2019 Unit 08: Human Activity and Biodiversity

Content Area: **Science**
Course(s): **Honors Biology**
Time Period: **June**
Length: **1 weeks**
Status: **Published**

Unit Overview

In this unit of study, *mathematical models* provide support for students' conceptual understanding of systems and students' ability to *design, evaluate, and refine solutions* for reducing the impact of human activities on the environment and maintaining biodiversity. Students create or revise a simulation to test solutions for mitigating adverse impacts of human activity on biodiversity. Crosscutting concepts of *systems and system models* play a central role in students' understanding of science and engineering practices and core ideas of ecosystems. Mathematical models also provide support for students' conceptual understanding of systems and their ability to develop design solutions for reducing the impact of human activities on the environment and maintaining biodiversity.

Enduring Understandings

- Humans impact the environment in ways that threaten biodiversity
- Humans rely on a healthy and stable environment for their survival

Essential Questions

- How do humans affect biodiversity and what are the consequences?
- Would we treat our resources and life support system if we were on a rocket headed for Mars as we do in our community right now?

Student Learning Objectives (Performance Expectations)

- Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants. (HS-ETS1-1)
- Create a computational simulation to illustrate the relationships among management of natural resources, the sustainability of human populations, and biodiversity. [Clarification Statement: Examples of factors that affect the management of natural resources include costs of resource extraction and waste management, per-capita consumption, and the development of new technologies. Examples of factors that affect human sustainability include agricultural efficiency, levels of conservation, and urban planning.] [Assessment Boundary: Assessment for computational simulations is limited to using provided multi-parameter programs or constructing simplified spreadsheet calculations.] (HS-ESS3-3)
- Create or revise a simulation to test a solution to mitigate adverse impacts of human activity on biodiversity. [Clarification Statement: Emphasis is on designing solutions for a proposed problem related to threatened or endangered species, or to genetic variation of organisms for multiple species.](HS-LS4-6)
- Design a solution to a complex real-world problem by breaking it down into smaller, more manageable

problems that can be solved through engineering.(HS-ETS1-2)

- Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity. [Clarification Statement: Examples of human activities can include urbanization, building dams, and dissemination of invasive species.] (HS-LS2-7)

- Evaluate a solution to a complex real-world problem based on prioritized criteria and tradeoffs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts. (HS-ETS1-3)

- Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem. (HS-ETS1-4)

Science & Engineering Practices

9-12.HS-ETS1-1.1	Asking Questions and Defining Problems
9-12.HS-ETS1-3.6.1	Evaluate a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations.
9-12.HS-ETS1-2.6.1	Design a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations.

Disciplinary Core Ideas

9-12.HS-LS2-6.LS2.C.1	A complex set of interactions within an ecosystem can keep its numbers and types of organisms relatively constant over long periods of time 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.
9-12.HS-LS2-7.LS4.D.1	Biodiversity is increased by the formation of new species (speciation) and decreased by the loss of species (extinction).
9-12.HS-LS2-7.LS4.D.2	Humans depend on the living world for the resources and other benefits provided by biodiversity. But human activity is also having adverse impacts on biodiversity through overpopulation, overexploitation, habitat destruction, pollution, introduction of invasive species, and climate change. Thus sustaining biodiversity so that ecosystem functioning and productivity are maintained is essential to supporting and enhancing life on Earth. Sustaining biodiversity also aids humanity by preserving landscapes of recreational or inspirational value.

Cross Cutting Concepts

9-12.HS-LS2-8.2.1	students understand that empirical evidence is required to differentiate between cause and correlation and to make claims about specific causes and effects. They suggest cause and effect relationships to explain and predict behaviors in complex natural and designed systems. They also propose causal relationships by examining what is known about smaller scale mechanisms within the system. They recognize changes in systems may have various causes that may not have equal effects.
9-12.HS-LS2-7.7.1	students understand much of science deals with constructing explanations of how things change and how they remain stable. They quantify and model changes in systems over

very short or very long periods of time. They see some changes are irreversible, and negative feedback can stabilize a system, while positive feedback can destabilize it. They recognize systems can be designed for greater or lesser stability.

Unit Sequence

- • Analysis of costs and benefits is a critical aspect of decisions about technology.
- • Analyze costs and benefits of a solution for reducing the impacts of human activities on the environment and biodiversity based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations.
- • Analyze costs and benefits of a solution to mitigate adverse impacts of human activity on biodiversity.
- • Anthropogenic changes (induced by human activity) in the environment—including habitat destruction, pollution, introduction of invasive species, overexploitation, and climate change—can disrupt an ecosystem and threaten the survival of some species.
- • Biodiversity is increased by the formation of new species (speciation) and decreased by the loss of species (extinction).
- • Both physical models and computers can be used in various ways to aid the engineering design process. Computers are useful for a variety of purposes, such as running simulations to test ways of solving a problem or to see which one is most efficient or economical, and in making a persuasive presentation to a client about how a given design will meet his or her needs.
- • Break down the criteria for the design of a simulation to test a solution for mitigating adverse impacts of human activity on biodiversity into simpler ones that can be approached systematically based on consideration of trade-offs.
- • Change and rates of change can be quantified and modeled over very short or very long periods.
- • Changes in the physical environment, whether naturally occurring or human induced, have contributed to the expansion of some species, the emergence of new distinct species as populations diverge under different conditions, and the decline—and sometimes the extinction—of some species.
- • Construct explanations for how the environment and biodiversity change and stay the same when affected by human activity.
- • Create a computational simulation to illustrate the relationships among management of natural resources, the sustainability of human populations, and biodiversity.
- • Create or revise a simulation based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations to test a solution to mitigate adverse impacts of human activity on biodiversity.
- • Criteria may need to be broken down into simpler ones that can be approached systematically, and decisions about the priority of certain criteria over others (trade-offs) may be needed.
- • Criteria may need to be broken down into simpler ones that can be approached systematically, and decisions about the priority of certain criteria over others (trade-offs) may be needed.
- • Design a solution for a proposed problem related to threatened or endangered species or to genetic variation of organisms for multiple species.
- • Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations.
- • Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.
- • Evaluate a solution for reducing the impacts of human activities on the environment and biodiversity based on scientific knowledge, student-generated sources of evidence, prioritized criteria,

and tradeoff considerations.

- Humans depend on the living world for the resources and other benefits provided by biodiversity. But human activity is also having adverse impacts on biodiversity through overpopulation, overexploitation, habitat destruction, pollution, introduction of invasive species, and climate change.
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- Modern civilization depends on major technological systems.
- Much of science deals with constructing explanations of how things change and how they remain stable.
- New technologies can have deep impacts on society and the environment including some that are not anticipated.
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- Quantify and model change and rates of change in the relationships among management of natural resources, the sustainability of human populations, and biodiversity.
- Scientific knowledge is a result of human endeavors imagination and creativity.
- Some system changes are irreversible.
- Sustaining biodiversity also aids humanity by preserving landscapes of recreational or inspirational value.
- The sustainability of human societies and the biodiversity that supports them require responsible management of natural resources.
- Thus sustaining biodiversity so that ecosystem functioning and productivity are maintained is essential to supporting and enhancing life on Earth.
- Thus sustaining biodiversity so that ecosystems' functioning and productivity are maintained is essential to supporting and enhancing life on Earth. Sustaining biodiversity also aids humanity by preserving landscapes of recreational or inspirational value.
- Use empirical evidence to make claims about the impacts of human activity on biodiversity.
- When evaluating solutions, it is important to take into account a range of constraints—including costs, safety, reliability, and aesthetics—and to consider social, cultural, and environmental impacts.
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- Concepts
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- Formative Assessment
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- Formative Assessment
- Part A: How might we change habits if we replaced the word "environment" with the word "life support system"?
- Part B: Does reducing human impacts on our global life support system require social engineering or mechanical engineering?
- Part C: Is the damage done to the global life support system permanent?

Standards / Indicators

SCI.HS-LS4-6	Create or revise a simulation to test a solution to mitigate adverse impacts of human activity on biodiversity.
SCI.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.
SCI.HS-LS2-7	Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity.

Lesson Titles

- conservation
- habitat fragmentation and destruction
- importance of biodiversity
- threats to biodiversity

Career Readiness, Life Literacies & Key Skills

WRK.K-12.P.1	Act as a responsible and contributing community members and employee.
WRK.K-12.P.4	Demonstrate creativity and innovation.
WRK.K-12.P.5	Utilize critical thinking to make sense of problems and persevere in solving them.
WRK.K-12.P.8	Use technology to enhance productivity increase collaboration and communicate effectively.
WRK.K-12.P.9	Work productively in teams while using cultural/global competence.

Interdisciplinary Connections:

LA.RH.9-10.7	Integrate quantitative or technical analysis (e.g., charts, research data) with qualitative analysis in print or digital text, to analyze information presented via different mediums.
LA.RST.9-10.2	Determine the central ideas, themes, or conclusions of a text; trace the text's explanation or depiction of a complex process, phenomenon, or concept; provide an accurate summary of the text.
LA.RST.9-10.3	Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text.
LA.RST.9-10.7	Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words.
LA.WHST.9-10.4	Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.
LA.WHST.9-10.5	Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on addressing what is most significant for a specific

	purpose and audience.
LA.WHST.9-10.6	Use technology, including the Internet, to produce, share, and update writing products, taking advantage of technology's capacity to link to other information and to display information flexibly and dynamically.
LA.WHST.9-10.7	Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.
LA.WHST.9-10.8	Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the usefulness of each source in answering the research question; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and following a standard format for citation.
TECH.8.1.12.A.CS1	Understand and use technology systems.
TECH.8.1.12.A.CS2	Select and use applications effectively and productively.
TECH.8.1.12.B.CS1	Apply existing knowledge to generate new ideas, products, or processes.
TECH.8.1.12.B.CS2	Create original works as a means of personal or group expression.
TECH.8.1.12.C.CS1	Interact, collaborate, and publish with peers, experts, or others by employing a variety of digital environments and media.
TECH.8.1.12.C.CS4	Contribute to project teams to produce original works or solve problems.
TECH.8.1.12.D.CS2	Demonstrate personal responsibility for lifelong learning.
TECH.8.1.12.E.CS1	Plan strategies to guide inquiry.
TECH.8.1.12.E.CS2	Locate, organize, analyze, evaluate, synthesize, and ethically use information from a variety of sources and media.
TECH.8.1.12.E.CS4	Process data and report results.
TECH.8.1.12.F.CS2	Plan and manage activities to develop a solution or complete a project.
TECH.8.1.12.F.CS3	Collect and analyze data to identify solutions and/or make informed decisions.

ELA/Literacy & Math Standards

- • Choose a level of accuracy appropriate to limitations on measurement when reporting quantities showing impacts of human activities on the environment and biodiversity.
- • Conduct short as well as more sustained research projects to determine the impacts of human activities on the environment and biodiversity, synthesizing information from multiple sources.
- • Conduct short as well as more sustained research projects to determine the impacts of human activity on biodiversity and how to mitigate these impacts.
- • Define appropriate quantities for the purpose of descriptive modeling of impacts of human activities on the environment and biodiversity.
- • Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on the impacts of human activity on biodiversity and how to mitigate these impacts.
- • Evaluate data presented in diverse formats in order to determine the impacts of human activity on biodiversity and how to mitigate these impacts.
- • Evaluate data to verify claims about the impacts of human activities on biodiversity and how to mitigate these impacts.
- • Evaluate data to verify claims about the impacts of human activities on the environment and

biodiversity, verifying the data when possible and corroborating or challenging conclusions with other sources of information.

- Represent symbolically the impacts of human activities on the environment and biodiversity, and manipulate the representing symbols. Make sense of quantities and relationships of the impacts of human activities on the environment and biodiversity
- Represent symbolically the relationships among management of natural resources, the sustainability of human populations, and biodiversity, and manipulate the representing symbols. Make sense of quantities and relationships among management of natural resources, the sustainability of human populations, and biodiversity.
- Synthesize information from a range of sources about the impacts of human activities on the environment and biodiversity into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible.
- Synthesize information from a range of sources into a coherent understanding of the impacts of human activities on biodiversity and how to mitigate these impacts.
- Use a mathematical model to describe a solution to mitigate adverse impacts of human activity on biodiversity. Identify important quantities in the impacts of human activities on the biodiversity and map their relationships using tools. Analyze those relationships mathematically to draw conclusions, reflecting on the results and improving the model if it has not served its purpose.
- Use a mathematical model to describe the impacts of human activities on the environment and biodiversity. Identify important quantities in the impacts of human activities on the environment and biodiversity and map their relationships using tools. Analyze those relationships mathematically to draw conclusions, reflecting on the results and improving the model if it has not served its purpose.
- Use a mathematical model to describe the management of natural resources, the sustainability of human populations, and biodiversity. Identify important quantities in relationships among management of natural resources, the sustainability of human populations, and biodiversity, and map their relationships using tools. Analyze these relationships mathematically to draw conclusions, reflecting on the results and improving the model if it has not served its purpose.
- Use units to understand the impacts of human activities on the environment and biodiversity and to guide the solution of multistep problems to reduce these impacts. Choose and interpret units consistently in formulas to determine the impacts of human activities on the environment and biodiversity. Choose and interpret the scale and origin in graphs and data displays showing impacts of human activities on the environment and biodiversity.
- English Language Arts/Literacy
- Mathematics

Instructional Strategies, Learning Activities, Levels of Blooms / DOK

- biome / biodiversity project
- class discussion
- class notes
- demonstration
- habitat fragmentation / destruction project
- poster presentation
- slide presentation
- TED talk
- video clip
- webquest

- worksheets

Modifications

ELL Modifications

- Focus on domain specific vocabulary and keywords
- Group students
- K-W-L charts (what I know - what I want to know - what I've learned).
- Provide ELL students with multiple literacy strategies
- Repeat, reword, clarify
- Tap prior knowledge
- Use graphic organizer
- Use real objects when possible

IEP & 504 Modifications

- Focus on domain specific vocabulary and keywords
- modeling and showing lots of examples
- non-verbal redirection of behaviors
- providing study guides that don't lead the student to study too much extraneous information (less unnecessary details)/scaffolded study guides
- rewording questions so that there are not higher level vocabulary within the question (you are testing for understanding of the content not the ability to understand the question)

Gifted and Talented Modifications

- Ask students' higher level questions that require students to look into causes, experiences, and facts to draw a conclusion or make connections to other areas of learning.
- Determine where students' interests lie and capitalize on their inquisitiveness. (Is there a specific career they are interested in? How would this apply to their interest?)
- Encourage students to explore concepts in depth and encourage independent studies or investigations
- Evaluation of thesis statements
- Generating and testing hypotheses
- Graph analysis / interpretation
- Journal article analysis

At Risk Modifications

- additional help during tutoring/Delsea One/Academic Enrichment
- hands-on Instruction
- modeling and showing lots of examples
- review, restate, reword directions
- testing modifications
- visuals

Alternative Assessments

Performance tasks
Project-based assignments
Problem-based assignments
Presentations
Reflective pieces
Concept maps
Case-based scenarios
Portfolios

Benchmark Assessments

Skills-based assessment
Reading response
Writing prompt
Lab practical

Formative Assessment

- exit ticket
- google survey
- Kahoot
- KWL form
- lesson summary
- previous class review
- question of the day
- Think-pair-share

Summative Assessment

- benchmark assessment / marking period assessment
- biodiversity quiz
- biodiversity test
- conservation project

Resources and Materials

- Building Biodiversity and the PREDICTS project and GLOBIO project: Students explore this website to develop an understanding of how computational models of the impacts on biodiversity are created. Next, they explore Conservation Maps for a global perspective of land use and conservation efforts. https://portals.iucn.org/library/efiles/documents/2008-002.pdf
- Carbon Stabilization Wedge: Students play this game in order to evaluate competing design solutions for developing, managing, and utilizing energy resources based on cost-benefit ratios. http://cmi.princeton.edu/wedges/game.php
- Climate Reanalyzer: Students use the Environmental Change Model of the Climate Reanlyzer to study the feedbacks in the climate system. http://cci-reanalyzer.org/
- Cost-Benefit Analysis Primer: Students read this explanation about how cost-benefit analysis is derived and applied in order to apply this model to design solutions related to human sustainability. Students then read the application of CBA to water sanitation. http://www.agecon.purdue.edu/staff/shively/COURSES/AGEC406/reviews/bca.htm
- Earth: Planet of Altered States: Watch a segment of a NASA video and discuss how the earth is constantly changing. https://www.opened.com/video/earth-planet-of-altered-states/42803
- GLOBE Carbon Cycle: Students collect data about their school field site through existing GLOBE protocols of phenology, land cover and soils as well as through new protocols focused on biomass and carbon stocks in vegetation. Students participate in classroom activities to understand carbon cycling at local and global scales. Students expand their scientific thinking through the use of systems models. http://globecarboncycle.unh.edu/index.shtml
- Google Classroom
- Know Your Energy Costs: The goal of this activity is to become aware of how much energy you use at school — and the financial and environmental costs. http://www.earthsciweek.org/classroom-activities/know-your-energy-costs
- Land and People: Finding a Balance: This environmental study project allows a group of students to consider real environmental dilemmas concerning water use and provide solutions to these dilemmas. http://www.earthsciweek.org/classroom-activities/land-and-people-finding-balance
- National Climate Assessment: Students explore the simulations found at this website in order to create a computational simulation to illustrate the relationships among management of natural resources, the sustainability of human populations, and biodiversity. http://nca2014.globalchange.gov/
- NSA Challenge: Recycling for a Cleaner World: Students will develop a strategy to increase recycling and waste diversion for their school. http://www.thestemnet.com/resource/create-resource-14
- One For All: A Natural Resources Game: Identify a strategy that would produce a sustainable use of resources in a simulation game. Draw parallels between the chips used in the game and renewable resources upon which people depend. Draw parallels between the actions of participants in the game and the actions of people or governments in real-world situations. http://www.sciencefriday.com/blogs/09/12/2014/one-for-all-a-natural-resources-game.html?series=&interest=&audience=&author=
- Rainforest carbon cycling and biodiversity: Students apply this model to simulate how atmospheric CO2 concentrations, which influence global climate, increase with I=P*A*T Equation and Its Variants: Students read this article to learn how ecological economics models are developed and applied to further

understand human impacts on our environment. http://www.nrem.iastate.edu/ECOS/rfsims

- Reefs at Risk: and NOAA Coral Reefs at Risk: Students access and explore a series of interactive maps displaying coral reef data from around the globe and develop hypotheses related to the impacts of climate change (i.e. increased levels of carbon dioxide in our atmosphere) on coral reef health. http://reefgis.reefbase.org/

- Stormwater Calculator or the Water Erosion Prediction Project: Students apply the stormwater runoff calculator to determine the impacts of land use change, precipitation variations, and other parameters on runoff. Alternatively, Catch It If You Can: students are scaffolded through the process of calculating stormwater runoff by exploring and applying this case study. http://www2.epa.gov/water-research/national-stormwater-calculator

- textbook

- The Bean Game: Exploring Human Interactions with Natural Resources: This activity explores the various influences of human consumption of natural resources over time. (use this as a primer for making a computational model). http://watersfoundation.org/resources/the-bean-game-exploring-human-interactions-with-natural-resources/

Technology

- chromebooks
- http://virtualbiologylab.org/biodiversity-ecology/
- internet

TECH.8.1.12	Educational Technology: All students will use digital tools to access, manage, evaluate, and synthesize information in order to solve problems individually and collaborate and to create and communicate knowledge.
TECH.8.1.12.B	Creativity and Innovation: Students demonstrate creative thinking, construct knowledge and develop innovative products and process using technology.
TECH.8.1.12.C	Communication and Collaboration: Students use digital media and environments to communicate and work collaboratively, including at a distance, to support individual learning and contribute to the learning of others.
TECH.8.1.12.E	Research and Information Fluency: Students apply digital tools to gather, evaluate, and use information.
TECH.8.1.12.F	Critical thinking, problem solving, and decision making: Students use critical thinking skills to plan and conduct research, manage projects, solve problems, and make informed decisions using appropriate digital tools and resources.
TECH.8.2.12.C	Design: The design process is a systematic approach to solving problems.