AP Biology Syllabus

Curricular Requirements	Page(s)
CR1 The teacher and students have access to college-level resources including a recently published (within the last 10 years) college-level textbook and reference materials in print or electronic format.	4
CR2 The course provides opportunities to develop student understanding of the required content outlined in each of the units described in the AP Course and Exam Description (CED).	10–32
CR3 The course provides opportunities to develop student understanding of the big ideas.	4–7
CR4 The course provides opportunities for students to develop the skills related to Science Practice 1: Concept Explanation.	5–6, 12, 14, 16–17, 19, 21, 24, 26–28, 30, 32
CR5 The course provides opportunities for students to develop the skills related to Science Practice 2: Visual Representations.	5–7, 12, 14, 16–17, 19, 21, 24, 26, 28, 30, 34
CR6 The course provides opportunities for students to develop the skills related to Science Practice 3: Questions and Methods.	6–7, 10, 12, 14, 16–19, 21, 24, 26–28, 30, 32, 34–35
CR7 The course provides opportunities for students to develop the skills related to Science Practice 4: Representing and Describing Data.	6–7, 14, 17, 21, 32–35
CR8 The course provides opportunities for students to develop the skills related to Science Practice 5: Statistical Test and Data Analysis.	5–7, 14, 18–19, 24, 26, 28, 30, 32–35
CR9 The course provides opportunities for students to develop the skills related to Science Practice 6: Argumentation.	5, 19–20, 24, 26, 34
CR10 The course provides students with opportunities to apply their knowledge of AP Biology concepts to real-world questions or scenarios (including societal issues or technological innovations) to help them become scientifically literate citizens.	21, 24, 32–33

CR11 Students spend a minimum of 25% of instructional time engaged in a wide range of hands-on, inquiry-based laboratory investigations to support the learning of required content and development of science practice skills throughout the course. Students must conduct a minimum of two labs per big idea.	5–8, 10, 12, 14, 16–18, 20–21, 24, 26–28, 32, 34
CR12 The course provides opportunities for students to record and present evidence of their laboratory investigations.	5–7, 10, 12, 14, 16–18, 20–21, 24, 26–27, 32, 34–35

Course Summary

In this course, the student will gain a foundation in the Life Sciences by focusing on four major themes: 1) how evolution drives the diversity and unity of life; 2) how life uses free energy to maintain homeostasis; 3) how living systems store, retrieve, transmit, and respond to information; and 4) how biological systems interact with each other. These themes are supported by a broad range of biological subdisciplines including biochemistry, molecular biology, cell biology, genetics, physiology, and ecology. The student will use practical experimentation to develop inquiry and reasoning skills to explore these themes throughout the course. This course effectively prepares the student for success on the AP® Biology exam by promoting the deductive reasoning and experimental interpretation skills emphasized in the AP curriculum.

Course Units

Semester A	Semester B
• Unit 1: Course Overview • Unit 2: Lab Safety, Equipment, and Scientific Methods • Unit 3: The Chemistry of Life • Unit 4: Biological Macromolecules Lab • Unit 5: The Cell (Structure and Function; Cell Communication) • Unit 6: Cell Structure Lab • Unit 7: Cell Cycle Lab • Unit 8: Mid-Semester Check • Unit 9: Metabolism (Cellular Energetics) • Unit 10: Cellular Respiration Lab (Cellular Energetics) • Unit 11: Photosynthesis Lab (Cellular Energetics) • Unit 12: Mitosis, Meiosis, and Inheritance (Heredity) • Unit 13: Mendelian Genetics Lab (Heredity) • Unit 14: Gene Expressions and Biotechnology (Gene Expressions and Regulation) • Unit 15: Biotechnology Lab • Unit 16: Semester Exam	• Unit 1: Course Overview • Unit 2: Mechanisms of Evolution (Natural Selection) • Unit 3: Darwinian Evolution Lab • Unit 4: Phylogeny Lab • Unit 5: The Evolutionary History of Biological Diversity • Unit 6: Unicellular Organisms Lab • Unit 7: Multicellular Organisms Lab • Unit 8: Mid-Semester Check • Unit 9: Animal Form and Function • Unit 10: Digestion, Circulation, and Respiration Lab • Unit 11: Excretion and Nervous System Lab • Unit 12: Ecology • Unit 13: Ecology Lab • Unit 14: Review and Full-Length Practice Exam • Unit 15: Semester Project: Research Paper • Unit 16: Semester Exam

Resource Requirements [CR1]

Urry, L., Cain, M., Wasserman, S., Minorsky, P., and Rebecca Orr. *Campbell Biology*. 12th ed., Pearson Higher Education, 2021.

Advanced Placement Biology Content [CR3]
Big Ideas

Big idea 1: The process of evolution drives the diversity and unity of life.

Activity:
Students will answer questions about the age of Earth and evolution. In addition, they will research and discuss the role of individuals, such as Charles Darwin, in evolutionary biology. [CR4, SP1]

Labs:

Darwinian Evolution Lab [CR5, CR8, CR9, CR11, CR12, SP2, SP4, SP5, SP6]
Students will use models to demonstrate Hardy-Weinberg Equilibrium and natural selection in populations. They will use scientific theories to explain how small ecological changes can affect populations, communities, and ecosystems.

Phylogeny Lab [CR5, CR8, CR11, CR12, SP2, SP5, SP6]

Students will construct cladograms based on genetic evidence to demonstrate the evolutionary relationship among different organisms. They will analyze these data and explain how organisms diverged from one another.

Big idea 2: Biological systems utilize free energy and molecular building blocks to grow, to reproduce, and to maintain dynamic homeostasis.

Activity:

Students will draw the electron transfer chain and chemiosmosis. They will label the drawings appropriately. [CR5, SP2]

Labs:

Cellular Respiration Lab [CR5, CR6, CR11, CR12, SP2, SP3, SP5, SP6]

Students will use respirometers and the gas laws to measure the rate of cellular respiration of germinating pea seeds. They will develop a scientific question, plan and collect data, and use scientific theories to explain their data.

Photosynthesis Lab [CR5, CR6, CR11, CR12, SP2, SP3, SP5, SP6]

Students will indirectly measure the net rate of photosynthesis in leaf disks by floating leaf disk assay. Students will develop a scientific question; plan, collect,

and analyze data; evaluate evidence to identify the impact of environmental factors on photosynthesis rates; and use scientific theories to explain their data.

Big idea 3: Living systems store, retrieve, transmit, and respond to information essential to life processes.

Activity:

Students will create a stop-motion video or digital flipbook of the cell cycle. They will draw sketches of the events taking place in the G_1, S, and G_2 phases of interphase; draw a set of diagrams representing the events taking place during mitosis and cytokinesis; and compare their drawings to ones in *Campbell Biology*. [CR5, SP2]

Labs:

Mendelian Genetics Lab [CR4, CR5, CR7, CR11, CR12, SP1, SP2, SP5, SP6]

Students will use Punnett squares to perform monohybrid and dihybrid crosses. They will predict and calculate the probabilities of the genotypes and phenotypes of mice offspring and parents. They will explain their predictions using accepted theories of genetic inheritance.

Biotechnology Lab [CR5, CR6, CR11, CR12, SP1, SP2, SP3, SP5]

Students will investigate biotechnology methods and bioengineer a corn plant. They will use a simulation of DNA analysis to identify twin frogs and a simulation of genetic engineering to engineer a new corn plant. Students will also create an action plan for bioengineering their corn plant and a diagram of their genetically engineered plant.

Big idea 4: Biological systems interact, and these systems and their interactions possess complex properties.

Activity:

Students will find an ecosystem and identify types of organisms from each trophic level. They will create a flow chart for the ecosystem they chose. [CR5, SP2]

Labs:

Digestion, Circulation, and Respiration Lab [CR5, CR8, CR11, CR12, SP2, SP3, SP5, SP6]

Students will build a flowchart of the digestive system. They will analyze how the composition of blood changes through the circulatory system. They will measure their blood pressure and pulse, and determine how they are related to blood flow. Students will build a lung capacity estimator and use it to measure their lung capacity at rest and after exercise.

Ecology Lab [CR5, CR6, CR7, CR11, CR12, SP2, SP3, SP5]

Students will create a closed-model ecosystem and examine the presence of trophic structure and nutrient cycles in ecosystems. They will combine producers, consumers, and decomposers in a controlled aquatic ecosystem and determine how organisms are connected through trophic structure and nutrient cycling. Students will also travel to field sites to document evidence of trophic structure and of the cycling of nutrients in nature.

Writing Assignments

In each lesson, students respond to questions about their textbook readings and other resources both within the online learning platform and in a notebook, as needed. Students will also complete a research paper based on a scientific study in which they create a hypothesis, plan out experimental methods, collect data, analyze data, and draw conclusions.

Laboratory Simulations [CR11, CR12]

The course is also structured around inquiry in the laboratory simulations and the use of the six science practices throughout the course.

Students will spend a minimum of 25 percent of this course participating in laboratory simulations/field studies. [CR11] Students will also maintain a portfolio throughout the course that documents all of their laboratory investigations. [CR12]

Science Practices

SP1: Concept Explanation

Explain biological concepts, processes, and models presented in written format.

SP2: Visual Representations

Analyze visual representations of biological concepts and processes.

SP3: Questions and Methods

Determine scientific questions and methods.

SP4: Representing and Describing Data

Represent and describe data.

SP5: Statistical Test and Data Analysis

Perform statistical tests and mathematical calculations to analyze and interpret data.

SP6: Argumentation

Develop and justify scientific arguments using evidence.

Assessments

Throughout the course, a variety of formative and summative assessments are used to assess student learning and prepare students for the expectations of the AP Biology exam. Students are provided with ample opportunity for skill practice, engagement in meaningful discourse with their peers, and application of their understanding via tasks that are representative of real-world scenarios. Summative assessment types lend themselves to a deeper level of rigor and include portfolios and discussions. Formative assessments are designed to be auto-graded to give students and teachers instant feedback for targeted instruction.

Most lessons contain a quick check assessment that covers the objectives in the lesson, and most units have at least one cumulative quiz that also assesses lesson objectives. Each instructional unit culminates in an online practice to help students review unit concepts and skills, followed by a unit test that consists of multiple choice and short answer and/or essay questions. To aid students in retaining content throughout the course of a semester, a mid-semester check unit appears in the middle of each semester, featuring a low-risk practice assessment covering the

objectives learned up to that point during the semester.

A graded full-length practice exam in the style of the AP Biology exam is given at the end of Semester B. Each semester ends with a semester exam.

Most units feature a discussion or portfolio that promotes critical thinking by expanding on topics students have learned. Each semester ends with a semester project and a semester exam. Graded assessments and participation all count toward the student's final grade.

Course Outline

Semester A

Unit 1: Course Overview [CR1, CR2]

In this unit, students will do the following:

- Acquaint themselves with the goals and expectations of the course.
- Ensure they have the required materials for the course. [CR1]
- Learn about the types of activities that will appear in the course.

Unit 2: Lab Safety, Equipment, and Scientific Methods [CR2, CR6, CR11, CR12, SP3, SP4]

In this unit, students will do the following:

- Understand and perform safe laboratory practices.
- Identify common laboratory equipment (e.g. graduated cylinder, beaker, flask, pipette, micropipette, Petri dish).
- State the four steps of a typical scientific method (observation, hypothesizing, experimentation, conclusion) and describe how they are employed.
- Define the independent and dependent variable in a given experiment and analyze what controls are needed to increase the validity of the experiment.
- Plan and carry out their own investigation using scientific

methods.

- Record work in the Lab Safety, Equipment, and Scientific Methods

Lab Report to be submitted and graded by the teacher. Lab report

sections include the following:

- Make an Observation
- Ask a Question
- Formulate a Hypothesis
- Design and Conduct an Experiment
- Analyze Results
- Make a Conclusion

Sample activities in this unit:

- Students will perform a household experiment that will allow them to go through all steps of the scientific method (e.g., comparing absorbing ability among different paper towel brands). [CR6, CR11, CR12, SP3, SP4]
- Students will learn about the scientific method, laboratory equipment, and safety procedures. They will define the independent and dependent variable in a given experiment and analyze what controls are needed to increase the validity of the experiment. (CR6, CR11, CR12, SP3)

Unit 3: The Chemistry of Life [CR2, CR4, CR5, SP1, SP2]

In this unit, students will do the following:

- Differentiate the chemical elements found in living things and how they assemble to form larger molecules.
- Explain how the properties of water and carbon make them essential to life.
- Compare the four classes of biological macromolecules and describe their functions.

Sample activities in this unit:

- Students will use representations and models to represent the molecular bonds that hold important biological molecules together, including carbohydrates, proteins, lipids, and nucleic acids. (LO 4.1, LO 4.2, LO 4.3) [CR5, SP2]
- Students will participate in a discussion about how the same repeating molecular units can produce a large number of varied structures among different organisms. (LO 1.15, LO 1.16) [CR4, SP1]

Unit 4: Biological Macromolecules Lab [CR2, CR4, CR6, CR11, CR12, SP1, SP3]

In this unit, students will do the following:

- Differentiate between biological macromolecules using biochemical assays.
- Explain and simulate the dehydration synthesis of biological macromolecules.
- Record work in the Biological Macromolecules Lab Report to be submitted to the teacher. Lab report sections include the following:
    - Complete table to identify nutrients.
    - Build a glucose molecule and dehydrate then hydrate the molecule.

Sample activities in this unit:

- Students will perform two laboratory simulations to investigate biological macromolecules.
    a. Students will use representations and models to simulate the dehydration synthesis of carbohydrate polymers.
    b. Students will plan and implement data collection strategies to use qualitative tests to identify unknown biological macromolecules
    - *Science practice skills applied*: 1, 3, 4 [CR11, CR12]
    - *Enduring understandings*: 4.A, 4.C

Unit 5: The Cell [CR2, CR4, CR5, SP1, SP2, SP3]

In this unit, students will do the following:

- Describe the current definition of a cell, based on cell theory.
- Describe the structure and function of cell membranes.
- Explain how cells transport materials through their membranes using passive transport (diffusion), facilitated diffusion, active transport, and bulk transport.
- Describe the major cell organelles and subcellular structures in prokaryotic and eukaryotic (plant and animal) cells and state the function of each.
- Explain the steps by which cells respond to internal and external signals.

Sample activities in this unit:

- Students will apply cell theory and its implications for defining life, as well as the difference between cell functions in unicellular versus multicellular

organisms. (LO 4.8, LO 4.9, LO 4.10). [CR4, SP1]

- Students will create, analyze and refine models of cell signaling systems and then generate scientific questions involving the evolution of cell signaling systems. (LO 3.31, LO 3.32, LO 3.33) [CR5, SP2, SP3]

Unit 6: Cell Structure Lab [CR2, CR4, CR5, CR6, CR7, CR8, CR11, CR12, ,SP1, SP2, SP3, SP4, SP5]

In this unit, students will do the following:

- Identify subcellular structures found in cells.
- Apply the scientific method to explain the behavior of large and small molecules partitioning across a semipermeable membrane.
- Record work in the Cell Structure Lab report to be submitted to the teacher. Lab sections include the following:
    - Cell Structure Table
    - Reading percent concentration table
    - Reading percent concentration graph
    - Build physical model of cell

Sample activities in this unit:

- Students will perform two laboratory simulations to investigate cell structures and function.
    a. Students will use models to represent the different organelles and subcellular components of the cell and identify their function.
    b. Students will engage in scientific questioning and plan, collect, and analyze data to explain their observations about osmosis, and to predict when osmosis will occur.
    - *Science practice skills applied*: 1, 2, 3, 4, 5 [CR 2, 4, 5, 6, 7, 8, 11, 12]
    - *Enduring understandings*: 2.B, 4.A, 4.C [SC 3b, 3d]

Unit 7: Cell Cycle Lab [CR2, CR4, CR5, CR6, CR11, CR12, SP1, SP2, SP3]

In this unit, students will do the following:

- Describe what characterizes each stage of the cell cycle.
- Describe what characterizes each stage of mitosis.
- Explain the consequences of cellular reproduction that is unregulated.
- Record work in the Cell Cycle Lab report to be submitted to the teacher. Lab sections include the following:
    - Cell Division Phase sketches and summary table.
    - Cell cycle phase length table
    - Mitosis and Meiosis Modeling
    - Simulating Meiosis

Sample activities in this unit:

- Students will participate in a lab simulation in which they use representations and models to communicate what occurs during the cell cycle. They will use scientific explanations and theories to explain what occurs during cancer, in terms of errors in controlling the cell cycle.
    - *Science practice skills applied*: 1, 2, 3 [CR 2, 4, 5, 6, 11, 12]
    - *Learning objectives applied:* 3.7, 3.8

Unit 8: Mid-Semester Check [CR2]

In this unit, students will do the following:

- Review the topics that they have learned from the beginning of the course.
- Demonstrate knowledge by completing a graded mid-semester check in the style of the AP Biology exam.

Unit 9: Metabolism [CR2, CR4, CR5, CR6, CR7, SP1, SP2, SP3, SP4]

In this unit, students will do the following:

- Explain how cells use free energy during metabolism to maintain homeostasis.
- Differentiate anaerobic respiration from aerobic respiration and describe the processes that occur in each.
- Compare photosynthesis to cellular respiration and explain the processes that occur in each.

Sample activities in this unit:

- Students will use models to represent cellular respiration and photosynthesis, ask scientific questions regarding the functioning and evolution of cellular respiration and photosynthesis, and design and interpret experiments regarding the products and reactants of respiration and photosynthesis. (LO 2.4, LO 2.41, LO 2.5, LO 4.6) [CR5, CR6, SP2, SP3]
- Students will participate in a discussion about why cells need energy to function and how that energy is taken in, transported, and consumed. (LO 2.5, LO 4.5, LO 4.6)[CR4, SP1]
- Students will complete an activity to show how there are a number of factors that can affect the rate of an enzyme-facilitated reaction. They will graph the number of toothpicks broken as a function of time. [CR7, SP4]
- Students will label the reactants, the products, and the activation energy on a graph of a chemical reaction. They will label the reactants with a plus or a minus to indicate energy level at the completion of the reaction and will identify the reaction as exergonic or endergonic. [CR7, SP4]
- Students will research other examples of fermentation and anaerobic respiration and will compare and contrast each of these examples with aerobic respiration. [CR4, SP1]
- Students will perform an experiment to demonstrate the cellular respiration process. [CR6, SP3]
- Students will model the Calvin cycle and use the model to explain the Calvin cycle's role in photosynthesis. (CR4, CR5, SP1, SP2)

Unit 10: Cellular Respiration Lab [CR2, CR6, CR11, CR12, SP3, SP4, SP6]

In this unit, students will do the following:

- Apply the scientific method to explain the production of gases during respiration.
- Record work in the Cellular Respiration Lab report to be submitted to the teacher. Lab sections include:
    - Form hypothesis.
    - Respirometer readings table
    - Results
    - Conclusion

Sample activities in this unit:

- Students will participate in a laboratory simulation in which they measure the rate of cellular respiration of living organisms. They will develop a scientific question, plan and collect data, and use scientific theories to explain their data.
    - *Science practice skills applied*: 3, 4, 6 [CR 2, 6, 11, 12]
    - *Learning objectives:* (2.4, 2.41, 2.5, 4.6)

Unit 11: Photosynthesis Lab [CR2, CR6, CR8, CR11, CR12, SP3, SP4, SP5, SP6]

In this unit, students will do the following:

- Apply the scientific method to explain the production of gases during photosynthesis.
- Record work in the Photosynthesis Lab report to be submitted to the teacher. Lab sections include the following:
    - Preliminary Floating Disk table
    - Scientific Method steps

Sample activities in this unit:

- Students will participate in a laboratory simulation in which they measure the rate of photosynthesis of living organisms. They will develop a scientific question, plan and collect data, analyze data, and use scientific theories to explain their data.
- Students will measure the rate of photosynthesis of living organisms. They

will develop a scientific question, plan and collect data, analyze data, and use scientific theories to explain their data.

- *Science practice skills applied*: 3, 4, 5, 6 [CR 2, 6, 8, 11, 12]
- *Learning objectives:* (2.4, 2.41, 2.5, 4.6)

Unit 12: Mitosis, Meiosis, and Inheritance [CR2, CR4, CR5, CR9, SP1, SP2, SP6]

In this unit, students will do the following:

- Describe the steps involved in cellular reproduction.
- Differentiate between meiosis and mitosis and explain how it results in genetic variation.
- Analyze the chromosomal basis of inheritance and explain how it leads to Mendelian patterns of inheritance.

Sample activities in this unit:

- Students will construct models to show how meiosis transfers information to the next generation. (LO 3.10, LO 3.11, LO 3.12, LO 4.5, LO 4.6) [CR4, CR5, SP1, SP2]
- Students will apply mathematical models to validate Mendelian genetic theory and predict genotypic and phenotypic ratios in Mendelian and non-Mendelian inheritance systems. (LO 3.14) [CR5, CR9, SP2, SP-6]
- Students will discuss the benefits versus the harmful effects of telomerase expression. They will research and write an essay explaining their position on the topic. [CR9, SP6]

Unit 13: Mendelian Genetics Lab [CR2, CR5, CR6, CR8, CR9, CR11, CR12, SP2, SP5, SP6]

In this unit, students will do the following:

- Predict the genotype and phenotypes of parents and offspring using Punnett squares from one- and two-trait Mendelian crosses.
- Perform Punnett square analysis for non-Mendelian genes, such as codominant, incomplete dominant, and X-linked traits.
- Record work in the Mendelian Genetics Lab report to be submitted to the teacher. Lab sections include the following:
    - Monohybrid Punnett square

- Genotype and phenotype ratio table
- Dihybrid Punnett square

Sample activities in this unit:

- Students will participate in a laboratory simulation in which they use Punnett squares to calculate the genotype of offspring and parents. They will explain their predictions using accepted theories of genetic inheritance.
  - *Science practice skills applied*: 2, 6 [CR 2, 5, 6, 8, 9, 11, 12]
  - *Learning objectives:* 3.2, 3.3

Unit 14: Gene Expressions and Biotechnology [CR2, CR4, CR5, CR6, CR7, SP1, SP2, SP3, SP4]

In this unit, students will do the following:

- Describe the steps of transcription and translation.
- Define gene regulation and describe where, when and how gene expression is controlled within cells.
- Compare how different genes are expressed and regulated among prokaryotes and eukaryotes.
- Define mutation and describe how it can affect the evolution of a population.
- Apply biotechnological techniques to bioengineering problems.

Sample activities in this unit:

- Students will plan a procedure for a genetic transformation using plasmids or other modern biotechnological technique, as well as a data collection plan, which will provide evidence that the transformation was successful. (LO 3.1, 3.3, 3.5, 3.6, 4.7) [CR6, CR7, SP3, SP4]
- Students will research the evolution of a gene family and write a brief essay explaining what gene duplication and mutation events led to the divergence of the gene family. Students will create a chart listing the different ways that genomes can vary and summarizing what they know about each. [CR4, CR5, SP1, SP2]

Unit 15: Biotechnology Lab [CR2, CR6, CR10, CR11, CR12, SP3]

In this unit, students will do the following:

- Apply the scientific method to identify genetically similar organisms using simulated biotech methods such as restriction enzyme analysis of DNA and gel electrophoresis.
- Describe the methods and social issues involved with bioengineering techniques using simulations, such as genetic engineering techniques used to create insect or herbicide-tolerant plants.
- Design engineering solutions to bioengineering problems.
- Record work in the Biotechnology Lab report to be submitted to the teacher.

Sample activities in this unit:

- Students will participate in a laboratory simulation in which they use restriction enzymes to identify genetically related individuals and create a strategy to engineer genetically-transformed corn plants.
    - *Science practice skills applied*: 3[CR 6, 10, 11, 12]
    - *Enduring understandings*: 3.B, 3.C

Unit 16: Semester Review and Exam [CR2]

In this unit, students will do the following:

- Review all topics covered this semester.
- Demonstrate knowledge by completing a graded semester exam written in the style of the AP Biology exam.

Semester B

Unit 1: Course Overview [CR1, CR2]

In this unit, students will do the following:

- Acquaint themselves with the goals and expectations of the course.
- Ensure they have the required materials for the course. [CR1]
- Learn about the types of activities that will appear in the course.

Unit 2: Mechanisms of Evolution [CR2, CR4, CR5, CR8, CR10, SP1, SP2, SP5]

In this unit, students will do the following:

- Analyze how environmental factors can affect gene frequency in a gene pool.
- Compare the conditions that can result in speciation.
- Critique scientific hypotheses regarding the origin of life on Earth and reconcile these hypotheses to current understanding of phylogeny.

Sample activities in this unit:

- Students will use mathematical models to understand how populations change and will apply the mechanisms of evolution to explain these observations. (LO 1.1, LO 1.2, LO 1.3, LO 3.24) [CR4, CR5, SP1, SP2)
- Students will engage in a discussion on the societal issues related to evolutionary theory and its common misconceptions. [CR10]
- Students will explain how to use the Hardy-Weinberg equation to determine if a population is evolving. [CR8, SP5]

Unit 3: Darwinian Evolution Lab [CR2, CR5, CR6, CR8, CR9, CR11, CR12, SP3, SP5, SP6]

In this unit, students will do the following:

- Apply Hardy-Weinberg equilibrium and the mechanism of evolution to predict changes in the allele frequency of a simulated population during periods of equilibrium and selection.
- Record work in the Darwinian Evolution Lab report to be submitted to the teacher. Lab sections include the following:

- Rainfall and Bird Beak histogram
- Finch population graph
- Beak size graph
- Hardy-Weinberg Equilibrium table

Sample activities in this unit:

- Students will participate in a laboratory simulation in which they use models to demonstrate Hardy-Weinberg Equilibrium. They will then use Hardy-Weinberg Equilibrium to test for the presence of natural selection occurring in populations. They will analyze data and use scientific theories to explain how small ecological changes can affect populations, communities, and ecosystems.
  - *Science practice skills applied*: 3, 5, 6 [CR 5, 6, 8, 9, 11, 12]
  - *Learning objectives*: 1.1, 1.2, 1.3, 3.24

Unit 4: Phylogeny Lab [CR2, CR5, CR6, CR8, CR9, CR11, CR12, SP2, SP3, SP5, SP6]

In this unit, students will do the following:

- Use evidence from the comparison of DNA sequences through BLAST to deduce evolutionary relationships between organisms.
- Record work in the Phylogeny Lab report to be submitted to the teacher. Lab sections include the following:
  - Construct a cladogram
  - Compare percent similarity
  - Form hypothesis
  - Analyze cladograms

Sample activities in this unit:

- Students will participate in a laboratory simulation in which they construct cladograms based on genetic evidence to demonstrate the evolutionary relationship between different organisms. They will analyze these data and, applying the theory of evolution, explain how organisms diverged from each other.
  - *Science practice skills applied*: 2, 3, 5, 6 [CR 5, 6, 8, 9, 11, 12]
  - *Learning objectives*: 1.11, 1.12 1.13, 1.17, 1.18, 1.19

Unit 5: The Evolutionary History of Biological Diversity [CR2, CR4, SP1]

In this unit, students will do the following:

- Compare organisms across the three domains of life and explain why viruses do not fit any of these classifications.
- Distinguish prokaryotes from each other and unicellular eukaryotes.
- Categorize eukaryotes into kingdoms and identify similarities and differences that exist within a kingdom.

Sample activities in this unit:

- Students will examine how organisms are classified and analyze those classifications to deduce the evolutionary history of groups of organisms. (LO 1.11, LO 1.12, LO 1.13, LO 1.16) [CR4, SP1]

Unit 6: Unicellular Organisms Lab [CR2, CR4, CR6, CR11, CR12, SP1, SP3]

- Explain the unity of life and diversity of life by observing and comparing similarities between bacteria.
- Record work in the Unicellular Organisms Lab report to be submitted to the teacher. Lab sections include the following:
    - Test table
    - Recording experiment results in table
    - Classify living organisms

Sample activities in this unit:

- Students will observe prokaryotic and eukaryotic unicellular life using virtual microscopy. They will identify traits that are common to all life, prokaryotes and eukaryotes, and they will identify differences that demonstrate the diversity of life in the biosphere.
    - *Science practice skills applied*: 1, 3 [CR 4, 6, 11, 12]
    - *Learning objectives*: 1.11, 1.12 1.13, 1.16

Unit 7: Multicellular Organisms Lab [CR2, CR4, CR6,

CR11, CR12, SP1, SP3]

In this unit, students will do the following:

- Explain the unity of life and diversity of life by observing and comparing similarities between phyla of multicellular organisms.
- Record work in the Multicellular Organisms Lab report to be submitted to the teacher. Lab sections include the following:
    - Traits of Different Phyla table
    - Classification of Multicellular Organisms table

Sample activities in this unit:

- Students will participate in a laboratory simulation in which they observe representative organisms from across multicellular phyla given 3–4 representative images of each phylum. They will then use the theory of common descent to explain the wide variety of organisms found at all scales in the biosphere.
    - *Science practice skills applied*: 1, 3 [CR 4, 6, 11]
    - *Learning objectives: 1.11, 1.12 1.13, 1.16*

Unit 8: Mid-Semester Check [CR2]

In this unit, students will do the following:

- Review the topics that they have learned from the beginning of the course.
- Demonstrate knowledge by completing a graded mid-semester check in the style of the AP Biology exam.

Unit 9: Animal Form and Function [CR2, CR4, CR5, CR6, CR8, SP1, SP2, SP3, SP5]

- Describe animal physiology and analyze how animals are adapted to their niches on Earth.
- Analyze how the digestive, circulatory, respiratory, immune, excretory, and endocrine systems interact to maintain homeostasis in animals.
- Explain how animals develop and utilize common signaling pathways in their development.
- Compare behavior among different animals and explain how behavior arises in animals through electrochemical signaling in the nervous system.

Sample activities in this unit:

- Students will engage in scientific questioning on the structure, function, and evolution of animal tissues, organs, and organ systems. (LO 4.8) [CR4, CR6, SP1, SP3]
- Students will use representations and models to analyze the structure and function of animal tissues, organs, and organ systems. (LO 4.9) [CR5, SP2]
- Students will analyze physiological processes mathematically and make predictions about how an organism's physiological state can change due to external influences. (LO 4.9) [CR4, CR8, SP1, SP5]

Unit 10: Digestion, Circulation, and Respiration Lab [CR2, CR4, CR5, CR6, CR7, CR8, C11, C12, SP1, SP2, SP3, SP4, SP5]

In this unit, students will do the following:

- Explain how the cells, tissues, and organs of the digestive system extract nutrients from food.
- Apply the scientific method to explain how the cells, tissues, and organs of the circulatory system respond to stress.
- Explain how the cells, tissues, and organs of the respiratory system transport gases.
- Record work in the Digestion, Circulation, and Respiration Lab report to be submitted to the teacher. Lab sections include the following:
    - Calculate volume of air
    - Formulate hypothesis
    - Create flowchart

- Write an essay

Sample activities in this unit:

- Students will participate in a laboratory simulation in which they use models and engage in scientific questioning to study the digestive, cardiovascular, and respiratory systems. They will plan, collect, and analyze data to explain physiological phenomena relating molecular processes to macroscopic organ systems. If accessible, students will participate in a cow heart dissection.
    - *Science practice skills applied*: 1, 3, 4, 5 [CR 4, 5, 6, 7, 8, 11, 12]
    - *Enduring understandings*: 2.A, 2.B, 2.C, 2.D, 2.E, 3.E, 4.A

Unit 11: Excretion and Nervous System Lab [CR2, CR4, CR6, CR7, CR8, CR11, CR12, SP1, SP3, SP4, SP5]

In this unit, students will do the following:

- Describe how the cells, tissues, and organs of the excretory system explain the composition of urine.
- Describe how the cells, tissues, and organs of the nervous system explain how humans perceive and respond to their environment.
- Record work in the Excretion and Nervous System Lab report to be submitted to the teacher. Lab sections include the following:
    - Senses table
    - Senses Neural map
    - Taste Receptor Density table
    - Smell Discrimination table
    - Two-Point Discrimination table
    - Localization of Sound table
    - Blind Spot table
    - Liquid Excretory System map
    - Urinalysis Lab table

Sample activities in this unit:

- Students will participate in a laboratory simulation in which they study ways by which the brain perceives the world and how wastes are eliminated by the kidneys. They will plan, collect, and analyze data to explain physiological phenomena relating molecular processes to macroscopic organ systems. They will complete the following sensory system exercises: taste threshold,

smell discrimination, two-point discrimination, thermal adaptation, localization of sound, proprioception, blind spot, visual acuity, astigmatism, myopia/hypermetropia, accommodation, and afterimages.

- *Science practice skills applied*: 1, 3, 4, 5 [CR 4, 6, 7, 8, 11, 12]
- *Learning objectives*: 3.40, 3.43, 3.44-3.49 4.8, 4.9

Unit 12: Ecology [CR2, CR4, CR7, CR8, CR10, SP1, SP4, SP5]

In this unit, students will do the following:

- Explain how individual interactions among organisms result in changes in populations.
- Explain how different populations interact in communities and ecosystems.
- Analyze the benefits and costs of strategies used to preserve ecosystems.

Sample activities in this unit:

- Students will use mathematics to model ecosystem interactions and collect and evaluate data to relate knowledge regarding matter and energy cycling across various ecological scales. (LO 4.11, LO 4.12, LO 4.13, LO 4.14, LO 4.15) [CR4, CR7, CR8, SP1, SP4, SP5]
- Students will participate in a discussion about human impact on the ecosystem, ecosystem services, and natural resource use. [CR10]
- Students will chart population growth in a set area over a set period of time for 1) amoebas in Lake Erie (r-selected) and 2) panthers in the Everglades (K-selected) and include information about the factors leading to changes in those populations. [CR7, SP4]

Students will practice calculating changes in population size by substituting sample numbers into a formula. [CR8, SP5]

Unit 13: Ecology Lab [CR2, CR5, CR6, CR9, CR11, CR12, SP2, SP3, SP6]

In this unit, students will do the following:

- Describe the ecological relationships present in natural ecosystems by creating a model ecosystem.
- Apply the scientific method to observe the cycling of matter in an actual ecosystem during a field walk.
- Record work in the Ecology Lab report to be submitted to the teacher. Lab sections include the following:
    - Recording data and observations
    - Complete field journal
    - Create nutrient and food chain diagrams

Sample activities in this unit:

- Students will participate in a laboratory simulation in which they observe a natural ecosystem and build a model ecosystem. They will engage in scientific questioning and apply scientific explanations to explain observations they make in the field.
    - *Science practice skills applied*: 2, 3, 6 [CR 5, 6, 9, 11, 12]
    - *Learning Objectives*: 4.13, 4.16

Unit 14: Semester Review and Full-Length Practice Exam [CR2, CR9, SP6]

In this unit, students will do the following:

- Review the entire course, using the results of the mid-semester check and unit tests to focus this review.
- Complete a full-length practice exam in the style of the AP Biology exam, over the course of three days.
- Students will explain how they feel about genetically modified organisms (GMOs) in grocery stores. They will use evidence to explain whether they feel safe consuming GMOs and if and how they would change governmental regulations on GMOs. (CR9, SP6)

Unit 15: Semester Project: Research Paper [CR2, CR6, CR7, CR8, CR12, SP3, SP4, SP5]

In the project unit, students will plan and carry out their own scientific observation using household materials or a local field area. They will create a project proposal that describes their hypothesis and their proposed experimental methods. They will then carry out their experiment inside or in the field. They will collect data and then analyze that data for trends, as well as present the data in the form of graphs or tables. They will then describe their study in a four-section scientific paper (introduction, methods, results, discussion). (CR6, CR7, CR8, CR12, SP3, SP4, SP5)

Unit 16: Semester Review and Exam [CR2]

In this unit, students will do the following:

- Review all topics covered this semester.
- Demonstrate knowledge by completing a graded semester exam written in the style of the AP Biology exam.