Domain Eukarya.

Eukaryotes have nucleated cells. Endosymbiosis has played an important role in the evolution of the group. Both mitochondria and chloroplasts were formed from free-living bacteria, and there is speculation that flagella and all other microtubular structures resulted from a third endosymbiotic event. Some eukaryotes lack mitochondria, but these were probably derived from ancestors that had them. Both plants and animals (and most other eukaryotic groups) have mitochondria derived from a single endosymbiotic event in the distant past. The chloroplasts of all the various photosynthetic eukaryotic lineages are all also thought to have been derived from one single endosymbiotic event, where a free-living cyanobacterium was assimilated into a eukaryotic cell. This picture is complicated, however, because several photosynthetic lineages were secondarily derived by the endosymbiosis of a photosynthetic eukaryote by another.

Kingdom Protista.

Protists are simply all the eukaryotes that are not plants, animals or fungi. In general, they are either unicellular or have structurally simple bodies. In this topic, we will survey three phyla of protists that are not closely related to each other, or to plants, but which are traditionally included in the study of botany. Two of these possess both plant-like, and animal-like characteristics and were claimed by both the zoologists and botanists in the nineteenth century.
I. Euglenophyta  (The Euglenoids).

This phylum of unicellular flagellates includes both photosynthetic and heterotrophic members. The whole group was probably derived from a heterotrophic particle eater. About one third of the members contain chloroplasts. The pigmentation of these is strikingly similar to that of another phylum of protists, the Chlorophyta (the green algae). The chloroplasts of Euglena contain chlorophylls a and b and carotenoids as do those of the Chlorophyta. In most other ways, however, euglenoids are unlike the green algae. They do not have cell walls. They do not seem to have meiosis. Their cells have a proteinaceous structure immediately below the plasma membrane (the pellicle) that provides shape while allowing for flexibility. Euglenoids store food in the form of paramylon usually suspended in the cytosol, where the green algae generally store food as starch associated with the chloroplast. Euglenoids may have an anterior eye spot which is never associated with a chloroplast. In the motile green algae, eyespots are always associated with the chloroplast. This enigmatic combination of characters can be explained if we consider the origins of euglenoid chloroplasts as a secondary endosymbiotic event where a green alga was engulfed by a euglenoid cell. The triple membrane system surrounding these chloroplasts is evidence of the idea, and molecular data also support it. By this interpretation, the outer membrane was derived from the plasmalemma of the euglenoid.

Euglena: You should know this genus as a member of a larger phylogenetic group, the euglenoids. Also, recognize these cellular structures: chloroplasts, paramylar bodies, eye spot, and flagellum. Recognize euglenoid motion.

- Take a drop of culture and make a wet mount. Observe individual motile cells carefully at 400x.

   Do the cells have an anterior or posterior flagellum?

   How might the eye spot and the cells’ motility be adaptive for a photosynthetic organism?

   - Now add a drop of nickel sulfate to the edge of the cover slip. Wick water up through a tissue from the other side to draw the nickel sulfate through the wet mount. Nickel sulfate will not kill the cells, but will paralyze the flagellum. Again observe cells at 400x. Note the eye spot, chloroplasts, and flagellum.
Draw a cell with these structures labelled.

| Diameter fov = _______ mm |

Observe the movement of the cells. The contraction of the cells is possible because there is no cell wall. The twisting is due to the spiral structure of the pellicle.

II. Myxomycota (The Plasmodial Slime Molds).

This is another group that wouldn’t fit into the old two kingdom system being both animal-like and plant-like. The plasmodial stage consists of a coenocytic ameboid mass. A coenocytic organism is essentially acellular, and the plasmodium is basically one huge cell. The plasmodium engulfs prey by phagocytosis and responds to external stimuli. When food or water are scarce, however, the plasmodium transforms itself into a mass of fungal-like sporangia.

IIa. The plasmodium. Take a water agar culture of Physarum from the front bench. Note the pattern presented by the plasmodium on the agar. Remove the cover of the petri plate and, with the 4x objective in place, position the entire plate onto your mechanical stage. Bring the plasmodium into focus and observe cytoplasmic streaming.

Is the flow always in one direction? ________________________________

If you have a second hand on your watch, time the flow from one reversal to another. Time at least three intervals. What are the times? Do they vary?

________________________________________________________________________________________

________________________________________________________________________________________

Compare your results with others in the class and record these comparisons below:

________________________________________________________________________________________
Speculate about how the oscillation of the flow of the cytoplasm may be adaptive.

Draw a plasmodium as it appears to the unaided eye on the agar.

**Plasmodium**                  **Sporangium**

**IIb. Sporangia.** view the examples of plasmodial slime mold sporangia on demonstration.

Next to your drawing of a plasmodium of *Physarum*, draw its sporangium.

**III. Rhodophyta**  (**The Red Algae**).

Rhodophyta is primarily a marine group of photosynthetic organisms. Members lack *flagella*. Their pigmentation includes *chlorophyll a* and *phycobilins* (*phycoerythrin* and *phycobilin*). The common name, red algae, is derived from their color, which is due to the accessory pigment phycoerythrin. The group is largely made up of multicellular “sea weeds” which have a complete *alternation of generations*. This means that there exists both haploid and diploid colonies in each species of red algae. Some members (the coralline red algae) are important reef builders. *Agar* is produced from the red alga genera, *Gelidium*, *Pterocladia* or *Gracilaria*. Irish Moss, *Chondrus crispus*, is the source of the commercially important emulsifier Carageenan. *Porphyra*, is a commercially grown red alga, and is processed into Nori, a staple in the Japanese diet

**Objectives:** Recognize examples seen in lab as *red algae*. Know why their color allows them to live at greater depths than other photoautotrophs

Observe the examples of red algae on demonstration.

Some members of the Red algae live deeper in the ocean than any other photosynthetic organism. How are their accessory pigmentation adaptive for these conditions?