**Stanford NGSS Integrated Curriculum: An Exploration of a Multidimensional World**

**Unit 1: A Balanced Biosphere**

**Essential Question:** How have natural processes and human activities created the ecosystems we see today?

**Total Number of Instructional Days:** 35.5 – 36.5

**Group Culminating Project:**

Design and Present a Map of a Hunger Games Arena

**Individual Culminating Project**

Create a Self-Guided Tour of Your Hunger Games Arena

**Lift-Off Task:**

A Well-Functioning Biosphere

**Task 2:**

Using Available Resources

**Task 3:**

Produce, Reuse, Recycle

**Task 4:**

Interactions Between Organisms

Connect to the Culminating Project using the Project Organizer

**Task 1:**

Pangaea

Puzzle

**Task 5:**

A Chain of Resources

**Unit 1 Pop-Out**

Environmental Ethics

(*Implement after project*)

**Storyline for Unit 1**

Every ecosystem on Earth is unique, with its own set of geologic features, essential natural resources, and interacting plants and animals. In this unit, students learn more about why an ecosystem works the way it does by looking at a complicated history of natural and artificial processes. By the end of the unit, students will be able to develop their own imitation ecosystem in the form of a *Hunger Games* arena for their culminating project.

In the Lift-Off Task, students are introduced to ecosystems with Biosphere 2, an artificial living environment built in Arizona in the 1990’s that was meant to be self-sustaining. By looking at the phenomenon of how a biosphere functions, students can begin to generate questions about what an ecosystem is and how it functions. These student-generated questions will guide them throughout this unit as they continue to make sense of this phenomenon and begin to imagine what their culminating project of an imitation ecosystem will look like.

In Task 1, students move to examining ecosystems from a macro perspective: based on plate motions, what geologic features are present in different ecosystems? Students engage with this question by thinking about a real case in scientific history—Alfred Wegener’s theory of Pangaea. In this task, students embark on the same journey as Wegener, making sense of the phenomenon of continent movement by collecting an abundance of data that might provide evidence. This will help them identify the geologic features within their own arena based on the continental location they choose.

In Task 2, students learn that some of these same processes also lead to the natural resources that are available in different regions. The question of how natural resources are made and distributed is a very important one for humans because we rely so heavily on them every day. In this task, students explore both the geoscience processes and the human actions that result in an uneven distribution of resources, which will help them to justify the resources they present in their arena.

In Task 3, students continue to consider nonliving things, but also begin to incorporate living organisms into their schema of an ecosystem. Here, students explore how living and nonliving parts of an ecosystem must interact to create a well-functioning ecosystem. Within this task, they construct a model that clearly shows how matter is cycled and energy flows through living and nonliving things. This helps them to envision their culminating project arena as a whole—including the living and nonliving components as well as their interactions.

Task 4 asks students to remember that this is not the only way organisms interact in an ecosystem. Regardless of the type of ecosystem, there are patterns that can be noticed in the way organisms interact with each other. These patterns have been classified into five different relationships: competition, predation, commensalism, mutualism, and parasitism. In this task, students analyze real-life examples in order to find their own patterns and make their own categories to explain interactions among organisms. As students begin to populate their arena with organisms for their culminating project, they will use these relationships to design a challenge for the game contestants.

In Task 5, students use what they have learned about the ways living and nonliving things interact in order to approach environments at a systems level. By engaging with a simulation, students are able to see data of real scenarios that allows them to predict how changing one part of an ecosystem can affect another—in other words, how different resources affect the populations of different organisms. Students will use this data to inform their culminating project, as they consider how removing a resource from their arena would impact the populations of organisms present.

Once students have completed all tasks and their Project Organizers, they can begin work on their culminating project. In this culminating project, student groups design a new *Hunger Games* arena for the upcoming film that mimics, or looks like, an ecosystem they might see on Earth. Each group presents their arena design to the director as a candidate for the next film in the form of a diorama or poster-sized annotated map. Individually, each student then creates a self-guided tour of their group’s arena, in the form of a brochure or flyer, so that the director has additional materials to consider as he makes his decision.

**Three-Dimensional Breakdown of the Performance Expectations**

This unit was developed to align with, teach, and assess students’ understanding and skills related to these Performance Expectations. Below, we have mapped out the disciplinary core ideas, crosscutting concepts, and science and engineering practices addressed in this unit. Aspects of the dimensions that are not explicitly addressed in this unit are crossed out.

|  |  |  |  |
| --- | --- | --- | --- |
| **Performance Expectations** | **Scientific and Engineering Practices** | **Disciplinary Core Ideas** | **Crosscutting Concepts** |
| **MS-LS2-1. Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem.** [Clarification Statement: Emphasis is on cause and effect relationships between resources and growth of individual organisms and the numbers of organisms in ecosystems during periods of abundant and scarce resources.] | **Analyzing and Interpreting Data**   * Analyze and interpret data to provide evidence for phenomena. | **LS2.A: Interdependent Relationships in Ecosystems**   * Organisms, and populations of organisms, are dependent on their environmental interactions both with other living things and with nonliving factors. * In any ecosystem, organisms and populations with similar requirements for food, water, oxygen, or other resources may compete with each other for limited resources, access to which consequently constrains their growth and reproduction. * Growth of organisms and population increases are limited by access to resources. | **Cause and Effect**   * Cause and effect relationships may be used to predict phenomena in natural or designed systems. |
| **MS-LS2-2. Construct an explanation that predicts patterns of interactions among organisms across multiple ecosystems.** [Clarification Statement: Emphasis is on predicting consistent patterns of interactions in different ecosystems in terms of the relationships among and between organisms and abiotic components of ecosystems. Examples of types of interactions could include competitive, predatory, and mutually beneficial.] | **Constructing Explanations**   * Construct an explanation that includes qualitative or quantitative relationships between variables that predict phenomena. | **LS2.A: Interdependent Relationships in Ecosystems**   * Similarly, predatory interactions may reduce the number of organisms or eliminate whole populations of organisms. Mutually beneficial interactions, in contrast, may become so interdependent that each organism requires the other for survival. Although the species involved in these competitive, predatory, and mutually beneficial interactions vary across ecosystems, the patterns of interactions of organisms with their environments, both living and nonliving, are shared. | **Patterns**   * Patterns can be used to identify cause and effect relationships. |
| **MS-LS2-3. Develop a model to describe the cycling of matter and flow of energy among living and nonliving parts of an ecosystem.** [Clarification Statement: Emphasis is on describing the conservation of matter and flow of energy into and out of various ecosystems, and on defining the boundaries of the system.] [Assessment Boundary: Assessment does not include the use of chemical reactions to describe the processes.] | **Developing and Using Models**   * Develop a model to describe phenomena. | **LS2.B: Cycles of Matter and Energy Transfer in Ecosystems**   * Food webs are models that demonstrate how matter and energy is transferred between producers, consumers, and decomposers as the three groups interact within an ecosystem. Transfers of matter into and out of the physical environment occur at every level. Decomposers recycle nutrients from dead plant or animal matter back to the soil in terrestrial environments or to the water in aquatic environments. The atoms that make up the organisms in an ecosystem are cycled repeatedly between the living and nonliving parts of the ecosystem. | **Energy and Matter**   * The transfer of energy can be tracked as energy flows through a natural system. |
| **MS-ESS2-3. Analyze and interpret data on the distribution of fossils and rocks, continental shapes, and seafloor structures to provide evidence of the past plate motions.** [Clarification Statement: Examples of data include similarities of rock and fossil types on different continents, the shapes of the continents (including continental shelves), and the locations of ocean structures (such as ridges, fracture zones, and trenches).] [Assessment Boundary: Paleomagnetic anomalies in oceanic and continental crust are not assessed.] | **Analyzing and Interpreting Data**   * Analyze and interpret data to provide evidence for phenomena. | **ESS2.B: Plate Tectonics and Large-Scale System Interactions**   * Maps of ancient land and water patterns, based on investigations of rocks and fossils, make clear how Earth’s plates have moved great distances, collided, and spread apart. | **Patterns**   * Patterns in rates of change and other numerical relationships can provide information about natural systems. |
| **MS-ESS3-1. Construct a scientific explanation based on evidence for how the uneven distributions of Earth’s mineral, energy, and groundwater resources are the result of past and current geoscience processes.** [Clarification Statement: Emphasis is on how these resources are limited and typically non-renewable, and how their distributions are significantly changing as a result of removal by humans. Examples of uneven distributions of resources as a result of past processes include but are not limited to petroleum (locations of the burial of organic marine sediments and subsequent geologic traps), metal ores (locations of past volcanic and hydrothermal activity associated with subduction zones), and soil (locations of active weathering and/or deposition of rock).] | **Constructing Explanations**   * Construct a scientific explanation based on valid and reliable evidence obtained from sources (including the students’ own experiments) 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.A: Natural Resources**   * Humans depend on Earth’s land, ocean, atmosphere, and biosphere for many different resources. Minerals, freshwater, and biosphere resources are limited, and many are not renewable or replaceable over human lifetimes. These resources are distributed unevenly around the planet as a result of past geologic processes. | **Cause and Effect**   * Cause and effect relationships may be used to predict phenomena in natural or designed systems. |

**Connections to Common Core Math and ELA Standards:**

Over the course of this unit, students will gain knowledge and skills in science, as well as in math and English-language arts. Below we list the Common Core ELA and Math standards for middle school and 7th grade that are relevant to the curriculum tasks in this unit. Within the curriculum, there are opportunities to incorporate components of the following ELA and Math Standards:

|  |  |  |
| --- | --- | --- |
| **Middle School Common Core ELA Standards** | | **Unit Task** |
| **Key Ideas and Details** | CCSS.ELA-Literacy.RST.6-8.1: Cite specific textual evidence to support analysis of science and technical texts. | Task 2  Culminating Project |
| **Integration of Knowledge and Ideas** | CCSS.ELA-Literacy.RST.6-8.7: Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table. | Task 2  Task 3  Culminating Project |
| CCSS.ELA-Literacy.RST.6-8.9: Compare and contrast the information gained from experiments, simulations, video, or multimedia sources with that gained from reading a text on the same topic. | Task 2 |
| **Research to Build and Present Knowledge** | CCSS.ELA-Literacy.WHST.6-8.9: Draw evidence from informational texts to support analysis, reflection, and research. | Task 2  Task 3  Culminating Project |
| **Comprehension and Collaboration** | CCSS.ELA-Literacy.SL.8.1: Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade [7] topics, texts, and issues, building on others’ ideas and expressing their own clearly. | All Tasks  Culminating Project |
| **Presentation of Knowledge and Ideas** | CCSS.ELA-Literacy.SL.8.4: Present claims and findings, emphasizing salient points in a focused, coherent manner with relevant evidence, sound valid reasoning, and well-chosen details; use appropriate eye contact, adequate volume, and clear pronunciation. | Task 1  Task 3  Culminating Project |
| CCSS.ELA-Literacy.SL.8.5: Integrate multimedia and visual displays into presentations to clarify information, strengthen claims and evidence, and add interest. | Task 1  Task 3  Culminating Project |

|  |  |  |
| --- | --- | --- |
| **Middle School and 7th Grade Common Core Math Standards** | | **Unit Task** |
| **Mathematical Practice** | CCSS.MATH.MP.2: Reason abstractly and quantitatively. | Task 5 |
| CCSS.MATH.MP.4: Model with mathematics. | Task 5 |

**Connections to English Language Development (ELD) Standards:**

We acknowledge that language development is a key component of disciplinary understanding and helps to support more rigorous and equitable outcomes for diverse students. This curriculum thus takes into account both the receptive and productive language demands of the culminating projects and strives to increase accessibility by including scaffolds for language development and pedagogical strategies throughout learning tasks. We aim to support language acquisition through the development of concept maps; utilizing sentence frames; implementing the Critique, Correct, Clarify technique; employing the Stronger Clearer strategy; and fostering large and small group discussions.

The California ELD Standards are comprised of two sections: the standards and a rubric. Outlined below are the standards from Section One that are met within this curriculum. For additional information, please refer to: <https://www.pausd.org/sites/default/files/pdf-faqs/attachments/SS_ELD_7.pdf>.

|  |  |  |
| --- | --- | --- |
| **7th Grade ELD Standards** | | |
| **Part I: Interacting in Meaningful Ways** | A: Collaborative | 1.Exchanging information and ideas with others through oral collaborative discussions on a range of social and academic topics |
| 2. Interacting with others in written English in various communicative forms (print, communicative technology, and multimedia) |
| 3. Offering and justifying options, negotiating with and persuading others in communicative exchanges |
| 4. Adapting language choices to various contexts (based on task, purpose, audience, and text type) |
| B: Interpretive | 5. Listening actively to spoken English in a range of social and academic contexts |
| 6. Reading closely literary and informational texts and viewing multimedia to determine how meaning is conveyed explicitly and implicitly through language |
| 7. Evaluating how well writers and speakers use language to support ideas and arguments with details or evidence depending on modality, text type, purpose, audience, topic, and content area |
| 8. Analyze how writers and speakers use vocabulary and other language resources for specific purposes (to explain, persuade, entertain, etc.) depending on modality, text type, purpose, audience, topic, and content area |
| C: Productive | 9. Expressing information and ideas in formal oral presentations on academic topics |
| 10. Writing literary and informational texts to present, describe, and explain ideas and information, using appropriate technology |
| 11. Justifying own arguments and evaluating others’ arguments in writing |
| 12. Selecting and applying varied and precise vocabulary and other language resources to effectively convey ideas |
| **Part II: Learning About How English Works** | A: Structuring Cohesive Texts | 1. Understanding text structure |
| 2. Understanding cohesion |
| B: Expanding and Enriching Ideas | 3. Using verbs and verb phrases |
| 4. Using nouns and noun phrases |
| 5. Modifying to add details |
| C: Connecting and Condensing Ideas | 6. Connecting ideas |
| 7. Condensing ideas |

**Connections to Environmental Awareness:**

Over the course of this curriculum, students will explore content related to various environmental principles and concepts that examine the interactions and interdependence of human societies and natural systems. In accordance with the *Education and the Environment Initiative (EEI),* tasks throughout this curriculum explore many of *California’s Approved Environmental Principles and Concepts.* The principles relevant to this unit are outlined in the chart below:

|  |  |  |
| --- | --- | --- |
| **Unit Task** | **EEI Principle** | **EEI Concept** |
| Task 2  Task 3  Culminating Project | Principle I: The continuation and health of individual human lives and of human communities and societies depend on the health of the natural systems that provide essential goods and ecosystem services. | Concept A: The goods produced by natural systems are essential to human life and to the functioning of our economies and cultures. |
| Concept B: The ecosystem services provided by natural systems are essential to human life and to the functioning of our economies and cultures. |
| Concept C: The quality, quantity, and reliability of the goods and ecosystem services provided by natural systems are directly affected by the health of those systems. |
| Task 2  Task 5  Culminating Project | Principle II: The long-term functioning and health of terrestrial, freshwater, coastal and marine ecosystems are influenced by their relationships with human societies. | Concept A: Direct and indirect changes to natural systems due to the growth of human populations and their consumption rates influence the geographic extent, composition, biological diversity, and viability of natural systems. |
| Concept B: Methods used to extract, harvest, transport and consume natural resources influence the geographic extent, composition, biological diversity, and viability of natural systems. |
| Task 2  Task 3  Culminating Project | Principle III: Natural systems change in ways that people benefit from and can influence. | Concept A: Natural systems proceed through cycles and processes that are required for their functioning. |
| Concept B: Human practices depend upon and benefit from the cycles and processes that operate within natural systems. |
| Task 2  Culminating Project | Principle IV: The exchange of matter between natural systems and human societies affects the long-term functioning of both. | Concept B: The byproducts of human activity are not readily prevented from entering natural systems and may be beneficial, neutral, or detrimental in their effect. |