Topic 22. Protista III - The Green Algae

Domain: Eukarya

Kingdom: Protista

Phylum: Chlorophyta

Genus: *Hydrodictyon*

Volvocine Line

Genus: *Chlamydomonas*

Genus: *Pandorina*

Genus: *Volvox*

Class: Charophaceae

Desmids

Genus: *Spirogyra*

Genus: *Chara*

Of all the phyla of protists, this is the one most directly relevant to botanists. **Plants are believed to have evolved from the green algae**. In fact, plants, which make up an entire kingdom, can be thought of simply as a clade of the green algae that have become adapted to life on land. There are several lines of evidence that lead us to this conclusion:

1. Green algae have the same photosynthetic pigments as plants (Chlorophylls a & b, xanthophylls and carotenoids).
2. They store their food as starch in plastids (chloroplasts) - unlike plants (except hornworts!), starch deposition is associated with a structure called a **pyrenoid**.
3. Some have cell walls composed of cellulose.
4. One class of the Chlorophyta, the charaphycean green algae, have members that undergo cytokinesis, like plants, through the creation of a cell plate mediated by a phragmoplast.

Today you will see seven genera of green algae. Observe them carefully and sketch each one. In each case, note the grass-green coloration which is a reflection of their pigmentation. Identify chloroplasts in each case and pyrenoids if apparent. You need to recognize each to genus or common name as well as being members of the green algae. You should also recognize ***Chara, Spirogyra***, and **desmids** belonging to the phylogeny that includes the plants. These are the charaphycean green algae, those in the class **Charophyceae**.

I. The Volvocine Line: The first three genera we will observe constitute a phylogenetic group all of which share the same basic cellular structure. This consists of two anterior flagella, a cup-shaped chloroplast with a prominent pyrenoid, and a red eye spot on the anterior end of the cell.

Ia. ***Chlamydomonas***: prepare a wet mount of this motile, unicellular green alga. While it requires some effort, look for the two flagella at the anterior end and the red eye spot. Look for cells that are moving but seem stuck in one place. In the center of the chloroplast a pyrenoid should be apparent. Compare your view with that of the electron micrograph by the culture.

Drawings:

Diameter fov = _____ mm

Diameter fov = _____ mm

View of eye spot **View of pyrenoid** **View of flagella**

Ib. ***Pandorina***: This alga consists of colonies of *Chlamydomonas*-like cells arranged in a sphere with their flagella projected outward. Observe the hanging-drop slide of free swimming colonies. Now prepare a wet mount of your own, but first observe without a cover slip. Then add a cover slip and observe at 400x to clearly see details of the individual cells. Draw both the colonies and the cells.

Colony Cell

Diameter fov = _____ mm

Diameter fov = _____ mm

Ic. ***Volvox***: This impressive algae again consists of colonies of *Chlamydomonas*-like cells. In this case, however, each colony includes over 500 cells. As before, observe the hanging-drop slide of free swimming colonies. Now prepare a wet mount of your own, but first observe without a cover slip. Then add a cover slip and observe at 400x to clearly see details of the individual cells. Draw both the colonies and the cells.

Drawings of *Volvox*

Diameter fov = _____ mm

Diameter fov = _____ mm

Of a whole colony (no cover slip) **Detail of cells (with cover slip)**

Speculate on the selective pressure driving this evolutionary trend towards multicellularity?

_____

_____

_____

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II. ***Hydrodictyon***: Observe the whole colonies of "water net". Prepare a wet mount of material from the bowl. Identify the pyrenoids associated with the chloroplast. Each cell has a single chloroplast that consists of a perforated sheet. The cell has a large central vacuole, and the chloroplast is wrapped around the vacuole in the

layer of cytosol between the cell and vacuole membranes. These cells are coenocytic, but you won't be able to see the nuclei. In vegetative reproduction, each cell gives rise to another whole colony (net).

Hydrodictyon Drawings:

Diameter fov = _____ mm

Of the net (at 40x) **Detail of the cell with pyrenoids labelled (400x).**

III. The Charophycean Green Algae (Class Charophyceae).

These algae form a sister group to the plants. They undergo cytokinesis through the production of a **phragmoplast.**

IIIa. ***Spirogyra***: Prepare a wet mount of this filamentous organism. Note that it is made up of unbranched filaments. Note the spiralled chloroplasts and the pyrenoids along the chloroplasts. By through-focusing, discern the nucleus in the center of the cell. Like plant cells viewed earlier it is surrounded by cytoplasm suspended in a large central vacuole.

Drawings of *Spirogyra*

Diameter fov = _____ mm

Detail of chloroplast with pyrenoids labelled **With a visible nucleus (if possible)**

IIIb. Desmids - *Cosmarium* (know common name): These are unicellular, though their bilateral symmetry often makes them appear as two-celled. Prepare a wet mount. Note chloroplasts and pyrenoids. By through-focusing you may be able to discern Brownian motion of gypsum particles in their vacuoles.

Drawing of a desmid - label pyrenoids:

Diameter fov = _____ mm

IIIa. ***Chara:*** This is a morphologically complex alga. Take a petri dish with a sample to your seat. Make a quick sketch. Now make a wet mount using material at the front not in the petri dish. **Note** the disk-shaped chloroplasts. They are similar to the ones observed in *Elodea* and those you will observe in moss protonemata. Of all the algae you will see today this is the one which is most plant-like, both in the complexity of its external structure and in its cellular structure. This affinity is also shown in the similarity between *Chara*'s sperm and those of the primitive plants as well as by how it undergoes cytokinesis.

Drawings of *Chara*

Diameter fov = _____ mm

Habit **Cellular Structure**