



## G-E-T High School Curriculum

### Align, Explore, Empower

Scope and Sequence

Advanced Biology/AP Biology/Biology 105

#### Unit 1 - Chemistry of Life

Length of Unit - 3 weeks

- Structure of water and hydrogen bonding
- Elements of life
- Intro. to biological macromolecules.
- Properties of macromolecules.
- Nucleic acids

In this unit, students will ...

- Explain how the properties of water that result from its polarity and hydrogen bonding affect its biological function.
- Describe the composition of macromolecules required by living organisms.
- Describe the properties of the monomers and the type of bonds that connect the monomers in biological macromolecules.
- Describe the structural similarities and differences between DNA and RNA.
- Explain how a change in the subunits of a polymer may lead to changes in structure or function of the macromolecule.

#### Unit 2 - Cell Structure & Function

Length of Unit - 4 weeks

- Cellular structure & components
- Cell structure & function
- Cell Size
- Plasma membranes
- Membrane permeability
- Membrane transport
- Cell compartmentalization & origin of compartmentalization

In this unit, students will ...

- Describe the structure and/or function of subcellular components and organelles.
- Explain how subcellular components and organelles contribute to the function of the cell.
- Describe the structural features of a cell that allow organisms to capture, store, and use energy.
- Explain the effect of surface area-to-volume ratios on the exchange of materials between cells or organisms and the environment.
- Explain how specialized structures and strategies are used for the efficient exchange of molecules to the environment.
- Describe the roles of each of the components of the cell membrane in maintaining the internal environment of the cell.
- Describe the Fluid Mosaic Model of cell membranes.

- Explain how the structure of biological membranes influences selective permeability.
- Describe the role of the cell wall in maintaining cell structure and function.
- Describe the mechanisms that organisms use to maintain solute and water balance.
- Describe the mechanisms that organisms use to transport large molecules across the plasma membrane.
- Explain how the structure of a molecule affects its ability to pass through the plasma membrane.
- Explain how concentration gradients affect the movement of molecules across membranes.
- Explain how osmoregulatory mechanisms contribute to the health and survival of organisms.
- Describe the processes that allow ions and other molecules to move across membranes.
- Describe the membrane- bound structures of the eukaryotic cell.
- Explain how internal membranes and membrane- bound organelles contribute to compartmentalization of eukaryotic cell functions.
- Describe similarities and/or differences in compartmentalization between prokaryotic and eukaryotic cells.
- Describe the relationship between the functions of endosymbiotic organelles and their free-living ancestral counterparts.

### Unit 3 - Cellular Energetics

Length of Unit - 4 weeks

- Enzyme Structure & catalysis
- Environmental impacts on enzymes
- Cellular energy
- Photosynthesis
- Cellular respiration
- Biological fitness

#### In this unit, students will ...

- Describe the properties of enzymes.
- Explain how enzymes affect the rate of biological reactions.
- Explain how changes to the structure of an enzyme may affect its function.
- Explain how the cellular environment affects enzyme activity.
- Describe the role of energy in living organisms.
- Describe the photosynthetic processes that allow organisms to capture and store energy.
- Explain how cells capture energy from light and transfer it to biological molecules for storage and use.
- Describe the processes that allow organisms to use energy stored in biological macromolecules.
- Explain how cells obtain energy from biological macromolecules in order to power cellular functions.
- Explain the connection between variation in the number and types of molecules within cells to the ability of the organism to survive and/or reproduce in different environments.

#### Unit 4 - Cell Communication & Cell Cycle

Length of Unit - 4 weeks

- Cell communication
- Signal transduction
- Changes in signal transduction pathways
- Feedback mechanism
- Cell cycle
- Regulation of cell cycle

#### In this unit, students will ...

- Describe the ways that cells can communicate with one another.
- Explain how cells communicate with one another over short and long distances.
- Describe the components of a signal transduction pathway.
- Describe the role of components of a signal transduction pathway in producing a cellular response.
- Describe the role of the environment in eliciting a cellular response.
- Describe the different types of cellular responses elicited by a signal transduction pathway.
- Explain how a change in the structure of any signaling molecule affects the activity of the signaling pathway.
- Describe positive and/or negative feedback mechanisms.
- Explain how negative feedback helps to maintain homeostasis.
- Explain how positive feedback affects homeostasis.
- Describe the events that occur in the cell cycle.
- Explain how mitosis results in the transmission of chromosomes from one generation to the next.
- Describe the role of checkpoints in regulating the cell cycle.
- Describe the effects of disruptions to the cell cycle on the cell or organism.

#### Unit 5 - Heredity

Length of Unit - 4 weeks

- Meiosis & genetic diversity
- Mendelian genetics
- Non-Mendelian genetics
- Environmental effects on genotype
- Chromosomal inheritance

#### In this unit, students will ...

- Explain how meiosis results in the transmission of chromosomes from one generation to the next.
- Describe similarities and/or differences between the phases and outcomes of mitosis and meiosis.
- Explain how the process of meiosis generates genetic diversity.
- Explain how shared, conserved, fundamental processes and features support the concept of common ancestry for all organisms.
- Explain the inheritance of genes and traits as described by Mendel's laws
- Explain deviations from Mendel's model of the inheritance of traits.
- Explain how the same genotype can result in multiple phenotypes under different environmental conditions.
- Explain how chromosomal inheritance generates genetic variation in sexual reproduction.

#### Unit 6 - Gene Expression & Regulation

Length of Unit - 4 weeks

- DNA & RNA Structure
- Replication
- Transcription & RNA Processing

- Translation
- Regulation of gene expression
- Gene expression & cell specialization
- Mutations
- Biotechnology

In this unit, students will ...

- Describe the structures involved in passing hereditary information from one generation to the next.
- Describe the characteristics of DNA that allow it to be used as the hereditary material.
- Describe the mechanisms by which genetic information is copied for transmission between generations.
- Describe the mechanisms by which genetic information flows from DNA to RNA to protein.
- Describe how the phenotype of an organism is determined by its genotype.
- Describe the types of interactions that regulate gene expression.
- Explain how the location of regulatory sequences relates to their function.
- Explain how the binding of transcription factors to promoter regions affects gene expression and/or the phenotype of the organism.
- Explain the connection between the regulation of gene expression and phenotypic differences in cells and organisms.
- Describe the various types of mutation.
- Explain how changes in genotype may result in changes in phenotype.
- Explain how alterations in DNA sequences contribute to variation that can be subject to natural selection.
- Explain the use of genetic engineering techniques in analyzing or manipulating DNA.

Unit 7 - Natural Selection

Length of Unit - 4.5 of weeks

- Evolution & Natural Selection
- Artificial Selection
- Population Genetics
- Hardy-Weinberg Equilibrium
- Evidence of evolution
- Common Ancestry
- Phylogeny
- Speciation
- Extinction
- Variation in populations
- Origin of life

In this unit, students will ...

- Describe the causes of natural selection.
- Explain how natural selection affects populations.
- Describe the importance of phenotypic variation in a population.
- Explain how humans can affect diversity within a population.
- Explain the relationship between changes in the environment and evolutionary changes in the population.
- Explain how random occurrences affect the genetic makeup of a population.
- Describe the role of random processes in the evolution of specific populations
- Describe the change in the genetic makeup of a population over time.
- Describe the conditions under which allele and genotype frequencies will change in populations.

- Explain the impacts on the population if any of the conditions of Hardy- Weinberg are not met.
- Describe the types of data that provide evidence for evolution.
- Explain how morphological, biochemical, and geological data provide evidence that organisms have changed over time.
- Describe the fundamental molecular and cellular features shared across all domains of life, which provide evidence of common ancestry.
- Describe structural and functional evidence on cellular and molecular levels that provides evidence for the common ancestry of all eukaryotes.
- Explain how evolution is an ongoing process in all living organisms.
- Describe the types of evidence that can be used to infer an evolutionary relationship.
- Explain how a phylogenetic tree and/or cladogram can be used to infer evolutionary relatedness.
- Describe the conditions under which new species may arise.
- Describe the rate of evolution and speciation under different ecological conditions.
- Explain the processes and mechanisms that drive speciation.
- Describe factors that lead to the extinction of a population.
- Explain how the risk of extinction is affected by changes in the environment.
- Explain species diversity in an ecosystem as a function of speciation and extinction rates.
- Explain how extinction can make new environments available for adaptive radiation.
- Explain how the genetic diversity of a species or population affects its ability to withstand environmental pressures.
- Describe the scientific evidence that provides support for models of the origin of life on Earth.

## Unit 8 - Ecology

Length of Unit - 4.5 weeks

- Responses to the environment
- Energy flow through ecosystems
- Population ecology
- Effect of density on populations
- Community ecology
- Biodiversity
- Disruptions to ecosystems

### In this unit, students will ...

- Explain how the behavioral and/or physiological response of an organism is related to changes in internal or external environment.
- Explain how the behavioral responses of organisms affect their overall fitness and may contribute to the success of the population.
- Describe the strategies organisms use to acquire and use energy.
- Explain how changes in energy availability affect populations and ecosystems.
- Explain how the activities of autotrophs and heterotrophs enable the flow of energy within an ecosystem.
- Describe factors that influence growth dynamics of populations.
- Explain how the density of a population affects and is determined by resource availability in the environment.
- Describe the structure of a community according to its species composition and diversity.
- Explain how interactions within and among populations influence community structure.
- Explain how community structure is related to energy availability in the environment.
- Describe the relationship between ecosystem diversity and its resilience to changes in the environment.
- Explain how the addition or removal of any component of an ecosystem will affect its overall short-term and long-term structure.
- Explain the interaction between the environment and random or preexisting variations in populations.
- Explain how invasive species affect ecosystem dynamics.
- Describe human activities that lead to changes in ecosystem structure and/ or dynamics.
- Explain how geological and meteorological activity leads to changes in ecosystem structure and/or dynamics.

**→ PLEASE NOTE: This course is taught as a block for one semester and as a skinny for the second semester. Due to this, the pacing may change at the instructor's discretion.**

**\*Instructor reserves the right to change the order of the units, and change the length of the unit depending on the needs of students.\***

**\*\*Curriculum shown above is based on the CED provided by the College Board for the course of AP Biology. CED can be provided upon request\*\***