La Cañada High School

Proposed Course Outline – The Living Earth

I. Course Title – 'The Living Earth' (NGSS Biology)

II. Grade Level(s) – Grade 11

III. Length/Credit – 1 Year - 10.0 units Satisfies One Year of Science for Graduation Credit

IV. Preparations – Completion of Physics 1P or Physics Advanced and Chemistry 1P or Chemistry Honors.

V. **Course Description**

The Living Earth is a conceptual biology course that introduces students to the subjects of ecosystem interactions and energy; history of earth's atmosphere: photosynthesis and respiration; inheritance of traits; evidence of evolution; structure, function and growth; ecosystem stability and the response to climate change. As the third high school class in a three course Next Generation Science Standards (NGSS) sequence, the Living Earth will employ the NGSS 3D instructional model that asks students to learn core disciplinary ideas related to the field of biology, to examine these content domains through cross-cutting concepts, and to employ the science and engineering practices to explore phenomena related to the topics mentioned above.

This course requires that significant instructional time be spent in hands-on laboratory work, with an emphasis on inquiry-based investigations that provide students with opportunities to demonstrate the foundational biological principles and apply all the attributes of the NGSS 3D instructional model and the seven science practices to their learning. This course is proposed as a UC Certified Lab Science.

VI. Standards/ESLRs Addressed

Introduction:

Based upon the 2016 California NGSS science framework, the Living Earth course framework is organized based upon six instructional segments. These instructional segments are centered upon observations of specific phenomenon. As students achieve the performance expectations (PEs) within each instructional segment, they uncover disciplinary core ideas (DCIs) from Physical Science, Earth and space science, and engineering. Students also focus on one or more crosscutting concepts (CCC) as tools to make sense of their observations and investigations; the CCCs are ongoing themes in all disciplines of science and engineering and help tie these seemingly disparate fields together. In addition to the exploration of phenomena through DCIs and CCCs, this course is organized based upon eight science and engineering practices (SEPs) which articulate the behaviors in which students need to engage in order to achieve conceptual understanding in the course. The science and engineering practices enable students to establish lines of evidence and use them to develop and refine testable explanations and predictions of natural phenomena. Because content, inquiry, and reasoning are equally important in The Living Earth, the learning objectives of the course described in the content outline combines content with inquiry and reasoning skills described in the science practices stated below.

VII. Brief Course Outline

Unit 1: Ecosystem Interactions and Energy

A. Guiding Question
   - Students use mathematical and computer models to determine the factors that affect the size and diversity of populations in ecosystems, including the availability of resources and interactions between organisms.

B. Performance Expectations: Students who demonstrate understanding can:
   - 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-LS2-5: 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-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.
- HS-ESS2-5: Plan and conduct an investigation of the properties of water and its effects on Earth materials and surface processes.
- HS-ESS2-6: Develop a quantitative model to describe the cycling of carbon among the hydrosphere, atmosphere, geosphere, and biosphere.

C. Highlighted Science and Engineering Practices
- [SEP-1] Asking Questions and Defining Problems
- [SEP-2] Developing and Using Models
- [SEP-3] Planning and Carrying Out Investigations
- [SEP-4] Analyzing and Interpreting Data
- [SEP-5] Using mathematics and Computational Thinking
- [SEP-6] Constructing Explanations (for science) and Designing Solutions (for engineering)
- [SEP-7] Engaging in Argument from Evidence

D. Highlighted Disciplinary Core Ideas
- LS2.A: Interdependent Relationships in Ecosystems
- LS2.B: Cycles of Matter and Energy Transfer in Ecosystems
- LS2.C: Ecosystem Dynamics, Functioning, and Resilience
- PS3.D: Energy in Chemical Processes
- LS4.D: Biodiversity and Humans
- LS4.C: Adaptation

E. Highlighted Cross Cutting Concept
- [CCC-2] Cause and Effect
- [CCC-3] Scale, Proportion, and Quantity
- [CCC-4] System and System Models
- [CCC-5] Energy and Matter: Flows, Cycles, and Conservation
- [CCC-6] Structure and Function
- [CCC-7] Stability and Change

Unit 2: History of Earth's Atmosphere: Photosynthesis and Respiration

A. Guiding Questions
- Students make a model that links photosynthesis and respiration in organisms to cycle energy and matter in the Earth system
- Students gather evidence about the linked history of Earth's biosphere and atmosphere.

B. Performance Expectations: Students who demonstrate understanding can:
- 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-LS2-3: 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-ESS2-6: Develop a quantitative model to describe the cycling of carbon among the hydrosphere, atmosphere, geosphere, and biosphere.

C. Highlighted Science and Engineering Practices
- [SEP-2] Developing and Using Models

- [SEP-5] Using mathematics and Computational Thinking
- [SEP-6] Constructing Explanations (for science) and Designing Solutions (for engineering)

D. Highlighted Disciplinary Core Ideas
- LS1.C: Organization for Matter and Energy Flow in Organisms
- LS2.B: Cycles of Matter and Energy Transfer in Ecosystems
- LS2.B: Cycles of Matter and Energy Transfer in Ecosystems
- PS3.D: Energy in Chemical Processes
- ESS2.D: Weather and Climate

E. Highlighted Cross Cutting Concept
- [CCC-5] Energy and Matter: Flows, Cycles, and Conservation

Unit 3: Inheritance of traits

A. Guiding Questions
- Students develop explanations about the specific mechanisms that enable parents to pass traits on to their offspring.
- Students make claims about which processes give rise to variation in deoxyribonucleic acid (DNA) codes and calculate the probability that offspring will inherit traits from their parents.

B. Performance Expectations: Students who demonstrate understanding can:
- 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-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-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.
- HS-ETS1-4: Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem.

C. Highlighted Science and Engineering Practices
- [SEP-1] Asking Questions and Defining Problems
- [SEP-2] Developing and Using Models
- [SEP-4] Analyzing and Interpreting Data
- [SEP-5] Using mathematics and Computational Thinking
- [SEP-6] Constructing Explanations (for science) and Designing Solutions (for engineering)
- [SEP-7] Engaging in Argument from Evidence

D. Highlighted Disciplinary Core Ideas
- LS1.A: Structure and Function
- LS1.B: Growth and Development of Organisms
- LS3.A: Inheritance of Traits
- LS3.B: Variation of Traits
- ETS1.B: Developing Possible Solutions

E. Highlighted Cross Cutting Concept
- [CCC-2] Cause and Effect
- [CCC-3] Scale, Proportion, and Quantity

- [CCC-4] System and System Models
- [CCC-6] Structure and Function
- [CCC-7] Stability and Change

Unit 4 Evidence of Evolution

A. Guiding Questions
   - Students develop a model about how rock layers record evidence of evolution as fossils.

Building on their learning from previous grades, they focus on effectively communicating this evidence and relating it to principles of natural selection.

B. Performance Expectations: Students who demonstrate understanding can:
   - 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-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-ESS1-5: Evaluate evidence of the past and current movements of continental and oceanic crust and the theory of plate tectonics to explain the ages of crustal rocks.
   - HS-ESS1-6: Apply scientific reasoning and evidence from ancient Earth materials, meteorites, and other planetary surfaces to construct an account of Earth's formation and early history.
   - HS-ESS2-7: Construct an argument based on evidence about the simultaneous coevolution of Earth's systems and life on Earth.

C. Highlighted Science and Engineering Practices
   - [SEP-4] Analyzing and Interpreting Data
   - [SEP-6] Constructing Explanations (for science) and Designing Solutions (for engineering)
   - [SEP-7] Engaging in Argument from Evidence
   - [SEP-8] Obtaining, Evaluating, and Communicating Information

D. Highlighted Disciplinary Core Ideas
   - ESS2.B: Plate Tectonics and Large-Scale System Interactions
   - LS2.C: Ecosystem Dynamics, Functioning, and Resilience
   - LS2.D: Social Interactions and Group Behavior
   - LS4.A: Evidence of Common Ancestry and Diversity
   - LS4.B: Natural Selection
   - LS4.C: Adaptation
   - PS1.C: Nuclear Processes
   - ESS1.C: The History of Planet Earth
   - ESS2.D: Weather and Climate
   - ESS2.E: Biogeology
   - ETS1.C: Optimizing the Design Solution

E. Highlighted Cross Cutting Concepts
   - [CCC-1] Patterns
   - [CCC-2] Cause and Effect
   - [CCC-7] Stability and Change

Unit 5: Structure, Function and Growth

A. Guiding Questions
   - Students use models to create explanations of how cells use DNA to construct proteins, build biomass, reproduce and create complex multicellular organisms.
   - Students investigate how these organisms maintain stability.

B. Performance Expectations: Students who demonstrate understanding can:
   - 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-LS1-6: 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-ESS2-5: Plan and conduct an investigation of the properties of water and its effects on Earth materials and surface processes.
   - HS-ESS2-6: Develop a quantitative model to describe the cycling of carbon among the hydrosphere, atmosphere, geosphere, and biosphere.
   - HS-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.
   - HS-ETS1-4: Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem.

C. Highlighted Science and Engineering Practices
   - [SEP-2] Developing and Using Models
   - [SEP-3] Planning and Carrying Out Investigations
   - [SEP-5] Using mathematics and Computational Thinking
   - [SEP-6] Constructing Explanations (for science) and Designing Solutions (for engineering)

D. Highlighted Disciplinary Core Ideas
   - LS1.A: Structure and Function
   - LS1.B: Growth and Development of Organisms
   - LS1.C: Organization for Matter and Energy Flow in Organisms
   - ESS2.C: The Roles of Water in Earth’s Surface Processes
   - ESS2.D: Weather and Climate
   - ETS1.B: Developing Possible Solutions

E. Highlighted Cross Cutting Concept
   - [CCC-4] System and System Models
   - [CCC-5] Energy and Matter: Flows, Cycles, and Conservation
   - [CCC-6] Structure and Function
   - [CCC-7] Stability and Change

Unit 6: Ecosystem Stability and the Response to Climate Change

A. Guiding Questions
   - Students use computer models to investigate how Earth’s systems respond to changes, including Climate Change.
   - Students make specific forecasts and design solutions to mitigate the impacts of these changes on the biosphere.

B. Performance Expectations: Students who demonstrate understanding can:
   - 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 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.
- HS-ETS1-1: Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.
- HS-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.
- HS-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.
- HS-ETS1-4: Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem.

C. Highlighted Science and Engineering Practices
   - [SEP-1] Asking Questions and Defining Problems
   - [SEP-2] Developing and Using Models
   - [SEP-3] Planning and Carrying Out Investigations
   - [SEP-4] Analyzing and Interpreting Data
   - [SEP-5] Using mathematics and Computational Thinking
   - [SEP-6] Constructing Explanations (for science) and Designing Solutions (for engineering)
   - [SEP-7] Engaging in Argument from Evidence
   - Highlighted Disciplinary Core Ideas

D. Highlighted Cross Cutting Concept
   - LS2.C: Ecosystem Dynamics, Functioning, and Resilience
   - LS4.D: Biodiversity and Humans
   - LS4.C: Adaptation
   - ETS1.B: Developing Possible Solutions
   - ESS2.D: Weather and Climate
   - ESS3.A: Natural Resources
   - ESS3.C: Human Impacts on Earth Systems
   - ESS3.D: Global Climate Change
   - ETS1.A: Defining and Delimiting Engineering Problems
   - ETS1.B: Developing Possible Solutions

E. Highlighted Cross Cutting Concepts
   - [CCC-2] Cause and Effect
   - [CCC-3] Scale, Proportion, and Quantity
   - [CCC-4] System and System Models
   - [CCC-5] Energy and Matter: Flows, Cycles, and Conservation
   - [CCC-6] Structure and Function
   - [CCC-7] Stability and Change

VIII. Methods of Assessment

Grades and Class Participation:

All work will be assessed and the students will receive points. Overall grades in the class will be by total percentage:

A=90+ B=80-89 C=70-79 D=60-69

Grades will be based on daily class assignments, homework, notebook checks, projects, quizzes and tests. Class participation is essential to the learning process; therefore, daily student attendance is essential for course success.

Grades for this class will derive from the following sources:

Exams	60%
Labs/Homework/Projects	40%

<u>Attendance Policy:</u> Attendance in this course will be treated the same way as it would be treated at a place of employment. If a student is absent, it is the student's responsibility to see the instructor to get "makeup" or "missed" information. Also, if a student is behind, he/she can set up appointment to use the computer lab before or after school, or during STEP, as is mutually agreeable to teacher and student.

<u>Academic Honesty:</u>
Students are expected to demonstrate honesty and integrity at all times. Each student is responsible for his or her own work, which includes test taking, homework, class assignments, individual contributions to group products, and the original creation of digital art, web pages, essays, compositions, and research papers. All work submitted by a student should be a true reflection of that student's knowledge, experience, effort and ability. It is unacceptable academic behavior to submit work that is not one's own. Refer to "Academic Honesty & Integrity" section in your student handbook. The consequences laid out in this section will be strictly adhered to in all incidents of cheating or plagiarism.

IX. **Materials/Textbook(s)** California HMH Science Dimensions The Living Earth

X. **Seeking "a-f" Approval –** Yes – Yes, this course will be submitted to the University of California for approval for the 2018-19 academic year in the subject domain "D" for Laboratory Science.

XI. **Seeking AP Class Approval –** No– This course does NOT seek AP approval.