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**Week 3: Cell Structure and Function**

**Part 1: Please note that this lab corresponds with the following Connect resources:**

**Section 5.2 diffusion:** “diffusion across a selectively permeable membrane,” “effect of density of media on the rate of diffusion,” effect of molecular weight of diffusion in air,”

**Section 5.3 Osmosis:** “osmosis: tonicity in red blood cells”

**Section 5.4 Enzyme activity:** “enzymes and digestion” and “how enzymes work series ( effect of concentration, effect of pH, effect of temperature, and enzyme activity)”

**Part 2: Relevant textbook passages:**

Chapter 3 “Cell Structure and Function”, sections 2 “how cells are organized” through section 6 “metabolism and the energy reactions—but stop after the enzyme section. You can also skip section 5 on cell junctions.

**Complete the worksheet using your textbook and Connect. For any questions that you need to Google (marked with an asterick)\*, please do so but provide a link to a CREDIBLE SOURCE. Answers that are not from credible sources will be counted incorrect.**

**Part 1: Connect resources**

**A. Diffusion:**

**1. Complete the lab and record any notes here for** “diffusion across a selectively permeable membrane.”

Diffusion rate can be influenced by many factors, such as media density, concentration gradient, temperature, molecular size, and membrane permeability.

In diffusion, molecules move from high concentration to low concentration.

A concentration gradient is present when there is a different concentration of solutes within a solution.

2. **Complete the lab and record any notes here for** “effect of density of media on the rate of diffusion.”

Diffusion is the net movement of a solute from an area of higher concentration to an area of lower concentration. This can occur within a single solution.

Diffusion occurred the fastest in liquid because liquids are less dense compared to semisolids

3. **Complete the lab and record any notes here for** “effect of molecular weight of diffusion in air.”

The precipitate formed closest to the hydrochloric acid (HCl) because its greater molecular weight (18 g/mol) made it unable to diffuse as far as ammonia (NH3) (10 g/mol)

B. Osmosis:

1. **Complete the lab and record any notes here for** “osmosis: tonicity in red blood cells.”

An isotonic environment is balanced so water enters and leaves cells at the same rate.

A hypertonic environment tends to cause a cell to shrivel or collapse as water exits the cell.

A hypotonic environment tends to cause a cell to swell or burst as water enters the cell.

When red blood cells are exposed to hypotonic solution, they swell and burst. Because the cell membranes are no longer intact, the solution will be clear (translucent).

When red blood cells are exposed to isotonic or hypertonic solutions, their cell membranes stay intact and will cause the solution to be cloudy (opaque).

C. **Enzyme activity:**

**1. Complete the lab and record any notes here for** “enzymes and digestion.”

Amylase is an enzyme found in saliva and pancreatic secretions that breaks down polysaccharides into smaller oligosaccharides and disaccharides such as maltose.

Benedict solution is used to identify monosaccharides and some disaccharides.

Stomach acids dramatically alter the pH of different parts of the digestive system.

pH affects the way enzymes such as amylase function.

Enzymes work best at a specific pH

2. **Complete the lab and record any notes here for** “how enzymes work: effect of concentration.”

A greater enzyme concentration increases the reaction rate because the chance of both collision and binding between substrate and enzyme is increased.

Adding more catalase speeds up the reaction.

3. **Complete the lab and record any notes here for** “how enzymes work: effect of pH.”

The influence of pH on enzyme activity reflects the fact that pH can affect enzyme-substrate binding.

Enzymes are active within a certain pH range, and their activity is decreased below and above that range.

The reaction rate is fastest near pH 7 and slower at higher and lower pH.

4. **Complete the lab and record any notes here for** “effect of temperature.”

The faster movement of molecules increases the chance of collision, thus making the binding between substrate and enzyme more likely.

The reaction rate between substrate and enzyme is increased as temperature increases.

Temperatures that are too high cause enzymes to denature and stop reacting.

As temperature increases, the reaction rate increases to a point. After a maximum rate, the reaction slows down as temperature increases.

5. **Complete the lab and record any notes here for** “enzyme activity.”

Enzymatic activity can be measured in two ways.  
-Amount of substrate consumed  
-Amount of product produced

Catalase is an enzyme that converts the substrate hydrogen peroxide (H2O2) into the products water (H2O) and oxygen (O2).

**Part 2: Textbook Chapter 3 sections 2, 3, 4, and 6.**

**3.2 How Cells are Organized**

Using Figure 3.4 on pg 47, please fill in the following table.

|  |  |
| --- | --- |
| Composition and Function (definition) | Structure/Organelle |
| Stack of membranous saccules; functions in processing, packaging, and distribution of molecules | Golgi Apparatus |
| Membranous sacs; storage and transport of substances | Vesicle |
| Has a double membrane; responsible for cellular respiration and production of ATP molecules | Mitochondrion |
| Particles that carry out protein synthesis | Ribosomes |
| Outer surface that regulates entrance and exit of molecules | Plasma Membrane |
| Region in nucleus that produces subunits of ribosomes | Nucleolus |
| Central body, having diffuse threads of DNA and protein | Chromatin |
| Vesicle that digests macromolecules and even cell parts | Lysosome |
| Composed of microtubules, actin filaments, and intermediate filaments; responsible for the shape of the cell and movement of its parts | Cytoskeleton |
| Membranous saccules and canals having no ribosomes; synthesizes lipid molecules | Smooth ER |

**3.3 The Plasma Membrane and How Substances Cross It (section 3.3)**

1. What are the major parts of the plasma membrane of the cell?

The plasma membrane is made up of a phospholipid bilayer with proteins embedded. The heads of the phospholipid bilayer are hydrophilic while the tails are hydrophobic. There are glycoproteins, extracellular matrices, glycolipids, carbohydrate chains, peripheral proteins, cholesterol, integral proteins, and filaments attached and directly adjacent to the plasma membrane.

2. What is diffusion? Look at the animation on diffusion. Take notes here on anything that you did not already know or write n/a.

Diffusion is the random movement of particles from an area of high concentration to an area of low concentration until they become equally distributed. It requires no energy. N/A

3. What is osmosis? Look at the animation on osmosis. Take notes here on anything that you did not already know or write n/a.

Osmosis is the net movement of water across a semipermeable membrane from an area of high concentration to an area of low concentration. N/A

4. Based on the fact that red blood cells maintain a concentration of 0.9% NaCl to maintain homeostasis, consider that the cells are submerged in the bloodstream at all times, which is subject to fluctuation. Fill in the table below.

|  |  |  |  |
| --- | --- | --- | --- |
| **Concentration of NaCl in the blood stream** | **Tonicity (hyper/hypo/iso)** | **Effect on Cells** | **Explanation** |
| 0.9% | Isotonic | Cells remain normal size and shape | The same solute concentration around and in the cell has no change on the size and shape |
| Higher than 0.9% | Hypertonic | Cells shrink and become smaller | The higher solute concentration around the cell than in the cell the cells lose water and shrink |
| Lower than 0.9% | Hypotonic | Cells grow in size and may burst | The lower solute concentration around the cell than in the cell causes the cells to gain water and grow in size or burst |

5. What is facilitated transport? Look at the animation on facilitated transport. Take notes here on anything that you did not already know or write n/a.

Facilitated transport requires the use of a plasma membrane carrier to move a substance into or out of a cell from higher to lower concentration. No energy is required. N/A

6. What is active transport? Look at the animation on active transport. Take notes here on anything that you did not already know or write n/a.

Active transport is the movement of a molecule across a plasma membrane from an area of lower concentration to an area of higher concentration. It uses a carrier protein and energy. N/A

7. What is endocytosis? Exocytosis? Look at the animation on endocytosis and exocytosis. Take notes here on anything that you did not already know or write n/a.

Endocytosis occurs during bulk transport when a portion of the plasma membrane invaginates (forms a pouch) to envelop a substance and fluid from outside of the cell. Exocytosis occurs when a vesicle fuses with the plasma membrane as secretion occurs, allowing the contents to be released outside of the cell. N/A

**3.4 The Nucleus and Endomembrane System (page 53-54, section 3.4)**

Imagine that a cell produces digestive enzymes that are sent to the digestive tract:

1. Which part of the endoplasmic reticulum would produce these enzymes?

Rough ER

2. How would they be transported to another part of the cell?

Vesicles

3. Which organelle would process and package these enzymes for export?

Golgi apparatus

Imagine that a cell produces a sex hormone (a lipid molecule):

1. Which part of the endoplasmic reticulum would produce these lipid molecules?

Smooth ER

2. How would they be transported to another part of the cell?

Vesicles

3. Which organelle would process and package these enzymes for export?

Golgi apparatus

The nucleus produces the subunits of ribosomes.

1. Where in the nucleus are the subunits produced?

Nucleolus

2. What part of the nuclear envelope allows them to get out of the nucleus?

Nuclear pores

3. Where do the subunits go and what happens to them?

Subunits move out of the nucleus and do their job assisting in synthesizing proteins.

**3.6 Enzyme Activity (section 3.6 )**

1. Write a statement relating metabolism, reactants, and products. Watch the animation on biochemical pathways and take notes.

Metabolism, reactants, and products are all related through enzymes. Metabolism is the sum of all reactants and their products. Substrates are converted by different enzymes to fit into other enzymes until the final product is reached.

2. What is feedback inhibition? Watch the animation on feedback inhibition and take notes.

The regulation of metabolic pathways, based on an end product interacting with an enzyme earlier in the process. The final product binds at a different site of the first enzyme, stopping production of the reaction.

3. What is an enzyme? What is a generalized formula to describe the reaction between an enzyme, its substrate and its products.

An enzyme is a metabolic assistant that aids in speeding up chemical reactions. E + S → ES → E + P

4. What is energy of activation? What does an enzyme do to the energy of activation for a particular reaction?

The energy that must be added to cause molecules to react with one another. Enzymes typically lower the amount of energy needed for activation of a reaction.

Review Questions:

1. Which organelle is responsible for protein synthesis?

Ribosomes

2. What term is used to describe the movement of molecules from an area of higher concentration to an area of lower concentration?

Diffusion

3. What is the name for the movement of water across a selectively permeable membrane?

Osmosis

4. Is 10% NaCl isotonic, hypertonic or hypotonic to red blood cells?

Hypertonic

5. In general, what does the wrong pH do to the shape of an enzyme?

The wrong pH will cause an enzyme to fold.

Source: https://www.bbc.co.uk/bitesize/guides/z9jrng8/revision/3

6. Which organelle carries on intracellular digestion?

Lysosomes