ENERGY IN CELLS

- The useable form of energy in cells is **ATP** (_____), which is used as the **activation energy** for many cell chemical reactions. When ATP is broken down by losing one of its 3 phosphate groups, it forms ADP (Adenosine _____) and a _____ group $H_2PO_4^-$

- The reaction is:

  Adenosine Triphosphate ⟶ Adenosine Diphosphate + Phosphate Group

  ATP ⟶ ADP + $H_2PO_4^-$

ENZYME FUNCTION

- **Metabolism** is all the chemical _____ of cells that provide for growth, response to stimuli, movement, maintenance and repair, and reproduction.

- A **Chemical Reaction** involves a change of chemical composition of the reactant chemicals to form different chemicals called _____

  REACTANTS ⟶ PRODUCTS

- **Activation Energy** - Chemical reactions require a certain amount of energy called the activation energy. If an overall reaction such as photosynthesis requires energy to occur, it is called an **endergonic reaction**. If the overall reaction such as respiration _____ energy, it is called an **exergonic reaction**.

- **Catalysts** are substances that regulate the speed at which a chemical reaction occurs, without being used up in the reaction. Catalysts reduce the amount of activation energy required for a reaction to occur. They can be used over and over again.

  $$\text{REACTANTS} \xrightarrow{\text{Catalysts}} \text{PRODUCTS}$$

- **Enzymes** are catalysts in living organisms. They are large globular proteins produced by living cells. Many are dissolved in the cytoplasm, or are in mitochondria and other organelles. About 2000 enzymes are known (e.g. lipase breaks down lipids to fatty acids and glycerol).

- **Action of Enzymes** - Enzymes have a specific shape. Part of the enzyme matches the shape of the molecule to be reacted called the substrate. The part of the enzyme that binds to the substrate is the active site. When the substrate and enzyme bind temporarily, an enzyme-substrate complex is formed. The activation energy needed for the reaction to occur is reduced. After the reaction is

complete, the substrate has formed a new product and the enzyme is released to be reused.

- **Two Theories of Enzyme Action**
  1. Lock and Key Model - Substrate molecules already have the right shape to fit an enzyme.
  2. Induced Fit Model - Interaction between the enzyme and the substrate induces or changes the shape of the molecules to produce a suitable fit.

FACTORS AFFECTING ENZYME ACTIVITY

- **Temperature** – Enzymes are proteins that function optimally at certain temperatures. They are inactivated or denatured by _____ above 50°C to 60°C. Enzymes are not inactivated by freezing, but either work slowly or do not work at all.

- **pH** – Enzymes are sensitive to changes in acidity. For example, the high acidity of stomach juice is needed for the enzyme pepsin to function, whereas an enzyme called trypsin in the small intestine requires alkaline surroundings.

- **Concentration of Enzyme** – If pH and temperature are kept constant, the rate of reaction is proportional to the amount of enzyme present. The more enzyme there is, the _____ reactions that occur.

- **Co-Enzymes** – Some vitamins and minerals (e.g. copper, zinc, iron) in small quantities work with enzymes to _____ up reactions.

- **Enzyme Inhibitors** – A pesticide called DDT stops the action of enzymes in insects, thereby _____ them.