Biology 1 – Big Ideas

I. Organisms share common characteristics of life. (Chapter 1)

Essential Question: *How do we know if something is alive?*

Concepts

A. Organisms are made up of simpler units called cells.
B. Organisms need light and/or chemicals to make cellular protoplasm.
C. Organisms obtain and use energy through photosynthesis or cellular respiration to carry out their life processes.
D. Organisms release waste chemicals produced by cells.
E. Organisms seek to maintain homeostasis at all biological levels of organization.
F. Organisms grow, develop and eventually die.
G. Organisms can reproduce their own kind using DNA.
H. Organisms adapt to changes in their environments.

II. Life emerges due to the chemical organization of matter into cells. (Chapter 2)

Essential Question: *How does life result from chemical structure and function?*

Concepts

A. Cells function as microscopic chemical factories synthesizing and degrading biological molecules necessary for life.
B. Liquid water forms hydrogen bonds, is a solvent, and forms hydronium ions allowing a wide range of biochemical reactions to occur.
C. Biological molecules produced by a cell can be used by the cell or transported outside for use by other cells.
D. Cells are composed mostly of: C, H, N, O, P, and S.
E. Carbon rings and chains form the backbone of all biological molecules.
F. Many biological molecules are polymers made from monomers that contain carbon chemically bound with other elements.
G. Carbohydrates, lipids, proteins, and nucleic acids are the chemical foundations for life.
H. Molecular structure is related to function.

III. Cells have organized structures and systems necessary to support chemical reactions needed to maintain the living condition. (Chapter 7, Chapter10)

Essential Question: *How does life result from cellular structure and function?*

Concepts

A. Cells are the basic unit of structure and function for all living things.
B. Cells occur in two basic forms: Prokaryotes (Bacteria and Archaea) and Eukaryotes (all other cells).
C. A cell's interior is separated or compartmentalized from the environment by a phospholipid bilayer plasma membrane.
D. The cytoplasm contains a collection of connected, internal membranous sacs that divide the cytoplasm into functional and structural compartments or organelles.
E. Chemical reactions and processes necessary for life are carried out in cytoplasm or organelles within a eukaryotic cell's protoplasm.
F. Structure is related to function at the cellular and organelle levels of biological organization.
G. Cells come only from the division of a pre-existing cell.

IV. Structure is related to function at all biological levels of organization. (Chapter 7; Chapter 18)

Essential Question: *How is structure related to function at all biological levels of organization?*

Concepts

A. Biological levels of organization from smallest to largest include: atoms, molecules, organelles, cells, tissues, organs, organ systems, multicellular organisms, populations, and communities.
B. The pattern of form following function is reflected at all biological levels of organization.

V. Through a variety of mechanisms organisms seek to maintain a biological balance between their internal and external environments. (Chapter 7, Chapter 18)

Essential Question: *How do organisms maintain a biological balance between their internal and external environments?*

Concepts

A. Homeostasis dynamically returns biological changes (body temperature, osmolarity, blood pressure, pH, blood glucose, etc.) to balance by modifying chemical reactions, adjusting energy transformations, and responding to environmental changes.
B. Molecules, ions and water move in and out of the cell through a variety of mechanisms.
C. Passive transport depends on the diffusion of substances with a concentration gradient moving across a membrane from an area of higher concentration to an area of lesser concentration without energy.
D. Both passive and facilitated diffusion move materials along a concentration gradient without energy.
E. Osmosis is the diffusion of water from an area of lower solute concentration (more aqueous solution) across a membrane to an area higher solute concentration (less aqueous solution).
F. Active transport moves atoms, ions and small molecule mostly against a concentration gradient and requires an expenditure of energy.
G. Active transport of larger substances and subcellular structures occurs through endocytosis and exocytosis.

VI. Organisms obtain and use energy to carry out their life processes. (Chapters 8 & 9)

Essential Question: *How do different organisms obtain and use energy to survive in their environment?*

Concepts

A. Forms of energy are required to maintain life.
B. The energy flow of biochemical reactions is governed by the physical laws of thermodynamics.
C. Most biochemical reactions require an input of energy.
D. Photosynthesis is the process that transforms light energy into potential chemical energy.
E. Cellular respiration is the process by which potential chemical energy in the bonds of glucose is transformed into potential chemical energy in the bonds of ATP.
F. ATP molecules store usable chemical energy to drive life processes through coupled reactions.
G. Glycolysis is the foundation of both aerobic and anaerobic respiration. Glycolysis, through anaerobic respiration, is the main energy source in many prokaryotes.

VII. DNA segments contain information for the production of proteins necessary for growth and function of cells. (Chapters 12 & 13)

Essential Question: *Why is DNA called the "blueprint of life"?*

Concepts

A. The basic molecular and the associated genetic code structure of DNA are universal, revolutionizing our understanding of disease, heredity and evolution.
B. DNA contains the complete set of instructions, the genetic code, for building and running an organism.
C. RNA is necessary for protein synthesis from DNA.
D. Many synthesized polypeptides require additional processing to acquire their active, three-dimensional structures.
E. Which genes are expressed at a given time is determined by the integration of internal and environmental signals received by a cell.
F. Enzymes are special proteins designed to catalyze most biochemical reactions that otherwise would not occur.

VIII. New cells arise from the division of pre-existing cells. (Chapter 10)

Essential Question: *How do cells grow and reproduce?*

Concepts

A. Cells grow when they can take in more nutrients through their plasma membranes than they can metabolize in their interior. Cells may divide when their metabolism exceeds nutrient absorption.
B. All cells go through a cell cycle.
C. Prokaryotic cells divide via binary fission.
D. Eukaryotic cells first divide their nucleus and then divide their cytoplasm to make new cells.
E. Cell differentiation occurs many times during development of a multicellular organisms giving rise to a diversity of cell types.

IX. Eukaryotic cells can differentiate and organize making it possible for multicellularity. (Chapter 10)

Essential Question: *What are the advantages of multicellularity?*

Concepts

A. A multicellular organization enables life functions such as movement, digestion, internal circulation of nutrients, excretion of waste and reproduction to be subdivided among specialized groups of cells.
B. The simplest level of multicellular organization is a tissue.
C. Different types of cells and tissues combine to form distinct structures known as organs which perform specific functions.
D. Organs work together as a system to perform common functions.
E. Organ systems function to meet an organism's needs.
F. Cells that have differentiated to perform specialized functions rely on the collective function of other specialized cells within a multicellular organism to maintain their living condition.

X. Hereditary information in genes is inherited and expressed. (Chapters 11, 14 (& 15))

Essential Question: *How is the hereditary information in genes inherited and expressed?*

Concepts

A. Sexually reproducing organisms produce gametes which transport hereditary information from one generation of organisms into another generation.
B. Meiosis involves a two-step nuclear division reducing the number of chromosomes in half – producing gametes.
C. One or more pairs of genes on one or more chromosomes code for the expression of inherited traits.
D. Two or more versions of a gene (alleles) contribute to the expression of inherited traits.
E. During the process of meiosis genetic recombinations may occur contributing to genetic variability within a population.
F. Patterns of inheritance reflecting how genes interact and express themselves (including dominant, recessive, codominance, incomplete dominance, sex-linked, sex-influenced, multiple alleles) can be predicted, observed and described.
G. The Punnett square is a tool that can be used to predict the probability of an offspring's genotype and phenotype.

XI. Evolution is the result of many random processes selecting for the survival and reproduction of a population. (Chapter 16)

Essential Question: *How do we scientifically explain the evidence and mechanisms for biological evolution?*

Concepts

A. Mutations alter a gene's genetic information, resulting in a change in the protein that is made, or how or when a cell makes that protein. Most mutations are evolutionary neutral.
B. Evolution occurs when the gene frequency of alleles in a population shifts to confer survival and reproductive success.
C. The differential reproductive success of populations of organisms with advantageous traits is known as natural selection.
D. Speciation occurs when one population is isolated from another population. The isolation can be geological, reproductive, or filling different ecological niches to reduce competition. With isolation comes changing environmental factors exerting selective pressure on mutations and adaptations.
E. Common anatomical and/or genetic structures and behaviors demonstrate that species have evolved from common ancestor
F. The fossil record documents patterns of mass and background extinctions and the appearance of new species.
G. There are similarities and differences between fossils and living organisms.
H. Selective breeding and biotechnology contribute to the deliberate changing of the genetic makeup of a population.

Key Vocabulary: atom, molecule, organelle, cell, tissue, organ, organ system, organism, species, population, community, ecosystem, prokaryotic, eukaryotic, unicellular, multicellular, autotrophic, heterotrophic, food chain, food web, sexual reproduction, asexual reproduction, carbohydrate, protein, lipid, nucleic acid, enzyme, adenosine triphosphate (ATP), homeostasis, photosynthesis, cellular respiration, glycolysis, metabolism, deoxyribonucleic acid (DNA), ribonucleic acid (RNA), natural selection, microevolution, macroevolution, cytoplasm, protoplasm, microscopic, macroscopic, phospholipid bilayer, passive transport, active transport, osmosis, diffusion, concentration gradient, endocytosis, exocytosis, solute, solvent, replication, transcription, translation, monomer, polymer, heredity, gene, genome, allele, chromosome, chromatid, centromere, homologous, heterozygous, homozygous, dominant, recessive, codominance, incomplete dominance, sex-linkage, sex-influenced traits, multiple alleles, genotype, phenotype, Punnett square, mitosis, meiosis, somatic cell, sex cell, gamete, genetic recombination, mutation, speciation, adaptation, cell cycle, biotechnology, inquiry, equilibrium, organic, inorganic