EL DORADO UNION HIGH SCHOOL DISTRICT
EDUCATIONAL SERVICES

Course of Study Information Page

COURSE TITLE **Environmental Science**	
DISTRICT COURSE NUMBER **(#0303)**	4-DIGIT STATE COURSE CODE (COMPLETED BY SILT) **2612**
Rationale:	Environmental Science is a practical, hands-on course. It's purpose is to provide students with knowledge and skills for becoming an informed and productive citizen of this global community. Students will use scientific practices, cross-cutting relationships, and core knowledge for life-long learning.
Course Description that will be in the Course Directory:	Environmental principals will be applied to inquiry, investigation, and application to real-world and global challenges.
How Does this Course align with or meet State and District content standards?	See attached Table of Contents
NCLB Core Subjects:	*Select up to two that apply:* ☐ Arts ☐ Economics ☐ English ☐ Foreign Language ☐ Geography ☐ Civics and Government ☐ History ☐ Mathematics ☐ Reading / Language Arts ☒ Science ☐ Not Core Subject
CDE CALPADS Course Descriptors: (See Page 2 for Definitions)	CTE TECH PREP COURSE INDICATORS: ☐ Tech Prep (32) (Higher Ed) ☐ Tech Prep & ROP(33) (Higher Ed) ☐ ROP (30) ☒ N/A CTE COURSE CONTENT CODE: ☐ CTE Introductory (01) ☐ CTE Concentrator (02) ☐ CTE Completer (03) ☐ Voc Subject ____ ☒ N/A INSTRUCTIONAL LEVEL CODE: ☐ Remedial (35) ☐ Honors UC-Certified (39) ☐ Honors Non UC-Certified (34) ☐ College (40) ☒ N/A
Length of Course:	☒ Year ☐ Semester
Grade Level(s):	☐ 9 ☐ 10 ☒ 11 ☒ 12
Credit:	☒ Number of credits: **10** ☒ Meets graduation requirements (subject **Physical Science**) ☒ Request for UC "a–g" requirements CSU/UC requirement **"g"** ☒ College Prep
Prerequisites:	Minimum compentency - Biology with a grade of "C" or better and completion of or concurrent enrollment in Algebra II. Completion and/or concurrent enrollment in Chemistry/ChemA is recommended.
Department(s):	Science
District Sites:	ORHS, PHS, EDHS, UMHS
Board of Trustees COS Adoption Date:	6/10/2014
Textbooks / Instructional Materials:	Vizualizing Environmental Science By Hassenhahl, Hager & Berg (4th Edition 2011) ISBN 9871118169834 BRV ISBN 978111817863 Wiley Publishing

Funding Source:	General Fund
Board of Trustees Textbook Adoption Date:	6/24/2014

Definitions

CALPADS	California Longitudinal Pupil Achievement Data System
CTE Technical Prep	A course within a CTE technical career pathway or program that has been articulated with a postsecondary education or through an apprenticeship program of at least 2 years following secondary instruction.
Instructional Level Code	Represents a nonstandard instructional level at which the content of a specific course is either above or below a 'standard' course instructional level. These levels may be identified by the actual level of instruction or identified by equating the course content and level of instruction with a state or nationally recognized advanced course of study, such as IB or AP.
Instructional Level Honors, UC Certified	Includes all AP courses.
Instructional Level Honors, non UC Certified	Requires Board approval.
Instructional Level College	Includes ACE courses. Equivalent to college course and content, but not an AP course. Not related to section, but to course.

EL DORADO UNION HIGH SCHOOL DISTRICT

EDUCATIONAL SERVICES

Course Title: Environmental Science #0303

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EDUCATIONAL SERVICES

Department: ________**Science** ____

Course Title: _______**Environmental Science** ____________________________ **Course Number:** ___**0303**____

UNIT TITLE: _____ **I. A Earth's Biosphere: Ecosystems & Humans** ______________________________

ESSENTIAL QUESTION: *Promote understanding with a thought-provoking question that gives meaning, relevance, and definition to the unit.*

- **Why do some species thrive while others barely survive or go extinct?**

UNIT OUTLINE: *Give a detailed descriptive summary of all topics covered in the unit. Explain what students will know and be able to do.*

Chapter 5: How Ecosystems Work
What is Ecology? Components of an Ecosystem, Communities, Interactions of Biotic & Abiotic Factors

A. Energy Flow Through Ecosystems

1. Laws of Thermodynamics
2. Producers Consumers, Decomposers
3. Energy in Ecosystems – Food Webs, Productivity,
4. Solar energy, Photosynthesis, Respiration, Producers & Consumers, Food Webs & Food Pyramids

B. Cycling of Matter in an Ecosystem - Biogeochemical Cycles (C, O, N, H_2O, P)
C. Ecological Niches
D. Interactions Among Organisms – Symbiosis, Predation, Competition, Keystone & Invasive Species

Chapter 6: Ecosystems & Evolution
A. Earth's Major Biomes – Tundra, Forests, Chaparral, Desert, Savanna
B. Aquatic Ecosystems - Freshwater Environments
C. Evolution - Population Responses to Changing Conditions Over Time
D. Ecologic Succession: Community Responses to Change – Primary, Secondary

NGSS DISCIPLINARY CORE IDEAS (DCI): *List broad scientific concepts that help students to connect personally to societal issues and increase their depth of learning.*

LS1.C: Organization for Matter and Energy Flow in Organisms (*Chapter 5*)

- 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*)
- 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. (*HS-LS1-6*)
- 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*)
- As a result of these chemical reactions, energy is transferred from one system of interacting molecules to another and release energy to the surrounding environment and to maintain body temperature. Cellular respiration is a chemical process whereby the bonds of food molecules and oxygen molecules are broken and new compounds are formed that can transport energy to muscles. (*HS-LS1-7*)

LS2.A: Interdependent Relationships in Ecosystems

- Ecosystems have carrying capacities, which limits numbers of organisms and populations they support. These limits result from factors such as: 1) availability of living / nonliving resources, challenges of predation, competition, and disease. Finite environments and resources affect the abundance of species. (*HS-LS2-1*),(*HS-LS2-2*)

LS2.B: Cycles of Matter and Energy Transfer in Ecosystems

- Photosynthesis and cellular respiration provide most of the energy for life processes. (*HS-LS2-3*)
- Plants or algae form the lowest level of the food web. Only a small fraction of the matter consumed at the lower level is transferred upward for growth and energy in cellular respiration. This inefficiency results in fewer organisms at higher levels of a food web - release energy for life functions, 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*)
- 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)

LS2.C: Ecosystem Dynamics, Functioning, and Resilience

- 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*)

- 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*)

LS2.D: Social Interactions and Group Behavior

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

LS3.B: Variation of Traits

- In sexual reproduction, chromosomes can sometimes swap sections during the process of meiosis, creating new genetic combinations and thus genetic variation. Although DNA replication is tightly regulated and remarkably 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*)
- Environmental factors also affect expression of traits, and hence occurrences of traits in a population. Thus the variation and distribution of traits observed depends on both genetic and environmental factors. (*HS-LS3-2),(HS-LS3-3*)

LS4.C: Adaptation

- 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 due to mutation and sexual reproduction, (3) competition for an environment's limited resources needed for survive and reproduction, and (4) the ensuing proliferation of organisms that are better able to survive and reproduce in that environment. (*HS-LS4-2*)
- Natural selection leads to adaptations dominated by organisms that are anatomically, behaviorally, and physiologically well-suited to survive and reproduce in a specific environment. Differential survival / reproduction of organisms with an advantageous heritable trait leads to an increase in individuals with that trait for future generations, and a decrease in individuals that do not. (*HS-LS4-3),(HS-LS4-4*)
- Adaptation also means that the distribution of traits in a population can change when conditions change. (*HS-LS4-3*)
- Changes in the physical environment (naturally or human induced), have contributed to the expansion, emergence, and the decline / extinction of some species. (*HS-LS4-5),(HS-LS4-6*)
- Species become extinct because they can no longer survive and reproduce in their altered environment. Species' evolution is lost if members cannot adjust to rapid or drastic changes. (*HS-LS4-5*)

LS4.D: Biodiversity and Humans

- Biodiversity is increased by the formation of new species (speciation) and decreased by the loss of species (extinction). *(sa HS-LS2-7)*
- 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. *(sa HS-LS2-7, HS-LS4-6).*

PERFORMANCE EXPECTATIONS: *Student performance that demonstrates student has mastered the Disciplinary Core Idea (DCI).*

Students who demonstrate understanding can:

LS1.C Organization for Matter & Energy Flow

HS-LS1-5. Use a model to illustrate how photosynthesis transforms light energy into stored chemical energy – Input/output of matter, transfer/ transformation of energy in photosynthesis by plants and other 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. Students will use evidence from models and simulations to support explanations.

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 - conceptual understanding of the input/output of cellular respiration.

LS2.A Interdependent Relationships in Ecosystems

HS-LS2-1. Use mathematical and/or computational representations to support explanations of factors that affect carrying capacity of ecosystems at different scales - quantitative analysis and comparison of the relationships among interdependent factors: boundaries, resources, climate, and competition.

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. [Clarification Statement: Examples of mathematical representations include finding the average, determining trends, and using graphical comparisons of multiple sets of data

LS2.B Cycling Matter & Energy in Ecosystems

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, particularly the role of aerobic and anaerobic respiration in different environments.

HS-LS2-4. Use mathematical representations to support claims for the cycling of matter and flow of energy among organisms in an ecosystem - stored energy in biomass to describe the transfer of energy from one trophic level to another, matter and energy are conserved. Emphasize atoms/molecules such as carbon, oxygen, hydrogen and nitrogen being conserved as they move through 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.

LS2-C Ecosystem Dynamics, Functions, Resilience

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 - Modest changes such as moderate hunting or a seasonal flood & extreme changes such as volcanic eruption or sea level rise.

LS2.D Social Interactions & Group Behavior

HS-LS2-8. Evaluate the evidence for the role of group behavior (flocking, schooling, herding, and cooperative behaviors such as hunting, migrating, and swarming) on individual and species' chances to survive and reproduce: 1) distinguishing group and individual behavior, 2) identifying evidence supporting the outcomes of group behavior, and 3) developing arguments based on evidence.

LS3.B Variation in Traits

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. Use mathematics to describe the probability of traits as it relates to genetic / environmental factors.

LS4.C Adaptation

HS-LS4-2. Explain the evidence that evolution results from four factors: (1) growth potential, (2) heritable genetic variation from mutation and sexual reproduction, (3) competition for limited resources, and (4) the proliferation of those organisms that are able to survive and reproduce in the environment. Use evidence to explain the influence of the four factors on: number of organisms, behaviors, morphology, or physiology in terms of ability to compete for limited resources and subsequent survival / adaptation.

HS-LS4-3. Apply 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 that natural selection leads to adaptation of populations. Use data to provide evidence for biotic and abiotic differences in ecosystems (seasonal temperature range, long-term climate change, acidity, light, geographic barriers, or evolution) that contribute to a change in gene frequency causing adaptation of populations.

HS-LS4-5. Evaluate the evidence that changes in environmental conditions may result in: (1) increases in the number of some species, (2) emergence of new species over time, and (3) extinction of other species. Determine cause and effect relationships from deforestation, fishing, fertilizers, drought, flood, and change of the environment affect distribution or disappearance of traits in species.

LS4.D Biodiversity & Humans

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

HS-ESS2-6. Develop a quantitative model to describe the cycling of carbon among the hydrosphere, atmosphere, geosphere, and biosphere. The carbon cycle is a property of the Earth system that arises from interactions among the hydrosphere, atmosphere, geosphere, and biosphere, particularly cycling of carbon through the ocean, atmosphere, soil, and biosphere (including humans), providing the foundation for living organisms.

INSTRUCTIONAL STRATEGIES: *Indicate how the instructional strategies support the delivery of curriculum and course goals. Explain how assignments support the Common Core Standards.*

Suggested Lab Activities:

- ***Vernier Lab Experiments:***

  Lab Manual – Investigating Environmental Science through Inquiry

  Experiment #14: " Cellular Respiration"
  Experiment #15: "Biodiversity in Ecosystems"
  Experiment #16: Biochemical Oxygen Demand"
  Experiment #18: Decomposition Column Investigation"
  Experiment #19: "Eco-column Investigation"
  Experiment #23: "Primary Productivity"

  Lab Manual – Water Quality with Vernier

  Experiment #6: "Biochemical Oxygen Demand"
  Experiment #9: "Fecal Coliform"

- ***Vernier Probeware & Sensors*** – 8 Lab Quest II Receiver, 8 CO_2 Gas Sensor, 8 Temperature Probes, 8 Relative Humidity Sensor, 8 Light Sensors, 8 Soil Moisture Sensors, 2 Dissolved Oxygen Sensor,8 pH Meters.

Other Suggested Labs, Projects, & Activities:

- True Project-Based Learning occurs when student research is focused on environments near their campus: New York Creek is a small, ephemeral stream that runs through Oak Ridge High School campus. Hangtown Creek is located one block from El Dorado High School. Union Mine High School is centered in an oak woodland environment. Ponderosa High School is located near small ponds. All comprehensive high schools can gather real-world data such as population investigations and measuring energy flow using Vanessa cardui (Painted Lady Butterflies),
- Models include diagrams, chemical equations, and conceptual models of photosynthesis (*LS2.B*)
- Mathematical comparisons of Carrying Capacity includes: graphs, charts, histograms, and population changes gathered from simulations or historical data sets (*LS2.A*)
- Models of carbon cycling among the biosphere, atmosphere, hydrosphere, and geosphere.

- Simulations and mathematical models to illustrate the role of photosynthesis and cellular respiration in the cycling of carbon among the biosphere, atmosphere, hydrosphere, and geosphere.
- Use proportional reasoning and distribution graphs to explain species adaptation to environmental change.
- Create / revise a solution to mitigate adverse impacts of human activity on biodiversity. Emphasize designing solutions for a problem related to threatened / endangered species, or to genetic variation of organisms. (*HS-LS4-6*)

ASSESSMENT: *Describe the Formative and Summative Assessments that will be used to demonstrate learning and mastery of the NGSS Core Ideas.*

- ***Assessment***: Creating and Utilizing Models to Define Solutions to Problems, Data Gathering Protocols (Quality Assurance & Quality Control), Written Laboratory Assignments, Tests, Quizzes, Written and Oral Responses, Formal Lab Write-Ups, Homework, Classwork, Reading of Case Studies.

- ***Assessment Boundaries:***

LS1.C Organization for Matter & Energy Flow

HS-LS1-5. Model photosynthesis transforming light energy into stored chemical energy - not biochemical steps.

HS-LS1-6. Explain how carbon, hydrogen, and oxygen from sugar molecules combine to form amino acids or other large carbon-based molecules - not specific reactions or identification of macromolecules.

HS-LS1-7. Illustrate cellular respiration as 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 - not the steps or specific processes involved in cellular respiration.

LS2.A Interdependent Relationships in Ecosystems

HS-LS2-1. Use mathematical and/or computational representations (graphs, charts, histograms) **to support explanations of factors** (boundaries, resources, climate, and competition) **that affect carrying capacity of ecosystems of different scales.** Deriving mathematical equations is not necessary.

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. Finding the average, determining trends, and using graphical comparisons of data provided to students.

LS2.B: Cycling Matter & Energy in Ecosystems

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 in different environments (excluding the specific chemical processes in respiration.

HS-LS2-4. Use mathematical representations to support claims for the cycling of matter (C, O, H, N) and flow of energy stored energy in biomass, transferred from one trophic level to another. Limit assessment to proportional reasoning to describe the cycling of matter and flow of energy.]

LS2.C Ecosystem Dynamics, Functions, Resilience

HS-LS2-5. Develop a model to illustrate the role (not specific chemical steps) **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 moderate (hunting or a seasonal flood) **to extreme** (volcanic eruption or sea level rise) **changing conditions may result in a new ecosystem.**

LS2.D Social Interactions & Group Behavior

HS-LS2-8. Evaluate the evidence for the role of group behavior (flocking, schooling, herding, hunting, migrating, and swarming) **on individual and species' chances to survive and reproduce.**

LS3.B Variation of Traits

HS-LS3-2. Make and defend a claim based on evidence that inheritable genetic variations may result from: (1) new genetic combinations through meiosis (not the phases of meiosis), **(2) viable errors occurring during replication, and/or (3) mutations caused by environmental factors (not** biochemical mechanism of specific steps in the process.)

HS-LS3-3. Apply concepts of statistics and probability to explain the variation and distribution of expressed traits in a population (not Hardy-Weinberg calculations.)

LS4.C Adaptation

HS-LS4-2. Explain the evidence that evolution results from four factors: (1) growth potential, (2) heritable genetic variation from mutation and sexual reproduction, (3) competition for limited resources, and (4) the proliferation of those organisms that are able to survive and reproduce in the environment. Use evidence to explain the influence on: number of organisms, behaviors, morphology, or physiology in terms of ability to compete for limited resources and subsequent survival / adaptation, not other mechanisms of evolution, such as genetic drift, gene flow through migration, or co-evolution.

HS-LS4-3. Apply statistics and probability to support explanations that organisms with an advantageous heritable trait tend to increase in proportion to organisms lacking this trait. Assessment is limited to basic statistical and graphical analysis, not allele frequency calculations.

HS-LS4-4. Construct an explanation based on evidence that natural selection leads to adaptation of populations. Use data to provide evidence for biotic and abiotic differences in ecosystems (seasonal temperature range, long-term climate change, acidity, light, geographic barriers, or evolution) that contribute to a change in gene frequency causing adaptation of populations.

HS-LS4-5. Evaluate the evidence that changes in environmental conditions may result in: (1) increases in the number of some species, (2) emergence of new species over time, and (3) extinction of other species. Determine cause and effect relationships from deforestation, fishing, fertilizers, drought, flood, and change of the environment affect distribution or disappearance of traits in species.

LS4.D Biodiversity & Humans

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

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

CROSS-CUTTING CONCEPTS: *Core ideas have application across all domains of science.*

Cause and Effect

- Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects. (*HS-LS2-8) (HS-LS3-1),(HS-LS3-2) (HS-LS4-2),(HS-LS4-4),(HS-LS4-5),(HS-LS4-6*)

Energy and Matter

- Changes of energy and matter in a system can be described in terms of energy and matter flows into, out of, and within that system. (*HS-LS1-5), (HS-LS1-6*)
- Energy cannot be created or destroyed—it only moves between one place and another place, between objects and/or fields, or between systems. (*HS-LS1-7) (HS-LS2-4*)
- Energy drives the cycling of matter within and between systems. (*HS-LS2-3*)

Patterns

- Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations of phenomena. (*HS-LS4-1),(HS-LS4-3*)

Scale, Proportion, and Quantity

- The significance of a phenomenon is dependent on the scale, proportion, and quantity at which it occurs. (*HS-LS2-1*)
- Using the concept of orders of magnitude allows one to understand how a model at one scale relates to a model at another scale. (*HS-LS2-2*)
- Algebraic thinking is used to examine scientific data and predict the effect of a change in one variable on another (e.g., linear growth vs. exponential growth). (*HS-LS3-3*)

Science is a Human Endeavor

- Technological advances have influenced the progress of science and science has influenced advances in technology. (*HS-LS3-3*)

Scientific Knowledge Assumes an Order and Consistency in Natural Systems

- Scientific knowledge is based on the assumption that natural laws operate today as they did in the past and they will continue to do so in the future. (*HS-LS4-1),(HS-LS4-4*)

Stability and Change

- Much of science deals with constructing explanations of how things change and how they remain stable. (*HS-LS2-6),(HS-LS2-7*)

Systems and System Models

- Models (e.g., physical, mathematical, computer models) can be used to simulate systems and interactions—including energy, matter, and information flows—within and between systems at different scales. (*HS-LS2-5*)
- Science and engineering are influenced by society and society is influenced by science and engineering. (*HS-LS3-3*)

SCIENCE & ENGINEERING PRACTICES: *Describe how students will investigate and build models and theories of core ideas by using one or more of the following practices. Explain.*

Analyzing and Interpreting Data
- Apply concepts of statistics and probability (including determining function fits to data, slope, intercept, and correlation coefficient for linear fits) to scientific and engineering questions and problems, using digital tools when feasible. (*HS-LS3-3) (HS-LS4-3*)

Constructing Explanations and Designing Solutions
- Construct and revise an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, models, theories, simulations, peer review) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. (HS-LS1-1) (*HS-LS1-6) (HS-LS4-2) (HS-LS4-4) (HS-LS2-3*)
- Design, evaluate, and refine a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations. (*HS-LS2-7*)

Developing and Using Models
- Develop a model based on evidence to illustrate the relationships between systems or components of a system. *(HS-LS2-5*)
- Use a model based on evidence to illustrate the relationships between systems or between components of a system. (*HS-LS1-4) (HS-LS1-5) (HS-LS1-7*)

Engaging in Argument from Evidence
- Evaluate the evidence behind currently accepted explanations or solutions to determine the merits of arguments. (*HS-LS2-6) (HS-LS4-5) (HS-LS2-8*)
- Make and defend a claim based on evidence about the natural world that reflects scientific knowledge, and student-generated evidence. (*HS-LS3-2*)

Obtaining, Evaluating, and Communicating Information
- Communicate scientific information (e.g., about phenomena and/or the process of development and the design and performance of a proposed process or system) in multiple formats (including orally, graphically, textually, and mathematically). (*sa HS-LS4-1*)

Planning and Carrying Out Investigations
- Plan and conduct an investigation individually and collaboratively to produce data to serve as the basis for evidence, and in the design: decide on types, how much, and accuracy of data needed to produce reliable measurements and consider limitations on the precision of the data (e.g., number of trials, cost, risk, time), and refine the design accordingly. (*HS-LS1-3*)

Science Models, Laws, Mechanisms, and Theories Explain Natural Phenomena
- A scientific theory is a substantiated explanation of some aspect of the natural world, based on a body of facts that have been repeatedly confirmed through observation and experiment and the science community validates each theory before it is accepted. If new evidence is discovered that the theory does not accommodate, the theory is generally modified in light of this new evidence. (*HS-LS4-1*)

Scientific Investigations Use a Variety of Methods
- Scientific inquiry is characterized by a common set of values that include: logical thinking, precision, open-mindedness, objectivity, skepticism, replicable results, with honest and ethical reporting of findings. (*HS-LS1-3*)

Scientific Knowledge is Open to Revision in Light of New Evidence
- Most scientific knowledge is quite durable, but is, in principle, subject to change based on new evidence and/or reinterpretation of existing evidence. (*HS-LS2-2),(HS-LS2-3*)
- Scientific argumentation is a mode of logical discourse used to clarify the strength of relationships between ideas and evidence that may result in revision of an explanation. (*HS-LS2-6),(HS-LS2-8*)

Using Mathematics and Computational Thinking

- Use mathematical and/or computational representations of phenomena or design solutions to support explanations. (*HS-LS2-1*)
- Use mathematical representations of phenomena or design solutions to support and revise explanations. (*HS-LS2-2*)
- Use mathematical representations of phenomena or design solutions to support claims. (*HS-LS2-4*)
- Create or revise a simulation of a phenomenon, designed device, process, or system. (*HS-LS4-6*)

INTERVENTIONS: *Describe methods used to support students who fail to master formative and summative assessment for each unit.* Regular Formative Assessment, APEX, Academic Recovery, After-school Tutoring, Homework Club, Study Group, Online Resources - teacher notes & worksheets posted online, Bozeman Science, Khan Academy, YouTube.

El Dorado Union High School District

EDUCATIONAL SERVICES

Department: _______**Science** ______________________________

Course Title: _______**Environmental Science** ______________________ **Course Number:**___**0303**__

UNIT TITLE: ______**I. B. Earth's Biosphere: Human Population Dynamics** ______________________

ESSENTIAL QUESTION: *Promote understanding with a thought-provoking question that gives meaning, relevance, and definition to the unit.*

- **Why are some nations capable of sustainable development, while others collapse into environmental degradation, economic and social ruin?**

UNIT OUTLINE: *Give a detailed descriptive summary of all topics covered in the unit. Explain what students will know and be able to do.*

Chapter 1: Environmental Challenges

A. **Human Impacts on the Environment** – MDC & LDC's, Human Population Growth, Resource Consumption,
B. **Sustainability & the Environment** – Exploitation
C. **Environment as a Science** – Goals, Scientific method, Predictions, Theories.
D. **How We Handle Environmental Problems-** NIMBY, Katrina, water consumption & pollution, Air pollution, soil degradation & agriculture, carbon footprints

Chapter 2: Sustainability & Human Values

A. **Human Use of the Earth** – Sustainable Consumption, Development, & Technology
B. **Human Values & Environmental Problems** – Ethics, Worldviews
C. **Environmental Justice & Ethics**
D. **Planning for Sustainable Living** – Poverty, Population, Earth's Resources, Feeding the World, Climate, Cities

Chapter 7: Human Population Change & the Environment

A. **Population Ecology** – Growth, Environmental Resistance, Carrying Capacity
B. **Human Population Patterns -** J & S Shaped Curves, Malthus, Future
C. **Demographics of Countries** – Fertility, Mortality, Transitions, Age Structure Diagrams
D. **Stabilizing World Population** – Culture & Fertility, SES, Education, Family Planning, Government Policies
E. **Population & Urbanization** – Problems & Benefits of Urban Environments, Urbanization Trends

NGSS DISCIPLINARY CORE IDEAS (DCI): *List broad scientific concepts that help students to connect personally to societal issues and increase their depth of learning.*

ESS3.B: Natural Hazards

- 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)

LS2.A: Interdependent Relationships in Ecosystems

- 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)*

LS2.C: Ecosystem Dynamics, Functioning, and Resilience

- 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)*
- 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)*

LS2.D: Social Interactions and Group Behavior

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

LS3.B: Variation of Traits

- 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),(HS-LS3-3)*

LS4.C: Adaptation

- Adaptation also means that the distribution of traits in a population can change when conditions change. *(HS-LS4-3)*
- Changes in the physical environment (naturally or human induced), have contributed to the expansion, emergence, and the decline / extinction of some species. *(HS-LS4-5),(HS-LS4-6)*
- Species become extinct because they can no longer survive and reproduce in their altered environment. Species' evolution is lost if members cannot adjust to rapid or drastic changes. *(HS-LS4-5)*

LS4.D: Biodiversity and Humans

- Biodiversity is increased by the formation of new species (speciation) and decreased by the loss of species (extinction). *(sa HS-LS2-7)*
- 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. *(sa HS-LS2-7, HS-LS4-6).*

PERFORMANCE EXPECTATIONS: *Student performance that demonstrates student has mastered the Disciplinary Core Idea (DCI).*

Students who demonstrate understanding can:

HS-ESS3-1. Construct an evidence-based explanation for ways where the following have influenced human activity: 1) availability of a natural resource such as water, 2) occurrence of natural hazards, and 3) changes in climate. Key water resources include fresh water (rivers, lakes, and groundwater) and regions of fertile soils such as river deltas. Natural hazards can occur from surface processes (tsunamis) and severe weather (hurricanes, floods, and droughts). Climate changes causing a rise in sea level affect populations and result in mass migrations.

LS2.A Interdependent Relationships in Ecosystems

HS-LS2-1. Use mathematical and/or computational representations (graphs, charts, histograms) **to support explanations of factors** (boundaries, resources, climate, and competition) **that affect carrying capacity of ecosystems of different scales.** Deriving mathematical equations is not necessary.

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. Finding the average, determining trends, and using graphical comparisons of data provided to students.

LS2.C Ecosystem Dynamics, Functions, Resilience

HS-LS2-5. Develop a model to illustrate the role (not specific chemical steps) **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 moderate (hunting or a seasonal flood) **to extreme** (volcanic eruption or sea level rise) **changing conditions may result in a new ecosystem.**

HS-LS2-7. Design, evaluate, and refine a solution for reducing the impacts of human activities (urbanization, building dams, and dissemination of invasive species) **on the environment and biodiversity**.

LS2.D Social Interactions & Group Behavior

HS-LS2-8. Evaluate the evidence for the role of group behavior (flocking, schooling, herding, hunting, migrating, and swarming) **on individual and species' chances to survive and reproduce.**

LS3.B Variation in Traits

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. Use mathematics to describe the probability of traits as it relates to genetic / environmental factors.

LS4.C: Adaptation

HS-LS4-5. Evaluate the evidence that changes in environmental conditions may result in: (1) increases in the number of some species, (2) emergence of new species over time, and (3) extinction of other species. Determine cause and effect relationships from deforestation, fishing, fertilizers, drought, flood, and change of the environment affect distribution or disappearance of traits in species.

LS4.D Biodiversity & Humans

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

HS-ESS2-6. Develop a quantitative model to describe the cycling of carbon among the hydrosphere, atmosphere, geosphere, and biosphere. The carbon cycle is a property of the Earth system that arises from interactions among the hydrosphere, atmosphere, geosphere, and biosphere, particularly cycling of carbon through the ocean, atmosphere, soil, and biosphere (including humans), providing the foundation for living organisms.

ESS3.B. Natural Hazards

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)

INSTRUCTIONAL STRATEGIES: *Indicate how the instructional strategies support the delivery of curriculum and course goals. Explain how assignments support the Common Core Standards.*

Suggested Lab Activities:

- ***Vernier Lab Experiments:***

  Lab Manual – <u>Investigating Environmental Science through Inquiry</u>

Experiment #20: "Global Warming"
Experiment #24: "Modeling for Growth"
Experiment #26: Fossil Fuel Energy"
Experiment #27: "Energy Conversions"
Experiment #33: " Investigating Indoor CO_2 Concentrations"

Lab Manual – Water Quality with Vernier
Experiment #31: "The Effect of Acid Deposition on Aquatic Ecosystems"

- ***Vernier Probeware & Sensors*** – 8 Lab Quest II Receiver, 8 CO_2 Gas Sensor, 8 Temperature Probes, 8 Relative Humidity Sensor, 8 Light Sensors, 8 Soil Moisture Sensors, 2 Dissolved Oxygen Sensor,8 pH Meters.

Suggested Lab Activities:
- ***Vernier Lab Experiments:*** Vernier Probeware & Sensors Include - Lab Quest II Receiver, Colorimeter, and Conductivity meters, Ion-Sensitive Electrodes, Melt Station, Mini GC Plus Gas Chromatograph, Temperature, O_2 Gas Sensor, pH Sensors.

Other Suggested Labs, Projects, & Activities:
- Mathematical comparisons of Carrying Capacity includes: graphs, charts, histograms, and population changes gathered from simulations or historical data sets (*LS2.A*)
- Models of carbon cycling among the biosphere, atmosphere, hydrosphere, and geosphere.
- Create / revise a solution to mitigate adverse impacts of human activity on biodiversity. Emphasize designing solutions for a problem related to threatened / endangered species, or to genetic variation of organisms. (*HS-LS4-6*)

ASSESSMENT: *Describe the Formative and Summative Assessments that will be used to demonstrate learning and mastery of the NGSS Core Ideas.*
- ***Assessment***: Regular Formative Assessments, Creating and Utilizing Models to Define Solutions to Problems, Data Gathering Protocols (Quality Assurance & Quality Control), Written Laboratory Assignments, Tests, Quizzes, Oral Responses, Written Notes & Worksheets, Lab Write-Ups, Homework, Classwork, Reading of Case Studies.

- ***Assessment Boundaries***:

LS2.A Interdependent Relationships in Ecosystems

HS-LS2-1. Use mathematical and/or computational representations (graphs, charts, histograms) **to support explanations of factors** (boundaries, resources, climate, and competition) **that affect carrying capacity of ecosystems of different scales.** Deriving mathematical equations is not necessary.

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. Finding the average, determining trends, and using graphical comparisons of data provided to students.

LS2.C Ecosystem Dynamics, Functions, Resilience

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 moderate (hunting or a seasonal flood) **to extreme** (volcanic eruption or sea level rise) **changing conditions may result in a new ecosystem.**

HS-LS2-7. Design, evaluate, and refine a solution for reducing the impacts of human activities (urbanization, building dams, and dissemination of invasive species) **on the environment and biodiversity**.

LS2.D Social Interactions & Group Behavior

HS-LS2-8. Evaluate the evidence for the role of group behavior on individual and species' chances to survive.

LS3.B Variation of Traits

HS-LS3-2. Make and defend a claim based on evidence that inheritable genetic variations may result from: (1) new genetic combinations through meiosis (not the phases of meiosis), **(2) viable errors occurring during replication, and/or (3) mutations caused by environmental factors (not** biochemical mechanism of specific steps in the process.)

HS-LS3-3. Apply concepts of statistics and probability to explain the variation and distribution of expressed traits in a population (not Hardy-Weinberg calculations.)

LS4.C Adaptation

HS-LS4-5. Evaluate the evidence that changes in environmental conditions may result in: (1) increases in the number of some species, (2) emergence of new species over time, and (3) extinction of other species. Determine cause and effect relationships from deforestation, fishing, fertilizers, drought, flood, and change of the environment affect distribution or disappearance of traits in species.

LS4.D Biodiversity & Humans

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

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

CROSS-CUTTING CONCEPTS: *Core ideas have application across all domains of science.*

Cause and Effect

- Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects. *(HS-LS2-8) (HS-LS3-1),(HS-LS3-2) (HS-LS4-2),(HS-LS4-4),(HS-LS4-5),(HS-LS4-6*)

Energy and Matter

- The total amount of energy and matter in closed systems is conserved. (*HS-ESS2-6*)

Influence of Engineering, Technology, and Science on Society and the Natural World

- New technologies can have deep impacts on society and the environment, including some that were not anticipated. Analysis of costs and benefits is a critical aspect of decisions about technology. (*HS-ESS2-2*)

Scale, Proportion, and Quantity

- The significance of a phenomenon is dependent on the scale, proportion, and quantity at which it occurs. (*HS-LS2-1*)
- Using the concept of orders of magnitude allows one to understand how a model at one scale relates to a model at another scale. (*HS-LS2-2*)
- Algebraic thinking is used to examine scientific data and predict the effect of a change in one variable on another (e.g., linear growth vs. exponential growth). (*HS-LS3-3*)

Science is a Human Endeavor

- Technological advances have influenced the progress of science and science has influenced advances in technology. (*HS-LS3-3*)
- Science and engineering are influenced by society and society is influenced by science and engineering. (*HS-LS3-3*)

Scientific Knowledge Assumes an Order and Consistency in Natural Systems

- Scientific knowledge is based on the assumption that natural laws operate today as they did in the past and they will continue to do so in the future. (*HS-LS4-4*)

Stability and Change

- Much of science deals with constructing explanations of how things change and how they remain stable. (*HS-LS2-6),(HS-LS2-7*)

Systems and System Models

- Models (e.g., physical, mathematical, computer models) can be used to simulate systems and interactions—including energy, matter, and information flows—within and between systems at different scales. (*HS-LS2-5*)

SCIENCE & ENGINEERING PRACTICES: *Describe how students will investigate and build models and theories of core ideas by using one or more of the following practices. Explain.*

Analyzing and Interpreting Data

- Apply concepts of statistics and probability (including determining function fits to data, slope, intercept, and correlation coefficient for linear fits) to scientific and engineering questions and problems, using digital tools when feasible. (*HS-LS3-3) (HS-LS4-3*)

Constructing Explanations and Designing Solutions

- Design, evaluate, and refine a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations. (*HS-LS2-7*)
- Construct an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, models, theories, simulations, peer review) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. (*HS-LS4-2),(HS-LS4-4*)

Developing and Using Models

- Develop a model based on evidence to illustrate the relationships between systems or components of a system. (*HS-LS2-5*)

Engaging in Argument from Evidence

- Evaluate evidence behind accepted explanations or solutions to determine the merits of arguments. (*HS-LS4-5*)
- Make and defend a claim based on evidence about the natural world that reflects scientific knowledge, and student-generated evidence. (*HS-LS3-2*)
- Evaluate the claims, evidence, and reasoning behind currently accepted explanations or solutions to determine the merits of arguments. (*HS-LS2-6*) (*HS-LS2-8*)

Scientific Knowledge is Open to Revision in Light of New Evidence

- Most scientific knowledge is quite durable, but is, in principle, subject to change based on new evidence and/or reinterpretation of existing evidence. (*HS-LS2-2*)
- Scientific argumentation is a mode of logical discourse used to clarify the strength of relationships between ideas and evidence that may result in revision of an explanation. (*HS-LS2-6*),(*HS-LS2-8*)

Using Mathematics and Computational Thinking

- Create or revise a simulation of a phenomenon, designed device, process, or system. (*HS-LS4-6*)
- Use mathematical and/or computational representations of phenomena or design solutions to support explanations. (*HS-LS2-1*) (*HS-LS2-2*) (*HS-LS2-4*)

INTERVENTIONS: *Describe methods used to support students who fail to master formative and summative assessment for each unit.* Regular Formative Assessment, APEX, Academic Recovery, After-school Tutoring, Homework Club, Study Group, Online Resources - teacher notes & worksheets posted online, Bozeman Science, Khan Academy, YouTube.

EDUCATIONAL SERVICES

Department: ________Science ____________________

Course Title: _______Environmental Science ____________________ Course Number:__0303___

UNIT TITLE: _____II. Earth's Atmosphere ____________________

ESSENTIAL QUESTION: *Promote understanding with a thought-provoking question that gives meaning, relevance, and definition to the unit.*

- **Are Americans responsible to other nations dealing with the effects of toxic compounds produced here at home?**

UNIT OUTLINE: *Give a detailed descriptive summary of all topics covered in the unit. Explain what students will know and be able to do.*

Chapter 8: Air & Air Pollution

A. **The Atmosphere** – Temperature Layers, Global Winds
B. **Types & Sources of Air Pollution** – Classification & Sources of Air Pollutants
C. **Effects of Air Pollution** – Human Health, Urban Air Pollution, Weather, Topography, Urban Heat Islands, Dust Bowls
D. **Controlling Air Pollutants** – Technologies, Legislation, Developing Countries
E. **Indoor Air Pollution** – Sick Buildings, Radon, Asbestos

Chapter 9: Global Atmospheric Changes

A. **The Atmosphere & Climate** – Solar Radiation, Climate, Precipitation
B. **Global Climate Change** – Cause & Effect, Mitigation & Adaptation
C. **Ozone Depletion in the Stratosphere** – Cause & Effect, Reversing Ozone Thinning
D. **Acid Deposition** – How Acid is Deposited, Effects, Politics, Recovery

NGSS DISCIPLINARY CORE IDEAS (DCI): *List broad scientific concepts that help students to connect personally to societal issues and increase their depth of learning.*

ESS2.A: Earth Materials and Systems

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

ESS2.D: Weather and Climate

- 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-ESS2-4*)
- Gradual atmospheric changes were due to plants and other organisms that captured carbon dioxide and released oxygen. (*HS-ESS2-6),(HS-ESS2-7*)
- Changes in the atmosphere due to human activity have increased carbon dioxide concentrations and thus affect climate. (*HS-ESS2-6),(HS-ESS2-4*)

ESS3.C: Human Impacts on Earth Systems

- The sustainability of human societies and the biodiversity that supports them requires responsible management of natural resources. (*HS-ESS3-3*)
- Scientists and engineers can make major contributions by developing technologies that produce less pollution and waste and that preclude ecosystem degradation. (*HS-ESS3-4*)

ESS3.D: Global Climate Change

- 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*)
- Through computer simulations and other studies, important discoveries are still being made about how the ocean, the

atmosphere, and the biosphere interact and are modified in response to human activities. (*HS-ESS3-6*)

ETS1.A: Defining and Delimiting Engineering Problems

- 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*)

ETS1.B: Developing Possible Solutions

- 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*)
- 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 to a client about how a given design will meet his or her needs. (*HS-ETS1-4*)

ETS1.C: Optimizing the Design Solution

- Criteria may need to be broken down into simpler ones that can be approached systematically, and decisions about the priority of certain criteria over others (trade-offs) may be needed. (*HS-ETS1-2*)
- 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. *(sa HS-ESS3-2),(sa HS-ESS3-4)*

PERFORMANCE EXPECTATIONS: *Student performance that demonstrates student has mastered the Disciplinary Core Idea (DCI).*

Students who demonstrate understanding can:

ESS2.A: Earth Materials and Systems

HS-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 - climate feedbacks from increased greenhouse gases cause rising global temperatures that melt glacial ice, reduces the amount of sunlight reflected from Earth's surface, and increases surface temperatures.

ESS2.D: Weather and Climate

HS-ESS2-4. Use a model to describe how variations in the flow of energy into and out of Earth's systems result in changes in climate, particularly timescale, volcanic eruption, ocean circulation, changes in human activity, solar output, changes to Earth's orbit and the orientation of its axis, long-term changes in atmospheric composition.

HS-ESS2-6. Develop a quantitative model to describe the cycling of carbon among the hydrosphere, atmosphere, geosphere, and biosphere - cycling of carbon through the ocean, atmosphere, soil, and biosphere (including humans), providing the foundation for living organisms.

HS-ESS2-7. Construct an argument based on evidence about the simultaneous coevolution of Earth's systems and life on Earth. 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. Photosynthetic life altered the atmosphere by producing oxygen, increasing weathering rates which allowed for evolution of animal life; microbial life on land increased the formation of soil, which in turn allowed for the evolution of land plants; evolution of corals created reefs that altered patterns of erosion and deposition along coastlines and provided habitats for the evolution of new life forms.

ESS3.D: Global Climate Change

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. Examples of evidence, for both data and climate model outputs, are for climate changes (such as precipitation and temperature) and their associated impacts on sea level, glacial ice volumes, or atmosphere and ocean composition.

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. Earth systems include: hydrosphere, atmosphere, cryosphere, geosphere, and/or biosphere. Impacts from a human activity increase: 1) atmospheric carbon dioxide, 2) photosynthetic biomass on land, 3) ocean acidification, and 4) resulting impacts on sea organism health and marine populations.

ETS1.A: Defining and Delimiting Engineering Problems

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.

ETS1.B: Developing Possible Solutions

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.

ETS1.C: Optimizing the Design Solution

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.

INSTRUCTIONAL STRATEGIES: *Indicate how the instructional strategies support the delivery of curriculum and course goals. Explain how assignments support the Common Core Standards.*

Suggested Lab Activities:

- ***Vernier Lab Experiments:***

  Lab Manual – <u>Investigating Environmental Science through Inquiry</u>

  Experiment #1: "Seasons and Angle of Insolation"
  Experiment #2: "Local Weather Study"
  Experiment #12: "Soil and Acid Precipitation"
  Experiment #21: UV Investigation"
  Experiment #22: "Sunscreen Comparison"
  Experiment #28: "Wind Energy"
  Experiment #29: "Solar Energy: Voltaic Cells"
  Experiment #30: "An Investigation of Passive Solar Heat"

  Lab Manual – <u>Water Quality with Vernier</u>

  Experiment #5: "Dissolved Oxygen"

- ***Vernier Probeware & Sensors*** – 8 Lab Quest II Receiver, 2 Dissolved Oxygen Sensors, 8 Temperature Probes, 8 Relative Humidity

Other Suggested Labs, Projects, & Activities: **Local Weather Monitoring -** Wind Speed of Air, Relative Humidity, Measure the Effects of Student-Made Wind Turbines, Investigate Wind Speed Over Land & Water. **CO_2 Monitoring** – Human Respiration, Photosynthesis, Indoor & Outdoor CO_2 Concentrations.

ASSESSMENT: *Describe the Formative and Summative Assessments that will be used to demonstrate learning and mastery of the NGSS Core Ideas.*

- ***Assessment:*** Regular Formative Assessments, Creating and Utilizing Models to Define Solutions to Problems, Data Gathering Protocols (Quality Assurance & Quality Control), Written Laboratory Assignments, Tests, Quizzes, Oral Responses, Written Notes & Worksheets.

- ***Assessment Boundaries:***

ESS2.D: Weather and Climate

HS-ESS2-4. Model flow of energy into and out of Earth's systems resulting in changes in climate. Assessment of the results of changes in climate is limited to changes in surface temperatures, precipitation patterns, glacial ice volumes, sea levels, and biosphere distribution.

HS-ESS2-6. Assessment based on quantitative modeling of carbon cycling among the hydrosphere, atmosphere, geosphere, and biosphere.

HS-ESS2-7. Evaluation based on student's evidence about the simultaneous coevolution of Earth's systems and life on Earth. Assessment does not include a comprehensive understanding of the mechanisms of how the biosphere interacts with all of Earth's other systems.

ESS3.C: Human Impacts on Earth Systems

HS-ESS3-4. Evaluate a technological solution that reduces impacts of human activities on natural systems. Assessment includes large-scale geoengineering design solutions such as altering global temperatures by making large changes to the atmosphere or ocean.

ESS3.D: Global Climate Change

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. Assessment is limited to one example of a climate change and its associated impacts.

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. Assessment is limited to published results of scientific computational models.

ETS1.A: Defining and Delimiting Engineering Problems

HS-ETS1-1. Assessment is based on the quality of analysis of a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.

ETS1.B: Developing Possible Solutions

HS-ETS1-3. Evaluation based on quality 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. Assessment based on 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.

ETS1.C: Optimizing the Design Solution

HS-ETS1-2. Assessment based on quality of student design of a solution to a complex real-world problem that can be solved through engineering.

CROSS-CUTTING CONCEPTS: *Core ideas have application across all domains of science.*

Cause and Effect

- Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects. (*HS-ESS2-4*)

Energy and Matter

- The total amount of energy and matter in closed systems is conserved. (*HS-ESS2-6*)
- Energy drives the cycling of matter within and between systems. (*HS-ESS2-4*)

Influence of Science, Engineering, and Technology on Society and the Natural World

- New technologies can have deep impacts on society and the environment, including some that were not anticipated. Analysis of costs and benefits is a critical aspect of decisions about technology. (*HS-ETS1-1) (HS-ETS1-3*)
- Engineers continuously modify these technological systems by applying scientific knowledge and engineering design practices to increase benefits while decreasing costs and risks. (*HS-ESS3-2*),(*HS-ESS3-4*)

Stability and Change

- Change and rates of change can be quantified and modeled over very short or very long periods of time. Some system changes are irreversible. *HS-ESS3-5*)
- Feedback (negative or positive) can stabilize or destabilize a system. (*HS-ESS3-4*) (*HS-ESS2-5*)
- Much of science deals with constructing explanations of how things change and how they remain stable. (*HS-ESS2-7*)

- Change and rates of change can be quantified and modeled over very short or very long periods of time. Some system changes are irreversible. (HS-*ESS2-1*)
- Feedback (negative or positive) can stabilize or destabilize a system. (*HS-ESS2-2*)

Systems and System Models
- Models (e.g., physical, mathematical, computer models) can be used to simulate systems and interactions—including energy, matter, and information flows— within and between systems at different scales. (*HS-ETS1-4*)
- When investigating or describing a system, the boundaries and initial conditions of the system need to be defined and their inputs and outputs analyzed and described using models. (*HS-ESS3-6*)

SCIENCE & ENGINEERING PRACTICES: *Describe how students will investigate and build models and theories of core ideas by using one or more of the following practices. Explain.*

Analyzing and Interpreting Data
- Analyze data using computational models in order to make valid and reliable scientific claims. (*HS-ESS3-5*)
- Analyze data using tools, technologies, and/or models (e.g., computational, mathematical) in order to make valid and reliable scientific claims or determine an optimal design solution. (*HS-ESS2-2*)

Asking Questions and Defining Problems
- Analyze complex real-world problems by specifying criteria and constraints for successful solutions. (*HS-ETS1-1*)

Constructing Explanations and Designing Solutions
- Design a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations. (*HS-ESS3-4) (HS-ETS1-2*)
- Evaluate a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations. (*HS-ETS1-3*)
- Construct an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, models, theories, simulations, peer review) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. (*HS-ESS3-1*)

Developing and Using Models
- Develop a model based on evidence to illustrate the relationships between systems or between components of a system. (*HS-ESS2-6*)
- Use a model to provide mechanistic accounts of phenomena. (*HS-ESS2-4*)

Engaging in Argument from Evidence
- Evaluate competing design solutions to a real-world problem based on scientific ideas and principles, empirical evidence, and logical arguments regarding relevant factors (e.g. economic, societal, environmental, ethical considerations). (*HS-ESS3-2*)
- Construct an oral and written argument or counter-arguments based on data and evidence. (*HS-ESS2-7*)

Scientific Investigations Use a Variety of Methods
- Science investigations use diverse methods and not always the same set of procedures to obtain data. (*HS-ESS3-5*)
- New technologies advance scientific knowledge. (*HS-ESS3-5*)

Scientific Knowledge is Based on Empirical Evidence
- Science knowledge is based on empirical evidence. (*HS-ESS3-5*)
- Science arguments are strengthened by multiple lines of evidence supporting a single explanation. (*HS-ESS3-5*)

Using Mathematics and Computational Thinking
- Use mathematical models and/or computer simulations to predict the effects of a design solution on systems and/or the interactions between systems. (*HS-ETS1-4*)
- Use a computational representation of phenomena or design solutions to describe and/or support claims and/or explanations. (*HS-ESS3-6*)

INTERVENTIONS: *Describe methods used to support students who fail to master formative and summative assessment for each unit.* Regular Formative Assessment, APEX, Academic Recovery, After-school Tutoring, Homework Club, Study Group, Online Resources - teacher notes & worksheets posted online, Bozeman Science, Khan Academy, YouTube.

El Dorado Union High School District

EDUCATIONAL SERVICES

Department: ________**Science** ____

Course Title: ______**Environmental Science** ______________________________ **Course Number:**__**0303**___

UNIT TITLE: ______ **III. Earth's Hydrosphere** ______________________________________

ESSENTIAL QUESTION: *Promote understanding with a thought-provoking question that gives meaning, relevance, and definition to the unit.*

- **What is the best way to balance demands for clean water without causing serious harm to the world's oceans.**
- **Is access to clean water a basic human right?**

UNIT OUTLINE: *Give a detailed descriptive summary of all topics covered in the unit. Explain what students will know and be able to do.*

Chapter 6. Ecosystems & Evolution

A. **Aquatic Ecosystems –**
   1. **Freshwater Ecosystems** – Standing Water (Thermal Stratification) , Flowing Water, Wetlands
   2. **Brackish Ecosystems** – Estuaries, Salt marshes, Mangroves.

Chapter 10. Freshwater Resources & Water Pollution

A. **Importance of Water** - Properties, Watersheds, Groundwater, Aquifers
B. **Water Resource Problems –** Aquifer Depletion, Overdrawn Surface Water, Salinization,
C. **Water Management –** Dams, Reservoirs, Conservation
D. **Water Pollution –** Types, Sources, Groundwater
E. **Water Quality –** Water Purification, Sewage Treatment, Legislation/Regulations, economic cost & benefits, long-term implications

Chapter 11. The Oceans & Fisheries

A. **The Global Ocean** – Currents & Atmosphere
B. **Major Ocean Life Zones** - Intertidal Zones, Benthics, Neritic (Euphotic and aphotic zones)
C. **Human Impacts on the Ocean –** Pollution, Marine Habitat, Fisheries, Ocean Dumping, Plastics, Coral Reefs, Mineral Extraction, Climate & Warmer Oceans

NGSS DISCIPLINARY CORE IDEAS (DCI): *List broad scientific concepts that help students to connect personally to societal issues and increase their depth of learning.*

ESS2.A: Earth Materials and Systems

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

ESS2.C: Role of Water in Earth's Processes

- The abundance of liquid water on Earth's surface and its unique combination of physical and chemical properties are central to the planet's dynamics. These properties include water's exceptional capacity to absorb, store, and release large amounts of energy, transmit sunlight, expand upon freezing, dissolve and transport materials, and lower the viscosities and melting points of rocks. (*HS-ESS2-5*)

ESS2.D: Weather and Climate

- 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-ESS2-4*)

- Gradual atmospheric changes were due to plants and other organisms that captured carbon dioxide and released oxygen. (*HS-ESS2-6*),(*HS-ESS2-7*)
- Changes in the atmosphere due to human activity have increased carbon dioxide concentrations and thus affect climate. (*HS-ESS2-6*),(*HS-ESS2-4*)

ESS3.A: Natural Resources
- Resource availability has guided the development of human society. (*HS-ESS3-1*)
- All forms of energy production and other resource extraction have associated economic, social, environmental, and geopolitical costs and risks as well as benefits. New technologies and social regulations can change the balance of these factors. (*HS-ESS3-2*)

ESS3.B: Natural Hazards
- 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*)

ESS3.D: Global Climate Change
- 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*)
- Through computer simulations and other studies, important discoveries are still being made about how the ocean, the atmosphere, and the biosphere interact and are modified in response to human activities. (*HS-ESS3-6*)

ETS1.B: Developing Possible Solutions
- 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. *(sa HS-ESS3-2),(sa HS-ESS3-4)*

PERFORMANCE EXPECTATIONS: *Student performance that demonstrates student has mastered the Disciplinary Core Idea (DCI).*

Students who demonstrate understanding can:

ESS2.A: Earth Materials and Systems

HS-ESS2-2. Analyze geoscience data to demonstrate that one change to Earth's surface can cause changes to other Earth's systems - climate feedbacks from increased greenhouse gases cause rising global temperatures that melt glacial ice, reduces the amount of sunlight reflected from Earth's surface, and increases surface temperatures.

ESS2.D: Weather and Climate

HS-ESS2-4. Use a model to describe how variations in the flow of energy into and out of Earth's systems result in changes in climate, particularly timescale, volcanic eruption, ocean circulation, changes in human activity, solar output, changes to Earth's orbit and the orientation of its axis, long-term changes in atmospheric composition.

HS-ESS2-5. Plan and conduct an investigation of the properties of water and its effects on Earth materials and surface processes. Mechanical (stream transportation, erosion, and deposition) and chemical (chemical weathering, melting, and recrystallization) investigations with water and a variety of solid materials provide the evidence for connections between the hydrologic cycle and system interactions such as the rock cycle.

HS-ESS2-6. Develop a quantitative model to describe the cycling of carbon among the hydrosphere, atmosphere, geosphere, and biosphere - cycling of carbon through the ocean, atmosphere, soil, and biosphere (including humans), providing the foundation for living organisms.

HS-ESS2-7. Construct an argument based on evidence about the simultaneous coevolution of Earth's systems and life on Earth - dynamic causes, effects, and feedbacks between the biosphere and Earth's other systems. Photosynthetic life produced oxygen in the oceans, altered the atmosphere, allowed for evolution of animal life; increased microbial life formed soil, land plants evolved. Evolution of corals created reefs that altered patterns of erosion and deposition along coastlines and provided habitats for the evolution of new life forms.

ESS3.A: Natural Resources and
ESS3.B: Natural Hazards

HS-ESS3-1. Construct an evidence-based explanation for ways where the following have influenced human activity: 1) availability of a natural resource such as water, 2) occurrence of natural hazards, and 3) changes in climate. Key water resources include fresh water (rivers, lakes, and groundwater) and regions of fertile soils such as river deltas. Natural hazards can occur from surface processes (tsunamis) and severe weather (hurricanes, floods, and droughts). Climate changes causing a rise in sea level affect populations and result in mass migrations.

ESS3.D: Global Climate Change

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 - evidence for climate changes (such as precipitation and temperature) and their associated impacts on sea level, glacial ice volumes, or atmosphere and ocean composition.

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. Earth systems include: hydrosphere, atmosphere, cryosphere, geosphere, and/or biosphere. Impacts of human activity increase: 1) atmospheric carbon dioxide, 2) photosynthetic biomass on land, 3) ocean acidification, and 4) impacts sea organism health and marine populations.

INSTRUCTIONAL STRATEGIES: *Indicate how the instructional strategies support the delivery of curriculum and course goals. Explain how assignments support the Common Core Standards.*

Suggested Lab Activities:

- ***Vernier Lab Experiments:***

  Lab Manual – Investigating Environmental Science through Inquiry

  Experiment #1

  Lab Manual – Water Quality with Vernier

  Experiment #1 – 12: "Water Quality Tests:" Temperature, pH, Turbidity, Total Suspended Solids, Dissolved Oxygen, Biochemical Oxygen Demand, Ortho - & Total Solids, Nitrates, Fecal Coliform, Ammonium Nitrate, Alkalinity, Total Dissolved Solids, Calcium and Water Hardness, Chlorine and Salinity, Stream-flow.

- ***Vernier Probeware & Sensors*** – 8 Lab Quest II Receiver, 2 Dissolved Oxygen Sensors, 8 Temperature Probes, 8 Relative Humidity Sensors, 8 pH Sensors, 8 Turbidity Sensors, 2 Dissolved Oxygen Sensor, 8 Colorimeters, Ammonium ISE, 8 Conductivity Meters, Calcium ISE, Conductivity Probe, 2 Flow Rate Sensors.

Other Suggested Labs, Projects, & Activities:

ASSESSMENT: *Describe the Formative and Summative Assessments that will be used to demonstrate learning and mastery of the NGSS Core Ideas.*

- ***Assessment:*** Regular Formative Assessments, Creating and Utilizing Models to Define Solutions to Problems, Data Gathering Protocols (Quality Assurance & Quality Control), Written Laboratory Assignments, Tests, Quizzes, Oral Responses, Written Notes & Worksheets.

- ***Assessment Boundaries:***

ESS2.A: Earth Materials and Systems

HS-ESS2-2. Analyze geoscience data to demonstrate that one change to Earth's surface can cause changes to other Earth's systems - climate feedbacks from increased greenhouse gases cause rising global temperatures that melt glacial ice, reduces the amount of sunlight reflected from Earth's surface, and increases surface temperatures.

ESS2.D: Weather and Climate

HS-ESS2-4. Use a model to describe how variations in the flow of energy into and out of Earth's systems result in changes in climate, particularly ocean circulation, long-term changes in atmospheric composition. Assessment of the results of changes in climate is limited to changes in surface temperatures, precipitation patterns, glacial ice volumes, sea levels, and biosphere distribution.

HS-ESS2-5. Plan and conduct an investigation of the properties of water and its effects on Earth materials and surface processes. Mechanical (stream transportation, erosion, and deposition) and chemical (chemical weathering, melting, and recrystallization) investigations with water and a variety of solid materials provide the evidence for connections between the hydrologic cycle and system interactions such as the rock cycle.

HS-ESS2-6. Assess quantitative model of the cycling of carbon among the hydrosphere, atmosphere, geosphere, and biosphere - cycling of carbon through the ocean, atmosphere, soil, and biosphere (including humans), providing the foundation for living organisms.

HS-ESS2-7. Assess students' argumentation of the coevolution of Earth's systems and life on Earth - dynamic causes, effects, and feedbacks between the biosphere and Earth's other systems. Photosynthetic life produced oxygen in the oceans, altered the atmosphere, allowed for evolution of animal life; increased microbial life formed soil, land plants evolved. Evolution of corals created reefs that altered patterns of erosion and deposition along coastlines. Assessment does not include mechanisms of how the biosphere interacts with all of Earth's other systems.

ESS3.A: Natural Resources and
ESS3.B: Natural Hazards

HS-ESS3-1. Construct an evidence-based explanation for ways where the following have influenced human activity: 1) availability of a natural resource such as water, 2) occurrence of natural hazards, and 3) changes in climate. Key water resources include fresh water (rivers, lakes, and groundwater) and regions of fertile soils such as river deltas. Natural hazards can occur from surface processes (tsunamis) and severe weather (hurricanes, floods, and droughts). Climate changes causing a rise in sea level affect populations and result in mass migrations.

ESS3.D: Global Climate Change

HS-ESS3-5. Analyze global climate models to forecast rate of global climate change and associated impacts to Earth systems. Assessment is limited to student successfully analyzing global climate change and associated impacts on sea level, glacial ice volumes, or ocean composition.

HS-ESS3-6. Modeling Relationships among Earth systems modified due to human activity. Earth systems include: hydrosphere, atmosphere, cryosphere, geosphere, and biosphere. Impacts from a human activity increase: 1) atmospheric carbon dioxide, 2) photosynthetic biomass on land, 3) ocean acidification, and 4) resulting impacts on sea organism health and marine populations. Assessment is limited to using published results of scientific computational models.

CROSS-CUTTING CONCEPTS: *Core ideas have application across all domains of science.*

Cause and Effect

- Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects. (*HS-ESS2-4) (HS-ESS3-1*)

Energy and Matter

- The total amount of energy and matter in closed systems is conserved. (*HS-ESS2-6*)
- Energy drives the cycling of matter within and between systems. (*HS-ESS2-3*)

Influence of Engineering, Technology, and Science on Society and the Natural World

- Modern civilization depends on major technological systems. (*HS-ESS3-1),(HS-ESS3*-3)
- Engineers continuously modify these technological systems by applying scientific knowledge and engineering design practices to increase benefits while decreasing costs and risks. (*HS-ESS3-2),(HS-ESS3-4*)
- New technologies can have deep impacts on society and the environment, including some that were not anticipated. (*HS-ESS3-3*)
- Analysis of costs and benefits is a critical aspect of decisions about technology. (*HS-ESS3-2*)

Influence of Engineering, Technology, and Science on Society and the Natural World

- New technologies can have deep impacts on society and the environment, including some that were not anticipated. Analysis of costs and benefits is a critical aspect of decisions about technology. (*HS-ESS2-2*)

Interdependence of Science, Engineering, and Technology

- Science and engineering complement each other in the cycle known as research and development (R&D). Many R&D

projects may involve scientists, engineers, and others with wide ranges of expertise. (*HS-ESS2-3*)

Science Addresses Questions About the Natural and Material World

- Science and technology may raise ethical issues for which science, by itself, does not provide answers and solutions. (*HS-ESS3-2*)
- Science knowledge indicates what can happen in natural systems—not what should happen. The latter involves ethics, values, and human decisions about the use of knowledge. (*HS-ESS3-2*)
- Many decisions rely on science, social, and cultural contexts to resolve issues. (*HS-ESS3-2*)

Science is a Human Endeavor

- Science is a result of human endeavors, imagination, and creativity. (*HS-ESS3-3*)

Structure and Function

- The functions and properties of natural and designed objects and systems can be inferred from their overall structure, the way their components are shaped and used, and the molecular substructures of its various materials. (*HS-ESS2-5*)

Stability and Change

- Much of science deals with constructing explanations of how things change and how they remain stable. (*HS-ESS2-7*)
- Change and rates of change can be quantified and modeled over very short or very long periods of time. Some system changes are irreversible. (*HS-ESS2-1) (HS-ESS3-3),(HS-ESS3-5*)
- Feedback (negative or positive) can stabilize or destabilize a system. (*HS-ESS2-2) (HS-ESS3-4*)

Systems and System Models

- When investigating or describing a system, the boundaries and initial conditions of the system need to be defined and their inputs and outputs analyzed and described using models. (*HS-ESS3-6*)

SCIENCE & ENGINEERING PRACTICES: *Describe how students will investigate and build models and theories of core ideas by using one or more of the following practices. Explain.*

Analyzing and Interpreting Data

- Analyze data using tools, technologies, and/or models (e.g., computational, mathematical) in order to make valid and reliable scientific claims or determine an optimal design solution. (*HS-ESS2-2*)
- Analyze data using computational models in order to make valid and reliable scientific claims. (*HS-ESS3-5*)

Constructing Explanations and Designing Solutions

- Construct an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, models, theories, simulations, peer review) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. (HS-ESS3-1)
- Design or refine a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations. (*HS-ESS3-4*)

Developing and Using Models

- Develop a model based on evidence to illustrate the relationships between systems or between components of a system. (*HS-ESS2-1),(HS-ESS2-3),(HS-ESS2-6*)
- Use a model to provide mechanistic accounts of phenomena. (*HS-ESS2-4*)

Engaging in Argument from Evidence

- Construct an oral and written argument or counter-arguments based on data and evidence. (HS-ESS2-7)
- Evaluate competing design solutions to a real-world problem based on scientific ideas and principles, empirical evidence, and logical arguments regarding relevant factors (e.g. economic, societal, environmental, ethical considerations). (*HS-ESS3-2*)

Planning and Carrying Out Investigations

- Plan and conduct an investigation individually and collaboratively to produce data to serve as the basis for evidence, and in the design: decide on types, how much, and accuracy of data needed to produce reliable measurements and consider limitations on the precision of the data (e.g., number of trials, cost, risk, time), and refine the design accordingly. (*HS-ESS2-5*)

Scientific Knowledge is Based on Empirical Evidence

- Science knowledge is based on empirical evidence. (*HS-ESS2-3*)
- Science disciplines share common rules of evidence used to evaluate explanations about natural systems. (*HS-ESS2-3*)
- Science includes the process of coordinating patterns of evidence with current theory. (*HS-ESS2-3*)
- Science arguments are strengthened by multiple lines of evidence supporting a single explanation. (*HS-ESS2-4*)

Using Mathematics and Computational Thinking

- Create a computational model or simulation of a phenomenon, designed device, process, or system. (*HS-ESS3-3*)
- Use a computational representation of phenomena or design solutions to describe and/or support claims and/or

explanations. (*HS-ESS3-6*)

Scientific Investigations Use a Variety of Methods

- Science investigations use diverse methods and procedures to obtain data. (*HS-ESS3-5*)
- New technologies advance scientific knowledge. (*HS-ESS3-5*)

Scientific Knowledge is Based on Empirical Evidence

- Science knowledge is based on empirical evidence. (*HS-ESS3-5*)
- Science arguments are strengthened by multiple lines of evidence supporting a single explanation. (*HS-ESS3-5*)

INTERVENTIONS: *Describe methods used to support students who fail to master formative and summative assessment for each unit.* Regular Formative Assessment, APEX, Academic Recovery, After-school Tutoring, Homework Club, Study Group, Online Resources - teacher notes & worksheets posted online, Bozeman Science, Khan Academy, YouTube.

El Dorado Union High School District

EDUCATIONAL SERVICES

Department: ________Science ____

Course Title: _______Environmental Science ________________________________ Course Number:___0303__

UNIT TITLE: ____IV. Earth's Lithosphere ____

ESSENTIAL QUESTION: *Promote understanding with a thought-provoking question that gives meaning, relevance, and definition to the unit.*

- **What is the best way to balance the supply and demand for Earth's natural resources?**

UNIT OUTLINE: *Give a detailed descriptive summary of all topics covered in the unit. Explain what students will know and be able to do.*

Chapter 12: Minerals & Soil Resources

A. **Plate Tectonics & the Rock Cycle** - Earth's Lithosphere - Volcanoes, Earthquakes, & the Rock Cycle.
B. **Economic Geology: Useful Minerals –** Economics, Extraction & Processing
C. **Environmental Implications of Mineral Use –** Mining, Refining, & Land Restoration
D. **Soil Properties & Processes –** Formation & Composition, Profiles, Organisms
E. **Soil Problems & Conservation** – Erosion, Pollution, Conservation, Regeneration

Chapter 13: Land Resources

A. **Land-Use in USA** – Public, Private, State, & Federal lands
B. **Forests** – Management, Deforestation, Tropical Rainforests, US Forest Lands
C. **Rangelands** – Rangeland Degradation & Desertification, US Trends
D. **National Parks & Wilderness Areas –** National Park Service, Wilderness Areas, Management of Federal Lands
E. **Conservation of Land Resources**

Chapter 14: Agriculture & Food Resources

A. **World Food Problems** – Population, Poverty, & World Hunger
B. **Principal Types of Agriculture –** Shifting, Nomadic, Slash-and-Burn, Monoculture, Poly-culture
C. **Solutions to Agriculture problems –** Loss of Agricultural Land, Domestication, Crop & Livestock Yields, Impacts
D. **Controlling Agricultural Pests –** Cost/Benefits to Pesticides, Alternatives

Chapter 16: Solid & Hazardous Waste

A. **Solid Waste** – Types, Disposal, Landfills
B. **Solid Waste Reduction –** Reduce, Reuse, Recycle, Replace, Integrated Waste Managment
C. **Hazardous Waste –** Types of Hazards

Managing Hazardous Waste – Accidents, Public Policy, Cleanup & Managing Toxic Waste, Federal and state laws, and consequences of non-compliance.

Chapter 17: Nonrenewable Resources

A. **Energy Consumption** – Worldwide Supply & Demand
B. **Coal** - Coal Deposits, Mining, Environmental Impacts, Scrubbers, Legislation
C. **Oil and Natural Gas** – Global Reserves, Refining, Environmental Impacts, Legislation
D. **Nuclear Energy** – Fissionable Materials, Reactors, Safety & Accidents, Nuclear Weapons, Radioactive Waste

Chapter 18: Renewable Resources

A. **Direct Solar Energy** – Photovoltaic Cells, Hydrogen Fuel
B. **Indirect Solar Energy** - Biomass Energy Production, Wind, Hydropower
C. **Other Renewable Resources** – Geothermal Energy, Tidal Energy
D. **Energy Solutions: Conservation and Efficiency** – Energy, Power & Consumption, Energy Efficiency Technology, Conservation, Green Architecture

NGSS DISCIPLINARY CORE IDEAS (DCI): *List broad scientific concepts that help students to connect personally to societal issues and increase their depth of learning.*

ESS1.C: The History of Planet Earth

- Continental rocks, which can be older than 4 billion years, are generally much older than the rocks of the ocean floor, which are less than 200 million years old. (*HS-ESS1-5*)

ESS2.A: Earth Materials and Systems

- Earth's systems, being dynamic and interacting, cause feedback effects that can increase or decrease the original changes. (*HS-ESS2-1*), (*HS-ESS2-2*)
- Evidence from deep probes and seismic waves, reconstructions of historical changes in Earth's surface and its magnetic field, and an understanding of physical and chemical processes lead to a model of Earth with a hot but solid inner core, a liquid outer core, a solid mantle and crust. Motions of the mantle and its plates occur primarily through thermal convection, which involves the cycling of matter due to the outward flow of energy from Earth's interior and gravitational movement of denser materials toward the interior. (*HS-ESS2-3*)
- The geological record shows that changes to global and regional climate can be caused by interactions among changes in the sun's energy output or Earth's orbit, tectonic events, ocean circulation, volcanic activity, glaciers, vegetation, and human activities. These changes can occur on a variety of time scales from sudden (e.g., volcanic ash clouds) to intermediate (ice ages) to very long-term tectonic cycles. (*HS-ESS2-4*)

ESS2.B: Plate Tectonics and Large-Scale System Interactions

- The radioactive decay of unstable isotopes continually generates new energy within Earth's crust and mantle, providing the primary source of the heat that drives mantle convection. Plate tectonics can be viewed as the surface expression of mantle convection. (*HS-ESS2-3*)
- Plate tectonics is the unifying theory that explains the past and current movements of the rocks at Earth's surface and provides a framework for understanding its geologic history. Plate movements are responsible for most continental and ocean-floor features and for the distribution of most rocks and minerals within Earth's crust. (*HS-ESS2-1*)

ESS2.E: Bio-Geology

- The many dynamic and delicate feedbacks between the biosphere and other Earth systems cause a continual co-evolution of Earth's surface and the life that exists on it. (*HS-ESS2-7*)

ESS3.C: Human Impacts on Earth Systems

- The sustainability of human societies and the biodiversity that supports them requires responsible management of natural resources. (HS-ESS3-3)
- Scientists and engineers can make major contributions by developing technologies that produce less pollution and waste and that preclude ecosystem degradation. (HS-ESS3-4)

LS4.C: Adaptation

- 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–and sometimes the extinction–of some species. (*HS-LS4-5*), (*HS-LS4-6*)
- 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*)

LS4.D: Biodiversity and Humans

- 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*) (*sa HS-LS2-7.*)

ETS1.A: Defining and Delimiting Engineering Problems

- Criteria and constraints also include satisfying any requirements set by society, such as taking issues of risk mitigation 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*)

ETS1.B: Developing Possible Solutions

- 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. *(sa HS-LS4-6)*
- 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 to a client about how a given design will meet his or her needs. *(sa HS-LS4-6)*

PERFORMANCE EXPECTATIONS: *Student performance that demonstrates student has mastered the Disciplinary Core Idea (DCI).*

Students who demonstrate understanding can:

ESS1.C History of Planet Earth

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, particularly the ability of plate tectonics to explain the ages of crustal rocks. Age of oceanic crust increases with distance from spreading mid-ocean ridges. Ages of North American continental crust increases away from a central ancient core.

ESS2.A Earth's Materials and Systems

HS-ESS2-1. Develop a model to illustrate how Earth's internal and surface processes operate at different spatial and temporal scales to form continental and ocean-floor features. Land features (mountains, valleys, and plateaus) and sea-floor features (trenches, ridges, and seamounts) are a result of both constructive forces (volcanism, tectonic uplift, and orogeny) and destructive mechanisms (weathering, mass wasting, and coastal erosion).

HS-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. Examples include: 1) loss of ground vegetation causing water runoff and soil erosion, 2) dammed rivers increase groundwater recharge, decrease sediment transport, and increase coastal erosion, and 3) loss of wetlands causes a decrease in local humidity that further reduces the wetland extent.

HS-ESS2-3. Develop a model based on evidence of Earth's interior to describe the cycling of matter by thermal convection in Earth's mantle.

ESS2.D Weather & Climate

HS-ESS2-6. Develop a quantitative model to describe the cycling of carbon among the hydrosphere, atmosphere, geosphere, and biosphere. The carbon cycle is a property of the Earth system that arises from interactions among the hydrosphere, atmosphere, geosphere, and biosphere. Cycling of carbon through the ocean, atmosphere, soil, and biosphere (including humans), provide the foundation for living organisms.

ESS2.E Bio-Geology

HS-ESS2-7. Construct an argument based on evidence about the simultaneous coevolution of Earth's systems and life on Earth. Dynamic causes, effects, and feedbacks between the biosphere and Earth's other systems, control the evolution of life, which in turn alters Earth's surface. Examples include: 1) photosynthetic life altered the atmosphere through the production of oxygen, which increased weathering rates and allowed for the evolution, 2) microbial life on land increased the formation of soil, which in turn allowed for the evolution of land plants, or 3) evolution of corals created reefs that altered patterns of erosion and deposition along coastlines and provided habitats for life.

ESS3.C: Human Impacts on Earth Systems

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. Key natural resources include: 1) access to fresh water, 2) regions of fertile soils such as river deltas, and 3) high concentrations of minerals and fossil fuels. Examples of natural hazards can be from interior processes (volcanic eruptions and earthquakes), surface processes (tsunamis, mass wasting and soil erosion), and severe weather (hurricanes, floods, and droughts). Changing climate affect human populations in the types of crops and livestock that can be raised.

HS-ESS3-2. Evaluate competing design solutions for developing, managing, and utilizing energy and mineral resources based on cost-benefit ratios. Emphasize conservation, recycling, reuse of minerals and metals resources, and minimizing impacts. Examples include: 1) developing best practices for agricultural soil use, mining (coal, tar sands, and oil shale), and 2) pumping petroleum and natural gas. Science knowledge indicates what can happen in natural systems—not what should happen.

HS-ESS3-3. Create a computational simulation to illustrate the relationships among management of natural resources, sustainability of human populations, and biodiversity. Factors affecting management of natural resources include: 1) costs of resource extraction and waste management, 2) per-capita consumption, and 3) development of new technologies. Factors affecting human sustainability include: 1) agricultural efficiency, 2) levels of conservation, and 3) urban planning.

HS-ESS3-4. Evaluate or refine a technological solution that reduces impacts of human activities on natural systems. Data includes: 1) quantity and types of pollutants released, 2) changes to biomass and species diversity, or 3) areal changes in land surface use such as urban development, agriculture and livestock, or surface mining. Limiting future impacts include: reducing, reusing, and recycling resources, geo-engineering design solutions.

LS2.C Ecosystem Dynamics, Functions, Resilience

HS-LS2-7. Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity.

LS4.C Adaptation

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. Emphasize cause and effect relationships of 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 species.

LS4.D Biodiversity & Humans

HS-LS4-6. Create or revise a simulation to test a solution to mitigate adverse impacts of human activity on biodiversity - threatened or endangered species and/or genetic variation of organisms.

INSTRUCTIONAL STRATEGIES: *Indicate how the instructional strategies support the delivery of curriculum and course goals. Explain how assignments support the Common Core Standards.*

Suggested Lab Activities:

- ***Vernier Lab Experiments:***

  Lab Manual – <u>Investigating Environmental Science through Inquiry</u>

  Experiment #8: "Soil Temperature"
  Experiment #9: "Soil Salinity"
  Experiment #10: "Soil pH"
  Experiment #11: "Soil Moisture"
  Experiment #13: "Managing Garden Soil Moisture"

  Lab Manual – <u>Water Quality with Vernier</u>

- ***Vernier Probeware & Sensors*** – 8 Lab Quest II Receiver, 8 Temperature Probes, 8 Conductivity Meters, 8 pH Sensors, 8 Soil Moisture Sensors.

Other Suggested Labs, Projects, & Activities:

- Soil Organisms
- NPK Content of Soils

ASSESSMENT: *Describe the Formative and Summative Assessments that will be used to demonstrate learning and mastery of the NGSS Core Ideas.*

- ***Assessment:*** Regular Formative Assessments, Creating and Utilizing Models to Define Solutions to Problems, Data Gathering Protocols (Quality Assurance & Quality Control), Written Laboratory Assignments, Tests, Quizzes, Oral Responses, Written Notes & Worksheets.

- ***Assessment Boundaries:***

ESS1.C History of Planet Earth

HS-ESS1-5. Students 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 as it relates to Earth's resources.

ESS2.A Earth's Materials and Systems

HS-ESS2-1. Develop a model to illustrate how Earth's internal and surface processes operate to form continental and ocean-floor features. Students will be assessed on their ability to make connections of land and sea-floor features as related to locating Earth's natural resources. Memorization of the formation of specific geographic features of Earth's surface is unnecessary.

HS-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. Student assessment is based on demonstrating how: 1) loss of ground vegetation causes an increase in water runoff and soil erosion, 2) dammed rivers increase groundwater recharge, decrease sediment transport, and increase coastal erosion, &/or 3) the loss of wetlands causes a decrease in local humidity that further reduces the wetland extent.

HS-ESS2-3. Develop a model based on evidence of Earth's interior to describe the cycling of matter by thermal convection. Student's evidence include maps of Earth's three-dimensional structure obtained from seismic waves, records of the rate of change of Earth's magnetic field (convection in the outer core), and identification of the composition of Earth's layers.

ESS2.D Weather & Climate

HS-ESS2-6. Assessment of student's ability to develop a quantitative model describing carbon cycling among the hydrosphere, atmosphere, geosphere, and biosphere, particularly cycling carbon through the ocean, atmosphere, soil, and biosphere.

ESS2.E Bio-Geology

HS-ESS2-7. Students are assessed on their ability to Construct an argument based on evidence about the simultaneous coevolution of Earth's systems and life on Earth - geoscience factors that control evolution, which in turn alters Earth's surface. Assessment does not include the mechanisms of how the biosphere interacts with all of Earth's other systems.

ESS3.C: Human Impacts on Earth Systems

HS-ESS3-1. Assessment based on student's explanation of how the availability of natural resources (fresh water, fertile soils, minerals, and fossil fuels), **occurrence of natural hazards** (volcanic eruptions, earthquakes) **and changes in climate have influenced human activity** (crops , livestock populations, mass migrations).

HS-ESS3-2. Evaluate students' design solutions for developing, managing, and utilizing energy and mineral resources based on cost-benefit ratios, conservation, recycling, and reuse of minerals and metals resources, and best practices for agricultural soil use, mining (for coal, tar sands, and oil shales), and pumping petroleum and natural gas. Assessment will focus on what can happen in natural systems—not what should happen.

HS-ESS3-3. Assessment determined by student ability to show relationships among management of natural resources, sustainability of human populations, and biodiversity. Required elements include: 1) costs of resource extraction and waste management, 2) per-capita consumption, and 3) development of new technologies, 4) agricultural efficiency, 5) levels of conservation, and 6) urban planning. Assessment for computational simulations is limited to using provided multi-parameter programs or constructing simplified spreadsheet calculations.

HS-ESS3-4. Evaluate students on their technological solution that reduces impacts of human activities on natural systems. Data includes: 1) quantity and types of pollutants released, 2) changes to biomass and species diversity, or 3) areal changes in land surface use such as urban development, agriculture and livestock, or surface mining. Limiting future impacts include: reducing, reusing, and recycling resources, geo-engineering design solutions.

LS2.C Ecosystem Dynamics, Functions, Resilience

HS-LS2-7. Assessment based on quality products - Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity.

LS4.C Adaptation

HS-LS4-5. Evaluate student 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. Emphasize cause and effect relationships of changes to the environment such as deforestation, fishing, application of fertilizers, drought, flood, and how the rate of change of the environment affect distribution or disappearance of species.

LS4.D Biodiversity & Humans

HS-LS4-6. Create or revise a simulation to test a solution to mitigate adverse impacts of human activity on biodiversity - threatened or endangered species and/or genetic variation of organisms.

CROSS-CUTTING CONCEPTS: *Core ideas have application across all domains of science.*

Cause and Effect
- Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects. (*HS-ESS3-1*) (*HS-LS4-5*),(*HS-LS4-6*)

Energy and Matter
- The total amount of energy and matter in closed systems is conserved. (*HS-ESS2-6*)

Influence of Engineering, Technology, and Science on Society and the Natural World
- New technologies can impact society and the environment, including some that were not anticipated. Analysis of costs and benefits is a critical aspect of decisions about technology. (*HS-ESS2-2*) (*HS-ESS3-3*) *(HS-ETS1-1) (HS-ETS1-3*)
- Modern civilization depends on major technological systems. (*HS-ESS3-1*),(*HS-ESS3-3*)
- Engineers continuously modify these technological systems by applying scientific knowledge and engineering design practices to increase benefits while decreasing costs and risks. (*HS-ESS3-2*),(*HS-ESS3-4*)

Interdependence of Science, Engineering, and Technology
- Science and engineering complement each other in the cycle known as research and development (R&D). Many R&D projects may involve scientists, engineers, and others with wide ranges of expertise. (*HS-ESS2-3*)

Patterns
- Empirical evidence is needed to identify patterns. (*HS-ESS1-5*)

Science Addresses Questions About the Natural and Material World
- Science and technology may raise ethical issues for which science, by itself, does not provide answers and solutions. (*HS-ESS3-2*)
- Science knowledge indicates what can happen in natural systems—not what should happen. The latter involves ethics, values, and human decisions about the use of knowledge. (*HS-ESS3-2*)
- Many decisions are made using science, social, and cultural contexts to resolve issues. (*HS-ESS3-2*)

Science is a Human Endeavor
- Science is a result of human endeavors, imagination, and creativity. (*HS-ESS3-3*)

Stability and Change
- Much of science deals with constructing explanations of how things change and how they remain stable. (*HS-ESS2-7*)
- Change and rates of change can be quantified and modeled over very short or very long periods of time. Some system changes are irreversible. (HS-ESS2-1) *(HS-ESS3-3)*
- Feedback (negative or positive) can stabilize or destabilize a system. (*HS-ESS2-2*) (*HS-ESS3-4*)

Systems and System Models

- When investigating or describing a system, the boundaries and initial conditions of the system need to be defined and their inputs and outputs analyzed and described using models. (*HS-ESS3-6*)
- Models (e.g., physical, mathematical, computer models) can be used to simulate systems and interactions—including energy, matter, and information flows— within and between systems. (*ESS3-2) (ESS3-4) (HS-ETS1-4*)

SCIENCE & ENGINEERING PRACTICES: *Describe how students will investigate and build models and theories of core ideas by using one or more of the following practices. Explain.*

Analyzing and Interpreting Data
- Analyze data using tools, technologies, and/or models (e.g., computational, mathematical) in order to make valid and reliable scientific claims or determine an optimal design solution. (*HS-ESS2-2*)

Asking Questions and Defining Problems
- Analyze complex real-world problems by specifying criteria and constraints for successful solutions. (*HS-ETS1-1*)

Constructing Explanations and Designing Solutions
- Construct an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, models, theories, simulations, peer review) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. (*HS-ESS3-1*)
- Design or refine a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations. (*HS-ESS3-4*) (*HS-ETS1-2*)
- Evaluate a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations. (*HS-ETS1-3*)

Developing and Using Models
- Develop a model based on evidence to illustrate the relationships between systems or between components of a system. (*HS-ESS2-1),(HS-ESS2-3*)

Engaging in Argument from Evidence
- Evaluate the evidence behind currently accepted explanations or solutions to determine the merits of arguments. *(HS-LS4-5*)
- Evaluate competing design solutions to a real-world problem based on scientific ideas and principles, empirical evidence, and logical arguments regarding relevant factors (e.g. economic, societal, environmental, ethical considerations). (*HS-ESS3-2*)

Engaging in Argument from Evidence
- Evaluate evidence behind currently accepted explanations or solutions to determine the merits of arguments. (*HS-ESS1-5*)
- Construct an oral and written argument or counter-arguments based on data and evidence. (*HS-ESS2-7*)

Science Addresses Questions About the Natural and Material World
- Science and technology may raise ethical issues for which science, by itself, does not provide answers and solutions. (*HS-ESS3-2*)
- Science knowledge indicates what can happen in natural systems—not what should happen. The latter involves ethics, values, and human decisions about the use of knowledge. (*HS-ESS3-2*)
- Many decisions are not made using science alone, but social and cultural contexts to resolve issues. (*HS-ESS3-2*)

Scientific Knowledge is Based on Empirical Evidence
- Science knowledge is based on empirical evidence. (*HS-ESS2-3*)
- Science disciplines share common rules of evidence used to evaluate explanations about natural systems. (*HS-ESS2-3*)
- Science includes the process of coordinating patterns of evidence with current theory. (*HS-ESS2-3*)

Using Mathematics and Computational Thinking
- Create a computational model or simulation of a phenomenon, designed device, process, or system. (HS-ESS3-3) (*HS-LS4-6*)
- Use mathematical models and/or computer simulations to predict the effects of a design solution on systems and/or the interactions between systems. (*HS-ETS1-4*)

INTERVENTIONS: *Describe methods used to support students who fail to master formative and summative assessment for each unit.* Regular Formative Assessment, APEX, Academic Recovery, After-school Tutoring, Homework Club, Study Group, Online Resources - teacher notes & worksheets posted online, Bozeman Science, Khan Academy, YouTube.

El Dorado Union High School District

EDUCATIONAL SERVICES

Department: _______Science ____

Course Title: _______Environmental Science ______________________ Course Number:__0303___

UNIT TITLE: ______ V. Environmental Careers ______________________________

ESSENTIAL QUESTION: *Promote understanding with a thought-provoking question that gives meaning, relevance, and definition to the unit.*

UNIT OUTLINE: *Give a detailed descriptive summary of all topics covered in the unit. Explain what students will know and be able to do.*

Introduction to Environmental Careers -

A. **Job Requirements** – Credentials, educational level
B. **Job Opportunities** – Academia, research & development, government, industry, legal, education

NGSS DISCIPLINARY CORE IDEAS (DCI): *List broad scientific concepts that help students to connect personally to societal issues and increase their depth of learning.*

ETS1.A: Defining and Delimiting Engineering Problems

- Criteria and constraints also include satisfying any requirements set by society, such as taking issues of risk mitigation 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*)
- 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*)

ETS1.B: Developing Possible Solutions

- 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*)
- 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 to a client about how a given design will meet his or her needs. (*HS-ETS1-4*)

ETS1.C: Optimizing the Design Solution

Criteria may need to be broken down into simpler ones that can be approached systematically, and decisions about the priority of certain criteria over others (trade-offs) may be needed. (*HS-ETS1-2*)

PERFORMANCE EXPECTATIONS: *Student performance that demonstrates student has mastered the Disciplinary Core Idea (DCI).*

Students who demonstrate understanding can:

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.

INSTRUCTIONAL STRATEGIES: *Indicate how the instructional strategies support the delivery of curriculum and course goals. Explain how assignments support the Common Core Standards.*

Suggested Lab Activities:
- ***Vernier Lab Experiments:*** NA

Other Suggested Labs, Projects, & Activities:
- *Career Research Project*

ASSESSMENT: *Describe the Formative and Summative Assessments that will be used to demonstrate learning and mastery of the NGSS Core Ideas.*
- ***Assessment:*** Regular Formative Assessments, Creating and Utilizing Models to Define Solutions to Problems, Data Gathering Protocols (Quality Assurance & Quality Control), Written Laboratory Assignments, Tests, Quizzes, Oral Responses, Written Notes & Worksheets, Career Report.

CROSS-CUTTING CONCEPTS: *Core ideas have application across all domains of science.*

Systems and System Models
- Models (e.g., physical, mathematical, computer models) can be used to simulate systems and interactions—including energy, matter, and information flows— within and between systems at different scales. (*HS-ETS1-4*)

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- Design a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations. (*HS-ETS1-2*)
- Evaluate a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations. (*HS-ETS1-3*)

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Written By: Debra Power, ORHS
Casey Ryan, ORHS