**Biology Mid-term Review**

1. Science
2. What is the science of biology
3. What is **science**?
4. What is the goal of science?
5. What is the scientific method?
6. **Observation**
7. **Inference**
8. **Hypothesis**
9. **Controlled** **experiment**
10. **Independent** vs **dependent** variable
11. **Qualitative** VS **Quantitative** data
12. **Conclusions**
13. What is a scientific **THEORY**?
14. What is a **bias**?
15. The Study of Life
16. What are the **6 defining characteristics of all living things**? (p 18-19)
17. Our living planet: interactions between living organisms
18. **Ecology**: the investigation and analysis of interactions among organisms, populations, and communities and their responses to external factors in their environment.
19. Levels of organization:
20. **species** – group of similar organisms that breed and reproduce
21. **population**- a group of individuals that belong to the same species that live in the same area
22. **community**-assemblage of different populations that live together in a defined area (think soil community-lots of different populations of unique species live and share the same location)
23. **Ecosystem**-the organisms that live in one place together with their physical environment
24. **Biome**-group of ecosystems that share similar climates and typical organisms
25. Biosphere-entire planet, with all of its organisms and physical environments
26. **Biotic** vs **Abiotic** Factors
27. Biotic-factors that are living or alive (such as other organisms)
28. Abiotic-physical parts of the ecosystem-not living. For example sunlight, heat, precipitation, humidity
29. **Methods** of doing Ecological Research
30. Observation
31. Experimentation
32. Modeling
33. Energy, Producers, Consumers

1. Energy cannot be created or destroyed! Living organisms CAPTURE energy and CONVERT it into usable chemical energy necessary for life to exist.

2. **Primary producers** (*autotrophs*)-“self-feeders”; organisms that capture energy from non-living sources and convert it into usable forms. Primary means “first” and these are the first producers of energy rich compounds that get used by other organisms through consumption in the food chain.

3. **Photosynthesis** vs. **Chemosynthesis**

4. **Consumers** (*heterotrophs*)-obtain energy by eating other organisms (autotrophs).

5. Types of consumers:

**carnivore**- kill and eat other animals

**herbivore**-eat plants, roots, seeds or fruits

**scavenger**-animals that consume animals that are already dead (killed by carnivores)

**omnivore**- eat a variety of food sources including plants and animals

**decomposer**- microbes that feed by chemically breaking down organic matter. Decomposition produces DETRITUS that forms food source for detritivore.

**detrititvore**- chew or grind detritus particles into even smaller pieces; They digest decomposers that live on and in detritus particles. Examples: sea pig; earthworm, shrimp

1. Energy flow in Ecosystems
2. **Food chain**: a series of steps in which organisms transfer energy and matter by eating and being eaten.
3. **Food Web**: complex interactions between multiple food chains within a single ecosystem.
4. **Trophic level**: each step within a food chain or food web; corresponds to an energy level.
5. Light and chemical energy continuously fuel the PRIMARY level of the food pyramid. This level represents 100% of captured energy.
6. Each level that consumes, beginning with first level consumers and on up to third level and so on, has access to smaller and smaller amounts of the energy captured by the primary producers.
7. **10 % rule**: about 10% of the energy available in one trophic level is transferred on to the next trophic level. The rest is released as heat back into the environment.
8. **Biogeochemical cycles**: processes by which elements, chemical compounds, and other forms of matter are passed from one organism to another and from one part of the biosphere to another. Examples: carbon cycle, nitrogen cycle, phosphorus cycle.
9. **Nutrient Limitation**- if a single essential nutrient is in short supply, primary productivity will be limited. This nutrient, which limits productivity, is called the **LIMITING NUTRIENT**.
10. **Relate Nutrient Cycles to Biomolecules**! (Which biomolecules contain nitrogen? Phosphorus? Nitrogen?)
11. The Chemistry of Life
12. What is an atom? (name 3 sub-atomic particles that make up an atom)
13. Chemical bonding: what is it?
14. **Covalent** vs **Ionic** Bonding
15. Properties of Water
16. **Polarity**
17. **Hydrogen bonding**
18. **Cohesion**
19. **Adhesion**
20. **Heat Capacity**
21. **Solution** vs **solvent** vs **mixture**
22. **pH** (and homeostasis)
23. Carbon
24. Carbon can bond with many elements, including HYDROGEN, OXYGEN, PHOSPHORUS, SULFUR, and NITROGEN to form the important molecules of life. Carbon has 4 VALENCE electrons that allow for this versatility in bonding.
25. **Biomolecules**
26. **monomer** vs **polymer**
27. **Carbohydrates** (sugars) –simple (monomer) vs complex (polymers-examples: cellulose or starch/glycogen)
28. **Lipids** (fats)-long chains of hydrocarbons; not soluble in water.
29. **Nucleic** **Acids** (DNA, RNA) (chains of nucleotides)
30. **Proteins** (polymers of amino acids; 3D shape; molecular “machines”).
31. Chemical Reactions and Enzymes
32. What is a chemical reaction? How is this different from physical changes such as water freezing to form ice- which is NOT a chemical reaction).
33. **Reactants** vs. **Products**
34. Energy in reactions (**energy absorbing** vs **energy releasing**)
35. **Activation energy** (the energy needed to get a reaction started). This applies to all chemical reactions whether reactions are energy absorbing or energy releasing.
36. **Enzymes**
37. proteins that act as **CATALYSTS** (speed up chemical reactions that are necessary for life that would otherwise occur too slowly or that could never take place on their own).
38. Enzymes speed of the chemical reactions that occur in cells.
39. Speeding up the reaction means LOWERING the activation energy.
40. Enzymes bring **SUBSTRATES** together. This interaction is highly specific. An enzyme works only on one specific set of substrates and binds in very specific ways (like a key fitting into a lock). A substrate is the reactant in an enzyme catalyzed reaction.
41. The site where a substrate binds is called the “ACTIVE SITE”.
42. Factors that affect enzyme activity: temperature, pH, or regulatory molecules
43. Cells: structure and function
44. Cell organization (organelles)
45. nucleus
46. cytoplasm
47. Vacuoles and vesicles
48. Lysosomes
49. Cytoskeleton
50. microtubules
51. microfilaments
52. Ribosomes
53. Endoplasmic Reticulum
54. Golgi
55. Mitochondria
56. Chloroplasts
57. Cell Wall
58. Cell membrane
59. Cell membrane: essential building block of cells-forms the barrier that defines a cell and the surface that allows cells to sense and respond to the environment. The membrane regulates what enters and leaves the cell and also supports and protects the cell.
60. **lipid BILAYER** – biomolecule (phospholipid) that forms the membrane.
61. **Fluid mosaic model**- proteins and carbohydrates embedded in the membrane “float” in the membrane. The membrane is flexible. These features led to the term “fluid mosaic” model.
62. **Selectively permeable**: some substances pass into the membrane and others don’t.
63. Cell Transport
64. **passive transport**-diffusion (movement of molecules from area of HIGH concentration to area of LOW concentration). Movement of molecules across the cell membrane without using energy is called PASSIVE transport.
65. **Facilitated diffusion**-diffusion of molecules down a gradient (from high to low concentration) through a cell membrane channel (like a door in the membrane). Example: aquaporin. NO energy required as movement occurs down a gradient (from HIGH to LOW concentration).
66. **Active Transport**: movement of molecules against a gradient (from low to high concentration). This requires energy. Energy = active.
67. **Molecular transport**: specialized transport proteins bind substrates and change shape to allow delivery of the substrates either inside or outside of the cell. Example: sodium/potassium transporter.
68. **Bulk Transport**:
69. **ENDOcytosis** (bringing materials inside cell through in-foldings or pockets in the membrane). Example: amoeba eats a single celled organism.
70. **EXOcytosis**-vacuole with waste for example fuses with the membrane and empties contents outside of the cell
71. Osmosis

**Osmosis** is the diffusion of water through a selectively permeable membrane. Water moves down a concentration gradient (from high water to low water concentration).

IMPORTANT: solutes (dissolved substances like salt or sugar) do NOT move freely across biological membranes. In osmosis, WATER diffuses, not the dissolved substances.

Water moves until equilibrium is reached (where concentration of water and dissolved substances is the same or **ISOTONIC** on either side of the membrane).

**HYPERTONIC**: Comparing two solutions (as in two sides of a membrane), the solution with the greater concentration of solutes is hypertonic. (HYPER HIGH)

**HYPOTONIC**: Comparing two solutions, the solution with the lesser concentration of solutes (HYPO LOW)

**OSMOTIC pressure**: net movement of water in or out of a cell produces a force known as osmotic pressure.

Put a cell in fresh water and water rushes in (there are more solutes inside the cell than outside). This happened when we put water on the onion cell.

Put a cell in salt water and water is drawn out of the cell into the surrounding medium. This happened when we put concentrated salt solution on our onion cells.

Cells adapt to the conditions they exist in. For example, FROG egg cells are adapted to exist in fresh water environments without taking up water (they lack AQUAPORIN channels in their membranes). For this reason, water enters the eggs slowly and osmotic pressure is not a problem.

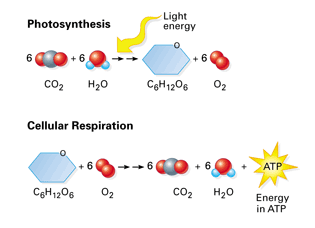
Plant cells and bacterial cells contain cell walls which protect against the effects of OSMOTIC PRESSURE.

1. Levels of organization in living systems:

Organelle, cell, tissue, organ, organ system, organism

Can you now add this to the levels of organization we studied in ECOSYSTEMS?

1. Cellular processes: photosynthesis and cellular respiration



Photosynthesis REMOVES carbon dioxide from the atmosphere and cellular respiration puts it back. Photosynthesis RELEASES oxygen and cellular respiration uses the oxygen to release energy from food.

Photosynthesis and cellular respiration are INTERDEPENDENT processes. Photosynthesis CONVERTS light energy (photons) from the sun into chemical energy stored in the bonds of the GLUCOSE molecule. When consumers EAT the glucose, the stored CHEMICAL ENERGY is converted into ATP (the energy molecule that drives chemical reactions essential for life).

Why do cells need ATP? Remember the important BIOMOLECULE polymers? (DNA & RNA, proteins, glygogen/starch). Building these polymers from monomer subunits TAKES energy. These reactions are UPHILL in energy terms. ATP supplies the energy to make these reactions happen. Remember ACTIVE TRANSPORT? Taking molecules into cells (where they are needed, sometimes against a gradient) REQUIRES energy input. So the ability to maintain homeostasis is costs ENERGY.

Nothing is for free!!

1. Viruses
2. Viruses can reproduce ONLY by infecting living cells
3. Most viruses are smaller than living cells. They consist of a protein coat called a CAPSID surrounding a nucleic acid core (DNA or RNA)
4. Viruses that infect bacteria are called bacteriophage
5. Human viral pathogens (disease causing agents) mostly contain RNA (which makes them retroviruses).
6. They don’t obtain or use energy
7. They do evolve.
8. They don’t grow or reproduce