

Chapter Three: Cells: The Basic Units of Life

Teacher Notes

Lesson One: The Diversity of Cells

-Cells and the Cell Theory

-Robert Hooke-first person to describe cells

-built a microscope in 1665; first looked at cork and then plants

-he spent most time looking at plants and fungi because they have a cell wall making seeing the individual cells easier.

-he didn't believe animals were made of cells

-Finding Cells in Other Organisms

-1673 Anton van Leeuwenhoek made his own microscopes

-viewed protists for the first time

-also looked at animal blood and saw differences between different animals.

-first person to see bacteria

-he discovered yeast in bread is a single-celled organism

-The Cell Theory

-First two parts written by Theodor Schwann in 1839

-In 1858, Rudolf Virchow stated that all cells could form only from other cells. Because of this the third part of the cell theory was added.

-Parts of the Cell Theory

-All organisms are made of one or more cells.

-The cell is the basic unit of all living things.

-All cells come from existing cells.

-Cell Size

-A Few Large Cells

-Chicken egg is an example of a large cell; it is able to be large because it is not taking in more nutrients.

-Many Small Cells

-Cells are small because they are required to take in food and get rid of waste through their outer surface. If a cell gets larger its surface area increases. If the volume grows faster than the surface area it will not be able to gain enough nutrients and get rid of enough waste.

-Ratio of cell's outer surface area to the cell's volume is called the surface area-to-volume ratio.

-surface area-to-volume ratio = surface area/volume

-Parts of a Cell

-The Cell Membrane and Cytoplasm

-Cell Membrane-a phospholipid layer that covers a cell's surface; acts as a barrier between the inside of a cell and the cell's environment.

-Cytoplasm-fluid and its contents inside of the cell

-Organelles-one of the small bodies in a cell's cytoplasm that are specialized to perform a specific function.

-Different types of cells have different types of organelles.

-Genetic Material

- Nucleus-in a eukaryotic cell, a membrane-bound organelle that contains the cell's DNA and that has a role in processes such as growth, metabolism, and reproduction.
- In humans, mature red blood cells lose their DNA
- Two Kinds of Cells
 - Prokaryotes-an organism that consists of a single cell that does not have a nucleus.
 - Prokaryotes are divided into Eubacteria and Archaeobacteria
 - Eukaryote-an organism made up of cells that have a nucleus enclosed by a membrane; eukaryotes include animals, plants, and fungi
- Prokaryotes: Eubacteria and Archaeobacteria
 - Eubacteria
 - know as bacteria
 - most common type of prokaryotes
 - world's smallest cells
 - have DNA; it is long, circular shaped sort of like a rubber band
 - they have no membrane covered organelles but do have ribosomes.
 - have a strong web-like exterior cell wall (used to retain shape)
 - cell membrane allows materials into and out of cell
 - may live on land, in water, or inside other organisms
 - Archaeobacteria
 - know as archaea
 - not as common as bacteria
 - are single-celled
 - have ribosomes, a cell membrane, and circular DNA
 - lacks a nucleus and membrane bound organelles
 - 3 types of archaeobacteria
 - heat-loving
 - salt-loving
 - methane-making (methane is a gas found in swamps or volcanic vents in the ocean)
 - heat-loving and salt-loving are sometimes called extremophiles (or live in places with extreme conditions)
 - heat-loving may live in hot springs
 - salt-loving may live in extremely salty water
- Eukaryotic Cells and Eukaryotes
 - largest cells
 - are usually about 10 times larger than bacteria cells
 - have a nucleus that holds DNA
 - have other membrane bound organelles including: golgi complex, mitochondrion, lysosome, endoplasmic reticulum, ribosome, and cell membrane
 - many are multicellular

Lesson Two: Eukaryotic Cells

- Cell Wall-a rigid structure that surrounds the cell membrane and provides support to the cell.

- outermost structure of plant cells made of cellulose
- allows plants to stand upright
- fungi and yeasts also have cell walls made of chitin
- Cell Membrane-a protective barrier that encloses a cell. It separates the cell's contents from its environment.
- all cells have cell membranes
- in cells without a cell wall it is the outer most area; in cells with cell walls it is just inside the cell wall.
- contains proteins, lipids, and phospholipids
 - hydrophobic-lipids afraid of water
 - hydrophilic-lipids that are water loving
 - some of the proteins and lipids control the movement of materials into and out of the cell.
 - some of the proteins form passageways for water and nutrients
- Cytoskeleton-a web of proteins in the cytoplasm.
 - acts as a muscle and skeleton
 - keeps cell membrane from collapsing; may help some cells move
 - made of three types of proteins
 - one is a hollow tube
 - others are long, stringy fibers
- Nucleus-a large organelle in a eukaryotic cell
 - contains DNA which contains information to make protein
 - proteins control chemical reactions in a cell
 - provide structural support for cells and tissues
 - proteins are not made in the nucleus
 - is covered by two membranes
 - nucleolus stores materials that will be used to make ribosomes
- Ribosomes-cell organelle composed of RNA and protein; the site of protein synthesis
 - smallest of all organelles
 - more ribosomes than any other organelle
 - some float freely in cytoplasm; others attach to membranes or the cytoskeleton
 - are not covered with a membrane
 - proteins are made within the ribosomes and are made of amino acids
- Endoplasmic Reticulum-a system of membranes that is found in a cell's cytoplasm and that assists in the production, processing, and transport of proteins and in the production of lipids.
 - folded membranes in which proteins, lipids, and other materials are made.
 - is an internal delivery system of the cell.
 - contains tubes and passageways
 - can be rough or smooth
 - Rough ER is covered by ribosomes and usually found near the nucleus
 - Smooth ER makes lipids and breaks down toxic materials that could damage the cell.
- Mitochondria-the cell organelle that is surrounded by two membranes and that is the site of cellular respiration.
 - main power source of the cell

- are covered by two membranes
- energy released by mitochondria is stored in a substance called ATP
- most ATP is made in the inner membrane of the mitochondria
- most eukaryotic cells have mitochondria
- mitochondria are the size of some bacteria
- mitochondria have their own DNA and can divide within a cell
- Chloroplasts-organelles in plant and algae cells in which photosynthesis takes place
 - have two membranes and their own DNA
 - use sunlight, carbon dioxide, and water to make sugar and oxygen
 - are green because they contain chlorophyll (a green pigment)
 - chlorophyll is found inside the inner membrane of a chloroplast
- Golgi Complex-cell organelles that helps make and package materials to be transported out of the cell.
 - named after the Italian scientist who first identified the organelle.
 - looks like ER
 - here the lipids and proteins may be modified to do different jobs
 - final products are enclosed in a piece of the Golgi complex's membrane which pinches off to form a small bubble. The bubble transports its contents to other parts of the cell or out of the cell.
- Cell Compartments
 - Vesicle-a small cavity or sac that contains materials in a eukaryotic cell.
 - can move materials out of a cell or around inside of the cell.
- Cellular Digestion
 - Lysosomes-vesicles that are responsible for digestion inside a cell and contain digestive enzymes.
 - destroy worn-out or damaged organelles, get rid of waste materials, and protect the cell from foreign invaders.
 - found mainly in animal cells
- Vacuoles-a large vesicle.
 - in some plant and fungal cells they act like large lysosomes
 - store digestive enzymes and aid in digestion within the cell
 - may store water and other liquids (which can also help support the cell)

Lesson Three: The Organization of Living Things

- The Benefits of Being Multicellular
 - Grow by making more cells not growing cells larger
 - example-an elephant has cells about the same size as yours
 - Some benefits of being multicellular
 - larger size
 - longer life-not limited to the life span of a single cell
 - specialization-each type of cell has a particular job; makes organisms more efficient.
- Cells Working Together
 - Tissue-a group of similar cells that perform a common function
 - example-cardiac tissue-one type of tissue found in a heart
 - Animals have 4 basic types of tissue

- nerve tissue
- muscle tissue
- connective tissue
- protective tissue
- Plants have 3 types of tissues
 - transport tissue-moves water and nutrients through a plant
 - protective tissue-covers the plant; helps to retain water and protects the plant against nutrients through a plant
 - ground tissue-where photosynthesis takes place
- Tissues Working Together
 - Organ-a collection of tissues that carry out a specialized function of the body
 - examples-heart, stomach, a leaf, a stem, a root
 - Organ System-a group of organs that work together to perform body functions
 - each has a specific job
- Organisms-a living thing; anything that can carry out life processes independently
 - organisms made of a single cell is called unicellular.
 - examples-bacteria, most protists, and some fungi
 - they may live in colonies but are unicellular because each cell carries out all life functions.
- Structure and Function
 - Structure-the arrangement of parts in an organism
 - Function-the special, normal, or proper activity of an organ or part
 - example-structure of lungs is a large spongy sac; the function is to take oxygen to your body and to release carbon dioxide.