Topic 17

Introduction to Domain Eukarya - Organisms with nucleated cells

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. All eukaryotes have mitochondria derived from a single endosymbiotic event in the distant past.

The chloroplasts of all photosynthetic eukaryotes 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 groups 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.

Domain: Eukarya

- **Kingdom: Protista**
  - **Euglenoids**
    - **Genus: *Euglena***
  - **Dinoflagellates**
  - **Plasmodial Slime Molds**
  - **The Red Algae**

I. The Euglenoids.

These unicellular flagellates include both photosynthetic and heterotrophic members. The 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 the Green Algae. The chloroplasts of *Euglena* contain **chlorophylls a and b** and **carotenoids** as do those of the Green Algae. In most other ways, however, euglenoids are quite different. They do not have **cell walls**. They do not seem to undergo **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 not 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 f**lagellum**. Recognize **euglenoid motion**.

Do the cells have an anterior or posterior flagellum?

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

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Draw a cell with these structures labelled.

Diameter fov = ______ mm

Phototropism in *Euglena*:

While viewing *Euglena* in a wet mount with your 10x objective, close down your field iris to generate a vignetted area of light surrounded by a halo of dark.

Choose a random area on your slide and count the number of cells present. Then, without moving your stage, wait three minutes with the light on. Now, again, count the number of cells in the illuminated area. Do this procedure twice and record your data below. Share your results with your class by reporting it on the board.

	Number of *Euglena* Cells -Start	Number of *Euglena* Cells - Finish
I.		
II.		

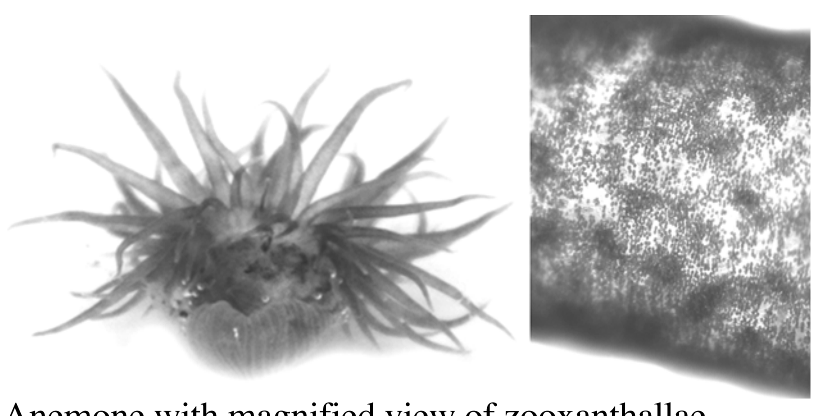
Record the average numbers of each from your entire class below:

Average number of cells - start ______________

Average number of cells - finish ______________

II. Dinoflagellates.

This is a group of flagellated unicellular organisms. They include both photosynthetic and non-photosynthetic members. Many members bioluminesce and this phenomenon is common in tropical seas. They are important primary producers as marine phytoplankton. They are also significant ecologically and commercially for the algal blooms they generate called 'Red Tides': see page 323 in your text. Their most important ecological roll, however, is as mutualistic symbionts in coral polyps. All corals contain symbiotic dinoflagellates called **zooxanthellae**. They are necessary for the survival of these reef forming organisms, and, hence, of all tropical reefs. Currently a major ecological crisis concerns the bleaching of reefs due to the loss of zooxanthellae from the tissues of corals. The phenomenon is poorly understood, but is a major concern for the continued survival of reef systems. Sea anemones are closely related to reef forming polyps and these also are associated with dinoflagellates of the genus *Symbiodinium*.



Anemone with magnified view of zooxanthallae

Anemone/*Symbiodinium*.

Each lab section has several anemones which may be viewed with a dissecting microscope. Each bench should prepare a wet mount using a clipped tentacle. Each student should view this slide and make a drawing of the tissue with the zooxanthellae.

III. The Plasmodial Slime Molds.

This is another group that wouldn't fit into the old two kingdom system having both animal-like and plant-like characteristics. The plasmodial stage consists of a coenocytic* ameboid mass.

*A coenocytic organism is acellular, and a 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**.

IIIa. The plasmodium. Working with a partner, 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, place the entire petri plate on the stage of one of the older, Olympus, microscopes. Start with the 4x objective in place. You may use the 10x objective, too, but not the 40x. Bring the plasmodium into focus and observe cytoplasmic streaming.

Is the flow always in one direction? ________________________________

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Time the flow from one reversal to another. Time at least three cycles of the your plasmodium.

Record these times?

___________ ___________ ___________

Do they vary? _____________

Compare your results with others in the class. Are they the same?

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

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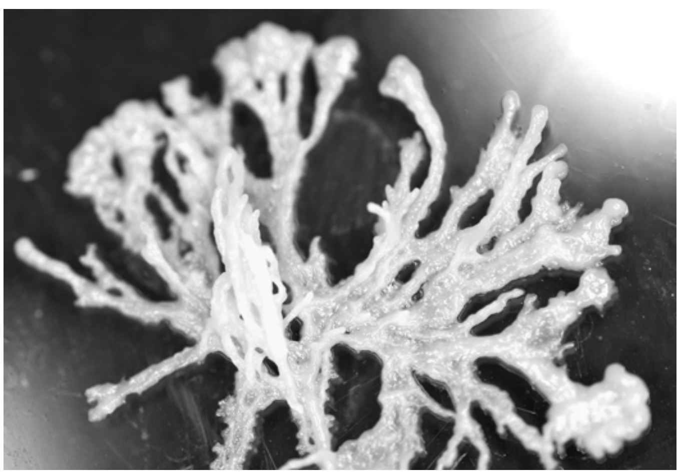
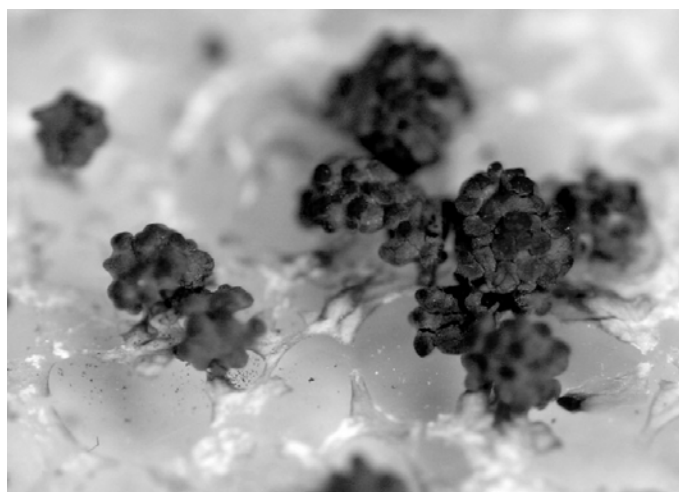
IIIb. Sporangia. view the examples of plasmodial slime mold sporangia on demonstration.

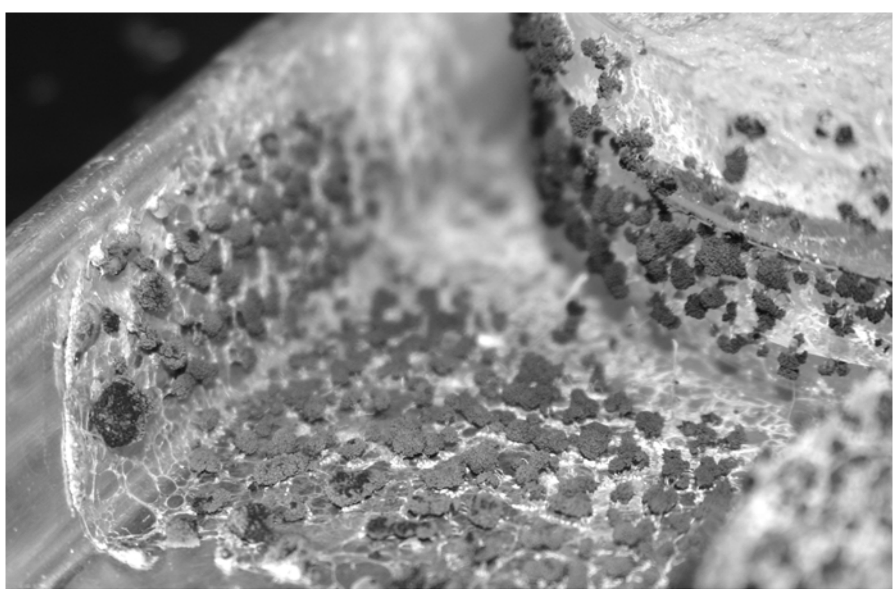


Plasmodium of *Physarum*



Sporangia of *Physarum* 40X

Sporangia of *Physarum* forming from a plasmodium that streamed out of petri dishes on to an aluminum tray.



IV. The Red Algae.

The red Algae are primarily a marine group of sea weeds. Members lack **flagella**. Their pigmentation includes **chlorophyll a** and **phycobilins** (**phycoerythrin** and **phycobilin**). Their 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”. 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 pigmentations adaptive for these conditions?

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