FOLSOM CORDOVA UNIFIED SCHOOL DISTRICT

HONORS BIOLOGY: THE LIVING EARTH

Date: March 2018
Proposed Grade Level(s): 9th
Grading: A-F

Course Length: 2 Semesters
Subject Area: Science
Credits: 5 per Semester

Prerequisite(s): Concurrent enrollment in Integrated Math 1 or higher. Grade of B or better in previous science course, and/or student i-Ready minimum scaled scores of 605 in Reading, and 515 in Math, and/or teacher recommendation.
Intent to Pursue ‘A-G’ College Prep Status: Yes
A-G Course Identifier: D - Laboratory science

COURSE DESCRIPTION:

This course is designed to prepare students for success in upper level advanced college level science courses. The course is based on the CA Next Generation Science Standards and includes the Disciplinary Core Ideas related to Life Science and integrates a selection of the Earth and Space Science concepts. This course also incorporates the eight Science and Engineering Practices and seven Crosscutting Concepts related to the NGSS. Students taking Honors Biology will explore amplified and enriched Biology concepts related, but not limited to: the interactions within ecosystems, energy dynamics, photosynthesis and cellular respiration, history of the earth’s atmosphere, natural selection, inheritance of traits, structure and function of organisms, system stability and response to change. Elements of critical thinking are required of students throughout the course.

COURSE GOALS:

- Students will explore the interconnected nature of science by engaging in the Science and Engineering Practices and applying the Crosscutting Concepts to explore the Disciplinary Core Ideas of Biology.
- Students will grow in scientific literacy and mathematical reasoning through alignment of science content with Common Core Standards for Literacy in Science and Technical Subjects and CCSS.
- Students will develop a deeper understanding of biology to prepare for college, careers, and citizenship.
- Students will expand upon biological concepts in order to prepare for upper-level advance science courses (AP/IB).

DETAILED UNITS OF INSTRUCTION:

Unit: Science Skills & Engineering Practices

Guiding Questions:
1. How do scientists and engineers differ in their approach to their work?
2. What skills are necessary to be a scientist or an engineer?

Topics/Skills:
- Safety
- Scientific Inquiry Process
- System and System Models
- Precision/Accuracy
• Graphing
• Analyzing raw data
• Communicating in Science through Claim, Evidence and Reasoning

**Unit: Ecosystems Interactions and Energy**

**Guiding Questions:**
1. What factors affect the size of populations within an ecosystem?
2. What are common threats to remaining natural ecosystems and biodiversity?
3. How can these threats be reduced?

**Topics/Skills:**
- Energy flow and matter cycling in systems
- Factors that affect carrying capacity of ecosystems
- Biodiversity
- Population dynamics
- Behavior and individual and species’ survival and reproduction

**Unit: Photosynthesis, Respiration and the History of Earth’s Atmosphere**

**Guiding Questions:**
1. How does the structure of plants enhance their ability to produce food?
2. How do living things acquire energy and matter for life?
3. How do organisms store energy?
4. How are photosynthesis and cellular respiration connected?
5. How do organisms use the raw materials they ingest from the environment?
6. How has the cycling of energy and matter changed over Earth’s history?

**Topics/Skills:**
- Structure/Function of Leaves/Plants
  - Example of how structure relates to function: stomata
- Cross section of leaf and identification of critical parts
- Photosynthesis: transformation of light energy to chemical energy
  - Sources of energy:
    - Light
    - Bonds breaking
    - Bonds forming
    - Chemical energy
  - Discussion of detailed biochemical pathways:
    - Light-dependent reactions - Photosystems I and II
    - Light-independent reactions or Calvin cycle
- Synthesis of carbon-based macromolecules
  - Discussion of carbon based molecules as source of energy
    - Carbohydrates/Sugars – contain carbon, hydrogen, oxygen atoms
    - Amino acids – largely composed of carbon, oxygen and hydrogen atoms
    - Enzymes
- Cellular Respiration and energy transfers from breaking and forming chemical bonds

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Discussion of detailed biochemical pathways: Glycolysis, Krebs cycle and Electron Transport Chain.

- Cycling of matter and flow of energy in aerobic and anaerobic conditions
- Model the carbon cycle and the role of photosynthesis and cellular respiration
- Environmental conditions that support ecosystem stability and change
- Coevolution of Earth’s systems and life on Earth

Unit: Evidence for Evolution

Guiding Questions:
1. How do we know how the earth was formed and it’s early history?
2. How do layers of rock form and how do they contain fossils?
3. Across the world, why do we see similar fossils, but living organisms that are very different from each other?
4. What evidence shows that different species are related?

Topics/Skills:
- Plate tectonics as a way of explaining the age of crustal rocks
  - Evaluating evidence of past and current movement of continental and oceanic crust
- Earth’s formation and early history
  - Using evidence from:
    - Radiometric dating of:
      - Earth materials
      - Meteorites
    - Craters
    - Composition of solar system objects
    - Activity of plate tectonic processes and surface process (i.e. volcanism and erosion)
- Properties of water and effects on life and Earth systems
  - Including: polarity, heat capacity, density
  - Mechanical and chemical processes
- Connections between the hydrological and rock cycle
- Empirical evidence supporting common ancestry and biological evolution
- Natural selection depends on:
  - Potential for species to increase in number
  - Heritable genetic variation
  - Competition for limited resources
  - Increase in organisms that are better able to survive and reproduce
- Natural selection and adaptation
  - Organisms with advantageous traits tend to increase in proportion compared to organisms lacking this trait
- Impacts of changes in environmental conditions
  - Increase individuals in a species
  - Emergence of new species
  - Extinction of species
Unit: Inheritance of Traits

Guiding Questions:
1. How are characteristics of one generation passed to the next?
2. What allows traits to be transmitted from parents to offspring?
3. How does variation affect a population under selective pressures?

Topics/Skills:
- DNA and chromosomes and traits passed from parent to offspring
  - Cell Cycle
  - Steps of Mitosis
- Inheritable genetic variation may result from:
  - New genetic combinations through meiosis
    - Discuss steps of meiosis
  - Mutations
    - as viable errors during replication
    - environmental factors (i.e. ultraviolet light exposure)
- Statistics and probability – variation and distribution of expressed traits in a population
  - Using punnett squares to predict outcomes of single/two-trait, multiple allele, co-dominance, and sex-linked traits
- Pedigrees and how they can be used to show how traits are inherited within a family
- Genetic role in natural selection and adaptation

Unit: Structure, Function, and Growth from Cells to Organisms

Guiding Questions:
1. What happens if a cell in our body dies?
2. How does the structure of DNA affect how cells look and behave?
3. How do systems work in a multi-celled organism and what happens if there is a change in the system?
4. How do organisms survive even when there are changes in their environment?

Topics/Skills:
- Structure of DNA determines structure of proteins
  - DNA found in nucleus of eukaryotic cells; cytoplasm of prokaryotic cells
  - Genes are regions in DNA
    - Genes code for Proteins
- Protein structure determines function (enzymes)
  - Proteins carry out functions that are essential to the organism
  - Proteins carry out essential life functions through systems of specialized cells
  - Gene sequence affects protein function
- Hierarchical organization of interacting systems provide specific functions in multicellular organisms
  - Review of cells and cell parts
  - Transport of materials in and out of cells
  - Discussion of at least two body systems and how they relate to the overall function of an organism (i.e. Digestive, Nervous, Immune, Skeletal etc.)
- Feedback mechanisms maintain homeostasis
Examples include regulating: body temperature, blood sugar, heart rate etc.

- Role of cellular division and differentiation in producing and maintaining complex organisms
  - Mitosis

**Unit: Ecosystem Stability and Response to Climate Change**

*Guiding Questions:*

1. *What effects changes in ecosystems that ultimately effect populations?*
2. *What are the changes that are happening in the climate and what effects are those having on life?*
3. *How are human activities impacting Earth’s systems and how does that affect life on Earth?*
4. *What can humans do to mitigate their negative impact on the environment?*

**Topics/Skills:**

- Ecosystem response to changing conditions
- Human impact on environmental conditions and biodiversity
- Availability of natural resources, occurrence of natural hazards and changes in climate influence human activity
- Designing solutions to reduce impact of human activities on natural systems
- Evaluate solutions for developing, managing, and utilizing energy and mineral resources based on cost-benefit ratios (i.e. recycling, reusing resources)
- Changing conditions and rates of speciation and extinction
- Global climate models, climate change, and future impacts on Earth systems
- Engineering processes and environmental problem management

All units will engage students in the following Science and Engineering Practices and Cross Cutting Concepts:

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<thead>
<tr>
<th>Science and Engineering Practices:</th>
<th>Cross Cutting Concepts</th>
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<tbody>
<tr>
<td>1. Asking questions and defining problems.</td>
<td>1. Patterns</td>
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<td>2. Developing and using models.</td>
<td>2. Cause and Effect</td>
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<td>3. Planning and carrying out investigations.</td>
<td>3. Scale, proportion, and quality</td>
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<td>4. Analyzing and interpreting data.</td>
<td>4. System and system models</td>
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<td>5. Mathematics and computational thinking.</td>
<td>5. Energy and matter</td>
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<td>6. Constructing explanations and designing solutions.</td>
<td>6. Structure and function</td>
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<td>7. Engaging in argument from evidence.</td>
<td>7. Stability and change</td>
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<td>8. Obtaining, evaluating, and communicating information.</td>
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**TEXTBOOKS AND RESOURCE MATERIALS:**

**Textbook** (*Tentative until formal adoption in Fall 2019*)


**Resource Materials**

None at this time
SUBJECT AREA CONTENT STANDARDS TO BE ADDRESSED:

Next Generation Science Standards

Life Science

- HS-LS1-1. Construct an explanation based on evidence for how the structure of DNA determines the structure of proteins which carry out the essential functions of life through systems of specialized cells.
- HS-LS1-2. Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms.
- HS-LS1-3. Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis.
- HS-LS1-4. Use a model to illustrate the role of cellular division (mitosis) and differentiation in producing and maintaining complex organisms.
- HS-LS1-5. Use a model to illustrate how photosynthesis transforms light energy into stored chemical energy.
- HS-LS1-6. Construct and revise an explanation based on evidence for how carbon, hydrogen, and oxygen from sugar molecules may combine with other elements to form amino acids and/or other large carbon based molecules.
- HS-LS1-7. Use a model to illustrate that cellular respiration is a chemical process whereby the bonds of food molecules and oxygen molecules are broken and the bonds in new compounds are formed resulting in a net transfer of energy.
- HS-LS2-1. Use mathematical and/or computational representations to support explanations of factors that affect carrying capacity of ecosystems at different scales.
- HS-LS2-2. Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales.
- HS-LS2-3. Construct and revise an explanation based on evidence for the cycling of matter and flow of energy in aerobic and anaerobic conditions.
- HS-LS2-4. Use mathematical representations to support claims for the cycling of matter and flow of energy among organisms in an ecosystem.
- HS-LS2-5. Develop a model to illustrate the role of photosynthesis and cellular respiration in the cycling of carbon among the biosphere, atmosphere, hydrosphere, and geosphere.
- HS-LS2-6. Evaluate the claims, evidence, and reasoning that the complex interactions in ecosystems maintain relatively consistent numbers and types of organisms in stable conditions, but changing conditions may result in a new ecosystem.
- HS-LS2-8. Evaluate the evidence for the role of group behavior on individual and species’ chances to survive and reproduce.
- HS-LS3-1. Ask questions to clarify relationships about the role of DNA and chromosomes in coding the instructions for characteristic traits passed from parents to offspring.
- HS-LS3-2. Make and defend a claim based on evidence that inheritable genetic variations may result from: (1) new genetic combinations through meiosis, (2) viable errors occurring during replication, and/or (3) mutations caused by environmental factors.
- HS-LS3-3. Apply concepts of statistics and probability to explain the variation and distribution of expressed traits in a population.
- HS-LS4-1. Communicate scientific information that common ancestry and biological evolution are supported by multiple lines of empirical evidence.
• HS-LS4-2. Construct an explanation based on evidence that the process of evolution primarily results from four factors: (1) the potential for a species to increase in number, (2) the heritable genetic variation of individuals in a species due to mutation and sexual reproduction, (3) competition for limited resources, and (4) the proliferation of those organisms that are better able to survive and reproduce in the environment.

• HS-LS4-3. Apply concepts of statistics and probability to support explanations that organisms with an advantageous heritable trait tend to increase in proportion to organisms lacking this trait.

• HS-LS4-4. Construct an explanation based on evidence for how natural selection leads to adaptation of populations.

• HS-LS4-5. Evaluate the evidence supporting claims that changes in environmental conditions may result in: (1) increases in the number of individuals of some species, (2) the emergence of new species over time, and (3) the extinction of other species.

• HS-LS4-6. Create or revise a simulation to test a solution to mitigate adverse impacts of human activity on biodiversity.

**Earth and Space Science**

• HS-ESS2-6. Develop a quantitative model to describe the cycling of carbon among the hydrosphere, atmosphere, geosphere, and biosphere.

• HS-ESS2-7. Construct an argument based on evidence about the simultaneous coevolution of Earth’s systems and life on Earth.

• HS-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.

• HS-ESS3-4. Evaluate or refine a technological solution that reduces impacts of human activities on natural systems.

• HS-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’s systems.

• HS-ESS3-6. Use a computational representation to illustrate the relationships among Earth systems and how those relationships are being modified due to human activity.

**COMMON CORE STATE STANDARDS:**

**Reading Standards for Literacy in Science & Technical Subjects (9th-10th)**

**Key Ideas & Details**
1. Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions.
2. Determine the central ideas or conclusions of a text; trace the text's explanation or depiction of a complex process, phenomenon, or concept; provide an accurate summary of the text.
3. Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text.

**Craft & Structure**
4. Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 9-10 texts and topics.
5. Analyze the structure of the relationships among concepts in a text, including relationships among key terms (e.g., force, friction, reaction force, energy).
6. Analyze the author's purpose in providing an explanation, describing a procedure, or discussing an experiment in a text, defining the question the author seeks to address.
Integration of Knowledge & Ideas
7. Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words.
8. Assess the extent to which the reasoning and evidence in a text support the author's claim or a recommendation for solving a scientific or technical problem.
9. Compare and contrast findings presented in a text to those from other sources (including their own experiments), noting when the findings support or contradict previous explanations or accounts.

Reading Range / Text Complexity
10. By the end of grade 10, read and comprehend science/technical texts in the grades 9-10 text complexity band independently and proficiently.

Writing Standards for Literacy in Science & Technical Subjects (Grades 9-10)

Text Types and Purposes
1. Write arguments focused on discipline-specific content.
   a. Introduce precise claim(s), distinguish the claim(s) from alternate or opposing claims, and create an organization that establishes clear relationships among the claim(s), counterclaims, reasons, and evidence.
   b. Develop claim(s) and counterclaims fairly, supplying data and evidence for each while pointing out the strengths and limitations of both claim(s) and counterclaims in a discipline-appropriate form and in a manner that anticipates the audience’s knowledge level and concerns.
   c. Use words, phrases and clauses to link the major sections of the text, create cohesion, and clarify the relationships between claim(s) and reasons, between reasons and evidence, and between claim(s) and counterclaims.
   d. Establish and maintain a formal style and objective tone while attending to the norms and conventions of the discipline in which they are writing.
   e. Provide a concluding statement or section that follows from or supports the argument presented.
2. Write informative/explanatory texts, including the narration of scientific procedures/experiments, or technical processes.
   a. Introduce a topic and organize ideas, concepts and information to make important connections and distinctions; include formatting (e.g., headings), graphics (e.g., figures, tables), and multimedia when useful to aiding comprehension.
   b. Develop the topic with well-chosen, relevant, and sufficient facts, extended definitions, concrete details, quotations, or other information and example appropriate to the audience’s knowledge of the topic.
   c. Use varied transitions and sentence structures to link the major sections of the text, create cohesion, and clarify the relationships among ideas and concepts.
   d. Use precise language and domain-specific vocabulary to manage the complexity of the topic and convey a style appropriate to the discipline and context as well as to the expertise of likely readers.
   e. Establish and maintain a formal style and objective tone while attending to the norms and conventions of the discipline in which they are writing.
   f. Provide a concluding statement or section that follows from and supports the information or explanation presented (e.g., articulating implications or the significance of the topic).

Production and Distribution of Writing
4. Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.
5. Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on addressing what is most significant for a specified purpose and audience.

6. Use technology, including the Internet, to produce, publish, and update individual or shared writing products, taking advantage of technology’s capacity to link to other information and to display information flexibly and dynamically.

**Research to Build and Present Knowledge**

7. Conduct short as well as more sustained research projects to answer a question (including a self-generated question), or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.

8. Gather relevant information from multiple print and digital sources (primary and secondary), using advanced searches effectively; assess the usefulness of each source in answering the research question; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and following a standard format for citation.

9. Draw evidence from informational texts to support analysis, reflection, and research.

**Range of Writing**

10. Write routinely over extended time frames (time for reflection and revision) and shorter time frames (a single sitting or a day or two) for a range of discipline-specific tasks, purposes, and audiences.

**Speaking and Listening Anchor Standards (Grades 9-10)**

**Comprehension and Collaboration**

1. Initiate and participate effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grades 9–10 topics, texts, and issues, building on others’ ideas and expressing their own clearly and persuasively.
   a. Come to discussions prepared having read and researched material under study; explicitly draw on that preparation by referring to evidence from texts and other research on the topic or issue to stimulate a thoughtful, well-reasoned exchange of ideas.
   b. Work with peers to set rules for collegial discussions and decision-making (e.g., informal consensus, taking votes on key issues, and presentation of alternate views), clear goals and deadlines, and individual roles as needed.
   c. Propel conversations by posing and responding to questions that relate the current discussion to broader themes or larger ideas; actively incorporate others into the discussion; and clarify, verify, or challenge ideas and conclusions.
   d. Respond thoughtfully to diverse perspectives, summarize points of agreement and disagreement, and, when warranted, qualify or justify their own views and understanding and make new connections in light of the evidence and reasoning presented.

2. Integrate and evaluate information presented in diverse media and formats, including visually, quantitatively, and orally.

3. Evaluate a speaker's point of view, reasoning, and use of evidence and rhetoric.

**Presentation of Knowledge and Ideas**

4. Present information, findings, and supporting evidence such that listeners can follow the line of reasoning and ensure that the organization, development, and style are appropriate to task, purpose, and audience.
   a. Plan and deliver an information/explanatory presentation that: presents evidence in support of a thesis, conveys information from primary and secondary sources coherently, uses domain specific vocabulary, and provides a conclusion that summarizes the main points.
b. Plan, memorize, and present a recitation (e.g., poem, selection from a speech or dramatic soliloquy) that conveys the meaning of the selection and includes appropriate performance techniques (e.g., tone, rate, voice modulation) to achieve the desired aesthetic effect.

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

6. Adapt speech to a variety of contexts and communicative tasks, demonstrating command of formal English when indicated or appropriate.

DISTRICT ESLRS TO BE ADDRESSED:

Students will be:

- **Self-Directed Learners:** Students will be expected to take responsibility for their learning by participating in class activities, labs, and discussions.
- **Effective Communicators:** Students will actively participate in class discussions on a regular basis. Students will be expected to interpret and communicate laboratory data.
- **Constructive Thinkers:** Students will participate in many hands-on activities and labs that require them to analyze their results, think critically and apply what they have learned to new situations. Students will develop models that explain various phenomena explored in the course.
- **Collaborative Workers:** Students will participate in cooperative groups for laboratory assignments and in class activities. They will be expected to collaborate with each other in developing class concepts.
- **Quality Producers/Performers:** Assessment of class work requires students to be quality producers in order to be successful in class. Students will be expected to produce quality reports demonstrating their organization, analysis and understanding of concepts in class and laboratory.
- **Responsible Citizens:** will use their science content knowledge and scientific inquiry to make informed decisions about issues related to science, the world around them, and their daily lives.