The EUHSD Biology curriculum document identifies what students should be able to know by grade level in a comprehensive standards-based course of study. The curriculum document is updated annually based on student academic achievement data, research and best practices, and input from stakeholders. The EUHSD curriculum document contains the following documents and/or information:

A. Course Description
B. Course Guidelines/Requirements - graduation credit information, transcript information, adopted materials, adopted technology, assessment outline
C. Instructional Materials References
D. Scope and Sequence Map with Essential Standards outlined by Unit
E. References to key essential design and implementation documents

A comprehensive course of study and/or program is designed so that all students have access to the rigorous curriculum necessary to graduate high school demonstrating college and career readiness skills. Student-Centered learning provides opportunity for collaboration, communication, and a robust learning environment and provides opportunities for all students to meet the goals of the district’s Instructional Focus at the time of this writing: “All students communicate their thinking, ideas and understanding by effectively using oral, written and/or non-verbal expression.”

Key design considerations in the transition to the new California Next Generation Science Standards is a focus on changes in pedagogy. The NGSS instructional shifts guide classroom teaching and learning and form the foundation of curriculum and instructional design. Specific references to the key NGSS Instructional shifts are outlined within the 2015/2016 California Science framework document.

The curriculum document is aligned to the California Next Generation Science Standards: [http://www.cde.ca.gov/pd/ca/sc/ngssstandards.asp](http://www.cde.ca.gov/pd/ca/sc/ngssstandards.asp)
# Biology Course Description

The introductory course of *Biology* covers the composition of matter and the changes it undergoes. Through hands-on and minds-on performance tasks and key activities students develop an understanding of the fundamental core ideas, cross-cutting concepts, and science and engineering practices used in Biology. Topics include: cells, genetics and biotechnology, ecology, evolution, and human environmental impacts. Questions on physical and chemical phenomena motivate the laboratory inquiry that students conduct.

## Course Requirements

<table>
<thead>
<tr>
<th>Course Requirements</th>
<th>Grade Level: 9-12</th>
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<tbody>
<tr>
<td><strong>Course Length:</strong></td>
<td>Year Long</td>
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<tr>
<td><strong>UC/CSU Requirement:</strong></td>
<td>Meets UC/CSU “d” requirements</td>
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<tr>
<td><strong>Graduation Requirement:</strong></td>
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<tr>
<td><strong>Course Number (Semester A):</strong></td>
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<tr>
<td>(P) 3655</td>
<td>Transcript Abbreviation (Semester A):</td>
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<td>(SE) 4346</td>
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<td>5 Biological Science</td>
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<tr>
<td><strong>Credits (Semester B):</strong></td>
<td>5 Biological Science</td>
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<tr>
<td><strong>Required Prerequisite/s:</strong> Completion or Concurrent Enrollment in Algebra 1 or Math 1 (Integrated)</td>
<td><strong>Recommended Prerequisite/s:</strong> None</td>
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<tr>
<td><strong>Board Approval Date (Curriculum):</strong></td>
<td>4/18/17</td>
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<tr>
<td><strong>Board Approval Date (Materials):</strong></td>
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<tr>
<td><strong>Core Instructional Material/s:</strong> <em>Biology</em> by Stephen Nowicki, McDougal Littell Publishing ©2008, ISBN:978-0-618-72510-6</td>
<td><strong>Supplemental Instructional Material/s:</strong></td>
</tr>
<tr>
<td>*EUHSD Biology teachers will pilot and supplement instruction through a variety of NGSS related materials, until such time that publishers release CA NGSS aligned instructional resources.</td>
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<tr>
<td><strong>Technology Resource/s:</strong></td>
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<tr>
<td>• Individual student computer</td>
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<tr>
<td>• Probeware</td>
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<tr>
<td>• Variety of classroom laboratory equipment (see specific units)</td>
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Assessment/s:
- Each unit of instruction outlines key performance based tasks required in order to address specific CA NGSS skills.
- Specific unit plans will be developed and will contain key unit formative and summative NGSS aligned assessments.
- Assessment is ‘science’ and three dimensional learning must be assessed three dimensionally. To assess our students, we plan and conduct investigations about student learning and then analyze and interpret data to develop models of what students are thinking. These models allow us to predict the effect of additional teaching that addresses patterns we notice in student understanding and misunderstanding. Assessment allows us to progressively improve our teaching practice, spiraling upward. Because of this strong link between assessment and instruction, this chapter is targeted to teachers and focuses on classroom assessment. It does not provide recommendations for district or state testing.
The Scope and Sequence Guide is a California standards-based document that delineates the standards-based skills students are expected to know and do in order to meet College and Career Readiness expectations. Each unit of study in the Scope and Sequence document is designed to build upon the previous unit and/or prerequisite coursework in support of student mastery of specific standards-based skills. The Scope and Sequence document provides the framework of understanding for key assignments, key assessments, and instructional resources and strategies that serve to assist students in meeting unit learning objectives. The document will be updated annually with input from all stakeholders.

In coursework requiring reading and writing, the following standards are not specifically stated in any one unit of study, but are the result of implementation throughout the curriculum as students participate in reading, writing, and speaking/listening standards-based activities.

• By the end of grade 11, students will read and comprehend literary nonfiction in the grades 11-CCR text completely and proficiently, with scaffolding as needed at the high range. (Reading Informational Text Standard 10)
• Students will write routinely over extending time frames (time for research, reflection, and revision) and shorter time frames (a single sitting or a day or two) for a range of tasks and purposes. (Writing Standard 10)
• “To be college and career ready, students must have ample opportunities to take part in a variety of rich and structured conversations – as part of a whole class, in small groups, and with a partner – build around important content in various domains. They must be able to contribute appropriately to conversations, make comparisons and contrasts, and analyze and synthesize a multitude of ideas according to the standards of evidence appropriate to a particular discipline.” (Standards for ELA Anchor Standards for Speaking/Listening)
**Unit Description:** In this unit, students will identify and explain the characteristics of living things. They will analyze single celled organisms and multicellular organisms as well as the structural organization in advanced organisms. Students will study the basic structure and function of cells and their role in keeping an organism alive. Students will plan and conduct an experiment in order to study homeostatic mechanisms within a living system.

**Essential Question/s:**
- What makes something alive?
- How does the human body maintain homeostasis (not destroy itself)?
- Is a virus a cell?

**Learning Objectives:**
- Identify and explain the basic characteristics of living things (e.g., cells, homeostasis, evolve, energy, reproduce, respond to the environment, genetics, growth).
- Explain and describe the basic structure and function of cells in single (prokaryote) and multicellular organisms (eukaryote).
- Use a model to explain that multicellular organisms have a structural organization that has a critical function for the organism (e.g., cells, tissues, organs, organ systems).
- Design and perform an experiment to look at the role of homeostasis in multicellular organisms with a focus on basic feedback mechanisms.

**Key Unit Performance Tasks/Activities:**
- **1-1 Organization of Organisms:** Students will create a model that shows the level of organization in a multicellular organism from cells to organ systems. Students will fill out a graphic organizer that will assist them in describing their model. They will then use the model to evaluate and predict what would happen to the organism if one of these components failed or did not exist. Students will argue how the living organism will respond to a failure or absence of a level of organization.
- **1-2 Homeostasis Lab:** Students will plan and conduct an experiment to determine how the human body maintains homeostasis by specifically measuring heart rate and/or blood pressure. Students will plan and conduct an investigation on a variable (e.g., jogging, sitting, hopping, etc.) to see how it affects the heart rate and/or blood pressure. Students will write an argument in their lab report to support their findings.

**Unit Assessments:**
- **1-1 Organization of Organisms:** Graphic Organizer with Model, CER
- **1-2 Homeostasis Lab:** Lab Report
DCI LS1.A: Multicellular organisms have a hierarchical structural organization, in which any one system is made up of numerous parts and is itself a component of the next level. (HS-LS1-2)

PE LS1-3: Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis. [Clarification Statement: Examples of investigations could include heart rate response to exercise, stomate response to moisture and temperature and root development in response to water levels.] [Assessment boundary: Assessment does not include interactions and functions at the molecular or chemical reaction level.]

DCI LS1.A: Feedback mechanisms maintain a living system's internal conditions within certain limits and mediate behaviors, allowing it to remain alive and function even as external conditions change within some range. Feedback mechanisms can encourage (through positive feedback) or discourage (negative feedback) what is going on inside the living system. (HS-LS1-3)

Scientific and Engineering Practices:
- Planning and carrying out investigations
- Using mathematics and computational thinking
- Developing and Using Models
- Obtaining, evaluating and communicating information
- Analyzing and interpreting data
- Engaging in argument from evidence
- Constructing Explanations (science) and Designing Solutions (engineering)

Crosscutting Concepts:
- Patterns
- Cause and Effect
- Systems and system models
- Structure and Function of Matter
- Stability and Change
- Scale, Proportion and quantity
### Meeting the Needs of ELs:

- Utilize the student information system to acquire the language levels of EUHSD English Learners.
- In 2012, the CA Department of Education adopted new language level proficiency descriptors and new EL state standards. Visit the following website to learn more about those new descriptors and corresponding standards: [http://www.cde.ca.gov/sp/el/er/documents/eldstdnpubllc14.pdf](http://www.cde.ca.gov/sp/el/er/documents/eldstdnpubllc14.pdf)
- In 2014, the CA Department of Education adopted new ELA-ELD Framework, with specific strategies designed to meet the needs of EL students. Visit the following URL to learn more about the new frameworks: [http://www.cde.ca.gov/ci/rl/cf/documents/elaeldfwchapter11.pdf](http://www.cde.ca.gov/ci/rl/cf/documents/elaeldfwchapter11.pdf)

### Unit Resources:

- Probeware (CO2, heart rate or blood pressure monitor)
- Computer Access
- Basic Lab Equipment and Materials: timer, rulers

### Online Resources:

- [https://youtu.be/gFuEo2ccTPI](https://youtu.be/gFuEo2ccTPI)
- [http://www.hhmi.org/biointeractive/](http://www.hhmi.org/biointeractive/)
- [https://www.biologycorner.com/](https://www.biologycorner.com/)
- [https://biomanbio.com/index.html](https://biomanbio.com/index.html)
**Unit 2 – Ecology**  
**Length:** 7-8 Weeks

**Unit Description:** In Unit 2, students will investigate the role of organisms within their ecosystems. Organism interactions and how this can affect a population and/or individual species will be analyzed. Students will explain how energy and matter cycles through biotic and abiotic components of the environment (biosphere, hydrosphere, geosphere and atmosphere). Students will take an investigative approach to better understand how photosynthesis and cellular respiration play a role in energy transformations and carbon cycling.

**Essential Question/s:**
- How do organisms interact on different scales within an ecosystem?
- How does a change in an ecosystem affect the organisms that live within it?
- Where does the energy and matter come from that sustains ecosystems?

**PE = Performance Expectations (White)**  
**DCI = Disciplinary Core Ideas**  
**SEP = Scientific & Engineering Practices**  
**CCC= Cross Cutting Concepts**

**PE LS2-1:** Use mathematical and/or computational representations to support explanations of factors that affect carrying capacity of ecosystems at different scales. [Clarification statement: Emphasis is on the quantitative analysis and comparison of the relationships among interdependent factors including boundaries, resources, climate and competition. Examples of mathematical comparisons could include, graphs, charts, histograms, and population changes gathered from simulations or historical data sets.] [Assessment Boundary: Assessment does not include deriving mathematical equations to make predictions.]

**DCI LS2.A:** Ecosystems have carrying capacities, which are limits to the numbers of organisms and populations they can support. These limits result from such factors as the availability of living and nonliving resources and from such challenges such as predation, competition, and disease. Organisms would have the capacity to produce populations of great size were it not for the fact that environments and resources are finite. This fundamental tension affects the abundance (number of individuals) of species in any given ecosystem. (HS-LS2-1) (HS-LS2-2)

**PE LS2-2:** Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales. [Clarification Statement: Examples of mathematical representations include finding the average, determining trends, and using graphical comparisons of

<table>
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<th>Learning Objectives: Students will be able to...</th>
<th>Key Unit Performance Tasks/Activities:</th>
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| - Compare and contrast species, populations and ecosystems.  
- Plan and carry out investigations that relate to matter and energy transfer within a system.  
- Plan and carry out investigations that relate to aerobic and anaerobic respiration.  
- Identify and explain an autotroph (producers) and heterotroph (consumers) and their roles in ecosystems.  
- Use or make a model to explain the relationships of organisms within ecosystems (food webs and food chains).  
- Use mathematical representation of the food web to identify the transfer of energy and matter between trophic levels (ecological pyramids). | - 2-1 Plant Lab: Students will plan and conduct an experiment involving plant growth. They need to change one variable (e.g., soil conditions, light conditions, amount of CO2, amount of water, bacteria free soil - heat treat, etc.) to see how altering the variable affects the overall growth of the plant (mass). Students will write a lab report to evaluate how this variable affects the overall plant. Within their lab report students will include an annotated model to show the plant/soil/air system.  
- 2-2 Biogeochemical Cycles: Students use multiple forms of scientific texts to create an annotated model to illustrate the role of photosynthesis and cellular respiration in the cycling of carbon within the hydrosphere, geosphere, biosphere and atmosphere with an emphasis of energy and matter. Students will then write an explanation for how carbon can combine with other elements to form new molecules.  
- 2-3 Ecological Pyramids: Students will then generate biomass and energy pyramids in order to mathematically represent the flow of energy and matter between trophic levels. Students will use these pyramids to relate it to the carrying capacity of the ecosystem. Students will then evaluate and write a claim using evidence to explain what should happen |

**Unit Assessments:**
- 2-1 Plant Lab: Lab Report  
- 2-2 Biogeochemical Cycles: Model, CER  
- 2-3 Ecological Pyramids: Model, CER  
- 2-4 Mealworm Lab: Lab Report  
- 2-5 Investigating Population Decline: Bibliography, Socratic Seminar  
- 2-6 Cellular Respiration: Graphic Organizer, Lab Report
DCI LS2.A: Ecosystems have carrying capacities, which are limits to the numbers of organisms and populations they can support. These limits result from such factors as the availability of living and nonliving resources and from such challenges as predation, competition, and disease. Organisms would have the capacity to produce populations of great size were it not for the fact that environments and resources are finite. This fundamental tension affects the abundance (number of individuals) of species in any given ecosystem. (HS-LS2-1) (HS-LS2-2)

DCI LS2.C: A complex set of interactions within an ecosystem can keep its numbers and types of organisms relatively constant over long periods of time under stable conditions. If a modest biological or physical disturbance to an ecosystem occurs, it may return to its more or less original status (i.e., the ecosystem is resilient), as opposed to becoming a very different ecosystem. Extreme fluctuations in conditions or the size of any population, however, can challenge the functioning of ecosystems in terms of resources and habitat availability. (HS-LS2-2) (HS-LS2-6)

PE LS2-3: Construct and revise an explanation based on evidence for the cycling of matter and flow of energy in aerobic and anaerobic conditions. [Clarification Statement: Emphasis is on conceptual understanding of the role of aerobic and anaerobic respiration in difference environments.] [Assessment Boundary: Assessment does not include the specific chemical processes of either aerobic or anaerobic respiration.]

DCI LS2.B: Photosynthesis and cellular respiration (including anaerobic processes) provide most of the energy for life processes. (HS-LS2-3)

PE LS2-4: Use mathematical representations to support claims for the cycling of matter and flow of energy among organisms in an ecosystem. [Clarification Statement: Emphasis is on using a mathematical model of stored energy in biomass to describe the transfer of energy from one trophic level to another and that matter and energy are conserved as matter cycles and energy flows through ecosystems. Emphasis is on atoms and molecules such as carbon, oxygen, hydrogen...]

- Use graphs to explain what factors affect the carrying capacity of ecosystems.
- Make and use graphical models to explain how different factors affect biodiversity and populations.
- Identify the carrying capacity and what causes these limits.
- Make a model to show how producers use photosynthesis to:
  o convert light energy into stored chemical energy that will then be passed on through the ecosystem (not biochemical steps of photosynthesis)
  o cycle carbon within the biosphere, atmosphere, hydrosphere, geosphere
- Make a model to show how consumers use cellular respiration to:
  o break down food molecules to transfer energy (not steps of cellular respiration)
  o cycle carbon within the biosphere, atmosphere, hydrosphere, geosphere
- Compare and contrast aerobic vs anaerobic respiration, with a focus on purpose of the process and environmental conditions that lead to the process.

PE LS2-5: Use graphs to explain what factors affect the carrying capacity of ecosystems. The carrying capacity is limited by factors such as the availability of living and nonliving resources and from such challenges as predation, competition, and disease. Organisms would have the capacity to produce populations of great size were it not for the fact that environments and resources are finite. This fundamental tension affects the abundance (number of individuals) of species in any given ecosystem. (HS-LS2-1) (HS-LS2-2)

PE LS2-6: Use graphs to explain what factors affect the carrying capacity of ecosystems. The carrying capacity is limited by factors such as the availability of living and nonliving resources and from such challenges as predation, competition, and disease. Organisms would have the capacity to produce populations of great size were it not for the fact that environments and resources are finite. This fundamental tension affects the abundance (number of individuals) of species in any given ecosystem. (HS-LS2-1) (HS-LS2-2)

2-4 Mealworm Lab: Students will plan and carry out an investigation to study the cycling of matter and cellular respiration using mealworms, potatoes, bromothymol blue as a CO2 indicator or Propeware. They will construct an explanation in the form of a lab report for how mass changed within the systems components and explain where the matter transferred to. Students should use graphs or math models to support their data. Within their lab report students will draw a model to show how carbon, water and energy transferred within the system.

2-5 Investigating Population Decline: Students will research a species of concern in Southern California to characterize trends in population changes of that species, the ecological niche of that species, the community interactions of that species, and any threats to that species. Students will produce an annotated bibliography of their research. Students will present an argument to their peers about why their species requires an investment by the community to sustain the population. Students will then use data from presentations by their peers to write an argument about which species of concern should receive the greatest resources for conservation. As a follow-up, students will participate in a Socratic seminar to discuss the needs of the population and propose solutions to maintain maximum biodiversity.

2-6 Cellular Respiration: Through a series of internet searches and readings, students will make a venn diagram comparing and contrasting aerobic and anaerobic respiration, looking at how the matter and energy flow in these two different processes. Then,
and nitrogen being conserved as they move through an ecosystem. [Assessment Boundary: Assessment is limited to proportional reasoning to describe the cycling of matter and flow of energy.]

**DCI LS2.B:** Plants or algae form the lowest level of the food web. At each link upward in a food web, only a small fraction of the matter consumed at the lower level is transferred upward, to produce growth and release energy in cellular respiration at the higher level. Given this inefficiency, there are generally fewer organisms at higher levels of a food web. Some matter reacts to release energy for life functions, some matter is stored in newly made structures, and much is discarded. The chemical elements that make up the molecules of organisms pass through food webs and into and out of the atmosphere and soil, and they are combined and recombined in different ways. At each link in an ecosystem, matter and energy are conserved. (HS-LS2-4)

**PE 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. [Clarification Statement: Examples of changes in ecosystem conditions could include modest biological or physical changes, such as moderate hunting or a seasonal flood; and, extreme changes, such as volcanic eruption or sea level rise.]

**DCI LS2.C:** A complex set of interactions within an ecosystem can keep its numbers and types of organisms relatively constant over long periods of time under stable conditions. If a modest biological or physical disturbance to an ecosystem occurs, it may return to its more or less original status (i.e., the ecosystem is resilient), as opposed to becoming a very different ecosystem. Extreme fluctuations in conditions or the size of any population, however, can challenge the functioning of ecosystems in terms of resources and habitat availability. (HS-LS2-2) (HS-LS2-6)

**PE LS1-5:** Use a model to illustrate how photosynthesis transforms light energy into stored chemical energy. [Clarification Statement: Emphasis is on illustrating inputs and outputs of matter and the transfer and transformation of energy in photosynthesis by plants and other photosynthesizing organisms. Examples of models could include using Mudwatt, students will design and perform an experiment to see what factors affect the production of electricity from organisms living in mud. Students will create an annotated model about the anaerobic process of organisms in the soil and how this can be used to produce electricity. Students will present their findings in the form of a lab report.]
DCI LS1.C: The process of photosynthesis converts light energy to stored chemical energy by converting carbon dioxide plus water into sugars plus released oxygen. (HS-LS1-5)

PE 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. [Clarification Statement: Emphasis is on using evidence from models and simulations to support explanations.] [Assessment Boundary: Assessment does not include specific biochemical steps.]

DCI LS1.C: The sugar molecules thus formed contain carbon, hydrogen and oxygen: their hydrocarbon backbones are used to make amino acids, and other carbon-based molecules that can be assembled into larger molecules (such as proteins or DNA), used for example to form new cells. (LS1-6)

PE 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. [Clarification Statement: Emphasis is on the conceptual understanding of the inputs and outputs of the process of cellular respiration.] [Assessment Boundary: Assessment should not include identification of the steps or specific processes involved in cellular respiration, but is limited to using the published results of scientific computational models.]

DCI LS1.C: As matter and energy flow through different organizational levels of living systems, chemical elements are recombined in different ways to form different products. (HS-LS1-6) (HS-LS1-7)

DCI LS1.C: As a result of these chemical reactions, energy is transferred from one system of interacting molecules to another. Cellular respiration is a chemical process in which the bonds of food molecules and oxygen molecules are broken and new compounds are formed that can transport
energy to muscles. Cellular respiration also releases the energy needed to maintain body temperature despite ongoing energy transfer to the surrounding environment. (HS-LS1-7)

PE 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. [Clarification Statement: Examples of models could include simulations and mathematical models.] [Assessment Boundary: Assessment does not include the specific chemical steps of photosynthesis and respiration.]

DCI PS3.D: The main way that solar energy is captured and stored on Earth is through the complex chemical process known as photosynthesis. (secondary to HS-LS2-5)

DCI LS2.B: Photosynthesis and cellular respiration are important components of the carbon cycle, in which carbon is exchanged among the biosphere, atmosphere, oceans, and geosphere through chemical, physical, geological, and biological processes. (HS-LS2-5)

PE LS2-8: Evaluate the evidence for the role of group behavior on individual and species chances to survive and reproduce. [Clarification Statement: Emphasis is on: (1) distinguishing between group and individual behavior, (2) identifying evidence supporting the outcomes of group behavior, and (3) developing logical and reasonable arguments based on evidence. Examples of group behavior include flocking, schooling, herding and cooperative behaviors such as hunting, migrating and swarming.]

DCI LS2.D: Group behavior has evolved because membership can increase the chances of survival for individuals and their genetic relatives. (HS-LS2-8)

PE ESS2-6: Develop a quantitative model to describe the cycling of carbon among the hydrosphere, atmosphere, geosphere, and biosphere. [Clarification Statement: **The carbon cycle is a property of the Earth system that arises from interactions among the hydrosphere, atmosphere, geosphere, and biosphere. Emphasis is on modeling biogeochemical cycles that include the cycling of carbon**]
through the ocean, atmosphere, soil, and biosphere (including humans), providing the foundation for living organisms.]

**DCI ESS2.D:** Gradual atmospheric changes were due to plants and other organisms that captured carbon dioxide and released oxygen. (HS-ESS2-6) (HS-ESS2-7)

**PE ETS1-2:** Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.

**Scientific and Engineering Practices:**
- Asking questions and Defining problems
- Planning and carrying out investigations
- Engaging in argument from evidence
- Using mathematics and computational thinking
- Developing and Using Models
- Obtaining, evaluating and communicating information
- Analyzing and interpreting data
- Constructing Explanations (science) and Designing Solutions (engineering)

**Crosscutting Concepts:**
- Patterns
- Cause and Effect
- Scale, Proportion and quantity
- Systems and system models
- Energy and Matter
- Structure and Function of Matter
- Stability and Change
Meeting the Needs of ELs:

- Utilize the student information system to acquire the language levels of EUHSD English Learners.
- In 2012, the CA Department of Education adopted new language level proficiency descriptors and new EL state standards. Visit the following website to learn more about those new descriptors and corresponding standards: http://www.cde.ca.gov/sp/el/er/documents/eldstdspublication14.pdf
- In 2014, the CA Department of Education adopted new ELA-ELD Framework, with specific strategies designed to meet the needs of EL students. Visit the following URL to learn more about the new frameworks: http://www.cde.ca.gov/ci rl cf/documents/elaeldfwchapter11.pdf

Unit Resources:

- Probeware (CO2 sensors)
- Computer Access
- Basic Lab Equipment and Materials: seedlings, soil for plants, plan containers, grow lights or green house, digital balances, rulers, BTB, mealworms, potatoes, containers for worms, Mudwatt containers, soil samples

Multimedia Texts:

- http://www.hhmi.org/biointeractive/
- https://www.biologycorner.com/
- https://biomanbio.com/index.html
Biology Scope and Sequence

Unit 3 – Human Environmental Impacts

Length: 3 Weeks

Unit Description: In this unit, students will study how human activity has impacted global ecosystems and how all of these systems are interconnected. They will analyze how human activities affect the cycling of carbon within the hydrosphere, atmosphere, geosphere and biosphere. Students will research how humans can mitigate their impact on the environment while considering societal needs and wants. Students will investigate the causes and effects of global warming.

Essential Question/s:
- How does human activity affect Earth systems and the health and wellbeing of human populations?
- What is the evidence of global warming and climate change?
- What human activity is most responsible for changing the climate of our planet?

PE = Performance Expectations (White)
DCI= Disciplinary Core Ideas
SEP = Scientific & Engineering Practices
CCC = Cross Cutting Concepts

**PE LS2-7:** Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity. * [Clarification Statement: Examples of human activities can include urbanization, building dams, and dissemination of invasive species.]

**DCI LS4.D:** Biodiversity is increased by the formation of new species (speciation) and decreased by the loss of species (extinction). (secondary to HS-LS2-7)

**DCI LS2.C:** Moreover, anthropogenic changes (induced by human activity) in the environment—including habitat destruction, pollution, introduction of invasive species, overexploitation, and climate change—can disrupt an ecosystem and threaten the survival of some species. (HS-LS2-7)

**DCI LS4.D:** Humans depend on the living world for the resources and other benefits provided by biodiversity. But human activity is also having adverse impacts on biodiversity through overpopulation, overexploitation, habitat destruction, pollution, introduction of invasive species, and climate change. Thus sustaining biodiversity so that ecosystem functioning and

Learning Objectives:
Students will be able to...
- Analyze and interpret data regarding human impact on the environment and predict future impacts to Earth’s systems.
- Construct explanations for the impact of human actions and design solutions to mitigate harm to the environment.
- Obtain, evaluate, and communicate data to support a claim that a change to one Earth system affects other Earth systems.
- Develop and use models to describe the cycling of carbon on Earth.
- Plan and conduct experiments to test for causes and effects of global warming.

Key Unit Performance Tasks/Activities:
- **3-1 Invasive Species Research Project:** Students select an invasive species to research and analyze the impact it has on the biodiversity of a particular ecosystem. Using a decision matrix, students will identify the pros and cons for keeping or removing the invasive species. The decision matrix must include how the species impacts both humans and the biodiversity of the ecosystem. Using the decision matrix, students must write an argument whether to keep or remove the invasive species.
- **3-2 Carbon Cycling and Climate Change:** Using data collected from NASA, students will summarize the vital signs of the Earth and how they are changing as a result of climate change. Students will then choose one vital sign and design a solution that can be immediately put into place to mitigate the effects. Students will present through data on the vital sign, how humans are impacting the environment and how changes in the environment are affecting humans.
- **3-3 Global Warming Experiment:** Students will perform an experiment to acquire data to see how global warming occurs. They will then design and perform an experiment to see how abiotic or biotic

Unit Assessments:
- **3-1 Invasive Species Research Project:** Argumentative Paper
- **3-2 Carbon Cycling and Climate Change:** Presentation
- **3-3 Global Warming Experiment:** Lab Report
productivity are maintained is essential to supporting and enhancing life on Earth. Sustaining biodiversity also aids humanity by preserving landscapes of recreational or inspirational value. (HS-LS4-6, secondary to HS-LS2-7)

**DCI ETS1.B:** When evaluating solutions, it is important to take into account a range of constraints, including cost, safety, reliability, and aesthetics, and to consider social, cultural, and environmental impacts. (HS-ETS1-3, secondary to HS-LS2-7, HS-LS4-6, HS-ESS3-2, HS-ESS3-4)

**PE ESS2-6:** Develop a quantitative model to describe the cycling of carbon among the hydrosphere, atmosphere, geosphere, and biosphere. [Clarification Statement: **The carbon cycle is a property of the Earth system that arises from interactions among the hydrosphere, atmosphere, geosphere, and biosphere.** Emphasis is on modeling biogeochemical cycles that include the cycling of carbon through the ocean, atmosphere, soil, and biosphere (including humans), providing the foundation for living organisms.]

**DCI ESS2.D:** Changes in the atmosphere due to human activity have increased carbon dioxide concentrations and thus affect climate. (HS-ESS2-6) (HS-ESS2-4)

**DCI ESS2.D:** Gradual atmospheric changes were due to plants and other organisms that captured carbon dioxide and released oxygen. (HS-ESS2-6) (HS-ESS2-7)

**PE ETS1-1:** Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.

**PE ETS1-2:** Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.

**DCI ETS1.A:** Criteria and constraints also include satisfying any requirements set by society, such as taking issues of risk mitigation factors (e.g., type of soil, presence of plants, water presence, ice, salt water, burning of fossil fuels) within the environment can effect global warming by studying carbon dioxide levels, temperature or other variables. Upon completion, students will write a claim, evidence reasoning about global warming based on their findings.
into account, and they should be quantified to the extent possible and stated in such a way that one can tell if a given design meets them. (HS-ETS1-1, secondary to HS-PS2-3, HS-PS3-3)

**DCI ETS1.A:** Humanity faces major global challenges today, such as the need for supplies of clean water and food or for energy sources that minimize pollution, which can be addressed through engineering. These global challenges also may have manifestations in local communities. (HS-ETS1-1)

**PE ESS2-2:** Analyze geoscience data to make the claim that one change to Earth’s surface can create feedbacks that cause changes to other Earth’s systems. [Clarification Statement: Examples should include climate feedbacks, such as how an increase in greenhouse gases causes a rise in global temperatures that melts glacial ice, which reduces the amount of sunlight reflected from Earth’s surface, increasing surface temperatures and further reducing the amount of ice. Examples could also be taken from other system interactions, such as how the loss of ground vegetation causes an increase in water runoff and soil erosion; how dammed rivers increase groundwater recharge, decrease sediment transport, and increase coastal erosion; or how the loss of wetlands causes a decrease in local humidity that further reduces the wetland extent.]

**DCI ESS2.D:** The foundation for Earth’s global climate systems is the electromagnetic radiation from the sun, as well as its reflection, absorption, storage, and redistribution among the atmosphere, ocean, and land systems, and this energy’s re-radiation into space. (HS-ESS2-2) (HS-ESS2-4)

**DCI ESS2.A:** Earth’s systems, being dynamic and interacting, cause feedback effects that can increase or decrease the original changes. (HS-ESS2-1) (HS-ESS2-2)

**DCI ETS1.B:** When evaluating solutions, it is important to take into account a range of constraints, including cost, safety, reliability, and aesthetics, and to consider social, cultural, and
environmental impacts. (HS-ETS1-3, secondary to HS-LS2-7, HS-LS4-6, HS-ESS3-2, HS-ESS3-4)

PE ESS3-5: Analyze geoscience data and the results from global climate models to make an evidence-based forecast of the current rate of global or regional climate change and associated future impacts to Earth systems. [Clarification Statement: Examples of evidence, for both data and climate model outputs, are for climate changes (such as precipitation and temperature) and their associated impacts (such as on sea level, glacial ice volumes, or atmosphere and ocean composition).] [Assessment Boundary: Assessment is limited to one example of a climate change and its associated impacts.]

DCI ESS3.D: Though the magnitudes of human impacts are greater than they have ever been, so too are human abilities to model, predict, and manage current and future impacts. (HS-ESS3–5)

DCI ESS2.D: Changes in the atmosphere due to human activity have increased carbon dioxide concentrations and thus affect climate. (HS-ESS2-6) (HS-ESS2-4)

DCI ESS2.D: Current models predict that, although future regional climate changes will be complex and varied, average global temperatures will continue to rise. The outcomes predicted by global climate models strongly depend on the amounts of human-generated greenhouse gases added to the atmosphere each year and by the ways in which these gases are absorbed by the ocean and biosphere. (secondary to HS-ESS3-6)

PE 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. [Clarification Statement: Examples of models could include simulations and mathematical models.] [Assessment Boundary: Assessment does not include the specific chemical steps of photosynthesis and respiration.]
**DCI PS3.D:** The main way that solar energy is captured and stored on Earth is through the complex chemical process known as photosynthesis. (secondary to HS-LS2-5)

**DCI LS2.B:** Photosynthesis and cellular respiration are important components of the carbon cycle, in which carbon is exchanged among the biosphere, atmosphere, oceans, and geosphere through chemical, physical, geological, and biological processes. (HS-LS2-5)

**Scientific and Engineering Practices:**
- Asking questions and Defining problems
- Planning and carrying out investigations
- Engaging in argument from evidence
- Using mathematics and computational thinking
- Developing and Using Models
- Obtaining, evaluating and communicating information
- Analyzing and interpreting data
- Constructing Explanations (science) and Designing Solutions (engineering)

**Crosscutting Concepts:**
- Patterns
- Cause and Effect
- Scale, Proportion and quantity
- Systems and system models
- Energy and Matter
- Structure and Function of Matter
- Stability and Change

**Meeting the Needs of ELs:**
- Utilize the student information system to acquire the language levels of EUHSD English Learners.
- In 2012, the CA Department of Education adopted new language level proficiency descriptors and new EL state standards. Visit the following website to learn more about those new descriptors and corresponding standards: [http://www.cde.ca.gov/sp/el/er/documents/eldstndspublication14.pdf](http://www.cde.ca.gov/sp/el/er/documents/eldstndspublication14.pdf)
- In 2014, the CA Department of Education adopted new ELA-ELD Framework, with specific strategies designed to meet the needs of EL students. Visit the following URL to learn more about the new frameworks: [http://www.cde.ca.gov/ci/rl/cf/documents/elaeldfwchapter11.pdf](http://www.cde.ca.gov/ci/rl/cf/documents/elaeldfwchapter11.pdf)

**Unit Resources:**
- Probeware (CO2 monitor, thermometer)
- Computer Access
- Basic Lab Equipment and Materials: beakers and flasks, thermometers, colored paper, saran wrap, plants, soil
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# Biology Scope and Sequence
## Unit 4 – Evolution and Change
### Length: 6 Weeks

**Unit Description:** In this unit, students will research and identify the numerous mechanisms that cause evolution within a population. They will plan and carry out investigations in order to better understand these mechanisms. Students will be able to explain the role that evolution plays on the survival or extinction of a species. Students will be able to communicate the role that humans have on the evolution of living things and will use various lines of evidence to explain how a population evolves.

**Essential Question/s:**
- What are the causes and evidence of evolution?
- What impact do humans have on evolution?
- Why is evolution important to living things?

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<thead>
<tr>
<th>PE = Performance Expectations (White)</th>
<th>DCI = Disciplinary Core Ideas</th>
<th>SEP = Scientific &amp; Engineering Practices</th>
<th>CCC = Cross Cutting Concepts</th>
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<td>PE ESS2-7: Construct an argument based on evidence about the simultaneous coevolution of Earth’s systems and life on Earth. [Clarification Statement: Emphasis is on the dynamic causes, effects, and feedbacks between the biosphere and Earth’s other systems, whereby geoscience factors control the evolution of life, which in turn continuously alters Earth’s surface. Examples include how photosynthetic life altered the atmosphere through the production of oxygen, which in turn increased weathering rates and allowed for the evolution of animal life; how microbial life on land increased the formation of soil, which in turn allowed for the evolution of land plants; or how the evolution of corals created reefs that altered patterns of erosion and deposition along coastlines and provided habitats for the evolution of new life forms.] [Assessment Boundary: Assessment does not include a comprehensive understanding of the mechanisms of how the biosphere interacts with all of Earth’s other systems.]</td>
<td>DCI ESS2.E: The many dynamic and delicate feedbacks between the biosphere and other Earth systems cause continual coevolution of Earth’s surface and the life that exists on it. (HS-ESS2-7)</td>
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### Learning Objectives:
- Students will be able to...
  - Obtain, evaluate, and communicate the importance of the historical background of evolution and the development of evolutionary theory.
  - Plan and carry out investigations involving natural, artificial, and/or sexual selection and its impact on evolution.
  - Develop and use graphical models that demonstrate human impact on evolution.
  - Construct a model/explanation based on evidence that the process of evolution primarily results from four factors.
  - Communicate scientific information that ancestry and biologic evolution are backed by multiple sources of empirical evidence.

### Key Unit Performance Tasks/Activities:
- **4-1 Human Skin Color: Evidence for Selection:** In this activity students will carry out an individual computer-based investigation to determine the relationship between the evolution of skin color and UV radiation. Students use real data to propose hypotheses, make predictions, and justify claims with evidence on how UV radiation and past human migration impacted the evolution of human skin color. Students will utilize information to solve a novel problem about the destruction of the ozone layer leading to an increase in UV radiation. They will then propose an outcome and engage in an argument from evidence about the future of skin color on Earth.
- **4-2 Modeling of Natural Selection:** Students will use a computer model to study the process of natural selection by conducting a predatory/prey simulation. Students will calculate survival percentage rate by phenotype in a population of color variations of “organisms”. Students will graph their data. They will make predictions, based on their results, as to the next generation and what the population will look like. Students will write a claim, evidence reasoning to support their prediction.

### Unit Assessments:
- **4-1 Human Skin Color: Worksheet, CER**
- **4-2 Modeling of Natural Selection: CER**
- **4-3 Evidence of Evolution: Infographic, Presentation**
- **4-4 Investigating Causes of Evolution: CER**
**PE ESS3-1**: Construct an explanation based on evidence for how the availability of natural resources, occurrence of natural hazards, and changes in climate have influenced human activity. [Clarification Statement: Examples of key natural resources include access to fresh water (such as rivers, lakes, and groundwater), regions of fertile soils such as river deltas, and high concentrations of minerals and fossil fuels. Examples of natural hazards can be from interior processes (such as volcanic eruptions and earthquakes), surface processes (such as tsunamis, mass wasting, and soil erosion), and severe weather (such as hurricanes, floods, and droughts). Examples of the results of changes in climate that can affect populations or drive mass migrations include changes to sea level, regional patterns of temperature and precipitation, and the types of crops and livestock that can be raised.]

**DCI ESS3.B**: Natural hazards and other geologic events have shaped the course of human history; [they] have significantly altered the sizes of human populations and have driven human migrations. (HS-ESS3-1)

**PE LS4-6**: Create or revise a simulation to test a solution to mitigate adverse impacts of human activity on biodiversity.^[Clarification Statement: Emphasis is on designing solutions for a proposed problem related to threatened or endangered species, or to genetic variation of organisms for multiple species.]

**DCI LS4.C**: Changes in the physical environment, whether naturally occurring or human induced, have thus contributed to the expansion of some species, the emergence of new distinct species as populations diverge under different conditions, and the decline—sometimes the extinction—of some species. (HS-LS4-5) (HS-LS4-6)

**DCI ETS1.B**: Both physical models and computers can be used in various ways to aid in the engineering design process. Computers are useful for a variety of purposes, such as running simulations to test different ways of solving a problem or to see which one is most efficient or economical; and in making a persuasive presentation.

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**4-3 The Evidence of Evolution**: Students use multiple forms of scientific texts to construct an infographic of the 5 major pieces of evidence for evolution (i.e., biogeography, anatomy, fossils, molecular homology, and embryology). Students are asked to then select one piece of evidence and create a presentation for the class on how the evidence supports evolution.

**4-4 Investigating Causes of Evolution**: Students investigate phenomena that cause evolution through hands on simulations on migration, natural selection, mutation, and gene flow. In each simulation, students will make predictions on how the phenotype of a population might change due to the phenomenon. Students create mathematical models of the simulation results and compare them with real world data. Students write an argument for whether or not the simulation makes sense using the comparison as supporting evidence.
to a client about how a given design will meet his or her needs.

**DCI LS4.D:** Humans depend on the living world for the resources and other benefits provided by biodiversity. But human activity is also having adverse impacts on biodiversity through overpopulation, overexploitation, habitat destruction, pollution, introduction of invasive species, and climate change. Thus sustaining biodiversity so that ecosystem functioning and productivity are maintained is essential to supporting and enhancing life on Earth. Sustaining biodiversity also aids humanity by preserving landscapes of recreational or inspirational value. (HS-LS4-6, secondary to HS-LS2-7)

**PE LS4-4:** Construct an explanation based on evidence for how natural selection leads to adaptation of populations. [Clarification Statement: Emphasis is on using data to provide evidence for how specific biotic and abiotic differences in ecosystems (such as ranges of seasonal temperature, long-term climate change, acidity, light, geographic barriers, or evolution of other organisms) contribute to a change in gene frequency over time, leading to adaptation of populations.]

**DCI LS4.C:** Natural selection leads to adaptation, that is, to a population dominated by organisms that are anatomically, behaviorally, and physiologically well suited to survive and reproduce in a specific environment. That is, the differential survival and reproduction of organisms in a population that have an advantageous heritable trait leads to an increase in the proportion of individuals in future generations that have the trait and to a decrease in the proportion of individuals that do not. (HS-LS4-3) (HS-LS4-4)

**PE 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. [Clarification Statement: Emphasis is on analyzing shifts in numerical distribution of traits and using these shifts as evidence to support explanations.] [Assessment
Boundary: Assessment is limited to basic statistical and graphical analysis. Assessment does not include allele frequency calculations.

**DCI LS4.C:** Adaptation also means that the distribution of traits in a population can change when conditions change. (HS-LS4-3)

**DCI LS4.B:** The traits that positively affect survival are more likely to be reproduced, and thus are more common in the population. (HS-LS4-3)

**DCI LS4.B:** Natural selection occurs only if there is both (1) variation in the genetic information between organisms in a population and (2) variation in the expression of that genetic information—that is, trait variation—that leads to differences in performance among individuals. (HS-LS4-2) (HS-LS4-3)

**PE 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. [Clarification Statement: Emphasis is on determining cause and effect relationships for how changes to the environment such as deforestation, fishing, application of fertilizers, drought, flood, and the rate of change of the environment affect distribution or disappearance of traits in species.]

**DCI LS4.C:** Species become extinct because they can no longer survive and reproduce in their altered environment. If members cannot adjust to change that is too fast or drastic, the opportunity for the species' evolution is lost. (HS-LS4-5)

**PE 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. [Clarification Statement: Emphasis is on using evidence to explain the influence each of the four factors has on number of organisms, behaviors, morphology, or physiology in terms of ability to compete for limited resources and subsequent survival of individuals and adaptation of species. Examples of evidence could include mathematical models such as simple distribution graphs and proportional reasoning.] [Assessment Boundary: Assessment does not include other mechanisms of evolution, such as genetic drift, gene flow through migration, and co-evolution.]

**DCI LS4.C:** Evolution is a consequence of the interaction of four factors: (1) the potential for a species to increase in number, (2) the genetic variation of individuals in a species due to mutation and sexual reproduction, (3) competition for an environment’s limited supply of the resources that individuals need in order to survive and reproduce, and (4) the ensuing proliferation of those organisms that are better able to survive and reproduce in that environment. (HS-LS4-2)

**PE LS4-1:** Communicate scientific information that common ancestry and biological evolution are supported by multiple lines of empirical evidence. [Clarification Statement: Emphasis is on a conceptual understanding of the role each line of evidence has relating to common ancestry and biological evolution. Examples of evidence could include similarities in DNA sequences, anatomical structures, and order of appearance of structures in embryological development.]

**DCI LS4.A:** Genetic information provides evidence of evolution. DNA sequences vary among species, but there are many overlaps; in fact, the ongoing branching that produces multiple lines of descent can be inferred by comparing the DNA sequences of different organisms. Such information is also derivable from the similarities and differences in amino acid sequences and from anatomical and embryological evidence. (HS-LS4-1)
### Scientific and Engineering Practices:
- Asking questions and Defining problems
- Planning and carrying out investigations
- Engaging in argument from evidence
- Using mathematics and computational thinking
- Developing and Using Models
- Obtaining, evaluating and communicating information
- Analyzing and interpreting data
- Constructing Explanations (science) and Designing Solutions (engineering)

### Crosscutting Concepts:
- Patterns
- Cause and Effect
- Scale, Proportion and Quantity
- Systems and System models
- Energy and Matter
- Structure and Function of Matter
- Stability and Change

### Meeting the Needs of ELs:
- Utilize the student information system to acquire the language levels of EUHSD English Learners.
- In 2012, the CA Department of Education adopted new language level proficiency descriptors and new EL state standards. Visit the following website to learn more about those new descriptors and corresponding standards: [http://www.cde.ca.gov/sp/el/er/documents/eldstndspublication14.pdf](http://www.cde.ca.gov/sp/el/er/documents/eldstndspublication14.pdf)
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### Unit Resources:
- Computer Access
- Basic Lab Equipment and Materials: rulers, timers, candy (M&Ms) or cereal (fruit loops) or other food product with multiple color but same shape, tweezers

### Multimedia Texts:
- [http://www.hhmi.org/biointeractive/](http://www.hhmi.org/biointeractive/)
- [https://www.biologycorner.com/](https://www.biologycorner.com/)
- [https://biomanbio.com/index.html](https://biomanbio.com/index.html)
**Biology Scope and Sequence**

**Unit 5 – Genetics and Heredity**

**Length:** 7-8 Weeks

**Unit Description:** Within this unit, students will investigate the mechanisms for inheritance of genetic traits. Students will learn how the structure of DNA determines the structure of proteins. This begins with developing a model for the Central Dogma and how it impacts traits for living organisms. Next, students investigate the possible changes to genes from the environment and how they impact the function of proteins at the cellular level. Students will explore how genetic variation occurs through meiosis and mutation. Last, genetic technologies for humans are evaluated based on their social, cultural, and environmental impacts.

**Essential Question/s:**
- What role does DNA play in evolution?
- What impact does the environment have on the genes of an organism?
- Why is DNA important?
- How do organisms get their DNA?

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**PE = Performance Expectations (White)**

**DCI = Disciplinary Core Ideas**

**SEP = Scientific & Engineering Practices**

**CCC = Cross Cutting Concepts**

**PE 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. [Assessment Boundary: Assessment does not include identification of specific cell or tissue types, whole body systems, specific protein structures and functions, or the biochemistry of protein synthesis.]

**LS1-A:** All cells contain genetic information in the form of DNA molecules. Genes are regions in the DNA that contain the instructions that code for the formation of proteins, which carry out most of the work of cells. (HS-LS1-1, secondary to HS-LS3-1) (Note: This Disciplinary Core Idea is also addressed by HS-LS3-1)

**PE LS1-4:** Use a model to illustrate the role of cellular division (mitosis) and differentiation in producing and maintaining complex organisms. [Assessment Boundary: Assessment does not include the specific gene control mechanisms or rote memorization of the steps of mitosis.]

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**Learning Objectives:**

Students will be able to…
- Describe how the structure of DNA determines the structure of proteins.
- Explain the purpose of DNA and proteins for living organisms.
- Formulate testable questions on the cause and effect of relationships between DNA, proteins, and the resulting traits in an organism.
- Explain the purpose of mitosis and meiosis in organisms.
- Construct an explanation on the idea that regions of DNA called genes can be regulated in multiple ways, which carry out the essential functions of life through systems of specialized cells.
- Use a model of cellular division to describe the genetic relationship between parent and daughter cells.
- Use Punnett Squares as a computational model to make a

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**Key Unit Performance Tasks/Activities:**

- **5-1 The Cell Cycle:** Students will use a model to compare and contrast mitosis and meiosis. Students will explain the purpose of each process and what would happen to an organism if either of these processes broke down or failed to work. Students explain the consequences if meiosis or mitosis does not work for a population in a Socratic discussion.
- **5-2 Genotypes and Phenotypes (Punnett Squares)**
  Teacher develops a scenario in which an offspring is not from the union of two suspected parents. The offspring is homozygous recessive for a trait. One parent should be homozygous dominant for that trait, and one homozygous recessive. In this example, the genotype and phenotypes of a set of parents and the phenotype of a suspected offspring are presented to students. Students then create a Punnett square, calculate phenotypic and genotypic probabilities, and use this information to argue that the baby could not be from the union of the two parents. Students will then perform an experiment to look at the genetic diversity within the classroom of known phenotypic characteristics. They will collect and graph the data to

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**Unit Assessments:**

- **5-1 Cell Cycle:** Model, CER, Socratic Discussion
- **5-2 Genotypes and Phenotypes: CER, Lab Report**
- **5-3 Sex, Mistakes and Proteins: Argumentative Paper**
- **5-4 Central Dogma: Model and CER**
- **5-5 Genetic Engineering: Research Paper**
- **5-6 Paternity Test: Lab Report**
**DCI LS1.B:** In multicellular organisms individual cells grow and then divide via a process called mitosis, thereby allowing the organism to grow. The organism begins as a single cell (fertilized egg) that divides successively to produce many cells, with each parent cell passing identical genetic material (two variants of each chromosome pair) to both daughter cells. Cellular division and differentiation produce and maintain a complex organism, composed of systems of tissues and organs that work together to meet the needs of the whole organism. (HS-LS1-4)

**PE 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. [Assessment Boundary: Assessment does not include the phases of meiosis or the biochemical mechanism of specific steps in the process.]

**DCI LS3.A:** Each chromosome consists of a single very long DNA molecule, and each gene on the chromosome is a particular segment of that DNA. The instructions for forming species’ characteristics are carried in DNA. All cells in an organism have the same genetic content, but the genes used (expressed) by the cell may be regulated in different ways. Not all DNA codes for a protein; some segments of DNA are involved in regulatory or structural functions, and some have no as-yet known function. (HS-LS3-1)

**PE 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. [Clarification Statement: Emphasis is on using data to support arguments for the way variation occurs.] [Assessment Boundary: Assessment does not include the phases of meiosis or the biochemical mechanism of specific steps in the process.]

**DCI LS3.B:** In sexual reproduction, chromosomes can sometimes swap sections during the process of meiosis (cell division), thereby creating new genetic combinations and thus more genetic variation. Although DNA replication is tightly regulated and remarkably predictable, errors can occur during meiosis that result in offspring with different combinations of genetic material.

- Students use reasoning and valid evidence to describe that new combinations of DNA can arise from several sources, including errors during replication, and mutations caused by environmental factors.
- Students perform and use appropriate statistical analyses of data, including probability measures, to determine the relationship between a trait’s occurrence within a population and environmental factors.
- **5-3 Sex, Mistakes and Poison (the Environment):** Students choose an observable or potentially observable genetic change such as: genetic disease, phenotype resulting from a mutation: albinism, captive breeding of endangered species, human loss of wisdom teeth, cliff swallow wing span reduction, inability of bulldogs to give birth naturally. Students conduct research on this genetic change and write an argument as to whether it was the result of sexual reproduction, genetic mutation, or environmental factors.

- **5-4 Central Dogma:** Using the central dogma, students will transcribe and translate the genome of a make-believe organisms in order to determine the genotype and phenotype of the creature. They will then create a visual representation of the organism and answer a series of questions using what they discovered about the genetics of the organism.

- **5-5 Genetic Engineering: Is it worth it?** Students choose an example of a biotechnology (e.g., gene sequencing, gene therapy, gene conversion, siRNA, etc.) and conduct text based research into the current uses/solutions/procedures associated with that technology. Next, students evaluate the technology and its effectiveness at addressing the human problem it is being used to solve. This evaluation must include: cost, safety, reliability, aesthetics, as well as possible social, cultural, and environmental impacts. The evaluation is communicated in a written report or as an information that is designed to reach an audience that is not familiar with the technology.
accurate, errors do occur and result in mutations, which are also a source of genetic variation. Environmental factors can also cause mutations in genes, and viable mutations are inherited. (HS-LS3-2)

**PE LS3-3:** Apply concepts of statistics and probability to explain the variation and distribution of expressed traits in a population. [Clarification Statement: Emphasis is on the use of mathematics to describe the probability of traits as it relates to genetic and environmental factors in the expression of traits.] [Assessment Boundary: Assessment does not include Hardy-Weinberg calculations.]

**DCI LS3-B:** Environmental factors also affect expression of traits, and hence affect the probability of occurrences of traits in a population. Thus the variation and distribution of traits observed depends on both genetic and environmental factors. (HS-LS3-2)

**PE ETS1-3:** Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts.

**DCI ETS1-B:** When evaluating solutions, it is important to take into account a range of constraints, including cost, safety, reliability, and aesthetics, and to consider social, cultural, and environmental impacts. (HS-ETS1-3, secondary to HS-LS2-7, HS-LS4-6, HS-ESS3-2, HS-ESS3-4)

**Scientific and Engineering Practices:**

- Engaging in argument from evidence
- Obtaining, evaluating and communicating information
- Using mathematics and computational thinking
- Developing and Using Models
- Asking questions (science) and defining problems (engineering)
- Analyzing and interpreting data
- Plan and carrying out investigations

**5-6 DNA Extraction and Electrophoresis:** Students will extract DNA from a provided item (strawberry or other fruit) in order to experience the basic process of DNA extraction. They will analyze how the structure of DNA is important to the individuality of a person. Using electrophoresis, students will analyze the DNA bands to easily identify which one’s match. Students will be able to explain the role of DNA, restriction enzymes, DNA inheritance, and electrophoresis. Students will write a claim with supporting evidence as to who matches the DNA bands.
### Cross Cutting Concepts:
- Patterns
- Structure and Function
- Cause and Effect: Mechanism and Explanation
- Scale, proportion and quantity
- System and system models

### Meeting the Needs of ELs:
- Utilize the student information system to acquire the language levels of EUHSD English Learners.
- In 2012, the CA Department of Education adopted new language level proficiency descriptors and new EL state standards. Visit the following website to learn more about those new descriptors and corresponding standards: [http://www.cde.ca.gov/sp/el/er/documents/eldstndspublication14.pdf](http://www.cde.ca.gov/sp/el/er/documents/eldstndspublication14.pdf)
- In 2014, the CA Department of Education adopted new ELA-ELD Framework, with specific strategies designed to meet the needs of EL students. Visit the following URL to learn more about the new frameworks: [http://www.cde.ca.gov/ci/rl/cf/documents/elaeldfwchapter11.pdf](http://www.cde.ca.gov/ci/rl/cf/documents/elaeldfwchapter11.pdf)

### Unit Resources:
- Computer Access
- Basic Lab Equipment and Materials: PTC paper, gel boxes, pipettes, DNA test kid, power source for gel boxes

### Multimedia Texts:
- [http://www.hhmi.org/biointeractive/](http://www.hhmi.org/biointeractive/)
- [https://www.biologycorner.com/](https://www.biologycorner.com/)
- [https://biomanbio.com/index.html](https://biomanbio.com/index.html)
- [http://learn.genetics.utah.edu/content/labs/gel/](http://learn.genetics.utah.edu/content/labs/gel/)