

Biology EOC Review Notes

What is Biology?

- Bio = life, -Logy = the study of
 - Biology is the study of living things and their surroundings

Organism = a living thing; anything possessing the characteristics of living things.

- Characteristics of living things:
 - o All living things grow and develop.
 - o All living things reproduce.
 - o All living things are organized.
 - o All living things adjust to their surroundings (adapt).
 - o All living things need energy (ATP).
 - o All living things are made up of cells.
 - o All living things contain genetic material (DNA).

Reproduction = organisms making more of their own kind, making offspring.

Offspring = babies, when organisms reproduce they produce offspring

Growth = organism gets bigger

Development = organism changes shape or form. It develops new structures.

Metamorphosis = type of development where an organism makes a very big change in shape or form. Ex: tadpole to a frog; caterpillar to a butterfly.

Environment = organism's surroundings, both living and nonliving.

Adaptation = physical change that arises in an organism over time through the process of evolution. Adaptations can be physical (webbed feet of ducks to swim) or behavioral (changing colors to blend in with surroundings) Animals adapt (thick fur for polar bear to keep warm) but plants also adapt (thorns for protection from predators, stop photosynthesis when not enough light or water).

Organization:

- All living things are organized in the following way: atoms → molecules → cell parts → cells → tissues → organs → organ system → organisms (smallest to largest)

Homeostasis:

- Homeostasis = an organism remaining constant in a changing environment; maintaining a stable, internal environment

Every organism tries to regulate how much of each chemical is present in it. They try to keep the level or the amount constant or the same. TOO much or TOO little is bad! Ex: body temperature = 98.6°F; too cold or too hot is

bad and that is why we sweat or shiver to maintain that 98.6°F

Scientific Method:

- Independent variable = the part of the experiment that is changed or manipulated in the beginning (I change the IV)
- Dependent variable = the part of the experiment that is different at the end; the part that is measured at the end. (DV = Data)
- Constants = conditions in an experiment that are the same for every group.
- Control = the group that is kept under normal conditions or that is not being tested.
- Hypothesis = prediction; testable sentence. Usually in “If....Then” format.
- Experiment = procedure done to test a hypothesis.
- Quantitative data = data that can be counted or measured, numbers
- Qualitative data = data gathered by observing qualities, descriptive

Biomolecules- molecules that help to make up cell parts, cells, and living things.

Organic Molecules - any molecule that contains some carbon (C). ALL of the biomolecules are ORGANIC.

The **FOUR** biomolecules:

• **Carbohydrates**- Composed of C,H,andO (ratio of CH₂O)

- o Examples include pasta, bread, and many vegetables
- o Store and release quick energy
- o Structural support in plants
- o Monosaccharides, disaccharides, polysaccharides (ex. Cellulose, starch, glycogen)

• **Lipids**- Composed of C,H,andO

- o Building block (subunit) is glycerol and 3 fatty acids
- o Examples include fats, oils, waxes, and steroids
- o Long-term energy storage, insulation, protective coatings o Major part of the cell membrane
- o Made in the smooth ER

• **Proteins**-Composed of C,H,O,and N

- o Building blocks (subunits) are amino acids, held together by peptide bonds o Helps with muscle contraction
- o Transports oxygen in blood (hemoglobin)
- o Examples include tuna, meat
- o Carries out (speeds up) chemical reactions (enzymes)
- o Made in ribosomes and rough ER

• **Nucleic Acids**-Composed of C,H,O,N,and P

- o Building block (subunit) is a nucleotide: sugar, phosphate, nitrogen base o Examples include DNA and RNA
- o Stores genetic information in cells in the form of a code

Biochemistry

- pH (Power of Hydrogen) scale of a solution (solute and solvent)

o Scale that determines how acidic (H⁺) or basic (OH⁻) a substance is

Acid: pH of 1-7

Base (ALKALINE): pH of 7-14

Neutral: pH of 7

Buffer: neutralizes a solution

Properties of Water

- o Expands when freezes: Causes ice to float, forms soil by cracking rocks, lakes do not freeze solid
- o Resists temperature change: keeps organisms' environments stable, oceans keep earth warm enough for life
- o High heat of vaporization: high energy needed to evaporate; helps body cool through sweating
- o Capillary action/capillarity: can creep up thin tubes for movement and transport
- o High surface tension: molecules stick together

Osmosis: movement of water (particles) in and out of a cell

- o Hypotonic: higher concentration of water OUTSIDE the cell; cell will swell
- o Hypertonic: higher concentration of water INSIDE the cell; cell will shrink
- o Isotonic: reaches equilibrium constant movement in and out

Cells

Important cell scientists:

1. Hooke: Looked at cork (dead cells), came up with term "cell."
2. Leeuwenhoek: Invented the microscope. First to look at living cells.
3. Schleiden: botanist, studied plant cells.
4. Schwann: zoologist, studied animal cells.
5. Virchow: first to see cells divide under the microscope.; therefore concluded that cells only come from other pre-existing cells

The Cell Theory: (based on discoveries made by Schleiden and Schwann)

1. all living things are made of cells. (this is why viruses are NOT living)
2. all cells come from pre-existing cells.
3. cells are the basic unit of life/organization.

Prokaryotic cells:

- primitive, small, NO membrane-bound organelles or nucleus, DNA is in the cytoplasm
first cells on Earth were prokaryotic
bacteria are this type of cell
Archaea and Eubacteria = two prokaryotic kingdoms

Eukaryotic Cells:

Advanced cells, larger than prokaryotic cells, DNA in nucleus, has organelles
Plants, animals, fungi, and protists are made of this kind of cell.

Endosymbiotic Theory:

- Big cell ate little cell and kept it around to do work. Little cell became an organelle.
- Evidence for theory:
 - Mitochondria: most scientists believe that they were once aerobic bacteria.
 - Chloroplast: most scientists believe that they were once cyanobacteria or blue green algae.

Cell Parts:

cell membrane: semi-permeable membrane surrounding all cells; allows materials to enter and leave the cell

cell wall: additional boundary of plant cells providing structural support, made of cellulose

cytoplasm: clear, gel-like fluid inside of a cell, where important chemical reactions take place

ribosomes: where proteins are made in the cell

ER: folded system of membranes for transport of materials through a cell

Smooth: no ribosomes, makes lipids Rough: has ribosomes, makes proteins

golgi apparatus: flattened stack of membranes for packaging and sorting proteins vacuole: storage of food and water

lysosome: digests food and old cell parts

mitochondria: produces ATP (energy) for the cell; powerhouse

chloroplast: transforms sunlight into glucose (food) in plant cells

nucleus: stores DNA, control center or brain of the cell

nucleolus: region within the nucleus that produces ribosomes

cytoskeleton: internal support system; made of microfilaments and microtubules

unicellular: organism made of one cell

multicellular: organism made of more than 1 cell

centriole: used for cell division in animal cells

flagella: long projections used for movement by cells

cilia: short, hair-like structures used for movement by cells

Plant Cells:

Plant cells have chloroplasts, central vacuoles, and cell walls; animal cells do NOT

Plant cells do NOT have centrioles and lysosomes

Plant cells are usually rectangular or square in shape due to cell walls

Plant cells can not pinch in to divide. Instead they must construct a cell plate to divide the two new cells.

Animal Cell:

Animal cells have centrioles, plants do NOT

Animal cells do NOT have cell walls or chloroplasts

Biomolecules and Cells:

Cell membranes are made of phospholipids, which are a type of lipid.

Cell walls are made of cellulose, a polysaccharide, which is a carbohydrate.

Cytoskeleton, centrioles, and ribosomes are made up of structural proteins.

Proteins are made in the ribosomes and rough ER.

Lipids are made in the smooth ER.

DNA, which is a nucleic acid, is stored in the nucleus.

RNA, which is a nucleic acid, is a copy of DNA, which carries the genetic code from the nucleus to the ribosome during protein synthesis.

Cell Differentiation:

- This is the process where cells in multicellular organisms become specialized or different. These cells differentiate into cells that do very different jobs.

Cell Energy:

Photosynthesis: Happens in plants in chloroplast, two parts to chloroplast: stroma and thylakoid (grana)

- o Chlorophyll in plants catches sunlight energy and uses this energy to make glucose sugar
- o Plants need carbon dioxide and water to do photosynthesis
- o $6 \text{ CO}_2 + 6 \text{ H}_2\text{O} + \text{sunlight} \rightarrow \text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2$

2 steps:

Light-Dependent Reactions use water and light to make oxygen, occurs in thylakoid

Light-Independent Reactions (Calvin cycle) use carbon dioxide to make glucose, occurs in stroma

o Desert plants adapt to dry conditions: CAM plants open stomata at night when transpiration rates are slower or close them completely when no water(become idle= no photosynthesis) ex. cactus. C4 plants photosynthesize rapidly when hot and dry so stomata open not as long during the day to conserve water

- **Cell Respiration:** ALL living things do respiration! Even plants, when they have no light! o happens in mitochondria. Breaks down glucose sugar to make energy or ATP.
- Mitochondria need oxygen and glucose to do respiration
- $\text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2 \rightarrow 6\text{CO}_2 + 6\text{H}_2\text{O} + 36\text{ATP}$
 - o First step is always glycolysis which makes 2 ATP, happens in cytoplasm
 - o Second step depends on presence of oxygen

If oxygen present: Krebs cycle and electron transport chain make 34 ATP, water, and CO_2 – happens inside mitochondria

If no oxygen: anaerobic respiration (Fermentation) occurs and makes lactic acid in muscles OR carbon dioxide and alcohol by yeast, also makes 2 ATP