Unit 1: Ecology

Content Area:	**Science**
Course(s):	
Time Period:	**Marking Period 1**
Length:	**2 weeks**
Status:	**Published**

Summary

Students will study the interactions between living things and their environment. This includes differences between biomes, ecosystems, and habitats. Students will explore the nature and forms of energy, food webs and chains. Students will also learn about species competition and how certain species live together in symbiotic relationships. Students will track a population's growth, learn about limiting factors and explore how to manage wild populations. Students will learn how energy moves through a food web / chain and the factors that influence energy intake at different trophic levels.

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LA.RL.11-12.1	Cite strong and thorough textual evidence and make relevant connections to support analysis of what the text says explicitly as well as inferences drawn from the text, including determining where the text leaves matters uncertain.
LA.RL.11-12.2	Determine two or more themes or central ideas of a text and analyze their development over the course of the text, including how they interact and build on one another to produce a complex account; provide an objective summary of the text.
LA.RI.11-12.1	Accurately cite strong and thorough textual evidence, (e.g., via discussion, written response, etc.), to support analysis of what the text says explicitly as well as inferentially, including determining where the text leaves matters uncertain.
LA.SL.11-12.1.A	Come to discussions prepared, having read and researched material under study; explicitly draw on that preparation by referring to evidence from texts and other research on the topic or issue to stimulate a thoughtful, well reasoned exchange of ideas.
LA.SL.11-12.1.B	Collaborate with peers to promote civil, democratic discussions and decision-making, set clear goals and assessments (e.g., student developed rubrics), and establish individual roles as needed.
LA.SL.11-12.1.C	Propel conversations by posing and responding to questions that probe reasoning and evidence; ensure a hearing for a full range of positions on a topic or issue; clarify, verify, or challenge ideas and conclusions; and promote divergent and creative perspectives.
LA.SL.11-12.4	Present information, findings and supporting evidence clearly, concisely, and logically. The content, organization, development, and style are appropriate to task, purpose, and audience.
LA.SL.11-12.5	Make strategic use of digital media (e.g., textual, graphical, audio, visual, and interactive elements) in presentations to enhance understanding of findings, reasoning, and evidence and to add interest.
	At the macroscopic scale, energy manifests itself in multiple ways, such as in motion, sound, light, and thermal energy.
	Energy cannot be created or destroyed, but it can be transported from one place to another and transferred between systems.
	Although energy cannot be destroyed, it can be converted to less useful forms—for example, to thermal energy in the surrounding environment.

	Multicellular organisms have a hierarchical structural organization, in which any one system is made up of numerous parts and is itself a component of the next level.
	Assessment does not include specific gene control mechanisms or rote memorization of the steps of mitosis.
	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 worlds.
	Use a model based on evidence to illustrate the relationships between systems or between components of a system.
	Models (e.g., physical, mathematical, computer models) can be used to simulate systems and interactions—including energy, matter, and information flows—within and between systems at different scales.
	Emphasis is on illustrating inputs and outputs of matter and the transfer and transformation of energy in photosynthesis by plants and other photosynthesizing organisms. Examples of models could include diagrams, chemical equations, and conceptual models.
	The process of photosynthesis converts light energy to stored chemical energy by converting carbon dioxide plus water into sugars plus released oxygen.
	Changes of energy and matter in a system can be described in terms of energy and matter flows into, out of, and within that system.
	As matter and energy flow through different organizational levels of living systems, chemical elements are recombined in different ways to form different products.
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SCI.HS.LS1.C	Organization for Matter and Energy Flow in Organisms
	As matter and energy flow through different organizational levels of living systems, chemical elements are recombined in different ways to form different products.
	As a result of these chemical reactions, energy is transferred from one system of interacting molecules to another. Cellular respiration is a chemical process in which the bonds of food molecules and oxygen molecules are broken and new compounds are formed that can transport energy to muscles. Cellular respiration also releases the energy needed to maintain body temperature despite ongoing energy transfer to the surrounding environment.
	Energy cannot be created or destroyed—it only moves between one place and another place, between objects and/or fields, or between systems.
	Emphasis is on quantitative analysis and comparison of the relationships among interdependent factors including boundaries, resources, climate, and competition. Examples of mathematical comparisons could include graphs, charts, histograms, and population changes gathered from simulations or historical data sets.
	The total amount of energy and matter in closed systems is conserved.
CS.9-12.8.1.12.DA.1	Create interactive data visualizations using software tools to help others better understand real world phenomena, including climate change.
CS.9-12.8.1.12.DA.5	Create data visualizations from large data sets to summarize, communicate, and support different interpretations of real-world phenomena.
CS.9-12.8.1.12.IC.1	Evaluate the ways computing impacts personal, ethical, social, economic, and cultural practices.
CS.9-12.8.2.12.EC.1	Analyze controversial technological issues and determine the degree to which individuals, businesses, and governments have an ethical role in decisions that are made.
CS.9-12.8.2.12.EC.3	Synthesize data, analyze trends, and draw conclusions regarding the effect of a technology

	on the individual, culture, society, and environment and share this information with the appropriate audience.
CS.9-12.8.2.12.ED.2	Create scaled engineering drawings for a new product or system and make modification to increase optimization based on feedback.
CS.9-12.8.2.12.ED.6	Analyze the effects of changing resources when designing a specific product or system (e.g., materials, energy, tools, capital, labor).
CS.9-12.8.2.12.ETW.1	Evaluate ethical considerations regarding the sustainability of environmental resources that are used for the design, creation, and maintenance of a chosen product.
CS.9-12.8.2.12.ETW.2	Synthesize and analyze data collected to monitor the effects of a technological product or system on the environment.
CS.9-12.8.2.12.ETW.3	Identify a complex, global environmental or climate change issue, develop a systemic plan of investigation, and propose an innovative sustainable solution.
CS.9-12.8.2.12.ITH.2	Propose an innovation to meet future demands supported by an analysis of the potential costs, benefits, trade-offs, and risks related to the use of the innovation.
CS.9-12.8.2.12.ITH.3	Analyze the impact that globalization, social media, and access to open source technologies has had on innovation and on a society's economy, politics, and culture.
WRK.9.2.12.CAP.13	Analyze how the economic, social, and political conditions of a time period can affect the labor market.
	Data are gathered, displayed, summarized, examined, and interpreted to discover patterns and deviations from patterns. Quantitative data can be described in terms of key characteristics: measures of shape, center, and spread. The shape of a data distribution might be described as symmetric, skewed, flat, or bell shaped, and it might be summarized by a statistic measuring center (such as mean or median) and a statistic measuring spread (such as standard deviation or interquartile range). Different distributions can be compared numerically using these statistics or compared visually using plots. Knowledge of center and spread are not enough to describe a distribution. Which statistics to compare, which plots to use, and what the results of a comparison might mean, depend on the question to be investigated and the real-life actions to be taken.
	Brainstorming can create new, innovative ideas.
	Modeling links classroom mathematics and statistics to everyday life, work, and decision-making. Modeling is the process of choosing and using appropriate mathematics and statistics to analyze empirical situations, to understand them better, and to improve decisions. Quantities and their relationships in physical, economic, public policy, social, and everyday situations can be modeled using mathematical and statistical methods. When making mathematical models, technology is valuable for varying assumptions, exploring consequences, and comparing predictions with data.
	Critical thinkers must first identify a problem then develop a plan to address it to effectively solve the problem.
	In real world problems, the answers are usually not numbers but quantities: numbers with units, which involves measurement. In their work in measurement up through Grade 8, students primarily measure commonly used attributes such as length, area, and volume. In high school, students encounter a wider variety of units in modeling, e.g., acceleration, currency conversions, derived quantities such as person-hours and heating degree days, social science rates such as per-capita income, and rates in everyday life such as points scored per game or batting averages. They also encounter novel situations in which they themselves must conceive the attributes of interest. For example, to find a good measure of overall highway safety, they might propose measures such as fatalities per year, fatalities per year per driver, or fatalities per vehicle-mile traveled. Such a conceptual process is sometimes called quantification. Quantification is important for science, as when surface area suddenly "stands out" as an important variable in evaporation. Quantification is also important for companies, which must conceptualize relevant attributes and create or choose suitable measures for them.

Essential Questions / Enduring Understandings

Essential Questions:

How do the laws of thermodynamics govern the structure and functioning of ecosystems and organism behavior?

What is the relationship between producers, consumers and decomposers?

How does the progressive loss of energy impact the biomass and energy at successive trophic levels?

How do limiting factors affect the ecological niche and population ecology of organisms in an ecosystem?

Enduring Understandings:

Energy is lost as it flows through ecosystems, resulting in "tiered" trophic levels that limit the population size of top level predators as a result of increased competition.

All organism interactions and behaviors are based on the need of every living thing to achieve 2 things: energy consumption for survival and reproduction.

Objectives

Student will know about scientific inquiry and scientific skills.

Students will know the difference between inferences and observations.

Students will know how to create and test a hypothesis through experimental design.

Students will know the steps of the scientific method in detail.

Students will know the laws of thermodynamics.

Students will know how trophic levels develop in an ecosystem.

Students will know how limited resources lead to inner and intraspecific competition.

Students will know how competition impacts the niche of an organism.

Students will know the role of keystone species.

Students will be skilled at differentiating between biotic and abiotic factors/resources.

Students will be skilled at differentiate between a food chain and a food web.

Students will be skilled at identifying trophic levels in a food web.

Students will be skilled at graphing population changes per the logistical growth model.

Students will be skilled at estimating wildlife populations via census vs sampling methods

Learning Plan

Primary Inquiry - What do you already know about environmental science? Independent worksheet to determine prior knowledge of students

Ecology Intro - Notes/discussion: How is ecology different from biology? What are the 2 main objectives for all living things? How do plants and animals differe in the way they aquire energy?

Food Chains and Trophic Levels - Students will be given examples of food chains to assess the flow of energy and identify trophic levels/energy availability at each step of the food chain. They will then brainstorm/group discuss why trophic levels get progressively smaller at the top of food chains based on the laws of thermodynamics. Class share/discussion of food chains in different ecosystems with varying energy availability.

Ecological Pyramids - Independent Reading Assignment: Jigsaw - In groups of 3, each student will research one of the 3 ecological pyramids: Biomass, Energy and Numbers. They will then teach eachother and make the connection between each pyramid and the loss of energy at each trophic level.

Ecological Niches and Competition - Students will research the difference between a fundamental vs realized niche and the aspects each encompasses, then connect this info to a case study about the green and brown anole lizard populations in Florida. Students will research the difference between a intra vs interspecific competition, then connect this info to a case study about bird species in a rainforest and which types of competition are taking place. Students will research the concept of resource partitioning and then connect it to a case study about darwin's finches in the Galapagos.

Logistical Growth - Students will take notes on Population Dynamics and learn about the logistical (s-shaped) growth curve. They will then research r vs k selected species and connect their population change to the model.

Population Assessment - Students will learn about census vs sampling population estimates and then conduct a field study assessment of leaves in a section of the back field behind the HS.

Keystone Species and Symbiotic Relationships - students will follow along and have a class discussion about the main types of symbiotic relationships, then see a video example of each. Students will then brainstorm what a keystone species is and see 3 video examples. This will lead into a case study assignment about wolves in yellowstone park as a prime example of the impact of keystone species loss.

Assessment

Formative Assessments:

- Worksheets

- Do Nows
- Exit Tickets
- Class Discussions

Quizzes:

- scientific method
- food chains, food webs and trophic levels
- Ecological Pyramids and Competition

Bench Marks:

SGO

- *Data Analysis, Graphing and Scientific Method Free Response Question*

Midterm and Final Exams

Alternative:

- Census vs Sampling Outdoor Lab
- Video segments
- Case Studies
- Independent Research

Summative:

Midterm and Final Exams

Unit Test:

- Organism Objectives
- Plants vs Animals and energy consumption
- Laws of Thermodynamics
- Food Webs and Trophic Levels
- Niches and Competition
- Ecological Pyramids
- Symbiotic Relationships and Keystone Species

Materials

Raven & Berg Evnironment Textbooks (ISBN: 978-1-119-39341-2)

Guided note packets (teacher developed)

Technology (student & teacher laptops, SmartBoard)

PowerPoints

Workshets/notes

Youtube/Netflix

Hula Hoops and Rope for population estimation

Logistical Growth Game

Suggested Strategies for Modification

See attached document
https://docs.google.com/spreadsheets/d/1P8BzKodtBsbWi4rQ0tunGWhZkCOg52IvbNO7yy-TFJI/edit?usp=sharing