Chapter 6: Protists I

Time Required:

Text reading - 20 minutes
Experimental - 1 to 2 hours

Experimental pre-setup:

Order protozoa kit one week prior
Practice using microscope

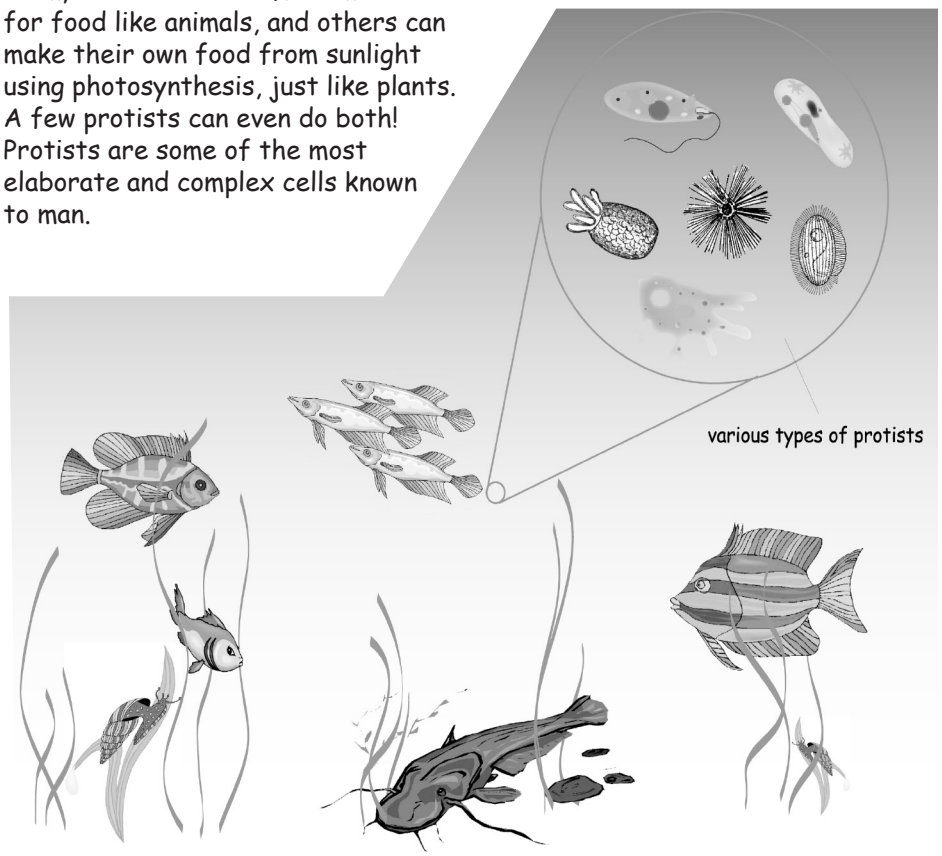
Additional Materials:

Protozoa kit
Carolina Biologicals, catalog # CE-13-1000)

6.1 Introduction

Protists, also called protozoa, are tiny creatures that are like both plants and animals. Most are made of only one cell. They are so small that they cannot be seen with the naked eye. For most of human history, nobody knew they even existed, but in the middle of the 17th century, the first microscopes were invented and an entirely new world of microscopic organisms, including protists, was found. Protists live almost everywhere, including soil, freshwater ponds and salt water oceans.

Despite their small size, protists are amazing creatures. They crawl, swim, and divide in half. Some hunt for food like animals, and others can make their own food from sunlight using photosynthesis, just like plants. A few protists can even do both! Protists are some of the most elaborate and complex cells known to man.



Overall Objectives:

The students will be introduced to the microscopic organisms known as protists. They will also be introduced to the function and use of a microscope.

Protists are members of the kingdom Protista.

[NOTE: In some texts, the term protist refers only to the microscopic species. In the 1970's and 80's, the boundaries of the kingdom Protista were expanded to include some multicellular organisms, such as seaweeds and slime molds, and the name of the kingdom was changed to Protoctista. In this chapter we will focus only on the microscopic varieties which will be called protists or protoza.]

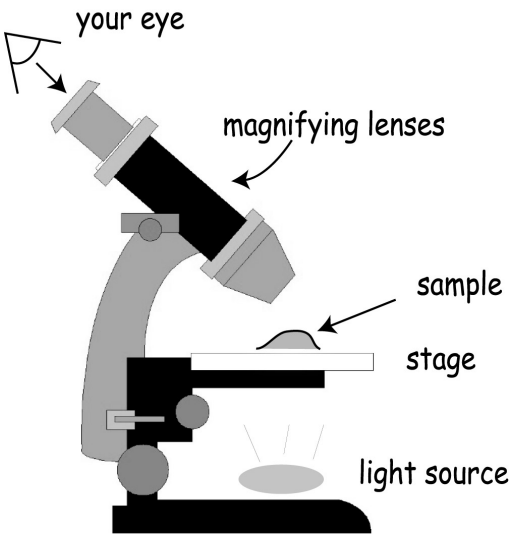
Protists are found everywhere there is water. Protists are found in both salt and fresh water, and in soil. Some well known protists include:

Malarial parasites
red tide organisms
diatoms
potato-blight organisms
Giardia
African sleeping sickness organisms

Protists have been difficult to classify because they are eukaryotes and can have both plant and animal-like qualities. Protist is an "umbrella term" that fits those organisms that can not be easily placed into any other kingdom.

6.2 The microscope

There are protists all around us all of the time, but because they are single celled organisms, they are not easily seen without a microscope.



Light Microscope

A microscope makes very small objects appear larger. Scientists use several different types of microscopes to look at cells, molecules, and even individual atoms! However, the easiest microscope to use, especially by students, is the *light* microscope. A light microscope is like a very powerful magnifying glass. To use a light microscope, the sample is placed below the magnifying lenses, usually on a small stage. In modern microscopes, the sample is illuminated with a light source that is placed either above or below the sample. This extra light illuminates the small structures found in microscopic samples.

In 1665, Robert Hooke, an English scientist, was the first person to observe cells with a small microscope. He was able to magnify thin slices of cork 30 times (30X) and was able to see individual cork cells. Around the same time, Anton van Leeuwenhoek, a Dutchman, made a much more powerful microscope. He magnified pond water 300 times (300X) and saw tiny one-celled "animacules" swimming around. He was the first person to observe the single-celled organisms that we now call protists. Much to his dismay, he even found protists living in his mouth!

This page introduces the students to the light microscope. There are many different types of microscopes today including the light microscope, the electron microscope, the scanning tunneling, and scanning force microscopes.

Light microscopes use lenses and light to magnify small objects and make them appear larger. If a light microscope is available, it would be good to discuss the various parts of the microscope at this time.

A sample is placed below the lens and a light source is placed below the sample. The observer looks through the lens at the sample below. If the lenses are powerful enough, individual cells can be seen. Plant and animal cells are between 10 and 100 microns in size (one micron is 1/1000 of a millimeter). A human hair is about 200 microns in diameter. Bacteria are smaller than plant or animal cells at about 1 micron in diameter. The unaided eye can easily visualize objects as small as 1mm so a magnification of 10X to 1000X allows us to see animal cells to bacteria.

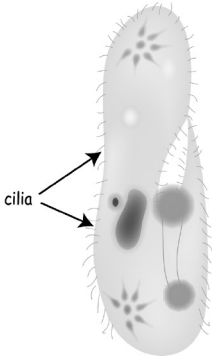
Robert Hooke is traditionally credited with observing the first cells in 1665. However, Galileo adapted lenses for use in microscopy as early as 1614. Hooke seems to have coined the term "cell," which comes from the Latin word *cella* and mean small room or cubicle. It appears that Hooke did not observe living cells. Anton van Leeuwenhoek is credited with the discovery of little animals that he called "aminacules." He observed the organisms we now call protists in pond water.

6.3 Movement

There are almost 60,000 known species of protists. This is as many as the number of known plants and animals in the visible world. Although protists are classified in the single kingdom, Protista, they vary in structure and function more than any other group of organism. Protists are divided into three main groups, depending mainly on how they move: the ciliates, the flagellates, and the amoeba.

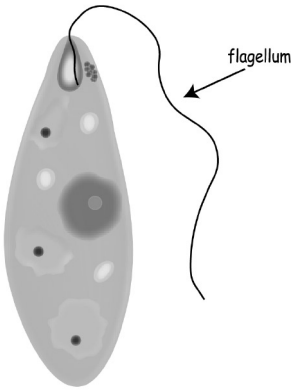
The ciliates swim with very small hair-like projections on their bodies called cilia. The cilia beat very rapidly and propel the tiny creature through the water like a little submarine. A Paramecium is a type of ciliate.

Ciliates



Paramecium

Flagellates



Euglena

Flagellates also swim, but instead of many short hair-like projections, flagellates have only one or two long whip-like flagella that extend from one end of their body. These whips propel the flagellate through the water much like the tail of a fish. A Euglena is a type of flagellate.

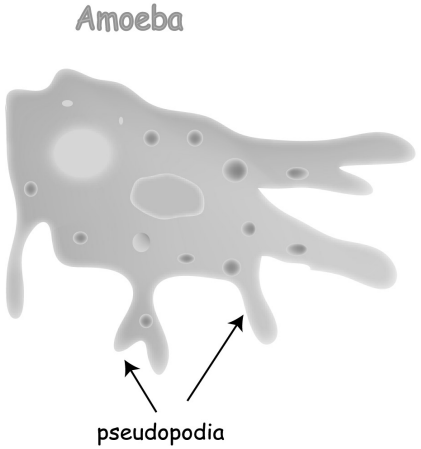
In this section the students will be introduced to the three main groupings of protists. These groupings are based primarily on how the organism moves.

The three groupings are: ciliates, flagellates and amoeba.

The ciliates include *Paramecium* and *Stentor*. This group is characterized by many small hair-like projections on their bodies called cilia. The cilia "beat" rhythmically propelling the organism smoothly through the water. By controlling the beating pattern and speed, ciliates can turn and even back up.

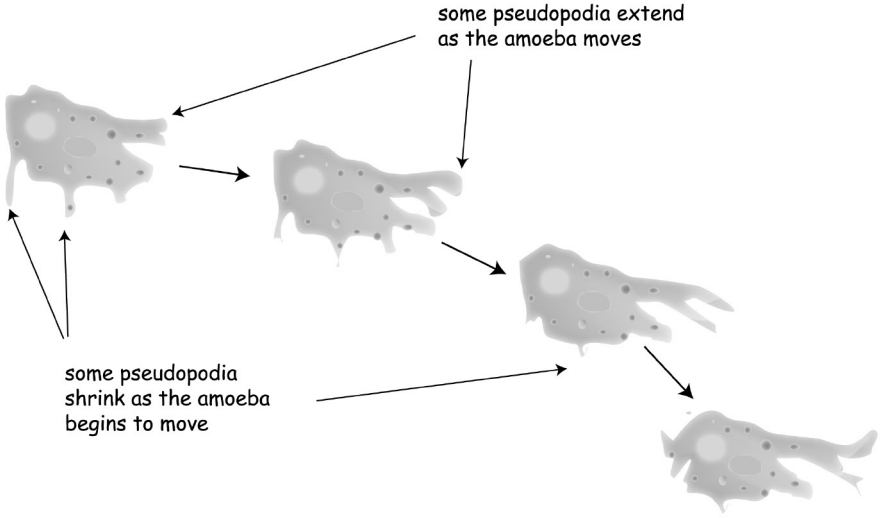
The flagellates include the uniflagellar species like *Euglena* and the dinoflagellates (two flagella) like *Ceratium* and *Pfiesteria*. Flagellates move using whips that propel them through the water.

Though they have a simple appearance in a microscope, cilia and flagella are actually very sophisticated machines. Each whip contains strands of long aggregate molecules called microtubules. As the microtubules slide past each other, the whip, or cilia, changes orientation. When the microtubules slide in the opposite direction, again the whip changes orientation and these successive changes cause the cilia, or flagella to beat or whip.



The amoeba move very differently; they do not swim or use flagella or cilia. Instead, amoeba crawl along surfaces by extending and bulging the edges of their membranes. The portions of their membranes that stick out are called pseudopodia. Pseudo is Greek and means "false" and podia means "foot." So a pseudopod is a "false foot."

In a microscope, the movement of an amoeba along the surface of a glass slide looks something like this:



The Amoeba (also called Rhizopods) do not have flagella or cilia for swimming, but rather use pseudopodia to move and feed. Pseudopods are "false feet" that allow the organism to creep along surfaces.

Amoebas are found in both freshwater and saltwater environments. Some amoebas are harmful to humans, such as *Entamoeba histolytica,* which causes amoebic dysentery.

6.4 Summary

Here are the main points to remember from this chapter:

- Protists are microscopic, one-celled organisms that have both plant-like and animal-like qualities.
- A microscope is a special instrument that makes very small things appear larger.
- There are three main types of protists based primarily on how they move: cilates, flagellates and amoeba.
- Cilates move with tiny hairlike projections called cilia.
- Flagellates move with one or two long whips called flagella.
- Amoeba move by crawling with pseudopods, or "false feet."

Discuss the main points of this chapter with the students.

Ask the students to think about the plant and animal qualities protists have. Ask them how protists eat and move and which of those things are like plants or animals. For example:

> *Some protists use the sun's energy to make food just like plants.*
>
> *Some protists eat other protists just like animals sometimes eat other animals.*
>
> *Amoeba use "false feet" to move and crawl like animals.*

Ask how a microscope makes things look bigger and how, without a microscope, things that are too small for our eyes cannot be seen. Ask the students to think about how exciting it must have been for the first microscopists to discover this new world of tiny organisms.

Discuss with the students the different types of movement protists display and how they are characterized by this movement.

Experiment 6: How do they move? Date:

Objective: *In this experiment, three types of protozoa will be observed. Based on their movement, protozoa in pond water will be characterized.*

Hypothesis: *We can tell the difference between ciliates and flagellates in pond water. We can only tell the difference between ciliates, flagellates and amoeba in pond water.*

Materials:

Microscope with a 10X objective
Microscope slides (Carolina Biological CE-63-2935)
3 eye droppers
fresh pond water or water mixed with soil
Protozoa study kit (Carolina Biologicals, catalog # CE-13-1000)
Protoslo (Carolina Biologicals, catalog # CE-88-5141) [optional]

Experiment:

1. Familiarize yourself with your microscope before beginning this lesson. Read the instruction manual for your microscope, if it is available, and try to look at any prepared samples that may have come with your microscope. If you already know how to operate a microscope, skip this step.
2. Take one of the protozoa samples and place a small droplet onto a glass slide that has been correctly positioned in the microscope.
3. Observe the movement of protozoa. If the organisms move too quickly, apply a droplet of Protoslo to the glass slide.
4. Patiently observe the movement of the protozoa. Note the type of protozoa in the Results section. Try to describe how the protozoa moves. Write down as many observations as you can.
5. Repeat step 4 with the other two protozoan types.

NOTE: **This is an optional experiment.** If a microscope is unavailable, or if protozoa cannot be ordered, this experiment can be skipped.

In this experiment the students will examine the three different types of protozoa discussed in this chapter and examine pond water to identify, based on movement, individual protozoa.

Have the students read the experiment *before* writing a hypothesis.

Microscope recommendation:

Carolina Biologicals sells a "student" microscope for $7.25 [catalogue # CE-97-2723]. It is made of plastic and is very durable. It has exceptional clarity for viewing protozoa and is easy for students to use. Together with the plastic well slides [catalogue # CE-63-2935, $2.30 for a pack of 10], this small microscope works very well.

The difficulty with this experiment is the viewing of the tiny organisms through the tiny eyepiece of a microscope. It is sometimes difficult for younger students to align their eye directly into the lens so that the sample is visible. Also, these organisms can swim rapidly through the field of view and it is easy to get frustrated trying to observe them. Protoslo will help slow the organisms down without killing them. Patience with this experiment is a must. It may be useful for the students to spend one day "playing" with the microscope and observing prepared slides, or pieces of hair, or other small objects before attempting to view the protozoa.

6. Now take a droplet of fresh pond water and place it in the microscope. Try to determine the type of protozoa you are observing based on how the organism moves. Write your results in the Results section.

Results:

Name _____

Name _____

Name _____

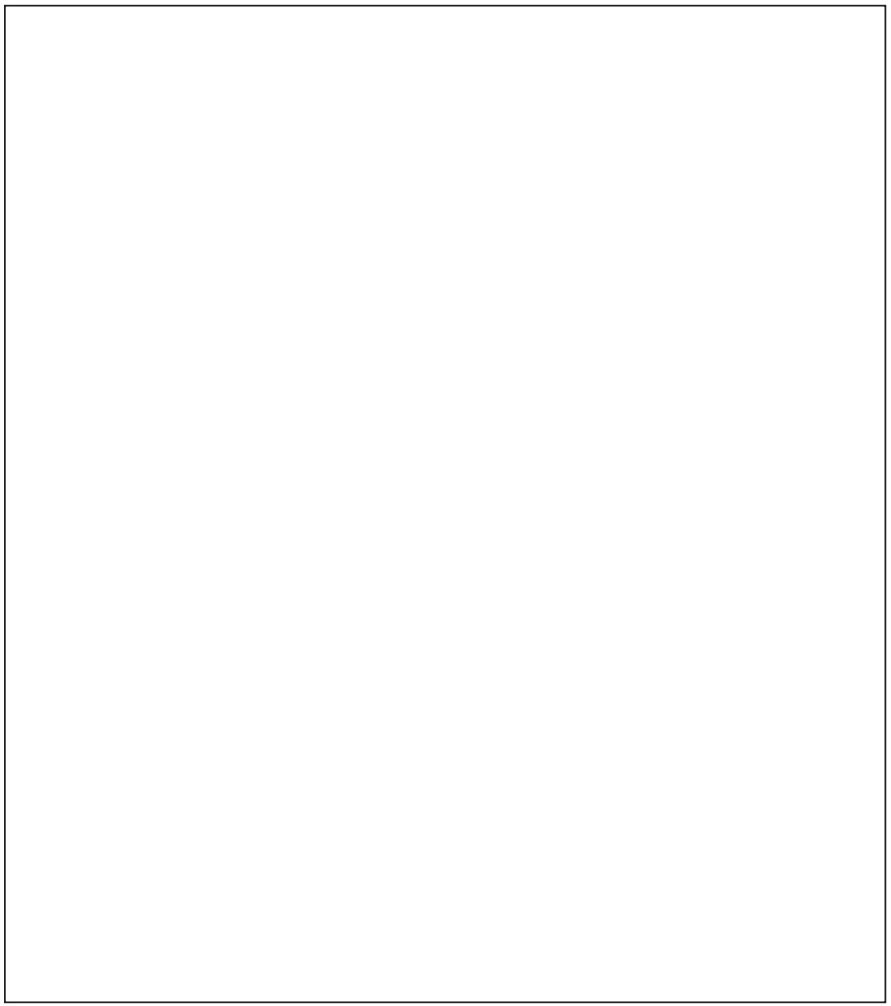
Have the students draw the movement of the protozoa in the boxes.

The Euglena will tend to move in a single direction, or not move at all, but "hover" just under the light.

The paramecium will move all over the place. It will roll, move forward and backward and spin. There are usually other things in the water with the paramecium. Have the students note what happens when the paramecium "bumps" into other objects or other paramecia.

The amoeba move very slowly. It can be difficult to visualize the amoeba. The amoeba are usually on the bottom of the container. Allow the container to set for 30 minutes and them remove the solution at the very bottom to place in the slide. The amoeba should be visible, but are clear. Prestained live amoeba can be purchased from Carolina Biological if it becomes too frustrating to view these organisms [catalogue # CE-13-1308].

Draw what you observe in the pond water



Have the students observe the organisms in pond water with their microscope. Have them draw as many organisms they can find.

See if they can identify any protists by observing their movement and comparing this movement to the known protists they observed earlier.

Conclusions:

We did not see any protozoa, only dirt.

We observed small protozoa that swam like paramecia.

We observed some amoeba.

We saw some organisms that we could not identify, but that looked liked protozoa.

Have the students write conclusions based on their observations. The conclusions will vary depending on if the experiment worked. It is important that the students write conclusions based on their observations. Some examples are given.

Review

Define the following terms:

protist: *A small eukaryotic creature that can be like both an animal and like a plant.*

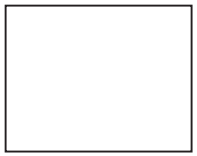
microscope: *An instrument used to look at small objects.*

cilia: *Small "hairs" found on certain protists that help them move.*

flagellum: *A long whip attached at one end to many types of protists that enable the protists to move.*

pseudopod: *"False feet" found on an amoeba that allow it to move and eat.*

Draw a paramecium



Draw a Euglena

Draw an amoeba

How do *Euglena* and *Paramecia* move? *Euglena and Paramecia move rapidly with small hairs and whips.*

How does an amoeba move? *An amoeba moves slowly with pseudopods.*

NOTES