Unit 1: Ecological Footprint

Content Area: **Science**
Course(s):
Time Period: **MP1**
Length: **25 days**
Status: **Published**

NJSLS - Science

9-12.HS-LS2-1	Use mathematical and/or computational representations to support explanations of factors that affect carrying capacity of ecosystems at different scales.
9-12.HS-LS2-6	Evaluate 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.
9-12.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.

Science and Engineering Practices

Using Mathematics and Computational Thinking

Use mathematical and/or computational representations of phenomena or design solutions to support explanations. (HS-LS2-1)

Use mathematical representations of phenomena or design solutions to support and revise explanations. (HS-LS2-2)

Engaging in Argument from Evidence

Evaluate the claims, evidence, and reasoning behind currently accepted explanations or solutions to determine the merits of arguments. (HS-LS2-6)

Scientific Knowledge is Open to Revision in Light of New Evidence

Most scientific knowledge is quite durable, but is, in principle, subject to change based on new evidence and/or reinterpretation of existing evidence. (HS-LS2-2)

Scientific argument is a mode of logical discourse used to clarify the strength of relationships between ideas and evidence that may result in a revision of an explanation. (HS-LS2-6)

Disciplinary Core Ideas

LS2.A: Interdependent Relationships in Ecosystems

Ecosystems have carrying capacities, which are limits to the number of organisms and populations they can support. These limits result from such factors as the availability of living and nonliving resources and from such challenges as predation, competition, and disease. Organisms would have the capacity to produce populations of great size were it not for the fact that environments and resources are finite. This fundamental tension affects the abundance (number of individuals) of species in any given ecosystem. (HS-LS2-1),(HS-LS2-2)

LS2.C: Ecosystem Dynamics, Functioning, and Resilience

A complex set of interactions within an ecosystem can keep its numbers and types of organisms relatively constant over long periods of me under stable conditions. If a modest biological or physical disturbance to an ecosystem occurs, it may return to its more or less original status (i.e., the ecosystem is resilient), as opposed to becoming a very different ecosystem. Extreme fluctuations in conditions or the size of any population, however, can challenge the functioning of ecosystems in terms of resources and habitat availability. (HS-LS2-2),(HS-LS2-6)

Crosscutting Concepts

Scale, Proporon, and Quanty

The significance of a phenomenon is dependent on the scale, proportion, and quantity at which it occurs. (HS-LS2-1)

Using the concept of orders of magnitude allows one to understand how a model at one scale relates to a model at another scale. (HS-LS2-2)

Stability and Change

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

Rationale and Transfer Goals

In this unit of study, students formulate answers to the question “How and why do organisms interact with each other (biotic factors) and their environment (abiotic factors), and what affects these interactions?”

Secondary ideas include the interdependent relationships in ecosystems; dynamics of ecosystems; and functioning, resilience, and social interactions, including group behavior. Students use mathematical reasoning and models to make sense of carrying capacity, factors affecting biodiversity and populations, the cycling of matter, and the flow of energy through systems. The crosscutting concepts of scale, proportion, quantity stability, and change are called out as organizing concepts for the disciplinary core ideas. Students are expected to use mathematical reasoning and models to demonstrate proficiency with the disciplinary core ideas.

Enduring Understandings

- Humans alter the environment in ways that affect other humans and other living things.
- An ecological footprint allows us to compare which people and which countries are doing more damage to the environment by measuring the resources that we use. (food, energy, land, etc.)
- There are limited resources on the Earth. We need to either become sustainable or start looking for renewable resources to ensure that future generations can also survive.
- The environment is facing many problems that affect everybody. Since everybody is connected in nature, we all share responsibility in finding solutions.

Essential Questions

- When they relocate bears, wolves, or other predators, how do they know that they will survive?
- What limits the number and types of different organisms that live in one place?
- How can a one or two-inch rise in sea level devastate an ecosystem?

Content - What will students know?

- Ecosystems have carrying capacities, which are limits to the number of organisms and populations they can support.
- These limits result from such factors as the availability of living and nonliving resources and from such challenges as predation, competition, and disease.
- Organisms would have the capacity to produce populations of great size were it not for the fact that environments and resources are finite. This fundamental tension affects the abundance (the number of individuals) of species in any given ecosystem.
- The significance of carrying capacity in ecosystems is dependent on the scale proportion and quantity at which it occurs.
- Most scientific knowledge is quite durable, but is, in principle, subject to change based on new evidence and/or reinterpretation of existing evidence.
- This fundamental tension affects the abundance (number of individuals) of species in any given ecosystem.
- Much of science deals with constructing explanations of how things change and how they remain stable.

- A complex set of interactions within an ecosystem can keep its numbers and types of organisms relatively constant over long periods of me under stable conditions.
- If a modest biological or physical disturbance to an ecosystem occurs, it may return to its more or less original status (i.e., the ecosystem) as opposed to becoming a very different ecosystem.
- Extreme fluctuations in conditions or the size of any population, however, can challenge the functioning of ecosystems in terms of resources and habitat availability.
- Scientific argument is a mode of logical discourse used to clarify the strength of relationships between ideas and evidence that may result in a revision of an explanation.

Skills - What will students be able to do?

- Compare and contrast the ecological footprints of various countries around the world.
- Graph data related to ecological footprints for various countries.
- Examine factors that increase or decrease your footprint.
- Examine ways that the school could reduce its footprint, by expanding the recycling program.
- Research composing as a way to reduce the ecological footprint.
- Write a persuasive essay encouraging our school to start composting.
- Crique another student's essay, and provide them feedback for their final draft.
- Read a current event that compares tap water vs. boiled water.
- Come up with ways to try and encourage our students to use tap water!
- Research and write about a current event about env. science and present it to the class.
- Visit Lindenwold Waste Management and interview the supervisor to learn about recycling in Lindenwold.
- Help reduce the school's footprint by doing a fall cleanup.
- Continue to model recycling for the school!
- Be able to view a hot topic issue from all sides using the "6 thinking hats" approach.-- Fracking debate.
- Design a picture that you can turn into a mural made of bole caps or find another project that uses "trash" or recycled materials. It's art, but it's also reducing waste, and thus reducing our footprint.

Activities - How will we teach the content and skills?

- Structure lessons around questions that are authentic, and relate to students ' interests, social/ family background, and knowledge of their community.
- Provide students with multiple choices for how they can represent their understanding.
- Provide opportunities for students to connect with people of similar backgrounds.
- Provide multiple grouping opportunities for students to share their ideas and to encourage work among various backgrounds and cultures.

- Engage students with a variety of Science and Engineering practices to provide students with multiple entry points and multiple ways to demonstrate their understanding.

Evidence/Assessments - How will we know what students have learned?

Use mathematical and/or computational representations to support explanations of factors that affect the carrying capacity of ecosystems at different scales.

Use quantitative analysis to compare relationships among interdependent factors and represent their effects on the carrying capacity of ecosystems at different scales.

Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales.

Use the concept of orders of magnitude to represent how factors affecting biodiversity and populations in ecosystems at one scale relate to those factors at another scale.

Evaluate the claims, evidence, and reasoning that support the contention that complex interactions in ecosystems maintain relatively consistent numbers and types of organisms in stable conditions, but changing conditions may result in a new ecosystem.

Construct explanations of how modest biological or physical changes versus extreme changes affect stability and change in ecosystems.

Environmental Benchmark #1

Spiraling for Mastery

Content or Skill for this Unit	Spiral Focus from Previous Unit	Instructional Activity
• A complex set of interactions within an ecosystem can keep its numbers and types of organisms relatively constant over long periods of me under stable conditions • Organisms would have the capacity to produce populations of great size were it not for the fact that environments and resources are finite. This fundamental tension affects	• 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	• Resources from the Holt Environmental Science Text: o Using the Figure: Life Depends on the Sun o Skill Builder: Vocabulary o MathPractice: A Meal Fit for a Grizzly Bear o Case Study: DDT in an Aquac Food Chain o Using the Figure: The Nitrogen Cycle

the abundance (the number of individuals) of species in any given ecosystem. • Ecosystems have carrying capacities, which are limits to the number of organisms and populations they can support. • These limits result from such factors as the availability of living and nonliving resources and from such challenges as predation, competition, and disease. • If a modest biological or physical disturbance to an ecosystem occurs, it may return to its more or less original status (i.e., the ecosystem) as opposed to becoming a very different ecosystem. • Compare and contrast the ecological footprints of various countries around the world. • Examine factors that increase or decrease your footprint • Read a current event that compares tap water vs. bottled water. • Extreme fluctuaons in condions or the size of any populaon, however, can challenge the funconing of ecosystems in terms of resources and habitat availability. • Research composng as a way to reduce the ecological footprint. • Research and write about a current event pertaining to env. science and present it to the class. • Much of science deals with construcng explanaons of how things change and	consequently constrains their growth and reproduction. • Growth of organisms and population increases are limited by access to resources. • 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 compeve, predatory, and mutually beneficial interactions vary across ecosystems, the paerns of interactions of organisms with their environments, both living and nonliving, are shared. • Ecosystems are dynamic; their characteristics can vary over me. Disruptions to any physical or biological component of an ecosystem can lead to shifts in all its populations. • Biodiversity describes the variety of species found in Earth's terrestrial and oceanic ecosystems. The completeness or integrity of an ecosystem's biodiversity is often used as a measure of its health. • Humans depend on Earth's land, ocean, atmosphere, and biosphere for many different resources. • Minerals, fresh water, and biosphere resources are limited, and many are not renewable or replaceable over human lifetimes.	○ Graphic Organizer: Chain-of-Events Chart ○ Case Study: Communies Maintained by Fire ○ Maps in Acon: Doppler Radar Tracking of Bats and Insects in Central Texas ○ Society & the Environment: Eating the Bait

how they remain stable. • Visit Lindenwold Waste Management and interview the supervisor to learn about recycling in Lindenwold. • Examine ways that the school could reduce its own footprint, by expanding the recycling program. • Scientific argumentation is a mode of logical discourse used to clarify the strength of relaonships between ideas and evidence that may result in revision of an explanation.	These resources are distributed unevenly around the planet as a result of past geologic processes. • Human activities have significantly altered the biosphere, sometimes damaging or destroying natural habitats and causing the extinction of other species. But changes to Earth's environment can have different impacts (negative and positive) on different living things. • Typically, as human populations and per-capita consumption of natural resources increase, so do the negative impacts on Earth unless the activities and technologies involved are engineered otherwise. • The many dynamic and delicate feedbacks among the biosphere and other Earth systems cause a continual co-evolution of Earth's surface and the life that exists on it 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. • Scientists and engineers can make major contributions by developing technologies that produce less pollution and waste and that preclude ecosystem degradation. • Although the magnitude of human impacts is greater than it has ever been, so	

	too are human abilities to model, predict, and manage current and future impacts. • 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.	

Key Resources

Bunny Population Growth Activity: Students collect data during a simulation and use it to support their explanation of natural selection in a rabbit population and how populations change over me when biotic or abiotic factors change.

African Lions Acvity: Students use the data presented to predict the zebra population during periods of increased rainfall. Students will create a representation of the data that illustrates both the lion population and zebra population during the same period

Animal Behavior: Students will make detailed observations of an organism's behavior and then design and execute a controlled experiment to test a hypothesis about a specific case of animal behavior. Students will record observations, make sketches, collect and analyze data, make conclusions, and prepare a formal report.

Biodiversity: Students use this lab to represent how biodiversity stops a disease from spreading

Career Readiness, Life Literacies, & Key Skills

TECH.9.4.12.CT.3	Enlist input from a variety of stakeholders (e.g., community members, experts in the field) to design a service learning activity that addresses a local or global issue (e.g., environmental justice).
TECH.9.4.12.CT.4	Participate in online strategy and planning sessions for course-based, school-based, or other project and determine the strategies that contribute to effective outcomes.
TECH.9.4.12.GCA.1	Collaborate with individuals to analyze a variety of potential solutions to climate change effects and determine why some solutions (e.g., political. economic, cultural) may work

	better than others (e.g., SL.11-12.1., HS-ETS1-1, HS-ETS1-2, HS-ETS1-4, 6.3.12.GeoGI.1, 7.1.IH.IPERS.6, 7.1.IL.IPERS.7, 8.2.12.ETW.3).
TECH.9.4.12.IML.2	Evaluate digital sources for timeliness, accuracy, perspective, credibility of the source, and relevance of information, in media, data, or other resources (e.g., NJSLSA.W8, Social Studies Practice: Gathering and Evaluating Sources.
TECH.9.4.12.IML.3	Analyze data using tools and models to make valid and reliable claims, or to determine optimal design solutions (e.g., S-ID.B.6a., 8.1.12.DA.5, 7.1.IH.IPRET.8).
TECH.9.4.12.IML.4	Assess and critique the appropriateness and impact of existing data visualizations for an intended audience (e.g., S-ID.B.6b, HS-LS2-4).
TECH.9.4.12.IML.5	Evaluate, synthesize, and apply information on climate change from various sources appropriately (e.g., 2.1.12.CHSS.6, S.IC.B.4, S.IC.B.6, 8.1.12.DA.1, 6.1.12.GeoHE.14.a, 7.1.AL.PRSNT.2).
TECH.9.4.12.IML.6	Use various types of media to produce and store information on climate change for different purposes and audiences with sensitivity to cultural, gender, and age diversity (e.g., NJSLSA.SL5).
TECH.9.4.12.IML.7	Develop an argument to support a claim regarding a current workplace or societal/ethical issue such as climate change (e.g., NJSLSA.W1, 7.1.AL.PRSNT.4).

Interdisciplinary Connections/Companion Standards

LA.RST.11-12.1	Accurately cite strong and thorough evidence from the text to support analysis of science and technical texts, attending to precise details for explanations or descriptions.
LA.WHST.11-12.2	Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes.