Cheat Sheet

Worksheet

1. **What is the fluid mosaic model?**
2. How often do adjacent phospholipids switch positions, how far can they travel per second?
3. **How do unsaturated fatty acids affect solidity of membrane?**
4. **How does cholesterol affect membrane fluidity?**
5. What is special about the membranes of fish living in extreme cold and why? How about archaea in extreme heat?
6. What is bacteriorhodopsin?
7. **What are integral proteins and transmembrane proteins, and what makes up their hydrophobic portions?**
8. **What are peripheral proteins?**
9. **What are integrins?**
10. **What genes and proteins play a part in infection by HIV?**
11. **What characterizes membrane carbs and what are they bound to?**
12. **What is exocytosis and which side of the vesicle becomes the extracellular part of the plasma membrane?**
13. **What molecules can easily pass through lipid bilayer?**
14. **What are transport proteins and what are two types of them?**
15. **What are aquaporins?**
16. **What is a concentration gradient?**
17. **What is tonicity and what do isotonic, hypertonic, and hypotonic solutions do to cells (both animal and plant)?**
18. **What is osmoregulation?**
19. **What are ion channels?**
20. **What is a sodium-potassium pump and how does it work?**
21. **What is membrane potential and what does is its range?**
22. **What is the electrochemical gradient?**
23. **What is an electrogenic pump and what is the main one of plants, fungi, and bacteria?**
24. Why is diarrhea so dangerous?
25. **What allows membranes to fuse in exocytosis and what are examples of cells that use exocytosis?**
26. **What is endocytosis and what are the three types?**
27. How do human cells take in cholesterol?

Answer Key:

1. Membrane is mosaic of protein molecules bobbing in fluid bilayer of phospholipids
2. 10^7 times per second, 2 μm
3. Cause membrane to remain fluid to lower temperature because of kinks, preventing close packing together
4. At high temperatures, restrains movement of phospholipids, decreasing fluidity
   At low temperatures, hinders close packing of phospholipids, lowering temp required for solidification
5. Fish have lot of unsaturated fatty acids to prevent solidification, archaea have unusual lipids that may prevent excessive fluidity
6. Bacterial transport protein, N-terminus outside cell, C-terminus inside, hydrophobic parts include seven transmembrane α helices
7. Integral proteins are proteins embedded in hydrophobic portion of membrane. Transmembrane protein spans membrane. Hydrophobic portion made up of 20-30 nonpolar amino acids usually coiled in α-helices
8. NOt embedded in lipid bilayer, loosely bound to surface of membrane, often to exposed parts of integral proteins
9. Membrane proteins with 2 subunits, bind to ECM on outside and associated to proteins attached to microfilaments on inside (transmembrane)
10. CD4 protein on surface of immune cells helps HIV infect cells, mutation in gene that codes for CCR5 protein prevents HIV from infecting cells (virus needs to bind to CCR5 as coreceptor)
11. Short, branched chains of fewer than 15 sugar units, some bonded to lipids to form glycolipids, most bound to proteins to form glycoproteins
12. Process where vesicle fuses with plasma membrane, outside face becomes continuous with inside face of plasma membrane
13. Hydrophobic and small molecules
14. Transport proteins are transmembrane proteins that facilitate movement of hydrophilic substances. Channel proteins have hydrophilic channel that acts as tunnel. Carrier protein hold onto passengers and shuttles passengers across by changing shape.
15. Aquaporins are channel proteins that facilitates passage of water molecules (up to 3 billion water molecules per second, channel fits 10 at a time)
16. Region along which density of chemical substance increases or decreases
17. Ability of surrounding solution to cause cell to gain/lose water. Isotonic means same amount of free water, stable cell volume (normal for animal cells, called flaccid in plant cells). Hypertonic means less free water in solution, causes cell to shrivel (animal cell) or become plasmolyzed (plant cell). Hypotonic means more free water in solution, cell will swell/lyse (called turgid in plant cell, is normal, wall exerts turgor pressure on cell)
18. Control of solute concentrations and water balance
19. Channel proteins that transport ions, many act as gated channels (open/close in response to stimulus)
20. Carrier protein that exchanges Na^+ for K^+ across plasma membrane actively, changes shape when terminal phosphate group of ATP is transferred to it, when open to outside

more affinity for K^+ (more K^+ inside cell, less Na^+ inside than outside), 3 sodium for every 2 potassium ions

21. Voltage across membrane, ranges from -50 to -200 mV (minus indicates inside is negative relative to outside)
22. Combination of chemical force (concentration gradient) and electrical force (membrane potential)
23. Transport protein that generates membrane potential Proton pump, actively transports hydrogen ions out of cell (protons)
24. Excretes waste so fast that reabsorption of sodium is impossible, causing sodium levels to fall
25. Specific proteins rearrange lipid molecules, pancreas use it to secrete insulin, nerve cells use to release neurotransmitters, plant cells deliver proteins and carbs to make cell walls
26. Endocytosis is process where cell takes in molecules by forming vesicles from plasma membrane. Phagocytosis, cell engulfs particle by extending pseudopodia around it and packaging it within food vacuole to be later fused with lysosome and digested, pinocytosis, cell gulps droplets of extracellular fluid in tiny vesicles, non-selective, vesicles often coated with coat protein, receptor-mediated endocytosis, specialized type of pinocytosis, enables cell to acquire bulk quantities of specific substances, receptors, once bound, cluster in coated pits, forming vesicle (other molecules from EC fluid also present), receptors recycled by vesicle
27. Use receptor-mediated endocytosis, cholesterol travels in blood in particles called low-density lipoproteins (LDLs), complexes of lipids and single protein. LDLs bind to receptors on plasma membrane and enter cell. In familial hypercholesterolemia (inherited disease), characterized by high level of cholesterol in blood, LDL receptor proteins missing

1. **What is the difference between catabolic and anabolic pathways (what are alternate names for them)?**
2. **What is thermodynamics?**
3. **What are the two laws of thermodynamics?**
4. **What characterizes a spontaneous process?**
5. **What characterizes a nonspontaneous process?**
6. **What is Gibbs free energy and what is it symbolized by?**
7. **How are free energy and spontaneity related?**
8. **How are spontaneity and equilibrium related?**
9. **What is the difference between an exergonic or endergonic reaction?**
10. **What is deltaG in respiration?**
11. **In living things, can metabolism be at equilibrium?**
12. **What are the three main types of work that a cell does?**
13. **What is energy coupling?**
14. **What is the structure of ATP?**
15. **What is the molecular formula of inorganic phosphate?**
16. **How much energy is released by the reaction that transforms ATP into ADP (in standard and in cellular conditions)?**
17. **What is phosphorylation?**
18. What is the reaction for glutamine synthesis from glutamic acid and what is its deltaG?
19. **How does ATP hydrolysis drive transport and mechanical work?**
20. What is the change in free energy in the hydrolysis of sucrose?
21. **What is activation energy?**
22. **What is the unstable condition that reactants are in once they have absorbed enough energy for the bonds to break called?**
23. **What is the exact definition of catalysis?**
24. **How does an enzyme catalyze a reaction?**
25. **What is an enzyme's substrate?**
26. **What is an enzyme-substrate complex?**
27. **What do most enzyme names end with?**
28. **What is the active site?**
29. What is the substrate of hexokinase?
30. **What is the tightening of the binding after initial contact called?**
31. **What holds the substrate in the active site?**
32. **What does it mean for an enzyme to be saturated?**
33. **Why does higher temperatures tend to increase activity of enzyme, what is avg. optimal temp in humans?**
34. **What are pepsin and trypsin?**
35. **What are cofactors and coenzymes (examples)?**
36. **What is the difference between competitive and noncompetitive inhibitors?**
37. How do sarin and penicillin work?
38. **What is allosteric regulation?**
39. **What are regulatory sites?**

40. **What is cooperativity?**

Answer Key:

1. Catabolic pathways break down molecules to release energy, anabolic pathways build up molecules (breakdown pathways, biosynthetic pathways)
2. Study of energy transformations that occur in a collection of matter
3. First law of thermodynamics - Energy of universe is constant, principle of conservation of energy
   Second law of thermodynamics - Every energy transformation or transfer increases entropy (measure of molecular disorder, or randomness) of universe
4. Leads to increase in entropy by itself and thus can proceed without requiring input of energy, energetically favorable
5. By itself leads to decrease in entropy, happens only if energy is supplied
6. The portion of energy that is free to do work when temperature and pressure are uniform (as in cell), symbolized by G; deltaG = deltaH - TdeltaS; delta G is change in free energy; deltaH is change in system's enthalpy (total energy in biological systems); T is temp in Kelvin; deltaS is change in entropy of system
7. Processes are spontaneous iff deltaG is negative
8. A process is spontaneous and can perform work only when it is moving to equilibrium
9. Exergonic reactions release energy and endergonic reactions absorb energy
10. -686 kcal/mol
11. No
12. Chemical work - Pushing of endergonic reactions that would not occur spontaneously
    Transport work - Pumping of substances across membrane against direction of spontaneous movement
    Mechanical work - Beating of cilia, contraction of muscle cells, movement of chromosomes, etc.
13. Use of an exergonic reaction to power an endergonic one
14.
15. $HOPO_3^{2-}$
16. 7.3 kcal of energy per mole of ATP hydrolyzed under standard conditions, 13 kcal/mol under cellular conditions
17. Transfer of a phosphate group to some other molecule (phosphorylated intermediate, less stable than original molecule)
18. glutamic acid + ammonia = glutamine, +3.4 kcal/mol
19. ATP phosphorylates transport proteins, causing shape change that allows for solute transport; ATP noncovalently binds to motor protein and then is hydrolyzed, causing a shape change that walks the motor protein forward
20. -7 kcal/mol
21. free energy of activation, initial investment of energy for starting reaction, abbr. E_A
22. transition state
23. Process by which catalyst selectively speeds up reaction without being consumed

24. Reduces the E_A barrier
25. Reactant an enzyme acts on
26. Formed when enzyme binds to substrate
27. -ase
28. Restricted region of enzyme that binds to substrate, typically pocket or groove on surface of enzyme where catalysis occurs, usually formed by only few of enzyme's amino acids
29. Glucose
30. Induced fit
31. weak interactions
32. The substrate is concentrated enough that as soon as a product is released from the active site, another substrate takes its place, at this point rate of reaction determined by speed at which active site converts substrate to product
33. Substrates tend to collide more frequently with active sites, 35-40 C
34. Pepsin, digestive enzyme that does not denature in stomach, trypsin, digestive enzymes reside in human intestine
35. Nonprotein helpers that may be bound tightly to enzyme as permanent resident ro bind loosely and reversibly with substrate, if organic referred to as coenzyme (made from vitamins)
36. Competitive inhibitors mimic substrates and compete for active site, noncompetitive inhibitors impede enzymatic activity by binding to another part of enzyme, causes change in shape
37. Nerve gas that binds to R group of serine, which is found in active site of acetylcholinesterase (enzyme important to nervous system), penicillin blocks active site of enzymes used by bacteria to make cell walls
38. Any case in which protein's function at one site is affected by binding of regulatory molecule to different site, protein is usually made from two or more subunit (each with own active site)
39. Also known as allosteric sites that are often at joining of subunits, where activator or inhibitor binds, all subunits change when regulatory molecule binds, enzyme usually oscillates between catalytically active and not, regulatory molecule stabilizes one of the states
40. A substrate binding to the active site of one subunit increases affinity of other active sites, amplifying response of enzymes to substrate