Unit 2: Ecosystems & Human Impact

Content Area:	**Science**
Course(s):	
Time Period:	**MP2**
Length:	**45 days**
Status:	**Published**

NJSLS - Science

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.
HS-LS2-7	Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity.
HS-LS4-6	Create or revise a simulation to test a solution to mitigate adverse impacts of human activity on biodiversity.
HS-ESS3-1	Construct an explanation based on evidence for how the availability of natural resources, occurrence of natural hazards, and climate change have influenced 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.
HS-ETS1-3	Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts.

Science and Engineering Practices

Using Mathematics and Computational Thinking — Create and use computational simulations and mathematical representations of phenomena and design solutions. *(HS-LS2-2, HS-LS4-6, HS-ESS3-3)*

Constructing Explanations and Designing Solutions — Design, evaluate, and refine a solution to a complex real-world problem based on scientific knowledge and evidence. *(HS-LS2-7, HS-ESS3-1)*

Engaging in Argument from Evidence — Evaluate competing design solutions and prioritize criteria and trade-offs to determine the best-supported solution. *(HS-ETS1-3)*

Developing and Using Models — Use models and simulations to predict the relationships among variables in complex systems. *(HS-ESS3-3, HS-LS4-6)*

Scientific Knowledge is Open to Revision in Light of New Evidence — Scientific explanations of populations and biodiversity are refined as new evidence and models become available. *(HS-LS2-2)*

Disciplinary Core Ideas

LS2.C: Ecosystem Dynamics, Functioning, and Resilience — Biomes and communities are shaped by climate and disturbance; anthropogenic changes can push an ecosystem to a new state. *(HS-LS2-2)*

LS4.D: Biodiversity and Humans — Biodiversity describes the variety of species in Earth's ecosystems;

humans depend on it, and human activity is driving extinction at unprecedented rates. *(HS-LS2-7, HS-LS4-6)*

ESS3.A: Natural Resources / ESS3.B: Natural Hazards — Resource availability and the occurrence of natural hazards shape where and how humans settle and how vulnerable communities are. *(HS-ESS3-1)*

ESS3.C: Human Impacts on Earth Systems — The sustainability of human populations depends on responsible management of resources; population size and per-capita consumption drive environmental impact. *(HS-ESS3-3)*

ETS1.B: Developing Possible Solutions — Solutions are evaluated against criteria and constraints, weighing cost, reliability, and social and environmental impacts. *(HS-ETS1-3)*

Crosscutting Concepts

Scale, Proportion, and Quantity — Patterns in biodiversity and population data are analyzed across spatial and temporal scales. *(HS-LS2-2, HS-ESS3-3)*

Cause and Effect — Human activities are examined as causes of biodiversity loss and environmental change, using evidence to distinguish cause from correlation. *(HS-LS2-7, HS-LS4-6)*

Stability and Change — Natural hazards and disturbances challenge the stability and resilience of ecosystems and human communities. *(HS-ESS3-1)*

Systems and System Models — Simulations model the interactions among resource use, population, and biodiversity. *(HS-ESS3-3, HS-LS4-6)*

Influence of Science, Engineering, and Technology on Society and the Natural World — Engineering and policy decisions shape how communities grow and how biodiversity is protected. *(HS-LS2-7, HS-ETS1-3)*

Rationale and Transfer Goals

In this unit, students formulate answers to the question, “How do organisms interact with their environment across biomes, why does biodiversity matter, and how do growing human populations reshape the environment?” Students first characterize the world's biomes and aquatic ecosystems and the biodiversity they contain, then examine extinction, conservation, and the ecosystem services humans depend on. The unit then turns to people: human population growth and prediction, environmental health and hazards, and the ways urbanization and land use transform natural systems.

The crosscutting concepts of cause and effect, systems and system models, and stability and change organize the disciplinary core ideas. The transfer goal is for students to independently use data, models, and simulations to evaluate human impacts and to design and refine solutions that balance human needs with ecological sustainability.

Enduring Understandings

- Biomes are determined largely by climate; terrestrial and aquatic ecosystems provide services that humans and other organisms depend on.
- Biodiversity is the variety of life; the integrity of an ecosystem's biodiversity is often used as a measure of its health, and human activity is driving extinction at an unprecedented rate.
- Protecting biodiversity requires deliberate solutions that can be modeled, tested, and refined.
- Human population size and per-capita consumption are primary drivers of environmental change; population dynamics can be modeled and predicted.
- Environmental health links human wellbeing to the quality of air, water, and soil and to exposure to biological, chemical, and physical hazards.
- How and where humans build — from sprawl to sustainable cities — has major, and manageable, environmental consequences.

Essential Questions

- What determines where different biomes and aquatic ecosystems occur?
- Why should we measure and protect biodiversity, and how can we do it effectively?
- How do human population size and consumption affect the environment?
- What makes a community healthy or hazardous to live in?
- How can cities grow without destroying the systems they depend on?

Content - What will students know?

- Biomes are defined by temperature and precipitation; climate diagrams (climatographs) can be used to identify and compare them.
- Aquatic ecosystems (freshwater, marine, and coastal) are structured by physical factors and provide distinct ecosystem services.
- Biodiversity includes genetic, species, and ecosystem diversity; its completeness is a measure of ecosystem health.
- Extinction is a natural process, but human activities (habitat loss, overharvesting, invasive species, pollution, and climate change) have greatly accelerated its rate.
- Conservation solutions — protected areas, captive breeding, legislation, and habitat restoration — can be designed, evaluated, and refined.
- Human population growth is described by trends, age-structure diagrams, and the demographic transition; growth can be modeled and predicted.
- Environmental health examines biological, social, chemical, and physical hazards; toxicology relates dose to response.
- Natural disasters and other natural hazards influence where and how people live and how resilient communities are.
- Land-use patterns, urbanization, and sprawl transform ecosystems; sustainable-city design can reduce environmental impact.

Skills - What will students be able to do?

- Interpret climate data to classify biomes and to relate community composition to abiotic conditions.
- Analyze biodiversity and extinction data across scales, using orders of magnitude where appropriate.
- Design, evaluate, and refine a solution for protecting biodiversity, and create or revise a simulation to test it.
- Build and interpret age-structure diagrams and use models to predict human population growth.
- Analyze an environmental-health hazard, including a dose-response relationship.
- Create a computational simulation relating resource management, population, and biodiversity.
- Evaluate competing urban-design or conservation solutions using prioritized criteria and trade-offs.

Activities - How will we teach the content and skills?

- Launch with the Savvas Chapter 6 Central Case (“Too Much of a Good Thing?”) and the Point Counterpoint “Should Elephant Culling Be Allowed?” as a structured debate.
- Use the “Which Biome?” data activity and climatograph analysis to connect climate to ecosystem type.
- Anchor biodiversity in the Chapter 7 Central Case (“Saving the Siberian Tiger”); run the “Overharvesting” modeling activity and a design-and-test task for a biodiversity-protection solution (HS-LS4-6).
- Model human demographics with the Chapter 8 Central Case (“China's Changing Population Needs”), the “Build and Compare Age-Structure Diagrams” lab, and “Using Census Data.”
- Explore environmental health with the Chapter 9 Central Case (“The Rise and Fall of DDT”), the “How Do Diseases Spread?” lab, “Testing for Lead,” and the “Should BPA Use Be Regulated?” Point Counterpoint.
- Investigate urbanization with the Chapter 10 Central Case (“Growing Pains in Portland, Oregon”) and “Patterns of Sprawl” / “Green Building Design” modeling; have students evaluate a sustainable-city proposal against prioritized trade-offs (HS-ETS1-3).
- Structure lessons around authentic, community-connected questions; provide multiple means of representation and varied grouping (UDL).

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

- **Assessments can be reviewed for each course inthis folder.**

- Formative: biome classification from climatographs, age-structure diagram analysis, the disease-spread lab, and a biodiversity CER.
- Summative: Savvas Chapter 6–10 assessments, a biodiversity-protection design-and-simulation task, and a sustainable-city proposal.
- Use mathematical representations to support and revise explanations about factors affecting biodiversity and populations across scales.
- Design, evaluate, and refine a solution for reducing human impacts on the environment and biodiversity, and revise a simulation to test it.

- Create a computational simulation relating resource management, human population sustainability, and biodiversity.
- Evaluate a real-world solution based on prioritized criteria and trade-offs.
- Environmental Benchmark #2 (administered during the last week of MP2; assesses Unit 2 content only).

Spiraling for Mastery

The spiral column draws on Unit 1 (Foundations of Environmental Science & Population Ecology).

Content or Skill for This Unit	Spiral Focus from Previous Unit	Instructional Activity
Biodiversity and populations across biomes and scales (HS-LS2-2).	Unit 1: population growth and carrying capacity (Ch. 4, HS-LS2-1).	Extend single-population models to the community and biome scale using the “Which Biome?” data activity.
Human impacts on biodiversity; extinction (HS-LS2-7, HS-LS4-6).	Unit 1: natural selection and environmental change (Ch. 5, HS-LS4-5).	Connect extinction to environmental-change reasoning; run the “Overharvesting” simulation and refine a protection solution.
Human population dynamics and sustainability (HS-ESS3-3).	Unit 1: exponential vs. logistic growth (Ch. 4).	Apply growth models to human demographics using age-structure diagrams and census data.
Natural hazards and community resilience (HS-ESS3-1).	Unit 1: ecosystem stability and change (Ch. 5, HS-LS2-6).	Link natural disasters (Ch. 9) to stability, resilience, and human settlement patterns.

Key Resources

Primary text and platform: Savvas Environmental Science (Withgott & Laposata) — Unit 2 (Ecology) and Unit 3 (Humans and the Environment), Chapters 6–10.

- Central Cases: “Too Much of a Good Thing?” (Ch. 6), “Saving the Siberian Tiger” (Ch. 7), “China's Changing Population Needs” (Ch. 8), “The Rise and Fall of DDT” (Ch. 9), “Growing Pains in Portland, Oregon” (Ch. 10).
- Point Counterpoints and Success Stories: “Should Elephant Culling Be Allowed?” (Ch. 6), “A Couple of Birds Make Big Comebacks” (Ch. 7), “Should BPA Use Be Regulated?” (Ch. 9).
- Labs, Real Data, and Modeling: “Which Biome?,” “Overharvesting,” “Build and Compare Age-Structure Diagrams,” “How Do Diseases Spread?,” “Testing for Lead,” “Patterns of Sprawl,” “Green Building Design,” “Using Census Data,” and “Home Hazard Survey.”
- Savvas online course: investigative-phenomenon videos, interactive simulations, and the Unit 2 and Unit 3 Anchoring Phenomenon Projects.

Career Readiness, Life Literacies, & Key Skills

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).
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).
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.
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).
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).
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

Standard	Companion Standard Description
RST.11-12.1	Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions and gaps or inconsistencies in the account.
RST.11-12.7	Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, charts) to address an environmental question or problem.
WHST.11-12.1	Write arguments focused on discipline-specific content, supporting a claim with reasoning and evidence (e.g., a policy or cost-benefit position).
WHST.11-12.7	Conduct short and sustained research projects to answer a question or solve a problem, synthesizing multiple sources on an environmental topic.
HSN-Q.A.1	Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in environmental data.
HSS-ID.B.6	Represent data on two quantitative variables on a scatter plot and describe how the variables are related.