Faculty of Science

Laboratory Manual

Basic Cytology

Bachelor of Biotechnology (Hons.)

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Basic Cytology

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LINCOLN UNIVERSITY COLLEGE
FACULTY OF SCIENCE (DEPARTMENT OF BIOTECHNOLOGY)
LABORATORY SAFETY RULES

The following rules must be obeyed by all students in the science laboratory of the faculty. Wilful or repeated in advertent non-compliance may result in dismissal or suspension from the laboratories

- No entry without permission:
  - Outsiders are not allowed to enter the laboratory without permission.
  - No student is allowed to enter the laboratory unless permission has been given by a laboratory assistant or a lecturer.

- At work in the laboratory:
  - No experiment may be attempted without the knowledge and permission of a lecturer.
  - Students must wear shoes in the laboratory. Students wearing slippers or sandals are not allowed to work in the laboratory.
  - Lab coat must be worn at all times during practical work in the laboratory.
  - Do not mouth pipette chemicals.
  - Do not eat or smoke in the laboratory.
  - Do not taste any chemicals, including dilute solutions. If any acid or alkali accidentally enters your eyes or mouth, wash immediately with plenty of tap water. Inform your lecturer, and seek medical attention if necessary.
  - Paper should be used to light up the Bunsen burners.
  - Used match sticks, filter papers, and other solid waste must never be thrown into the sinks. They must be thrown into the dustbins provided. Lighted match sticks and smoldering materials must be extinguished with tap water before thrown in to the dustbins.
  - Any equipment broken or damaged must be reported to the laboratory assistant.

- Before leaving the laboratory:
  - All the equipment and benches must be cleaned at the end of each practical session.
  - Wash hands and arms with soap and water before leaving the laboratory.
  - No student is allowed to take away any chemicals, equipment or other property of the laboratory.

INTRODUCTION

1. The Scientific Method

- Making observations
- Generating hypotheses
- Making predictions
- Designing and carrying out experiments
- Constructing scientific models

2. Practical Exercises

To get the most out of the practical exercises, you need to follow carefully the instructions given. These instructions have been designed to provide you with the experience in the following skills:

- Following instructors
- Handling apparatus
- Having due regard for safely
- Making accurate observations
- Recording results in an appropriate form
- Presenting quantitative results
- Drawing conclusions

3. Following Instructions

Instructions are provided in the order in which you need to carry them out. We would advise that before carrying out the instructions, you read through the entire exercise. This will help you to remember what you have learned.

Each practical exercise in the book begins with a few lines describing its purpose in most cases the following headings are also used:

- Procedure-numbered steps that need to be carried out.
- For consideration -some questions to help you think carefully about the results you have obtained.
- Materials-a list of the apparatus, chemicals and biological materials you need.

4. Handling apparatus

Biologists need to able to use many different types of apparatus, for example, photometers (to measure water uptake by plants), respirometers (to measure oxygen uptake or carbon dioxide production), Petri dishes (for plating out bacteria and other microorganisms) and the light microscope (to magnify specimens). Many of the practical exercises are designed to help you derive the maximum benefit from a piece of apparatus.

5. Having Due Regard for Safety

Surveys have been shown that science laboratories are among the safest places to be. Nevertheless, this is no cause for complacency.

- Always move slowly and carefully in a laboratory.
- Never put your fingers in your mouth or eyes after using chemicals or touching biological specimens until you have washed your hands thoroughly with soap and warm water, and dried them.
- Make sure glass objects (e.g, thermometers, beakers) cannot roll off tables or be knocked onto the floor.
- Wear safely goggles whenever there is a risk of damage to the eyes.

<u>Situations of risk include:</u>

- Heating anything with a Bunsen burner (even heating water has its dangers')
- Handling many liquids, particularly those identified as corrosive, irritant, toxic or harmful

- Handling corrosive or irritant solids
- Some dissection work
- Allow Bunsen burners, tripods, gauzez and beakers to cool down before handling them.
- Never allow your own body fluids (especially blood and saliva) to come into contact with someone else, or theirs into contact with you.
- Keep long hair tied back and do not wear dangly earrings.
- Do not allow electrical equipment to come into contact with water.
- If you are unsure how to carry out a scientific procedure, ask.
- Make sure you understand why you are going to do something before you do it.
- Wear a lab coat when using chemicals or handling any biological specimens.
- Follow exactly agreed procedures with regard to cuts, burns, electric shocks and other accidents (e.g. with chemicals).
- Follow exactly all specific safely instructions given in this book or provided by your teacher for particular practical exercises (e.g. use of gloves, disinfection)

With practice, these procedures should become second nature to you. They will enable you to carry out practical work in safety.

6. Making Accurate Observations

In most cases the practical exercise will make it clear what you need to observe, e.g. the time taken for a certain volume of gas to be evolved or the width of a sample cells. Ensure that you know how to use any necessary equipment before starting practical. Think carefully about the precision with which you will make your observations.

7. Recording Results in an Appropriate Form

Results can be recorded in various ways. Often it is helpful to record raw data in a table. Most data will be in the form of numbers, i.e. they will be quantitative data (also known as numerical data). However, some data, e.g. flower colour, will be qualitative data.

One form in which some biological findings can be recorded is a drawing. You don't need to be professional artist to make worthwhile biological drawings. If you follow the following guidelines, a drawing can be of considerable biological value:

- Ensure that your completed drawing will cover at least a third of A4 page.
- Plan your drawing so that the various parts are is proportion and will not be drawn too small. Small marks to indicate the length and breadth of the drawing are a great help in planning and a faint outline can be rapidly drawn to show the relative positions of the parts.
- The final drawing should be made with clean, firm lines using a sharp HB pencil and, if needed, a good quality eraser (not a fluid).If important details are too small to be shown in proportion, they can be put in an enlarged drawing at the side of the main drawing.
- Avoid shading and the use of colour unless you are an excellent artist and they really help, for example when drawing soil profiles.
- When drawing structures seen with the naked eye or hand lens, use two lines to delineate such things as blood vessels and petioles. This will help you to indicate the relative widths of such structures.
- When drawing low power plan drawings from the light microscope, do not attempt to draw individual cells-just different tissues.
- When drawing plant cells at high power under the light microscope, use two lines to indicate the width of cell walls, but a single line to indicate a membrane.
- Always put a scale on each drawing.

8. Presenting Quantitative Results

Presentation of data is all about using graphs or other visual means to make it easier to see what your results tell you. The following four ways of presenting data are the most frequently used in biology: line graphs, bar charts, histograms and scatter graphs (Figure 1).

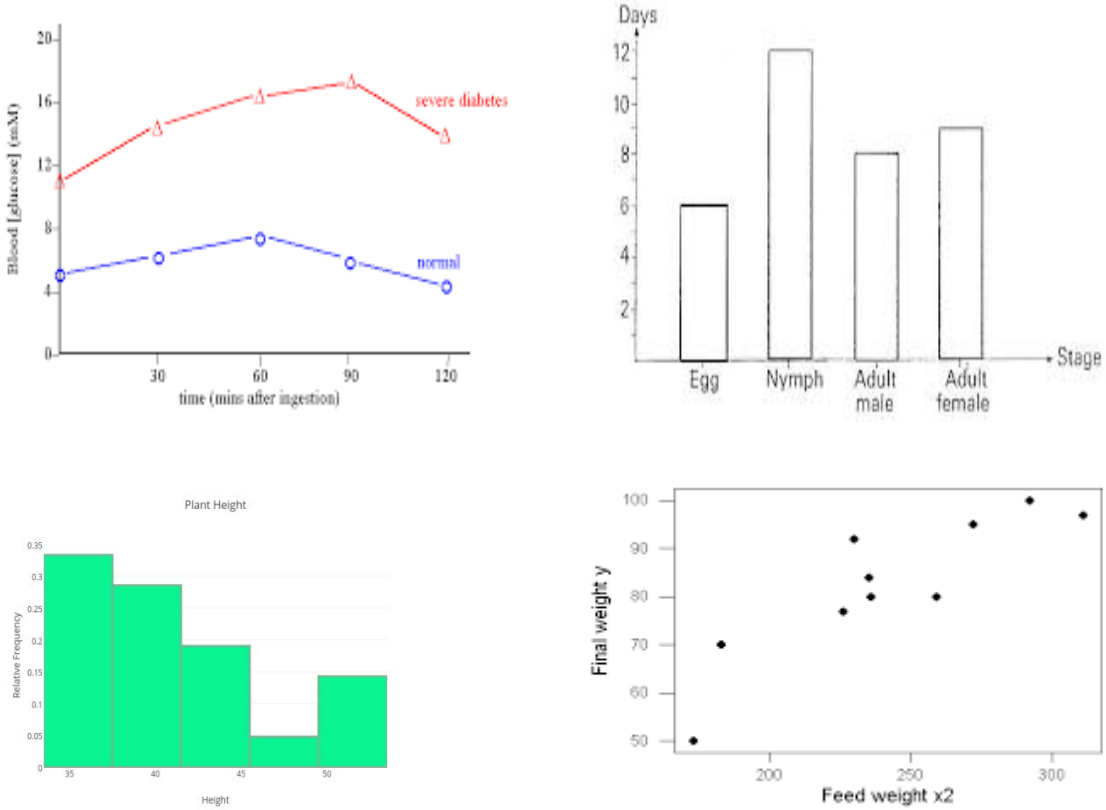


Figure 1: Line graphs, bar charts, histograms and scatter graphs

9. Drawing Conclusions

Finally, you will need to draw conclusions. If your practical exercise has involved the testing of a hypothesis, for example that the enzyme pepsin works better at low pH than in neutral or alkaline conditions, your conclusion should indicate whether the hypothesis has been refuted (i.e. shown not to be the case) or supported. Of course, even if your hypothesis has been supported, it doesn't mean that it has been confirmed with 100% certainty- in other words it isn't proved. Science proceeds more by showing that certain ideas are wrong than by showing that others are right (think about that!). Your conclusion might therefore include further ways of testing the original hypothesis, or might raise new possibilities to be investigated.

Often you will only be able to arrive at your conclusions after statistically analysing your data.

10. Writing a Scientific Lab Report

Title

- Communicate the subject investigated in the paper.

Introduction

- State the hypothesis.
- Give well-defined reasons for making the hypothesis.
- Explain the biological basis of the experiment.
- Cite sources to substantiate background information.

- Explain how the method used will produce information relevant to your hypothesis.
- State a prediction based on your hypothesis. (If the hypotheis is supported, then the results will be.)

Materials and Methods

- Use the appropriate style.
- Give enough detail so the reader could duplicate your experiment
- State the control treatment, replication and standardized variables that were used.

Results

- Summarize the data (do not include raw data).
- Present the data in an appropriate format (table or graph).
- Present tables and figures neatly so they are easily read.
- Label the axes of each graph completely.
- Give units of measurement where appropriate.
- Write a descriptive caption for each table and figure.
- Include a short paragraph pointing out important results but do not interpret the data.

Discussion

- State whether the hypothesis was supported or proven false by the results, or else state that the results were inconclusive.
- Cite specific results that support your conclusions.
- Give the reasoning for your conclusions.
- Demonstrate that you understand the biological meaning of your results.
- Compare the results, with your predictions and explain any unexpected results.
- Compare the results to other research or information available to you.
- Discuss any weaknesses in your experimental design or problems with the execution of the experiment.
- Discuss how you might extend or improve your experiment.

Conclusion

- Restate your conclusion.
- Restate important results.

Literature Cited

- Use the proper citation form in the text.
- Use proper citation form in the Literature Cited section.
- Refer in the text to any source listed in this section.

Acknowledgement

- State any appropriate acknowledgement that you think is necessary.

Practical 1
Title: Cheek and onion cell observation

Cheek cell lab

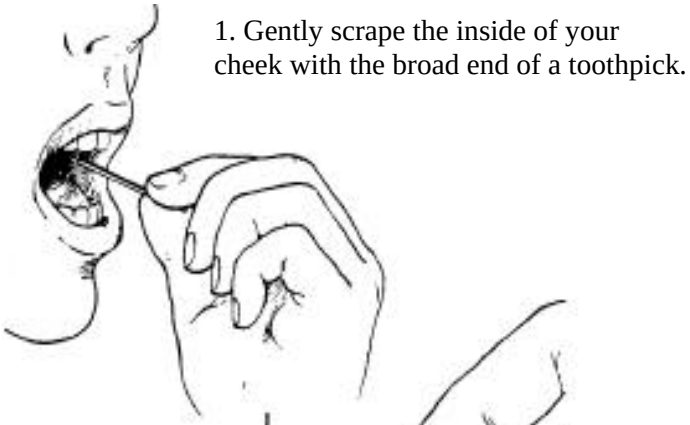
Objectives:
After completing the practical, you will be able:
1. To observe the cheek cell
2. To identify major animal cell structures such as nucleus, cytoplasm and cell membrane
3. To relate the structure of the cheek cell to its function

Introduction:
Cells are the fundamental units of life, because a cell is the simplest unit capable of independent existence and all living things are made of cells. Some organisms are made up of one cell (unicellular, amoeba) and some are made up of many cells (multicellular, animals, plants). Cells are made up of 90% water and may contain several different types of internal structure. Prokaryotic cells (bacteria) have a nuclear region but no internal membrane system and are very tiny. Eukaryotic cells (protists, fungi, plants, animals) are usually larger, contain a nucleus and have several internal membrane bound structures called organelles (eg. nucleus).

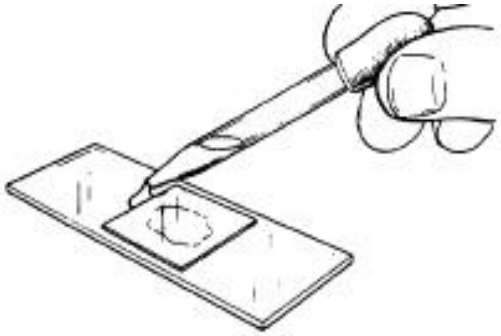
Animals are multicellular organisms that are heterotrophic (obtain food from external sources). Animal cells are surrounded by a cell membrane that contains the entire cell internally. The cell membrane is a phospholipid bilayer that is semi-permeable (that is it lets some molecules in/out and not others). The cell membrane is not a rigid structure and unless some force (other cells, internal or external matrix) contains it, it cannot maintain its shape and will often expand to its greatest perimeter (circle). Animal cell has a nucleus. The nucleus is a membrane bound structure in the cell that contains much of the cell's DNA. DNA is a molecule that contains the code for building the proteins all organisms need to grow and reproduce. The nucleus is usually visible in a cell at moderate magnification (40-100x). Plant cells also have chloroplasts that may be visible. Other internal structure in animal cell is usually too small to be seen at the magnifications of 40x and100x.

Materials:
-Toothpick
-Iodine stain
-Slide
-Cover slip
-Cheek cell

Methods:
Follow the instructions below to examine epithelial cells obtained from the inner lining of your cheek. First, try to determine something of their structure by adjusting the diaphragm and the condenser. Next, add a drop of Iodine stain to the edge of the cover slip and draw it under as shown in figure below.

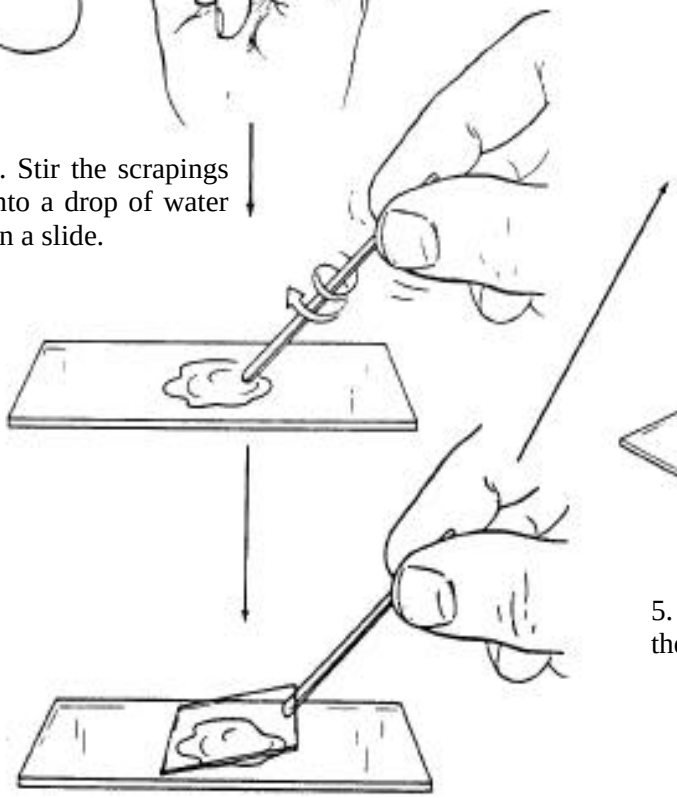


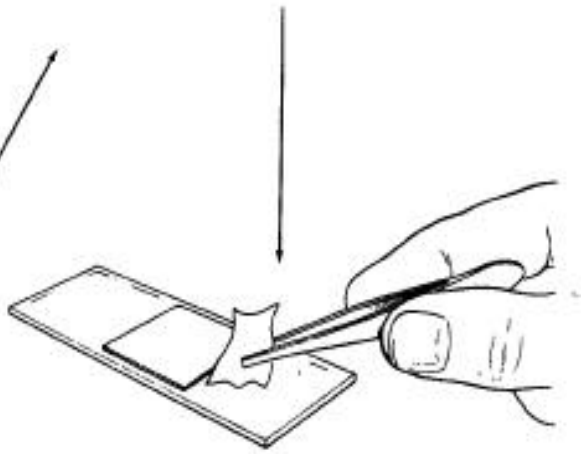
1. Gently scrape the inside of your cheek with the broad end of a toothpick.



4. Add one or two drops of methylene blue stain to edge of coverslip.

2. Stir the scrapings into a drop of water on a slide.





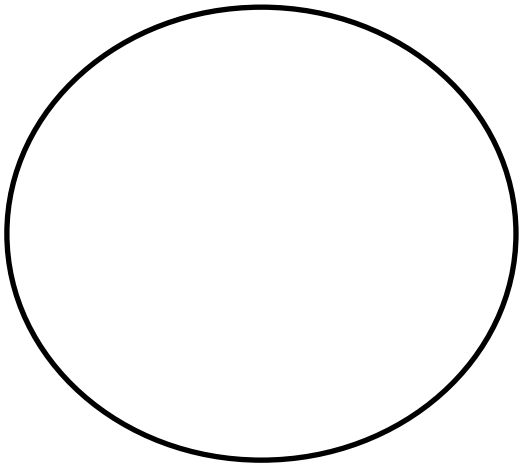
5. Draw the stain under by touching lens paper to the opposite side of coverslip

3. Lower a coverslip over your specimen, gently, to avoid trapping air bubbles. Examine with your microscope. Add more water to the edge of the coverslip with an eyedropper if the slide begins to dry.

Observations

1. Draw a picture of what cheek cells look like under the microscope at magnification of 4x, 10x and 40x.
2. Identify and label the cell parts of cheek.
3. Write a brief description of your observations.

Magnification:



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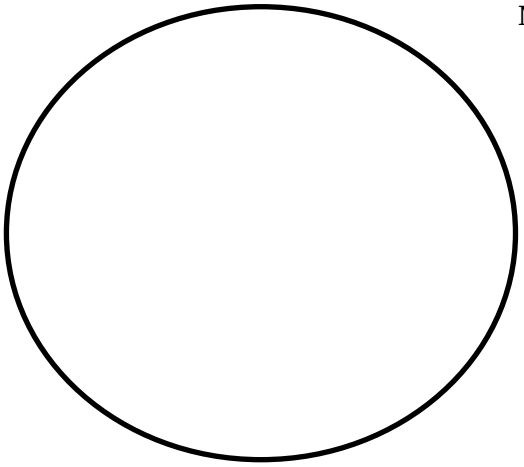

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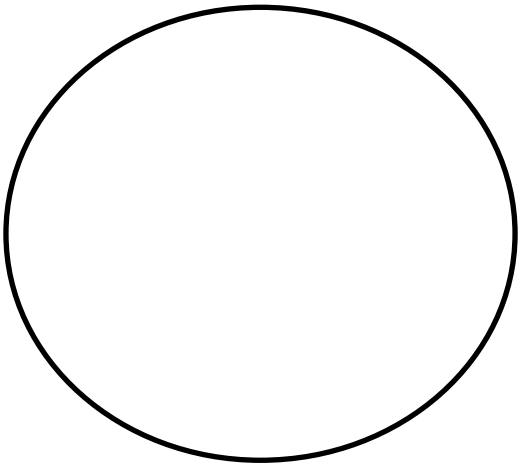


Questions:

1. Describe the shapes of the cell membrane. Were all the cells the same shape? Explain why.
2. Explain the reasons why you used iodine stain. What would it have looked like without the stain?
3. Make a chart that lists the cell parts that you observed and labelled and tell what each part does for the cell.
4. Describe where the cell parts were placed/located inside the cell in relation to each other.
5. Describe the ways that all the cells you observed were alike and how they were different from each other.

Onion epithermal cell observation

Objectives:

After completing the practical, you will be able:

1. To observe the cheek cell
2. To identify major onion epithermal cell structures such as nucleus, cytoplasm and cell membrane
3. To relate the structure of the onion epithermal cell to its function

Introduction:

Plant cells are surrounded by a cell membrane but are also surrounded by a cell wall made of cellulose that gives the cells structure. These cellulose cell walls are the building blocks for wood and fiber in plants. Plant cell has a nucleus. The nucleus is a membrane bound structure in the cell that contains much of the cell's DNA. DNA is a molecule that contains the code for building the proteins all organisms need to grow and reproduce. The nucleus is usually visible in a cell at moderate magnification (40-100x). Plant cells also have chloroplasts that may be visible. These are the structures that contain chlorophyll (photosynthetic pigment) and are therefore green. Also visible in plant cells may be vacuoles (open spaces). Other internal structure in plant cells are usually too small to be seen at the magnifications that a student-compound microscope has.

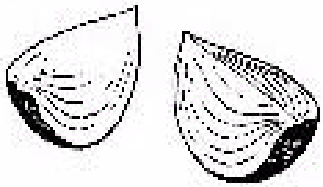
Under low power objective: The "lines" that form the network between the cells are non, living cell walls composed chiefly of cellulose. The cell wall surrounds the plasma membrane, which encloses the cytoplasm. The central part of many plant cells (which is difficult to observe in living cells) is taken up by a vacuole that is filled with water and salts.

Under high power objective: Locate the nucleus, which appears as a dense structure in the translucent cytoplasm. Note that in some cells, the nucleus looks circular and seems to be lying in the central part of the cell. In other cells it seems to be compressed and pushed against the cell wall. The central vacuole, nucleus, and cell wall are separated from the cytoplasm by membranes, but the membranes are difficult to observe in the preparation that will be used.

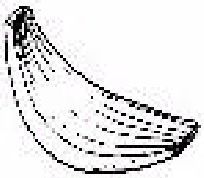
Materials:

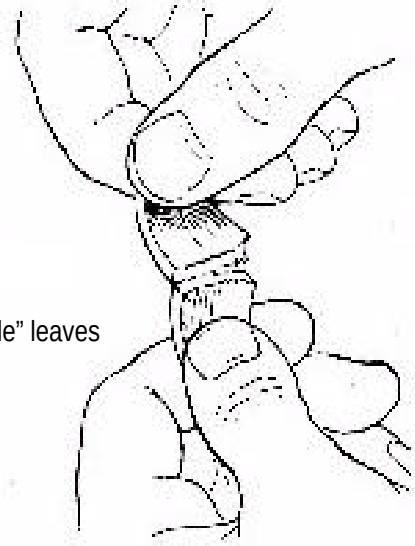
-Light microscope with light source
-Onion
-Tweezers
-Microscope slide
-Cover slip
-Iodine

Methods:



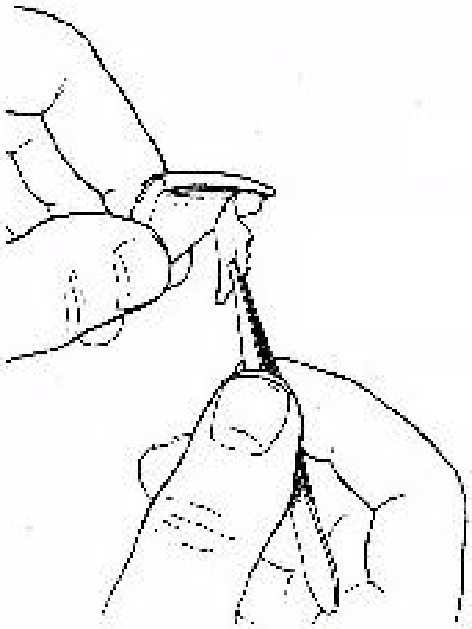
1. Cut an onion in to quarters



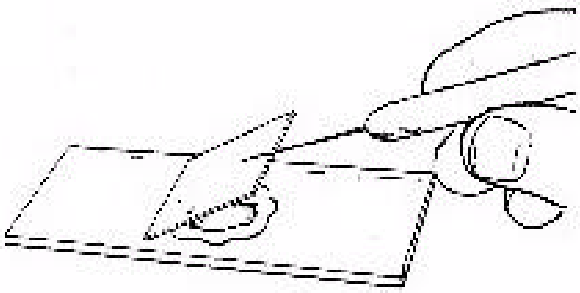


2. Remove one of the fleshy “scale” leaves

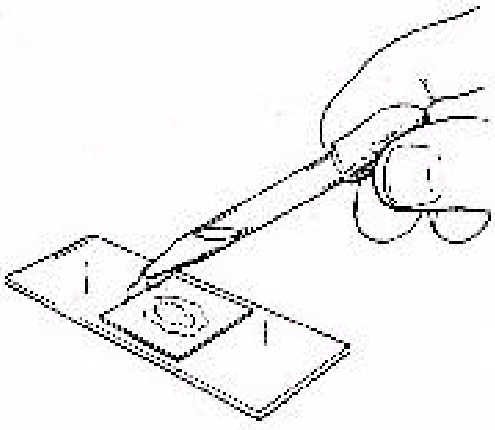
3. Snapping the “leaf” backward usually produces a ragged piece epidermis.



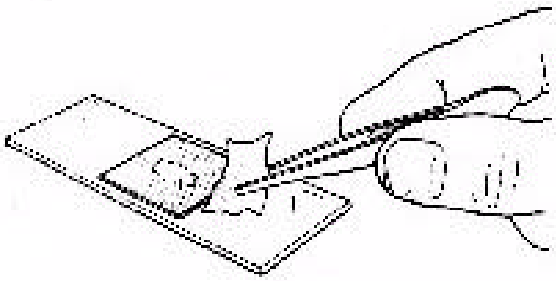
4. Remove a small piece of epidermis and spread it smoothly in a drop of water on a slide



5. Gently lower a cover slip to prevent trapping air bubbles. Examine with your microscope. Add more water to the edge of the coverslip with an eyedropper if the slides begin to dry.



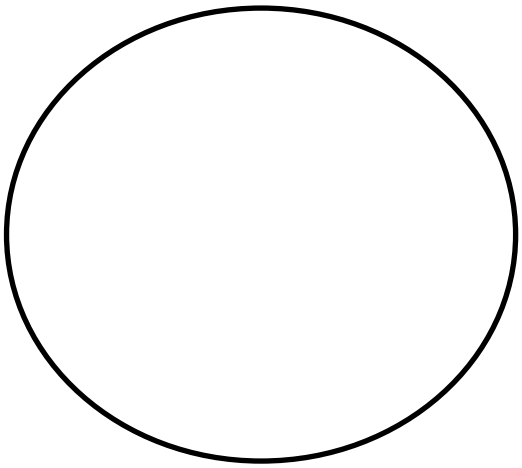
6. Add one or two drops of Iodine stain to the edge of the cover slip.



7. Drew the stain under by touching absorbent paper to the opposite side of the cover slip.

Observations:

1. Draw a picture of what onion epithelial cells look like under the microscope at magnification of 4x, 10x and 40x.
2. Identify and label the cell parts of onion epithelial cell.
3. Write a brief description of your observations.



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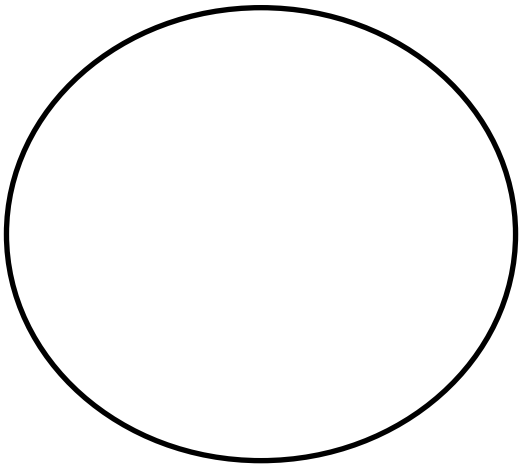

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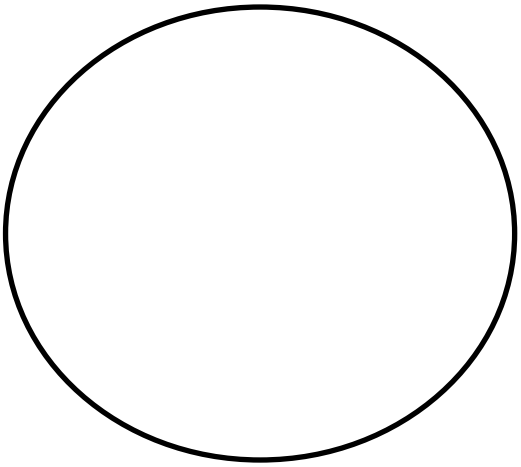

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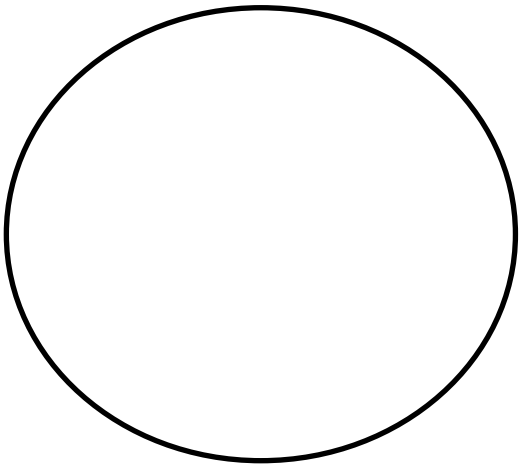

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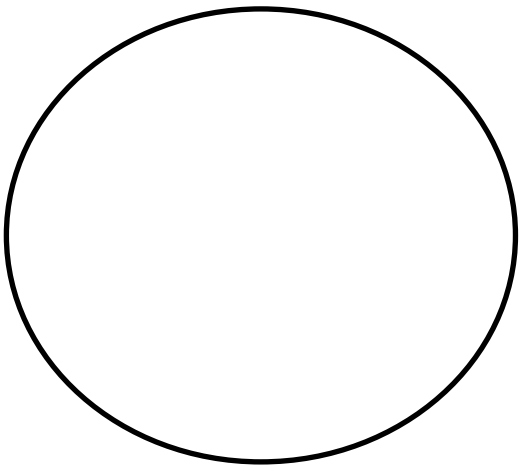

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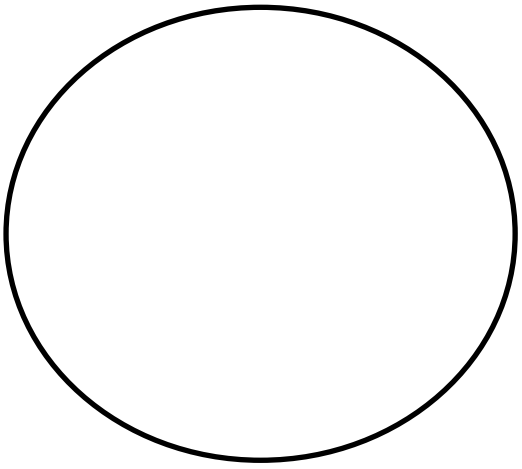

Magnification:

Practical 2

Title: Anatomy and physiology of female organs

Objectives:

After completing the practical, you will be able:

1. To identify the female external and internal female organs
2. To understand the functions and structures of female organs

Introduction:

The female reproductive system is made up of the internal and external sex organs that function in reproduction of new offspring. In the human the female reproductive system is immature at birth and develops to maturity at puberty to be able to produce gametes, and to carry a fetus to full term. The internal sex organs are the uterus, Fallopian tubes, and ovaries. The uterus or womb accommodates the embryo which develops into the fetus. The uterus also produces vaginal and uterine secretions which help the transit of sperm to the Fallopian tubes. The ovaries produce the ova (egg cells). The external sex organs are also known as the genitals and these are the organs of the vulva including the labia, clitoris, and vaginal opening. The vagina is connected to the uterus at the cervix.

At certain intervals, the ovaries release an ovum, which passes through the Fallopian tube into the uterus. If, in this transit, it meets with sperm, a single sperm can enter and merge with the egg, fertilizing it.

Fertilization usually occurs in the Fallopian tubes and marks the beginning of embryogenesis. The zygote will then divide over enough generations of cells to form a blastocyst, which implants itself in the wall of the uterus. This begins the period of gestation and the embryo will continue to develop until full-term. When the fetus has developed enough to survive outside the uterus, the cervix dilates and contractions of the uterus propel the newborn through the birth canal (the vagina).

The vulva consists of all of the external parts and tissues and includes the mons pubis, pudendal cleft, labia majora, labia minora, Bartholin's glands, clitoris, and vaginal opening.

The vagina is a fibromuscular (made up of fibrous and muscular tissue) canal leading from the outside of the body to the cervix of the uterus or womb. It is also referred to as the birth canal in the context of pregnancy. The vagina accommodates the male penis during sexual intercourse. Semen containing spermatozoa is ejaculated from the male at orgasm, into the vagina potentially enabling fertilization of the egg cell (ovum) to take place.

The cervix is the neck of the uterus, the lower, narrow portion where it joins with the upper part of the vagina. It is cylindrical or conical in shape and protrudes through the upper anterior vaginal wall. Approximately half its length is visible, the remainder lies above the vagina beyond view. The vagina has a thick layer outside and it is the opening where the fetus emerges during delivery.

The uterus or womb is the major female reproductive organ. The uterus provides mechanical protection, nutritional support, and waste removal for the developing embryo (weeks 1 to 8) and fetus (from week 9 until the delivery). In addition, contractions in the muscular wall of the uterus are important in pushing out the fetus at the time of birth.

The uterus contains three suspensory ligaments that help stabilize the position of the uterus and limits its range of movement. The uterosacral ligaments keep the body from moving inferiorly and

anteriorly. The round ligaments restrict posterior movement of the uterus. The cardinal ligaments also prevent the inferior movement of the uterus.

The uterus is a pear-shaped muscular organ. Its major function is to accept a fertilized ovum which becomes implanted into the endometrium, and derives nourishment from blood vessels which develop exclusively for this purpose. The fertilized ovum becomes an embryo, develops into a fetus and gestates until childbirth. If the egg does not embed in the wall of the uterus, a female begins menstruation.

The Fallopian tubes are two tubes leading from the ovaries into the uterus. On maturity of an ovum, the follicle and the ovary's wall rupture, allowing the ovum to escape and enter the Fallopian tube. There it travels toward the uterus, pushed along by movements of cilia on the inner lining of the tubes. This trip takes hours or days. If the ovum is fertilized while in the Fallopian tube, then it normally implants in the endometrium when it reaches the uterus, which signals the beginning of pregnancy.

The ovaries are small, paired organs located near the lateral walls of the pelvic cavity. These organs are responsible for the production of the egg cells (ova) and the secretion of hormones. The process by which the egg cell (ovum) is released is called ovulation. The speed of ovulation is periodic and impacts directly to the length of a menstrual cycle.

After ovulation, the egg cell is captured by the Fallopian tube, after traveling down the Fallopian tube to the uterus, occasionally being fertilized on its way by an incoming sperm. During fertilization the egg cell plays a role; it releases certain molecules that are essential to guiding the sperm and allows the surface of the egg to attach to the sperm's surface. The egg can then absorb the sperm and fertilization can then begin.[citation needed] The Fallopian tubes are lined with small hairs (cilia) to help the egg cell travel.

Materials:

-Slides with samples of the female reproductive system
-Microscope

Question:

1. Describe the functions and structures of female external and internal organs.

Practical 3
Title: Inflammation

Objective:
After completing the practical, you will be able:

1. To understand the difference and contrast between acute and chronic inflammation

Introduction:

Inflammation is part of the protective response of the body tissues to adverse stimuli, like irritants, pathogens, or damaged cells. It involves immune cells, molecular mediators, and blood vessels. The aim of the inflammation is to remove the cause of cell damage, to clear necrotic cells and damaged tissues, and to start tissue recovery.

Depending on the speed of the reaction and the duration, Inflammation is:

- Acute inflammation,
- Chronic inflammation.

Acute inflammation is the early response of the organism to adverse stimuli. It is acquired by an increased transport of leukocytes (especially granulocytes) and plasma from the blood in the damaged tissues.

In acute inflammation develops the so called “triple response of Lewis: (1) redness, (2) increased blood flow, and (3) edema.

The inflammatory response is spread by series of biochemical events. The immune system, the local vascular system, and different cells in the damaged tissue are included in the process.

The acute inflammation process is initiated by immune cells, which are already present in the involved tissue. These are:

- Dendritic cells,
- Kupffer cells,
- Histiocytes,
- Resistant macrophages,
- Mast cells.

When infections, burns or injuries occur, the above listed cells are subject to activation and release inflammatory mediators. This mediators cause the clinical signs of inflammation. Vasodilatation and the resulting increased blood flow cause redness and increased temperature. Increased permeability of the blood vessels leads to exudation of fluid and plasma proteins into the tissue. This results in swelling. Some of the released mediators (e.g. bradykinin) raise the sensitivity to pain (hyperalgesia). The mediators also alter blood vessels to allow migration of leukocytes, primarily macrophages and neutrophils, out of the blood vessels (extravasation) into the tissue. White blood cells migrate along the chemotaxis gradient created by local cells to reach the site of injury.

The acute inflammation is the first line of protection against injury. Acute inflammatory reactions require constant stimulation. Inflammatory mediators have a short lifecycle and are rapidly degraded in tissue. Therefore, acute inflammation begins to desist when the stimulus is removed.

The chronic inflammation is an inflammatory reaction that lasts for months or years. Most often acute inflammation precedes the chronic, but this is not always the case.

The chronic inflammation can be due to:

- Prolonged irritation of chemicals,
- Foreign particles – dust, surgical thread, etc.,
- Infection by microorganisms that cannot be overcome for a long time by the body - tuberculosis, syphilis, brucellosis.

The following immune cells are involved in the chronic inflammation process:

- Macrophages,
- Neutrophils,
- Lymphocytes.

Depending on the body's response, the chronic inflammation is:

- Granulomatous inflammation,
- Non-granulomatous inflammation.

The inflammation is granulomatous in case of tuberculosis, toxoplasmosis, mechanical irritation from a foreign body, rheumatoid arthritis, and others. Typical for this type of inflammation is the formation of granuloma, isolating the infected site. The granuloma wall is usually made of fibrous deposits of collagen, and sometimes calcium, and specific cells. In the center are located the causative agent and areas of necrosis.

The non-granulomatous inflammation is characterized by the accumulation of specific inflammatory cells in the damaged location. Granuloma is not formatted. Diffuse necrosis and fibrosis occur. The most common causes of this type of inflammation are chronic viral infections such as chronic hepatitis, chronic autoimmune diseases such as rheumatoid arthritis, chronic atrophic gastritis, allergic inflammation, etc.

The aim of the chronic inflammation is to limit and remove the agent, which cannot be removed by acute response (acute inflammation). Restriction and removal of the agent depend on the reactivity of the immune system.

Materials:

-Slides with samples of the acute and chronic inflammation
-Microscope

Question:

1. Describe the difference between acute and chronic inflammation.

Practical 4
Title: Cell injury death and adaptation

Objective:
After completing the practical, you will be able:

1. To understand the difference and contrast between hyperplasia, hypertrophy, atrophy and metaplasia.

Introduction:

In cell biology and pathophysiology, cellular adaptation refers to changes made by a cell in response to adverse environmental changes. The adaptation may be physiologic(al) (normal) or pathologic(al) (abnormal). Five minor types of adaptation include atrophy, hypertrophy, hyperplasia and metaplasia.

Atrophy is a decrease in cell size. If enough cells in an organ atrophy the entire organ will decrease in size. Thymus atrophy during early human development (childhood) is an example of physiologic atrophy. Skeletal muscle atrophy is a common pathologic adaptation to skeletal muscle disuse (commonly called "disuse atrophy"). Tissue and organs especially susceptible to atrophy include skeletal muscle, cardiac muscle, secondary sex organs, and the brain.

Hypertrophy is an increase in cell size. If enough cells of an organ hypertrophy so will the whole organ. The heart and kidneys have increased susceptibility to hypertrophy. Hypertrophy involves an increase in intracellular protein rather than cytosol (intracellular fluid). Hypertrophy may be caused by mechanical signals (e.g., stretch) or trophic signals (e.g., growth factors). An example of physiologic hypertrophy is in skeletal muscle with sustained weight bearing exercise. An example of pathologic hypertrophy is in cardiac muscle as a result of hypertension.

Hyperplasia is an increase in the number of cells. It is the result of increased cell mitosis, or division. The two types of physiologic hyperplasia are compensatory and hormonal. Compensatory hyperplasia permits tissue and organ regeneration. It is common in epithelial cells of the epidermis and intestine, liver hepatocytes, bone marrow cells, and fibroblasts. It occurs to a lesser extent in bone, cartilage, and smooth muscle cells. Hormonal hyperplasia occurs mainly in organs that depend on estrogen. For example, the estrogen-dependent uterine cells undergo hyperplasia and hypertrophy following pregnancy. Pathologic hyperplasia is an abnormal increase in cell division. A common pathologic hyperplasia in women occurs in the endometrium and is called endometriosis.

Metaplasia occurs when a differentiated cell of a certain type is replaced by another cell type, which may be less differentiated. It is a reversible process thought to be caused by stem cell reprogramming. Stem cells are found in epithelia and embryonic mesenchyme of connective tissue. A prominent example of metaplasia involves the changes associated with the respiratory tract in response to inhalation of irritants, such as smog or smoke. The bronchial cells convert from mucus-secreting, ciliated, columnar epithelium to non-ciliated, squamous epithelium incapable of secreting mucus. These transformed cells may become dysplasic or cancerous if the stimulus (e.g., cigarette smoking) is not removed. The most common example of metaplasia is Barrett's esophagus, when the non-keratinizing squamous epithelium of the esophagus undergoes metaplasia to become mucinous columnar cells, ultimately protecting the esophagus from acid reflux originating in the stomach. If stress persists, metaplasia can progress to dysplasia and eventually carcinoma; Barrett's esophagus, for example, can eventually progress to adenocarcinoma of the esophagus if not treated.

Materials:
-Slides with samples of the hyperplasia, hypertrophy, atrophy and metaplasia
-Microscope

Question:

1. Describe the hyperplasia, hypertrophy, atrophy, & metaplasia with aid of examples.

Notes

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