BIOLOGY 101

CHAPTER 3: CELLS

CELLS ARE THE UNITS OF LIFE

Cells isolate the chemical reactions necessary for life processes.

THE DISCOVERY OF CELLS– Simple Lenses Revealed the Cellular Basis of Life.

Robert Hook gave cells their name after observing cork (bark) cells.
Mid 1600's - Anton van Leeuwenhoek, father of microscopy, made microscopes that magnify to 200X.

CELL THEORY EMERGES - Mid 1800's -improvement of microscopes made it possible to see parts of cells.
Schleiden and **Schwann**.1. All organisms are made of one or more cells.
2. The cell is the fundamental (smallest) unit of life. (The chemical reactions of life take place within cells.)
Virchow 3. All cells arise from pre-existing cells. (Pastuer's experiments added support)

MICROSCOPES MAGNIFIY CELL STRUCTURES

Light microscope (brightfield) - Light comes through the object on the slide to your eye.

Electron microscopes-**Developed in the 1930s. Electron microscopes use a beam of electrons to produce an image that is projected on a screen**.

Transmission electron microscope- shows internal features, electrons pass through the specimen.
Scanning electron microscope- bounces electrons off the specimen showing the surface.

Dissecting scope (stereomicroscope) - Lower magnification, greater working distance for fine dissections.

ALL CELLS HAVE FEATURES IN COMMON

Similarities are basic structure and functions.

1.**PLASMA MEMBRANE**- external membrane of the cell, a lipid bilayer that controls access into and out of cell.
2.**DNA& RNA**(Nucleic acids) - the molecules that controls the structure and function of cells.
A chromosome is a giant DNA molecule that carries the hereditary information
3.**CYTOPLASM**- Everything between plasma membrane and nuclear envelope.
4.**RIBOSOMES**- A structure upon which proteins are synthesized.

What makes cells different?

Differences are the specialization of the cells. Determines **size, shape, organelles** and **location in organism**. ex .muscle, nerves

SURFACE-TO-VOLUME RATIO(A/V) determines cell's ability to exchange materials with its environment.
A cell's shape affects it's A/V. (Ex. **Microvilli** extend a cells surface area in the digestive tract.)
Cells A/V increased by: Flattening the cell, Other long extensions of the cell, Dividing into multicelled,

DIFFERENT CELL TYPES CHARACTERIZE LIFE'S THREE DOMAINS

Prokaryotic cells have: Plasma membrane, DNA & RNA, Cytoplasm, Ribosomes, (Most have cell walls.)
Prokaryotic cells lack nucleus and organelles.
Domain BacteriaContains Earth's Most AbundantOrganisms.

Bacterial shapes – Round **Coccus**, Rod shaped **Bacillus**, Curved (example) **Spirillum**

Gram staining is used to further identify bacteria

Eubacteria that are able to do photosynthesis are called **cyanobacteria**
Some bacteria are found in **soil** and are able to fix atmospheric N2 gas into nitrates. The name of this bacteria is **Nostoc**. They fix nitrogen gas in cells called **heterocysts**.

Another cyanobacteria, ***Oscillatoria***glides through the water.

REVIEW

Domain Archaea Includes Prokaryotes with Unique Biochemistry.
(Nonfatty acid lipids, different cellwalls)

Domain Eukarya Contains Cells with Complex Cells

Eukaryotic cells have: **Plasma membrane, DNA in nucleus, Cytoplasm, Ribosomes** plus many **Organelles**

Kingdom Protista – Protists are **single-celled** (Examples: Amoeba, Paramecium, Euglena & others)

Kingdom Fungi - Fungi are multicelled (except yeast) **saprophytes** (decomposers)

Kingdom Plantae–Plants are multicelled **autotrophs** (producers)

Kingdom Animalia – Animals are multicelled **heterotrophs** (consumers)

Human cheek cells –You added **methylene blue** dyeto your cheek cells on a slide. Viewed through a microscope on high power, you can see the **plasma membrane, cytoplasm**, and **nucleus**.
If you looked closely you probably saw some **bacteria**.

A MEMBRANE SEPARATES EACH CELL FROM ITS SURROUNDINGS.

Phospholipids - major component - form the **lipid bilayer**,
Proteins in the membrane add structure and function

PHOSPHOLIPID BILAYER- Phospholipid molecules arranged with their hydrophilic heads toward the outside and their hydrophobic tails sandwiched in the middle. The lipid bilayer changes with the density of the lipids.

FLUID MOSAIC MODEL-The theory of plasma membrane structure.
Fluid -The bilayer is in constant motion.
Mosaic - Membrane proteins arranged in an asymmetrical manner carry out most membrane functions.

MEMBRANE PROTEINS

TRANSPORT PROTEINS - Imbedded in membranes, they create passageways across membranes.

ENZYMES – facilitate chemical reactions

RECOGNITION PROTEINS – identify all body cells as your own and identify specific tissues
Require matching for organ transplants; allow immune system to identify cells of the body

ADHESION PROTEINS – attach cells to other cells

RECEPTOR PROTEINS – transmit signals to the interior of a cell

EUKARYOTIC ORGANELLES DIVIDE LABOR

ORGANELLES- membranous structures that perform specific jobs for the cell (isolate reactions)

The Nucleus, Endoplasmic Reticulum, and Golgi Interact to Secrete Substances

ENDOMEMBRANE SYSTEM -Builds and reconstructs cell parts and makes cell products for export.

Endomembrane system includes-Nucleus, ER -> Golgi -> Vesicles

NUCLEUS - double membrane bound organelle houses the nucleic acids DNA and RNA (cellularinformation).

Nuclear envelope- double lipid bilayer surrounding the nucleus penetrated by **nuclear pores**

Nucleolus- dark-staining region in nucleus (site of the formation of ribosomes, can be many nucleoli.

Chromosomes- in eukaryotes, a linear strand of DNA plus support proteins that are condensed.

Chromatin- relaxed DNA (uncoiled chromosomes) that fill the nucleus.
Genes are portions of the chromosomes.
The genetic information passes from DNA to RNA to proteins, which carry out the work of the cell.

ENDOPLASMIC RETICULUM- folded set of membranes in the cytoplasm, the main station for synthesis of proteins and lipids.

Rough Endoplasmic Reticulum- studded with many ribosomes (protein synthesis sites) where polypeptides are assembled.

Smooth Endoplasmic Reticulum- site of lipid synthesis.

Vesicles- membrane sacs used to transport proteins within the cell and to export things from the cell by **exocytosis**. Vessicles are also formed by **endocytosis**.

GOLGI APPARATUS- another system of membranes that are involved in lipid and protein modification.
The number of Golgi apparatus in a cell is determined by its type of specialization.
The cells of secretory organs have a larger number of Golgi apparatus.

LYSOSOMES, VACUOLES, & PEROXISOMES ARE CELLULAR DIGESTIONCENTERS

Lysosomes-organelles that contain digestive (hydrolytic) enzymes. Fuse with endocytic vesicles to digest engulfed food particles and worn out cell parts (recycling them into raw materials).
Whole cellular digestion - breaking of lysosomes, ex. transformation of caterpillar into butterflies.

Vacuoles – serve for storage
Plants – **central vacuole** stores water
Protists – **contractile vacuole** pumps out excess water
Animals – **fat vacuoles** store fat for energy, food vacuoles serve for digestion

Peroxisome – convert hydrogen peroxide and other cell byproducts to nontoxic and useful substances

PHOTOSYNTHESIS OCCURS IN CHLOROPLASTS

Chloroplasts- are the organelles of photosynthesis, converting solar energy into chemical energy in the form of carbon compounds. Chloroplasts contain chlorophyll and other light absorbing pigments.

MITOCHONDRIA EXTRACT ENERGY FROM NUTRIENTS
Mitochondria - convert nutrient molecules (primarily carbohydrates) into **ATP**.

This is **aerobicrespiration**.

Mitochondria contain their own DNA and are capable of self replication.

May have evolved when a small cell was engulfed by a larger one.