

Cells

Introduction

Cells are the fundamental unit of life. All living things are composed of cells. While there are several characteristics that are common to all cells, such as the presence of a cell membrane, cytoplasm, DNA and ribosomes, not all cells are the same.

Prokaryotic cells lack a nucleus and membrane-bound organelles. Eukaryotic cells are compartmentalized by membrane-bound organelles with specialized functions. In eukaryotes, DNA is located within the nucleus; whereas, prokaryotes lack a nucleus. In some stained preparations the nucleus may contain one or more darker-stained bodies, the nucleoli (singular-nucleolus). Ribosomal RNA (rRNA) is transcribed within the nucleolus. The nucleus also contains a number of structures called chromosomes, which are composed of DNA and proteins. Chromosomes can be seen only after special staining procedures applied to dividing cells. When cells are not dividing, chromosomes are seen as chromatin. An exception is one inactivated and condensed chromosome in female mammals. This chromosome, which may be visible as a dark spot in the nucleus, is called a Barr body.

The nucleus in living cells is sometimes indistinguishable from the cytoplasm unless the cell is stained. When stained, the nucleus appears darker than the surrounding cytoplasm.

The cytoplasm is the region of the cell outside the nucleus. It contains fluid, ribosomes, the cytoskeleton, and, in eukaryotes, other membrane-bound organelles.

The minute "power-plants" in the cytoplasm of cells are called mitochondria. These organelles are roughly the size of many bacteria and can only be seen at higher magnifications in specially prepared slides.

Plastids are organelles found in plants and algae. Some organic compounds are produced and stored in plastids. The green pigment, chlorophyll, is located in special photosynthetic plastids called chloroplasts. Other kinds of plastids include chromoplasts, which contain pigments other than chlorophyll, and amyloplasts which store starch.

The central sap vacuole often occupies a large space within the cytoplasm of plant cells, but may be small or absent in other types of cells. Often, other organelles found in plant cells are located adjacent to the plasma membrane because the central vacuole takes up so much space within the cell. Under healthy conditions for plant cells, the central vacuole is large and produces turgor pressure against the cell wall, which is located outside the cell membrane. The cell wall keeps plant cells from bursting. Some other cells also have cell walls, but they are generally made of different materials. Plant cell walls are made of cellulose, while bacteria have cell walls made of peptidoglycan

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and fungi have cell walls made of chitin. Archaea and algae also have cell walls made of various compounds.

Objectives

Having completed the lab on cells, the student should be able to:

1. Visually differentiate prokaryotic cells, eukaryotic cells, plant cells, and animal cells
2. Identify the following cell parts: cytoplasm, nucleus, cell wall, chloroplast, cell membrane, nucleolus, vacuole, amyloplast, nuclear membrane, and, chromatin.
3. State functions of the cell parts.
4. State structural differences between:
 1. prokaryotic and eukaryotic cells.
 2. human and amphibian red blood cells.
 3. plant and animal cells.

Animal Cells

Animals are a group of eukaryotic, multicellular, heterotrophic organisms that ingest organic matter for sustenance. Many animals have cells that differentiate into specialized tissues including epithelial, connective, muscle, and nervous tissue.

Starfish egg cell

Introduction

Because of the quantity of stored food, animal egg cells are among the largest known

single cells.

Materials

☐ prepared slide of unfertilized starfish egg

☐ compound microscope

Procedure

1. Examine your slide of the starfish eggs and select a perfectly spherical cell to study. Move the slide so that the cell will be near the center of the field and turn to high power. Regulate the light for good contrast and focus carefully. Note the central spherical structure, the nucleus, and the surrounding cytoplasm. The cytoplasm is bounded by the cell membrane, which is very thin and pliable. Also note that the spherical nucleus is bounded by a well-defined nuclear envelope. Within the nucleus is the granular appearing chromatin and the nucleolus, a distinct, deeply stained, rounded body.

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2. In the area below, draw a starfish egg with a diameter of approximately 2 cm. Label the cell membrane, chromatin, nucleolus, nuclear envelope, nucleus, and cytoplasm.
3. Using the diameter of the high or low power fields determined in the Measurement lab, estimate the diameter of the starfish egg cell in micrometers:

Cheek epithelial cells

Introduction

Cells that cover a surface, whether outside the body or inside the body are called epithelial cells. Epithelial cells from inside your mouth are easily collected and examined under the microscope.

Materials

☐ slide

☐ cover slip

☐ toothpick

☒ dropping pipette

☒ methylene blue stain

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☒ metric ruler

☒ compound microscope

Procedure

1. With a toothpick, gently scrape the inside lining of your cheek. Place the material collected into a drop of water on a slide. Add one drop of methylene blue stain and mix the two solutions. Add a cover slip and observe with the microscope.

Use both low and high power.

2. Find the cell membrane, nucleus, nuclear envelope, and cytoplasm.

3. Draw three representative cells, each about 2 cm in diameter. Label one cell with structures listed above.

Cheek epithelial cells

4. Estimate the approximate diameter of each cell in micrometers:

5. What purpose do epithelial cells serve?

Human blood cells

Introduction

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Blood contains both pigmented and non-pigmented cells. Their color is derived from hemoglobin or other oxygen-transporting compounds dissolved in their cytoplasm. As the red blood cells (erythrocytes) of mammals mature, their nuclei disintegrate and the resulting "cells" without nuclei are no longer cells in the strict sense.

Non-pigmented cells are white blood cells (leukocytes). In slides stained with Wright's stain, the nucleus of these white blood cells is prominent. There are several types of leukocytes in mammalian blood. The larger leukocytes, often with a lobed nucleus, are called phagocytic cells and are responsible for ingesting foreign particles and invading organisms in the blood. The smaller leukocytes, with large spherical nuclei, are called

lymphocytes and are responsible for immune responses.

Materials

☑ prepared slides of human blood with Wright's stain

☑ metric ruler

☑ compound microscope

Procedure

1. Examine the human blood slide with low and high power. Note the most prolific cells without nuclei. These are the red blood cells. Observe their shape and size.

Also note the few white blood cells on the slide. You may need to move your field of view to observe several white blood cells.

2. Estimate the diameter of the red blood cells and a white blood cell in micrometers:

Red blood cell White blood cell

3. Draw a red blood cell making the diameter 20 mm. Draw a white blood cell to the same scale.

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Red Blood Cell White Blood Cell

4. From the descriptions given above, determine if the white blood cell you have drawn a lymphocyte or a phagocytic cell.

Amphibian blood cells

Introduction

The red blood cells of amphibians are much larger than mammals and possess a nucleus.

Materials

☑ prepared slides of amphibian blood

☑ compound microscope

☑ metric ruler

Procedure

1. Examine the amphibian blood slide and locate the large oval cells with nuclei.
2. Draw and label structures on an amphibian red blood cell making it 5 cm in length

Amphibian Red Blood Cell

3. Estimate its length and its width in micrometers:

Length Width

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4. Compare size, shape, and structural details of the red blood cells of human and amphibian.

Plant Cells

Fundamental Cell Types

Parenchyma: These cells have thin walls, allowing free transfer of materials between membranes of adjacent cells. Major functions include formation of boundary layers (epidermis), chemical synthesis (chlorenchyma), and food storage.

Sclerenchyma: These cells are thick-walled and non living at maturity. Among sclerenchyma cells are those that produce hard parts such as nut shells (stone cells), those that provide strength for stems (fibers), and those that transport water and dissolved minerals up the plant stem (vessel elements).

Parenchyma

Boundary Parenchyma

Onion Epidermis

Introduction

The onion bulb is made up of specialized leaves or scales. Each leaf is covered by a single layer of epidermal cells.

Materials

☐ onion bulb

☐ slide

☒ cover slip

☒ compound microscope

☒ Iodine solution

☒ metric ruler

Procedure

1. Peel a small portion of the delicate epidermis covering the inner surface of an onion scale and place it on a slide. Make a wet mount by covering the piece of

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epidermis with Iodine solution and a cover slip. Reduce the amount of light passing through the preparation.

Draw several cells. Make the individual cells 20 mm wide. Label the structures in one cell: nucleus, nucleoli, nuclear envelope, cytoplasm, and cell wall.

Onion epidermal cell

2. How many nucleoli are present in each nucleus?

3. Give the length of the cell in micrometers.

Synthetic Parenchyma

Chlorenchyma of Elodea

Introduction

Elodea is a water plant that grows abundantly in ponds around Spokane. The cells are favorable objects for the study of cell structure and an example of cells synthesizing food.

Materials

☒ Elodea

☒ slide

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☒ cover slip

☒ dropping pipette

☐ compound microscope

☐ metric ruler

Procedure

1. Place a leaf from an Elodea on a slide with a drop of water and cover with a cover slip. Under low power move the slide about and observe the cells present. Change to high power and with the fine adjustment, focus at various depths of the leaf.
2. Distinguish the following parts of the cell: cell wall, cytoplasm, and chloroplasts. A center portion of the cell within the cytoplasm appears clear. This area contains water and materials in solution and is called the central sap vacuole or water vacuole. The membrane around this structure is too narrow to be distinguishable with the light microscope. The cell or plasma membrane is present but is not visible because it is thin and in direct contact with the cell wall. A nucleus is present but difficult to see because this preparation is not stained and the chlorophyll masks other structures in the cell.
3. Draw one Elodea cell. Make your drawing 75 mm in its longest dimension. Label the cell parts you can distinguish.

Elodea parenchymal cell (Chlorenchyma)
4. The movement of the cytoplasm is detected by the movement of the chloroplasts which are suspended in cytoplasm. The chloroplasts are carried along in the cytoplasm as if in a current. This movement is known as cyclosis or cytoplasmic streaming. With arrows, indicate the directions of streaming (cyclosis) on the drawing above.
5. Give the length of the Elodea cell in micrometers:

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Storage Parenchyma

Parenchyma cells of Potato

Introduction

Potato cells also illustrate the storage role of parenchyma cells. Starch-forming amyloplasts are found in abundance in storage organs. Amyloplasts in potato cells have accumulated abundant starch and are called starch grains.

Materials

☒ potato

☒ slide

☒ cover slip

☒ Iodine solution

☒ dropping pipette

☒ compound microscope

☒ metric ruler

Procedure

1. Place a thin section of potato on a slide and mount with a drop of water and a cover slip. Observe with low and high power. Note that cells are filled with large starch grains.
2. Place a drop of Iodine solution on the edge of the cover slip so that the drop overlaps the edge of the cover slip and the slide. Allow time for the stain to move slowly under the cover slip. Observe again after the potato tissue appears darker in color.
3. Draw several cells with the diameter of each cell approximately 30 mm. Label the cell wall and starch grains.

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Potato parenchymal cells

4. Focus with high power on lightly stained starch grains. Draw several starch grains with their series of concentric rings. These result from the layered construction of starch grains.
5. Give the measurements of a typical potato cell in micrometers:

6. What color changes took place when Iodine solution was added to the cells?

Prokaryotic Cells

Prokaryotic cells belonging to the archaea, bacteria, and cyanobacteria generally lack membrane-bound organelles.

Bacteria

Materials

- ☒ prepared Gram stain slides
- ☒ immersion oil
- ☒ lens paper
- ☒ compound microscope

Procedure

1. Using the compound microscope, getting the stained bacteria cells in focus at high power.
2. Once in focus, turn the revolving nose piece toward the oil immersion lens. Before the lens is "clicked" in place, put a drop of immersion oil on the slide in the area being observed. Continue turning the revolving nose piece until the oil immersion lens is in place. The drop of oil should touch both the lens and the slide. Adjust the fine focus.
3. Draw a few of the bacteria cells.
4. Do you see any details in the cytoplasm of individual bacteria cells?

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Filamentous Cyanobacteria

Materials

- ☒ live sample containing filamentous cyanobacteria
- ☒ disposable pipette
- ☒ clean slide
- ☒ cover slip
- ☒ compound microscope

Procedure

1. Prepare a wet mount from the live sample by placing a drop of sample on the

clean slide. Place the cover slip on the drop by placing one edge of the cover slip on the slide adjacent to the drop of sample. Lower the coverslip into the drop of sample.

2. Examine the sample using the compound microscope at high power.

3. Draw a single filament of the cyanobacteria. The cyanobacteria have a dark green color and may be slowly moving.

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4. Do you see any details in the cytoplasm of individual cells in the filament?

Summary

Which structures are found in the following cells?

Cell Nucleus Cytoplasm Central Sap

Vacuole Plastids Cell

Membrane

Cell

Wall

Starfish egg

Cheek Epithelial

Human Red

Blood

Amphibian Red

Blood

Onion

Elodea

Potato

Bacteria

Cyanobacteria

About this document ...

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