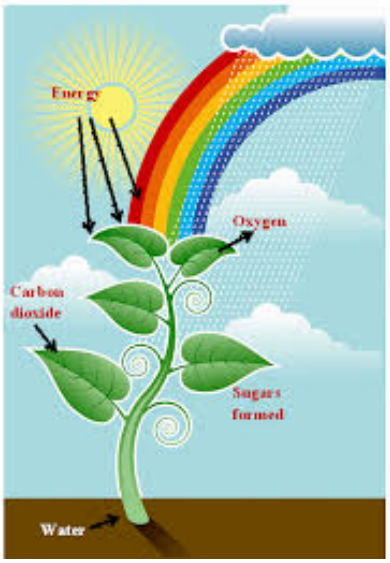
Key Terms:

Absorption Spectrum
Accessory Pigments
Acetyl Coenzyme A
Action Spectrum
Activation Energy
Active Site
Aerobic
Allosteric Site
Anabolic Pathways
Anaerobic
ATP
Autotrophs
Catabolic Pathways
Catalysts
Calvin Cycle
Carbon Cycle
Cellular Respiration
Chemiosmosis
Chemoautotrophs
Chlorophyll
Chloroplast
Coenzymes
Cofactors
Competitive Inhibitors
Consumers
Cristae
Detritovores (Decomposers)
Electron Transport System (ETS)
Endergonic
Energy Flow
Entropy
Enzyme Inhibition
Enzymes
Enzyme-Substrate Complex
Exergonic
$FADH_2$
Fermentation
Food Chain
Food Web
Glycolysis
Grana
Heterotrophs
Induced Fit Model
Krebs Cycle



Key Concepts

- Enzymes are biological catalysts whose specificity is dictated by the shape and charge of the active site
- Enzyme activity is dependent on many factors and can be altered by surrounding conditions
- ATP is the universal energy currency in cells
- Cellular respiration involves eh stepwise oxidation of glucose in the mitochondria
- Photosynthesis uses light energy to fix carbon in organic compounds. This occurs in the chloroplast
- Both photosynthesis and respiration use chemiosmosis to generate ATP

Essential Knowledge:

Enzyme Structure and Function (4.B.1)

□ Using **enzymes** as an illustrative example, explain how change in the structure of a molecular system may change its function.

□ Describe the general role of enzymes as biological **catalysts**. Include reference to the **active site** and the importance of **specificity**.

□ With reference to **enzyme-substrate complex** and **activation energy**, explain how enzymes work as catalysts in cells.

□ Explain the **induced fit model** of enzyme function. Compare and contrast this with the old lock and key example

□ Recall the difference between **endergonic** and **exergonic** reactions and outline the role of enzymes in **anabolism** and **catabolism**.

□ Describe the effect of substrate concentration, enzyme concentration, pH, and temperature on enzyme activity.

□ Distinguish between **cofactors** and **coenzymes**. Using examples, explain the role of cofactors in enzyme activity

□ Describe **enzyme inhibition**. Explain the difference between **competitive inhibitors** and **non-competitive inhibitors**. Be able to interpret graphs of activity showing each type of inhibition.

□ Explain the role of **allosteric interactions** in the control of metabolic pathways.

□ Explain how compartmentalization within cells and organisms contributes to functional efficiency.

Energy in Living Systems (2.A.1, 2.A.2)

□ Explain how order in biological systems is maintained by constant input of free energy. Explain what happens when there is loss of order or free energy flow.

□ Distinguish between **autotrophs** and **heterotrophs** with respect to their source of free energy and carbon.

□ Using specific examples explain how **exergonic reactions** are coupled with energetically unfavorable reactions to offset **entropy** in biological systems.

□ Using examples describe how energy-related pathways in biological systems are sequential and may be entered at multiple points in the pathway.

Key Terms:

Law of Thermodynamics
Light Dependent Reactions
Light Independent reactions
Matrix
Mitochondria
NAD^+
$NADP^+$
Noncompetitive Inhibitors
Nutrient Cycles
Oxidation
Oxidative Phosphorylation
Photoautotroph
Photophosphorylation
Photosynthesis
Photosystem I & II
Photorespiration
Primary Producers
Primary Consumers
Producers
Pyruvate
Redox Reactions
Reduction
Secondary Consumers
Stroma
Substrate
Substrate-level Phosphorylation
Tertiary Consumers
Thylakoid
Thylakoid Space
Transition Reaction
Trophic Levels

Photosynthesis (2. A.2)

- □ Describe the structure and role of the **chloroplasts**.
- □ Explain the role of **chlorophyll a** and **accessory pigments** in light capture by green plants. Explain what is meant by **absorption spectrum** and **action spectrum** of pigments.
- □ Explain what happens in the **electron transport system** (ETS)
- □ Describe and explain **photosynthesis** in a C_3 plant, include reference to
    - The generation of ATP and NADPH2 in the **light dependent reactions**
    - The **Calvin cycle** and the fixation of CO_2 using ATP and $NADPH_2$ in the **light independent** phase
    - Include reference to the reduction of G3P and the regeneration of ribulose biphosphate (RuBP)
- □ Describe the factors that affect photosynthetic rate and yield.
- □ Explain the role of **chemiosmosis** during photosynthesis including where specifically the ATP is generated. Compare this to chemiosmosis in the mitochondria.

Cell Respiration (2.A.2)

- □ Explain the role of **ATP** in metabolism. Describe the synthesis of ATP and explain how it stores and releases its energy. Compare cellular respiration and photosynthesis as energy transformation processes.
- □ Describe the structure and function of a mitochondrion. Identify the location of each step in glucose catabolism: **glycolysis**, **transition reaction** (link reaction), **Krebs cycle**, and **electron transport system** (ETS) also called electron transport chain.
- □ Describe glycolysis and recognize it as the major **anaerobic** pathway in cells. State the net yield of ATP and NADH from glycolysis.
- □ Describe the complete oxidation of glucose to CO_2, including reference to:
    - The conversion of **pyruvate** to **acetyl-coenzyme A.**
    - The stepwise oxidation of intermediates in the **Krebs cycle**.
    - Generation of **ATP** by c**hemiosmosis** in the ETS.
    - The role of oxygen as the terminal electron acceptor.
- □ Describe **fermentation** in mammalian muscle and in yeast, identifying the H^+ acceptor to each case. Compare and explain the differences in the yields of ATP from aerobic respiration and from fermentation.

Energy Flow in Ecosystems (2.A.2, 4.A.6)

- □ Describe how energy enters ecosystems through the activity of **autotrophs**. Recognize autotrophs as **producers** in ecosystems. Distinguish between **photoautotrophs** (photosynthetic organisms) and **chemoautotrophs** (chemosynthetic organsims) in terms of their source of free energy.
- □ Describe how **heterotrophs** obtain their free energy. Recognize heterotrophs as **consumers** in ecosystems. Distinguish between the different types of consumers, outlining the role of each in **trophic groups** in energy transfer and nutrient cycling.
- □ Recall how energy-capturing processes use different types of electron acceptors (e.g. $NADP^+$ in photosynthesis, oxygen in cellular respiration).
- □ Describe how energy is transferred between **trophic levels** in **food chains** and **food webs**. Comment on the efficiency of energy transfers.
- □ Understand how food chains and webs are dependent on **primary productivity**.
- □ Describe **energy flow** quantitatively using an energy flow diagram. Include reference to trophic levels, direction of energy flow, processes involved in energy transfer, energy sources, and energy sinks.
- □ Describe the role of **nutrient cycles** in ecosystems. Use specific examples, e.g. the **carbon cycle**, **nitrogen cycle**, or hydraulic cycle to show how nutrients are exchanged within and between ecosystems, moving between the atmosphere, the Earth's crust, water, and organisms.