Chapter 5 – Microbial Metabolism

1. *Distinguish among metabolism, catabolism, and anabolism.*
    - **Metabolism** refers to all chemical reactions that occur within a living organism.
    - **Catabolism** refers to degradative reactions that release energy (exothermic) by breaking down large molecules into smaller ones.
    - **Anabolism** refers to biosynthetic reactions that build large complex molecules from simpler ones. Require energy (endothermic) and often needed for growth and reproduction.

2. *Contrast oxidation and reduction reactions.*
    - **OIL RIG**: oxidation involves loss, reduction involves gain.
    - Can be oxidized in three ways: losing electrons, hydrogen atom, or gain of oxygen atom.

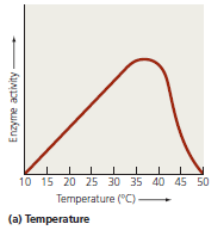
3. *Compare and contrast the three types of ATP phosphorylation.*
    - **Substrate-level phosphorylation** involves the transfer of phosphate to ADP from another phosphorylated organic compound.
    - **Oxidative phosphorylation** involves using redox reactions to attach inorganic phosphate to ADP.
    - **Photophosphorylation** is using light energy to phosphorylate ADP with inorganic phosphate.

4. *Make a table listing the six basic types of enzymes, their activities, and an example of each.*

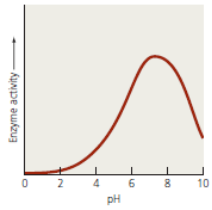
Class	Type of Reaction Catalyzed	Example
Hydrolase	Hydrolysis (catabolic)	Lipase—breaks down lipid molecules
Isomerase	Rearrangement of atoms within a molecule (neither catabolic nor anabolic)	Phosphoglucoisomerase—converts glucose 6-phosphate into fructose 6-phosphate during glycolysis
Ligase or polymerase	Joining two or more chemicals together (anabolic)	Acetyl-CoA synthetase—combines acetate and coenzyme A to form acetyl-CoA for the Krebs cycle
Lyase	Splitting a chemical into smaller parts without using water (catabolic)	Fructose-1,6-bisphosphate aldolase—splits fructose 1,6-bisphosphate into G3P and DHAP
Oxidoreductase	Transfer of electrons or hydrogen atoms from one molecule to another	Lactic acid dehydrogenase—oxidizes lactic acid to form pyruvic acid during fermentation
Transferase	Moving a functional group from one molecule to another (may be anabolic)	Hexokinase—transfers phosphate from ATP to glucose in the first step of glycolysis

5. *Describe the components of holoenzyme, and contrast protein and RNA enzymes.*
    - A combination of the protein, **apoenzyme**, and a cofactor form a full active **holoenzyme**.
    - RNA enzymes, or **ribozymes**, are not made of protein but instead RNA. They remove/splice RNA.

6. *Define activation energy, enzyme, apoenzyme, cofactor, coenzyme, active site, and substrate.*
    - **Apoenzyme** = a proteinaceous portion of an enzyme that is not active on its own
    - **Cofactors** = a 'key' of sorts that activates the function of apoenzymes.
        - Can be inorganic (Fe, Mg, Zn) or organic (aka coenzymes)
    - The shape of the enzyme's functional site, **the active site**, is complementary to shape of the substrate.



(a) Temperature



(b) pH

7. *Describe how temperature, pH, substrate concentration, and competitive and non-competitive inhibition.*
    - If **temperature** is too high or too low, active site alters shape causing 'fit' issues.