LECTURE ONE

THE CELL

Plant and animal cells

All animals and plants are made of cells. Animal cells and plant cells have features in common, such as a nucleus, cytoplasm and cell membrane. Plant cells also have a cell wall, chloroplasts and a large vacuole.

INTRODUCTION

The cell can be defined as the basic unit of structure and function of a living thing, whether of plants or animals.

important Events in the Discovery of Cells

1665 - Robert Hooke looks at cork under a microscope. Calls the chambers he see "cells"

1665 - 1675 Anton van Leeuwenhoek, studies organisms living in pond water. He calls them "Animalcules."

1830 - German scientists Matthias Schleiden (Botanist) and Theodor Schwann (zoologist) summarized the findings of many scientists and concluded that all living organisms are made of cells. This forms the basis of the Cell Theory of Biology.

The Cell Theory

1. All organisms are composed of cells.

2. The cell is the structural and functional unit of life. Any unit smaller than a cell is not alive.

3. Cells arise by division of pre-existing cells. Spontaneous generation does not exist

1. What is a cell
2. In what year:
   - did Robert Hooke discovered the Cork cell?
   - did Schwann and Schleiden proposed cell theory?
   - did Anton Van Leeuwenhoek Studied living things in the pond?
3. Anton Van Leeuwenhoek Called the living organisms in pond as ____
4. State the cell theory.
5. Which of the cell theories disproves the theory of Spontaneous generation?

4. A Cell contains the information for its structural and functional development in its nucleic acids. This information is usually passed down from parents to their off-springs.

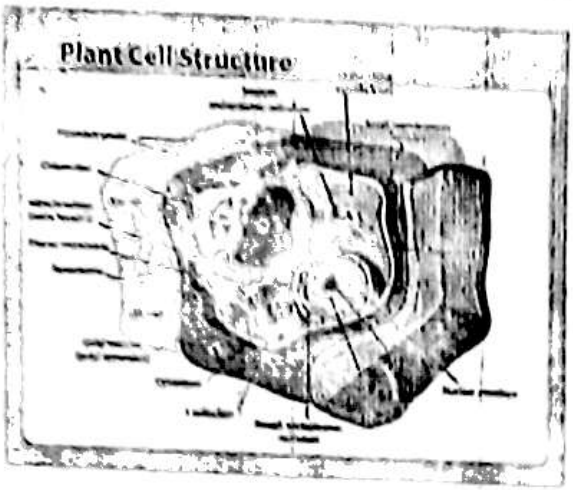


Figure 1.1: A Plant cell (Source: Wikipedia .org)

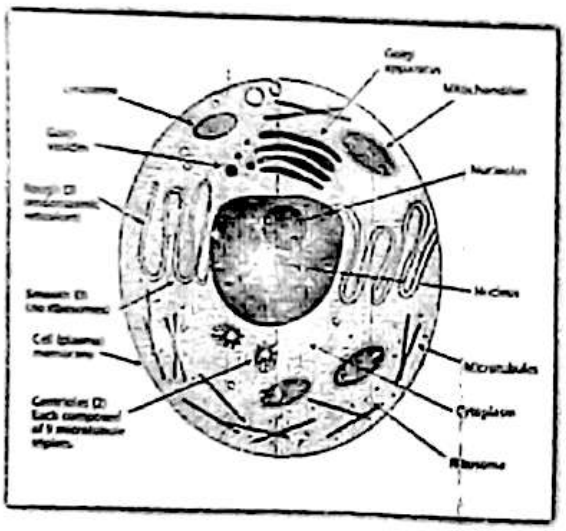


Figure 1.2: An Animal Cell. (Source: bp.blogspot.com)

Functions of the parts of a cell

1. Cell membrane – A partially permeable barrier .It controls exchange between the cell and its environment.

2. Nucleus- contains the chromosomes that have the DNA .The DNA is organized into genes. These control all the activities of the cell.
3. Endoplasmic reticulum (ER). Rough ER transports proteins made by the ribosome. Smooth ER is the site for lipid and protein synthesis.
4. Ribosome- Protein synthesis.
5. Mitochondria- also known as the power house of the cell. It is the site for energy production.
6. Golgi apparatus- internal processing transport system. Makes the lysosomes.
7. Lysosomes- also known as suicide squads. Concerned with the breakdown of structures or molecules. Gets rid of old organelles, digest bacteria.
8. Cell wall -Middle lamella- provides mechanical support and protection, cements neighbouring cells together.
9. Chloroplast-It is the organelle in which photosynthesis takes place.
10. Large central vacuole- storage of various substances including waste products.

TYPES OF CELL

There are two types of cells (i) Prokaryotic and (ii) Eukaryotic.

Characteristics of Prokaryotic Cell

Pro = before; karyon = nucleus

1 ⇒ They are relatively small in size about 5 to 10 um.

2 ⇒ They do not have membrane-bound organelles .The DNA lies free in the cytoplasm (Nucleoid).

3 ⇒ They do not have a true nucleus.

4 ⇒ They are the earliest and most primitive cell type.

Characteristics of Eukaryotic Cells

Eu = true; karyon = nucleus

⇒ They have membrane-bound organelles.

Their De-oxyribonucliec acid (DNA) is found inside the nucleus.

The DNA is associated with protein to form chromosomes

Evolved from prokaryotes by endosymbiotic association of two or more prokaryotes

Examples include Protists, Fungi, Animals, and Plants.

COMPARISON OF PLANT AND ANIMAL CELL

Part	Animal cell	plant cell
Cell wall	Absent	Present
Shape	Round/irregular	Rectangular
Vacuole	One or more (small)	One (Large)
Chloroplast	Absent	Present
Centrioles	Present	only in lower plants
Cytoplasm	Present	Present
Endoplasmic reticulum	Present	Present
Ribosomes	Present	Present
Mitochondria	Present	Present
Plastids	Absent	Present
Golgi apparatus	Present	Present
Plasma membrane	Cell membrane	Cell membrane and wall
Nucleus	Present	Present
Lysosomes	Found in cytoplasm	Not found
Cilia	Seen in some	Not seen
Flagella	Present in some cells	Present in some cells
Microtubules	Present	Present

REVISION QUESTIONS

1. What is a cell?
2. Differentiate between a plant and animal cell
3. State the cell theory.
4. Differentiate between the prokaryotic and Eukaryotic cell.

Basic

LECTURE TWO

MOVEMENT OF MATERIALS IN AND OUT OF THE CELL

OSMOSIS

Introduction

Osmosis was first documented by a man called Jean -Antoine Nollet in 1748. French physician René Joachim Henri Dutrochet (1776–1847) coined the word osmosis. It is defined as the movement of water molecules across a semi-permeable membrane from region of low concentration to one of high concentration. This movement is aimed at equalizing the solute concentrations of the two solutions. In other words, create a balance.

It is the solvent molecules that moves and not the solute molecules.

Basic explanations

Osmosis is the movement of a solvent across a semipermeable membrane towards a higher concentration of solute. In biological systems, the solvent is typically water, but osmosis can occur in other liquids, supercritical liquids, and even gases. When a cell is submerged in water, the water molecules pass through the cell membrane from an area of low solute concentration to high solute concentration. For example, if the cell is submerged in saltwater, water molecules move out of the cell. If a cell is submerged in freshwater, water molecules move into the cell.

When the membrane has a volume of pure water on both sides, water molecules pass in and out in each direction at exactly the same rate. There is no net flow of water through the membrane.

Osmotic pressure is the main cause of support in many plants. The osmotic entry of water raises the turgor pressure exerted against the cell wall, until it equals the osmotic pressure, creating a steady state.

When a plant cell is placed in a solution that is hypertonic relative to the cytoplasm, water moves out of the cell and the cell shrinks. In doing so, the cell becomes flaccid. In extreme

1. Who was the first to document Osmosis and what year?
2. Who coined the word 'osmosis' and in what year?
3. What do you understand by Osmosis?

cases, the cell becomes plasmolyzed– the cell membrane disengages with the cell wall due to lack of water pressure on it.

When a plant cell is placed in a solution that is hypotonic relative to the cytoplasm, water moves into the cell and the cell swells to become turgid.

Osmosis can be demonstrated when potato slices are added to a high salt solution. The water from inside the potato moves out to the solution, causing the potato to shrink and to lose its 'turgor pressure'. The more concentrated the salt solution, the bigger the difference in size and weight of the potato slice.

USES OF OSMOSIS

1. Osmosis is responsible for the ability of plant roots to draw water from the soil. Plants concentrate solutes in their root cells by active transport, and water enters the roots by osmosis.

2. Osmosis is also responsible for controlling the movement of guard cells.

3. Reabsorption of water by the proximal and distal convoluted tubules of the nephron.

4. Reabsorption of tissue fluid into the venule ends of the blood capillaries.

5. Absorption of water by the alimentary canal — stomach, small intestine and the colon.

In unusual environments, osmosis can be very harmful to organisms. For example, freshwater and saltwater aquarium fish placed in water of a different salinity than that to which they are adapted to will die quickly, and in the case of saltwater fish, dramatically. Another example of a harmful osmotic effect is the use of table salt to kill leeches and slugs.

Summary of Activities in Osmosis

If the medium is hypotonic relative to the cell cytoplasm — the cell will gain water through osmosis.

1. What is Hypertonic, Hypotonic and Isotonic Solution?
2. What is flaccidity, Plasmolysis, turgidity of a cell?
3. List 7 uses of Osmosis.

If the medium is isotonic — there will be no net movement of water across the cell membrane.

If the medium is hypertonic relative to the cell cytoplasm — the cell will lose water by osmosis.

OSMOSIS AND FOOD PRESERVATON

Food can be preserved by causing any microorganism that comes in contact with it to become plasmolysed and, therefore, shrivel and die. To do this food is placed in a high salt or sugar medium. The salt or sugar concentration is higher than the cytoplasm of the bacteria or fungi. Bacteria or fungi, that contaminate the food, will lose water by osmosis and their metabolic rate will reduce. Many will die but some bacteria may survive by forming dormant resistant endospores. Meat and fish are often preserved in salt. Fruit is commonly preserved in sugar as in jam or syrup.

DIFFUSION

Diffusion is the movement of particles (atoms, ions or molecules) from a region in which they are in higher concentration to regions of lower concentration. If you put a drop of iodine or potassium permanganate crystals in a beaker of water eventually the entire beaker of water will have a bluish purple tint. Iodine solution molecules or those of the potassium permanganate moved through the water until it was equally distributed throughout the beaker. Diffusion takes place along a concentration gradient A concentration gradient exists until the diffused substance is evenly distributed. The same thing happens when you spray perfume or insecticides.

Uses of diffusion

A) Entrance of carbon dioxide into leaf stomata.

B) Oxygen diffusing out of the stomata and lenticels of leaves.

1. Explain Osmosis and Food preservation.
2. Explain Diffusion
3. Role of diffusion in living organisms.

Plasmolysis

Plasmolysis is the process in which cells lose water in a hypertonic solution. The reverse process known as cytolysis occure if the cell is in a hypotonic solution resulting in a lower external osmotic pressure and a net flow of water into the cell.

Plasmolysis is also the separation of plant cell cytoplasm from the cell wall as a result of water loss. Plasmolysis can be induced in the laboratory by placing a plant cell in a strongly saline or sugary solution, so that water is lost by osmosis.

If onion epidermal tissue is immersed in a solution of calcium nitrate, cells rapidly lose water by osmosis and the protoplasm of the cells shrinks. Plasmolysed cells die unless they are transferred quickly from the salt or sugar solution to water.

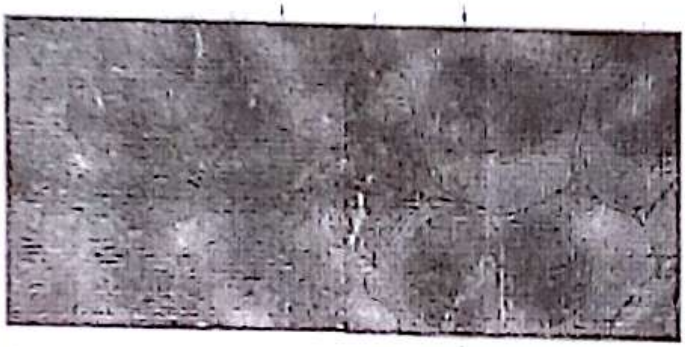


Figure 2.1: Normal cell Figure 2.2: Plasmolysed cell

Source: "https://en.wikipedia.org/w/index"

Revision Questions

1. Differentiate between osmosis, diffusion and plasmolysis.
2. Mention the roles of osmosis and diffusion in biological systems.

1. What is the difference between Plasmolysis and Cytolysis.?

LECTURE THREE

ECOLOGY

Ecology is the study of the interactions between organisms and the environment. The Environment broadly embraces everything external to an organism that affects it, including physical (abiotic factors such as light, temperature, rainfall, humidity, various pollutants, and topography) as well as biotic factors such as parasites, predators, mates and competitors. The biotic environment include all the living part of the environment, while the abiotic environment include the non-living part of the environment.

LEVELS OF ECOLOGY

There are two main levels of ecology: (I) Autecology (II) Synecology.

Autecology: This refers to the study of an individual species in relation to its environment. It entails the study of its structure, morphology; physiology and its niche (ways it utilizes its resources and roles it plays in the environment.

Synecology: This is the study of different groups of organisms or species in relation to their environments. Aspects of synecology include the qualitative and quantitative nature of a population. It is also known as community ecology. Factors that influence the population are also studied under synecology.

SOME ECOLOGICAL TERMS

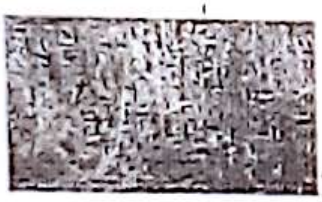
1. **Population:** These are group of individuals belonging to the same species living in a particular geographic area at a particular time. E.g. A group of fish, herd of cattle etc.
2. **Community:** This is a unit composed of all the populations of all the species living in a given area. This include population of different species of plants and animals. It also comprises the entire living component (biotic) and their interactions with one another
3. **Ecosystems:** These are communities and their physical environments considered together. This may apply to a local area or a widespread one, for example, the sycamore tree in a given wood lot may be regarded as a population, and so many sycamore trees in a county. Similarly a small pond and its inhabitant or the pond and the forest in which it is located may be treated as an ecosystem. Different ecosystems are linked to one and another by biological, chemical and physical processes. Inputs and outputs of energy, gases, inorganic and organic chemical compounds can cross ecosystem boundaries by

1. What is ecology?
2. Explain the two levels of ecology.
3. What is population, community and ecosystem?

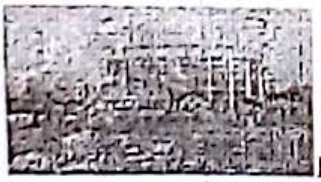
way of meteorological factors such as wind and precipitation. Geological factors such as running water and gravity likewise biological factors.

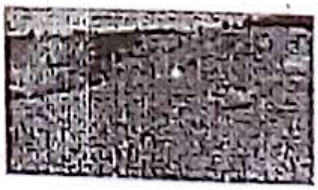
4. **Environment:** This refers to the sum total of external factors surrounding an organism in the place it lives. Everything external to an organisms which influences its life in the place where it lives is termed the environment. This may include the same species of organism, other species of plants and animals, microorganisms etc. Essentially the environment consist the biotic (living) and abiotic (non-living factors) and their interaction with one another. The biotic environment is made up of producers, consumers and decomposers.
5. **Habitat:** This is the specific locality where an organism or a group of organisms live. It entails the physical and geographical portion of the environment in which an organism or organisms are found. A habitat, or biome, is the type of environment in which plant and animals live. Habitat is dictated by what kinds of plants grow there, the climate and the geography. Rainforest, coral reefs and the tundra are all habitats where particular kinds of plants and animals might be found. Based on the size (dimension) of a habitat, there are two basic categories namely: (i) microhabitat (ii) macrohabitat. Based on the presence or absence of water (fluid medium), we have terrestrial and aquatic habitats.

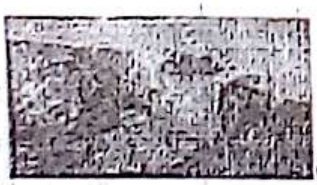
-Terrestrial Habitats: Terrestrial habitats include forests, grasslands, deserts and rainforests. They are typically defined by factors such as plant structure (trees and grasses), leaf types (eg broad leaf and needle leaf), plant spacing (forest, woodland, savanna) and climate.


Beech wood


Broadleaf forest


Brownfield land


Chalk grassland


Coastal


Coniferous forest

1.

2. 1. What is Environment?

3. 2 What is a habitat?

3. Classification of habitat based on size.

4. Classification of habitat based on the presence or absence of fluid.

5- What are examples of terrestrial habitat (Unit 6).

Desert

Farmland

Flooded grassland

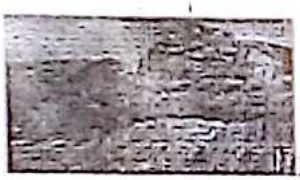
Heathland

Hedgerows

Limestone pavements

Mangroves

Mediterranean forest



Moorland

Mountain grassland

Mountains

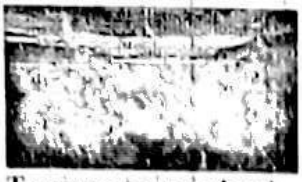
Oak wood

Parkland

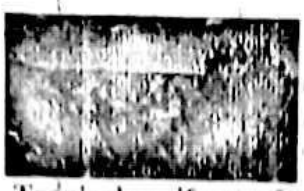
Polar

Rainforest

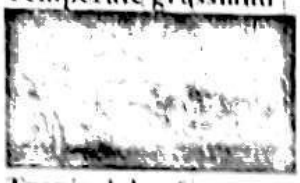
Taiga



Temperate grassland



Tropical coniferous forest



Tropical dry forest

Tropical grassland

Tundra

Urban

Wildflower meadow

Freshwater Habitats: Freshwater habitats include bogs, ponds, lakes, rivers and streams. About 3% of earth's water is freshwater, but this includes the water locked up in the ice caps and trapped in rocks and soil as groundwater. Only a tiny fraction (0.014%) is surface water in the form of rivers, lakes and swamps.

Bog

Brackish water

Lakes and ponds

Marsh

6. **Niche**: A species niche refers to the ecological role of a species in the community i.e. the way an organism uses its environment to make a living. The niche includes such factors as what it frequently focus on, important variables of an organisms niche such as food, time and sites of activity and a few key physical variables like temperature. It can also be termed the biological status of an organism within its community.

EXERCISES

1. What is a habitat?
2. Classify habitats based on size and fluid medium
3. Outline examples of terrestrial and aquatic habitats