SCHOOL DISTRICT OF THE CHATHAMS

AP Environmental Science
Grades 11 & 12
Full Year

Course Overview

This exciting course integrates concepts from biology, ecology, chemistry and the social sciences to examine the interrelationships of the natural world. Students in the course analyze environmental problems both natural and human-made, evaluate the relative risks associated with these problems, and examine alternative solutions for resolving and/or preventing them. The course is collaborative and inquiry-based. The curriculum has been approved by the College Board's Advanced Placement Program and prepares students for the AP Environmental Science Exam.

New Jersey Student Learning Standards
The New Jersey Student Learning Standards (NJSLS) can be located at www.nj.gov/education/cccs/2020/.

Life Science:
HS-LS2-1 Use mathematical and/or computational representations to support explanations of factors that affect carrying capacity of ecosystems at different scales.
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-LS2-4 Use mathematical representations to support claims for the cycling of matter and flow of energy among organisms in an ecosystem.
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.
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.
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.

Earth and Space Science:
HS-ESS1-5 Evaluate evidence of the past and current movements of continental and oceanic crust and the theory of plate tectonics to explain the ages of crustal rocks.
HS-ESS2-1 Develop a model to illustrate how Earth's internal and surface processes operate at different spatial and temporal scales to form continental and ocean-floor features.
HS-ESS2-2 Analyze geoscience data to make the claim that one change to Earth's surface can create feedbacks that cause changes to other Earth's systems.
HS-ESS2-4 Use a model to describe how variations in the flow of energy into and out of Earth's systems result in changes in climate.
HS-ESS2-5 Plan and conduct an investigation of the properties of water and its effects on Earth's materials and surface processes.

HS-ESS2-6 Develop a quantitative model to describe the cycling of carbon among the hydrosphere, atmosphere, geosphere, and biosphere.
HS-ESS3-1 Construct an explanation based on evidence for how the availability of natural resources, occurrence of natural hazards, and changes in climate have influenced human activity.
HS-ESS3-3 Create a computational simulation to illustrate the relationships among the management of natural resources, the sustainability of human populations, and biodiversity.
HS-ESS3-4 Evaluate or refine technological solutions that reduce the impact of human activities on natural systems.
HS-ESS3-5 Analyze geoscience data and the results from global climate models to make an evidence-based forecast of the current rate of global or regional climate change and associated future impacts to Earth's systems.
HS-ESS3-6 Use a computational representation to illustrate the relationships among Earth's systems and how those relationships are being modified due to human activity

Technology Standards
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).
9.4.12.TL.2: Generate data using formula-based calculations in a spreadsheet and draw conclusions about the data.
9.4.12.TL.3: Analyze the effectiveness of the process and quality of collaborative environments.

21st Century Integration | NJSLS 9
9.3.12.AG-NR.1 Plan and conduct natural resource management activities that apply logical, reasoned and scientifically based solutions to natural resource issues and goals.
9.3.12.AG-NR.2 Analyze the interrelationships between natural resources and humans.
9.3.12.AG-NR.3 Develop plans to ensure sustainable production and processing of natural resources.
9.3.12.AG-NR.4 Demonstrate responsible management procedures and techniques to protect or maintain natural resources.
9.3.12.AG-ENV.3 Develop proposed solutions to environmental issues, problems and applications using scientific principles of meteorology, soil science, hydrology, microbiology, chemistry and ecology.

Career Ready Practices
CRP2. Apply appropriate academic and technical skills
CRP4. Communicate clearly and effectively and with reason.
CRP5. Consider the environmental, social and economic impacts of decisions.
CRP6. Demonstrate creativity and innovation.
CRP7. Employ valid and reliable research strategies.
CRP8. Utilize critical thinking to make sense of problems and persevere in solving them.

Interdisciplinary Connections
English Language Arts:
Reading
- RST.11-12.1 Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account.
- RST.11-12.8 Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information.

Writing

- WHST.9-12.2 Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes.
- WHST.9-12.5 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.
- WHST.9-12.7 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.
- WHST.11-12.8 Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the strengths and limitations of each source in terms of the specific task, purpose, and audience; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and overreliance on any one source and following a standard format for citation.
- WHST.9-12.9 Draw evidence from informational texts to support analysis, reflection, and research.

Speaking and Listening

- 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.

<u>Mathematics:</u>

- 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 formulas; choose and interpret the scale and the origin in graphs and data displays.
- HSN.Q.A.2 Define appropriate quantities for the purpose of descriptive modeling.
- HSN.Q.A.3 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.
- HSS-ID.A.1 Represent data with plots on the real number line.
- HSS-IC.A.1 Understand statistics as a process for making inferences about population parameters based on a random sample from that population.
- HSS-IC.B.6 Evaluate reports based on data.
- HSF-IF.C.7 Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases.
- HSF-BF.A.1 Write a function that describes a relationship between two quantities.

Units of Study

Unit 1: The Living World: Ecosystems *(~20 days)*

- How does the movement of energy through an ecosystem differ from the movement of nutrients through an ecosystem?
- How are species diversity and the amount of energy in an ecosystem correlated?

Unit 2: The Living World: Biodiversity *(~15 days)*

- How do the abiotic factors found in a biome influence the biotic factors found in that biome?

Unit 3: Population *(~12 days)*

- What are the different models of growth populations of organisms typically follow?
- What type of population growth does human species exhibit? What are the ecological consequences of this type of population growth?

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Unit 4: Earth Systems & Resources *(~20 days)*
- What is the ecological price for extracting natural resources?
- How has the presence (or absence) of natural resources influenced human development around the globe?

Unit 5: Land & Water Use *(~20 days)*
- How does your use of natural resources impact the world?
- Why are sustainable practices difficult to implement?

Unit 6: Energy Resources & Consumption *(~30 days)*
- Where does the energy humans use in their daily lives come from?
- What are the possible consequences of the continually increasing energy demand caused by the growing global human population?

Unit 7: Atmospheric Pollution *(~10 days)*
- How does the atmosphere interact with other spheres of the Earth?
- How have humans interfered with the natural atmospheric processes?

Unit 8: Aquatic & Terrestrial Pollution *(~15 days)*
- How does pollution impact your health?
- How can you decrease your waste?

Unit 9: Global Climate Change *(~8 days)*
- Why are laws created to protect endangered species?
- How can local human activities have a global impact?

Learning Objectives/Discipline Standards of Practice

Learning Objectives:
- Construct a model to describe the flow and conversion of energy
- Analyze drawbacks and benefits of proposed technical solutions designed to reduce negative impacts of human energy demand on natural systems
- Contrast biogeochemical cycles of matter in Earth's systems
- Interpret real-time or simulated data and graphs/ models of Earth's internal and surface processes and predict future movements of continental, oceanic crust and plate tectonics
- Synthesize geoscience data and the results from global climate models to propose an evidence based forecast of the current rate of global or regional climate change along with associated future impact to Earth's systems
- Apply geoscience data to support the claim that a change in Earth's surface can create feedback mechanisms that cause other Earth's systems to change
- Demonstrate understanding of the relationship between economic factors and their impact on pollution, population patterns and disease patterns globally
- Illustrate how direct harvesting, pollution, atmospheric changes, and natural disasters affect population dynamics in given ecosystems based on data and accepted mathematical models
- Utilize mathematical representations to support how various factors affect carrying capacity of ecosystems at different scales
- Formulate an explanation based on evidence showing how the availability of natural resources, occurrence of natural hazards, and changes in climate have influenced human activity

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- Assess technical solutions that reduce impacts of human activities on natural systems
- Model the relationships between Earth's systems and resource management and how ineffective management impacts sustainability, populations and biodiversity
- Evaluate, and compare and contrast technical solutions that reduce impacts of human activities on natural systems
- Generate a plan to protect biodiversity and maintain ecosystem function
- Compile evidence of how humans intentionally and unintentionally modify ecosystems, as a result of population growth, technology, and consumption and illustrate how it threatens current local and global ecosystem stability and biodiversity.

Discipline Standards of Practice

Science and Engineering Practices

- Plan and Carryout and Investigation
    - Identify or pose a testable question based on observations, data or a model
- Constructing Explanations and Designing Solutions
- Using Mathematics and Computational Thinking
    - Using data to evaluate a hypothesis
    - Perform mathematical equations in the curriculum
- Analyzing and Interpreting Data
- Developing and Using Models
    - Describe characteristics of a biological concept, process or model represented visually
- Engaging in Argument from Evidence
    - Making a scientific claim
    - Provide reasoning to justify a claim by connecting evidence to biological theories
- Asking Questions and Defining Problems
- Obtaining, Evaluating, and Communicating Information

Crosscutting Concepts

- Structure and Function
- Stability and Change
- Systems and System Models
- Energy and Matter
- Scale, Proportion, and Quantity
- Cause and effect

Instructional Resources and Materials

Resources

Environmental Science for AP*, Andrew Friedland, Rick Relyea, David Courard-Hauri. W.H. Freeman and Company/BFW, 2012. (ISBN-13: 978-0-7167-3849-7)

Materials & Benchmark Tasks

- Unit 1 Labs
    - Ecocolumn Project
    - Soil Respiration Experiment
    - Impact of nitrogen addition on forests
- Unit 2 Labs
    - Quadrat and transect lab
    - Biodiversity in school courtyards using iNaturalist
    - Net Primary Productivity lab

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- Unit 3 Labs:
    - Island biogeography lab
    - Population growth in lemna minor (duckweed)
    - World of 7 Billion research interest project
- Unit 4 Labs:
    - Physical and chemical properties of soil lab
    - Copper mine site selection
    - Strip mining with ding-dongs
- Unit 5 Labs:
    - Sustainable farm permit project
    - Garden planning and seed starting
    - Groundwater modeling lab
    - Copper extraction from malachite lab
- Unit 6 Labs
    - Wind turbine efficiency lab
    - Solar energy lab with PV cells
    - Efficient model home project
- Unit 7 Labs
    - Measuring tailpipe pollution
    - Indoor air pollution experimental design and data collection
- Unit 8 Labs
    - Landfill siting project
    - Water quality index lab
    - Stream assessment
- Unit 9 Labs
    - Greenhouse effect experimental design
    - Energy and carbon emissions of household appliances
    - Urban heat island

Assessment Strategies
Assessment is designed to measure a student's mastery of a course standard and learning objective. Assessment can be used for both instructional purposes (formative assessment) and for evaluative purposes (summative assessment).

The following is a general list of the many forms assessment may take in learning.

- Tests
- Quizzes
- Lab Design
- Lab Notebooks
- Lab Reports
- Case Studies
- Data Analysis
- Presentations
- Projects

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