Greenwich Public Schools Curriculum Overview
Honors Biology

Personalized learning is achieved through standards-based, rigorous and relevant curriculum that is aligned to digital tools and resources.

Note: Teachers retain professional discretion in how the learning is presented based on the needs and interests of their students.

Course Description

Prerequisite: B+ or better in Science 8 and teacher recommendation.
Honors Biology is a lab-based honors level, in-depth study of biology. Topics focus on: the scientific method, the chemistry and metabolism of living organisms, the structure and function of cells, microbiology, genetics and biotechnology, human inheritance, evolution, taxonomic classification of organisms and ecology and humans and their environment. Independent work and extensive reading outside the class are requirements of the course. Honors biology is designed for high-ability, highly motivated students.

Unit Guide

- Unit 1: Cell Homeostasis
  - Module 1: Cell Structure and Transport
    - *Basic Brain Anatomy, Structure of Plasma Membrane, Cell Structure Overview , Simple Diffusion, Facilitated Diffusion, Active Transport, Bulk Transport*
  - Module 2: Neuroscience
    - *Neuron at Rest (Sodium-Potassium Pump), Action Potential, Transmission Across a Synapse, Basics of Neurotransmitters*

- Unit 2: Human Homeostasis
  - Module 1: Human Diseases (data analysis)
  - Module 2: Biochemistry
    - *Carbs, Proteins, Lipids, Hydrolysis and Dehydration Synthesis, Basic Digestive System and Enzymes*
  - Module 3: Physiology
    - *Homeostasis, Feedback Loops, Circulation and the Heart*

- Unit 3: Ecological Systems
  - Module 1: Ecosystems
    - *Trophic levels and food webs, Populations, Carrying Capacity, Carbon cycle, Nitrogen cycle, Water cycle*
  - Module 2: Climate Change and Biodiversity
    - *Geoscience data*
  - Module 3: Photosynthesis / Cell Respiration

- Unit 4: Cancer Biology
  - Module 1: Cancer and DNA
    - *DNA structure, DNA replication, mutations, protein synthesis*
  - Module 2: Regulation of the Cell Cycle
    - *Interphase vs Mitosis, cell cycle checkpoints, and connection to the development of cancer.*

- Unit 5: Heredity and Genetics
  - Module 1: Genetics
    - *Sexual vs asexual reproduction, meiosis, phenotypes and genotypes, karyotypes and chromosomal abnormalities, punnett squares, and mendelian genetics.*
  - Module 2: Heredity
    - *Pedigree analysis and patterns of inheritance*

- Unit 6: Microbiology and Evolution
  - Module 1: Immunology
    - *Bacteria vs Viruses, Cell Structure, Modes of disease transmission, Lines of defense*
  - Module 2: Quorum Sensing
    - *Social interactions and making new antibiotics based on the concepts of quorum sensing*
  - Module 3: Evolution
    - *Natural selection, evidence of evolution, phylogenetic trees, and the history of Earth*

Enduring Understanding and/or Performance Tasks

- Unit 1 : Cell Homeostasis
  - **Enduring Understandings**
    - Biological systems have specialized structures that enable specific functions necessary to sustain life.
    - Biological systems must respond to changes in internal and external environments in order to maintain dynamic homeostasis.
  - **Performance Tasks**
    - Explain how cell membranes function in maintaining dynamic homeostasis for biological systems.
    - Use data to investigate how various solutes and/or solvents passively move across membranes.
    - Explain how materials move into or out of the cell across the cell membrane.
    - Create and/or use representations and/ or models to predict the movement of solutes into or out of the cell.

- Unit 2: Human Homeostasis
  - **Enduring Understandings**
    - Four classes of macromolecules serve as the primary building blocks of biological systems
    - Biological systems must respond to changes in internal and external environments in order to maintain dynamic homeostasis.

- **Performance Tasks**
  - Explain the role macromolecules play in supporting cellular function.
  - Describe how organ systems work together to maintain homeostasis.
  - Predict the consequence of a disruption in homeostasis.
  - Describe the effect of enzymes on the rate of chemical reactions in biological systems.
  - Predict how a change in pH and/or temperature will affect the function of an enzyme.

➢ Unit 3: Ecological Systems

- **Enduring Understandings**
  - Nutrients are recycled through the biosphere, lithosphere, hydrosphere, and atmosphere through the help of decomposers
  - Energy on earth originates from the sun, and feeding relationships cycle energy through an ecosystem
  - Cellular respiration is how organisms convert energy from food into stored energy molecules
  - Photosynthesis is how photosynthetic organisms convert solar energy to chemical energy
  - Human activities are resulting in adverse effects on the environment
- **Performance Tasks**
  - Explain the importance of the cycling of carbon for biological systems.
  - Explain the importance of the cycling of nutrients for biological systems.
  - Create and/or use models to describe the cycling of water, nitrogen, and carbon between biotic and abiotic systems.
  - Create and/or use models to explain the energy flow through the food web of a community, and how energy production in organisms plays a role in the cycling of carbon in ecosystems. .
  - Describe how ecological processes rely on the biological diversity of the community.
  - Use evidence to support the claim that changes in ecosystems have resulted from human activities.
  - Create and/or use models to design solutions that mitigate the adverse effects of a human-induced environmental change on the biodiversity of an ecosystem.
  - Explain why the products of photosynthesis are ecologically relevant.
  - Create and/or use models to explain the process of converting solar energy into chemical energy through photosynthesis.
  - Use data to describe what factors affect rates of photosynthesis.
  - Explain why the processes of energy production in producers and consumers are dependent on one another.
  - Create and/or use models to explain how consumers obtain usable energy from the products of photosynthesis.
  - Describe how consumers store the energy produced during cellular respiration.

➢ Unit 4: Cancer Biology

- **Enduring Understandings**
  - Biological systems depend on the cycling of matter within and between Earth's

systems.
    - Most ecosystems rely on the conversion of solar energy into chemical energy for use in biological processes.
    - Changes to the environment can alter interactions between organisms.
  - **Performance Tasks**
    - Explain the importance of the growth phases in the cell cycle.
    - Explain how the cell cycle is regulated.
    - Explain why chromosome duplication must occur prior to mitotic division.
    - Create and/or use models to explain the phases of mitosis.
    - Predict the consequences for biological systems if the cell cycle regulation is altered.
    - Explain how the structure of DNA enables storage of heritable information.
    - Explain the role of mRNA in protein synthesis.
    - Identify the role of amino acids proteins synthesis.
    - Create and/or use models to demonstrate how the information in genes is expressed as proteins.
    - Describe how changes in DNA sequences may affect protein structure and function.
    - Create and/or use models to explain the consequences of changes in the DNA.
    - Describe the monomers necessary for cells to build DNA.

➢ Unit 5: Heredity and Genetics
  - **Enduring Understandings**
    - The molecular structure of DNA enables its function of storing life's genetic information.
    - Encoded in DNA is the heritable information responsible for synthesis of RNA, which makes gene expression possible.
    - Models can be used to illustrate and predict the inheritance of traits.
  - **Performance Tasks**
    - Explain why asexual reproductive strategies do not lead to genetic diversity.
    - Explain why reduction division must occur to produce gametes.
    - Explain how meiotic cellular division followed by fertilization leads to genetic diversity within a population.
    - Create and/or use models to explain how chromosome number is halved during meiosis.
    - Describe how some organisms have an altered number of chromosomes in their genome.
    - Predict how altered chromosome numbers may affect organisms.
    - Explain the relationship between genotype and phenotype.
    - Describe the type of inheritance pattern based on data and/or use of models.
    - Use a pedigree to predict the inheritance of a trait within a family.
    - Create and/or use models to analyze the probability of the inheritance traits.

➢ Unit 6: Microbiology and Evolution
  - **Enduring Understandings**
    - The theory of evolution states that all organisms descend from a common ancestor and share some characteristics.

        - Biological evolution is observable as phenotypic changes in a population over multiple successive generations.
        - Speciation, extinction, and the abundance and distribution of organisms occur in response to environmental conditions.
    - **Performance Tasks**
        - Describe the structural differences between viruses and cells.
        - Use scientific evidence to justify a claim of an evolutionary relationship between species.
        - Describe shared characteristics (homologies) among organisms that provide evidence for common ancestry
        - Create or modify models to illustrate evolutionary relationships.
        - Use models of evolutionary relationships to describe and/or analyze how different species are related.
        - Describe how selective pressures in the environment can affect an organism's fitness.
        - Explain how selective pressures in the environment could cause shifts in phenotypic and/or allele frequencies.
        - Use data to describe how changes in the environment affect phenotypes in a population.

Standards

- Vision of the Graduate Standards
    - Pose and pursue substantive questions
        - Ask questions, based on observed phenomena and patterns, that can be answered empirically and distinguish a scientific question from a non-scientific question.
    - Explore, define, and solve complex problems
        - Plan and conduct experimental procedures, identifying relevant variables and collecting appropriate data in order to identify causal relationships and make predictions.
    - Critically interpret, evaluate, and synthesize information
        - Analyze data using mathematics and statistics, to look for patterns or to test whether data are consistent with a hypothesis.
    - Collaborate with others to produce a unified work and/or heightened understanding
        - Use scientific evidence and models to construct explanations of phenomena or solve engineering problems.
    - Communicate effectively for a given purpose
    - Read, evaluate, and produce scientific texts and construct scientific arguments to communicate about science.

- Next Generation Science Standards Performance Expectations
    - Unit 1: Cell Homeostasis
        - LS1-3
    - Unit 2: Human Homeostasis
        - LS1-2, LS1-3 , LS1-7
    - Unit 3: Ecological Systems
        - LS2-4, LS2-5, ESS2-6, LS2-1, LS2-2, LS2-6, ESS2-2, ESS2-4, ESS3-5, LS2-7, LS4-6, LS1-5 , LS1-6

- Unit 4: Cancer Biology
  - LS1-4
- Unit 5: Heredity and Genetics
  - LS1-1, LS3-1, LS3-2, LS3-3
- Unit 6: Microbiology and Evolution
  - LS2-8 (Social Interaction), LS4-2, LS4-3, LS4-4, LS4-1, LS4-5, LS2-3, ESS1-5, ESS2-1, ESS2-7

Resources and Assured Experiences

- Textbook: Campbell Biology: Concepts and Connections, 7th Ed.
- Mouse Party: Effect of Illicit Drugs on the Brain
- Modeling ecosystems and biogeochemical cycles
- Liver Enzyme Lab
- Homeostasis Lab
- Heart Dissection
- Fugate Family or Sickle Cell Anemia Case Study
- Faces of Cancer activity
- Zone of Inhibition Lab
- Diffusion/Osmosis Lab
- Gizmo
- POGIL