Course Title: Biology

Course #: 1511-1512

Course Description:
In this required, college-prep laboratory science course, students explore the fundamental properties of life. Topics of study include the fundamentals of ecology and nutrient cycles; macromolecules, which make up living things; cell structure and function; cellular energy; introduction to genetics; and evolution. Students engage in class discussions, laboratory investigations, research, and the construction of models.

UC/CSU Approval: “d” approved

Grade Level: 9

Estimated Homework Per Week: 1.5 hrs
This is a general guideline for planning and scheduling purposes. A student’s ability level may affect actual preparation time needed.

Prerequisite: Dependent on reading comprehension scores on English in the HSPT.

Recommended Prerequisite Skills: none

Course Grade Scale:
• Homework/Classwork 10%
• Labs 25%
• Quizzes and Tests 50%
• Final Exam 15%

Major Assessments/Units/Topics:

Assessments per unit: 2-3 Quizzes, Unit Test, Formal Lab Write Up, Activity.

Unit 1 The Science of Biology
What is Science
• Scientific method - observation, inference, hypothesis, controlled experiment, independent and dependent variable, control group, data, sources of error, conclusion (Apply through an inquiry based lab)

Studying Life
Unit 2 Ecology

The Biosphere
- Ecology
- Levels of organization within the biosphere - an individual, to population, to community, to ecosystem, to biome, to biosphere.
- Biotic and abiotic factors

Energy, Producers, and Consumers
- Primary producers
  - Sunlight is the main energy source for life on Earth; some organisms rely on stored inorganic chemical compounds.
- Consumers
  - Energy flows from the sun or inorganic compounds to autotrophs then to heterotrophs.
  - About 10% of the energy available in one trophic level is transferred to the next level.

Energy Flow in Ecosystems
- Food chains and food webs
- Food webs and disturbance
- Trophic levels and ecological pyramids

Cycles of Matter
- The water cycle
- Nutrient cycles (nitrogen and carbon)
- Nutrient limitations

Biodiversity
- Climate Change
  - Anthropogenic effects on the environment: students choose an effect to study, and do a poster symposium to present their topic. Use the HIPPCO acronym as an overview.

Unit 3 The Chemistry of Life

Properties of Water
- Polarity
- Hydrogen bonding
- Cohesion and surface tension
- Adhesion and capillary action

Carbon Compounds
- Carbon and carbon structures
- Macromolecules, monomer, polymer
- Carbohydrates, structures, monosaccharide, polysaccharide
- Lipids, structure, glycerol and fatty acids, saturated, unsaturated
- Nucleic acids, structure, nucleotides
- Protein, structure, amino acids
- Structure and function

Chemical Reactions and Enzymes
- Chemical reaction, reaction, product
- Activation energy
• Enzyme-substrate complex, substrate
• Regulation, temperature, pH, regulatory molecules

**Unit 4 Cell Structure and Function**

Life is Cellular
• Prokaryotic and eukaryotic cells

Cell Structure
• Organelles (REVIEW ONLY), Figure 7-11 Making Proteins
• Cell membrane Fluid Mosaic Model, Figure 7-13, lipid bilayer, semipermeable
• Differences between plant and animal cells

Cell Transport
• Passive transport, diffusion
• Facilitated diffusion
• Osmosis, aquaporin, isotonic, hypotonic, hypertonic, osmotic pressure
• Active transport, molecular transport, protein pumps, bulk transport, endocytosis, exocytosis
• Cellular communication (7.4), receptor
• Gap junctions
• (Use examples from theme - diabetes, cystic fibrosis, immune cells)

Homeostasis
• Cell specialization
• Levels of organization
• Limits to Cell Size
• Surface area of cell membrane vs. cytoplasm volume
• Rate of cell transport to support necessary cell functions

**Unit 5 Energy and Life**
• ATP

Photosynthesis: An Overview
• Chlorophyll, pigments, thylakoid, stroma, electron carriers, equation
• Light dependent reactions
• Light-independent reactions

The Process of Photosynthesis
• Discussion is needed to come to a consensus on how in-depth we want to teach this section, overview using diagram
• Factors affecting photosynthesis

Cellular Respiration: an overview
• Calorie, equation,
• Stages of respiration, aerobic, anaerobic
• Comparing photosynthesis and cell respiration

The Process of Cellular Respiration
• OVERVIEW using diagram, glycolysis, Krebs cycle (pyruvic acid --> citric acid, energy extracted, electron transport chain, the totals (use diagram)

Fermentation
• Fermentation, alcoholic fermentation, lactic acid fermentation
Energy and exercise

Unit 6 DNA and Protein Synthesis, Cell Cycle

Identifying the Substance of Genes

- Bacterial transformation, Hershey-Chase, the role of DNA

The structure of DNA

- Nucleotides, bases, covalent bonds, Chargaff's rule
- Antiparallel strands, hydrogen bonding, base paring

DNA Replication

- Replication of the DNA molecule

RNA

- messenger RNA, ribosomal RNA, transfer RNA
- RNA synthesis, transcription, RNA polymerase, promoters, RNA editing, introns, exons.

Ribosomes and Protein Synthesis

- polypeptides, codon, codon chart, start and stop codons
- Translation, anticodon, tRNA, amino acids, peptide bond, gene expression

Mutations

- Mutations, point mutations, substitutions, insertions, deletions, frameshift mutations, use the example from the theme (diabetes, cystic fibrosis), sickle cell disease,
- Chromosomal mutations, examples such as Down's syndrome

Studying the Human Genome

- Manipulating DNA, cutting DNA, restriction enzyme, separating DNA, gel electrophoresis, Reading DNA

Cell Growth, Division, and Reproduction

- Limits to cell size, surface area to volume ratio.
- Cell division, asexual reproduction, sexual reproduction

The Process of Cell Division

- Chromosomes, chromatin
- Cell cycle, phases of the cell cycle
- Mitosis, cytokinesis, phases of mitosis and diagrams, cytokinesis

Regulating the Cell Cycle

- Controls on cell division, cyclin, internal regulatory proteins, external regulators, growth factors, apoptosis.
- Cancer, tumor, causes of cancer, treatments for cancer (TED talk)

Unit 7 Genetics and Heredity, Meiosis

The Work of Gregor Mendel

- genetics, trait, genes, alleles, dominance
- segregation, F1 cross, gametes

Applying Mendel's Principles

- Probability, heterozygous, homozygous, phenotype, genotype, Punnett square
- Independent assortment, dihybrid cross

Other Patterns of Inheritance

- Incomplete dominance, codominance, multiple alleles, polygenic traits
- Environmental influence, (Ted Talk Epigenetics)
Meiosis
- Chromosome number, homologous, diploid, haploid
- Phases of meiosis - main events (prophase I - tetrads and crossing over), diagrams, zygote
- Comparing meiosis and mitosis
- Gene linkage and gene maps

Human Chromosome
- Karyotype, genome, sex chromosomes, autosomes
- Human traits, codominant and multiple alleles, blood groups, sex-linked inheritance, sex-linked genes
- Human pedigrees

Human Genetic Disorders
- Sickle cell disease, cystic fibrosis, Huntington's disease
- Chromosomal disorders

Unit 8 Evolution
Darwin's Voyage of Discovery
- REVIEW, species vary globally, species vary locally, species vary over time.

Ideas That Shaped Darwin's Thinking
- Lyell's principles of geology, Lamarck's ideas, Malthus's view of population growth, artificial selection.

Darwin Presents His Case
- Evolution by natural selection, struggle for existence, variation and adaptation, survival of the fittest, common descent.

Evidence of Evolution
- Biogeography, fossils, comparing anatomy and embryology, vestigial structures, embryology, molecular biology.
- Grant's study - HHMI the beaks of a finch.

Genes and Variation
- Populations and gene pools, allele frequency.
- Mutations, genetic recombination in sexual reproduction.

Evolution as Genetic Change in Populations
- Directional selection, stabilizing selection, disruptive selection.
- Genetic drift, bottleneck effect, founders effect.
- The Hardy-Weinberg principle.