11- Higher Microorganisms Algae (Instructor: Şeref Tağı)

Characteristics of Algae

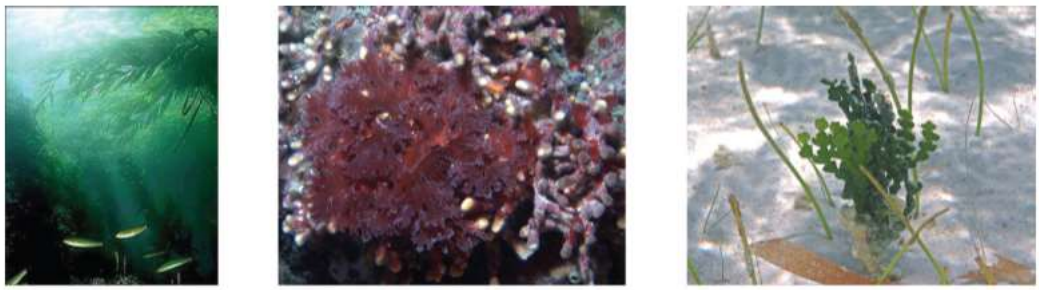
The algae are autotrophic protists that can be unicellular or multicellular. The term algae is not a taxonomic classification — it is used to describe eukaryotic microorganisms that live a photosynthetic lifestyle. These organisms are found in the supergroups Chromalveolata (dinoflagellates, diatoms, golden algae, and brown algae) and Archaeplastida (red algae and green algae). They are important ecologically and environmentally because they are responsible for the production of approximately 70% of the oxygen and organic matter in aquatic environments. Some types of algae, even those that are microscopic, are regularly eaten by humans and other animals. Additionally, algae are the source for agar, agarose, and carrageenan, solidifying agents used in laboratories and in food production. Although algae are typically not pathogenic, some produce toxins. Harmful algal blooms, which ocur when algae grow quickly and produce dense populations, can produce high concentrations of toxins that impair liver and nervous-system function in aquatic animals and humans.

Like protozoans, algae often have complex cell structures. For instance, algal cells can have one or more chloroplasts that contain structures called pyrenoids to synthesize and store starch. The chloroplasts themselves differ in their number of membranes, indicative of secondary or rare tertiary endosymbiotic events.

Although the algae and protozoa were formerly separated taxonomically, they are now mixed into supergroups. The algae are classified within the Chromalveolata and the Archaeplastida. Although the Euglenozoa (within the supergroup Excavata) include photosynthetic organisms, these are not considered algae because they feed and are motile.

The dinoflagellates and stramenopiles fall within the Chromalveolata. The dinoflagellates are mostly marine organisms and are an important component of plankton.

When a population of dinoflagellates becomes particularly dense, a red tide (a type of harmful algal bloom) can occur. Red tides cause harm to marine life and to humans who consume



(a) (b) (c)

(a) These large multicellular kelps are members of the brown algae. Note the "leaves" and "stems" that make them appear similar to green plants. (b) This is a species of red algae that is also multicellular. (c) The green alga Halimeda incrassata, shown here growing on the sea floor in shallow water, appears to have plant-like structures, but is not a true plant (https://openstax.org/details/books/microbiology)

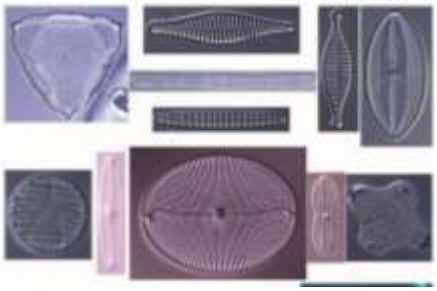
contaminated marine life. Major toxin producers include Gonyaulax and Alexandrium, both of which cause paralytic shellfish poisoning.

The stramenopiles include the golden algae (Chrysophyta), the brown algae (Phaeophyta), and the diatoms (Bacillariophyta).

Brown algae (Phaeophyta) are multicellular marine seaweeds. Some can be extremely large, such as the giant kelp (Laminaria). They have leaf-like blades, stalks, and structures called hold fasts that are used to attach to substrate. Brown algae are also called kelp. They're large multicellular organisms that can grow rapidly in their ocean habitat. They produce alginate, which is used as a food thickener.

Diatoms are a major component of photoplankton, another group of singlecelled protists. They use photosynthesis for energy, but instead of storing it in starch like the green algae do, they store it as an oil, which can be lethal if ingested in a high enough concentration. They make a cell wall of silica, the outermost part of which is called the frustule; the frustule remains long after the cell dies. The shapes of diatom frustules are often very ornate and beautiful and are either pinnate (elongated) or centric (round). By being encased in a two-part, hard-shelled, silica wall , the cells can withstand great pressures and are not easily

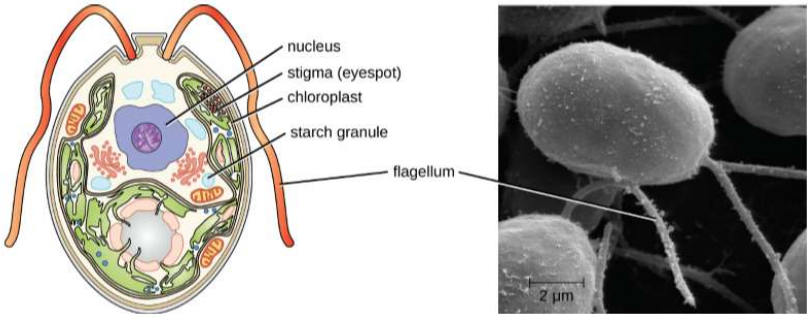
crushed or destroyed by predators. Diatoms carry out photosynthesis and compose an important part of the phytoplankton found in marine and freshwater environments. The massive accumulations of fossilized diatom walls are mined and ground up into diatomaceous earth, which has many useful applications, such as a filtering agent in swimming pools and a mild abrasive in household products, including toothpastes and metal polishes. Diatomaceous earth also can be used as a pesticide, because it grinds holes in the exoskeleton of crawling insects, causing the animals to desiccate.



The diversity in shape of the diatoms (Alcamo's 2011)

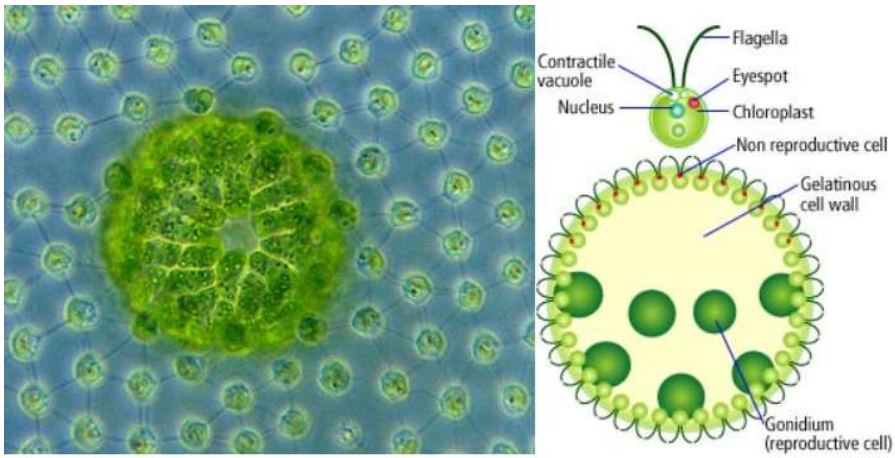
The Archaeplastids include the green algae (Chlorophyta), the red algae (Rhodophyta), another group of green algae (Charophyta), and the land plants.The Charaphyta are the most similar to land plants because they share a mechanism of cell division and an important biochemical pathway, among ,among other traits that the other groups do not have.

Chlamydomonas is a green alga that has a single large chloroplast, two flagella, and a stigma(eyespot); it is important in molecular biology research. Green algae are most like plants. They have cellulose in their cell walls, contain the same chlorophylls as plants, and store starch. Most green algae are unicellular; however, others are either colonial (growing together in a colony), filamentous, or able to form multicellular structures . Some green algae live in soil; others live inside rocks, using the light that filters through their semitransparent home.



Chlamydomonas is a unicellular green alga (https://openstax.org/details/books/microbiology)

Chlorella is a non motile, large, unicellular alga, and Acetabularia is an even larger unicellular green alga. Volvox is a colonial, unicellular alga. A *volvox* is a plant-like uni-cellular organism that is filled with a lot (1000s) of little green algae pieces. These 1000s of pieces are called colonies. The volvox is green because of the algae and because it contain chloroplast which holds the green pigment chlorophyll. The chloroplast is used for photosynthesis which makes this cell more like a plant cell. Because of its plant-like activities, this cell is more autotrophic as it produces its own nutrients by using photosynthesis. Volvox's produce asexually. Paramecium species of cells can be great predators for a Volvox. A small paramecium will live inside of a larger Volvox and eat from the inside out. A Volvox breathes air by exchanging gases through its cell membrane.



https://sites.google.com/site/exploringprotozoa/protozoa/volvox

Lichen on the other hand are a symbiotic partnership between a single-celled green algae and a filamentous fungi.

References:

1- Alcamo's Fundamentals of Microbiology, 2011, Ninth Edition (9 ed.) by Jeffrey C. Pommerville, Jones & Bartlett Publishers, Canada
2- "Download for free at https://openstax.org/details/books/microbiology."
3- https://commons.wikimedia.org/wiki/File:Simple_diagram_of_yeast_cell_(en).svg