NEW MILFORD PUBLIC SCHOOLS

New Milford, Connecticut

AP Environmental Science Curriculum

June 2017

BOE Approved March 2018

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New Milford's Mission Statement

The mission of the New Milford Public Schools, a collaborative partnership of students, educators, family and community, is to prepare each and every student to compete and excel in an ever-changing world, embrace challenges with vigor, respect and appreciate the worth of every human being, and contribute to society by providing effective instruction and dynamic curriculum, offering a wide range of valuable experiences, and inspiring students to pursue their dreams and aspirations.

11th and 12th Grade: AP Environmental Earth Science

Pacing Calendar 2017-2018

Unit	Timeline
1. Environmental Systems Topics: Nature of Environmental Science, Sustainability, Environmental Systems, Biogeochemical Cycles, Plate Tectonics, Species Interactions, Energy Flow in a Community, Invasive Species, Succession, Biome (aquatic and terrestrial), Importance of Biodiversity, Causes of loss of biodiversity, Conservation biology	Start: August 30 End: September 29 August 30 – pre-assessment, if applicable -Multiple choice and true/false quiz from past AP exams September 29 – summative assessment -Chapter 1,5,4,11 Test September 18 – performance assessment -Invasive Species Brochure
2. Population Topics: Evolution by Natural Selection, Ecosystem Services, Population Biology Concepts, Human Population Growth, Factors Affecting Population Growth, Demography, Impacts of Growth	Start: October 3 End: October 20 October 3 – pre-assessment, if applicable -Multiple choice and true/false quiz from past AP exams October 20 – summative assessment -Chapter 3,8 Test October 16 – performance assessment -Population Analysis
3. Water and Aquatic Ecosystems Topics: Importance of Water, Freshwater Ecosystems, Assess Problems of Water Quality and Supply, Possible Solutions to Water Problems / Conservation of Water, Wastewater Treatment, Marine Ecosystems, Human Impacts on Marine Ecosystems, Marine Fisheries and Fishing Issues	Start: October 24 End: November 15 October 24 – pre-assessment, if applicable -Multiple choice and true/false quiz from past AP exams November 15 – summative assessment -Chapter 15,16 Test November 3 – performance assessment -Water Quality Lab
4. Earth Resources and Land Use Topics: Fundamentals of Soil Science (types, formation, properties, problems), Importance of Soil in Agriculture, Soil Erosion and Degradation, Soil Conservation, Feeding the World, Pest Management, Genetically Modified Food, Sustainable Agriculture, Resource Management, Forest Management, Mining Impacts, Parks and Reserves	Start: November 17 End: December 22 November 17 – pre-assessment, if applicable -Multiple choice and true/false quiz from past AP exams December 22 – summative assessment -Chapter 9,10,12,23 Test December 4 – performance assessment -Soil Salinization Lab
5. Urbanization and Human Health	Start: January 3 End: January 19 January 3 – pre-assessment, if applicable

Topics: Urbanization, Urban Sprawl, City Planning and Land Use, Transportation, Environmental Impacts and Advantages of Urban Areas, Environmental Health Hazards Types, Abundance, Distribution, and Movement of Toxicants, Risk Assessment, Policy and Regulation	-Multiple choice and true/false quiz from past AP exams January 19 – summative assessment -Chapter 13,14 Test January 12 – performance assessment -BPA Case Study
MIDTERMS	MIDTERMS
6. Atmosphere and Climate Topics: Structure and Function of the Atmosphere, Outdoor Air Pollution, Ozone Depletion, Acidic Deposition, Indoor Air Pollution, Global Climate , Human Influence on Global Climate, Global Warming, Ways to Respond to Climate Change	Start: January 29 End: February 16 January 29 – pre-assessment, if applicable -Multiple choice and true/false quiz from past AP exams February 16 – summative assessment -Chapter 17,18 Test February 12 – performance assessment -Vehicle Exhaust Testing
7. Energy Resources and Consumption Topics: Nature and Extraction of Fossil Fuels, Environmental, Social, Political, and Economic impact of Fossil Fuels, Nonrenewable Alternatives to Fossil Fuels, Pros and Cons of Nuclear Power, Hydroelectric Power: Methods and Impacts, Renewable Alternatives to Fossil Fuels, Advantages and Disadvantages of Solar, Wind and Geothermal, Future Options for Hydrogen Fuel Cells	Start: February 22 End: March 21 February 22 – pre-assessment, if applicable -Multiple choice and true/false quiz from past AP exams March 21 – summative assessment -Chapter 19,20,21 Test March 12 – performance assessment -Home Energy Audit
8. Waste Management and Sustainability Topics: Methods of Waste Disposal, Waste Management, Ways of Reducing Waste, Sustainable Solutions, Compatibility with Economic Welfare	Start: March 23 End: April 12 March 23 – pre-assessment, if applicable -Multiple choice and true/false quiz from past AP exams April 12 – summative assessment -Chapter 22,24 Test April 3 – performance assessment -Garbage Mogul Project
AP Exam Prep and Review	Start: April 23 End: May 11
Post AP Exam Independent Research Project	Start: May 14 End: June

Subject/Course: AP Environmental Science **Unit 1: Environmental Systems** **Grade: 11-12th**

Stage 1 Desired Results

ESTABLISHED GOALS

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 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-LS4-5. Evaluate the evidence supporting claims that changes in environmental conditions may result in (1) increases in the number of individuals of some species, (2) the emergence of new species over time, and (3) the extinction of other species.

CCSS.ELA-LITERACY.RST.11-12.3
Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks; analyze the specific results based on explanations in the text.

CCSS.ELA-LITERACY.RST.11-12.9
Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process,

Transfer

Students will be able to independently use their learning to...

Developing and Using Models
Analyzing and Interpreting Data
Constructing Explanations and Design solutions
Planning and Carrying Out Investigations

Meaning

UNDERSTANDINGS

Students will understand that...

- Environmental science is grounded in social, political, economic as well as scientific principles.
- Earth is made up of interconnected systems and imbalance in any one system can alter the equilibrium of the entire system
- Energy conversions underlie all ecological processes
- Matter is cycled through an ecosystem while energy flows in one direction.
- Increased biodiversity enables an ecosystem to be healthy, stable, and resilient.
- Humans have the ability to change natural systems

ESSENTIAL QUESTIONS

- How do organisms interact with each other and their environment and what are the effects of these interactions?
- How does energy transform from one form to another?
- How do human activities alter the environment?
- What does it mean to have an environmentally sustainable society?
- Why should we care about biodiversity?

phenomenon, or concept, resolving conflicting information when possible.	***Acquisition***	
	Students will know…	*Students will be skilled at…*
	• the types of species interactions • the difference between food chains and food webs • the role keystone species play in a food web • the causes and effects of invasive species • the mechanisms of the major biogeochemical cycles • the causes and effects of biodiversity loss	• Characterize the nature of environmental science • Articulate the concept of sustainability • Compare and contrast the types of species interactions • Construct food webs and trophic pyramids to show energy flow • Predict the impact of of the loss of keystone species on ecosystem dynamics • Discuss causes of biodiversity loss • Compare how water, carbon, nitrogen, and phosphorus cycle through the environment • Explain human impact on impacting biogeochemical cycles • Describe economic and ecological benefits of species diversity. • Explain how saving other species and the ecosystem services they provide can help us save our own species and our cultures and economies. • Describe the effects of invasive species to an ecosystem. • Summarize the roles and limitations of wildlife refuges, gene banks, botanical gardens, wildlife farms, zoos, and aquariums in protecting some species. • Characterize biomes using climate, flora, and fauna • Create climatograms from temperature and precipitation data

Stage 2 – Evidence		
Code	**Evaluative Criteria**	**Assessment Evidence**
M, A	scored according to rubric regarding Content Accuracy, Evidence, Social Impact, and Technical Writing	**PERFORMANCE TASK(S):** Invasive Species Brochure or PSA Goal - create in informational brochure or public service announcement about in invasive species in order to educate the public on the causes and consequences of this species Role - wildlife biologist Audience - the general public Scenario - The students are wildlife biologists that work for a state park. They are creating an information piece in order to educate the general public about in issue a particular invasive species is creating. They will provide details about the organism, describe the economic and environmental damage being done, and outline prevention measures to be taken. Product - an information poster, brochure, or public service video
		OTHER EVIDENCE: tests and quizzes practice Free Response Questions (FRQs) class discussions lab activities modeling activities Eco-footprint calculations Case Studies

Stage 3 – Learning Plan

Code	*Pre-Assessment*	
	Multiple choice and true/false quiz from past AP exams.	
	Summary of Key Learning Events and Instruction	**Progress Monitoring**
M	Tragedy of the Commons - read Garrett Hardin's Tragedy of the Commons. Students will discuss what "commons" exist today how humans are impacting these "commons"	Warm-up questions Exit tickets
T, A	Plate Tectonics Mapping and Analysis Activity - students plot the most recent volcanic and earthquake activity on the planet in order to see patterns. Students then compare to a map of tectonic plates to make correlations.	Small Group Discussions
A	Design of Food Webs - students create a food web poster of a desert ecosystem	
A	Trophic Pyramids - students diagram pyramids showing biomass, energy loss, and number of organisms for various ecosystems	
T, A	Predator Prey Simulation Lab - students simulate the interactions between wolves and mice and collect data on population size	
T, A	Biodiversity Lab - use a variety of techniques such as Berlese Funnels to measure invertebrate diversity in soil	

Suggested Resources

Withgott, Jay and Laposata, Matthew. (2014) Environment: The Science Behind the Stories. Boston, MA. Pearson Benjamin Cummings.

Laboratory Investigations: AP Environmental Science Lab Manual – January, 2005 by William Molnar

Subject/Course: AP Environmental Science **Unit 2: Population** **Grade: 11-12th**

Stage 1 Desired Results

ESTABLISHED GOALS

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

HS-LS4-5. Evaluate the evidence supporting claims that changes in environmental conditions may result in (1) increases in the number of individuals of some species, (2) the emergence of new species over time, and (3) the extinction of other species

CCSS.ELA-LITERACY.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.

CCSS.ELA-LITERACY.RST.11-12.7
Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem.

CCSS.ELA-LITERACY.WHST.11-12.2.B
Develop the topic thoroughly by selecting the most significant and relevant facts, extended definitions, concrete details, quotations, or other information and examples appropriate to the audience's knowledge of the topic.

Transfer

Students will be able to independently use their learning to...

Use Mathematics and Computational Thinking
Constructing Explanations and Designing Solutions

Meaning

UNDERSTANDINGS

Students will understand that...

- Multiple factors affect population dynamics (births, immigration, deaths, emigration, density, and dispersion)
- Populations unrestricted by limiting factors will grow exponentially until they meet environmental resistance
- Rising human population and increasing affluence and consumption each increase environmental impact
- Social, political, and economic factors impact human population dynamics

ESSENTIAL QUESTIONS

- How do human activities alter the environment?
- How do communities and ecosystems respond to changing environmental conditions?
- How does family planning, the status of women, and wealthy/poverty affect population growth?
- What are efforts and challenges are involved in the conservation of biodiversity?
- How can different environmental factors affect carrying capacity, growth and other fundamental concepts of population ecology?
- What is species diversity and why is it important?

	Acquisition	
	Students will know…	*Students will be skilled at…*
	• the mechanism of evolution by natural selection • how evolution influences biodiversity • the difference between exponential and logistic growth • the impact of density dependent and density independent factors on populations • carrying capacity is the maximum amount of individuals an ecosystem can support • the different reproductive strategies and survivorship curves • the demographic transition model • the sociological, economic, and environmental impacts of human population growth	• explain the factors that impact speciation and extinctions • explaining the effect of density dependent and density independent factors on population growth • calculating population growth rates • Explaining and applying the fundamentals of demography (births, deaths, immigration, emigration) • using various methods to estimate population size such as mark-recapture • evaluating how human population, affluence, and technology affect the environment • comparing age structure diagrams of developing and developed countries

Stage 2 – Evidence		
Code	**Evaluative Criteria**	**Assessment Evidence**
T, M, A		**PERFORMANCE TASK(S):** Population Analysis Goal - create a plan advising the government on a plan for population management Role - advisor to president Audience - president / government officials Situation - you have been hired as an independent contractor to analyze the population data for a country. You need to analyze the data as well as the social, economic, and political factors affecting the population in order to formulate a plan for future population management. Product - proposal to the government officials including your analysis and plan
		OTHER EVIDENCE: tests and quizzes practice Free Response Questions (FRQs) class discussions lab activities modeling activities Eco-footprint calculations Case Studies

Stage 3 – Learning Plan		
Code	***Pre-Assessment***	
	Multiple choice and true/false quiz from past AP exams.	
	Summary of Key Learning Events and Instruction	**Progress Monitoring**
T, A	Mark - Recapture Lab - Students will simulate the mark-recapture technique for estimating population size using beans. Students will carry out the calculations to estimate the size of a fictional population of beanfish in a pond.	Warm-up questions Exit tickets
T,A	Doubling Time Activity - students will calculate the doubling time for a fictional bacteria population	Small Group Discussions
T,A	Analysis of exponential and logistic graphs	
T,M	Case Study Analysis	
T,A	Population Growth Lab – Inquiry based lab in which students design experiment to determine effect of various factors on population growth and carrying capacity	

Suggested Resources

Withgott, Jay and Laposata, Matthew. (2014) Environment: The Science Behind the Stories. Boston, MA. Pearson Benjamin Cummings.

National Center for Case Study Teaching in Science (http://sciencecases.lib.buffalo.edu/cs/collection/)

Laboratory Investigations: AP Environmental Science Lab Manual – January, 2005 by William Molnar

Subject/Course: AP Environmental Science **Unit 3: Water and Aquatic Ecosystems** **Grade: 11-12th**

Stage 1 Desired Results

ESTABLISHED GOALS

HS-LS4-5. Evaluate the evidence supporting claims that changes in environmental conditions may result in (1) increases in the number of individuals of some species, (2) the emergence of new species over time, and (3) the extinction of other species

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 materials and surface processes.

CCSS.ELA-LITERACY.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.

CCSS.ELA-LITERACY.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.

CCSS.ELA-LITERACY.WHST.11-12.4
Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.

Transfer

Students will be able to independently use their learning to...

Developing and Using Models
Analyzing and Interpreting Data
Constructing Explanations and Designing Solutions

Meaning

UNDERSTANDINGS

Students will understand that...

- Water is an essential resource necessary for maintaining functioning ecosystems
- Water availability varies across time and location water shortage is a major issue facing some regions
- Water pollution can be physical, chemical, or biological in nature
- There are multiple ways to increase the sustainability of water use
- Earth is made up of interconnected systems and imbalance in any one system can alter the equilibrium of the entire system

ESSENTIAL QUESTIONS

- How do human activities alter the environment?
- How do Earth's systems interact?
- Why is water considered liquid gold?
- How can we use Earth's resources sustainably?
- How do we treat drinking water and wastewater?
- how can human address the issue of freshwater depletion?
- How are ocean fisheries responding to harvesting?
- What should be our priorities for sustaining aquatic biodiversity?

	Acquisition	
	Students will know…	*Students will be skilled at…*
	• the distribution of freshwater and saltwater on the planet • the difference between the types of water pollution including toxic chemical, sediments, thermal,pathogen or nutrient-based in nature • how water is used residentially, by industry, and by agriculture • the value wetlands play both ecologically and economically • methods for sustainable water use • the pros and cons of dam construction • how fishing techniques impact marine ecosystems	• conducting various water quality tests to samples of water in order to determine overall health of the body of water • distinguish between point source and nonpoint source pollution • explain the process of eutrophication • describe the current state of ocean fisheries and explain the reasons for their decline • list and explain two major pieces of legislation geared towards protecting or cleaning up our water

Stage 2 – Evidence		
Code	**Evaluative Criteria**	**Assessment Evidence**
T, M, A		**PERFORMANCE TASK(S):** Water Quality Lab Role - Stream Analyst for the DEEP Audience - DEEP supervisor Format - lab report Topic - Students will perform basic water quality tests, such as dissolved oxygen, nitrate testing, turbidity, and macroinvertebrate testing, on a nearby body of water in order to determine the overall health of the water.
		OTHER EVIDENCE: tests and quizzes practice Free Response Questions (FRQs) class discussions lab activities modeling activities Eco-footprint calculations Case Studies

Stage 3 – Learning Plan		
Code	***Pre-Assessment***	
	Multiple choice and true/false quiz from past AP exams.	
	Summary of Key Learning Events and Instruction	**Progress Monitoring**
T,A	Personal Water Audit - students conduct an audit of the amount of water they use in a day, week, and year. They then propose ways to reduce their water consumption.	Warm-up questions Exit tickets
T,A	Klamath Water Basin Case Study - University of Buffalo Case Study Collection	Small Group Discussions
A,M	Overfishing Simulation Activity - students will observe the basic problem of fisheries to the public	

Suggested Resources

Withgott, Jay and Laposata, Matthew. (2014) Environment: The Science Behind the Stories. Boston, MA. Pearson Benjamin Cummings.

National Center for Case Study Teaching in Science (http://sciencecases.lib.buffalo.edu/cs/collection/)

Laboratory Investigations: AP Environmental Science Lab Manual – January, 2005 by William Molnar

Subject/Course: AP Environmental Science **Unit 4: Earth Resources and Land Use** **Grade: 11-12th**

Stage 1 Desired Results

ESTABLISHED GOALS

HS-ESS2-5. Plan and conduct an investigation of the properties of water and its effects on Earth materials and surface processes.

HS-LS2-7. Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity.

HS-LS4-5. Evaluate the evidence supporting claims that changes in environmental conditions may result in (1) increases in the number of individuals of some species, (2) the emergence of new species over time, and (3) the extinction of other species.

HS-ESS3-2. Evaluate competing design solutions for developing, managing, and utilizing energy and mineral resources based on cost-benefit ratios.

CCSS.ELA-LITERACY.RST.11-12.2

Determine the central ideas or conclusions of a text; summarize complex concepts, processes, or information presented in a text by paraphrasing them in simpler but still accurate terms.

CCSS.ELA-LITERACY.RST.11-12.3

Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks; analyze the specific results based on explanations in the text.

Transfer

Students will be able to independently use their learning to...

Planning and Carrying Out Investigations
Analyzing and Interpreting Data
Engaging in Argument from Evidence

Meaning

UNDERSTANDINGS

Students will understand that...

- The mineral and organic make up of soil affect fertility, erodibility, and overall soil ecosystem health
- As the human population and consumption increases, pressure from agriculture increases and soil degradation increases
- There are alternatives to traditional farming practices that can increase soil sustainability
- Earth is made up of interconnected systems and imbalance in any one system can alter the equilibrium of the entire system

ESSENTIAL QUESTIONS

- How do human activities alter the environment?
- How do Earth's systems interact?
- How is sustainable agriculture possible?
- What type of issues are involved and park design?
- How can humans conserve soil and provide solutions to soil erosion and land degradation?
- What is food security and why is it difficult to attain?
- What environmental problems arise from industrialized food production?
- How can we produce food more sustainably?

	Acquisition	
CCSS.ELA-LITERACY.RST.11-12.7 Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem. CCSS.ELA-LITERACY.WHST.11-12.2.B Develop the topic thoroughly by selecting the most significant and relevant facts, extended definitions, concrete details, quotations, or other information and examples appropriate to the audience's knowledge of the topic.	*Students will know…* • the components of soil and how soil forms • how soil erosion occurs • methods to increase soil sustainability such as no till farming, terracing, crop rotation, and low flow irrigation • that the green revolution was aimed to increase agricultural production without further land degradation • the pros and cons of pest management strategies including the use of synthetic chemicals, biological control, and integrated pest management • the differences between traditional and organic agricultural practices • resource management has increasingly focused on sustainable use as well as extraction of resources • the difference between harvesting techniques including clear-cutting, selective cutting, and the seed tree method • the difference between the BLM, National Reserves, National Parks, and Wilderness areas	*Students will be skilled at…* • classifying soil type using the soil triangle • explaining how human activity impacts soil health • identify the goals, methods, and environmental impacts of the "green revolution" • explain the challenges of feeding a growing population • evaluate the approaches to pest management • identify the principles, goals, and approaches to resource management • summarize the ecological and economic benefits of forests • explain the fundamentals of forest management • compare the major land management agencies in terms of their goals, methods, and impacts • describing the environmental impacts of extracting, processing, and using mineral resources

		Stage 2 – Evidence
Code	**Evaluative Criteria**	**Assessment Evidence**
T, M, A		**PERFORMANCE TASK(S):** Soil Salinization Lab Goal - advise the town's department of public works on a plan for dealing with roadside salinization caused by plows and winter road treatment Role - soil scientist Audience - department of public works employees Scenario - Students have been contracted by the town to do a study on the impacts of road salting on grass and other vegetation along roadsides. Product - a report detailing their findings and potential solutions to remedy or prevent the issue in the future
		OTHER EVIDENCE: tests and quizzes practice Free Response Questions (FRQs) class discussions lab activities modeling activities Eco-footprint calculations Case Studies

Stage 3 – Learning Plan

Code	*Pre-Assessment*	
	Multiple choice and true/false quiz from past AP exams.	
	Summary of Key Learning Events and Instruction	**Progress Monitoring**
T,A	Properties of Soil Lab - students circulate through stations investigating the properties of soil including composition, porosity, texture, and chemistry	Warm-up questions Exit tickets
T,A	Mining Simulation Lab - students simulate the extraction and reclamation procedure that mining companies must undergo to obtain mineral resources. Students then conduct a cost benefit analysis of the process.	Small Group Discussions
T,A	Natural Areas Project – research history, species, ecosystem, and ecological importance of a protected area in the U.S.	

Suggested Resources

Withgott, Jay and Laposata, Matthew. (2014) Environment: The Science Behind the Stories. Boston, MA. Pearson Benjamin Cummings.

Laboratory Investigations: AP Environmental Science Lab Manual – January, 2005 by William Molnar

Subject/Course: AP Environmental Science **Unit 5: Urbanization and Human Health** **Grade: 11-12th**

Stage 1 Desired Results

ESTABLISHED GOALS

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-ESS3-1. 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.

CCSS.ELA-LITERACY.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.

CCSS.ELA-LITERACY.RST.11-12.7
Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem.

Transfer

Students will be able to independently use their learning to...

Analyzing and Interpreting Data
Engaging in Argument from Evidence

Meaning

UNDERSTANDINGS

Students will understand that...

- The shift from rural to urban living has been driving by industrialization
- The linear mode of production and consumption is unsustainable and more circular modes will need to be adopted to create sustainable cities
- There are two approaches to risk assessment and management: innocent until proven guilty and precautionary
- Toxicants can be both natural and man-made and can cycle between environmental systems

ESSENTIAL QUESTIONS

- How do human activities alter the environment?
- How can we use Earth's resources sustainably?
- What is the connection between environmental health and human health?
- What are philosophical approaches to risk and how are the related to regulatory policy?
- What are the environmental impacts and advantages of urban centers?

	Acquisition	
	Students will know…	*Students will be skilled at…*
	• the causes and effects of urbanization • the negative impacts of urban sprawl • the definition of "smart growth" • the components of sustainable cities • environmental health seeks to mitigate environmental factors that affect human health and environmental systems • toxicants may be natural or man-made and include carcinogens, mutagens, teratogens, allergens, neurotoxins, and endocrine disruptors • the difference between bioaccumulation and biomagnification • the definition of LD50 or TC50 • the roles of the EPA, CDC, FDA and OSHA	• assess the impacts of urban and suburban sprawl • outline planning and practices for sustainable cities • describe the types of environmental toxicants • compare the philosophical approaches to risk management • identify and describe several policies and regulations concerning environmental health • calculating the LD50 for a toxicant

Stage 2 – Evidence		
Code	**Evaluative Criteria**	**Assessment Evidence**
T,M,A		**PERFORMANCE TASK(S):** Case Study Analysis of BPA data Role - Environmentalist Audience - The teacher/the public Format - Public Service Announcement Task - students analyze and consider the validity of data on estrogen mimicking chemicals leaching out of plastics. They then draw conclusions about the impact on mammals. Students will then be asked to propose methods to educate the public about the issue.
		OTHER EVIDENCE: tests and quizzes practice Free Response Questions (FRQs) class discussions lab activities modeling activities Eco-footprint calculations Case Studies

Stage 3 – Learning Plan		
Code	***Pre-Assessment*** Multiple choice and true/false quiz from past AP exams.	
	Summary of Key Learning Events and Instruction	**Progress Monitoring**
M,T	Kermit to Kermette Case Study - University of Buffalo Case Study Collection	Warm-up questions
T,A	LD50 Graph Data Analysis Activity	Exit tickets
M	Toxic Sites (Molnar) -researching Super Fund sites	Small Group Discussions

Suggested Resources

Withgott, Jay and Laposata, Matthew. (2014) Environment: The Science Behind the Stories. Boston, MA. Pearson Benjamin Cummings.

National Center for Case Study Teaching in Science (http://sciencecases.lib.buffalo.edu/cs/collection/)

Laboratory Investigations: AP Environmental Science Lab Manual – January, 2005 by William Molnar

Subject/Course: AP Environmental Science **Unit 6: Atmosphere and Climate** **Grade: 11-12th**

Stage 1 Desired Results

ESTABLISHED GOALS

HS-ESS3-4. Evaluate or refine a technological solution that reduces impacts of human activities on natural systems.

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-ESS3-5. 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-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-LS4-5. Evaluate the evidence supporting claims that changes in environmental conditions may result in (1) increases in the number of individuals of some species, (2) the emergence of new species over time, and (3) the extinction of other species.

Transfer

Students will be able to independently use their learning to...

Planning and Carrying Out Investigations
Developing and Using Models

Meaning

UNDERSTANDINGS

Students will understand that...

- Earth is made up of interconnected systems and imbalance in any one system can alter the equilibrium of the entire system
- Climate varies over time and space through both natural and man-made processes
- Life on Earth is shaped by and influences climate
- Humans influence the atmosphere and Earth's climate

ESSENTIAL QUESTIONS

- How do human activities alter the environment?
- How can we use Earth's resources sustainably?
- How do organisms interact with each other and their environment and what are the effects of these interactions?
- How do organisms respond to climate change?

CCSS.ELA-LITERACY.RST.11-12.2 Determine the central ideas or conclusions of a text; summarize complex concepts, processes, or information presented in a text by paraphrasing them in simpler but still accurate terms. CCSS.ELA-LITERACY.RST.11-12.3 Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks; analyze the specific results based on explanations in the text.	***Acquisition***	
	Students will know…	*Students will be skilled at…*
	• the atmosphere consists of four layers over which temperature, pressure, humidity, and composition vary • weather is a short-term phenomena of temperature and precipitation whereas climate is the long-term patterns in temperature and precipitation • solar energy helps create seasons and weather patterns • the major air pollutant are CO, SO2, NO2, tropospheric ozone, particulate matter, and lead • the causes and effects of smog • the causes and effects of the "ozone hole" • acid deposition is caused by SO2 and NO2 reacting with atmospheric water • bodies of water, soil, plants and animals may experience negative impacts from acid deposition • natural causes of climate changes include milankovitch cycles, solar output, and ocean circulation • the difference between proxy indicators and direct atmospheric sampling • increases in global temperature will affect sea levels, frequency of extreme weather events, agricultural growing seasons, allergies, and the distribution of flora and fauna • strategies for mitigating climate change including but not limited to reducing emissions, legislation, and reducing consumption	• describe the composition, structure, and function of the atmosphere • distinguish between weather and climate • describe the types of outdoor air pollution • explain the causes and impacts of ozone depletion • explain the causes and impacts of acid deposition • describe the types of indoor air pollution • summarize the methods of climate research • analyze climate data and draw conclusions about the trends in global climate

Stage 2 – Evidence		
Code	**Evaluative Criteria**	**Assessment Evidence**
T,M,A		**PERFORMANCE TASK(S):** Air Pollution and Vehicle Exhaust Testing Role - DMV Audience - Car Owner/Driver Format - Emissions Report Task - students will test the emissions of several vehicles to ensure that they meet the CT state emission requirements
		OTHER EVIDENCE: tests and quizzes practice Free Response Questions (FRQs) class discussions lab activities modeling activities Eco-footprint calculations Case Studies

Stage 3 – Learning Plan

Code	*Pre-Assessment*	
	Multiple choice and true/false quiz from past AP exams.	
	Summary of Key Learning Events and Instruction	**Progress Monitoring**
T,A	Analysis of Ozone Data - graph and analyze ozone data to determine trends and correlations between ozone levels and legislation	Warm-up questions Exit tickets
T,A	Emissions Trading Game - students simulate the process that industry uses to meet the CAA regulations for emissions	Small Group Discussions
T,A,M	Acid Deposition - students measure the pH of unpolluted water and simulated acid rain and model the effects of acid rain on human-made structures.	
T,A,M	Exploring Air Pollution of Fossil Fuels – students measure amount of air pollutants from everyday activities and relate to human health	

Suggested Resources

Withgott, Jay and Laposata, Matthew. (2014) Environment: The Science Behind the Stories. Boston, MA. Pearson Benjamin Cummings.

Laboratory Investigations: AP Environmental Science Lab Manual – January, 2005 by William Molnar

Subject/Course: AP Environmental Science **Unit 7: Energy Resources and Consumption** **Grade: 11-12th**

Stage 1 Desired Results

ESTABLISHED GOALS

HS-ESS3-2. Evaluate competing design solutions for developing, managing, and utilizing energy and mineral resources based on cost-benefit ratios.

HS-PS1-8. Develop models to illustrate the changes in the composition of the nucleus of the atom and the energy released during the processes of fission, fusion, and radioactive decay.

HS-PS3-3. Design, build, and refine a device that works within given constraints to convert one form of energy into another form of energy.

CCSS.ELA-LITERACY.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.

CCSS.ELA-LITERACY.RST.11-12.7
Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem.

Transfer

Students will be able to independently use their learning to...

Engaging in Argument from Evidence
Using Mathematics and Computational Thinking

Meaning

UNDERSTANDINGS

Students will understand that...

- Natural and human activities impact the cycling of matter and the flow of energy through ecosystems.
- You cannot get something for nothing. According to the first law of thermodynamics, or the law of conservation of energy, whenever energy is converted from one form to another in, no energy is created or destroyed. This means that in causing such changes, we cannot get more energy out than what we put in.
- You cannot break even. According to the second law of thermodynamics, whenever energy is converted from one form to another, we always end up with lower-quality or less usable energy than we started with.
- A key factor to consider in evaluating the long-term usefulness of any energy resource is its net energy yield.
- Making the transition to a more sustainable energy future will require sharply increasing energy efficiency, using

ESSENTIAL QUESTIONS

- Why is energy efficiency an important energy resource?
- How can we make the transition to a more sustainable energy future?
- How can we transition to a more sustainable energy future?
- What are the environmental impacts of fossil fuel use? What are some solutions?
- How can energy be conserved and how can efficiency be enhanced?
- What are major sources of renewable energy? What are the benefits and potential for their growth?
- How can we deal with pollution?

	a mix of environmentally friendly renewable energy resources, and including the harmful environmental and health costs of energy resources in their market prices.	
	Acquisition	
	Students will know…	*Students will be skilled at…*
	• fossil fuels are created very slowly as buried organic matter is transformed through heat and pressure • the advantages and disadvantages of coal, natural gas, and oil extraction and use • the process behind hydrofracking • the process of converting nuclear fuel to energy • the mechanism of a hydrogen fuel cell • emissions from fossil fuel combustion pollute the air, pose human health risks, and are linked to climate change • extraction of fossil fuels leads to soil degradation and water pollution • By using a mix of renewable energy sources—especially solar, wind, flowing water, sustainable biofuels, and geothermal energy—we could drastically reduce pollution, greenhouse gas emissions, and biodiversity losses.	• describing the nature and origin of fossil fuels and evaluating the advantages and disadvantages of their extraction and use • describing the nature and origin of renewable energy resources and evaluating the advantages and disadvantages of their use • summarizing the the process of harnessing nuclear energy • debating the benefits and consequences of nuclear power • explain the mechanism of a hydrogen fuel cell • calculating efficiency of various sources of energy • converting between various units of energy (calories, joules, BTUs…)

Stage 2 – Evidence		
Code	**Evaluative Criteria**	**Assessment Evidence**
T, M, A		**PERFORMANCE TASK(S):** Home Energy Audit Role - homeowner Audience - their teacher Format - Spreadsheet Task - conduct a home energy audit to determine the kW of energy used by each appliance in the home and determine where efficiency of energy usage may be improved
		OTHER EVIDENCE: tests and quizzes practice Free Response Questions (FRQs) class discussions lab activities modeling activities Eco-footprint calculations Case Studies

Stage 3 – Learning Plan		
Code	***Pre-Assessment*** Multiple choice and true/false quiz from past AP exams.	
	Summary of Key Learning Events and Instruction	**Progress Monitoring**
T,A	Energy conversion and efficiency problems	Warm-up questions
M, A	Energy Resources Comparison Graphic Organizer	Exit tickets
M	Article Summary/Reflection and Class Discussion - topic: alternative energy sources	Small Group Discussions
T,A	Research the use of solar cookers in underdeveloped countries	
M	Video: Gasland	

Suggested Resources

Withgott, Jay and Laposata, Matthew. (2014) Environment: The Science Behind the Stories. Boston, MA. Pearson Benjamin Cummings.

National Center for Case Study Teaching in Science (http://sciencecases.lib.buffalo.edu/cs/collection/)

Laboratory Investigations: AP Environmental Science Lab Manual – January, 2005 by William Molnar

Subject/Course: AP Environmental Science **Unit 8: Waste Management and Sustainability** **Grade: 11-12th**

Stage 1 Desired Results

ESTABLISHED GOALS

HS-ESS3-3. Create a computational simulation to illustrate the relationships among the management of natural resources, the sustainability of human populations, and biodiversity.

CCSS.ELA-LITERACY.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.

Transfer

Students will be able to independently use their learning to...

Analyzing and Interpreting Data
Engaging in Argument from Evidence

Meaning

UNDERSTANDINGS

Students will understand that...

- Earth is made up of interconnected systems and imbalance in any one system can alter the equilibrium of the entire system
- Modern methods of waste management are far safer for people and gentler on the environment however human consumption has created more waste than ever before
- Making the transition to a more sustainable energy future will require sharply increasing energy efficiency, using a mix of environmentally friendly renewable energy resources, and including the harmful environmental and health costs of energy resources in their market prices.
- The best solution to our waste problem is to reduce our generation of waste

ESSENTIAL QUESTIONS

- How do human activities alter the environment?
- How can we use Earth's resources sustainably?
- How can environmental protection enhance economic well-being?
- How can waste be reduced?

	Acquisition	
	Students will know…	*Students will be skilled at…*
	• the major categories of waste are industrial, solid, hazardous and wastewater • how a sanitary landfill guards against contamination or groundwater, air, and soil • the process used to improve incinerator emissions and harness energy from landfills • incinerators reduce waste volume but produce toxic ash to be disposed of • the difference between composting and recycling	• comparing municipal and industrial waste in terms of components and disposal methods • Explaining conventional waste disposal methods of landfills and incinerators • evaluating the approaches for reducing waste (source reduction, composting, recycling) in terms of effectiveness

Stage 2 – Evidence		
Code	**Evaluative Criteria**	**Assessment Evidence**
M, A		**PERFORMANCE TASK(S):** Garbage Mogul Project Role - Entrepreneur/Environmental Advocate Audience - their teacher Format - Project/physical prototype Task - Students watch a video about Terracycle, a company that makes and sells products made from recycled material such as pencil cases made from Capri Sun juice pouches. Students will then create a unique item made from as much recycled material as possible. Students then estimate how much waste is saved from a landfill.
		OTHER EVIDENCE: tests and quizzes practice Free Response Questions (FRQs) class discussions lab activities modeling activities Eco-footprint calculations Case Studies

Stage 3 – Learning Plan		
Code	***Pre-Assessment*** Multiple choice and true/false quiz from past AP exams.	
	Summary of Key Learning Events and Instruction	**Progress Monitoring**
T, M, A	Wastewater Treatment Lab - students model the process of cleaning up wastewater for disposal	Warm-up questions Exit tickets Small Group Discussion
T, M, A	Eco-Footprint Calculations - use an online platform to calculate your eco-footprint then modify your behaviors to try to improve your footprint	
A	Article Summary/Reflection - topic of E-waste	

Suggested Resources

Withgott, Jay and Laposata, Matthew. (2014) Environment: The Science Behind the Stories. Boston, MA. Pearson Benjamin Cummings.

National Center for Case Study Teaching in Science (http://sciencecases.lib.buffalo.edu/cs/collection/)

Laboratory Investigations: AP Environmental Science Lab Manual – January, 2005 by William Molnar