What are Protists?

Protists are eukaryotes, and most are single-celled. You can think about protists as all eukaryotic organisms that are neither animals, nor plants, nor fungi.

Even among themselves, they have very little in common. Although theses organisms were put in the category *Protista* by Ernst Haeckel in 1866, the Kingdom Protista was not an accepted classification in the scientific world until the 1960s. These unique organisms can be so different from each other that sometimes Protista is called the "junk drawer kingdom." This kingdom contains the eukaryotes that cannot be put into any other kingdom.

Unicellular or Multicellular?

Most protists, such as the ones shown in Figure below, are so small that they can be seen only with a microscope. Protists are mostly unicellular (one-celled) eukaryotes that exist as independent cells. A few protists are multicellular (many-celled) and surprisingly large. These protists do not, however, show cellular specialization or differentiation into tissues. For example, kelp is a multicellular protist and can be over 100-meters long with cells that perform mostly the same jobs.

Characteristics of Protists

A few characteristics are common between protists:

1 They are eukaryotic, which means they have a nucleus.
2 Most have mitochondria.
3 They can be parasites.
4 They all prefer aquatic or moist environments.

For classification, the protists are divided into three groups:

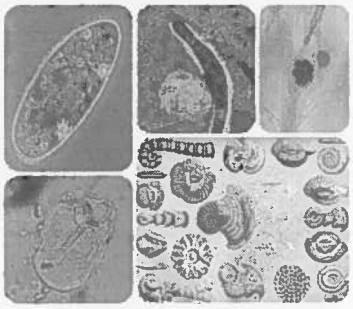
1 Animal-like protists
2 Plant-like protists
3 Fungi-like protists.

But remember, protists are not animals, nor plants, nor fungi (Figure below).

Classification of Protists

As there are many different types of protists, the classification of protists can be difficult. Recently, scientists confirmed that the protists are related by analyzing their DNA. Protists with more common DNA sequences are more closely related to each other then those with fewer common DNA sequences.

Find information on different types of protists here: http://www.ucmp.berkeley.edu/alllife/eukaryotasy.html



Protists come in many different shapes.

Slime molds are protists, but had previously been classified as fungi but are now placed in the Kingdom Protista. Slime molds live on decaying plant life and in the soil.

How Protists Obtain Food

The cells of protists need to perform all of the functions that other cells do, such as grow and reproduce, maintain homeostasis, and obtain energy. They also need to obtain food to provide the energy to perform these functions.

For such simple organisms, protists get their food in a complicated process. Although there are many photosynthetic protists, such as algae, that get their energy from sunlight, many others must "swallow" their food through a process called endocytosis. Endocytosis happens when a cell takes in substances through its membrane. The process is described below:

1 The protist wraps its cell wall and cell membrane around its prey, which is usually bacteria.
2 It creates a food vacuole, a sort of "food storage compartment," around the bacteria.
3 The protist produces toxins which paralyze its prey.
4 Once paralyzed, the food material moves through the vacuole and into the cytoplasm of the protist.

Other protists are parasitic and absorb nutrients meant for their host, harming the host in the process.

Animal-like Protists

Animal-like, plant-like, and fungi-like protists are different from each other mainly because they have different ways of getting carbon. Carbon is important in the formation of organic compounds like carbohydrates, lipids, proteins, and nucleic acids. You get it from eating, as do other animals.

Animal-like protists are called protozoa. Protozoa are single-celled eukaryotes that share certain traits with organisms in the animal kingdom. Like animals, they can move, and they they get their carbon from outside sources. They are heterotrophs, which means they eat things outside of themselves instead of producing their own food.

Animal-like protists are very small, measuring only about 0.01–0.5mm. Animal-like protists include the zooflagellates, ciliates, and the sporozoans.

Euglena are animal-like protists. Over 1000 species of Euglena exist. They are used in industry in the treatment of sewage. [Figure3]

Some animal-like protists literally "eat with their tails." The tail of a protist is a flagellum. These protists are called flagellates. Flagellates are filter-feeders. They acquire oxygen and nitrogen by constantly whipping the flagellum back and forth, a process called filter-feeding. The whipping of the flagellum creates a current that brings food into the protist. Recall that prokaryotes can also have flagella (the plural of flagellum).

Different Kinds of Animal-like Protists

Are there different types of animal-like protists? Yes. They are different because they move in different ways.

- Flagellates have long flagella, or tails. Flagella rotate in a propeller-like fashion. An example of a flagellate is the *Trypanosoma*, which causes African sleeping sickness.
- Other protists have what are called transient pseudopodia, which are like temporary feet. The cell surface extends out a membrane, and the force of this membrane moves the cell forward. An example of a protist with a pseudopod is the amoeba.
- Another way protists move is by the movement of cilia. Cilia are thin, very small tail-like projections that extend outward from the cell body. Cilia beat back and forth, moving the protist along. The *paramecium* has cilia that propel it.
- A few protists are do not move at all, such as the *toxoplasma*. These protists form spores that become new protists, and are known as sporozoa.

Plant-like Protists

Plant-like protists are autotrophs. This means that they produce their own food. They perform photosynthesis to produce sugar by using carbon dioxide and the energy from sunlight, just like plants. Plant-like protists live in soil, in seawater, on the outer covering of plants, and in ponds and lakes (Figure below). Protists like these can be unicellular or multicellular. Some protists, such as kelp, live in huge colonies in the ocean.

Plant-like protists are essential to the environment because they produce oxygen through photosynthesis, which helps other organisms, like animals, survive.

Plant-like protists are classified into a number of basic groups (Table below).

Plant-like Protists

Phylum	Description	Number (approximate)	Example
Chlorophyta	green algae - related to higher plants	7,500	*Chlamydomnas, Ulva, Volvox*
Rhodophyta	red algae	5,000	*Porphyra*
Phaeophyta	brown algae	1,500	*Macrocystis*
Chrysophyta	diatoms, golden-brown algae, yellow-green algae	12,000	*Cyclotella*
Pyrrophyta	dinoflagellates	4,000	*Gonyaulax*
Euglenophyta	euglenoids	1,000	*Euglena*

Red algae are a very large group of protists making up about 5,000.

Fungus-like Protists

Fungus-like protists are heterotrophs that have cell walls and reproduce by forming spores (see Lesson 9.2 for more information about spores). Fungus-like protists usually do not move, but some develop movement at some point in their lives.

There are essentially three types of fungus-like protists (see Table below):

Water molds, Downy mildews and Slime molds.

Slime molds represent the characteristics of the fungus-like protists. Most slime molds measure about one or two centimeters, but a few slime molds are as big as several meters. They often have bright colors, such as a vibrant yellow. Others are brown or white.

Stemonitis is a kind of slime mold which forms small brown bunches on the outside of rotting logs. *Physarum polycephalum* lives inside rotting logs and is a gooey mesh of yellow "threads" that are a several centimeters long. *Fuligo*, sometimes called "vomit mold," is a yellow slime mold found in decaying wood.

Fungus-like Protists

Protist	**Source of Carbon**	**Environment**	**Characteristics**
omycetes: water molds	decomposed remains, parasites of plants/animals	most live in water	Causes a range of diseases in plants; common problem in greenhouses where the organism kills new seedlings (plants from seeds); includes the downy mildews, which are easily identifiable by the appearance of white "mildew" on leaves.

Mycetozoa: slime molds	dispose of dead plant material, feed on bacteria	common in soil, on lawns, and in the forest commonly on deciduous logs	Includes the cellular slime mold, which involves numerous individual cells attached to each other, forming one large "supercell," essentially a bag of cytoplasm containing thousands of individual nuclei. The plasmodial slime molds spend most of their lives as individual cells, but when a chemical signal is released, they form a cluster that acts as one organism.

Importance of Protists

Humans could not live on Earth if it were not for protists. Why? Protists produce almost one-half of the oxygen on the planet, decompose and recycle nutrients that humans need to live, huge part of food chain. Humans use protists for many other reasons:

- Many protists are also commonly used in medical research. For example, medicines made from protists are used in treatment of high blood pressure, digestion problems, ulcers, and arthritis.
- Other protists are used in scientific studies. For example, slime molds are used to analyze the chemical signals used in cells.
- Protists are also valuable in industry. Look on the back of a milk carton. You will most likely see carrageenan, which is extracted from red algae. This is used to make puddings and ice cream solid. Chemicals from other kinds of algae are used to produce many kinds of plastics.

Lesson Summary

- Protists are highly diverse organisms that belong to the Kingdom Protista.
- Protists are divided into three subgroups: animal-like protists, plant-like protists and fungus-like protists.
- Animal-like protists are unicellular eukaryotes that share certain traits with animals, such as mobility and heterotrophy.
- Plant-like protists are unicellular or multicellular autotrophs that live in soil, in seawater, on the outer covering of plants, and in ponds and lakes.
- Fungus-like protists, such as water molds, downy mildews, and slime molds, are heterotrophs that reproduce by forming spores.

Review Questions

1. List the characteristics that all protists share.
2. List two ways that protists obtain food.
3. Describe the characteristics of an animal-like protist.
4. Describe the characteristics of a plant-like protist.
5. Describe the characteristics of a fungi-like protist.
6. Name three kinds of fungi-like protists.

Apply Concepts

7. Explain why protists are important to life on Earth.
8. You find a protist that is a heterotroph and lives in the ocean. Is this protist most similar to a plant, animal, or fungus? Why or why not?