Exsciting Possibilities™

Saturday
April 15th, 2023
10 am – 2 pm



What are Algae? Did you know seaweed is algae, composed of large clusters of single-celled plants?

Seaweed (macroalgae) types: Green/Blue-green, Brown and Red

Green Seaweed (Chlorophytes) - Sea Lettuce, Umibudo

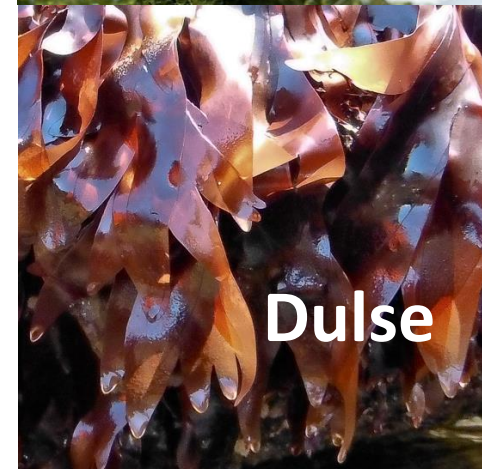
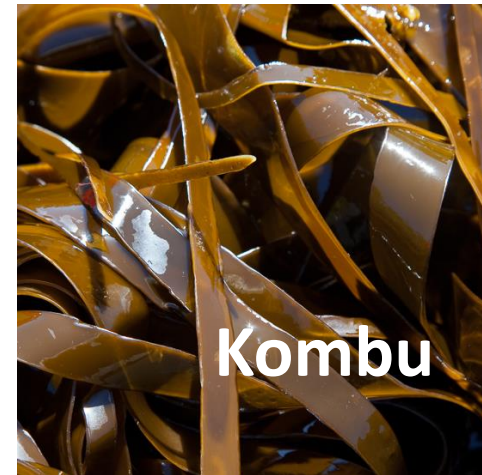
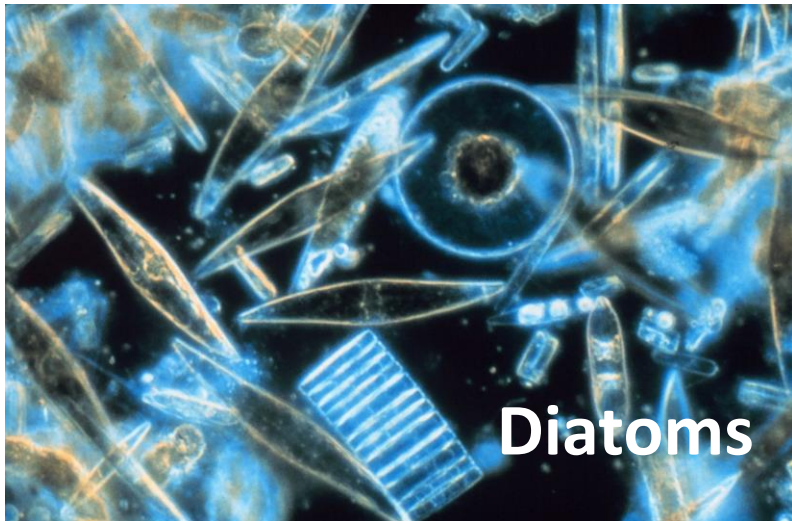
Brown Seaweed (Phaeophytes) – Kombu (kelp), Wakame, Arame, Hijiki

Red Seaweed (Rhodophytes) - Nori, Dulse, Irish Moss

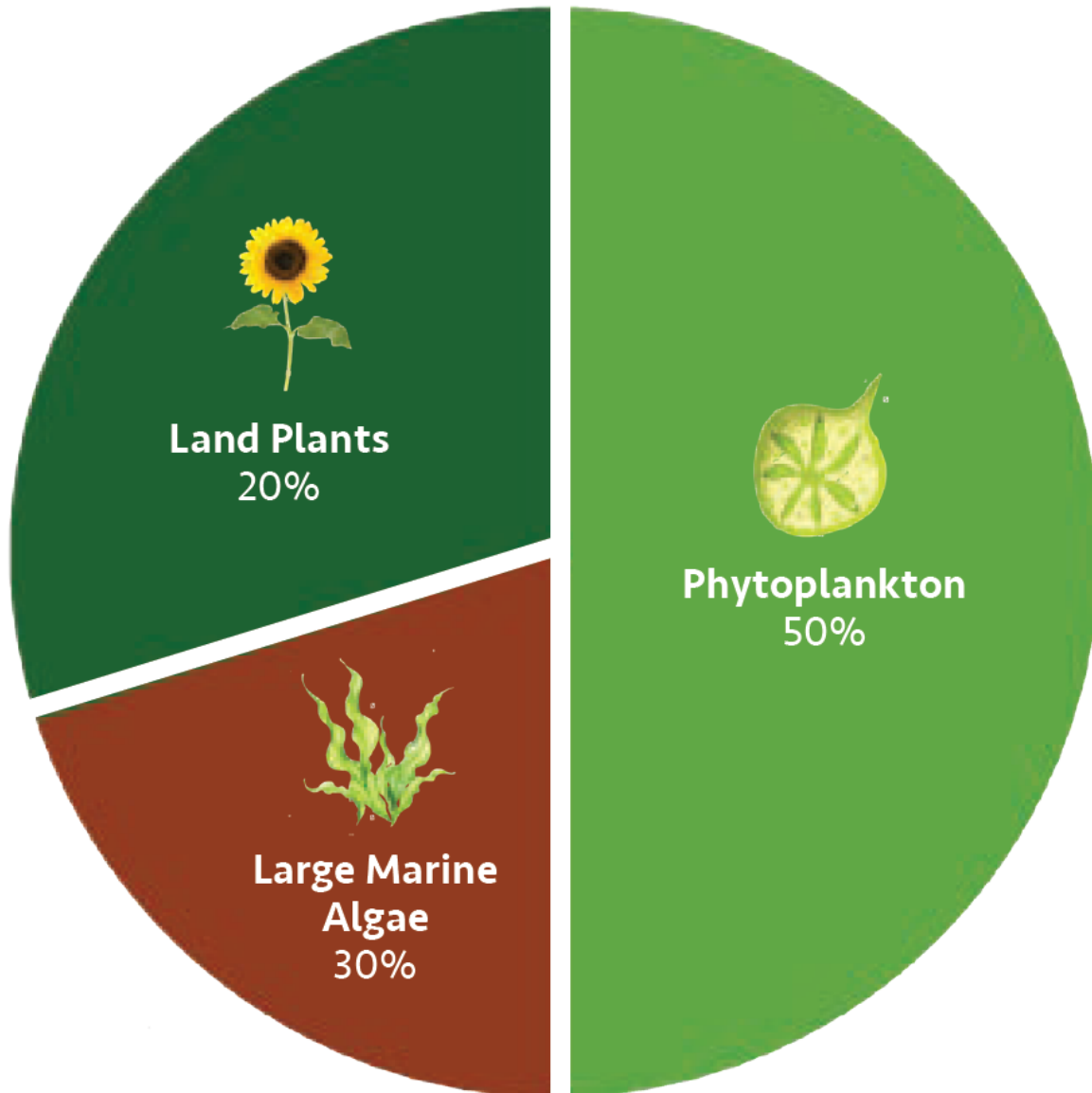
Phytoplankton (microalgae): microscopic, single algal cells

Dinoflagellates

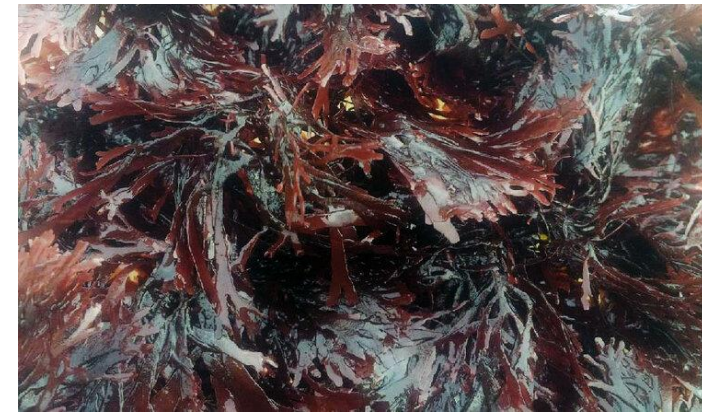
Diatoms



WORLD OXYGEN PRODUCTION



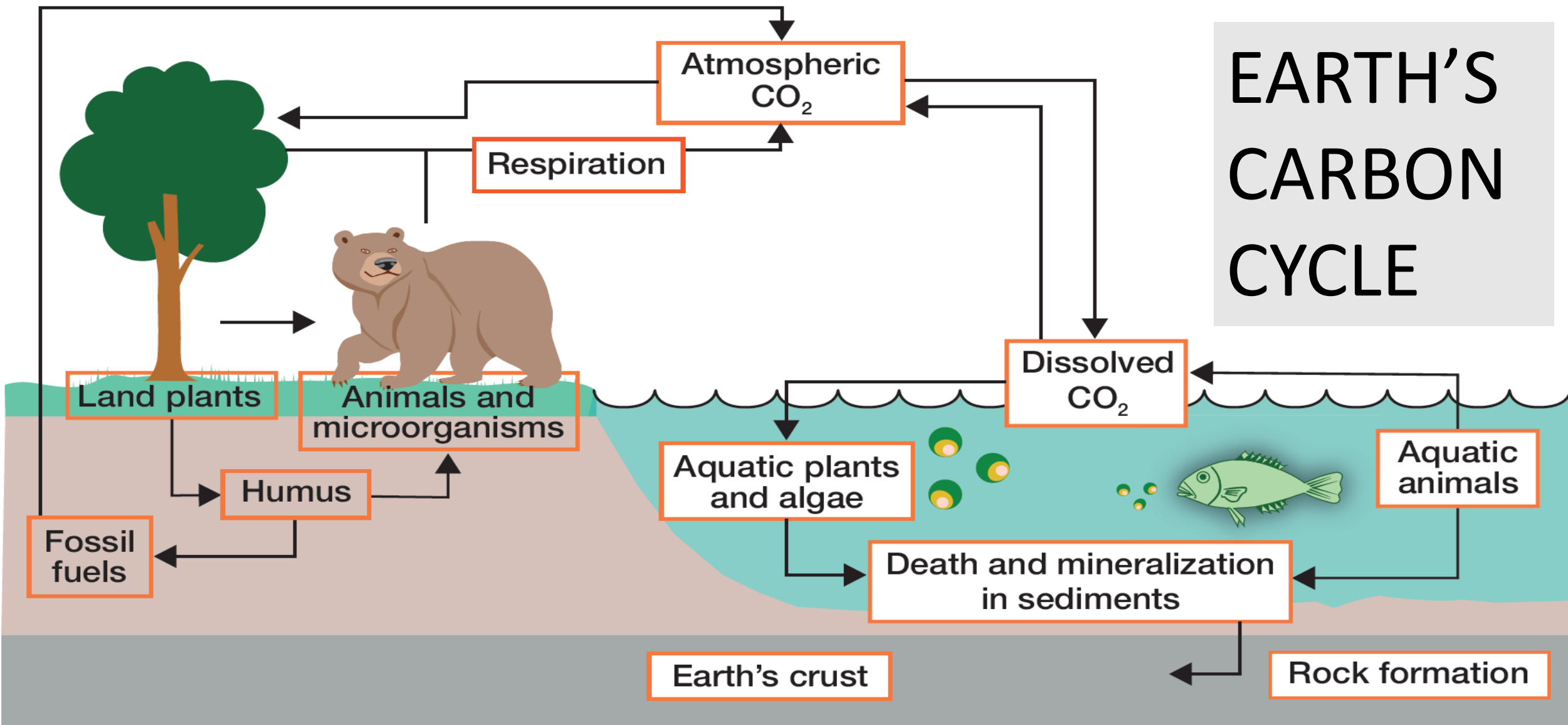
WORLD OXYGEN PRODUCTION



80% of O₂ is due to algae!



EARTH'S CARBON CYCLE



The carbon cycle is **nature's way of recycling carbon atoms, which move from the atmosphere into living and nonliving things and then back into the atmosphere over and over again.**

For example, carbon dioxide is used by plants to make food, the food is eaten by land animals and given back to the atmosphere as they breathe out carbon dioxide.

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!

Fluorescence: Know by the Glow!

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?

Labeled cup	Observations		
	Color	Plant	Algae
Regular flashlight			
UV flashlight			

Bioluminescence

What is it?

Bioluminescence: light emitted by living organisms

Chemiluminescence: light emitted by chemical reactions (e. g. Glow sticks)

Phosphorescence: a long-lasting light emission from some minerals

What types of organisms have bioluminescence?

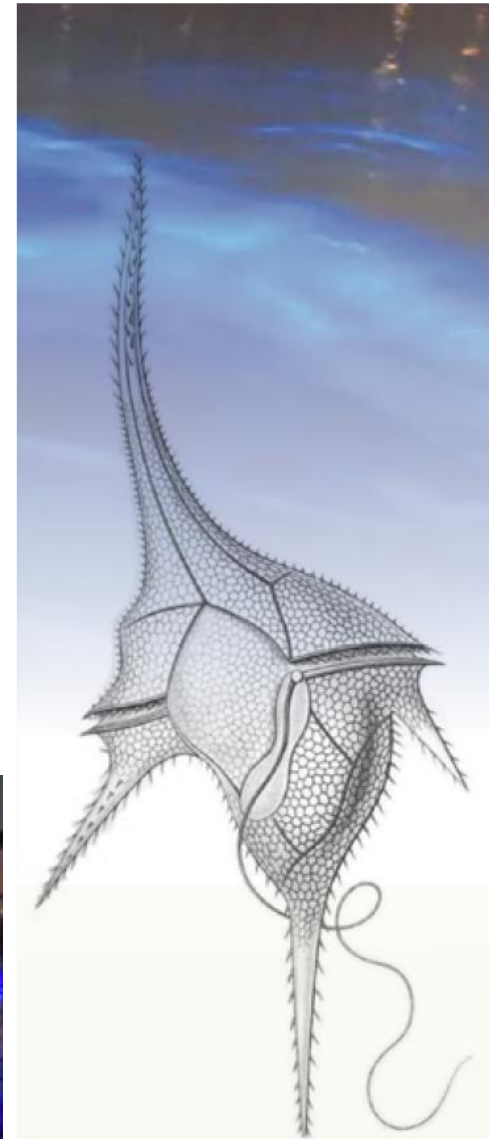
Fireflies and many sea creatures

Phytoplankton microalgae (dinoflagellates)



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

Fun Fact: all of these bioluminescence emissions are based on a substance called *Luciferin*. It reacts with oxygen in the air to produce energy which 'turns on' the light!



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!

<https://www.chesapeakebay.net/news/blog/alexandrium-monilatum-sheds-light-on-a-bay-issue>



Were you aware?
These 'algal light shows' are common along the southern Atlantic coast of the US

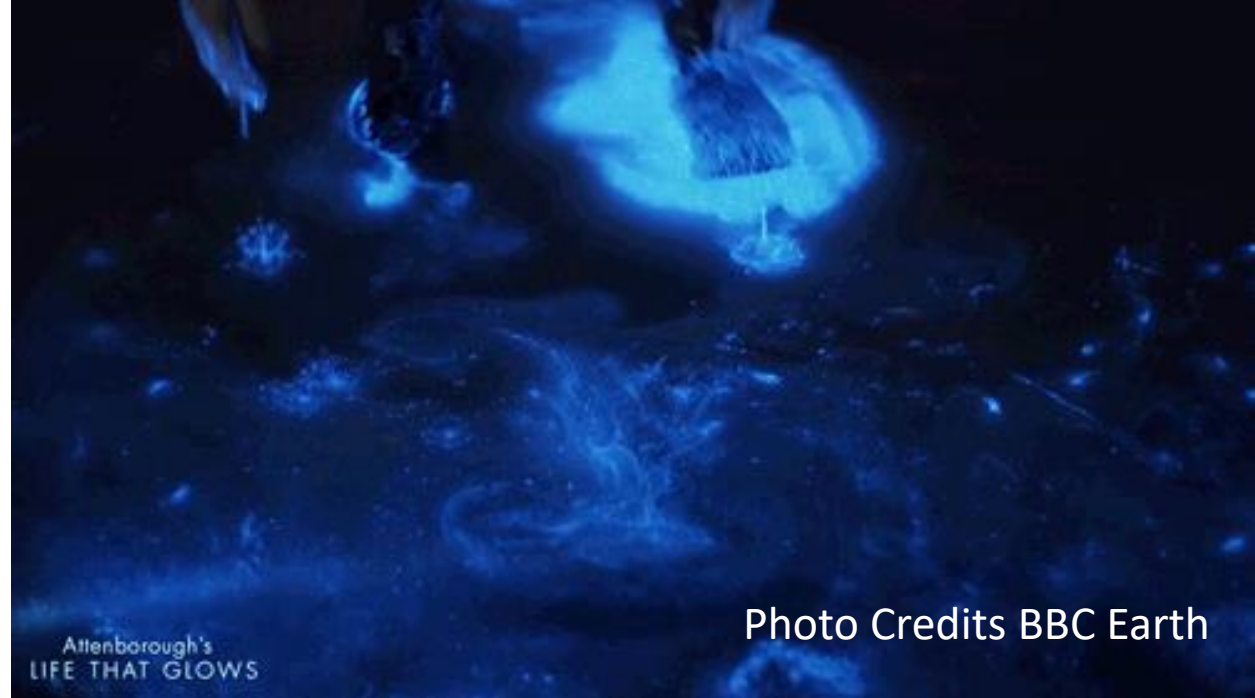


Photo Credits BBC Earth



Transforming Gels

By Susan Hershberger



Question to investigate

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

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?

How does it work?

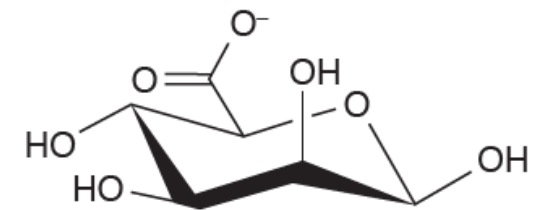
Although the gels are similar products, they have different melting points and dissolve in water at different speeds. Typically, the Cold Gel melts and dissolves faster, while the Shelf-stable Gel breaks up more when squished. Cold Gel contains *gelatin*, while Shelf-stable Gel has *carrageenan*. How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

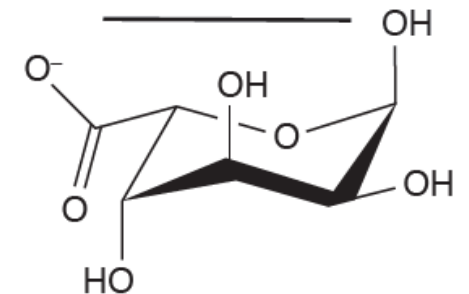
Water pods / 'Popping' Boba Teas hands-on activity



The 'skins' of the pods are an edible substance derived from brown algae called *Calcium Alginate*. This coagulated form of the natural polysaccharide, *algin*, has many other uses including medical wound dressings for ulcers, skin graft sites, and severe burns.



β-D-mannuronate (M)



α-L-guluronate (G)

You can make your own popping bobas: just ask us for some help!

Edible Water Bottles ['water pods']

The prototype named Ooho! was created in 2014 in London by a group of design students. Soon after, Rodrigo Garcia González and Pierre-Yves Paslier co-founded Skipping Rocks Lab. Oohos were used during the 2019 London Marathon, preventing the need for 200,000 plastic water bottles!

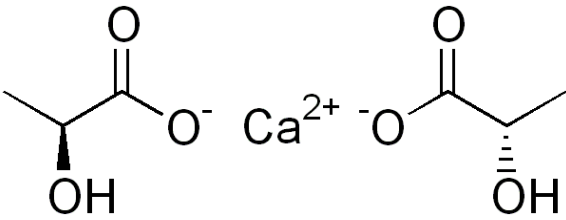


How do the 'water pods' form?

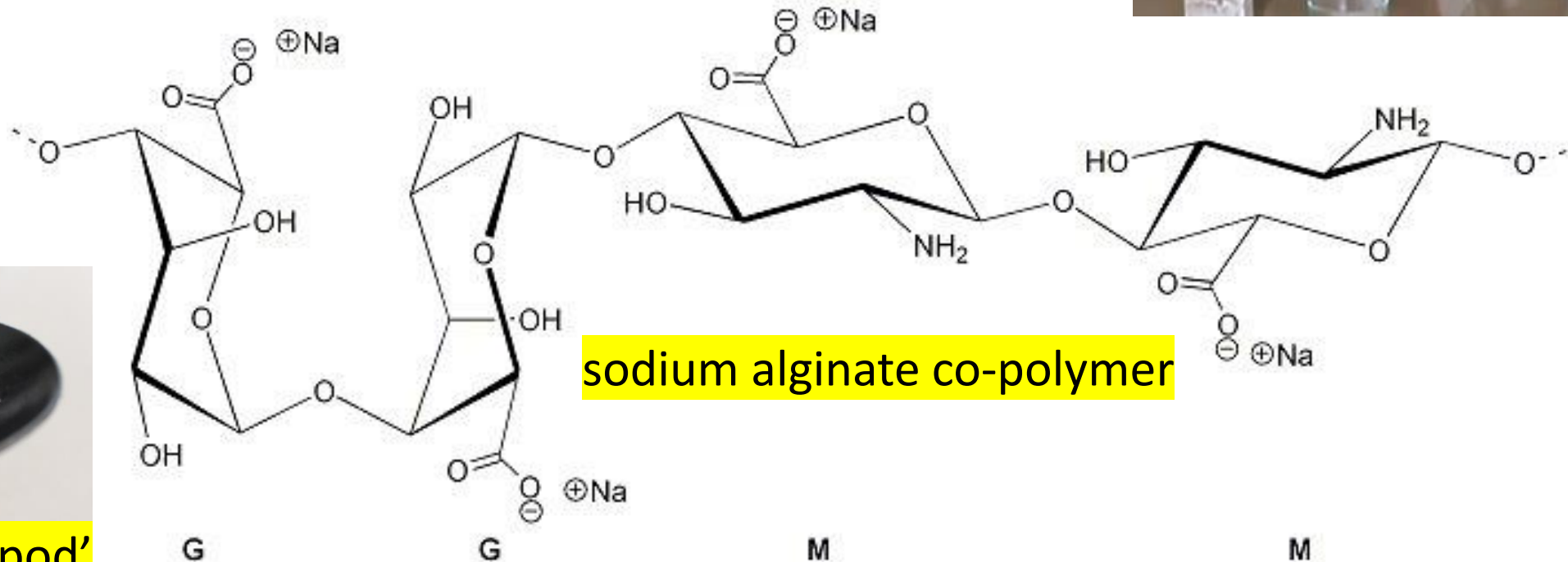
Brown seaweeds contain a polysaccharide substance known as algin.

Sodium alginate is an unbranched co-polymer of 1,4-linked- β -d-mannuronate (M) and α -l-guluronate (G) sugars derived from algin.

Sodium alginate (NaAlg) coagulates when exposed to calcium lactate (CaLac_2) and forms calcium alginate (CaAlg_2) and sodium chloride (NaLac), according to the following reaction: $2\text{NaAlg} + \text{CaLac}_2 \rightarrow \text{CaAlg}_2 + 2\text{NaLac}$



calcium lactate



calcium alginate 'water pod'

Human activities can cause algae to go crazy!

Algal 'blooms' can occur when excessive amounts of fertilizer chemicals such as phosphates enter bodies of water. They are nutrients for algae and cause an explosion in growth at the surface, releasing toxins and blocking sunlight from reaching plants and animals below the surface.



Sequence of images of algal (phytoplankton) blooms in the Baltic Sea during August 2015 captured by the Landsat 8 satellite. Photo credit: ESA

Algae control and future uses



Harvesting the algae can lead to new, sustainable products such as medicines, cosmetics and fuels

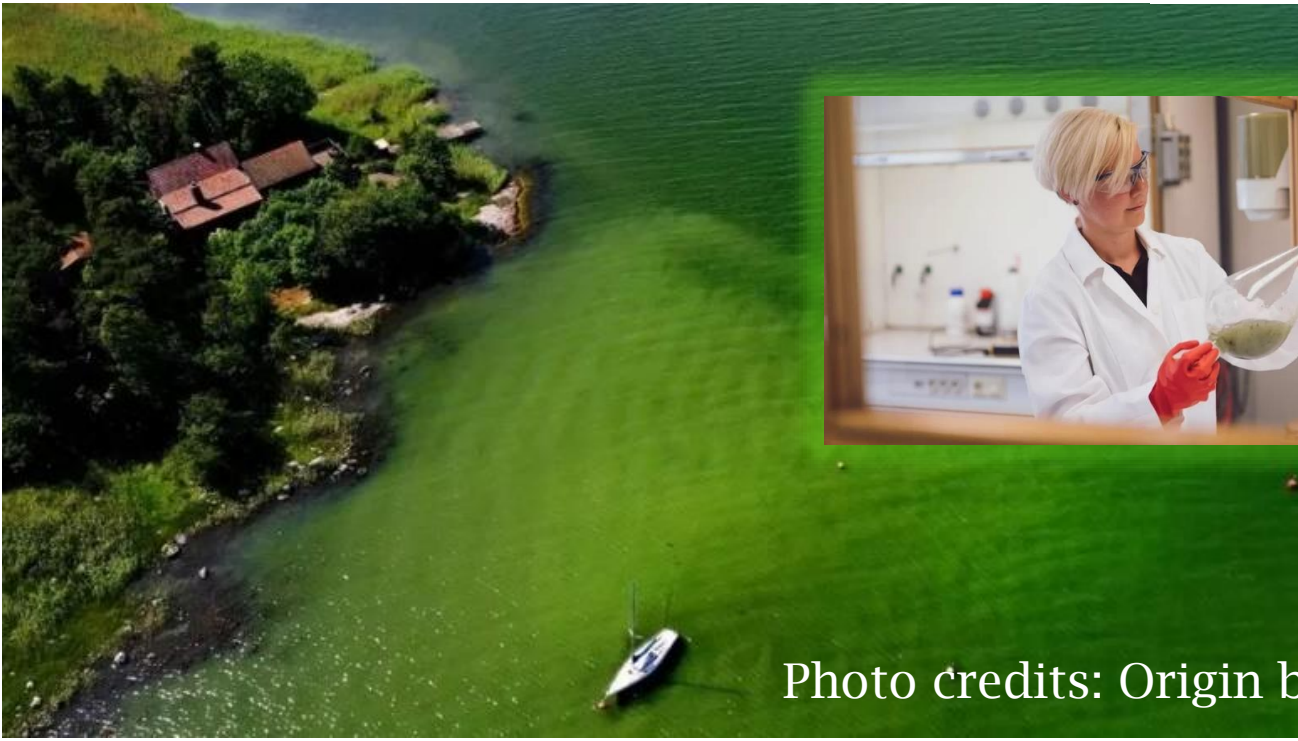


Photo credits: Origin by Ocean (<https://www.originbyocean.com>)

Proposed Layout for AMAZING ALGAE

Co-sponsored by Lehigh Valley Section of the American Chemical Society
at Inquiry Island, Da Vinci Science Center, April 15, 2023, 10am-2pm

