Unit 08: Ecology

Content Area: **Science**
Course(s):
Time Period: **Marking Period 4**
Length: **5-6 Weeks**
Status: **Published**

Summary

Introduction:

The main focus of this unit is ecology. Students will learn about each level of biological organization as the unit progresses from the biosphere to individuals. The unit will begin with a review of how energy moves through ecosystems and how nutrients are recycled within ecosystems. At the biome level, students will learn about the major environments that compose the planet. Moving on to ecosystems, students will learn about the importance of how organisms interact with other living organisms and the nonliving factors of the environment. When discussing populations, students will evaluate population dynamics, including factors that influence population size, limiting factors on population growth, and types of population dispersal. Students will apply mathematics when calculating population size, density, and growth rate. The unit will be connected to climate change when students investigate how human activity is impacting biodiversity.

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Standards

MA.S-ID	Interpreting Categorical and Quantitative Data
9.1.12.CFR	Civic Financial Responsibility
	Brainstorming can create new, innovative ideas.

MA.S-ID.A	Summarize, represent, and interpret data on a single count or measurement variable
LA.RL.9-10.1	Cite strong and thorough textual evidence and make relevant connections to support analysis of what the text says explicitly as well as inferentially, including determining where the text leaves matters uncertain.
9.4.2.CI.1	Demonstrate openness to new ideas and perspectives (e.g., 1.1.2.CR1a, 2.1.2.EH.1, 6.1.2.CivicsCM.2).
MA.S-ID.A.2	Use statistics appropriate to the shape of the data distribution to compare center (median, mean) and spread (interquartile range, standard deviation) of two or more different data sets.
9.4.2.CI.2	Demonstrate originality and inventiveness in work (e.g., 1.3A.2CR1a).
9.4.2.CT	Critical Thinking and Problem-solving
9.2.12.CAP.3	Investigate how continuing education contributes to one's career and personal growth.
	Critical thinkers must first identify a problem then develop a plan to address it to effectively solve the problem.
	Career planning requires purposeful planning based on research, self-knowledge, and informed choices.
9.4.2.CT.2	Identify possible approaches and resources to execute a plan (e.g., 1.2.2.CR1b, 8.2.2.ED.3).
9.4.2.CT.3	Use a variety of types of thinking to solve problems (e.g., inductive, deductive).
	Individuals should practice safe behaviors when using the Internet.
	Digital communities allow for social interactions that can result in positive or negative outcomes.
9.4.2.DC.6	Identify respectful and responsible ways to communicate in digital environments.
9.4.2.GCA	Global and Cultural Awareness
	Individuals from different cultures may have different points of view and experiences.
9.4.2.GCA.1	Articulate the role of culture in everyday life by describing one’s own culture and comparing it to the cultures of other individuals (e.g., 1.5.2.C2a, 7.1.NL.IPERS.5, 7.1.NL.IPERS.6).
9.4.2.IML	Information and Media Literacy
9.4.2.IML.1	Identify a simple search term to find information in a search engine or digital resource.
	Digital tools can be used to display data in various ways.
9.4.2.IML.2	Represent data in a visual format to tell a story about the data (e.g., 2.MD.D.10).
9.4.2.IML.3	Use a variety of sources including multimedia sources to find information about topics such as climate change, with guidance and support from adults (e.g., 6.3.2.GeoGI.2, 6.1.2.HistorySE.3, W.2.6, 1-LSI-2).
	Information is shared or conveyed in a variety of formats and sources.
LA.W.9-10.1.A	Introduce precise claim(s), distinguish the claim(s) from alternate or opposing claims, and create an organization that establishes clear relationships among claim(s), counterclaims, reasons, and evidence.
9.4.2.TL.2	Create a document using a word processing application.
9.4.2.TL.3	Enter information into a spreadsheet and sort the information.
MA.A-REI.A	Understand solving equations as a process of reasoning and explain the reasoning
MA.A-REI.B	Solve equations and inequalities in one variable
	Collaboration can simplify the work an individual has to do and sometimes produce a better product.

LA.W.9-10.2.E	Establish and maintain a style and tone appropriate to the audience and purpose (e.g., formal and objective for academic writing) while attending to the norms and conventions of the discipline in which they are writing.
LA.W.9-10.2.F	Provide a concluding paragraph or section that supports the information or explanation presented (e.g., articulating implications or the significance of the topic).
MA.A-REI.D	Represent and solve equations and inequalities graphically
	Comprehension and Collaboration
LA.SL.9-10.2	Integrate multiple sources of information presented in diverse media or formats (e.g., visually, quantitatively, qualitatively, orally) evaluating the credibility and accuracy of each source.
LA.SL.9-10.4	Present information, findings, and supporting evidence clearly, concisely, and logically. The content, organization, development, and style are appropriate to task, purpose, and audience.
LA.L.9-10	Language
	Obtaining, Evaluating, and Communicating Information
	Planning and Carrying Out Investigations
LS1.C	Organization for Matter and Energy Flow in Organisms
HS-LS2-1	Use mathematical and/or computational representations to support explanations of factors that affect carrying capacity of ecosystems at different scales.
LS2.A	Interdependent Relationships in Ecosystems
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.
LS2.A	Interdependent Relationships in Ecosystems
LS2.C	Ecosystem Dynamics, Functioning, and Resilience
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.
LS2.B	Cycles of Matter and Energy Transfer in Ecosystems
HS-LS2-4	Use mathematical representations to support claims for the cycling of matter and flow of energy among organisms in an ecosystem.
LS2.B	Cycles of Matter and Energy Transfer in Ecosystems
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.B	Cycles of Matter and Energy Transfer in Ecosystems
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.
LS2.C	Ecosystem Dynamics, Functioning, and Resilience
HS-LS2-7	Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity.
LS4.D	Biodiversity and Humans
HS-LS4	Biological Evolution: Unity and Diversity
HS-LS4-2	Construct an explanation based on evidence that the process of evolution primarily results from four factors: (1) the potential for a species to increase in number, (2) the heritable genetic variation of individuals in a species due to mutation and sexual reproduction, (3) competition for limited resources, and (4) the proliferation of those organisms that are better able to survive and reproduce in the environment.

HS-LS4-4	Construct an explanation based on evidence for how natural selection leads to adaptation of populations.
HS-LS4-5	Evaluate the evidence supporting claims that changes in environmental conditions may result in: (1) increases in the number of individuals of some species, (2) the emergence of new species over time, and (3) the extinction of other species.
HS-LS4-6	Create or revise a simulation to test a solution to mitigate adverse impacts of human activity on biodiversity.
LS4.D	Biodiversity and Humans
	Analyzing and Interpreting Data
	Analyzing data in 9–12 builds on K–8 experiences and progresses to introducing more detailed statistical analysis, the comparison of data sets for consistency, and the use of models to generate and analyze data.
ESS2.A	Earth Materials and Systems
ESS2.D	Weather and Climate
	Stability and Change
	Modeling in 9–12 builds on K–8 experiences and progresses to using, synthesizing, and developing models to predict and show relationships among variables between systems and their components in the natural and designed world(s).
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	Cause and Effect
ESS2.E	Biogeology
HS-ESS3	Earth and Human Activity
HS-ESS3-3	Create a computational simulation to illustrate the relationships among management of natural resources, the sustainability of human populations, and biodiversity.
ESS3.C	Human Impacts on Earth Systems

Essential Questions/ Enduring Understanding

Essential Questions:

What is the importance of cycling matter within an ecosystem and how energy is transformed as it moves through an ecosystem?

How do organisms interact with other living organisms and nonliving factors within an ecosystem and how do these interactions impact carrying capacity and population growth?

How is the shape of a pyramid a good representation of how biomass, energy, and the number of organisms changes as you move up trophic levels in an ecosystem?

What is the importance of biodiversity and what are possible solutions to environmental issues such as climate change?

Enduring Understanding:

All organisms are connected and interdependent on one another.

Energy is transformed as it moves through an ecosystem, while matter is recycled within an ecosystem.

An ecosystem includes all of the interactions between living organisms with each other and with their physical environment.

Human activity has an impact on biodiversity and the global climate.

Objectives

Students will know key vocabulary: ecosystem, habitat, niche, community, population, ecology, biosphere, biotic, abiotic, biome, autotroph, heterotroph, producer, consumer, and biodiversity.

Students will know how each level of biological organization has emergent properties.

Students will know how the abiotic factors of each biome relate to the biotic factors.

Students will know how energy is transformed as it moves through an ecosystem.

Students will know how matter cycles within an ecosystem in various biogeochemical cycles.

Students will know how burning fossil fuels impact the carbon cycle.

Students will know the effects symbiotic relationships have on organisms.

Students will know how organisms in a population are dispersed.

Students will know why population growth is limited and how growth changes over time.

Students will know the adaptive advantages of each of the two types of reproductive strategies a species can have.

Students will know how to calculate the rates of change in population size due to birth, mortality, immigration, and emigration.

Students will know why the human population is growing beyond its carrying capacity.

Students will know how humans are impacting the planet both directly and indirectly.

Students will be skilled at identifying biotic and abiotic factors of an ecosystem.

Students will be skilled at determining the type of relationship between two species.

Students will be skilled at depicting how energy travels through an ecosystem using food webs, food chains, and food pyramids.

Students will be skilled at calculating the changes in energy, biomass, and the number of organisms up trophic levels.

Students will be skilled at calculating population size and population density.

Students will be skilled at determining the carrying capacity of a population.

Students will be skilled at graphing population growth and analyzing data for trends that are explained by an understanding of population dynamics.

Students will be skilled at evaluating the impact of climate change on the planet and creating possible solutions.

Learning Plan

Unit Notes: Students will record detailed notes in a notebook that cover the learning goals of the unit.

Ecology Prompts: Students will respond to prompts throughout the unit. Each prompt will connect to a specific topic in the unit. For some prompts students will conduct online research and for other prompts students will reflect on how the course content relates to them.

Biome Travel Brochure: Students will be assigned one terrestrial or aquatic biome to research. Students will use the information gained from online research to create a brochure that emphasizes the local and global importance of the biome. Additional information to be included in the project is the biotic and abiotic factors, a packing list, and a description of the biome. Information should be displayed creatively, using color and images. Students will present what they have learned about the biome to the class. Students will take notes on each biome as they watch the presentations.

Biogeochemical Cycles Poster: Students will work in groups to learn about one of the biogeochemical cycles. They will create a poster that depicts each component of the biogeochemical cycle. Students will then present the poster to the class to teach the class about how nutrients are recycled within an ecosystem.

Energy in an Ecosystem and Biomagnification: For this activity, students will complete a packet that focuses on how energy, biomass, and the number of organisms changes at each trophic level. Students will calculate the amount of energy, biomass, and the number of organisms that reach each successive trophic level. Students will also create their own energy pyramid that contains organisms from each trophic level. Lastly, students

will learn about the effect of biomagnification on ecosystems. Students will use colored beads to model the increase in toxins moving up the food chain.

Community Interactions Activity: In this activity students will visit different stations in the classroom that have examples of different species interactions. Students will identify the specific type of community interaction displayed at each station and justify their identification using evidence from the depiction of the interaction and their understanding of community interactions. The focus of this activity is for students to learn how all species are connected within a community.

Population Estimate Lab: This activity will model the procedure ecologists use to estimate population size and density. Students will be provided with an unknown number of popcorn kernels to represent the original population size. Students will randomly select a given number of popcorn kernels, which they will mark with a pen, and then "release" back into the original population. Students will again randomly select a given number of popcorn kernels and count the number of marked versus unmarked popcorn kernels in their sample selection. Students will use a mathematical equation to estimate the size of the original popcorn kernel population.

Deer Population Graph: Students will complete a packet that uses mathematical skills to analyze trends in population size and density of a population of deer in response to environmental factors. Students will graph the population size over time in order to calculate the rate of population growth and carrying capacity. Students will make conclusions about why the deer population has changed over time using their understanding of density dependent and density independent limiting factors.

Human Population Growth Graph: Students will be provided with data about how the human population size has changed over time. Students will graph the data and analyze the graph for trends in population growth rate. Students will learn about historical events that have influenced the growth of the human population. They will determine if the human population demonstrates exponential or logistic growth and support their conclusion using evidence from data and reasoning from their knowledge of population dynamics.

Climate Change Impact Project: For this project students will work in groups to research an environmental issue and develop a solution to the issue. Students will conduct online research using databases to gather evidence from data about the causes, consequences, and contributors of the environmental issue. Students will then develop their own unique solution to help mitigate the consequences of the environmental issue. Students will write proposals that outline the logistics and the description of the solution and will then create a model of the solution. Students will present their research on the environmental issue and their solution to the class.

Assessment

Formative:

Do Now Questions.

Exit Ticket Questions.

Ecology Prompts

Quizzes (biomes, energy and ecosystems, population ecology, community interactions)

Participation in class discussions

Worksheets and classwork (Energy in an Ecosystem, Population Dynamics)

Summative:

Unit Assessment

Formal Lab Reports (Mark Recapture Simulation, Population Dynamics)

Benchmark:

Honors Biology Final Exam

Alternative Assessments:

Ocean Acidification Lab

Biome Travel Brochure

Human Environmental Impact Project

Materials

Textbook: Biology Concepts and Connections (Pearson Education) by Campell, Reece, Taylor, Simon, Dickey (2009)

Unit Learning Outline

Technology: computers for student and teacher, SmartBoard projector

Teacher Slide Presentations

Whiteboard + Accessories

Guided Notes/Worksheets

Lab Report Outline and Rubric

Personal Protective Equipment: safety glasses, gloves

Lab Equipment: beakers, water,sodium bicarbonate, acid indicator, dice, beans, corn kernels, cups

Graphing paper, rulers, colored pencils/markers