

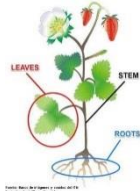
MIDDLE and HIGH SCHOOL

Next Gen Science Standards:

MS-LS1-1

HS-LS1-5. Use a model to illustrate how photosynthesis transforms light energy into stored chemical energy.

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Climate of Change Part IV: The Future of Aquaculture

Seaweed vs Plants

Developed by the Island Institute, Rockland, Maine

Revised and formatted by Maine Agriculture in the Classroom

Overview:

Seaweeds have been harvested and used throughout the world for centuries and are highly valued in many countries today. The U.S. is just now discovering the many health benefits seaweeds provide and there is a shift towards kelp aquaculture. But what are seaweeds? Are they water plants or a species of their own? How are seaweeds used in today's society? In this lesson, students will investigate these questions. To begin the lesson, the teacher will introduce the differences between seaweeds and land plants, followed by a microscope lab exercise where students will be using their different senses to identify the differences and similarities between sugar kelp (*Saccharina latissima*) and a sunflower leaf (or geranium or other house plant leaf). As a wrap-up activity, students will be able to taste test seaweed salad (provided by the teacher). Students are encouraged to use their five senses during this lesson to help sharpen observation skills.

Essential Questions:

- What are the differences and similarities between seaweeds and land plants?
- What is the composition of a kelp (macroalgae) cell and how does it differ from a plant cell?
- What are some different human uses for seaweed?

Learning Objectives:

Students will

- demonstrate the differences and similarities between plants and macroalgae.
- assess different types of cells under a microscope
- explain the process of photosynthesis for both plants and macroalgae.

NOTE: It is important that students know how to properly use a microscope in Part II of this lesson. If students do not have the necessary skills, do the microscope activity together as a class. The teacher can demonstrate how to prepare slides and use a microscope. Students may take turns looking through the microscope, comparing and contrasting the kelp slide and the geranium leaf slide.

Below are useful resources on how to use a compound light microscope:

- <http://www.scienceprofonline.com/microbiology/how-to-use-compound-microscope.html>
- <https://www.youtube.com/watch?v=SUo2fHZaZCU>
- <http://www.carolina.com/teacher-resources/Interactive/how-to-use-student-compound-microscope/tr11039.tr>



Materials:

PART I

- Kelp and land plant diagram (for teacher to use as guide)
- Draw kelp and land plant diagrams on the board with blank spaces to label the different parts
- Chemical equation for photosynthesis
- Lab worksheets

PART II

- Microscope station materials:
 - Microscope and slides for each station
 - Kelp samples for microscope (slides can be made ahead of time depending on students' microscope skills)
 - Houseplant leaf cross-section for microscope (slides can be made ahead of time depending on students' microscope skills)

PART III

- Seaweed salad samples for students to taste in small cups with forks or chopsticks
- Handwashing station
- Oceanside West High School Seaweed Explorations cookbook to share with students

Teacher Preparation:

Part III: The night/morning before this lesson prepare the seaweed salad according to the recipe in Background Information :

Background Information:

PART I – Differences and similarities between seaweeds and land plants

Seaweeds are a type of macroalgae; they are not plants, even though at first glance they appear to be plants. There are many differences between seaweeds and plants, mostly at the cellular level.

(Source: <http://simply-science-nbep.blogspot.com/search?q=seaweed%2Fplants>)

Seaweed

- May be unicellular, colonial, or multicellular
- Holdfast, staples and blades compose multi-cellular algae
- Each cell in algae must obtain its own nutrients from water for survival
- Photosynthetic
- Can be found on land and water
- Reproduction: can reproduce through tiny spores or by replication of the growth of broken pieces

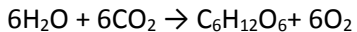
Land Plants

- Only multi-cellular
- Roots, stems, leaves, flowers, fruits, seeds and cones
- Have vascular systems
- Photosynthetic
- Can be found on land and water
- Reproduction: complex, multi-cellular reproductive systems and certain species require assistance from wind, birds, bugs or bats for pollination



The main similarity between seaweeds and plants is that they are both photosynthetic. Both need sunlight for survival.

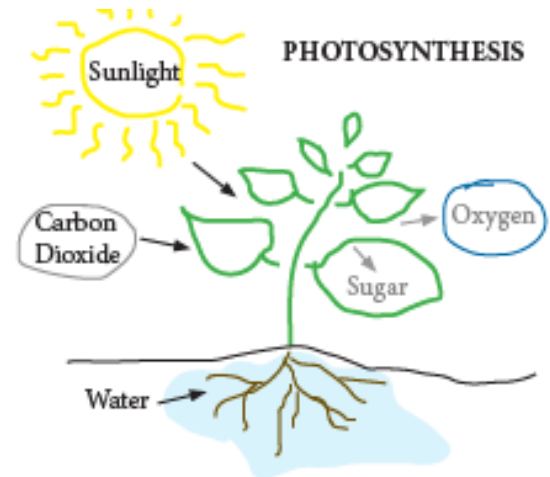
Chemical equation for photosynthesis:



For younger students, photosynthesis may be explained by the following:

water + carbon dioxide from atmosphere + sunlight

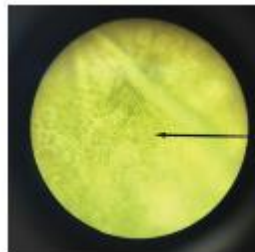
→ sugar + oxygen (see graphic at right). Teachers may hand out the diagram for younger students, or draw/post in classroom.



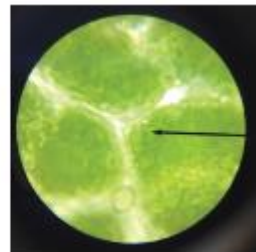
PART II – Using observation and microscope skills

Students will first observe a small piece of sugar kelp and a sunflower leaf (or other house plant leaf) and draw pictures, using the worksheet as a guide. Next, students will look at the sugar kelp and leaf under a microscope. Students can either prepare the wet mount slides themselves or the teacher can prepare slides ahead of time before the start of the lesson. Students will draw pictures of what they observe under the microscope at 40x TM (total magnification) objective lens (if there is time, allow students to view the slides at different magnifications). Students should use the worksheet as a guide to help them with this step. Below are examples of what students should observe under the microscope

Sugar kelp



Sunflower leaf



PART III – Eating seaweeds and other uses

The teacher will prepare the following seaweed salad recipe the night/morning before the lesson. The teacher can also print copies of the "cookbook" created by Oceanside West High Schools students. Printed double-sided, it will fold in h form a book.

Cucumber Wakame Salad (8-10 small portions)

- 2-3 medium cucumbers, julienned
- 3oz rehydrated/softened wakame seaweed, cut into 2-inch lengths
- 6 Tbs rice vinegar
- 2 Tbs toasted sesame oil
- 2 Tbs tamari or soy sauce
- 2 tsp fresh grated ginger
- 1/4 cup lightly toasted sesame seeds

Mix vinegar, oil, soy sauce and ginger. Add cucumber and wakame and mix well, then top with toasted sesame seeds.

This recipe was developed by students from Oceanside High School West at Herring Gut Learning Center.



This activity is a fun way to introduce students to a new food. Before sampling the salad, ask students what they think it will taste like. Have them make observations about the appearance of the salad – what color is it, what does it smell like, what looks the same/ different from a “regular” lettuce salad? Make sure to provide small cups/dishes and utensils for each student and be sure to have students wash their hands after the microscope lab activity. Once students have made their observations, they may now try the salad. While sampling the salad, ask students what other products seaweed may be found in. These videos may inspire creative thinking around the many uses seaweed provides.

Bath and spa seaweed products:

- <https://www.youtube.com/watch?v=c9EmV6LCV8E> (2:14 minutes)
- <https://www.youtube.com/watch?v=UXrM9TFrc0> (12:24 minutes)

Once finished, ask students to come up with a list of words describing the salad (ex. salty, chewy, flavorful) and avoid words judging the salad (ex. gross or good). Hand out the cookbook that students at Oceanside West High School created. This may inspire students and their families to cook with seaweed.

Procedure:

PART I

- Begin the lesson by drawing or posting the kelp and plant diagram (see next page) on the board as a discussion topic
- Do you think these diagrams are plants, algae or animals? (Kelp is a seaweed that is a type of macroalgae (macro means big; micro means small); the flowering plant is a land plant.)
- What type of seaweed/plant species is this? (Sugar kelp; flowering plant)
- How are seaweeds and plants different (see above table for reference); how are they similar? (Both undergo photosynthesis to convert sunlight to energy.)
 - What is photosynthesis? For older students, ask a volunteer to write the chemical equation on the board:
$$6\text{H}_2\text{O} + 6\text{CO}_2 \rightarrow \text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2$$
 - Water + carbon dioxide from atmosphere + sunlight → sugar + oxygen
- Hand out worksheets to students and explain the lab procedures:
 - First, have students break up into small teams
 - Have groups go to a station around the room; the stations are all the same, each with a piece of sugar kelp, a geranium leaf, slides and a microscope
 - Students will first examine each sample, using their eyes only and draw what they observe
 - Using the microscope, students will then examine the slides and draw what they observe**Remind students to use proper microscope handling procedures

PART II

- Allow students about 15 minutes at their station, making sure they have adequate time to make all observations and to fill in their worksheets
- Once students have completed their observations, come back as a group to discuss the following questions:
 - Was it easier to use the microscope or the naked eye to make observations?
 - What was the difference between the kelp and geranium samples? What were the similarities?
 - What are some special adaptations that kelp have to survive in the ocean? (holdfasts to attach to ocean bottom, fronds to absorb sunlight)

PART III

- Now it is time for taste testing! Make sure students wash their hands before sampling the seaweed salad
- Put a sample of the seaweed salad in a small cup for each student
 - Ask students what other products seaweed may be found in. Besides food, what are some other human uses kelp can provide? (toothpaste, cosmetics)



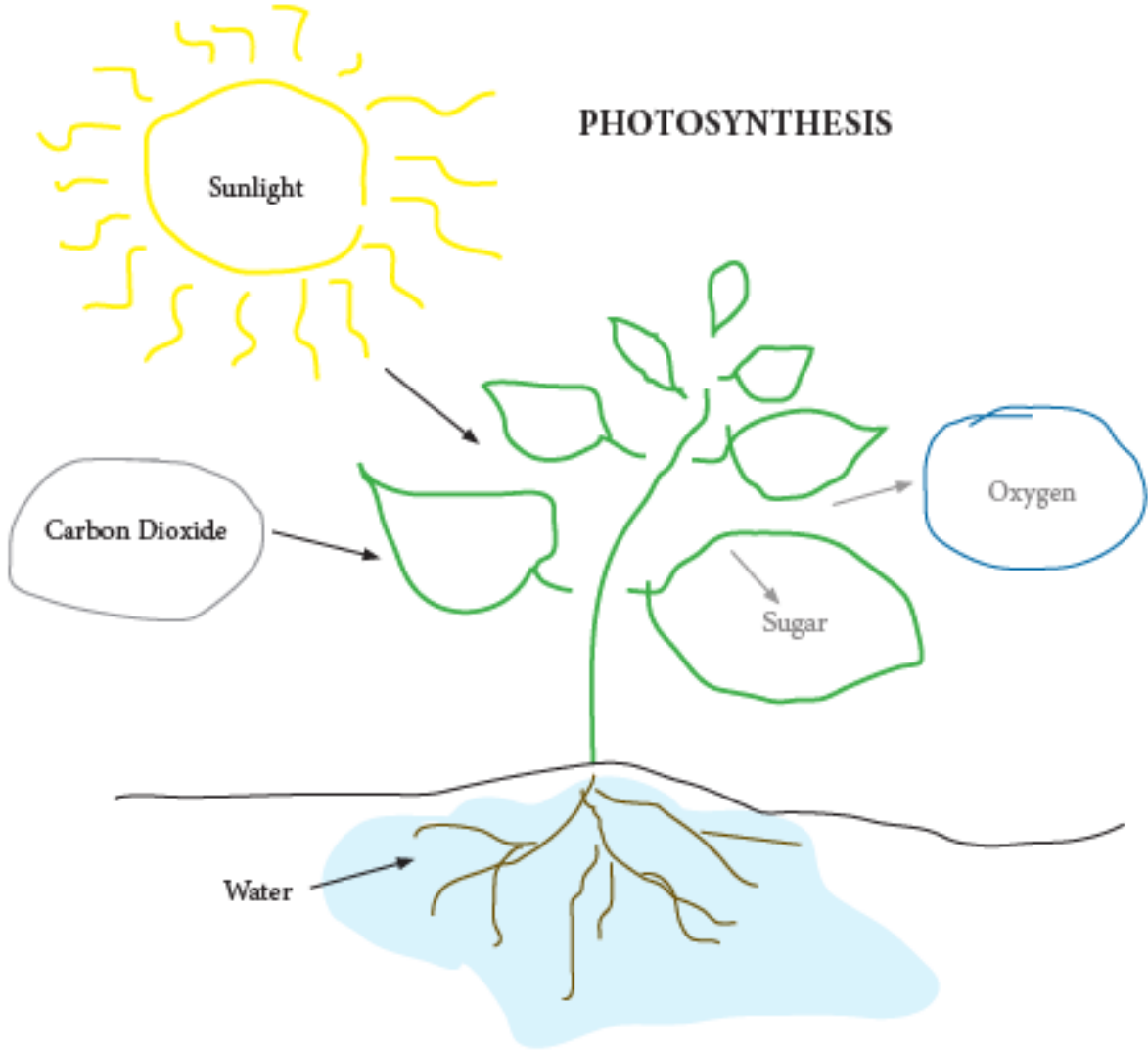
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- After allowing students to sample the salad, ask students their opinions about the flavor, texture, appearance, etc.
 - Pass out seaweed cookbooks to students and inspire them to create their own seaweed snack.

Additional Resource:

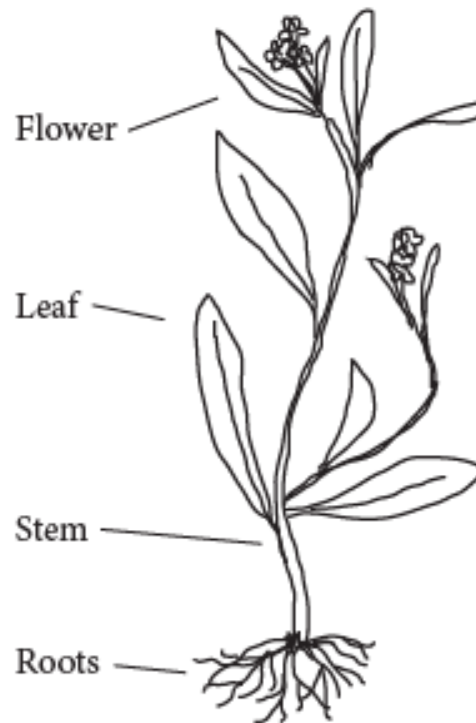
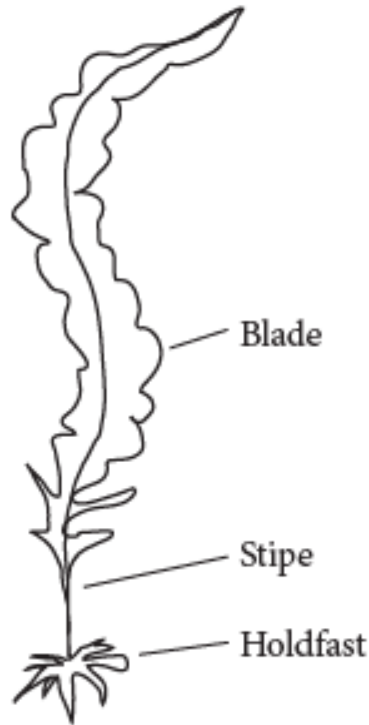
- NOAA lesson plan: Taking a closer look at seaweed
[https://coast.noaa.gov/data/SEAMedia/Lessons/G4U3L4 Taking a Closer Look at Seaweeds.pdf](https://coast.noaa.gov/data/SEAMedia/Lessons/G4U3L4%20Taking%20a%20Closer%20Look%20at%20Seaweeds.pdf)



PHOTOSYNTHESIS



Kelp vs. Plant



Seaweeds:

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- holdfast, stipes and blades compose multi-cellular algae
- each cell in algae must obtain its own nutrients from water for survival
- photosynthetic
- can be found on land and water
- reproduction: can reproduce through tiny spores or by replication of the growth of broken pieces

Plants:

- only multi-cellular
- roots, stems, leaves, flowers, fruits, seeds and cones
- have vascular systems
- photosynthetic
- can be found on land and water
- reproduction: complex, multi-cellular reproductive systems and certain species require assistance from wind, birds, bugs or bats for pollination

Source: <http://simply-science-nbep.blogspot.com/2011/06/algae-vs-plants.html>



Miso Soup with Dulse (Serves 1)

Ingredients:

- 1 cup water
- 1 Tbsp miso
- ¼ cup sliced dulse seaweed
- 2 slices kombu
- 2 Tbsp minced scallion
- 1 Tbsp grated ginger
- 2 Tbsp diced tofu

Boil the water with the kombu to make dashi. Remove water from heat and strain out kombu. Chop kombu into thin strips. Stir miso into remaining broth, and add the rest of the ingredients.



This is what I know: acid rain is leaching the trace minerals out of the soil and washing the nutrients downstream to the ocean. The seaweeds capture them. And I? I go about in my little boat harvesting them, drying them and sending these nutrients back upstream...upstream, from earth's ocean bloodstream back into humanity's salty bloodstream, by way of amending the soil, by way of fertilizing the plants in the garden, by feeding the animals on the farm and by supplying nourishing food for the table...food that is nutrient-dense, like wild herbs from the sea. –Larch Hanson, a sustainable seaweed harvester



Seaweed Nutrition

Seaweed is incredibly **nutrient dense**. One gram of seaweed fulfills the daily iodine requirement, important for thyroid and brain health. It is also a rich source of *calcium* and *protein*. The plentiful fiber in seaweed is soluble (versus insoluble), which turns into a gel and slows down digestion. Almost all seaweeds contain vitamins A, B, C, E, and K, and minerals sodium, potassium, magnesium, copper, and zinc.

Dulse: very high in vitamins B6 and B12

Kelp: high in soluble and insoluble fiber

Kombu: high in iodine (which helps thyroid control metabolism)

Wakame: highest calcium of all seaweed, contains *fucoxanthin* which improves insulin resistance

Nori: richest protein source of sea flora, omega-3 fatty acids, and vitamin C (antioxidant)



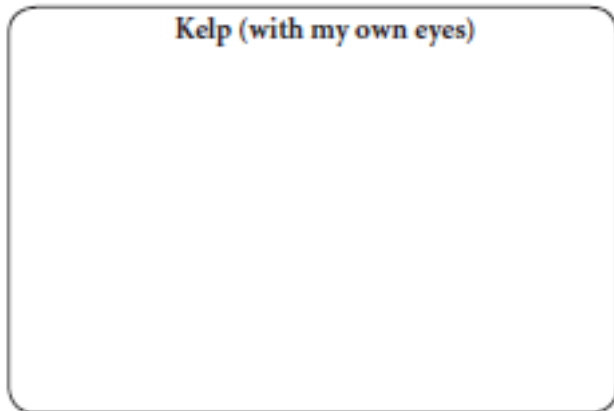
Name: _____ Date: _____

Seaweed or Plant?

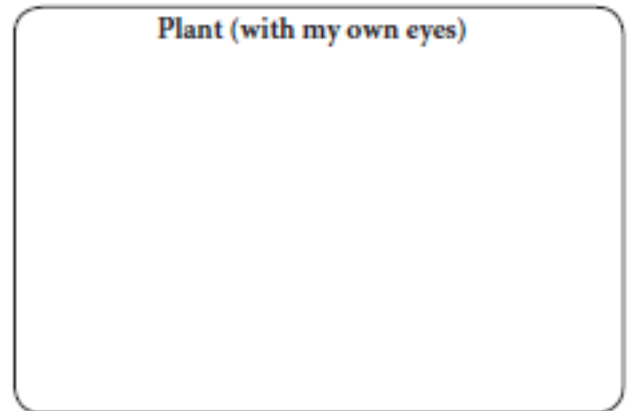
- You will be examining a piece of sugar kelp (*Saccharina latissima*) and a geranium leaf to determine if there are differences between the two samples. Begin by making a prediction about what you think you may observe after examining both specimens.
- Take a few minutes to then carefully look at the samples up close, using your eyes only and draw a diagram. What do you observe?
- Now, use the compound microscope at 40xTM and observe the kelp and geranium samples. Record what you observed.

Predictions:

Kelp (with my own eyes)

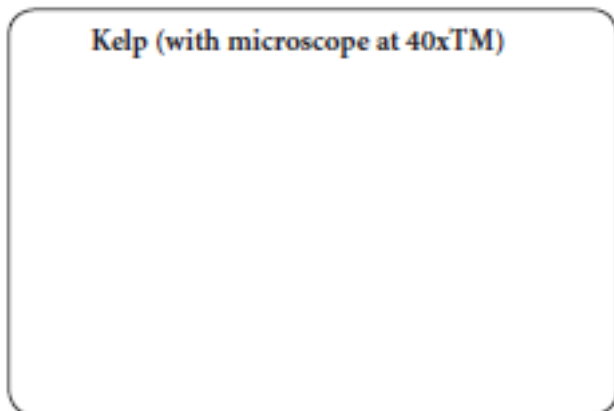


Plant (with my own eyes)

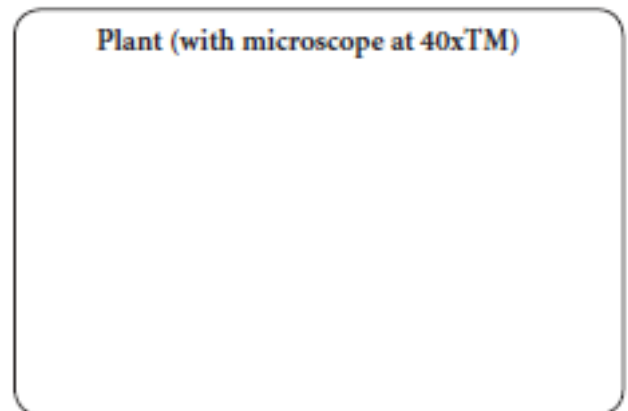


What differences did you observe without using a microscope?

Kelp (with microscope at 40xTM)



Plant (with microscope at 40xTM)



What differences did you observe when looking through a microscope?



Simply Science

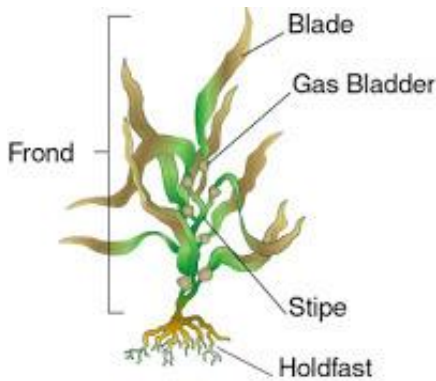
Explaining environmental issues

Showing posts sorted by relevance for query **seaweed/plants**. Sort by date Show all posts

Thursday, June 2, 2011

Algae vs. Plants

Diagram of algae



Plants and algae are both photosynthetic. Both are also considered eukaryotes, consisting of cells with specialized components. They both also have the same life cycle called alternation of generations. However, algae are not plants. So, what are they? They are merely members of the Kingdom Protista. Plants compose their own kingdom, Kingdom Plantae. While plants and algae may sometimes appear to be quite similar visually, they in fact have a number of differences between them. In terms of where they live, how they survive and reproduce, and what composes them, plants and algae are vastly different.

Did you know that seaweed is not a plant? First of all, algae may be unicellular, colonial, or multi-cellular. Plants, on the other hand, are only multi-cellular.

Holdfasts, stipes and blades compose multi-cellular algae. In comparison, plants have roots, stems, leaves, flowers, fruits, seeds and cones. The roots of plants not only hold them in place, they nourish them. Plants possess vascular systems, which allow for the uptake and transport of water and nutrients. In contrast, each cell in algae must obtain its own nutrients from water for survival.

Clearly, plants cannot move, as they are rooted to the ground. On some algae, holdfasts, which are comparable to the roots of plants, hold them in place. Some algae drift with the water currents. Some algae are actually actively mobile. Dinoflagellates, for instance, whip themselves through the water with a tail-like structures called flagella. Other algae may move by pushing their bodies forward in a crawling motion.

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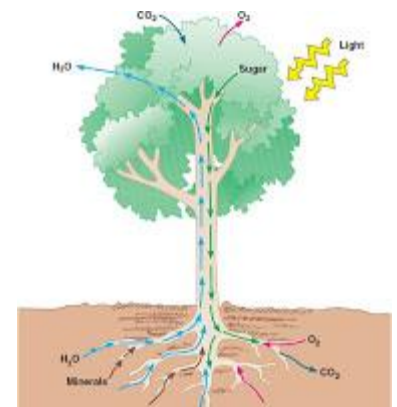


Diagram of a plant vascular system





Algae

Typically algae are found in water; although, they may be found on land or snow and, strangely enough, even growing in rocks or marine animals or on the fur of some rainforest animals such as sloth. Plants are generally found on land; however, they can also live in water, such as eelgrass in marine systems and water lilies in fresh water.

Reproduction could not be more different for plants and algae. Plants have complex, multi-cellular reproductive systems and some even require the assistance of wind, birds, or bugs for pollination. Algae, comparatively, can reproduce through tiny spores or even by replication or the growth of broken pieces.



Eelgrass is a submerged aquatic vegetation (plant)

Despite all of their differences, algae and plants can often appear deceptively similar. So, next time you're on the beach and you come across what appears to be a plant, take a second glance because it may in fact be algae.

~Elizabeth Gooding

