Chapter 20 **Protists** **Name _____**

Lab Characteristics of Green Algae

Background Information

Green algae are members of phylum Chlorophyta and contain chlorophylls *a* and *b* within their chloroplasts. It is these chlorophylls that give the algae their green color. The body of algae is referred to as a thallus. Green algae are the most diverse of all of the algae types. Their body form may be unicellular, colonial, filamentous, or multicellular. Their method of sexual reproduction may include isogametes, heterogametes, or congugation. Green algae are found mainly in moist areas on land, in fresh water, and some are even found living in salt water.

In this investigation, you will observe some characteristics of several different types of algae.

Problem

Why are the green algae considered the most diverse of all of the algae?

Materials *(per group)*

Microscope	Chlamydomonas	Oedogonium
Spirogyra	Ulva	Volvox

Procedure

Part A. Unicellular Algae

1. Obtain a prepared slide of a green algae called *Chlamydomonas*. It is a small, unicellular algae about the size of a white blood cell. Find one large cell on high power and measure its longer dimension in micrometers (µm). _____ .

2. Use the textbook to make a drawing of *Chlamydomonas*. See page 526. Label the flagella and cell wall.

3. Reproduction in *Chlamydomonas* may either be sexual or asexual. Use page 528 as a reference and sketch the sexual reproductive cycle used by *Chlamydomonas*. When gametes are identical in appearance, they are called **isogametes** and are designated as a + or - sign.

Chlamydomonas - 400X	*Chlamydomonas* - Sexual Reproduction

4. Answer questions 1 through 4 in Observations.

Part B. Colonial Green Algae

1. Obtain a prepared slide of a green algae called *Volvox*. It is a spherical colonial algae. Find a colony on either scanning or low power and measure its diameter in micrometers (µm). _____ . If the colony is too large to measure with the ocular micrometer, then estimate its size. The diameter of the field of view on scanning power is 4 mm. On low power it is 1.5 mm.

2. Each *Volvox* cell is very similar to an individual *Chlamydomonas*. A typical *Volvox* colony is a hollow sphere of mucilage having 500 or more biflagellated algae cells fairly equally spaced around its outer surface. The combined beating of their flagella causes the colony to glide slowly through the water, rolling as it goes. Large colonies can reach a diameter of a millimeter or so and are easily visible to the naked eye.

3. Make a sketch on high power of several cells in the *Volvox* colony. Include the following labels on your sketch: single algal cell and mucilage.

4. They reproduce asexually by a process involving a group of surface cells which form a plate on the inside of the parent sphere. The plate becomes concave and eventually forms a sphere attached internally to the parent sphere. Before it becomes a free-swimming daughter colony, it turns completely inside-out, so that the flagella of the individual cells are now on the outside of the newly formed colony. Eventually, the mature parent colony ruptures, allowing the daughters, many of which will have third generation colonies developing within them, to escape.

5. Make a drawing of a Volvox colony with at least one daughter colony located on the inside. Use either scanning or low power for this task. Label the daughter colony.

Volvox - 400X	*Volvox* Colony - Asexual Reproduction

6. Answer questions 5 through 8 in Observations.

Part C. Filamentous Green Algae

1. Obtain a prepared slide of a green algae called *Spirogyra*. It is a filamentous green algae. The cells of each filament are similar to each other because they were produced by mitosis.

2. Make a sketch on high power of a single cell of the *Spirogyra*. Include the following labels on your sketch: cell wall, nucleus, chloroplast, and pyrenoid. Measure the length and width in micrometers (µm). _____ and _____ .

Spirogyra - Vegetative Cell - 400X

3. During sexual reproduction, filaments of opposite mating types lie side by side and form projections that grow toward each other. These projections touch and the separating wall dissolves, thus forming a **conjugating tube**. The cellular contents of the + strain then migrate through the conjugation tube and fuse with the nonmotile - strain. The resulting zygote develops a thick, resistant cell wall and is referred to as a **zygospore**. The zygospore is released when the filament disintegrates, and then the zygospore undergoes meiosis to form haploid zoospores that become new filaments.

4. Make a series of drawings depicting the process of sexual reproduction in the green algae *Spirogyra*. Label the following drawings as such: 1st drawing -conjugation tube; 2nd drawing - + and - strains; 3rd drawing - zygospore.

Forming the Conjugating Tube	Beginning the Transfer Process	Forming the Zygospore

5. Answer questions 9 through 12 in Observations.

6. Obtain a prepared slide of a green algae called *Oedogonium*. It is a filamentous green algae like Spirogyra but its method of sexual reproduction is different. *Oedogonium* have distinctly different gametangia. The male structures are called **antheridia** and consist of a series of small cells that produce many flagellated sperm cells. The female gametangium is called an **oogonium** and will contain an egg. The oogonium will appear to be a large, bulging cell within the algal filament.

7. Make two drawings, one showing a filament with antheridia and the other showing a filament with an oogonium. Use high power for your drawings and compare the length of one antheridium with that of the length of one oogonium. The antheridium length is _____ micrometers (µm) and the oogonium length is _____ micrometers (µm).

Oedogonium - Antheridium - 400X	*Oedogonium* - Oogonium - 400X

8. Answer questions 13 and 14 in Observations.

Part D. Multicellular Green Algae

1. Obtain a prepared slide of a green algae called *Ulva*. Ulva is also known as "sea lettuce". The slide that you are going to use represents only a small piece of the entire algae thallus. Brown algae, red algae, and some green algae are very complex in their body structures. These algae are said to be multicellular and form complex structures like holdfasts, stipes, blades, and even specialized reproductive structures.

2. Using high power, measure the diameter of only one *Ulva* cell. Its diameter is _____ micrometers (µm). Try focusing up and down through the *Ulva* cells. Can you determine the number of cell layers that make up this slide? _____ .

3. Reproduction in *Ulva* may either be sexual or asexual. Use page 529 as a reference and sketch the alternation of generations used by *Ulva*.

Sporophyte Generation	Gametophyte Generation

4. Answer questions 15 through 17 in Observations.

Observations

1. What type of thallus does the *Chlamydomonas* have?

2. Is a zoospore larger or smaller than an adult *Chlamydomonas*??

3. What are isogametes?

4. Which cells of the sexual life cycle of the *Chlamydomonas* are haploid?

5. What are the tiny spheres inside the *Volvox* colony?

6. How do you think the number of cells in a young *Volvox* colony compares to the number in a mature colony?

7. Each *Volvox* cell is biflagellate. What does the term biflagellate mean?

8. If the daughter colonies form by asexual reproduction, would the daughter colonies be genetically different or identical to each other?

9. Are the filaments of *Spirogyra* branched?

10. What is the shape of the chloroplast in *Spirogyra* ?

11. What term is used to describe the method of sexual reproduction in *Spirogyra*?

12. Is the zygospore haploid or diploid?

13. Are the gametes produced by *Oedogonium* isogametes or heterogametes?

14. Name one feature that is common to both *Spirogyra* and *Oedogonium*.

15. Sporophyte generations always produce _____ reproductive cells while gametophyte generations always produce _____ reproductive cells.

16. Does meiosis in *Ulva* produce gametes or spores? They are both haploid reproductive cells.

17. How many cell layers does *Ulva* have?

Analysis and Conclusions

1. How is *Chlamydomonas* animal-like? How is it plant-like?

2. List three ways in which the green algae you observed in this investigation are different.

4. List two ways in which the green algae you observed in this investigation are similar.

Critical Thinking and Application

1. Are unicellular organisms necessarily simple organisms? Explain your answer.

2. Why are algae not able to grow on land to any great extent?

3. What is the advantage of a holdfast to an alga, such as *Ulva,* that lives in coastal waters?

4. Suppose a new species of unicellular green algae containing chlorophyll and an eyespot is discovered. Would you expect this type of algae to have either flagella or cilia? Explain.

5. Green algae is believed to be the ancestor of the plants. Name five characteristics that are common to both green algae and green plants.

   a)

   b)

   c)

   d)

   e)