GRADE 12

LIFE SCIENCES

MODULE 1

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User-friendly learning format

- Each matric subject is divided into 12 modules to ensure paced and easy learning.
- You have access to learning material, 24 hours per day and 7 days a week.
- Monitor your progress at the end of each module.
- Each module has exercises based on the topics covered in the module and previous module.
- The questions are based on the type of assessment candidates may expect in the National examination to practice the application of knowledge gained.
- At the end of each module, a compulsory quiz ensures that the candidate has gained the general knowledge required for the topic covered before progress is made to the following module.
- The modules were compiled from multiple resources, both prescribed by the Department of Education and other professionals, to ensure that the topics are covered in detail and from all perspectives.
- Subject specialists with years of experience in teaching their subjects, proof-read all modules and assisted with recommendations to ensure full coverage and easy learning.
- Modules are updated as the curriculum changes to ensure the validity of the learning material.

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UNIT 1: INTRODUCTION

LEARNING OBJECTIVES

At the end of this unit, you should be able to:

- Know the layout of the national Life Sciences question papers.
- Provide an overview of the topics that will be covered in Life Sciences.

You should spend more or less 1 hour on this unit.

1. FORMAT OF QUESTION PAPERS

The National Amended Senior certificate examination consists out of two question papers. Each question paper is 2 hours 30 min and 150 marks each.

Each question paper has the following format:

SECTION	TYPES OF QUESTIONS	MARKS
A	Short answers, objective questions like multiple choice, terminology and matching items	50
B	Two questions of 40 marks each, divided in three to four subsections	80
C	Essay question	20

2. LIFE SCIENCES TOPICS

The following topics will be covered in Life Sciences:

2.1. Life Sciences Paper 1

- Meiosis
- Reproduction in Vertebrates
- Human Reproduction
- Responding to the Environment (Humans)
- Human Endocrine System
- Homeostasis in Humans
- Responding to the Environment (Plants)
- Human Impact

2.2. Life Sciences Paper 2

- DNA: Code of Life
- Meiosis
- Genetics and Inheritance
- Evolution

UNIT 2: GRAPHS

LEARNING OBJECTIVES

At the end of this unit, you should be able to:

- Draw line graphs.
- Draw bar graphs.
- Draw histograms.
- Draw pie charts.

You should spend more or less 3 hours on this unit.

1. INTRODUCTION

Graphs and charts condense large amounts of information in a format that is easier to understand, showing important points clearly and effectively.

The four types of graphs and charts that you will be expected to draw are line graphs, bar graphs, histograms and pie charts.

The usage of these graphs and charts:

- Line graphs show the relationship between two types of information where the independent variable is continuous. Line graphs are useful in showing trends over time and are often used for biological data.
- Bar graphs show different categories of data and are used when the independent variable is not a set of continuous numbers or continuous groups (discontinuous data). They are best used to compare values across categories.
- Histograms have connected bars displaying continuous data. They are used when the values of the independent variables are continuous but fit into categories or groups that follow on after each other.
- Pie charts are circular charts used to compare parts of the whole. They are divided into sectors that are equal in size to the quantity represented. They are used for discontinuous data.

2. THE DRAWING OF LINE GRAPHS

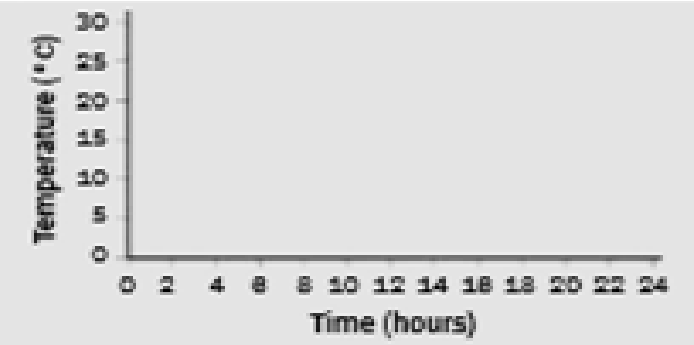
Identify the dependent and the independent variables from the information you are given usually in table format

- Dependent variable: This is the variable or factor that is being measured, i.e. the temperature in degrees Celsius in this example.
- Independent variable: This is the variable that the investigator can change.
- The dependent variable changes as the independent variable changes, in other words the time in hours in this example.

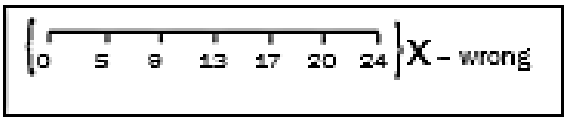
TIME (HOURS)	TEMPERATURE (oCELSIUS)
0	16
5	24
9	28
13	26
17	21
20	19
24	17

Air temperature recorded over a 24-hour period.

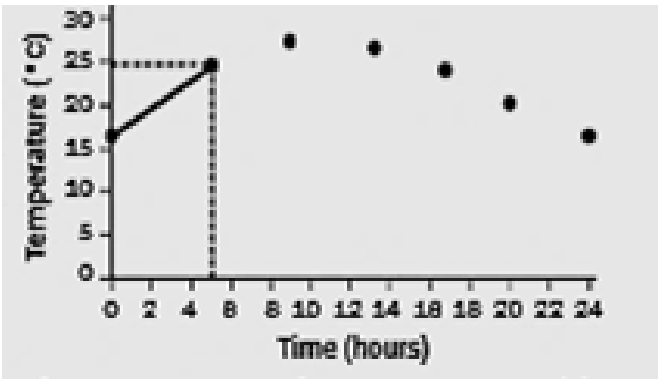
Draw a set of axes and label the X and Y axes. The dependent variable goes on the Y-axis and the independent variable on the X-axis. Include the unit in each label, for example temperature in °C and time in hours. Do not forget to label the axes.



Choose a scale for the X and the Y axes. Make sure that the scale includes the highest numbers in the table for each of the variables. Do not use the values for the Y-axis directly from the table unless they have regular intervals.



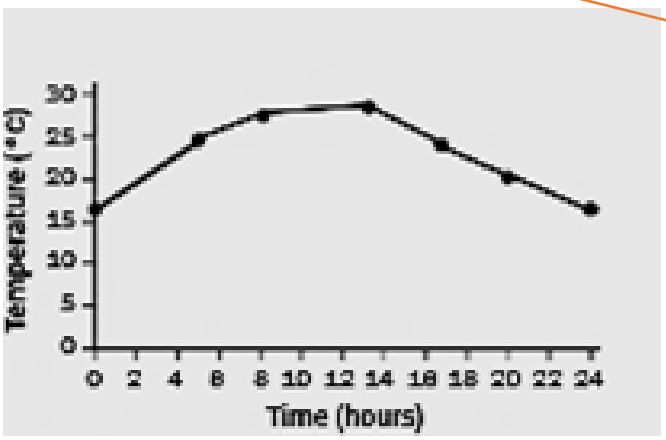
Place a dot at the point where the two values for each result intersect (meet). In the example, the point where 5 hours and 24°C intersect on the graph is indicated by the second dot on the graph. Plot all the points using the information in the table.



Join the dots using a ruler until all the dots have been joined in sequence.

Give the graph a heading or caption. The heading or caption should include both variables. In this case both air temperature and the time period of 24 hours must be mentioned in the heading.

Line graph indicating air temperature recorded over a 24-hour period.



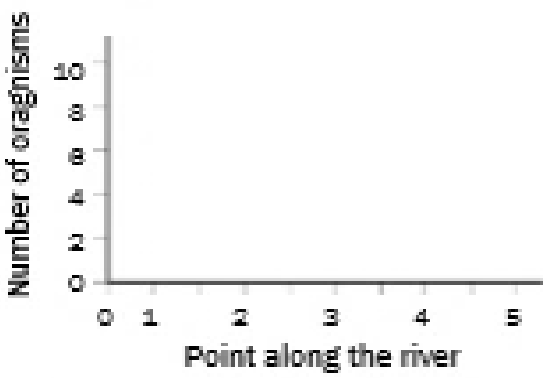
3. THE DRAWING OF A BAR GRAPH

To draw a bar graph, follow the same first three steps that were followed to draw a line graph. Use the table to identify the dependent and independent variables. Draw the axes and choose a scale.

NB! There will be no units when labelling the X- and the Y-axes in this particular graph.

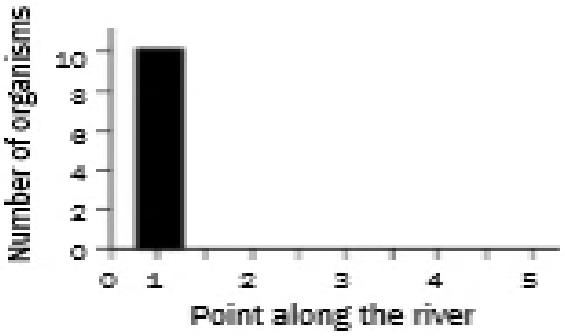
Point Number	Number of organisms
1	10
2	12
3	8
4	8
5	4

Number of organisms found in the water at different points along a river.



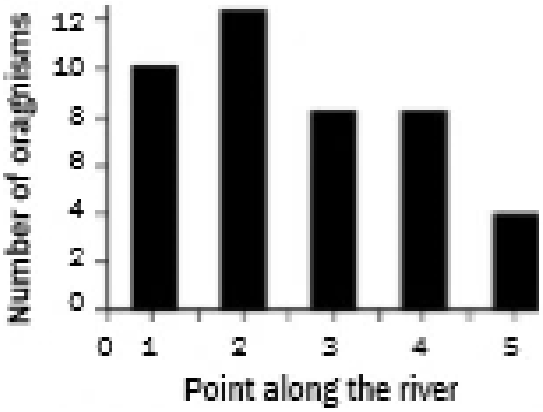
Draw the axes and choose a scale

Draw a bar to show that 10 organisms were found at point number 1 on the river. Then draw bars to represent the number of organisms found at each of the points along the river. Since this is a bar graph, the bars should not touch as the points along the river have no direct relationship with each other.



Give the graph a heading or caption.

A bar graph indicating the number of organisms found at different points along a river.



4. THE DRAWING OF A HISTOGRAM

A histogram is drawn in exactly the same way as a bar graph. The only difference is that a histogram is used when the independent variable is groups of information along a continuous scale. Note that in a histogram, the bars are drawn without any spaces between them.

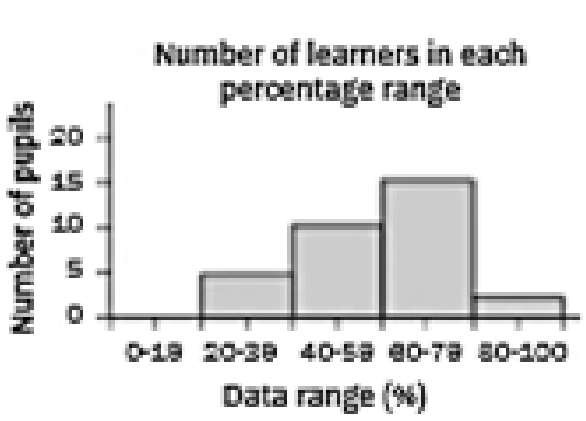
NB!

When the independent variable is continuous data (an infinite number of values that are evenly distributed), we use a line graph or histogram. When the independent variable is discontinuous data (a fixed number of values that do not form an ordered scale), we use a bar graph or pie chart.

Range	Number of pupils
0 – 19	0
20 – 39	5
40 – 59	11
60 – 79	16
80 - 100	3

Number of learners with a particular percentage (%) score

Histogram of information regarding pupils with a particular score:



5. THE DRAWING OD A PIE CHART

Add all the data in the table together. In this case, you will add all the numbers in the 'Number of women' column to find out how many women took part in the investigation.

Thus, 34 + 38 + 22 + 30 + 76 = 200 women.

When you do the calculations for the pie chart, then ‘200’ will be the denominator (the number that you divide by).

Contraceptive	Number of women
Sterilisation	34
Pill	38
Condom	22
Rhythm method	30
None	76

Table of contraceptive use by a sample group of women

Convert your data to angles. Divide each number by 200. Then, since there are 360° in a circle, the angles are worked out by multiplying by 360.

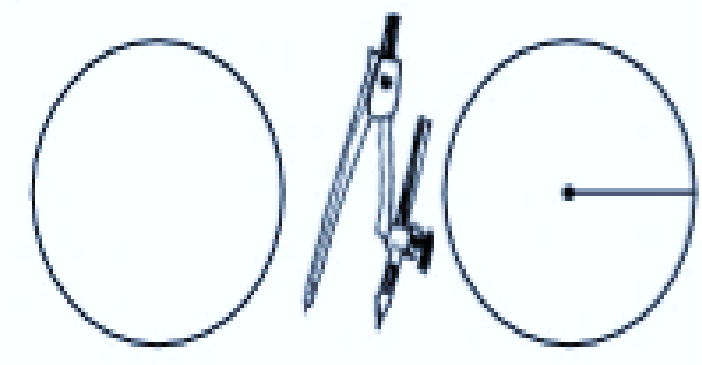
$\frac{34}{200}$ × 360 = 61,2° (round down to 61°)
$\frac{38}{200}$ × 360 = 68,4° (round down to 68°
$\frac{22}{200}$ × 360 = 39,6° (round up to 40°)
$\frac{30}{200}$× 360 = 54°
$\frac{76}{200}$ × 360 = 136,8° (round up to 137)

Check that the calculations are correct. All the degrees should add up to 360°.

In the example: 61° + 68° + 40° + 54° + 137° = 360° √

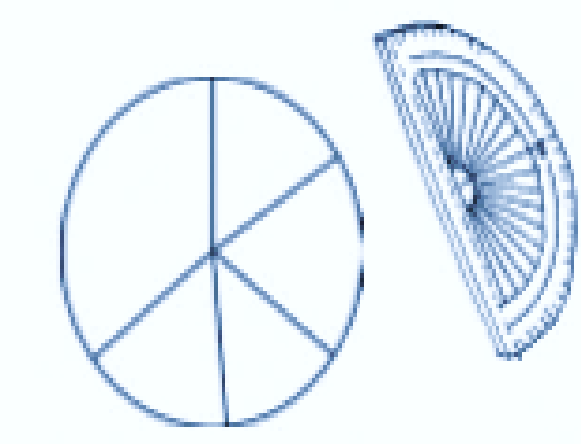
If the degrees don’t add up to 360°, you have done something wrong. Go back and check your work.

Use a mathematical compass to draw a circle:



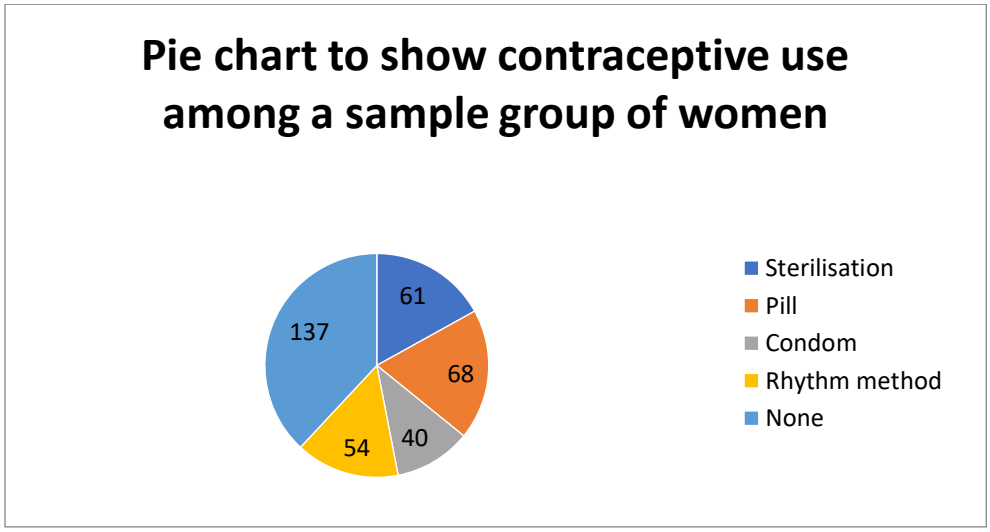
Draw in one radius on the circle. Start at the exact middle of the circle and draw a line to the edge of the circle.

Use a mathematical protractor to measure out the sectors of the pie chart according to the angles you calculated.



Label each of the sections of the pie chart with the correct information. In this example, each section should be labelled with the correct contraceptive method used by women (OR provide a key for the different sections).

Give the pie chart a heading or caption. Remember that both variables should be included in the heading or caption. In this example the two variables are the type of contraceptive and the number of women.



UNIT 3: ESSAY WRITING

LEARNING OBJECTIVES

At the end of this unit, you should be able to:

- Apply the method of successful essay writing.

You should spend more or less 1 hours on this unit.

1. ESSAY WRITING

The essay in the final examination is allocated 20 marks. Answering this question requires planning. Look at the planning steps using the following essay question, which appeared in the Life Sciences Paper 2 March 2012: Version 1 exam paper, as an example.

EXAMPLE QUESTION: Describe the role of the hypothalamus and the adrenal glands in bringing about changes to the blood vessels of the human skin and explain why these changes take place.

Content (17)
Synthesis (3)
Total (20)

Read the essay question thoroughly to determine the topics that are being covered. Underline the key words in the essay question that provide clues to the different topics:

- **Nervous system** – since the hypothalamus (a part of the brain) is involved
- **Endocrine system** – since adrenal glands are involved
- **Temperature regulation** – since this involves blood vessels of the skin

Interpret and analyse the essay question. Identify the aspects or processes that are required from each of the topics identified. You may need to read the question more than once to enable you to do this.

Hypothalamus – What effect does it have on the blood vessels of the skin? Adrenal glands – What effect do they have on the blood vessels of the skin?
If you cover the above in your essay you will only be answering the 'describe' part required by the essay question.

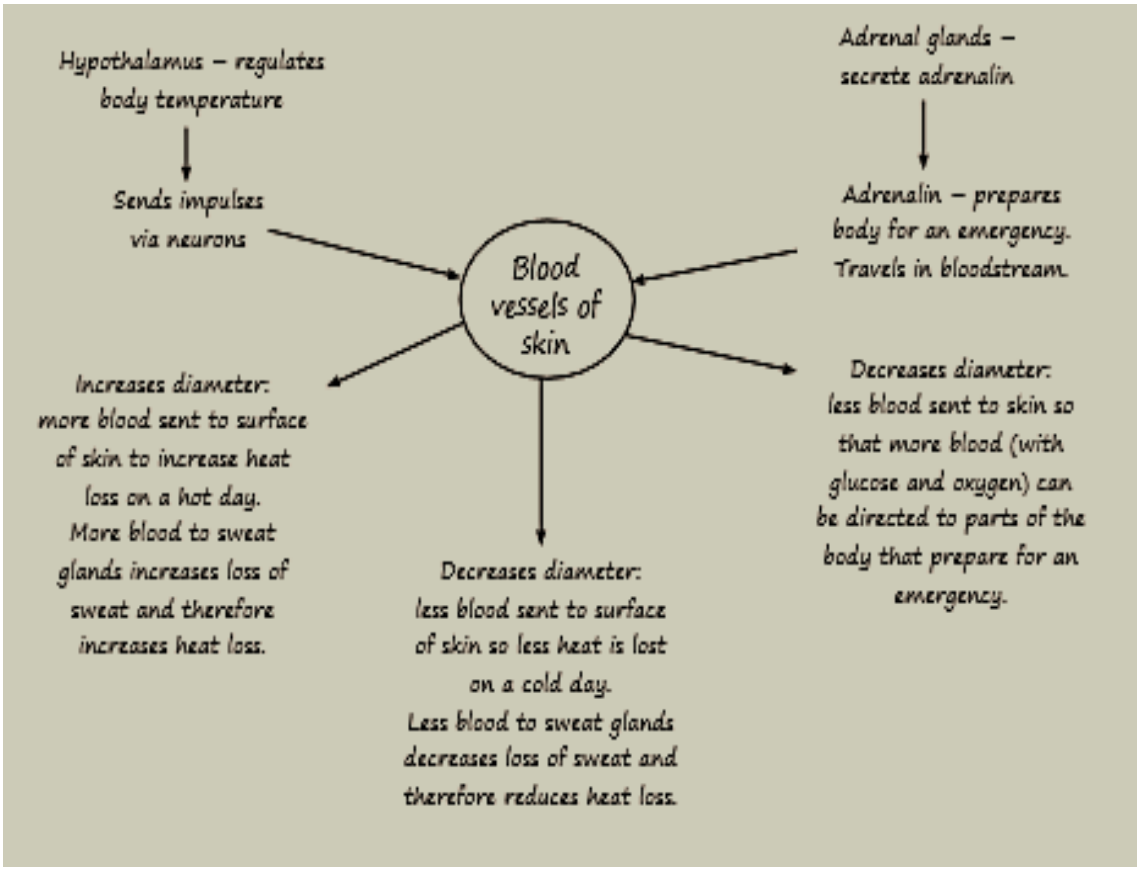
NB!

The essay also requires an 'explanation' of why these changes take place. For the explanation, you need to elaborate on the functions of the hypothalamus and the adrenal gland that involve the blood vessels of the skin as follows:

Hypothalamus – controls body temperature by stimulating a change in the diameter of the blood vessels of the skin. Adrenal glands secrete adrenalin into the bloodstream, which decreases the diameter of the blood vessels of the skin so that more blood (with oxygen and glucose) can be directed to other parts of the body to prepare for an emergency.

Write the first draft of the essay in a logical and organised manner, linking each aspect that is discussed. This will help to obtain a high mark from the 3 marks allocated for the synthesis of the essay. The plan or draft of the essay may take the form of a flow diagram. Note that the final answer to the essay MAY NOT be in the form of a flow diagram.

Make sure you are answering the question. Keep referring back to the question to guide you.



- Write out the final version of the essay. Put a line across the plan of the essay so that the marker assesses the final answer and not the plan or draft.
- Now read the question again one more time to check if the answer corresponds to the question.
- Proofread the essay carefully. This is the opportunity to pick out any spelling errors or incomplete words, sentences or ideas.
- NB! A thorough knowledge of the subject material is necessary to complete an essay successfully.

UNIT 4: LINE DRAWINGS

LEARNING OBJECTIVES

At the end of this unit, you should be able to:

- Draw a labelled diagram.

You should spend more or less 15 minutes on this unit.

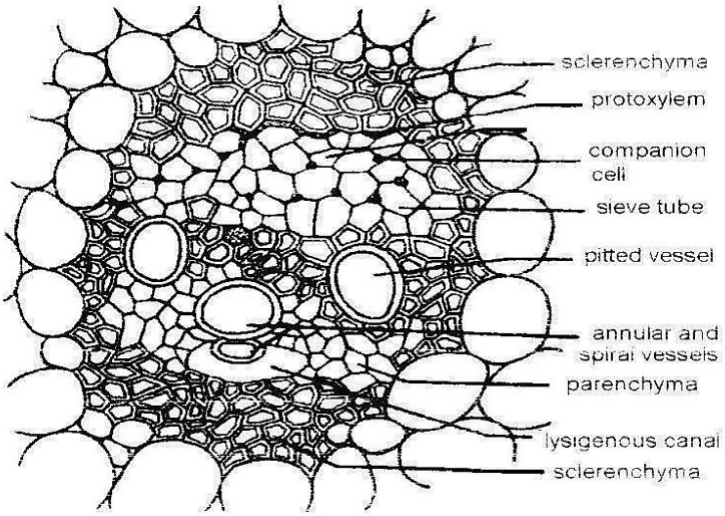
In the exam, it may be required to draw a labelled diagram.

Keep these tips in mind if you are asked to draw a labelled diagram:

- Draw in pencil and use neat, strong lines.
- Do not use shading in the diagram.
- The diagram must not be too small. It must be clear and correctly proportioned.
- The label lines must point directly to the structure that is being labelled.
- The label lines should not have arrow points.
- If possible, label lines should all end at the same point so that the labels are neatly aligned.
- Label lines should never cross. If two label lines cross, neither label will be marked.
- Print the labels neatly in pen.
- Finally, give the diagram a descriptive heading that states exactly what it illustrates.

For example:

Line drawing of a vascular bundle of a maize plant



UNIT 5: ANATOMY OF AN ANIMAL CELL

LEARNING OBJECTIVES

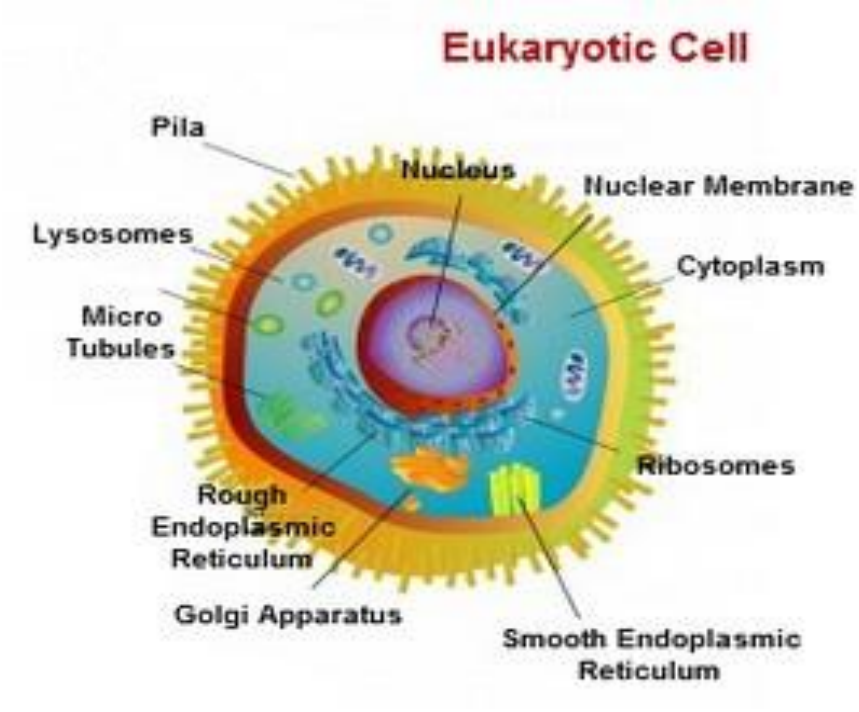
At the end of this unit, you should be able to:

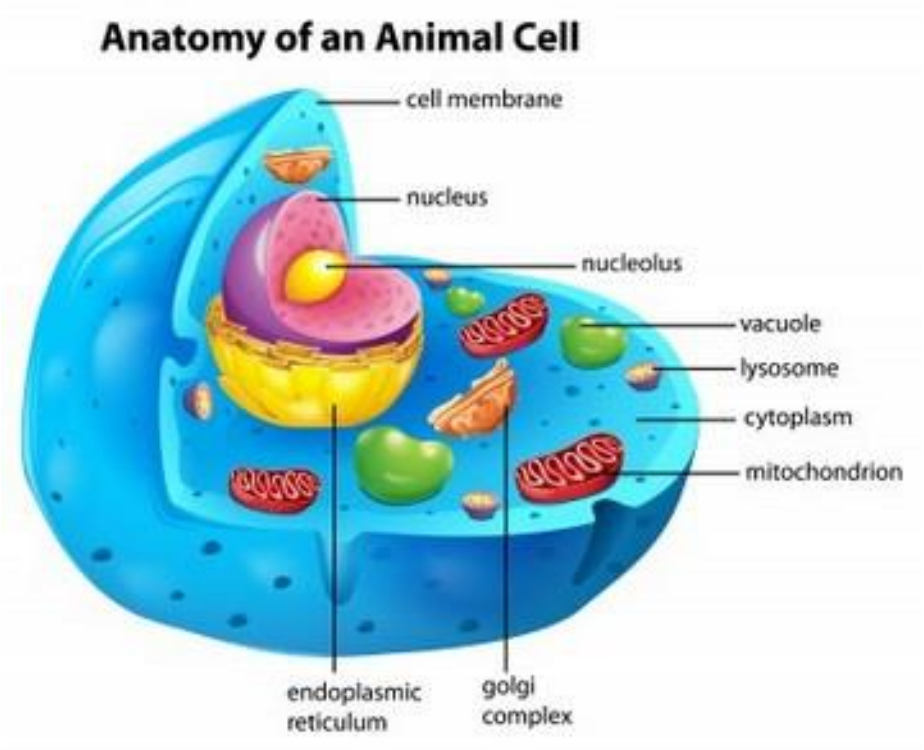
- Discuss the organelles and structure of a eukaryotic cell.
- Label a diagram of a eukaryotic cell.
- Discuss the functions and structures of the organelles found in a eukaryotic cell.
- Discuss the functions of a eukaryotic cell.
- Discuss the cell cycle

You should spend more or less 2 weeks on this unit.

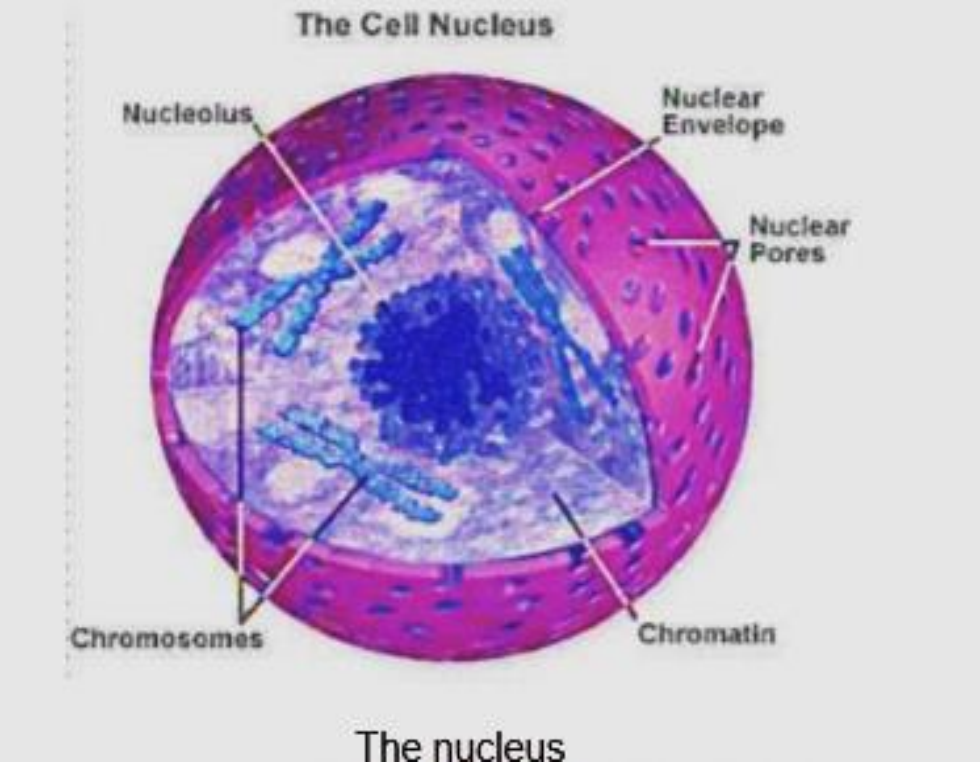
1. DIAGRAMS OF AN ANIMAL CELL (EUKARYOTIC CELL)

1.1. Quarter cross section diagram (Fig 1)





1.2. Cross Section diagram (Fig 2)



The nucleus

1.3. Quarter cross section diagram of the nucleus (Fig 3)

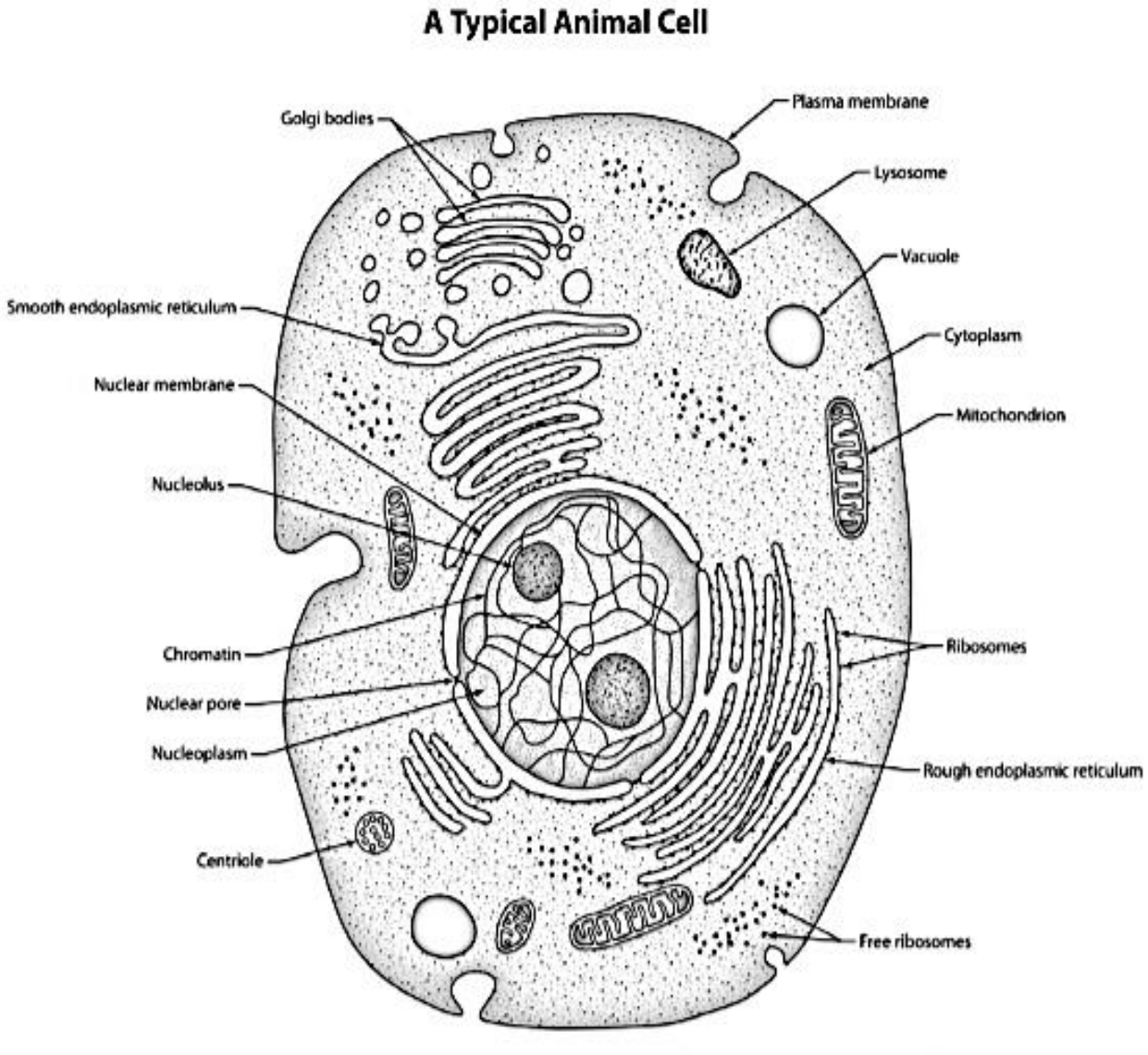


Fig 4 Two-dimensional drawing of an animal cell

2. PARTS OF AN ANIMAL CELL

Cell Nucleus
The cell nucleus is referred to as the control center of the cell. The genetic material of the organism is present in the cell. The replication of DNA, and synthesis of RNA occurs in the nucleus of the cell. It also regulates the activities of the other cellular organelles.

Location and structure of the nucleus: (See Fig 3)

- Location and shape in animal cells: Rounded and in the center of the cell.
- Location and shape in plant cells: Lens shaped and pushed to the side of the cell by the vacuole.
- Nuclear membrane or envelope – Surrounds the nuclear contents and is a double membrane.
- Nuclear pores – Numerous and control the passage of molecules and structures into and out of the nucleus.
- Nucleoplasm – The ‘cytoplasm’ of the nucleus.
- Nucleolus – This is an extra dense area of DNA and protein where the ribosomes (rRNA is synthesized) are produced.
- Chromatin – Is made up of DNA (a nucleic acid) and proteins called histones. When the cell is about to divide the chromatin condenses into separate chromosomes.

Mitochondria
The mitochondria is referred to as the power house of the cell. Its main function if to produce energy for the cell by the process of cellular respiration. The energy produced is ATP.

Endoplasmic Reticulum
It is a network for transportation of certain substances in and out of the nucleus.

Golgi Apparatus
It is involved with processing and packaging of the molecules that are synthesized by the cells. The crude proteins that are passed on by the ER to the apparatus are developed by the golgi apparatus into primary, secondary, and tertiary proteins.

Ribosomes
The function of ribosomes is protein synthesis. These are made up of RNA and proteins.

Lysosomes
They are referred to as the suicide bags of the cell. They have digestive enzymes and are in the shape of sacs and are involved in clearing the unwanted waste materials from the cell. They also engulf damaged materials like damaged cells, and invading microorganisms and digest food particles.

Vacuole
They are large storage organelles. They store excess food or water.

Cell membrane
This forms the outer covering of the cell, and is semi-permeable.

Cytoplasm
This is a gel-like matrix where all the other cell organelles are suspended inside the cell.

Centrioles
These organize the microtubules assembly during cell division.

Endoplasmic Reticulum
This is a network of membranes composed of rough and smooth endoplasmic reticulum.

Microtubules
These are hollow rods, functioning primarily as support and shape to the cell.

Nucleolus
This is the structure within the nucleus and helps in synthesis of ribosomes.

Nucleopore
This is the tiny hole in the nuclear membrane that allows the movement of nucleic acids and proteins in or out of the cell.

3. FUNCTION OF AN ANIMAL CELL

All living organisms are made up of cells. Cells are differentiated into plant cells and animal cells. Structurally there are a few differences in plant and animal cells though their functionality is almost the same.

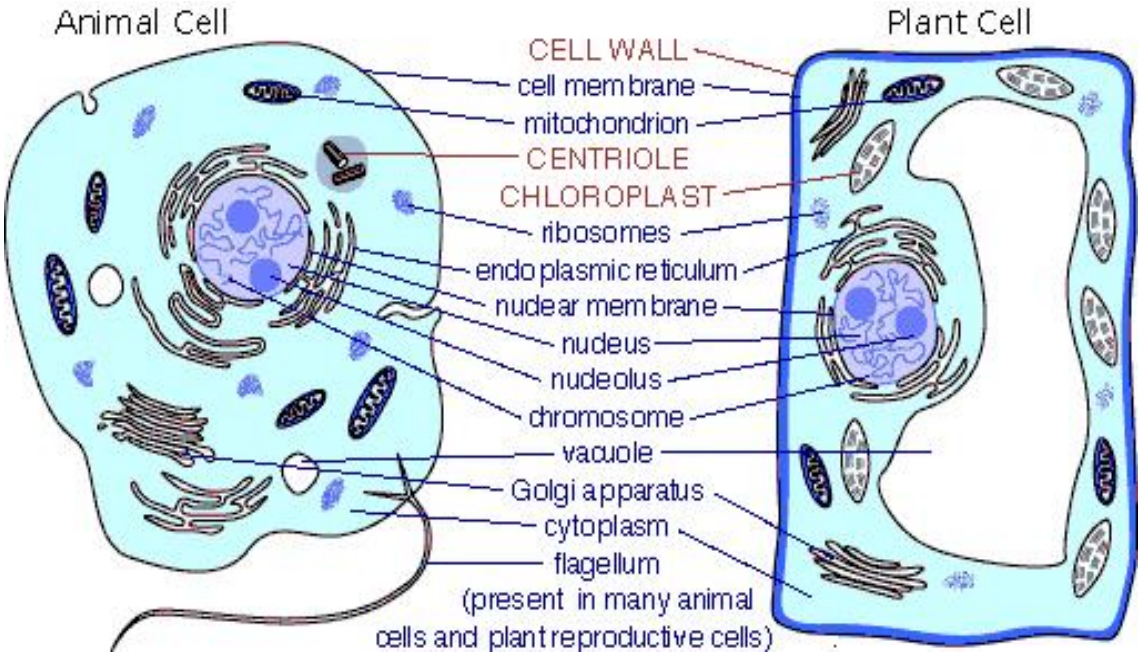


Fig 5 Construction of animal and plant cells

All the cells are enclosed in a protective membrane called the cell membrane. However, plant cells have an extra addition, namely the cell wall.

The cells have certain organelles that are membrane bound within them and these structures are called cellular organelles. These organelles are specified to perform certain activities that are important for the survival of the cell. All the cells function together in coordination with each other and help the organism to survive.

The functions of animal cell are carried out by the different cell organelles. The organelles of the cell function as a unit and regulate the activities of the cell.

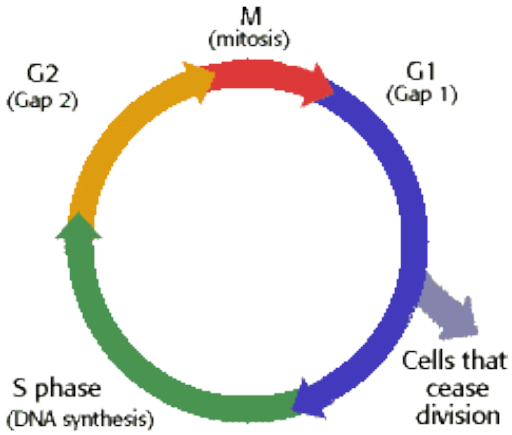
The different cell organelles and their functions were discussed previously.

- The animal cells perform a variety of activities through the aid of the cellular organelles in each cell.
- These cells function as a unit and the cells together form tissues. A group of tissues with similar functions form an organ.
- A group of organs with a specific function to perform becomes an organ system.
- Thus, the microscopic cells form the basic unit for the activities and coordination of an organism and helps with the survival of the organism.

3.1. THE CELL CYCLE

Cells pass through a cell cycle through mitosis (cell division) and interphase (phase between divisions). In more developed organisms, actively dividing cells take 18 to 24 hours to complete the cell cycle. During this cell cycle, mitosis is completed in ½ to 2 hours. Most of the time is spent in interphase.

Stages of the cell cycle



The interphase consists of G1, S and G2 stages.

G1 phase:
This takes place before DNA replication. After mitosis, the cells grow, they may differentiate and there is intense metabolic activity. The DNA is active, mRNA is produced, and protein synthesis takes place. Actively dividing cells in other words, the cells in a developing embryo and meristematic cells in plants, spend hours in this phase before moving to the next phase of DNA replication. Some cells mature, specialise and continue to be metabolically active but do not continue with DNA replication, the G2 phase and cell division.

As they mature, they lose their ability to divide for example red blood cells, muscle cells and nerve cells. Some cells, once they mature and specialise, divide only occasionally for example cortex cells in plant stems. They may spend years in this phase and only re-enter the cell cycle when stimulated. In all human cells (except the sex cells and rbc's), the chromatin consists of 46 chromosomes. Each chromosome consists of a long ribbon-like structure, the DNA (double helix), wrapped around histone molecules. (Nucleosome – a group of histone molecules with DNA wrapped around it).

S1 phase:
This constitutes DNA replication. Each of the 46 DNA strands makes a copy of itself, so that there are now two strands of DNA (2 double helices), each wrapped around histones. The two strands are held together at the centromere. The double structure is a chromosome and each strand is called a chromatid.

G2 phase:
Occurs after DNA replication: The cells continue to grow, synthesise proteins and undergo other metabolic activity. The cell begins to prepare for mitosis.