

**Randolph Township Schools
Randolph High School**

**Environmental Science
Curriculum**

*“When one tugs at a single thing in nature, he finds it attached to the rest of the world.”
~John Muir, naturalist, Sierra Club founder*

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Curriculum Developed:
July 2017

Date of Board Approval:
October 17, 2017

**Randolph Township Schools
STEM Department
Environmental Science**

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Randolph Township Schools

Mission Statement

We commit to inspiring and empowering all students in Randolph schools to reach their full potential as unique, responsible and educated members of a global society.

Randolph Township Schools Affirmative Action Statement

Equality and Equity in Curriculum

The Randolph Township School district ensures that the district's curriculum and instruction are aligned to the state's standards. The curriculum provides equity in instruction, educational programs and provides all students the opportunity to interact positively with others regardless of race, creed, color, national origin, ancestry, age, marital status, affectional or sexual orientation, gender, religion, disability or socioeconomic status.

N.J.A.C. 6A:7-1.7(b): Section 504, Rehabilitation Act of 1973; N.J.S.A. 10:5; Title IX, Education Amendments of 1972

RANDOLPH TOWNSHIP BOARD OF EDUCATION

EDUCATIONAL GOALS

VALUES IN EDUCATION

The statements represent the beliefs and values regarding our educational system. Education is the key to self-actualization, which is realized through achievement and self-respect. We believe our entire system must not only represent these values, but also demonstrate them in all that we do as a school system.

We believe:

- The needs of the child come first
- Mutual respect and trust are the cornerstones of a learning community
- The learning community consists of students, educators, parents, administrators, educational support personnel, the community and Board of Education members
- A successful learning community communicates honestly and openly in a non-threatening environment
- Members of our learning community have different needs at different times. There is openness to the challenge of meeting those needs in professional and supportive ways
- Assessment of professionals (i.e., educators, administrators and educational support personnel) is a dynamic process that requires review and revision based on evolving research, practices and experiences.
- Development of desired capabilities comes in stages and is achieved through hard work, reflection and ongoing growth

Randolph Township Schools
STEM Department
Environmental Science

Introduction

This full-year course of study is designed to introduce students to ecological concepts and environmental problems, which impact the world in which they live. Students will investigate the interrelationships between organisms and their environment and examine cause and effect throughout the year. Environmental Science is heavily grounded in real world applications and problem solving. Students will be provided with the knowledge to evaluate choices that can reduce the negative impact man has made on the environment. Students will relate technological advancement to current ecological struggles as well as the use of similar technologies used to mitigate the damage currently being inflicted. This program will provide ways in which students can become more aware and proactive regarding the interactions of themselves and their environment. This course encourages environmental sentience and understanding of concrete everyday problems which affect their lives as they become citizens of the world. Central topics include: general science skills, earth systems, energy resources, land and water resources, pollution, human dynamics, and ecology. Activity-based investigations are utilized to allow students to further examine course concepts.

RANDOLPH TOWNSHIP SCHOOL DISTRICT
Curriculum Pacing Chart
Environmental Science

SUGGESTED TIME ALLOTMENT	UNIT NUMBER	CONTENT - UNIT OF STUDY
5 weeks	I	Foundations
5 weeks	II	Ecology, Patterns and Processes
5 weeks	III	Human Demographics
5 weeks	IV	Earth's Resources
5 weeks	V	Energy
5 weeks	VI	Challenges
6 weeks	VII	Sustainable Future

RANDOLPH TOWNSHIP SCHOOL DISTRICT

Environmental Science

UNIT I: Foundations

TRANSFER: One has to be knowledgeable about how to consume information and aware of how scientific studies are performed and interpreted.

STANDARDS / GOALS:	ENDURING UNDERSTANDINGS	ESSENTIAL QUESTIONS
<p>HS-LS1-C Organization for Matter and Energy Flow in Organisms As matter and energy flow through different organizational levels of living systems chemical elements are recombined in different ways to form different products. As a result of these chemical reactions, energy is transferred from one system of interacting molecules to another. Cellular respiration is a chemical process in which the bonds of food molecules and oxygen molecules are broken and new compounds are formed that can transport energy to muscles. Cellular respiration also releases the energy needed to maintain body temperature despite ongoing energy transfer to the surrounding environment. (HS-LS1-7)</p> <p>LS2.B: Cycles of Matter and Energy Transfer in Ecosystems Photosynthesis and cellular respiration (including anaerobic processes) provide most of the energy for life processes. (HSL2-3) Plants or algae form the lowest level of the food web. At each link upward in a food web, only a small fraction of the</p>	Data driven science changes as more information becomes available.	<ul style="list-style-type: none"> • How do scientists provide answers to questions I care about?
	The Scientific Method is used to ensure reliability and replicability of scientific investigations.	<ul style="list-style-type: none"> • How does one construct an unbiased and reliable experiment?
	Environmental legislature is governed by scientific, economic, sociological, and cultural norms.	<ul style="list-style-type: none"> • How is pseudoscience mistaken as truth?
	KNOWLEDGE	SKILLS
	<p>Students will know: The process and application of the Scientific Method.</p> <p>The elements necessary to effectively carry out a controlled experiment.</p>	<p>Students will be able to: Formulate a testable hypothesis</p> <p>Apply scientific and engineering ideas to design, evaluate, and refine a device that minimizes the force on a macroscopic object during a collision</p> <p>Construct a graph appropriately identifying the dependent and independent variables.</p>

<p>matter consumed at the lower level is transferred upward, to produce growth and release energy in cellular respiration at the higher level. Given this inefficiency, there are generally fewer organisms at higher levels of a food web. Some matter reacts to release energy for life functions, some matter is stored in newly made structures, and much is discarded. The chemical elements that make up the molecules of organisms pass through food webs and into and out of the atmosphere and soil, and they are combined and recombined in different ways. At each link in an ecosystem, matter and energy are conserved. (HS-LS2-4) Photosynthesis and cellular respiration are important components of the carbon cycle, in which carbon is exchanged among the biosphere, atmosphere, oceans, and geosphere through chemical, physical, geological, and biological processes. (HS-LS2-5)</p>	<p>The effects of bias on scientific discovery, and what is done to minimize its impact.</p> <p>The effect of the Tragedy of the Commons as it applies to social responsibilities.</p> <p>Developed and developing countries are defined demographically; socioeconomically; and environmentally.</p> <p>VOCABULARY: Commons, pseudoscience, control group, test group, independent variable, dependent variable, probability, sample, double-blind experiment, ethics, interdependence, conclusion, bias, Tragedy of the Commons, Scientific Method, Law of Unintended Consequences, observations, observational study, inferences, correlation, cause-and-effect relationship, empirical evidence, hypothesis, testable, predictions, falsifiable, experimental study, peer-reviewed, theory, statistics, policy, precautionary principle, adaptive management</p>	<p>Design an experiment and identify the components of a controlled experiment.</p> <p>Differentiate between reliable and unreliable sources/information.</p> <p>Model the adverse effects personal interest has on shared resources.</p> <p>Analyze costs, trade-offs of various hazards and evaluate possible solutions to environmental problems and related health problems and related health issues at the local/regional level.</p>
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ASSESSMENT EVIDENCE: Students will show their learning by completing the:

- Pill Bug Behavior Lab Write-Up
- Journal Writing Prompts: Hetch Hetchy Debate, Astrology Science or Not
- Data Analysis Activity: “The Poison Pump”
- Town Debate: the influence of cultural, economic, and scientific principles on Environmental Legislature

- Design an experiment and analyze results

KEY LEARNING EVENTS AND INSTRUCTION:

- Suggested Labs and Performance assessments: Pill Bug Activity, The Poison Pump Review, Tragedy of the Commons Goldfish activity, Environmental Risk Ranking, Process Oriented Guided Inquiry Learning

RANDOLPH TOWNSHIP SCHOOL DISTRICT
Environmental Science
Unit I: Foundations

SUGGESTED TIME ALLOTMENT	CONTENT-UNIT OF STUDY	SUPPLEMENTAL UNIT RESOURCES
5 Weeks	<ul style="list-style-type: none"> ● The Interdisciplinary Nature of Environmental Science ● Ethics and Environmental Policy ● Developed vs. Developing Nations ● The Use and Implementation of the Scientific Method 	<p>Environmental Science Journal Writing Prompts Current Events from appropriate periodicals and news sources</p> <p>TedEd Lesson: How simple ideas lead to scientific discoveries - Adam Savage https://ed.ted.com/lessons/how-simple-ideas-lead-to-scientific-discoveries#digdeeper</p> <p>Ted Talk: Advice to a young scientist https://www.ted.com/talks/e_o_wilson_advice_to_young_scientists</p> <p>Multimedia: Myth Busters Who gets Wetter? Eyes of Nye: Pseudoscience An Honest Liar</p>

RANDOLPH TOWNSHIP SCHOOL DISTRICT
Environmental Science
UNIT II: Ecology, Patterns and Processes

TRANSFER: All life is interconnected and dependent on the same resources found on Earth, including you.

STANDARDS / GOALS:	ENDURING UNDERSTANDINGS	ESSENTIAL QUESTIONS
<p>LS2.A: Interdependent Relationships in Ecosystems Ecosystems have carrying capacities, which are limits to the numbers of organisms and populations they can support. These limits result from such factors as the availability of living and nonliving resources and from such challenges such as predation, competition, and disease. Organisms would have the capacity to produce populations of great size were it not for the fact that environments and resources are finite. This fundamental tension affects the abundance (number of individuals) of species in any given ecosystem. (HS-LS2-1),(HS-LS2-2)</p> <p>LS2.C: Ecosystem Dynamics, Functioning, and Resilience A complex set of interactions within an ecosystem can keep its numbers and types of organisms relatively constant over long periods of 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.</p>	If organisms do not adapt to the environment they will not survive.	<ul style="list-style-type: none"> • How does evolution relate to the study of environmental science?
	Energy flows through ecosystems from the sun to producers to consumers.	<ul style="list-style-type: none"> • How is Earth’s inner structure related to its functionality?
	As it applies to matter, Earth is a closed system, and is maintained through biogeochemical cycles.	<ul style="list-style-type: none"> • How does the environment affect how and where an organism lives?
	Populations interact with one another in many different manners.	<ul style="list-style-type: none"> • Where did the water you drink come from?
	The specific conditions of a population’s environment determine which heritable traits are adaptations.	<ul style="list-style-type: none"> • How is energy passed through an ecosystem?
	KNOWLEDGE	SKILLS
<p>Students will know: The biosphere is divided into several different levels that are defined by unique chemical, physical, and behavioral characteristics.</p>	<p>Students will be able to: Model and describe the different divisions of the geosphere. Model and describe the different divisions of the atmosphere.</p>	

<p>Extreme fluctuations in conditions or the size of any population, however, can challenge the functioning of ecosystems in terms of resources and habitat availability. (HS-LS2-2),(HS-LS2-6)</p> <p>Moreover, 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. (HS-LS2-7)</p>	<p>Energy flows within an ecosystem from prey to consumer.</p> <p>Ninety percent of the energy is lost as it flows from organism to organism.</p> <p>How organisms have adapted to their environment using examples from the diversity of organisms.</p> <p>There are several different ways in which populations interact with one another including symbiosis, competition, and predation.</p> <p>As an environment changes, the populations inhabiting the area must adapt or face extinction.</p> <p>VOCABULARY: Energy, transfer, trophic level, succession, biome, evolution, adaptation, biodiversity, atmosphere, population, ecology, niche, biome, latitude, food web</p>	<p>Model the energy transfer through an ecosystem.</p> <p>Calculate the energy transfer throughout an ecosystem.</p> <p>Evaluate the evidence for the role of group behavior and changes in populations over time.</p> <p>Analyze the relationships between populations within an ecosystem.</p> <p>Predict how changes within an ecosystem will affect population dynamics.</p> <p>Use mathematical representations to support claims for the cycling of matter and flow of energy among organisms in an ecosystem.</p>
<p>ASSESSMENT EVIDENCE: Students will show their learning by:</p> <ul style="list-style-type: none"> ● Chemthink Modules: Particulate Nature of Matter and Atoms: An Interactive online tutorial that includes a quiz at the completion of each module ● Constructing a Climatogram and data comparison ● Deer Dilemma Class Debate: Students conduct a town meeting debate to discuss a deer overpopulation problem ● Food Web Models ● Environmental cycles group presentations <p>KEY LEARNING EVENTS AND INSTRUCTION:</p> <ul style="list-style-type: none"> ● Suggested Labs and Performance assessments: Turkey Trouble Activity; A look at Carrying Capacity, Human Survivorship Changes lab, Living Edens Ecosystem, Natural Selection Quick Lab, Process Oriented Guided Inquiry Learning activities 		

RANDOLPH TOWNSHIP SCHOOL DISTRICT
Environmental Science
Unit II: Ecology, Patterns and Processes

SUGGESTED TIME ALLOTMENT	CONTENT-UNIT OF STUDY	SUPPLEMENTAL UNIT RESOURCES
5 Weeks	<ul style="list-style-type: none"> • Energy Transfer • Ecology • Evolution and Extinction • Biogeochemical Cycles • Biodiversity • Atmosphere and Geosphere Divisions 	Environmental Science Journal Writing Prompts Current Events from appropriate periodicals and news sources Multimedia: Blue Planet Afterlife: The Strange Science of Decay More Than Honey Walking with Monsters

RANDOLPH TOWNSHIP SCHOOL DISTRICT
Environmental Science
UNIT III: Human Demographics

TRANSFER: Human quality of life, interactions, and environmental awareness varies greatly across populations.		
<p>STANDARDS / GOALS:</p> <p>LS4.D: Biodiversity and Humans There are many different kinds of living things in any area, and they exist in different places on land and in water.</p> <p>LS4-2 Biological Evolution: Unity and Diversity Construct an explanation based on evidence that the process of evolution primarily results from four factors: (1) the potential for a species to increase in number, (2) the heritable genetic variation of individuals in a species due to mutation and sexual reproduction, (3) competition for limited resources, and (4) the proliferation of those organisms that are better able to survive and reproduce in the environment.</p> <p>LS2-4 Ecosystems: Interactions, Energy, and Dynamics Use mathematical representations to support claims for the cycling of matter and flow of energy among organisms in an ecosystem.</p> <p>LS2.B: Cycles of Matter and Energy Transfer in Ecosystems Plants or algae form the lowest level of the</p>	ENDURING UNDERSTANDINGS	ESSENTIAL QUESTIONS
	The human population is defined by several different factors, all of which are used to accurately predict changes in population health, size, and consumption levels.	<ul style="list-style-type: none"> How do humans differ from other animals in regard to territorial range?
	The human population has surpassed carrying capacity which affects all of life on Earth.	<ul style="list-style-type: none"> How does the human population affect the environment?
	Environmental conditions greatly influence population health, mortality rate, and growth rate.	<ul style="list-style-type: none"> How does the environmental conscience vary from culture to culture?
	KNOWLEDGE	SKILLS
	<p>Students will know: There are predictable trends found in the demographic transition model.</p> <p>One can mitigate their ecological footprint through several small adjustments as well as through large changes in daily activities.</p>	<p>Students will be able to: Evaluate the impact of human population demographics on the environment.</p> <p>Analyze the demographics to determine its place in the demographic transition model.</p> <p>Calculate individual carbon footprints based off of daily activities.</p>

<p>food web. At each link upward in a food web, only a small fraction of the matter consumed at the lower level is transferred upward, to produce growth and release energy in cellular respiration at the higher level. Given this inefficiency, there are generally fewer organisms at higher levels of a food web. Some matter reacts to release energy for life functions, some matter is stored in newly made structures, and much is discarded. The chemical elements that make up the molecules of organisms pass through food webs and into and out of the atmosphere and soil, and they are combined and recombined in different ways. At each link in an ecosystem, matter and energy are conserved.</p>	<p>Developing countries tend to have substandard health care and sanitation practices, and have a very uneven age distribution.</p> <p>VOCABULARY: Carrying capacity, life expectancy, fertility rate, growth rate, exponential growth, population densities, overpopulation, mortality rate, demographic transition, pronatalist, antinatalist, Dust Bowl, Green Revolution, carbon footprint</p>	<p>Create graphs showing population changes and age distributions of different countries.</p> <p>Discuss how countries evolve culturally, and how this impacts fertility rates, birth rates, and death rates.</p>
<p>ASSESSMENT EVIDENCE: Students will show their learning by:</p> <ul style="list-style-type: none"> ● Researching and analyzing human demographics from around the world with varying socioeconomic states ● Carbon footprint analysis ● Recognizing Human Impacts ● Ecological Footprints and Sustainability <p>KEY LEARNING EVENTS AND INSTRUCTION:</p> <ul style="list-style-type: none"> ● Suggested Labs and Performance assessments: Carrying Capacity Competition, Human Survivorship Changes, Process Oriented Guided Inquiry Learning Activities 		

RANDOLPH TOWNSHIP SCHOOL DISTRICT
Environmental Science
UNIT III: Human Demographics

SUGGESTED TIME ALLOTMENT	CONTENT-UNIT OF STUDY	SUPPLEMENTAL UNIT RESOURCES
5 Weeks	<ul style="list-style-type: none"> • Human Demographics • Population Transitions • Socioeconomic Conditions and Consumerism • Carbon Footprint 	<p>Environmental Science Journal Writing Prompts Current Events from appropriate periodicals and news sources</p> <p>Multimedia resources: PBS Nova “World in the Balance, the People Paradox” The Eyes of Nye “Human Population” No Impact Man The Yes Men Fix the World Walmart: The High Cost of Low Price The High Price of Fashion</p>

RANDOLPH TOWNSHIP SCHOOL DISTRICT

**Environmental Science
Unit IV: Earth’s Resources**

TRANSFER: Humanity depends upon Earth’s finite resources for survival.		
STANDARDS / GOALS:	ENDURING UNDERSTANDINGS	ESSENTIAL QUESTIONS
<p>ESS3.A: Natural Resources Resource availability has guided the development of human society. (HS-ESS3-1)</p> <p>ESS3.B: Natural Hazards Natural hazards and other geologic events have shaped the course of human history; [they] have significantly altered the sizes of human populations and have driven human migrations. (HS-ESS3-1)</p>	Increase of human sickness is related to increased use of factory farming which in turn increases risk for human disease.	<ul style="list-style-type: none"> How are sustainable methods of agriculture designated and why might they not be employed?
	Genetically Modified Organisms are necessary to support the growing human population, but the use of these are raising concerns amongst consumers.	<ul style="list-style-type: none"> Should all GMO products be labeled with DNA identification?
	Food production often utilizes inhumane practices to increase profit margins.	<ul style="list-style-type: none"> How can one become more environmentally conscious as it applies to nutrition?
	KNOWLEDGE	SKILLS
<p>LS4.D: Biodiversity and Humans 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</p>	<p>Students will know: Carrying capacity is the number of people, other living organisms, or crops that a region can support without environmental degradation.</p> <p>Food providers use deceiving terms such as: cage free, certified humane, free range, and organic animal products to gain consumer trust.</p>	<p>Students will be able to: Predict and analyze consequences of exceeding the carrying capacities at both local and global levels.</p> <p>Apply scientific knowledge and research to current environmental impacts of human food processing and consumption.</p>

<p>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.</p>	<p>Modern farming techniques massively increased crop yields and helped to avoid predicted worldwide famine.</p> <p>The benefits and consequences of concentrated animal feeding operations.</p> <p>VOCABULARY: Food and agriculture, animal agriculture, domestication, ruminants, pasture, factory farming, Concentrated Animal Feeding Operations (CAFOs), dairy cattle, beef cattle, veal, finishing, pasteurization, growth hormones, antibiotics, Federal Humane Slaughter Act, cage free, free range, certified humane, organic, Dust Bowl, wind erosion, water erosion, soil horizons, famine, undernutrition, malnutrition, Green Revolution, irrigation, fertilizers, pesticides, organic agriculture, genetically modified organisms</p>	<p>Discuss and analyze the benefits and potential ecological and human health consequences of using GMOs, and whether the increased cost of organic is worth the benefit.</p> <p>Calculate the environmental impact of an average omnivorous meal.</p> <p>Create bacterial cultures from food samples and perform a culture count.</p> <p>Construct and revise an explanation based on evidence for the cycling of matter and flow of energy in aerobic and anaerobic conditions.</p>
<p>ASSESSMENT EVIDENCE: Students will show their learning by:</p> <ul style="list-style-type: none"> ● Eco Art Project ● Food production research ● The Science Behind Our Food Chemistry Lab 		

- Food Inc. Reaction Paper
- GMO Labeling Activity
- Environmental Impact of Our Food

KEY LEARNING EVENTS AND INSTRUCTION:

Suggested Labs and Performance assessments: Bacteria on Chicken Lab, GMO Research and Labeling Essay, Seafood Watch Research Assignment, Aquatic Species Diversity Lab, Process Oriented Guided Inquiry Learning.

RANDOLPH TOWNSHIP SCHOOL DISTRICT
Environmental Science
Unit IV: Earth's Resources

SUGGESTED TIME ALLOTMENT	CONTENT-UNIT OF STUDY	SUPPLEMENTAL UNIT RESOURCES
5 Weeks	<ul style="list-style-type: none"> • Plant Agriculture • Animal Agriculture • Food Production • Genetically Modified Organisms 	Environmental Science Journal Writing Prompts Current Events from appropriate periodicals and news sources Multimedia: Food Inc. Dirt! Fresh The Eyes of Nye: Genetically Modified Foods Future of Foods

RANDOLPH TOWNSHIP SCHOOL DISTRICT

Environmental Science

Unit V: Energy

TRANSFER: Modern living centers around the use of energy and there are ways to be an environmentally conscious while maintaining a “plugged in” lifestyle.

STANDARDS / GOALS:	ENDURING UNDERSTANDINGS	ESSENTIAL QUESTIONS
<p>ESS3.A: Natural Resources All forms of energy production and other resource extraction have associated economic, social, environmental, and geopolitical costs and risks as well as benefits. New technologies and social regulations can change the balance of these factors. (HS-ESS3-2)</p> <p>ETS1.B: Developing Possible Solutions When evaluating solutions, it is important to take into account a range of constraints, including cost, safety, reliability, and aesthetics, and to consider social, cultural, and environmental impacts. (<i>secondary</i>) (HS-ESS3-2)</p>	Sustainable energy must be renewable with a low environmental impact.	<ul style="list-style-type: none"> • Which is the best source of energy for the modern population?
	Biofuels are part of a growing fuel replacement category. Research and development is necessary to overcome challenges of making fuel from cellulose and the “food versus fuel” controversy.	<ul style="list-style-type: none"> • Can humans depend upon green energy alone?
	The processes of using fossil fuels - petroleum and natural gas - are expensive and pose environmental threats including explosions, pollution, and oil spills.	<ul style="list-style-type: none"> • Why are new fuel and energy sources not being adopted despite their benefits?
	All alternative energy sources have advantages and disadvantages; it is important to take into consideration the benefits and tradeoffs of each.	<ul style="list-style-type: none"> • How do cost, availability, and environmental impact influence fuel usage?
	KNOWLEDGE	SKILLS
	<p>Students will know: How fossil fuels are formed.</p>	<p>Students will be able to: Describe the timeline of fossil fuel formation noting major transitions in composition.</p>

	<p>Advantages and disadvantages (origins, safety, benefits, and hazards) of the various energy sources.</p> <p>The consequences associated with coal and fossil fuel dependence.</p> <p>The cost and availability of the different forms of renewable and nonrenewable energy sources.</p> <p>The different sources of renewable energy in terms of cost and where they are geographically available.</p> <p>How nuclear reactors are constructed to generate electricity while containing radiation.</p> <p>VOCABULARY: Emissions, nonrenewable, oil, petroleum, petrochemicals, crude oil, peak oil, reserves, natural gas, fracking, unconventional reserves, energy security, energy independence, nuclear energy, nuclear fission, isotopes, radioactive, radioactive half-life, renewable energy, sustainable energy, wind energy, solar energy, photovoltaic (PV) cells, active solar technologies, solar thermal systems, geothermal energy, payback time, hydropower, conservation, biofuel, carbon debt</p>	<p>Distinguish between renewable and nonrenewable energy resources.</p> <p>Argue the pros and cons of various energy sources.</p> <p>Discuss the different strategies for reducing our reliance on fossil fuels, especially in regards to transportation.</p> <p>Analyze an electricity bill and explain how the costs are calculated.</p> <p>Support by defending the use of any of the various renewable energy sources.</p> <p>Explain how nuclear waste decays, half-life, and why waste disposal is so difficult.</p>
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ASSESSMENT EVIDENCE: Students will show their learning by:

- Designing a graphic representation of the pros and cons of a specific energy source - nonrenewable or renewable

- Presenting a supporting argument for a selected energy source and then presenting counter argument against the same energy source
- Developing a personal or group “action plan” to decrease dependence on nonrenewable energy sources and incorporate renewable energy sources into daily activities
- Organizing and defending a proposal to “local government” to adopt renewable energy sources
- Researching possible energy fuel sources for various locations and presenting best energy model for that ecosystem

KEY LEARNING EVENTS AND INSTRUCTION:

Suggested Labs and Performance assessments: Resource Cookie Activity: Fossil Fuel Extraction, cost comparison, and environmental impact of the various energy sources, Energy Audit Lab, Burning Biofuels: Comparing Nonrenewable and Renewable Fuels Lab, Oil Spill Challenge, Process Oriented Guided Inquiry Learning

RANDOLPH TOWNSHIP SCHOOL DISTRICT
Environmental Science
Unit V: Energy

SUGGESTED TIME ALLOTMENT	CONTENT-UNIT OF STUDY	SUPPLEMENTAL UNIT RESOURCES
5 Weeks	<ul style="list-style-type: none"> • Renewable Energy • Nonrenewable Energy • Fossil Fuels • Nuclear Energy • Green Energy 	<p>Environmental Science Journal Writing Prompts Current Events from appropriate periodicals and news sources</p> <p>National Energy Education Development (NEED) Project's "Energy From Public Lands"</p> <p>Science Buddies "Burning Biofuels: Comparing Nonrenewable and Renewable Fuels"</p> <p>Multimedia: Gasland 30 Days-Coal Mining Chernobyl Heart Walking with Monsters- Age of Reptiles</p>

RANDOLPH TOWNSHIP SCHOOL DISTRICT

Environmental Science

UNIT VI: Challenges

TRANSFER: Human actions are causing extreme harm to the environment and all organisms are affected.

STANDARDS / GOALS:	ENDURING UNDERSTANDINGS	ESSENTIAL QUESTIONS
<p>L S2. C Ecosystem Dynamics, Functioning, and Resilience Moreover, 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.</p> <p>LS4.D: Biodiversity and Humans Biodiversity is increased by the formation of new species (speciation) and decreased by the loss of species (extinction). (secondary)</p> <p>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</p>	Climate change is a serious and dangerous event that affects all life on Earth.	<ul style="list-style-type: none"> ● To what degree are environmental health and human health related?
	Waste is a uniquely human invention that when handled improperly threatens all living things.	<ul style="list-style-type: none"> ● Why do the production and disposal of human-generated waste pose such a major threat to the environment?
	There are different categories of pollutants that impact the environment (such as: point source water pollutants, nonpoint source water pollutants, primary air pollutants, secondary air pollutants). Biomimicry is beneficial for designing and implementing solutions.	<ul style="list-style-type: none"> ● Which protocols and practices best reduce waste?
	Environmental threats depend greatly on the quantity of pollutant and less on the identity of the contaminant.	<ul style="list-style-type: none"> ● Is it possible for the Earth to recover from the consequences of human impact on the environment?

<p>biodiversity also aids humanity by preserving landscapes of recreational or inspirational value. (secondary) (Note: This Disciplinary Core Idea is also addressed by HS-LS4-6.)</p> <p>ETS1.B: Developing Possible Solutions When evaluating solutions, it is important to take into account a range of constraints including cost, safety, reliability and aesthetics and to consider social, cultural and environmental impacts.</p> <p>ESS2.D: Weather and Climate Current models predict that, although future regional climate changes will be complex and varied, average global temperatures will continue to rise. The outcomes predicted by global climate models strongly depend on the amounts of human-generated greenhouse gases added to the atmosphere each year and by the ways in which these gases are absorbed by the ocean and biosphere. (secondary) (HS-ESS3-6)</p> <p>ESS3.D: Global Climate Change Through computer simulations and other studies, important discoveries are still being made about how the ocean, the atmosphere, and the biosphere interact and are modified in response to human activities. (HS-ESS3-6)</p>	<p style="text-align: center;">KNOWLEDGE</p> <p>Students will know: The difference between weather patterns and climate changes.</p> <p>The relationship between ocean level, thermal expansion, and the melting of land ice.</p> <p>Environmental recovery is possible.</p> <p>Knowledge of the source and chemical composition of a pollutant is important when proposing a solution for reducing/eliminating the pollutant.</p> <p>VOCABULARY: asthma; air pollution; primary air pollutants; secondary air pollutants; ground-level ozone; particulate matter (PM); smog; point source pollution; nonpoint source pollution; environmental justice; environmental racism; acid deposition, Clean Air Act, greenhouse gases, greenhouse effect</p>	<p style="text-align: center;">SKILLS</p> <p>Students will be able to: Examine, compare, and fact check several publications about the current state of global climate.</p> <p>Construct comparative graphs to show change in greenhouse emissions and temperature correlations.</p> <p>Evaluate the changes that occurred following the implementation of environmental protocols in various ecosystems.</p> <p>Examine and analyze satellite images of the Arctic ozone hole.</p> <p>Analyze water samples and determine/predict the source of pollution.</p> <p>Propose possible solutions to environmental challenges.</p>
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ASSESSMENT EVIDENCE: Students will show their learning by:

- Visually organizing major historical events that have impacted the environment
- Designing an experiment to model the negative effects of pollution and proposed solutions to the problem
- Research environmental wellbeing of various countries around the world and the measures being taken to improve conditions

KEY LEARNING EVENTS AND INSTRUCTION:

- Suggested Labs and Performance assessments: Field Trip: Sewage Treatment Plant, Pollution Prevention: Solid Waste, Toxicity Testing and the LC50, Landfill Planning and Placement Lab, Experimental Design: Environmental Contamination Lab, Acidification of Ocean Lab

RANDOLPH TOWNSHIP SCHOOL DISTRICT
Environmental Science
UNIT VI: Challenges

SUGGESTED TIME ALLOTMENT	CONTENT-UNIT OF STUDY	SUPPLEMENTAL UNIT RESOURCES
5 Weeks	<ul style="list-style-type: none"> • Air Pollution • Water Pollution • Land Pollution • Climate Change 	<p>Environmental Science Journal Writing Prompts Current Events from appropriate periodicals and news sources</p> <p>Reading Excerpts: Silent Spring by Rachel Carson This Changes Everything: Capitalism vs The Climate by Naomi Klein</p> <p>“Carbon Dioxide in the Atmosphere” https://uni.edu/storm/downloads/highschool/CarbonDioxideinatom.pdf</p> <p>Climate Interactive Tools https://www.climateinteractive.org/tools/</p> <p>Multimedia: An Inconvenient Truth An Inconvenient Truth Sequel</p> <p>Multimedia: A Plastic Ocean Trashed Plastic Paradise Chasing Ice</p>

RANDOLPH TOWNSHIP SCHOOL DISTRICT
Environmental Science
UNIT VII: Sustainable Future

TRANSFER: There are policies and legislations the determine the treatment of the environment; one must be well informed to make the right choice.

STANDARDS / GOALS:	ENDURING UNDERSTANDINGS	ESSENTIAL QUESTIONS
<p>ESS3.C: Human Impacts on Earth Systems The sustainability of human societies and the biodiversity that supports them requires responsible management of natural resources. (HS-ESS3-3) (HS-ESS3-4)</p>	<p>The future depends on making human societies more sustainable.</p> <p>Sustainable societies rely on renewable energy, use matter sustainably, implement population control, and depend on local biodiversity.</p>	<ul style="list-style-type: none"> • What roles do conservation and energy efficiency play in helping achieve sustainability?
<p>ETS1.B: Developing Possible Solutions When evaluating solutions, it is important to take into account a range of constraints, including cost, safety, reliability, and aesthetics, and to consider social, cultural, and environmental impacts. (<i>secondary</i>) (HS-ESS3-4)</p>	<p>Environmental policy and protocol are often examples of adaptive management.</p> <p>Group and individual decisions impact the environment now and in the future; it is important to avoid social traps when making decisions.</p>	<ul style="list-style-type: none"> • What factors are most influential in developing and implementing policies to protect the environmental futures of the human population?
<p>ESS2.D: Weather and Climate Current models predict that, although future regional climate changes will be complex and varied, average global temperatures will continue to rise. The outcomes predicted by global climate models strongly depend on the amounts of human-generated greenhouse gases added to the atmosphere each year and by the ways in which these gases are absorbed by</p>	<p>Economical, accessible, and reasonable environmentally friendly decisions can be made by anyone.</p> <p>Human societies and individuals are driven by various factors; utilizing those factors as motivation increases the likeliness that environmentally friendly choices are made.</p>	<ul style="list-style-type: none"> • How often should the average person make environmentally friendly decisions? How might this impact his/her everyday life? • How can people be encouraged to make choices that help achieve a sustainable future?

<p>the ocean and biosphere. (<i>secondary</i>) (HS-ESS3-6)</p> <p>ESS3.D: Global Climate Change Through computer simulations and other studies, important discoveries are still being made about how the ocean, the atmosphere, and the biosphere interact and are modified in response to human activities. (HS-ESS3-6)</p>	<p>KNOWLEDGE</p>	<p>SKILLS</p>
<p>Students will know:</p> <p>There are advantages and disadvantages to different worldviews when it comes to the environment.</p> <p>The role of the EPA as it applies to American environmentalism.</p> <p>How to conserve and protect the environment at a local and global level.</p> <p>The three pillars of sustainability: economic development, social development, and environmental protection.</p> <p>VOCABULARY: Technological fix, evaluate and respond, gloom and doom, rosy optimism, frontier, anthropocentric, biocentric, ecocentric, climate change, impact, adaptation, environmental justice, urban planner, infill development, smart growth, green building, stewardship movement</p>	<p>Students will be able to:</p> <p>Categorize and reflect on the actions associated with different attitudes/worldviews.</p> <p>Review and evaluate environmental legislation.</p> <p>Identify potential social traps in local and federal policy.</p> <p>Compare and analyze environmental standards of various locations from the United States and around the world.</p> <p>Assess conditions that present environmental concerns.</p> <p>Propose and defend possible solutions to environmental issues.</p> <p>Develop a model for increasing the health of the earth with examples of actions that support a sustainable society.</p>	

ASSESSMENT EVIDENCE: Students will show their learning by:

- Researching and evaluating sustainable development approaches applicable to various environmental concerns
- Applying concepts from Land and People: Finding a balance lesson
- Researching and presenting on the history and future of environmental legislation
- Developing and designing an individual sustainable action plan then collaborating with peers to develop and design a sustainable action plan from a business standpoint.

KEY LEARNING EVENTS AND INSTRUCTION:

- Suggested Labs and Performance assessments: Woburn Case Study, What Can I Do? Presentation and initiative, Land and People: Finding a balance, Community Service Project, Global Climate Change and Automobiles, Field Trip: Wetlands Mitigation

RANDOLPH TOWNSHIP SCHOOL DISTRICT

Environmental Science

UNIT VII: Sustainable Future

SUGGESTED TIME ALLOTMENT	CONTENT-UNIT OF STUDY	SUPPLEMENTAL UNIT RESOURCES
6 Weeks	<ul style="list-style-type: none">• Pollution Prevention and Mitigation• Green Citizenship• Environmental Legislation and Policy• Environmental Responsibility	Environmental Science Journal Writing Prompts Current Events from appropriate periodicals and news sources Reading Excerpts: Rancher, Farmer, Fisherman by Miriam Horn Multimedia: A Civil Action Before the Flood Sustainable Minimalism