



Curriculum & Instruction

SUMMIT PUBLIC SCHOOLS

Content Area: Science
Course: Biology CPA
Grade(s): 9

Course Overview

Biology is a college-preparatory laboratory course designed to provide general knowledge of the structural and functional patterns of living organisms. Cells, genetics, evolution, and taxonomy are emphasized. Students also develop an understanding of environmental problems. Biological concepts are used to evaluate actions taken to improve daily life. Students are required to master and apply major biological concepts. Expectations include developing research skills and improving abilities to investigate problems scientifically.

New Jersey State Learning Standards

Summit Public Schools curriculum aligns with the [New Jersey Student Learning Standards](#).

Content Area Standards:

From Molecules to Organisms: Structures and Processes

- HS-LS1-1 Construct an explanation based on evidence for how the structure of DNA determines the structure of proteins which carry out the essential functions of life through systems of specialized cells.
- HS-LS1-2 Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms.
- HS-LS1-3 Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis.
- HS-LS1-4 Use a model to illustrate the role of cellular division (mitosis) and differentiation in producing and maintaining complex organisms.
- HS-LS1-5 Use a model to illustrate how photosynthesis transforms light energy into stored chemical energy.
- HS-LS1-6 Construct and revise an explanation based on evidence for how carbon, hydrogen, and oxygen from sugar molecules may combine with other elements to form amino acids and/or other large carbon-based molecules.
- HS-LS1-7 Use a model to illustrate that cellular respiration is a chemical process whereby the bonds of food molecules and oxygen molecules are broken and the bonds in new compounds are formed, resulting in a net transfer of energy.

Ecosystems: Interactions, Energy, and Dynamics

- HS-LS2-1 Use mathematical and/or computational representations to support explanations of factors that affect carrying capacity of ecosystems at different scales.
- HS-LS2-2 Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales.
- HS-LS2-3 Construct and revise an explanation based on evidence for the cycling of matter and flow of energy in aerobic and anaerobic conditions.
- HS-LS2-4 Use mathematical representations to support claims for the cycling of matter and flow of energy among organisms in an ecosystem.
- HS-LS2-5 Develop a model to illustrate the role of photosynthesis and cellular respiration in the cycling of carbon among the biosphere, atmosphere, hydrosphere, and geosphere.
- HS-LS2-6 Evaluate the claims, evidence, and reasoning that the complex interactions in ecosystems maintain relatively consistent numbers and types of organisms in stable conditions, but changing conditions may result in a new ecosystem.
- HS-LS2-7 Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity.
- HS-LS2-8 Evaluate the evidence for the role of group behavior on individual and species' chances to survive and reproduce.

Heredity: Inheritance and Variation of Traits

- HS-LS3-1 Ask questions to clarify relationships about the role of DNA and chromosomes in coding the instructions for characteristic traits passed from parents to offspring.
- HS-LS3-2 Make and defend a claim based on evidence that inheritable genetic variations may result from: new genetic combinations through meiosis, viable errors occurring during replication, and/or mutations caused by environmental factors.
- HS-LS3-3 Apply concepts of statistics and probability to explain the variation and distribution of expressed traits in a population.

Biological Evolution: Unity and Diversity

- HS-LS4-1 Communicates scientific information that common ancestry and biological evolution are supported by multiple lines of empirical evidence.
- HS-LS4-2 Construct an explanation based on evidence that the process of evolution primarily results from four factors: The potential for a species to increase in number, the heritable genetic variation of individuals in a species due to mutation and sexual reproduction, competition for limited resources, and the proliferation of those organisms that are better able to survive and reproduce in the environment.
- HS-LS4-3 Apply concepts of statistics and probability to support explanations that organisms with an advantageous heritable trait tend to increase in proportion to organisms lacking this trait.
- HS-LS4-4 Construct an explanation based on evidence for how natural selection leads to adaptation of populations.

- HS-LS4-5 Evaluate the evidence supporting claims that changes in environmental conditions may result in: increases in the number of individuals of some species, the emergence of new species over time, and the extinction of other species.
- HS-LS4-6 Create or revise a simulation to test a solution to mitigate adverse impacts of human activity on biodiversity.

Earth and Space Science

- HS-ESS1-5: Evaluate evidence of the past and current movements of continental and oceanic crust and the theory of plate tectonics to explain the ages of crustal rocks.
- HS-ESS1-6: Apply scientific reasoning and evidence from ancient Earth materials, meteorites, and other planetary surfaces to construct an account of Earth's formation and early history.

Engineering Design

- HS-ETS1-1: Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.
- HS-ETS1-4: Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem.

Interdisciplinary Standards:

NJSLS ELA/Literacy:

- RST.9-10.1 Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions.
- RST.9-10.2 Determine the central ideas or conclusions of a text; summarize complex concepts, processes, or information presented in a text.
- RST.9-10.3 Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks.
- RST.9-10.4 Determine the meaning of symbols, key terms, and other domain-specific words and phrases as used in scientific or technical contexts.
- RST.9-10.5 Analyze the structure of relationships among concepts in a text, including relationships among key terms.
- RST.9-10.6 Analyze the author's purpose in providing an explanation, describing a procedure, or discussing an experiment.
- RST.9-10.7 Translate quantitative or technical information expressed in words into visual form and information expressed visually or mathematically into words.
- RST.9-10.8 Assess the extent to which the reasoning and evidence in a text support the author's claim or recommendation.
- RST.9-10.9 Compare and contrast findings presented in a text with those from other sources, including their own experiments.
- RST.9-10.10 By the end of grade 10, read and comprehend science/technical texts in the grades 9–10 text complexity band independently and proficiently.
- WHST.9-12.1 Write arguments focused on discipline-specific content.
- WHST.9-12.2 Write informative/explanatory texts, including scientific procedures, experiments, and technical processes.

- WHST.9-12.4 Produce clear and coherent writing appropriate to task, purpose, and audience.
- WHST.9-12.5 Develop and strengthen writing through planning, revising, editing, rewriting, or trying a new approach.
- WHST.9-12.6 Use technology to produce, publish, and update individual or shared writing products.
- WHST.9-12.7 Conduct short and sustained research projects to answer questions or solve problems and synthesize multiple sources.
- WHST.9-12.8 Gather relevant information from authoritative print and digital sources; assess sources and integrate information while avoiding plagiarism.
- WHST.9-12.9 Draw evidence from informational texts to support analysis, reflection, and research.
- WHST.9-12.10 Write routinely over extended and shorter time frames for a range of discipline-specific tasks, purposes, and audiences.
- SL.9-10.1 Initiate and participate effectively in collaborative discussions with diverse partners about scientific topics and texts.
- SL.9-10.2 Integrate multiple sources of information presented in diverse media or formats.
- SL.9-10.4 Present information, findings, and supporting evidence clearly and logically.
- SL.9-10.5 Make strategic use of digital media to display information and enhance understanding.
- SL.9-10.6 Adapt speech to a variety of contexts and tasks, demonstrating command of formal English when appropriate.

NJSLS Mathematics Standards Associated with HS-LS

- MP.2 Reason abstractly and quantitatively.
- MP.4 Model with mathematics.
- HSN-Q.A.1 Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.
- HSN-Q.A.2 Define appropriate quantities for the purpose of descriptive modeling.
- HSN-Q.A.3 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.
- HSF-IF.C.7 Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases.
- HSF-BFA.1 Write a function that describes a relationship between two quantities.
- HSS-ID.A.1 Represent data with plots on the real number line.
- HSS-IC.A.1 Understand statistics as a process for making inferences about population parameters based on a random sample from that population.
- HSS-IC.B.6 Evaluate reports based on data.

Career Readiness, Life Literacies and Key Skills Standards:

- 9.4.12.CT.2 Explain the potential benefits of collaborating to enhance critical thinking and problem solving.
- 9.4.12.CT.4 Participate in a brainstorming session to generate new and innovative ideas and solutions.

- 9.4.12.IML.3 Analyze data using tools and models to make valid and reliable claims, or to determine optimal design solutions.
- 9.4.12.IML.4 Assess and critique the appropriateness and impact of existing data visualizations for an intended audience.
- 9.4.12.IML.5 Evaluate, synthesize, and apply information on a current issue from various sources appropriately.
- 9.4.12.IML.6 Use various types of media to produce and store information for different purposes and audiences.
- 9.4.12.IML.8 Evaluate media sources for point of view, bias, and motivations.
- 9.4.12.TL.1 Assess digital tools based on features such as accessibility options, capacities, and utility for accomplishing a specified task.
- 9.4.12.TL.2 Generate data using formula-based calculations in a spreadsheet and draw conclusions about the data.
- 9.3.HL-BRD.3 Demonstrate basic knowledge of recombinant DNA, genetic engineering, bioprocessing, monoclonal antibody production, nanotechnology, bioinformatics, genomics, proteomics and transcriptomics to conduct biotechnology research and development
- 9.3.HL-BRD.6 Summarize and explain the larger ethical, moral and legal issues related to biotechnology research, product development and use in society.

Computer Science and Design Thinking Standards:

- 8.1.12.DA.1 Create interactive data visualizations using software tools to help others better understand real world phenomena.
- 8.1.2.DA.2: Store, copy, search, retrieve, modify, and delete data using a computing device.
- 8.1.12.DA.5 Create data visualizations from large data sets to summarize, communicate, and support different interpretations of real-world phenomena.
- 8.1.12.DA.6 Create and refine computational models to better represent the relationships among different elements of data collected from a phenomenon or process.
- 8.1.12.DA.5 Create data visualizations from large data sets to summarize, communicate, and support different interpretations of real-world phenomena.
- 8.1.12.AP.1 Design algorithms to solve computational problems using a combination of original and existing algorithms.
- 8.1.12.AP.4 Design and iteratively develop computational artifacts for practical intent, personal expression, or to address a societal issue.
- 8.1.12.IC.1 Evaluate the ways computing impacts personal, ethical, social, economic, cultural practices
- 8.1.12.IC.3 Predict potential impacts and implications of emerging technologies using evidence from credible sources.
- 8.2.12.EC.1: Analyze controversial technological issues and determine the degree to which individuals, businesses, and governments have an ethical role in decisions that are made.
- 8.2.12.EC.3: Synthesize data, analyze trends, and draw conclusions regarding the effect of a technology on the individual, culture, society, and environment and share this information with the appropriate audience.
- 8.2.12.ED.1 Use research to design and create a product or system that addresses a problem and make modifications based on input from potential consumers.

- 8.2.12.ED.4 Design a product or system that addresses a global problem and document decisions made based on research, constraints, trade-offs, and aesthetic and ethical considerations.
- 8.2.12.ETW.2 Synthesize and analyze data collected to monitor the effects of a technological product or system on the environment.
- 8.2.12.ETW.3 Identify a complex, global environmental or climate change issue, develop a systemic plan of investigation, and propose an innovative sustainable solution.

Career Ready Practices

- CRP 1. Act as a responsible and contributing citizen and employee.
- CRP 2. Apply appropriate academic and technical skills.
- CRP 3. Attend to personal health and financial well-being.
- CRP 4. Communicate clearly and effectively and with reason.
- CRP 5. Consider the environmental, social and economic impacts of decisions.
- CRP 6. Demonstrate creativity and innovation.
- CRP 7. Employ valid and reliable research strategies.
- CRP 8. Utilize critical thinking to make sense of problems and persevere in solving them.
- CRP 9. Model integrity, ethical leadership and effective management.
- CRP 10. Plan education and career paths aligned to personal goals.
- CRP 11. Use technology to enhance productivity.
- CRP 12. Work productively in teams while using cultural global competence.

New Jersey Curriculum Mandates:

This curriculum integrates lessons that address the following interdisciplinary New Jersey Curriculum Mandates:

- [Climate Change Education](#) (Grades K - 12)

Learning Objectives

Learning objectives are clear, specific statements that define what students should know, understand, and be able to do by the end of a lesson or course.

- Describe the levels of biological organization in multicellular organisms from cells to organ systems.
- Explain how cell specialization and communication support overall organism function.
- Analyze how feedback mechanisms maintain homeostasis in response to internal and external stimuli.
- Model the process of cell growth and division, including mitosis and the role of DNA.
- Explain how the structure of cells supports their function within tissues and organs.
- Describe the roles of ATP, glucose, and other biomolecules in storing and releasing energy in organisms.
- Compare and contrast the processes of photosynthesis and cellular respiration in terms of energy flow and matter cycling.
- Explain how producers convert solar energy into chemical energy.
- Trace the flow of energy and cycling of matter through Earth's systems.

- Evaluate how changes in environmental conditions affect energy transformations in living systems.
- Define and analyze carrying capacity and limiting factors in ecosystems.
- Illustrate the interdependence of organisms through food webs, symbiotic relationships, and nutrient cycles.
- Differentiate the flow of energy from the cycling of matter in an ecosystem.
- Predict the effects of natural and human-induced disturbances on ecosystem stability and biodiversity.
- Assess the impact of human activities on ecosystem services and biodiversity conservation.
- Describe the structure and function of DNA and RNA in storing and transmitting genetic information.
- Explain the processes of transcription and translation in protein synthesis.
- Use Biotechnology tools to study human genomics.
- Analyze the role of genes and chromosomes in inheritance and the expression of traits.
- Model patterns of inheritance using Punnett squares and probability.
- Explore sources of genetic variation including mutation, meiosis, and recombination.
- Interpret fossil, genetic, and anatomical evidence supporting the theory of common ancestry.
- Analyze geologic evidence such as rock strata, radiometric dating, and fossil records to understand Earth's history.
- Describe major events in Earth's prebiotic and early biotic history.
- Explain how early environmental conditions contributed to the emergence of life on Earth.
- Evaluate the role of plate tectonics and climate change in shaping Earth's biological history.
- Analyze DNA and fossil evidence to determine evolutionary relationships.
- Explain the mechanisms of natural selection and how it leads to adaptation and speciation.
- Evaluate how genetic variation and environmental pressures influence survival and reproduction.
- Describe how human activity and natural events drive evolutionary change.
- Predict the impact of advantageous traits on population dynamics over time.

Units of Study

Units of study are organized collections of lessons and learning experiences focused on a specific topic and set of skills within a course. Each unit is guided by a set of essential questions.

Unit 1: Ecology (30 Days)

- How can carrying capacities be determined in Ecosystems?
- How are organisms dependent upon each other?
- How does the movement of energy through a food web differ from the movement of nutrients through a food web?
- How can biological or physical disturbances, both natural or anthropogenic, affect the health of an ecosystem?
- How do humans help or hinder biodiversity in ecosystems?

Uni 2: Chemistry of Life (25 days)

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- How do organisms harness, store, and utilize energy from different resources and in different conditions?
- How are matter and energy cycled amongst the different spheres of the earth?
- How is solar energy captured and stored on Earth?
- How are photosynthesis and respiration processes that affect all of Earth's processes?
- What conditions existed that allowed Earth to support life?

Unit 3 - Cells and Homeostasis (20 days)

- How are multicellular organisms organized to allow for different functions to occur, interact, and to be regulated?
- How do organisms regulate their internal environment under different stressors?
- How do cells of multicellular organisms grow and pass on information?

Unit 4 - Genetics and Biotechnology (30 days)

- How does the cell get information to carry out its processes?
- How do cells receive instructions for forming species' characteristics?
- How are genetic combinations changed to create species variation?
- How has biotechnology changed the way we live?
- What evidence supports common ancestry of all life forms?
- What evidence can be found about the Earth from long ago?

Unit 5: Heredity and Evolution (30 days)

- What models can be used to better understand inheritance?
- How can DNA be used to look at the evolutionary record of organisms?
- How does natural selection occur?
- How are species populations affected by environmental changes that are human induced or occur naturally?
- How can adaptations or advantageous heritable traits affect the population of an organism?

Instructional Resources and Materials

Instructional resources are the information sources teachers utilize to guide their teaching and assessing. Instructional materials are the texts students read or review. The instructional resources and materials may vary in order to meet the learning needs of students.

Required:

- *OpenStax Biology 2e* textbook (PDF)

Recommended:

- Global Learning and Observations to Benefit the Environment (GLOBE)
- POGIL
- Online Microscopes
- Gizmos
- Supplemental videos
- Microscopes

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- 3-D molecular kits

Teacher Resources:

- GLOBE.gov
- POGIL
- HHMI resources
- Gizmos
- Lab manuals

Assessment Strategies

Assessment measures a student's mastery of a course standard and learning objective. Assessment can be used for both instructional purposes and for evaluative purposes. Teachers may choose one or more of the following ideas to assess learners. They may also modify these ideas to make the assessment more responsive to students' interests and needs.

Formative:

- Daily Bell-Ringer Questions,
- Informal questioning and discussion,
- Labs/Activities
- Research projects

Summative:

- Quizzes
- Project: Human Impact
- Unit Tests

Benchmark:

- Unit tests

Alternative:

- Project

Suggested Strategies for Modification & Differentiation

[Modifications Chart](#)