

BI 163 LABORATORY COLLECTION AND OBSERVATION OF CELLS

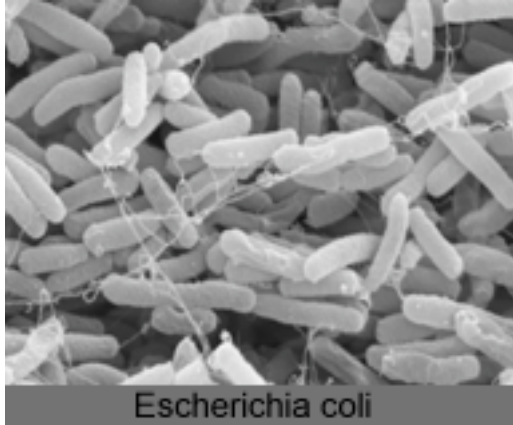
(Reviewed Fall 2010)

Prokaryotes

Prokaryotes are set apart from all other organisms because their cells lack nuclei. Phylogenetic evidence indicates that there are two very distinct groups of prokaryotes: Bacteria and Archaea. These two groups diverged from one another near the time of the origin of life!

Domain Bacteria

Bacteria are single-celled organisms that lack nuclei. They are also distinguished from eukaryotic organisms by some unique features of their protein synthesis. You will learn more about that later in the course. Bacteria come in a great variety of shapes and sizes (although from our perspective they are all very small!). Bacteria can be found in almost any habitat on earth. One of the most famous bacterial species is *Escherichia coli* (shown below), which lives in the human colon.



Domain Archaea

Archaea are also single-celled organisms that lack nuclei. Their protein synthesis, however, is more like that of eukaryotes than that of bacteria. Archaea come in a great variety of shapes and sizes and can be found in a great diversity of habitats.

Eukaryotes

Eukaryotes are organisms whose cells include a nucleus. They also contain a variety of organelles such as mitochondria and chloroplasts, which are specialized to carry out specific cellular functions.

Protists

Protists is a general term for unicellular eukaryotes. There are currently a number of different groups of protists, although the phylogeny of these organisms is still under revision. As would be expected, protists are a very diverse group (if they are really even a group at all). They are often placed into three categories based on their method of obtaining energy. Fungus-like protists absorb food from their surroundings. Plant-like protists (algae) are photosynthetic. And animal-like protists (protozoa) engulf food particles (i.e. "eat").



Protozoa (Paramecium)
Photo by Y. Tsukii (Hosei Univ)

Fungi (Mushrooms, Yeasts, Molds)

Fungi are a diverse group that includes both unicellular forms (such as yeasts) and multicellular forms (such as mushrooms and molds). Fungi are the great decomposers of the world (along with some help from the bacteria). Although sometimes incorrectly lumped with plants and algae as "flora" (as opposed to "fauna"- animals), fungi are actually not close relatives of the plants at all. Fungi are also generally characterized by their method of obtaining energy, namely absorption of nutrients from their surroundings. This sets them apart

from plants, which use photosynthesis to obtain energy from the sun, and animals, which actively ingest food. Another characteristic of fungi is cell walls enforced with chitin, the same substance found in insect exoskeletons. (For comparison, plant cell walls are made of cellulose, and animal cells do not have cell walls at all.)

Fungi are mainly terrestrial, and grow in filaments called "hyphae" (singular = "hypha"). Tightly packed masses of hyphae called "mycelia" (singular = "mycelium") form larger structures. The most familiar parts of fungi are spore-producing reproductive bodies such as mushrooms, toadstools, "shelves" of fungus on trees, puff balls, blue or green molds, etc. These are the only visible part of many fungi, but the main "body" of the fungus is the hyphae down in the soil or rotten log (or loaf of bread!)

Most people think of fungi only as mushrooms (or athlete's foot!). But they actually take on a great diversity of forms. One important aspect of fungi is their interaction with other organisms. Many are parasitic. Fungi are responsible for several major plant diseases. But others are symbiotic. Lichens are a symbiotic relationship between a fungus and a photosynthetic bacterium (cyanobacterium).

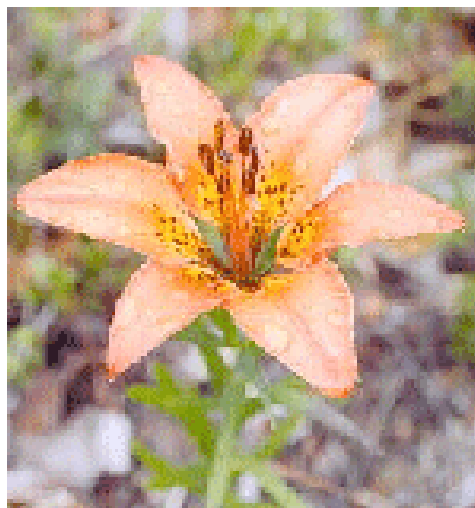


Plants

Plants are the very foundation of life on earth. Along with cyanobacteria and algae, plants convert light energy from the sun into chemical energy stored in carbohydrates like starches and sugars. They accomplish this through a process called photosynthesis, which requires chemical compounds called photosynthetic pigments. By far the most common of these pigments is chlorophyll, which gives plants their green color.

All other organisms depend on the photosynthesizers for survival. Unable to obtain energy directly from the sun, animals must eat plants (or one another) and break down the energy contained in their tissues. The final link in the cycle are decomposers like bacteria and fungi who convert dead plants and animals back into raw materials which new plants can use again. Thus the whole web of life is driven by the sun's light, trapped and stored by the plants. (Exceptions include some bacteria that can obtain energy directly from chemicals in their environment.)

Besides harnessing solar energy, plants perform a second vital function: they produce oxygen. The process of photosynthesis uses carbon dioxide and releases oxygen. This is the opposite of what happens when we breathe- we take in oxygen and release carbon dioxide. Except for a few anaerobic bacteria and yeasts, all organisms "breathe" on a cellular level. Thus all organisms need oxygen. Plants take up some of the excess carbon dioxide in the air, and replenish the oxygen as it is used up, thereby helping to maintain the composition of the atmosphere. You will be learning more about the photosynthetic process later in this course.



lily: a monocot

Animals

All animals share two basic characteristics: they are multicellular, and they obtain energy by ingesting other organisms. Animals are also generally mobile, but this is not a hard and fast rule. Animal cells lack cell walls, and most are highly specialized for a particular function. A collection of cells forms a *tissue*; a collection of tissues forms an *organ*; and a collection of organs forms an *organism*.

Other than this brief description, we will forego a general introduction to animals due to the overwhelming diversity and complexities of each phylum.



Exercise

Several prepared slides and fresh specimens are available in the laboratory (see Appendices B and C in *Use and care of the Compound Light Microscope* for tips on preparing slides). Your instructor may also allow some time for you to collect specimens on your own. Using proper microscopy technique, examine cells representing each of the five kingdoms discussed above. As you examine each specimen, take particular note of the following features:

- **Size:** Use the eyepiece micrometer (see Appendix E in *Use and Care of the Compound Light Microscope*) to estimate the sizes of the cells you observe.
- **Shape:** Are the cells round, rectangular, or some other shape?
- **Arrangement:** Do the cells exist alone, or in some orientation with other cells? If they exist with other cells, is the relationship a simple colony (i.e., a grouping of identical unicellular organisms) or do multiple specialized cells form a complex tissue?
- **Organelles:** Are any organelles visible? Usually only the nucleus, chloroplasts, some vacuoles, and cell walls (typically represented by a rigid shape) are discernable, but other organelles might be evident in some cases. Often special staining techniques are required to reveal otherwise hidden and difficult to see organelles.

As you make your observations, try to discern the specific characteristics unique to cells in the groups described above.

Assignment

Illustrations and photomicrographs are important for documenting microscopic studies. Choose one cell type from each of bacteria, protists, fungi, plants and animals, and create a neat, accurate illustration of what you see through the microscope. (Blank “fields of view” and color pencils are provided.)

Your illustrations should also include the following features:

- Labels of visible organelles and other structures
- An accurate scale bar
- A properly descriptive figure title (e.g., Figure 1. Microscopic preparation of yeast cells, *Saccharomyces cerevisiae*.)

Illustrations are due at the end of the lab session, or as otherwise indicated by your instructor.