EL DORADO UNION HIGH SCHOOL DISTRICT
EDUCATIONAL SERVICES

Course of Study Information Page

COURSE TITLE **Earth & Space Sciences**		
DISTRICT COURSE NUMBER **0305**		4-DIGIT STATE COURSE CODE (COMPLETED BY SILT) **2626**
Rationale:	According to the Next Generation Science Standards (NGSS), students in high school science classes will develop understanding of a wide range of topics in Earth and Space Science (ESS). The Disciplinary Core Ideas emphasize: 1) Space Systems, 2) History of Earth, 3) Earth's Systems, 4) Weather and Climate, and 5) Human Sustainability; all designed to promote community-based geoscience literacy.* The performance expectations strongly reflect societal issues such as resources, hazards, and environmental impacts. Teachers are strongly encouraged to use engineering and technology concepts to engage students in designing solutions to challenges facing today's society. * NGSS Science Framework, June 2016	
Course Description that will be in the Course Directory:	Earth and Space Sciences is an introductory high school class that promotes geoscience literacy for students. Topics range from the expansive universe down to the interraction of humans with the Earth's atmosphere, hydrosphere, geosphere, and biosphere.	
How Does this Course align with or meet State and District content standards?	Meets or exceeds NGSS Earth & Space Science Standards ESS1 - ESS3	
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: **5 credits per semester** ☒ Meets graduation requirements (subject **Science**) ☐ Request for UC "a–g" requirements CSU/UC requirement **g**	☒ College Prep
Prerequisites:	None	

 F6143A 10/31/11; Rev. 11/5/15

Department(s):	Science
District Sites:	All School Sites
Board of Trustees COS Adoption Date:	January 23, 2007
Textbooks / Instructional Materials:	Earth Science by Allison, DeGaetano, Pasachoff ISBN-13 978-0-55-4000539-3
Funding Source:	General Funds
Board of Trustees Textbook Adoption Date:	January 23, 2007

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

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Course Title: Earth and Space Sciences

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Course Title: Earth and Space Sciences

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EDUCATIONAL SERVICES

Department: **Science**

Course Title: **Earth and Space Sciences** Course Number: **305**

Unit Title: **Earth Systems: Plate Tectonics, Earthquakes, Volcanoes, Geohazards, & Resources**

Content Area Standards (Please identify the source): List content standards students will master in this unit.

Source: Next Generation Science Standards—"Disciplinary Core Ideas"

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. (ESS1-5)
- Although active geologic processes, such as plate tectonics and erosion, have destroyed or altered most of the very early rock record on Earth, other objects in the solar system, such as lunar rocks, asteroids, and meteorites, have changed little over billions of years. Studying these objects can provide information about Earth's formation and early history. (ESS1-6)

ESS2.A: Earth Materials and Systems

- Earth's systems, being dynamic and interacting, cause feedback effects that can increase or decrease the original changes. (ESS2-1),(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 dense materials toward the interior. (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 long-term tectonic cycles. (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. (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. (ESS2.B Grade 8 GBE) (ESS2-1)

PS4.A: Wave Properties

- Geologists use seismic waves and their reflection at interfaces between layers to probe structures deep in the planet. (secondary to ESS2-3)

Unit Outline: A detailed descriptive summary of all topics covered in the unit. Explain what the students will learn, know and be able to do.

Essential Question: How do humans rely on a dynamic Earth?

Guiding Questions:

- Where does oil and gas come from?
- How do gas and oil deposits relate to carbon cycling and Earth systems?
- What is the impact of driving cars and using other fossil fuels on the Earth system?
- How did California's landscape get to look the way it does today?
- What forces shape the Earth's surface?
- How do those processes affect humans?
- What causes earthquakes?
- How do Earth's natural systems influence our cities?
- How do cities affect Earth's natural systems?

Outline of Topics:

I. Plate Tectonics

- A. Continental Drift
  1. Wegener's Hypothesis
  2. Paleo-magnetism
  3. Sea-Floor Spreading
- B. The Theory of Plate Tectonics
  1. Causes of Plate Movement
  2. Plate Boundaries
- C. The Changing Continents
  1. Earth's Changing Surface
  2. Climates and Life on Earth
  3. Supercontinent Cycle

II. Deformation of the Crust

- A. How Rock Deforms
  1. Isostasy
  2. Stress & Strain
  3. Fractures, Folds, and Faults
- B. How Mountains Form
  1. Types of Plate Collisions
  2. Types of Mountains
  3. Folded vs Fault-block Mountains

III. Earthquakes

- A. How and Where Earthquakes Happen
  1. Body & Surface Waves
  2. Structure of Earth's Interior
  3. Earthquakes & Plate Boundaries
- B. Studying Earthquakes
  1. Measure & Record Earthquakes
  2. Locating Epicenters
  3. Earthquakes Magnitude & Intensity
- C. Earthquakes and Risks to Society
  1. Earthquakes and Tsunamis
  2. Effects on Buildings
  3. Safety Precautions
  4. Forecasting Earthquake Risks

IV. Volcanoes

- A. Types of Volcanoes
- B. Volcanoes and Their Hazards
  1. Magma Composition
  2. Major Volcanic Zones
  3. Volcanic Eruptions
  4. Pyroclastic Material
- C. Signaling Volcanic Hazards

Performance Expectations:

- 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. Emphasis is on the ability of plate tectonics to explain the ages of crustal rocks. Examples include evidence of the ages, oceanic crust increasing with distance from mid-ocean ridges, and the ages of North American continental crust increasing with distance away from a central ancient core.
- 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. Emphasis is on how the appearance of land features (such as mountains, valleys, and plateaus) and sea-floor features (such as trenches, ridges, and seamounts) are a result of both constructive forces (such as volcanism, tectonic uplift, and orogeny) and destructive mechanisms (such as 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 could also be taken from system interactions such as how the loss of ground vegetation causes an increase in water runoff and soil erosion; how dammed rivers increase groundwater recharge, decrease sediment transport, and increase coastal erosion; or how the loss of wetlands causes a decrease in local humidity that further reduces the wetland extent.
- HS-ESS2-3. Develop a model based on evidence of Earth's interior to describe the cycling of matter by thermal convection. Emphasis is on both a one-dimensional model of Earth, with radial layers determined by density, and a three-dimensional model, which is controlled by mantle convection and the resulting plate tectonics. Examples of evidence include maps of Earth's three-dimensional structure obtained from seismic waves, records of the rate of change of Earth's magnetic field.
- 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.
- ESS3-2. Evaluate competing design solutions for developing, managing, and utilizing energy and mineral resources based on cost-benefit ratios. Emphasis is on the conservation, recycling, and reuse of resources (such as minerals and metals) where possible, and on minimizing impacts where it is not. Examples include developing best practices for agricultural soil use, mining (for coal, tar sands, and oil shales), and pumping (for petroleum and natural gas). Science knowledge indicates what can happen in natural systems—not what should happen.

Science & Engineering Practices

- Developing and Using Models
  - Develop a model based on evidence to illustrate the relationships between systems or between components of a system. (ESS2-1),(ESS2-3),(ESS2-6)
  - Use a model to provide mechanistic accounts of phenomena. (ESS2-4)
- 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. (ESS2-5)
- 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. (ESS2-2)
- Engaging in Argument from Evidence
  - Construct an oral and written argument or counter-arguments based on data and evidence. (ESS2-7)
- 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. (ESS2-3)
  - Science includes the process of coordinating patterns of evidence with current theory. (ESS2-3)
  - Science arguments are strengthened by multiple lines of evidence supporting a single explanation. (ESS2-4)
- Constructing Explanations and Designing Solutions
  - Construct an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, 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. (ESS1-2)
    - Apply scientific reasoning to link evidence to the claims to assess the extent to which the reasoning and data support the explanation or conclusion. (ESS1-6)
- Science Models, Laws, Mechanisms, and Theories Explain Natural Phenomena
    - Models, mechanisms, and explanations collectively serve as tools in the development of a scientific theory. (ESS1-6)
    - 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. (ESS1-2),(ESS1-6)

Instructional Strategies: Indicate how the Instructional Strategies support the delivery of the curriculum and the course goals. Indicate how assignments support the Anchor Standards.

The following assignments support the Common Core Standards as they are directly in line with NGSS – Modeling, Engineering, Experimentation, Research, Making and Supporting Claims.

Model Making:
- Concept Mapping: Graphic Organizer Topics - Rock Cycle, Plate Tectonic Features (integrate mountains, earthquakes, volcanoes and their subcategories)
- Mineral Scavenger Hunt – Poster of Minerals & Their Uses
- Minerals Wanted Poster
- Scale Model of Earth's layers
- Draw, Color, & Label a World Map: Tectonic Plates, Plate Boundaries & Physiographic Features
- Label & Color Physiographic Map of the U.S.
- Mapping the Ring of Fire
- Evidence for Continental Drift (Tectonic Plate Puzzle)
- Plate Tectonic Origami
- Sea-Floor Spreading – Coloring Isochrons of the Ocean Floor
- Art 101: Drawing Block Diagrams of Plate Boundaries
- What Earthquake Waves Tell Us about Earth's Interior (Cross-Curricular with Geometry)
- Locating Patterns of Earthquake & Volcano Distribution
- Graphing Earthquake Depths
- Graphing Patterns of Volcanism
- Profile of Volcano Types
- Geologic Cross-Section of the World

Engineering Physical 3-D Models:
- 3-D Models of Six Crystal Systems
- Convection of Colored Hot & Cold Water
- Model of Seafloor Spreading
- Shake & Quake: Students Build Earthquake-Proof Structures (to be tested with shake tables)
- Lab: Crayola Magma in Plaster of Paris
- U.S.G.S Paper Model of a Volcano
- Modeling Faults –Medium can include wooden blocks, peanut butter sandwiches, cardboard, or any layered materials.
- 3-D Modeling Project: Teaching an NGSS Objective (Individual Semester Project)

Experimentation:
- Lab: Bubble Clusters
- Lab: Growing Six Crystals from Solution
- Lab: The Chemistree- Absorptions & Evaporation
- Lab: Cooling Rate & Crystal Size
- Lab: Mineral Identification
- Lab: Rock Cycle Simulation (with crayon shavings)
- Lab: Rock Identification
- Lab: Properties of Igneous Rocks
- Lab: a Study of Sedimentary Rocks
- Lab: A Study of Metamorphic Rocks

- Lab: Eating Your Way Through Geology (Cookies Emulate Rock Types)
- Mining Lab: How is a Resource Depleted? (beans)
- Mining Lab: Cookie Mining activity (cookies)
- Mining Lab: Prospecting Underground Using Core Samples (Marble Cake)
- Lab: Determining Crustal Densities
- Outdoor Lab: Hot Air Balloons
- Lab Simulating Earth's Mantle - cornstarch as a non-Newtonian fluid
- Lab: Magnetism & Mid-Ocean Ridges (3-D modeling uses adding machine tape)
- Lab: Silica & the Viscosity of Magma
- Lab: Find the Epicenter of an Earthquake

Computer Simulations:

- PhET computer simulation - Plate Tectonics
- Simulating an Earthquake
- Online Activity: The Virtual Seismologist

Student Research Projects:

- NGSS Research Topics (ex. CA Geologic Survey Tsunami Hazards in California)
- Children's Pop Up Book: 1) Minerals, 2) Rocks, 3) Continental Drift, 4) Mountains, Earthquakes, or Volcanic Hazards to Humans, 5) Natural Resources of California
- Pet Rock

Other:

- Video: Dante's Peak and Study Guide

<u>Assessments</u>: May include, but not limited to:

The following assignments support the Common Core Standards as they are directly in line with NGSS – Modeling, Engineering, Experimentation, Research, Making and Supporting Claims.

Assessment Types: Graphic Organizers, Physical Paper Models, Engineered 3-D Models, Computer Simulations, Research Projects, Labs, Worksheets, Tests, Quizzes, Unit Exams

Assessment Boundaries:

- ESS2-1. Assessment does not include memorization of the details of the formation of specific geographic features of Earth's surface.
- ESS2-4. 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.
- ESS2-7. Assessment does not include a comprehensive understanding of the mechanisms of how the biosphere interacts with all of Earth's other systems.

<u>Interventions</u>: May include, but not limited to:

Pyramid of Intervention: As one progresses from one tier to another the interventions become more focused. This tiered model is progressive so that the achievement of all students is continuously monitored. For students who do not achieve, interventions are provided and those not responding positively are referred for further evaluation.

- **Tier 1:** Support is available to all students; teacher strategies include NGSS research and evidence-based learning that is engaging for all students. Teachers with failing students may employ other strategies: differentiated instruction, preferential seating, extended time on tests, more on-on-one instruction, parent conferences, and (when practical) re-take opportunities.
- **Tier 2:** Academic and behavioral support is expanded from the classroom to consultation / collaboration with school site professionals who help identify programs or processes to meet the student needs. Instruction becomes needs-based such as differentiation, early intervention programs, individual academic programs or consultation with intervention specialists.
- **Tier 3:** Interventions provide the student with individualized instruction such as the SST model. A team of teachers, parents, and administrators focus on the need of the student and make recommendations for specific intervention. SST recommendations are designed to be implemented, monitored, and recorded and managed by a school coordinator or administrator.
- **Tier 4:** Students benefit from specifically designed instruction based on need and SPED requirements, 504, and or school psychologists.

EL DORADO UNION HIGH SCHOOL DISTRICT

EDUCATIONAL SERVICES

Department: **Science**

Course Title: **Earth and Space Sciences** Course Number: **305**

Unit Title: **Weather and Climate**

Content Area Standards (Please identify the source): List content standards students will master in this unit.

Source: Next Generation Science Standards—"Disciplinary Core Ideas"

ESS2.A: Earth Materials and Systems
- Earth's systems, being dynamic and interacting, cause feedback effects that can increase or decrease the original changes. (ESS2-1),(ESS2-2)
- 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 long-term tectonic cycles. (ESS2-4)

ESS2.C: The Roles of Water in Earth's Surface 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. (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. (ESS2-2) (ESS2-4)
- Gradual atmospheric changes were due to plants and other organisms that captured carbon dioxide and released oxygen. (ESS2-6),(ESS2-7)
- Changes in the atmosphere due to human activity have increased carbon dioxide concentrations and thus affect climate. (ESS2-6),(ESS2-4)

ESS2.E: Biogeology
- 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. (ESS2-7)

Unit Outline: A detailed descriptive summary of all topics covered in the unit. Explain what the students will learn, know and be able to do.

Essential Question: What effects does the Earth's atmosphere have on our health and well-being?

Guiding Questions:
- What regulates weather and climate?
- What effects are humans having on the climate?
- Why do droughts have such a strong impact on California and other parts of the world?
- How will changes in climate affect our water resources?
- How do Earth's natural systems influence our cities?
- How do cities affect Earth's natural systems?

The topic of global climate change offers an excellent opportunity to explore the concept of planet Earth as a system (ESS2.A), and to apply science and engineering practices to a very important and highly visible societal issue.

Outline of Topics:

I. Earth's Atmosphere

A. Atmosphere's Composition
B. Pressure &Temperature Layers
C. Solar Energy
   1. Energy Transfer
   2. Latitude
D. Global Winds

II. Water

A. Relative Humidity
B. Clouds
C. Precipitation

III. Weather

A. Weather Maps
B. Air Masses
C. Fronts
D. Human Impacts
E. Forecasting

IV. Climate

A. Temperature & Precipitation
B. Heat Balance
C. Climate Zones
D. Climate Change & Human Activity

V. Biogeochemical Cycles

A. Cycling of Materials
   1. Carbon
   2. Nitrogen
   3. Water

Performance Expectations:

- 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 systems. Examples should include climate feedbacks, such as how an increase in greenhouse gases causes a rise in global temperatures that melts glacial ice, which reduces the amount of sunlight reflected from Earth's surface, increasing surface temperatures and further reducing the amount of ice. Examples could also be taken from other system interactions: 1) loss of ground vegetation causes an increase in water runoff and soil erosion, and 2) loss of wetlands causes a decrease in local humidity that further reduces the wetland extent.
- 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. Examples of the causes of climate change differ by timescale, over 1-10 years: large volcanic eruption, ocean circulation; 10-100s of years: changes in human activity, ocean circulation, solar output; 10-100s of thousands of years: changes to Earth's orbit and the orientation of its axis; and 10-100s of millions of years: long-term changes in atmospheric composition.
- 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. Emphasis is on modeling biogeochemical cycles that include the cycling of carbon through the ocean, atmosphere, soil, and biosphere (including humans), providing the foundation for living organisms.
- 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. Examples include how photosynthetic life altered the atmosphere through the production of oxygen, which in turn increased weathering rates and allowed for the evolution of animal life.
- 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 (such as on sea level, glacial ice volumes, or atmosphere and ocean composition).
- ESS3-6. Use a computational representation to illustrate the relationships among Earth systems and how

those relationships are being modified due to human activity. Examples of Earth systems to be considered are the hydrosphere, atmosphere, cryosphere, geosphere, and/or biosphere. An example of the far-reaching impacts from a human activity is how an increase in atmospheric carbon dioxide results in an increase in photosynthetic biomass on land and an increase in ocean acidification, with resulting impacts on sea organism health and marine populations.

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

Science & Engineering Practices

- Developing and Using Models
  - Develop a model based on evidence to illustrate the relationships between systems or between components of a system. (ESS2-1),(ESS2-3),(ESS2-6)
  - Use a model to provide mechanistic accounts of phenomena. (ESS2-4)
- 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. (ESS2-5)
- 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. (ESS2-2)
- Engaging in Argument from Evidence
  - Construct oral and written argument or counter-arguments based on data and evidence. (ESS2-7)

Instructional Strategies: Indicate how the Instructional Strategies support the delivery of the curriculum and the course goals. Indicate how assignments support the Anchor Standards.

The following assignments support the Common Core Standards as they are directly in line with NGSS – Modeling, Engineering, Experimentation, Research, Making and Supporting Claims.

Model Making:

- Concept Mapping: Graphic Organizer Topics – Weather, Climate, Risks to Humans,
- Drawing Angle of Insolation for Seasons
- Diagram of the Atmosphere (Including Temperature & Pressure Layers, Jet Streams, Auroras, Ionosphere, Satellites)
- Outdoor Activity: Draw & Identify Clouds
- Graphing: At What Height Do Clouds Form?
- Contouring: Wind & Pressure Relationships
- Native Winds & Breezes
- Analyzing Global Wind Patterns & Biomes
- Prevailing World Winds
- Reading a Station Model & Weather Maps
- Lab Tracking Weather Data
- SmartBoard Activity: Modeling Fronts
- Tracking CA's water distribution
- Tracking Hurricanes
- Graphing Climate Characteristic
- Creating Climatographs & Climatograms
- Graph: Total Ozone Mapping Data

Engineering 3-D Models:

- Convection: Make & Fly Hot Air Balloons
- Design and Build an Eco-Friendly Home
- Build a Continent Using Factors that Influence Climate & Biomes

Experimentation:

- Lab: Energy & the Earth – Sources of Energy & Energy Transfer (Cooking Popcorn)
- Lab: Absorption & Radiation of Heat
- Lab: Direct & Indirect Rays of the Sun (Angle of Incidence)

- Lab: Calculating Percent Oxygen in the Atmosphere
- Lab: Dew Point & Relative Humidity
- Lab: Evaporation & Wind Chill
- Lab: Greenhouse Effect
- Lab: Biogeochemical Cycling of Carbon
- Lab: Where Did the O2 Go?
- Lab: CO2 Sinks

Computer Simulations:

- Greenhouse Effect Simulation

Student Research Projects:

- Weather Forecasting / Prediction
- Research Topics: Global Climate Change, Greenhouse Effect, Ozone Depletion, EPA, Environmental Legislation

Assessments: May include, but not limited to:

Assessment Types: Graphic Organizers, Physical Paper Models, Engineered 3-D Models, Computer Simulations, Research Projects, Labs, Worksheets, Tests, Quizzes, Unit Exams

Assessment Boundaries:

- ESS2-4. 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.]
- ESS3-5. Assessment is limited to one example of a climate change and its associated impacts.
- ESS3-6. Assessment does not include running computational representations but is limited to using the published results of scientific computational models.

Interventions: May include, but not limited to:

See Pyramid of Interventions as listed above.

EDUCATIONAL SERVICES

Department: **Science**

Course Title: **Earth and Space Sciences** Course Number: **305**

Unit Title: **Oceans**

Content Area Standards (Please identify the source): List content standards students will master in this unit.

Source: Next Generation Science Standards—"Disciplinary Core Ideas"

ESS2.C: The Roles of Water in Earth's Surface 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 and transmit sunlight. (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. (ESS2-2) (ESS2-4)

ESS2.E: Biogeology

- 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. (ESS2-7)

ESS3.A: Natural Resources

- Resource availability has guided the development of human society. (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. (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.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. (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. (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. (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. (secondary to ESS3-2),(secondary to ESS3-4)

Unit Outline: A detailed descriptive summary of all topics covered in the unit. Explain what the students will learn, know and be able to do.

Essential Question: How are the global ocean basins an untapped resource?

Guiding Questions:

- How and why are the oceans constantly changing?
- What is the role of water on climate & weather, and how does this water affect the appearance of Earth's surface?
- How do the oceans and humans impact one another?

Outline of Topics:

I. The Water Planet
  - A. Identify the major divisions of the global ocean.

II. Properties of Ocean Water
  - A. Describe the chemical composition of ocean water.
  - B. Describe the salinity, temperature, density, and color of ocean water.

III. Life in the Oceans
  - A. Explain how marine organisms alter the chemistry of ocean water.
  - B. Describe the major zones of life in the ocean.

IV. Ocean Currents
  - A. Describe how wind patterns, the rotation of Earth, and continental barriers affect surface currents in the ocean.
  - B. Identify the major factor that determines the direction in which a surface current circulates.
  - C. Explain how differences in the density of ocean water affect the flow of deep currents.

V. Ocean Waves
  - A. Describe the formation of waves and the factors that affect wave size
  - B. Explain how waves interact with the coastline.
  - C. Identify the cause of destructive ocean waves.

VI. Tides
  - A. Describe how the gravitational pull of the moon causes tides.
  - B. Compare spring tides and neap tides.
  - C. Explain how the coastline affects tidal currents.

VII. Ocean Resources
  - A. Describe resources humans get from the ocean.
  - B. Explain the threats that water pollution poses to marine organisms.

Performance Expectations:

- 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 should include climate feedbacks, such as how an increase in greenhouse gases causes a rise in global temperatures that melts glacial ice, which reduces the amount of sunlight reflected from Earth's surface, increasing surface temperatures and further reducing the amount of ice. Examples could also be taken from other system interactions, such as how the loss of ground vegetation causes an increase in water runoff and soil erosion; how dammed rivers increase groundwater recharge, decrease sediment transport, and increase coastal erosion; or how the loss of wetlands causes a decrease in local humidity that further reduces the wetland extent.
- 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. Examples of the causes of climate change differ by timescale, over 1-10 years: large volcanic eruption, ocean circulation; 10-100s of years: changes in human activity, ocean circulation, solar output; 10-100s of thousands of years: changes to Earth's orbit and the orientation of its axis; and 10-100s of millions of years: long-term changes in atmospheric composition.
- ESS2-5. Plan and conduct an investigation of the properties of water and its effects on Earth materials and surface processes. Emphasis is on mechanical and chemical investigations with water and a variety of solid materials to provide the evidence for connections between the hydrologic cycle and system interactions commonly known as the rock cycle. Examples of mechanical investigations include stream transportation and deposition using a stream table, erosion using variations in soil moisture content, or frost wedging by the expansion of water as it freezes. Examples of chemical investigations include chemical weathering and recrystallization (by testing the solubility of different materials) or melt generation (by examining how water lowers the melting temperature of most solids).

- ESS2-6. Develop a quantitative model to describe the cycling of carbon among the hydrosphere, atmosphere, geosphere, and biosphere. Emphasis is on modeling biogeochemical cycles that include the cycling of carbon through the ocean, atmosphere, soil, and biosphere (including humans), providing the foundation for living organisms.
- 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. Examples of include how photosynthetic life altered the atmosphere through the production of oxygen, which in turn increased weathering rates and allowed for the evolution of animal life; how microbial life on land increased the formation of soil, which in turn allowed for the evolution of land plants; or how the evolution of corals created reefs that altered patterns of erosion and deposition along coastlines and provided habitats for the evolution of new life forms.
- 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. Examples of key natural resources include access to fresh water (such as rivers, lakes, and groundwater), regions of fertile soils such as river deltas, and high concentrations of minerals and fossil fuels. Examples of natural hazards can be from surface processes (such as tsunamis, mass wasting and soil erosion), and severe weather (such as hurricanes, floods, and droughts). Examples of the results of changes in climate that can affect populations or drive mass migrations include changes to sea level, regional patterns of temperature and precipitation, and the types of crops and livestock that can be raised.
- HS-ESS3-2. Evaluate competing design solutions for developing, managing, and utilizing energy and mineral resources based on cost-benefit ratios. Emphasis is on the conservation, recycling, and reuse of resources (such as minerals and metals) where possible, and on minimizing impacts where it is not. Examples include developing best practices for 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, the sustainability of human populations, and biodiversity. Examples of factors that affect the management of natural resources include costs of resource extraction and waste management, per-capita consumption, and the development of new technologies.
- HS-ESS3-4. Evaluate or refine a technological solution that reduces impacts of human activities on natural systems. Examples of data on the impacts of human activities could include the quantities and types of pollutants released, changes to biomass and species diversity. Examples for limiting future impacts could include large-scale geoengineering design solutions (such as altering global temperatures by making large changes to the atmosphere or ocean).
- 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 (such as 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. Examples of Earth systems to be considered are the hydrosphere, atmosphere, cryosphere, geosphere, and/or biosphere. An example of the far-reaching impacts from a human activity is how an increase in atmospheric carbon dioxide results in an increase in photosynthetic biomass on land and an increase in ocean acidification, with resulting impacts on sea organism health and marine populations.

Science & Engineering Practices

- Developing and Using Models
    - Develop a model based on evidence to illustrate the relationships between systems or between components of a system. (ESS2-1),(ESS2-3),(ESS2-6)
    - Use a model to provide mechanistic accounts of phenomena. (ESS2-4)
- 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. (ESS2-5)
- 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. (ESS2-

2),(ESS3-5)

- Using Mathematics and Computational Thinking
  - Create a computational model or simulation of a phenomenon, designed device, process, or system. (ESS3-3)
  - Use a computational representation of phenomena or design solutions to describe and/or support claims and/or explanations. (ESS3-6)
- 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. (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. (ESS3-4)
- Engaging in Argument from Evidence
  - Construct an oral and written argument or counterarguments based on data and evidence. (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). (ESS3-2)
- Scientific Investigations Use a Variety of Methods
  - Science investigations use diverse methods and variety of procedures to obtain data. (ESS3-5)
  - New technologies advance scientific knowledge. (ESS3- 5)
- Scientific Knowledge is Based on Empirical Evidence
  - Science knowledge is based on empirical evidence. (ESS2-3),(ESS3-5)
  - Science disciplines share common rules of evidence & evaluate explanations of natural systems. (ESS2-3)
  - Science includes the process of coordinating patterns of evidence with current theory. (ESS2-3)
  - Science arguments are strengthened by lines of evidence supporting an explanation. (ESS2-4),(ESS3-5)

Instructional Strategies: Indicate how the Instructional Strategies support the delivery of the curriculum and the course goals. Indicate how assignments support the Anchor Standards.

The following assignments support the Common Core Standards as they are directly in line with NGSS – Modeling, Engineering, Experimentation, Research, Making and Supporting Claims.

Model Making:

- Density and Layering of Liquids
- Modeling Coriolis, chalk on the Globe
- Oil spill clean-up (feather, felt soaked in mineral spirits - or baby oil, cleaned by a method of their choice)
- Sonar modeling
- Oceans & Currents of the World
- Convection currents in the Ocean

Engineering Physical 3-D Models:

Experimentation:

- Lab: Earth's Land and Water
- Lab: Heating of Land vs. Oceans
- Lab: Density of Fresh vs. Salt Water
- Lab: Estuary Discharge Rates

Computer Simulations:

- Ocean Organism & Layers Web Quest
- Tides Web Quest

Student Research Projects:

- Marine Organism Web Quest

- "Plankton" taxonomy under the microscope (pond critters)

Assessments: May include, but not limited to:

Assessment Types: Graphic Organizers, Physical Models, Engineered 3-D Models, Computer Simulations, Research Projects, Labs, Worksheets, Tests, Quizzes, Unit Exams

Assessment Boundaries:

- ESS2-4. 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.
- ESS2-7. Assessment does not include a comprehensive understanding of the mechanisms of how the biosphere interacts with all of Earth's other systems.
- ESS3-3. Assessment for computational simulations is limited to using provided multi-parameter programs or constructing simplified spreadsheet calculations.
- ESS3-5. Assessment is limited to one example of a climate change and its associated impacts.
- ESS3-6. Assessment does not include running computational representations but is limited to using the published results of scientific computational models.

Interventions: May include, but not limited to:

See Pyramid of Interventions as listed above.

EL DORADO UNION HIGH SCHOOL DISTRICT

EDUCATIONAL SERVICES

Department: **Science**

Course Title: **Earth and Space Sciences** Course Number: **305**

Unit Title: **Earth's Place in the Universe**

Content Area Standards (Please identify the source): List content standards students will master in this unit.

Source: Next Generation Science Standards—"Disciplinary Core Ideas"

ESS1.A: The Universe and Its Stars

- The star called the sun is changing and will burn out over a lifespan of approximately 10 billion years. (ESS1-1)
- The study of stars' light spectra and brightness is used to identify compositional elements of stars, their movements, and their distances from Earth. (ESS1-2),(ESS1-3)
- The Big Bang theory is supported by observations of distant galaxies receding from our own, of the measured composition of stars and non-stellar gases, and of the maps of spectra of the primordial radiation (cosmic microwave background) that still fills the universe. (ESS1-2)
- Other than the hydrogen and helium formed at the time of the Big Bang, nuclear fusion within stars produces all atomic nuclei lighter than and including iron, and the process releases electromagnetic energy. Heavier elements are produced when certain massive stars achieve a supernova stage and explode. (ESS1-2),(ESS1-3)

ESS1.B: Earth and the Solar System

- Kepler's laws describe common features of the motions of orbiting objects, including their elliptical paths around the sun. Orbits may change due to the gravitational effects from, or collisions with, other objects in the solar system.

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. (ESS1-5)
- Although active geologic processes, such as plate tectonics and erosion, have destroyed or altered most of the very early rock record on Earth, other objects in the solar system, such as lunar rocks, asteroids, and meteorites, have changed little over billions of years. Studying these objects can provide information about Earth's formation and early history. (ESS1-6)

PS1.C: Nuclear Processes

- Spontaneous radioactive decays follow a characteristic exponential decay law. Nuclear lifetimes allow radiometric dating to be used to determine the ages of rocks and other materials. (secondary to ESS1-5),(secondary to ESS1-6)

PS3.D: Energy in Chemical Processes and Everyday Life

- Nuclear Fusion processes in the center of the sun release the energy that ultimately reaches Earth as radiation. (secondary to ESS1-1)

PS4.B: Electromagnetic Radiation

- Atoms of each element emit and absorb characteristic frequencies of light. These characteristics allow identification of the presence of an element, even in microscopic quantities. (secondary to ESS1-2)

Unit Outline: A detailed descriptive summary of all topics covered in the unit. Explain what the students will learn, know and be able to do.

Essential Question: If the cosmos within me and you, how do we fit into the universe?

Guiding Questions:

- How do we know what stars are made of?
- What fuels our Sun?
- Will it ever run out of that fuel?
- Do other stars work the same way as our Sun?
- What are the predictable patterns of movement in our solar system and beyond?
- What can those motions tell us about the origin of the Universe and our planet?

Outline of Topics:

I. **Galaxies & the Universe**
   A. Nuclear Reactions
   B. Electromagnetic Spectrum
   C. The Expanding Universe
      1. Big Bang Theory
      2. Cosmic Background Radiation
   D. Galaxies
      1. Galaxy Shapes
      2. Milky Way Galaxy

II. **Stars**
   A. The Sun
      1. Atmosphere
      2. Interior
      3. Energy – Heat, Light, Nuclear
   B. Stellar Evolution
      1. Positions & Distances
      2. Star Formation
      3. Life Cycle of Stars
         a) Hertzsprung-Russell Diagrams
         b) Nucleosynthesis

III. **Our Solar System**
   A. Kepler's Law
      1. Terrestrial & Gas Planets
      2. Man-Made Satellites
      3. Sun-Earth-Moon System

Performance Expectations:

- HS-ESS1-1. Develop a model based on evidence to illustrate the life span of the sun and the role of nuclear fusion in the sun's core to release energy that eventually reaches Earth in the form of radiation. Emphasis is on the energy transfer mechanisms that allow energy from nuclear fusion in the sun's core to reach Earth. Examples of evidence for the model include observations of the masses and lifetimes of other stars, as well as the ways that the sun's radiation varies due to sudden solar flares ("space weather"), the 11-year sunspot cycle, and non-cyclic variations over centuries.
- HS-ESS1-2. Construct an explanation of the Big Bang theory based on astronomical evidence of light spectra, motion of distant galaxies, and composition of matter in the universe. Emphasis is on the astronomical evidence of the red shift of light from galaxies as an indication that the universe is currently expanding, the cosmic microwave background as the remnant radiation from the Big Bang, and the observed composition of ordinary matter of the universe, primarily found in stars and interstellar gases (from the spectra of electromagnetic radiation from stars), which matches that predicted by the Big Bang theory (3/4 hydrogen and 1/4 helium).
- HS-ESS1-3. Communicate scientific ideas about the way stars, over their life cycle, produce elements. Emphasis is on the way nucleosynthesis, and therefore the different elements created, varies as a function of the mass of a star and the stage of its lifetime.
- HS-ESS1-4. Use mathematical or computational representations to predict the motion of orbiting objects in the solar system. Emphasis is on Newtonian gravitational laws governing orbital motions, which apply to

human-made satellites as well as planets and moons.

- HS-ESS1-6. Apply scientific reasoning and evidence from ancient Earth materials, meteorites, and other planetary surfaces to construct an account of Earth's formation and early history. Emphasis is on using available evidence within the solar system to reconstruct the early history of Earth, which formed along with the rest of the solar system 4.6 billion years ago. Examples of evidence include the absolute ages of ancient materials (obtained by radiometric dating of meteorites, moon rocks, and Earth's oldest minerals), the sizes and compositions of solar system objects, and the impact cratering record of planetary surfaces.

Science & Engineering Practices

- Developing and Using Models
  - Develop a model based on evidence to illustrate the relationships between systems or between components of a system. (ESS1-1)
- Using Mathematical and Computational Thinking
  - Use mathematical or computational representations of phenomena to describe explanations. (ESS1-4)
- Constructing Explanations and Designing Solutions
  - Construct an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, 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. (ESS1-2)
  - Apply scientific reasoning to link evidence to the claims to assess the extent to which the reasoning and data support the explanation or conclusion. (MS-ESS1-6)
- Engaging in Argument from Evidence
  - Evaluate evidence behind currently accepted explanations or solutions to determine the merits of arguments. (ESS1-5)
- Obtaining, Evaluating, and Communicating Information
  - Communicate scientific ideas (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). (ESS1-3)
- 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. (ESS1-2),(ESS1-6)
  - Models, mechanisms, and explanations collectively serve as tools in the development of a scientific theory. (ESS1-6)

Instructional Strategies: Indicate how the Instructional Strategies support the delivery of the curriculum and the course goals. Indicate how assignments support the Anchor Standards.

The following assignments support the Common Core Standards as they are directly in line with NGSS – Modeling, Engineering, Experimentation, Research, Making and Supporting Claims.

Model Making:

- Concept Mapping: Graphic Organizer Topics - Variety of Galaxy Shapes, Life Cycle of Stars, Scale & Structure of the Earth, Moon, Solar System, Galaxy, & Universe
- Make a Spectroscope
- Illustrate Phases of the Moon
- Formation of the Solar System - Noodle Tools
- Dimensions of the Solar System (Using Adding Machine Tape)
- Draw, Color & Label an H-R Diagram
- Calculation of Hubble Constant

Engineering 3-D Models:

- Outdoor Activity: Scaled Chalk Model of the Solar System
- Hubble Tuning Fork Diagram
- Celestial Globe – Night Sky, Chart the Seasons

- Balloon Model to demonstrate expansion of the Universe
- Children's Pop Up Book Topics: Earth-Moon System, Seasons, Stars, Galaxies, Solar System

Experimentation:

- Lab: Emission Spectra of Stars
- Lab: Spectroscope Evaluation of Light Frequencies
- Lab: Emission & Absorption Spectra of Stars
- Lab: Measuring Parallax
- Lab: The Rotating Sun (Track Sunspots)
- Lab: Calculating Size of the Sun
- Lab: Coronal Mass Ejections
- Lab: Bolide Impacts (comparison of size vs. speed)
- Lab: Ages of Lunar Features
- Lab: Backward Motion of Planets
- Math Lab: Calculating the Eccentricity of Planet Orbits
- Lab: Moon on a Stick (aka Modeling Moon Phases & Eclipses)
- Lab Modeling the Seasons
- Lab: Using Shadows to Determine the Apparent Motion of the Sun (aka Stick in the Ground) – Measure Shadow on Fall Equinox; make predictions; repeat during Winter Solstice, and Spring Equinox

Computer Simulations:

- NASA Spacelink: On-Line Educational Resources
- Windows to the Universe

Student Research Projects:

- Investigating Tides, Seasons, & Lunar Phases
- Theory of Moon Formation
- The Inner Planets
- The Outer Planets
- Comets, Dwarf Planets, Moons, or Asteroids
- Alvarez Asteroid Impact Theory
- Cosmic Microwave Background Radiation (CMB)
- Nebula, Black Holes, Supernovae, Red Giants, White Dwarves
- Dark Matter
- String Theory
- Nucleosynthesis

Other:

- Extraterrestrial Excursions
- Thought Experiments: Comparison of the Universe to the Size of Solar System

Assessments: May include, but not limited to:

Assessment Types: Graphic Organizers, Physical Models, Engineered 3-D Models, Computer Simulations, Research Projects, Labs, Worksheets, Tests, Quizzes, Unit Exams

Assessment Boundaries:

- ESS1-1. Assessment does not include details of the atomic and sub-atomic processes involved with the sun's nuclear fusion.
- ESS1-3. Details of the many different nucleosynthesis pathways for stars of differing masses are not assessed.
- ESS1-3. Mathematical representations for the gravitational attraction of bodies and Kepler's Laws of orbital motions should not deal with more than two bodies, nor involve calculus.

Interventions: May include, but not limited to:

See Pyramid of Interventions as listed above.