Laboratory 4: Cell Structure and Function

Although the cell is the basic structural and functional unit of all organisms, cells differ enormously in size, shape, and function. Some are free living, independent organisms, while others are immovably fixed as part of tissues of multicellular organisms.

All cells exchange materials with their immediate environment and therefore have a plasma membrane that controls which substances are exchanged by allowing some materials to pass through it while slowing or stopping others. The cytoplasm is protected from the environment, yet still can exchange materials with it. Within the cytoplasm, cells differ in the type and number of organelles.

Prokaryotic cells (bacteria) have the simplest structure with each independent cell lacking any internal membrane organelles, including the lack of a nuclear membrane to separate the genetic chromosome material from the rest of the cytoplasm.

More typical and more specialized are the eukaryotic cells, with a double nuclear membrane and membrane organelles specialized to fit their function. Since no one cell would have all organelles possible, observing a variety of animal cells will give you an idea of the similarities and differences among cells.

Part 1: Eukaryotic Cells

A. Animal cells

We will examine a few examples of animal cells. All animal cells are eukaryotic, therefore they, have a nucleus and other membrane bound organelles including mitochondria.

Procedure 1: Examining Human Epithelial Cells

Step 1: Place a fraction of a drop of methylene blue dye on the microscope slide
Step 2: Using the broad end of a toothpick, gently scrape the inside of your cheek, mix scraping into drop of dye on the slide
Step 3: Place cover slip, examine under compound microscope, going up to 400x magnification
Step 4: Sketch the cells you see under 400x magnification

Questions:
What structures were visible in the stained slides?

What are their functions?
Procedure 2: Examining the effect of salt on blood cells

There are three terms describe the concentration of solutes outside of a cell:

Hypertonic: Concentration of solutes outside cell is greater than in side
Isotonic: Inside and outside have same conc.
Hypotonic: Outside the cell the concentration of solutes is lower than inside.

Step 1: Place fraction of a drop of blood in the isotonic solution onto a microscope slide
Step 2: Place coverslip on the slide and observe under the microscope
Step 3: Sketch the blood cells at the 400x magnification
Step 4: Repeat these steps with the hypertonic solutions.
Step 5: Sketch the blood cells at the 400x magnification

Questions:

1. What did the blood cells look like in the iso-, hyper- and hypotonic solutions?

B. Plant cells - Potato Cells

Plastids are organelles in plant cells that produce and store food or energy. Chloroplasts are a type of plastid where photosynthesis occurs. The type plastids we will examine in the potato are called amyloplasts, these are plastids that store starch. We will use iodine here to stain the starch in the amyloplasts.

Procedure 3: Examining potato cells

Step 1: Cut as thin a slice of potato as possible using a scalpel.
Step 2: Place it on a slide with a few drops of Lugol's iodine, and cover with a coverslip.
Step 3: Using low power, examine the cells for dark-stained bodies within the cells of the potato. These are amyloplasts that contain starch. The transparent membrane and wall can faintly be seen.
Step 4: Sketch and label any organelles seen.

Question: Do you think potatoes are a good source of carbohydrates? __________
Part 2: Prokaryotic Cells

There are two classification schemes that are widely accepted. There is not universal acceptance for either scheme. The classification scheme favored by microbiologists, and used in your textbook is the three domain scheme: Bacteria (Eubacteria), Archaebacteria, and Eukaryotes. In this scheme the eukaryote domain is broken down into four kingdoms: protista, fungi, plantae, and animalia. The second scheme that is widely accepted is the six kingdom classification scheme: eubacteria, achaebacteria, protista, fungi, plantae, and animalia.

In the second scheme prokaryotes are placed into the two kingdoms Archaebacteria and Eubacteria versus two domains, but essentially the two schemes are the same.

Prokaryotic organisms are characterized by cells that lack most organelles including a true nucleus, a nuclear membrane, mitochondria, endoplasmic reticulum, Golgi apparatus, and lysosomes. Many of these simplest living organisms are unicellular.

Archaebacteria

Archaebacteria can live in extreme environments. It is believed that archaebacteria are remnants of an ancient lineage of bacteria surviving in environments similar as those that existed when began on earth. The three major groups of archaebacteria are:

Methanogens (methane makers) live in oxygen-free (anaerobic) environments, including the guts of animals and swamps.

Extreme halogens (salt lovers) live in very salty environments including salt ponds.

Extreme thermophiles (heat lovers) can withstand very high heat conditions and live in hot springs and hydrothermal vents. They can even start the food chain by producing energy from hydrogen sulfide.

Bacteria (eubacteria)

Most prokarotes fall into the eubacteria domain. Unlike archeabacteria, eubacteria have fatty acids in their plasma membrane and many incorporate peptidoglycan in their cell walls. Neither archeabacteria, eubacteria have nuclei
A. Shapes of bacteria

The cells of most bacteria have one of three fundamental shapes; bacillus (rod shape), spirillum (spiral shape), and coccus (spherical shape). Different species may appear as either single individual cells or grouped together in colonies or filaments. Even at high power, bacterial cells are difficult to see because they are seldom over 5 micrometers in diameter.

 Procedure 4: Observing Bacteria Shapes

Step 1: Observe the prepared slide of each bacteria type. Note the absence of a true nucleus in these cells.

Step 2: Diagram the three shapes seen and label each.