# *SCHOOL DISTRICT OF THE CHATHAMS*

## Biology B
**Grade 9**
**Full Year**

**Course Overview**

This course provides students with a comprehensive understanding of key concepts that help them make sense of life science. The ideas are building upon students' science understanding of disciplinary core ideas, science and engineering practices, and crosscutting concepts from earlier grades. There are five life science topics in high school: 1) Structure and Function, 2) Inheritance and Variation of Traits, Matter and Energy in Organisms and Ecosystems, 4) Interdependent Relationships in Ecosystems, and 5) Natural Selection and Evolution. The performance expectations for high school life science blend core ideas with scientific and engineering practices and crosscutting concepts to support students in developing usable knowledge that can be applied across the science disciplines.

**New Jersey Student Learning Standards**
*The New Jersey Student Learning Standards (NJSLS) can be located at www.nj.gov/education/cccs/2020/.*

Life Science
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.
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.
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: (1) new genetic combinations through meiosis, (2) viable errors occurring during replication, and/or (3) 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.
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: (1) the potential for a species to increase in number, (2) the heritable genetic variation of individuals in a species due to mutation and sexual reproduction, (3) competition for limited resources, and (4) 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: (1) increases in the number of individuals of some species, (2) the emergence of new species over time, and (3) 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.

**Technology Standards**
9.4.12.IML.7: Develop an argument to support a claim regarding a current workplace or societal/ethical issue such as climate change (e.g., NJSLSA.W1, 7.1.AL.PRSNT.4).
9.4.12.TL.2: Generate data using formula-based calculations in a spreadsheet and draw conclusions about the data.
9.4.12.TL.3: Analyze the effectiveness of the process and quality of collaborative environments.

**21st Century Integration | NJSLS 9**
9.3.HL-BRD.4 Demonstrate the principles of solution preparation, sterile techniques, contamination control, and measurement and calibration of instruments used in biotechnology research.
9.3.HL-BRD.2: Apply the fundamentals of biochemistry, cell biology, genetics, mathematical concepts, microbiology, molecular biology, organic chemistry and statistics to conduct effective biotechnology research and development of products.

***Revision Date:*** *March 2022*

**Career Ready Practices**

CRP2. Apply appropriate academic and technical skills.
CRP4. Communicate clearly and effectively and with reason.
CRP6. Demonstrate creativity and innovation.
CRP7. Employ valid and reliable research strategies.
CRP8. Utilize critical thinking to make sense of problems and persevere in solving them.

**Interdisciplinary Connections**

English Language Arts:

Reading

- RST.11-12.1 Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account.
- RST.11-12.8 Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information.

Writing

- WHST.9-12.2 Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes.
- WHST.9-12.5 Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on addressing what is most significant for a specific purpose and audience.
- WHST.9-12.7 Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.
- WHST.11-12.8 Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the strengths and limitations of each source in terms of the specific task, purpose, and audience; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and overreliance on any one source and following a standard format for citation.
- WHST.9-12.9 Draw evidence from informational texts to support analysis, reflection, and research.

Speaking and Listening

- SL.11-12.5 Make strategic use of digital media (e.g., textual, graphical, audio, visual, and interactive elements) in presentations to enhance understanding of findings, reasoning, and evidence and to add interest.

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.
- 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.

***Revision Date:*** *March 2022*

- 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-BF.A.1 Write a function that describes a relationship between two quantities.

**Units of Study**

Unit 1: Cellular Organization 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 2: Biochemistry of Energy Transformations *(~ 20 Days)*
- 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?

Unit 3: Ecology *(~15 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?

Unit 4: DNA and Inheritance *(~ 20 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?

Unit 5: History of the Earth *(~ 15 Days)*
- What evidence supports common ancestry of all life forms?
- What evidence can be found about the Earth from long ago?
- What geologic evidence exists to describe the Earth's evolution before life's existence?
- What conditions existed that allowed Earth to support life?

Unit 6: Evolution*(~ 15 Days)*
- 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?

**Learning Objectives/Discipline Standards of Practice**

***Revision Date:*** *March 2022*

Learning Objectives

- Develop and use models to make sense of science phenomena
- Plan an investigation
- Carry out an investigation
- Use a variety of scientific investigative practices.
- Develop and Use Models
- Ask Questions and Define Problems
- Defining Problems problem that occur
- Engaging in Argument based on scientific evidence
- Analyzing and Interpreting Data
- Design an experiment
- Measure the rate of photosynthesis in a green plant
- Design, evaluate and refine solutions to improve ecosystem health and biodiversity loss.
- Use mathematical computations to approximate the amount of energy at each trophic level using the Rule of 10%
- Use ecological pyramids (of numbers, biomass, and energy) to show a graphical representation of each trophic level in a food chain (or web)
- Use scientific evidence to create explain and argue the health of an ecosystem
- Analyze and interpret specific examples of each of the lines of evidence that support natural selection
- Obtain and evaluate examples from the fossil record
- Use evidence to state a scientific claim and engage in argument to defend claims
- Apply scientific reasoning to claims
- Obtaining, Evaluating, and Communicating Information
- Constructing Explanations and Designing Solutions
- Analyzing and Interpreting Data
- Engaging in Argument from Evidence
- Science Models, Laws, Mechanisms, and Theories

Discipline Standards of Practice

Science and Engineering Practices

- Plan and Carryout and Investigation
- Ask questions and define problems
- Develop and use models
- Obtain, evaluate and communicate information
- Analyze and interpret data
- Construct explanations and design solutions
- Engage in argument from evidence
- Use mathematics and computational thinking

Crosscutting Concepts

- Cause and Effect
- Scale, Proportion and Quantity
- Structure and Function
- Patterns
- Energy and Matter
- Systems and System Models
- Stability and Change

**Instructional Resources and Materials**

***Revision Date:*** *March 2022*

*Whole class resources have been identified with an asterisk.*

**Resources**

Daniel, L., Hummer, P.J. & Kaskel, A. (2003). Biology: An Everyday Experience. Ohio: Glencoe/McGraw-Hill.

**Materials**

- Compound light microscope
- Spinach leaves
- Yeast
- Paper models for Hare/Lynx Lab
- Carbon Cycle Game Materials: dice, station cards.
- Model Kits with beads
- DNA extraction supplies
- Electrophoresis supplies - edvotek sickle cell lab kit
- Paper models
- Lecithin
- Darwin Simulation
- Peppered Moth Lab
- Evidence of Evolution Activity
- Adaptation Activity

**Assessment Strategies**

*Assessment is designed to measure a student's mastery of a course standard and learning objective. Assessment can be used for both instructional purposes (formative assessment) and for evaluative purposes (summative assessment).*

The following is a general list of the many forms assessment may take in learning.

- Tests
- Quizzes
- Projects
- Unit Assessments
- Labs

***Revision Date:*** *March 2022*