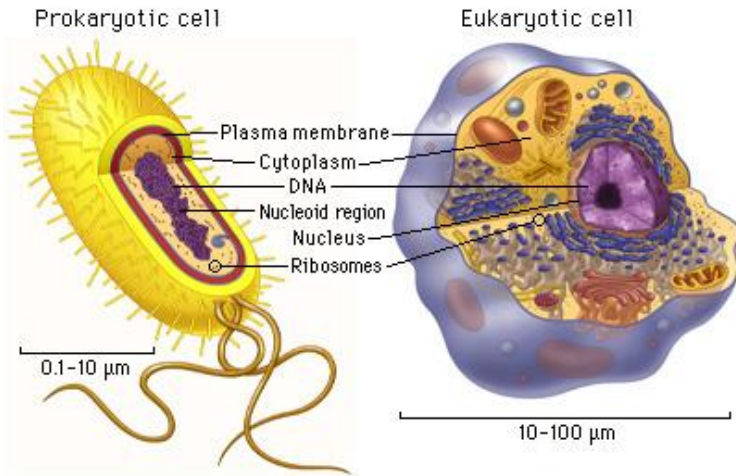


The Unicellular and Colonial Organisms

Prokaryotic and Eukaryotic Cells



As you know, the building blocks of life are cells. **Prokaryotic** cells are those cells that do NOT have a nucleus. They mostly include bacteria and archaea. These cells do not have membrane-bound organelles.

Eukaryotic cells are those that have a true nucleus. That would include plant, animal, algae, and fungal cells. As you can see, to the left, eukaryotic cells are typically larger than prokaryotic cells.

Today in lab, we will look at examples of both prokaryotic and eukaryotic unicellular organisms that are commonly found in pond water. When examining pond water under a microscope...

- The unpigmented, moving microbes will usually be protozoans.
- Greenish or golden-brown organisms will typically be algae.
- Microorganisms that are blue-green will be cyanobacteria.

As you can see below, living things are divided into 3 domains based upon shared characteristics. Domain Eukarya is further divided into 4 Kingdoms.

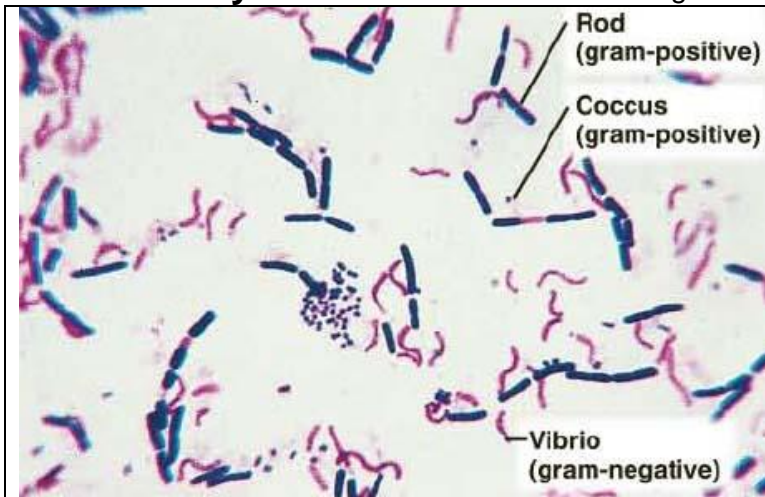
Domain	Kingdom	Cell type	Organization	Nutrition	Organisms
Archaea	Archaeobacteria	Prokaryotic	Unicellular-small; Lacking peptidoglycan	Absorb, Photosyn., Chemosyn.	Archaeobacteria
Bacteria	Eubacteria	Prokaryotic	Unicellular-small; Peptidoglycan in cell wall	Absorb, Photosyn., Chemosyn.	Bacteria, Cyanobacteria
Eukarya	Protista	Eukaryotic	Unicellular or colonial	Ingestion, Photosynthesis	Protozoa, Algae
	Fungi	Eukaryotic	Multicellular	Absorption	Fungi, yeast, molds
	Plantae	Eukaryotic	Multicellular	Photosynthesis	Plants
	Animalia	Eukaryotic	Multicellular	Ingestion	Animals

Prokaryotic Organisms — the archaea, non-photosynthetic bacteria, and cyanobacteria

Archaea - Microorganisms that resemble bacteria, but are different from them in certain aspects.

- Archaea cell walls do not include the macromolecule peptidoglycan, which is always found in the cell walls of bacteria.
- Archaea usually live in extreme, often very hot or salty environments, such as hot mineral springs or deep-sea hydrothermal vents.
 - Some carry out a simple form of photosynthesis.
- Some scientists believe that archaea were the earliest forms of cellular life.

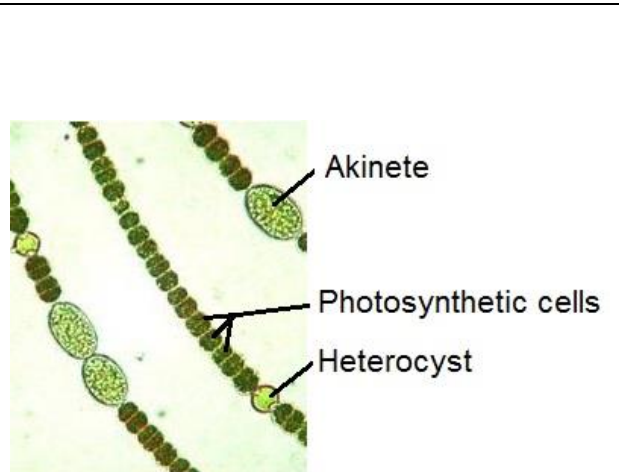
Non-Photosynthetic Bacteria — Microorganisms that contain peptidoglycan in their cell walls.

 <p>Micrograph showing Gram-stained bacteria. Labels indicate: Rod (gram-positive), Coccus (gram-positive), and Vibrio (gram-negative).</p>	<p>These bacteria are commonly divided into 2 groups based upon their appearance after Gram staining.</p> <ul style="list-style-type: none">• Bacteria that appear purple are gram-positive.• Bacteria that are pink are gram-negative. <p>Bacteria are also classified based upon their morphology (shape).</p> <ul style="list-style-type: none">◦ Coccus is spherical.◦ Bacillus is rod shaped.◦ Vibrio are shaped like commas.
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Cyanobacteria - photosynthetic bacteria that are generally blue-green in color. They were once classified as algae because they have **chlorophyll a**. This explains why they are often referred to as the **blue-green algae**. **Cyanobacteria do not contain chloroplasts**. They are present in almost all moist environments, and over a 1,000 species have been reported. We will look at one examples of cyanobacteria, *Anabaena*.

Anabaena is a **filamentous cyanobacteria** that exists as plankton. It is known for its **nitrogen fixing** abilities, and they form symbiotic relationships with certain plants, such as the mosquito fern. They are one of four genera of cyanobacteria that **produce neurotoxins**, which are harmful to local wildlife, as well as farm animals and pets. Production of these neurotoxins is assumed to be a part of its symbiotic relationships, protecting the plant from herbivores.

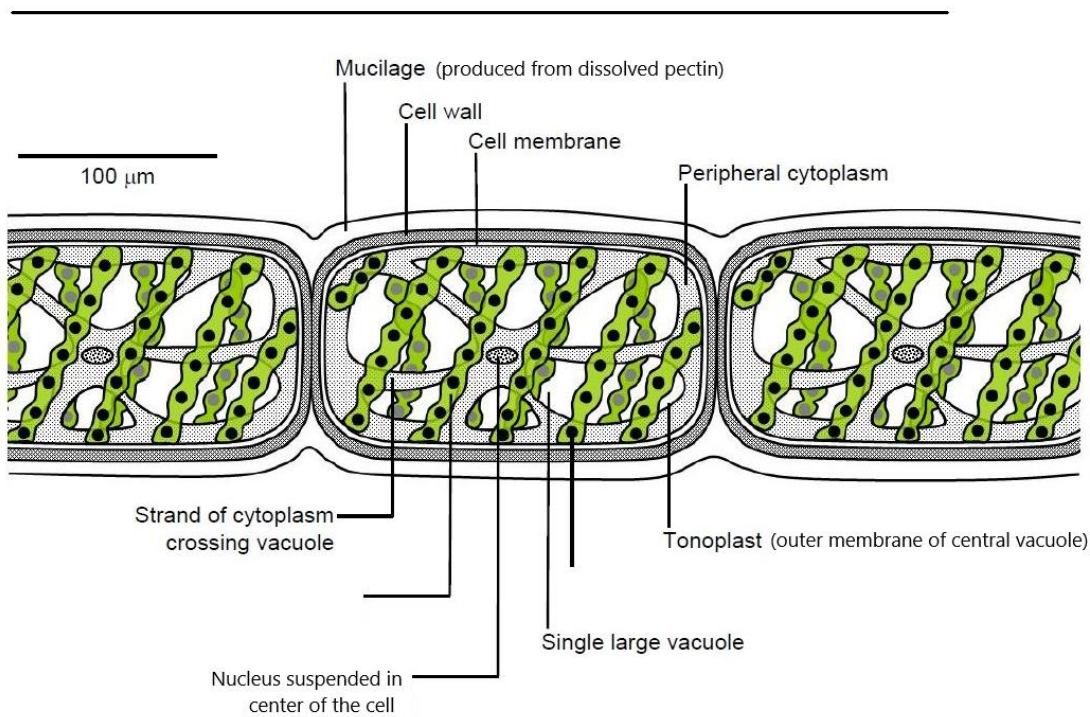
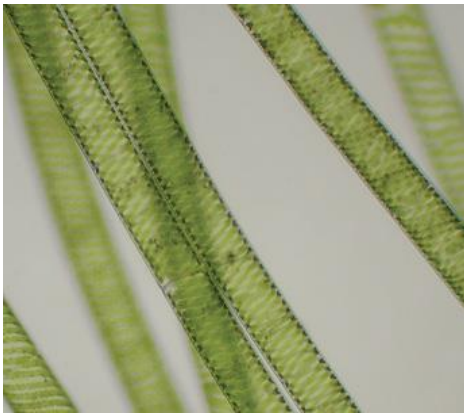
- **Heterocysts** – cells with a slightly thicker wall that are nitrogen-fixing & are where the filaments commonly break.
- **Akinetes** – dense-looking cells that are somewhat oblong and are resistant to freezing & desiccation (drying out).



Eukaryotic Organisms - Single-celled, eukaryotic organisms belong to **Kingdom Protista**, and are called protists. Those protists that are animal-like are put in **Subkingdom Protozoa**, and the protists that are plantlike belong to **Subkingdom Algae**.

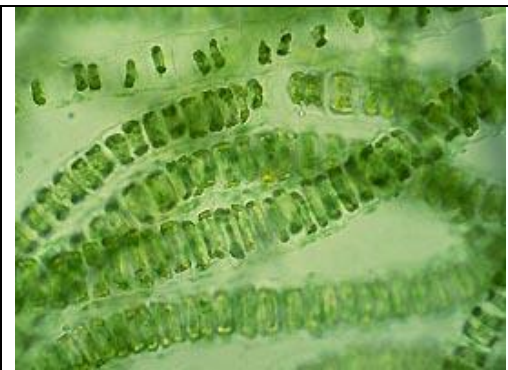
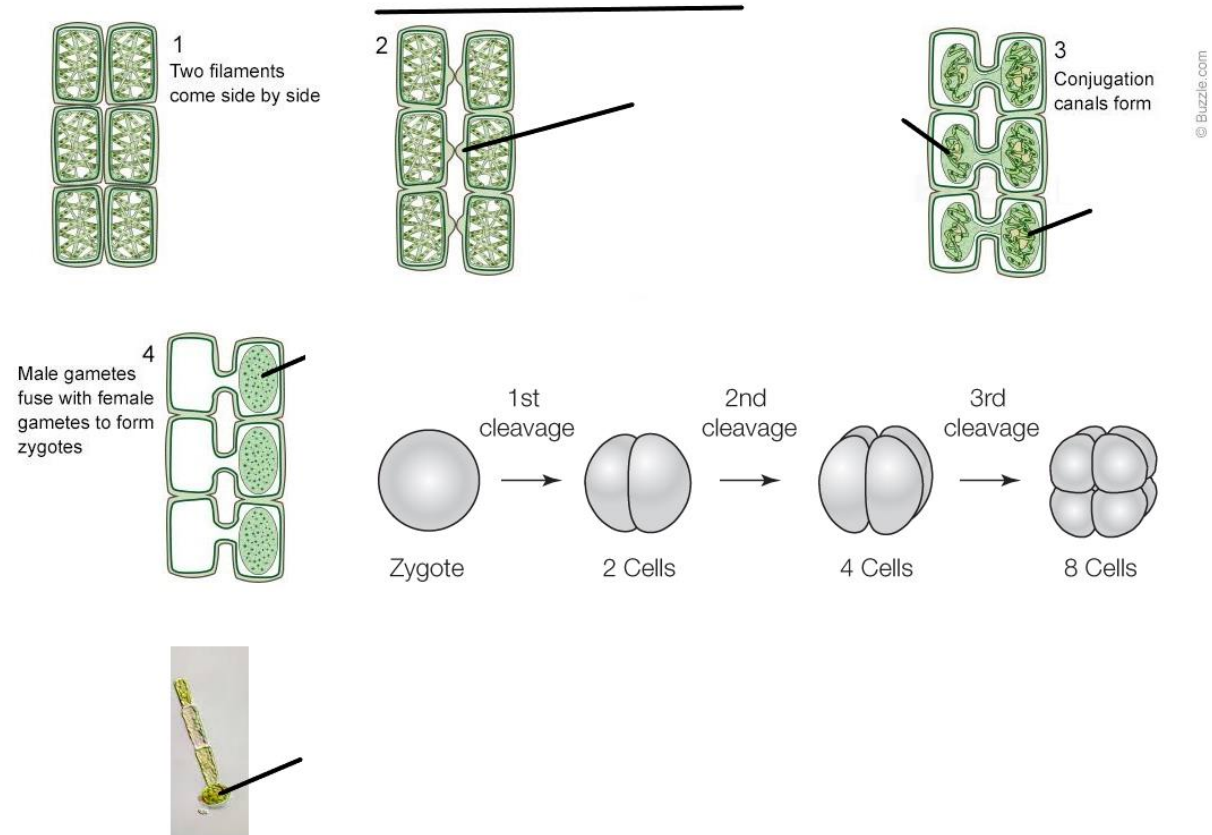
Subkingdom Algae includes all the photosynthetic, eukaryotic protists. They lack the tissue differentiation found in plants. Algae may be unicellular, colonial, or filamentous. Algae have distinct, visible nuclei and chloroplasts. There are 7 different divisions of algae, but we will examine only a selection of them:

Spirogyra is a filamentous green algae of the, named for the helical or **spiral arrangement of the chloroplasts**. It is commonly found in freshwater areas. *Spirogyra* measures approximately 10 to 100µm in width and may stretch centimeters long. This particular algal species, commonly found in polluted water, is often referred to as "pond scum". The cell wall has two layers: the outer wall is composed of **pectin that dissolves in water to make the filament slimy to touch** while the inner wall is of cellulose. The cytoplasm forms a thin lining between the cell wall and the large vacuole it surrounds. The chloroplasts are ribbon shaped, serrated or scalloped, and spirally arranged. The chloroplasts have micro-compartments, known as **pyrenoids**, that function in carbon fixation. In spring *Spirogyra* grows under water, but when there is enough sunlight and warmth they produce large amounts of oxygen, adhering as bubbles between the tangled filaments. The filamentous masses come to the surface and become visible as slimy green mats.



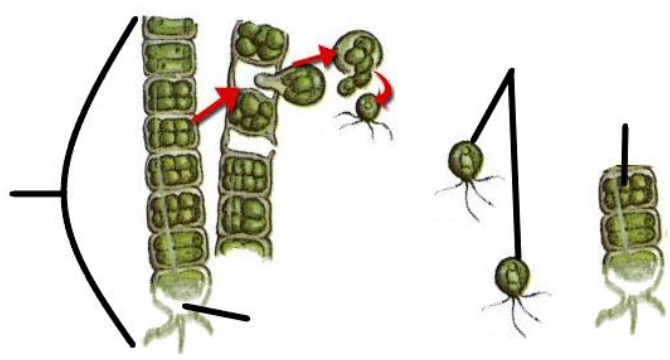
Spirogyra

Sexual Reproduction in *Spirogyra*.



Ulothrix is a **filamentous green algae**, generally found in fresh and marine water. Its cells are normally as broad as they are long, and they thrive in the low temperatures of spring and winter. They become attached to surfaces by a modified holdfast cell.

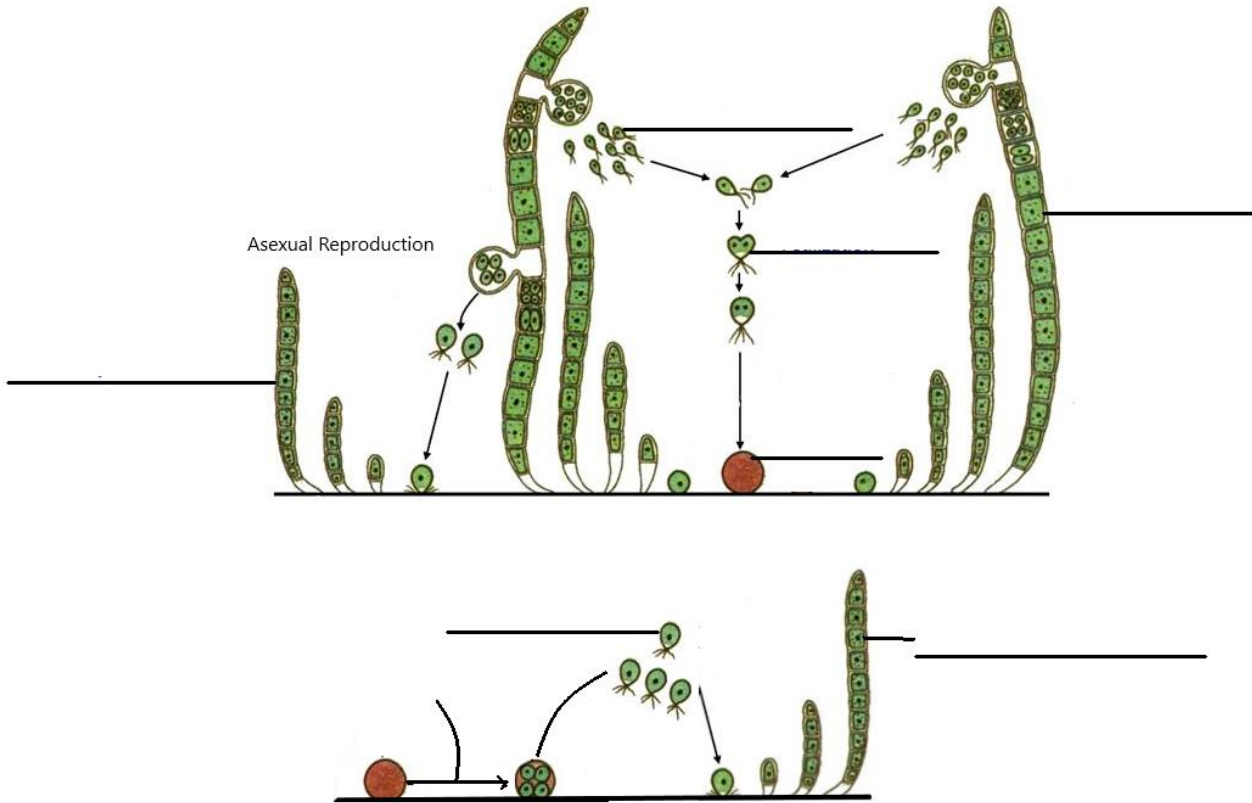
Ulothrix Asexual Reproduction
 (Essentially, this is cloning. It is much faster, but the cost is that all the offspring are identical.)



Ulothrix

Sexual Reproduction

Ulothrix uses sexual reproduction when times are bad. It results in variation in the new filaments.



Diatoms are a major group of **golden brown algae**, and are one of the most common types of **phytoplankton** (microscopic plants). Diatoms are **primary producers** within the food chain. Most diatoms are unicellular, although they can exist as colonies in the shape of filaments or ribbons, fans, zigzags, or stellate colonies. Diatom cells are characteristically encased within a unique cell wall made of **silica** (hydrated silicon dioxide) called a **frustule**. These frustules show a wide diversity in form, but **usually consist of two symmetrical sides with a split between them**, hence the group name.

Diatoms, viewed under a microscope



Dinoflagellates — (*dinos*, Greek “whirling,” *flagellum*, Latin “whip, surge”) are a group of flagellate protists. Many are photosynthetic, but a large number are **mixotrophic** (they both photosynthesize and ingest prey). Most are marine, but they are also common in fresh water. An algal bloom of dinoflagellates can result in a visible coloration of water colloquially known as **red tide**. When this happens, many marine animals suffer because the dinoflagellates produce a **neurotoxin** which affects muscle function. Humans may also be affected by eating fish or shellfish containing the toxins.

Various Dinoflagellates, viewed under a microscope



Seaweeds — is a loose term that encompasses macroscopic, multicellular, benthic marine algae. Seaweeds include members of red, brown, and green algae. Seaweeds are used as foods, medicines, fertilizers, etc. Some larger seaweeds have food- and water-conducting tissues, but none have true xylem, phloem, roots, or leaves. Some do have **holdfasts**, rootlike structures that anchor them to rocks. Others have **bladders** (bulblike swellings that enable seaweeds to float), **stipes** (stalks), and/or **blades** (flattened, leaflike bodies).

Slime Molds — organisms that use spores to reproduce, formerly classified as fungi. Some of these organisms appear as a gelatinous “slime” during part of their life cycles. They decompose (and feed upon) dead plant, bacteria, yeasts, and fungi. When food is abundant, slime molds exist as single-celled organisms, but when food is in short supply, slime molds congregate and start moving as a single body. In this state, they may form stalks that produce fruiting bodies, releasing spores.

