Course Overview

Edgenuity AP® Biology is a nine-unit, college-level biology course that engages students in the study of evolution, energetics, information storage and transmission, and systems interactions. This yearlong course covers the advanced concepts of biology and features interactive or hands-on experiences, such as projects and laboratory investigations, that encourage inquiry and higher-order thinking applications. The concepts of this course include biochemistry, cells, enzymes, metabolism, cell communication, cell cycle, heredity, gene expression, evolution, genetic diversity, and ecology. The course is designed to prepare students to take the College Board AP Biology exam.

Philosophy

This course was designed to prepare students for college-level biology. It revolves around four big ideas and the enduring conceptual understandings and the essential knowledge that supports them. Embedded in the course are tasks and activities that give students opportunities to develop and apply science practices that can be used for inquiry-based learning which help deepen student understanding and higher-order thinking. Inquiry-based tasks and activities allow students to connect conceptual knowledge to real-world scenarios.

Instructional Context

Students can take the AP Biology course at any time during high school.

Instructional Resources

Textbook

Teachers and students of the Edgenuity AP Biology course are required to have a copy of the textbook below.

Urry, Lisa A., Michael Cain, Steven Wasserman, and Peter Minorsky. *Campbell Biology in Focus*, 3rd ed. Hoboken: Pearson, 2019.

Other Instructional Resources

Students are directed or encouraged to use reliable websites to complete projects throughout the course. The websites are listed below.

1. https://www.cancer.gov
2. https://www.cdc.gov
3. https://www.conservationmagazine.org/2008/09/the-sterile-banana/
4. https://www.genome.gov/about-genomics/fact-sheets/Deoxyribonucleic-Acid-Fact-Sheet
5. https://www.genome.gov/For-Patients-and-Families/Genetic-Disorders
6. https://www.ghr.nlm.nih.gov/condition/diamond-blackfan-anemiaii
7. https://www.ghr.nlm.nih.gov/condition?initial=s
8. https://www.ghr.nlm.nih.gov/gene/MITF
9. https://www.newscientist.com/article/dn6730-wolves-genetic-diversity-worryingly-low/
10. https://www.nih.gov/

11. https://www.nytimes.com/2016/04/26/science/channel-island-foxes-least-genetic-diversity.html
12. https://www.rarediseases.org/rare-diseases/anemia-blackfan-diamond/
13. https://www.rarediseases.org/rare-diseases/tietze-syndrome/
14. https://www.sciencedaily.com/releases/2012/10/121023204636.htm
15. https://www.yourgenome.org/facts/what-is-dna-replication

AP Biology Content

The Edgenuity AP Biology course is designed to expose students to four big ideas and the statements that represent the enduring understanding and knowledge that is essential to the understanding of the four big ideas. The course incorporates opportunities for students to apply the six science practices outlined in the College Board Course and Exam Description document. The course consists of eight units.

Units of Instruction

Unit 1: Introduction to the AP Biology Course and Biochemistry

Unit 2: Cells

Unit 3: Enzymes and Metabolism

Unit 4: Cell Communication and Cell Cycle

Unit 5: Heredity

Unit 6: Gene Expression

Unit 7: Evolution and Genetic Diversity

Unit 8: Ecology

Big Ideas and Science Practices

Throughout the course, students are exposed to the four big ideas and the six science practices outlined in the College Board Course and Exam Description document.

Big Ideas

Big Idea 1: Evolution (EVO) – Covered in Units 2, 5, 7, 8

- The process of evolution drives the diversity and unity of life.

Big Idea 2: Energetics (ENE) – Covered in Units 1, 2, 3, 4, 8

- Biological systems use energy and molecular building blocks to grow, reproduce, and maintain dynamic homeostasis.

Big Idea 3: Information Storage and Transmission (IST) – Covered in Units 1, 4, 5, 6, 8

- Living systems store, retrieve, transmit, and respond to information essential to life processes.

Big Idea 4: Systems Interactions (SYI) – Covered in Units 1, 2, 3, 5, 7, 8

- Biological systems interact, and these systems and their interactions exhibit complex properties.

Science Practices

Science Practice 1: Concept Evaluation

- Students are able to explain biological concepts, processes, and models presented in written format.

Science Practice 2: Visual Representations

- Students are able to analyze visual representations of biological concepts and processes.

Science Practice 3: Questions and Methods

- Students are able to determine scientific questions and methods.

Science Practice 4: Representing and Describing Data

- Students are able to represent and describe data.

Science Practice 5: Statistical Tests and Data Analysis

- Students are able to perform statistical tests and mathematical calculations to analyze and interpret data.

Science Practice 6: Argumentation

- Students are able to develop and justify scientific arguments using evidence.

The Investigative and Inquiry Component

The Edgenuity AP Biology is designed to give students opportunities to use scientific inquiry to explain phenomena and answer scientific questions.

Students engage in hands-on projects and inquiry-based investigations throughout the course. They spend a minimum of 25% of the instructional time on these activities.

Students will conduct 10 inquiry-based laboratory investigations. These investigations have been designed so that at least two investigations cover one of the four big ideas. Students will record their findings in a laboratory notebook or a Student Guide. They will be required to build and maintain a laboratory portfolio, which is a compilation of their lab reports and their reflections on the Big Ideas covered in, and Science Practices applied during, their laboratory investigations.

The lab reports contain details of students' investigations including:

- Scientific question
- Hypothesis or prediction
- Experimental procedure and methods (experimental and constant variables as well as experimental and control groups)

- Mathematical or statistical analyses, when appropriate
- Discussion and the use of evidence from the laboratory investigation

Big Ideas and Science Practice in Laboratory Investigations

Unit	Laboratory Investigation	Big Ideas	Science Practices
2	Cell Size	ENE	1, 3, 4, 5, 6
2	Tonicity and Osmoregulation	ENE	1, 3, 4, 6
3	Enzyme Activity	ENE	1, 3, 4, 6
3	Photosynthesis	ENE	1, 3, 4, 5, 6
5	Mitosis and Meiosis	IST	2, 3, 5
6	Biotechnology	IST	2, 3, 6
7	Artificial Selection	EVO	1, 3, 4, 5
7	Hardy-Weinberg Equilibrium	EVO	1, 2, 3, 4, 6
8	Response to the Environment	SYI	1, 3, 4, 5
8	Energy Flow through Ecosystems	SYI	1, 2, 3, 4, 5, 6

Course Components and Features

Content lessons are designed to help students develop conceptual knowledge of the required content outlined in each of the units described in the College Board AP Biology Course and Exam Description, as well as deepen their understanding of the four big ideas. Content lessons have embedded tasks and short-essay questions or assignments that give students opportunities to develop science practices required by the College Board for an AP Biology course. Throughout the course, content lessons help students relate and apply AP Biology concepts to real-world scenarios.

Reading lessons serve to deepen student understanding of important concepts using the assigned textbook for this course. Students are instructed to note vocabulary terms and take notes. After completing the reading, students answer free-response questions to assess their understanding and help them develop and apply science practices.

Skills lessons help students develop skills—such as writing short and long essays and displaying and analyzing data—that are needed to successfully complete the Edgenuity AP Biology course, pass the College Board AP Biology exam, and prepare for college-level courses.

Lab lessons come in two formats: wet labs and virtual labs. The Edgenuity AP Biology course includes 10 lab lessons, which help students apply conceptual knowledge and provide opportunities to bridge that knowledge and their understanding of how it makes sense in the real world. Lab lessons are designed to include an inquiry component and help students develop science practices. Students are required to submit a lab report after each lab lesson. To give students opportunities to record and present evidence of their investigations, they are required to maintain a lab notebook or portfolio (hard copy or electronic).

Projects are assignments that help assess student understanding of AP Biology concepts learned in the content lessons. Projects also give students opportunities to develop and apply science practices and apply concepts to real-world scenarios through hands-on activities. The Edgenuity AP Biology course includes 25 projects.

Study Guides are downloaded at the start of each unit, completed while students work through the lessons in the unit, and uploaded to the Virtual Classroom at the end of each unit. Students complete guiding questions that cover the essential concepts, record relevant vocabulary terms, and make connections with the material across the unit. These guides help students develop science practices and prepare them for the unit exam and the College Board AP Biology exam.

Student Guides contain background information about key concepts, guide students through the steps required to complete a project or a lab lesson, and help them develop science practices. Each Student Guide also includes a list of materials needed to ensure the successful completion of the activity/lab.

Teacher Guides are provided to help the teacher support knowledge building and development of science practices as well as guide students to successfully complete activities associated with projects and lab lessons. The teacher is directed to read through both the Student and Teacher Guides to ensure that scientific equipment/materials and all necessary resources are prepared prior to the activity and adequate time is allotted to conduct hands-on, college-level biology laboratory investigations.

Review lessons in Unit 9 help students prepare for the AP Biology exam. They will review content covered in the course and learn test-taking strategies for success. Included in this unit are two free-response question practice exams, which allow students to practice these strategies, apply concepts, and further develop scientific practices.

Formal assessments come in the form of unit and cumulative tests. The questions in each test cover the required content outlined in the College Board AP Biology Course and Exam Description. Test questions are in multiple-choice format, which helps students practice for the AP Biology exam. These tests assess student understanding and give them opportunities to apply science practices.

Units of Instruction

The outline highlights the course components per unit.

Unit 1: Introduction to the AP Biology Course and Biochemistry
Big Ideas: 2, 3, and 4
Enduring Understandings:

- ENE-1: The highly complex organization of living systems requires constant input of energy and the exchange of macromolecules.
- IST-1: Heritable information provides for continuity of life.
- SYI-1: Living systems are organized in a hierarchy of structural levels that interact.

Content Lesson Topics:

- Structure, Properties, and Bonding of Water (Skills 1.A, 1.B, 2.A), CR 10
- The Elements of Life (Skills 1.A, 2.A)
- Structure, Properties, and Functions of Biological Molecules (Skills 1.A, 2.A, 2.B, 6.E)
- Nucleic Acids (Skills 1.A, 2.A, 5.A)

Skills Lessons Topics:

- Short Essay (Skills 1.B, 4.B, 6.A, 6.B)
- Experimental Design (Skills 1.B, 3.A, 3.B, 3.C)
- Data Display and Analysis (Skills 1.A, 1.B, 3.C, 4.A, 4.B)
- Statistical Analysis (Skills 1.A, 2.A, 3.B, 5.A, 5.B, 5.C, 5.D)

Reading Lessons:

- Chapter 2: The Chemical Context of Life (Skill 1.A)
- Chapter 3: Carbon and the Molecular Diversity of Life (Skills 1.A, 1.B)

Projects:

- Effect of Change on Macromolecules (Skills 1.B, 2.A, 2.D, 6.E), CR 10

  Students will develop a model of a macromolecule and use the model to predict the effect of structural and environmental changes on the function of the macromolecule. They will conduct research to learn about structural and environmental changes that may affect the function of the macromolecule of their choice.

- Experimental Design Principles (Skills 3.A., 3.B, 3.C)

  Students will follow experimental design principles to design their own investigation. They will develop a scientific question, formulate a hypothesis, write a null hypothesis if applicable, and identify the evidence and reasoning used to formulate the hypothesis. They will then describe the details of their investigation, including the setup, materials, variables, procedure, and data collection.

- Creating Graphs from Spreadsheet Data (Skills 3.C, 3.E, 4.A, 5.A, 6.A, 6.B)

  Students will record data, create bar graphs, and analyze graphs in a spreadsheet program.

- Statistical Analysis of Data (Skills 3.A, 3.B, 3.C, 3.E, 4.A, 5.A, 6.A)

  Students will investigate whether a fungus is sensitive to light and if this affects growth. They will create a graph of a data set and accompanying calculations. Using this information, students will answer questions as it relates to the statistical significance of their findings and design a plan to extend the experiment.

Unit 2: Cells
Big Ideas: 1, 2, and 4
Enduring Understandings:

- EVO-1: Evolution is characterized by a change in the genetic makeup of a population over time and is supported by multiple lines of evidence.
- ENE-1: The highly complex organization of living systems requires constant input of energy and the exchange of macromolecules.
- ENE-2: Cells have membranes that allow them to establish and maintain internal environments that are different from their external environments.
- SYI-1: Living systems are organized in a hierarchy of structural levels that interact.

Content Lesson Topics:

- Components, Structure, and Functions of Cells (Skills 1.A, 1.B, 2.D, 6.A, 6.B, 6.E)
- Cell Size (Skills 1.B, 2.B, 2.C, 2.D, 4.B, 5.A), CR 10
- Cell Membrane Properties, Structure, and Function (Skills 1.A, 2.B)
- Transport Mechanisms across the Cell Membrane (Skills 1.A, 1.B, 1.C, 2.A, 2.B, 6.E), CR 10
- Osmoregulation (Skills 1.B, 1.C, 2.B, 5.A), CR 10
- Cell Compartmentalization and Its Evolution (Skills 1.A, 1.C, 6.A, 6.B, 6.E)

Reading Lessons:

- Chapter 4: A Tour of the Cell (Skills 1.A, 1.B)
- Chapter 5.1-5.5: Membrane Transport and Cell Signaling (Skills 1.A, 1.B)

Projects:

- Cell Membrane Structure (Skills 1.B, 2.D)

  Students will model the fluid mosaic structure of the cell membrane, including phospholipids and membrane proteins.

- Transport across Membranes (Skill 3.E)

  Students will review the experimental design of a laboratory experiment investigating the osmolarity of different types of apples. They will evaluate the experimental design, identify sources of error, and suggest improvements. They will propose a new investigation or an extension of the laboratory investigation of osmolarity. Finally, students will provide a description of a controlled procedure to investigate their proposed area of study.

- Water and Solute Potential (Skills 3.B, 4.A, 4.B, 5.A, 6.A)

  Students will calculate and graph the solute potential of increasing molar concentrations of a sucrose solution and describe how the change in molarity of the solution affects potato cubes submerged in the solution.

Lab Lessons:

- Cell Size (Skills 1.B, 3.A, 3.B, 3.C, 3.D, 3.E, 4.B, 5.A, 6.A, 6.B), CR 10

  Students will use artificial cells to calculate the surface area, volume, and surface area to volume ratio. They will then observe the rate of diffusion into the artificial cells.

- Tonicity and Osmoregulation (Skills 1.B, 3.A, 3.B, 3.C, 3.D, 6.A, 6.B), CR 10

  Students will model and examine molecule movement through an artificial membrane.

Unit 3: Enzymes and Metabolism
Big Ideas: 2 and 3
Enduring Understandings:

- ENE-1: The highly complex organization of living systems requires constant input of energy and the exchange of macromolecules.
- SYI-3: Naturally occurring diversity among and between components within biological systems affects interactions with the environment.

Content Lesson Topics:

- The Structure, Function, and Activity of Enzymes (Skills 1.A, 1.B, 2.A, 2.D, 4.B, 6.A, 6.E), CR 10
- Energy and Life (Skills 1.A, 1.B, 2.B, 6.A, 6.B)
- Photosynthesis (Skills 1.A, 1.B, 6.A, 6.B, 6.E, 6.D)
- Cellular Respiration (Skills 1.A, 2.B, 2.D)
- Variation and Fitness (Skills 1.B, 1.C, 2.C, 3.C, 4.B, 6.C)

Reading Lessons:

- Chapter 6: An Introduction to Metabolism (Skills 1.A, 1.B)
- Chapter 7: Cellular Respiration and Fermentation (Skill 1.A)

Project:

- Cellular Respiration (Skills 3.A, 3.C, 3.D, 3.E, 4.A, 4.B, 6.A, 6.B)

  Students will review the experimental design and results of a laboratory experiment investigating the cellular respiration of peas and the effect of temperature on respiration. They will construct a graph for the rate of CO_2 production for dormant peas, germinating peas, and cold-germinating peas. Students will then analyze the rate of CO_2 production for the different peas and write a conclusion for the laboratory investigation based on the evidence in the graph. Finally, students will evaluate the experimental design, identifying sources of error and/or points of refinement.

Lab Lessons:

- Enzyme Activity (Skills 1.B, 1.C, 3.A, 3.B, 3.C, 3.D, 4.A, 4.B, 6.E), CR 10

  Students will collect data to determine the baseline reaction for the decomposition of hydrogen peroxide using the peroxidase enzyme. They will change the pH of the reaction and determine how pH affects the reaction rate. They will design and conduct an experiment to determine how another variable affects the activity of enzymes.

- Photosynthesis (Skills 1.B, 3.A, 3.B, 3.C, 3.D, 3.E, 4.B, 5.A, 5.D, 6.A, 6.B)

  Students will use spinach leaves to observe photosynthesis indirectly. They will design and conduct their own experiment to test a factor that may affect the rate of photosynthesis.

Unit 4: Cell Communication and Cell Cycle
Big Ideas: 2 and 3
Enduring Understandings:

- ENE-3: Timing and coordination of biological mechanisms involved in growth, reproduction, and homeostasis depend on organisms responding to environmental cues.
- IST-1: Heritable information provides for continuity of life.
- IST-3: Cells communicate by generating, transmitting, receiving, and responding to chemical signals.

Content Lesson Topics:

- Communication between Cells (Skills 1.A, 1.B, 1.C)
- Signal Transduction (Skills 1.A, 2.A, 2.B, 6.A, 6.C, 6.E), CR 10

- Feedback (Skills 1.A, 1.B), CR 10
- The Cell Cycle and Mitosis (Skills 1.A, 2.B, 4.B, 5.A, 6.E)
- Cell Cycle Regulations and Disruptions (Skills 1.A, 6.A, 6.E)

Reading Lessons:

- Chapter 5.6: Membrane Transport and Cell Signaling (Skills 1.A, 1.B)
- Chapter 9: The Cell Cycle (Skill 1.A)

Skills Lessons:

- Long Essay (Skills 1.B, 3.B, 5.C, 5.D, 6.A, 6.B, 6.E)
- Data-Based Essay (Skills 4.B, 5.A, 6.A, 6.C, 6.E)

Projects:

- Alteration of Signal Transduction Pathways (Skills 1.B, 1.C, 2.D, 6.E), CR 10

  Students will examine the effects of drugs on signal transduction pathways. They will research a drug that affects a signal transduction pathway, create a visual representation of the signal pathway, and predict the effects of the drug on the signal pathway.

- Feedback (Skills 2.D, 6.C, 6.E)

  Students will create a visual representation of positive and negative feedback mechanisms and predict the causes or effects of changes in these mechanisms. Their presentations will include a graphic organizer describing two feedback loops they researched and a diagram of each feedback loop.

- AP Biology Free-Response Question (Skills 1.A, 3.B, 3.C, 3.D, 5.A, 5.C, 5.D, 6.B, 6.E)

  Students will respond to a long free-response question (FRQ)

Unit 5: Heredity
Big Ideas: 1, 3, and 4
Enduring Understandings:

- EVO-2: Organisms are linked by lines of descent from common ancestry.
- IST-1: Heritable information provides for continuity of life.
- SYI-3: Naturally occurring diversity among and between components within biological systems affects interactions with the environment.

Content Lesson Topics:

- Meiosis (Skills 1.A, 1.B, 2.D)
- Meiosis and Genetic Diversity (Skills 1.A, 1.B, 2.B)
- Mendelian Inheritance (Skills 1.A, 1.B, 3.B, 3.D, 5.A, 5.C, 5.D, 6.A)
- Non-Mendelian Inheritance (Skills 1.A, 2.C, 2.D, 5.A, 5.C, 5.D)
- Effect of the Environment on Phenotype (Skills 1.B, 1.C)
- Chromosomal Inheritance (Skills 1.A, 1.B, 2.B, 2.D, 5.A, 6.E)

Reading Lessons:

- Chapter 10: Meiosis and Sexual Life Cycles (Skill 1.B)

- Chapter 11: Mendel and the Gene Idea (Skill 1.B)
- Chapter 12: The Chromosomal Basis of Inheritance (Skill 1.B)

Projects:

- Meiosis and Genetic Diversity (Skills 1.B, 2.D, 3.A)

  Students will examine, through research, how meiosis connects to traits and genetic diversity. They will complete a graphic organizer to highlight key ideas from their research. Additionally, students will construct a testable question about genetic diversity.

- Mendelian Inheritance (Skills 1.B, 2.D, 3.B, 5.A, 6.E)

  Students will perform a tetra hybrid cross. Based on this cross, they will apply probability and Mendel's laws to determine the traits of offspring. Students will also analyze the parent, F1, and F2 generations.

- Non-Mendelian Inheritance (Skills 1.B, 2.B, 2.D, 3.B, 5.A, 5.C, 5.D)

  Students will create and analyze Mendelian and non-Mendelian crosses using Punnett squares. They will also use chi-square hypothesis testing to draw conclusions on inheritance patterns.

- Chromosomal Inheritance (Skills 1.B, 2.A, 2.B, 2.D)

  Students will examine different karyotypes and research the effects of a genetic disorder. In a written analysis, students will explain how nondisjunction in meiosis can affect a karyotype and can cause the effects of the genetic disorder.

Lab Lesson:

- Mitosis and Meiosis (Skills 2.A, 2.B, 2.D, 3.B, 3.C, 5.A, 5.C, 5.D)

  Students will gather data about the frequency of mitotic stages in eukaryotic cells. They will use statistical analysis to analyze obtained data. Students will also construct a model to show how genetic information is passed from one generation to another generation through meiosis.

<u>Unit 6: Gene Expression</u>
Big Idea: 3
Enduring Understandings:

- IST-1: Heritable information provides for continuity of life.
- IST-2: Differences in the expression of genes account for some of the phenotypic differences between organisms.
- IST-4: The processing of genetic information is imperfect and is a source of genetic variation.

Content Lesson Topics:

- DNA and RNA Structure (Skills 1.A, 1.B, 6.B, 6.E)
- DNA Replication (Skills 1.A, 2.B, 2.D)
- Transcription, RNA Processing, and Translation (Skills 1.A, 1.B, 2.B, 2.D, 6.E)
- Gene Expression Regulation (Skills 1.A, 1.B, 6.A, 6.B, 6.E)
- Cell Specialization (Skills 1.A, 1.B, 2.B, 3.B, 6.B)

- Mutations (Skills 1.A, 1.B, 2.B, (6.E)
- Biotechnology (Skills 1.A, 1.B, 6.D), CR 10

Reading Lessons:

- Chapter 13: The Molecular Basis of Inheritance (Skills 1.A, 1.B)
- Chapter 14: Gene Expression: From Gene to Protein (Skill 1.A)
- Chapter 15: Regulation of Gene Expression (Skills 1.A, 1.B)

Projects:

- DNA Replication (Skills 1.A, 2.A, 2.B, 2.D, 6.B, 6.E)

  Students will create a diagram of the structure of DNA, analyze the components used to build DNA, and how its structure is related to the function of DNA replication. They will create a flowchart documenting the steps of DNA replication and a graphic organizer to analyze the function of enzymes involved in the process. Students will predict the consequences of errors in replication.

- Transcription and Translation (Skills 1.A, 2.B, 2.D, 6.B, 6.E)

  Students will choose and research a disorder that affects transcription and/or translation in eukaryotic cells. They will model transcription and translation and complete a graphic organizer on the disorder. Students will explain the causes and effects of the disorder on the processes of transcription and/or translation and protein synthesis as a whole. They will then predict and justify the effect of a malfunction of an important participant in the protein synthesis process.

- Mutations (Skills 1.A, 1.B, 2.C, 2.D, 3.A)

  Students will research two disorders caused by genetic mutations and theorize how it is possible to have an association between genetics and a health outcome.

Lab Lesson:

- Biotechnology (Skills 2.A, 3.D, 6.A, 6.B, 6D), CR 10

  Students will use gel electrophoresis to create genetic profiles. Students will then use these profiles to narrow a list of suspects from a crime scene.

Unit 7: Evolution and Genetic Diversity
Big Ideas: 1 and 4
Enduring Understandings:

- EVO-1: Evolution is characterized by a change in the genetic makeup of a population over time and is supported by multiple lines of evidence.
- EVO-2: Organisms are linked by lines of descent from common ancestry.
- EVO-3: Life continues to evolve within a changing environment.
- SYI-3: Naturally occurring diversity among and between components within biological systems affects interactions with the environment.

Content Lesson Topics:

- Natural Selection (Skills 1.A, 1.B, 4.B, 6.A, 6.B, 6.E), CR 10
- Artificial Selection (Skills 1.A, 1.B, 1.C, 2.D), CR 10
- Variation in and Evolution of Populations (Skills 1.A, 1.B, 1.C, 6.A, 6.C, 6.E)
- Hardy-Weinberg Equilibrium (Skills 1.A, 4.B, 5.A, 6.A)
- Common Ancestry and Phylogeny (Skills 1.A, 1.B, 2.D, 6.A)
- Evidence for Evolution and Continuing Evolution (Skills 1.A, 1.B, 2.D, 5.A, 6.A, 6.B, 6.E), CR 10
- Origins of Life (Skills 1.A, 2.D, 3.B, 6.D)
- Speciation and Extinction (Skills 1.A, 1.B, 1.C, 6.A, 6.B, 6.E), CR 10

Reading Lessons:

- Chapter 20: Phylogeny (Skill 1.B)
- Chapter 21: The Evolution of Populations (Skill 1.A)
- Chapter 22: The Origin of the Species (Skill 1.B)

Projects:

- Evidence of Evolution (Skills 3.C, 4.A, 4.B, 6.A, 6.B, 6.E)

  Students will explore and analyze evidence for evolution.

- Evolutionary History Research (Skills 2.D, 3.B, 3.E, 6.A, 6.B)

  Students will conduct research on evolutionary history on a single, broad group, such as aquatic mammals. They will write an essay that identifies the evidence presented for evolution and evaluates the author's claims. Students will also create a time line to represent the evolutionary history of the group researched.

- Phylogeny (Skills 1.A, 1.B, 2.A, 2.D, 3.D, 4.B)

  Students will construct and analyze cladograms and phylogenetic trees to determine evolutionary relationships among organisms.

- Extinction (Skills 3.A, 3.B, 3.C, 3.D, 3.E, 4.B, 6.E)

  Students will examine an experiment related to the survival of monarch butterflies and predict the results of the experiment.

- Origin of Life on Earth (Skills 1.B, 1.C, 2.A, 3.B, 3.E, 6.A., 6.B)

  Students will interpret and analyze models of the formation of the first biological molecules on early Earth.

Lab Lessons:

- Artificial Selection (Skills 1.B, 3.A, 3.B, 3.C, 3.D, 4.A, 4.B, 5.A, 5.B)

  Students will grow first-generation Brassica rapa plants. Students will cross plants from the first generation to ensure that the second-generation plants are better protected from herbivory. Students will then grow second-generation plants. Finally, students will statistically analyze and compare data from the first-generation and second-generation plants.

- Hardy-Weinberg Equilibrium (Skills 1.C, 3.A, 3.B, 3.C, 3.D, 4.A, 6.A, 6.B, 6.E)

Students will describe and represent a beetle population in Hardy-Weinberg equilibrium. Students will then use a simulation and different scenarios to model the effect of migration, natural selection, and genetic drift on a beetle population.

Unit 8: Ecology
Big Ideas: 1, 2, 3, and 4
Enduring Understandings:

- EVO-1: Evolution is characterized by a change in the genetic makeup of a population over time and is supported by multiple lines of evidence.
- ENE-1: The highly complex organization of living systems requires constant input of energy and the exchange of macromolecules.
- ENE-3: Timing and coordination of biological mechanisms involved in growth, reproduction, and homeostasis depend on organisms responding to environmental cues.
- ENE-4: Communities and ecosystems change on the basis of interactions among populations and disruptions to the environment.
- IST-5: Transmission of information results in changes within and between biological systems.
- SYI-1: Living systems are organized in a hierarchy of structural levels that interact.
- SYI-2: Competition and cooperation are important aspects of biological systems.
- SYI-3: Naturally occurring diversity among and between components within biological systems affects interactions with the environment.

Content Lesson Topics:

- Responses (Skills 1.A, 1.B, 1.C,), CR 10
- Energy Flow (Skills 1.A, 2.A, 5.A, 6.A, 6.D), CR 10
- Density of Populations (Skills 1.A, 5.A, 6.B, 6.E)**,** CR 10
- Population Ecology (Skills 1.A, 4.B, 5.A)
- Community Ecology (Skills 1.A, 1.B, 1.C, 5.A, 5.B, 6.A, 6.B, 6.E), CR 10
- Biodiversity (Skills 1.A, 1.B, 6.A, 6.B, 6.E), CR 10
- Changes in Ecosystems (Skills 1.A, 1.B, 6.A, 6.B, 6.E), CR 10

Reading Lessons:

- Chapter 40: Population Ecology and the Distribution of Organisms (Skills 1.A, 1.B)
- Chapter 41: Ecological Communities (Skill 1.A)
- Chapter 42: Ecosystems and Energy (Skills 1.A, 1.B)
- Chapter 43: Conservation Biology and Global Change (Skills 1.A, 1.B)

Projects:

- Population Ecology (Skills 4.A, 4.B, 5.A, 6.A, 6.B, 6.C, 6.E)

  Students will construct and analyze the population graph of a species using principles and mathematical models of population ecology.

- Changes in Ecosystems (Skills 1.B, 1.C, 3.C, 4.B, 5.D, 6.A, 6.B, 6.D)

Students will analyze data and draw conclusions about how biodiversity affects the stability of ecosystems and individual species.

Lab Lessons:

- Response to the Environment (Skills 1.A, 3.A, 3.B, 3.C, 3.D, 4.C, 5.C, 5.D)

  Students will observe and analyze fruit fly behavior to determine its response to different stimuli. Students will design and conduct their own investigation to answer an experimental question.

- Energy Flow through Ecosystems (Skills 1.A, 1.B, 2.D, 3.A, 3.B, 3.C, 3.D, 3.E, 4.A, 4.B, 5.A, 6.A, 6.B, 6.D)

  Students will conduct an experiment to net primary productivity. Students will design an additional experiment to test how certain factors affect the net primary productivity of plants.