Huntsville City Schools

Pacing Guide

Course: Environmental Science Grade: 11-12

Environmental Science is a course that introduces students to a broad view of the biosphere and the physical parameters that affect it. The course incorporates the scientific and engineering practices reflecting the scientific processes used in science, technology, engineering, and mathematics (STEM) fields. The scientific and engineering practices are implemented through a student-centered and collaborative classroom environment that is laboratory-intensive and includes field investigations and case studies.

Core ideas are explored and developed in more detail and refined with increases sophistication and rigor based upon knowledge gained in earlier grades. Students learn by construction explanations from evidence acquired through analysis and interpretation of data from laboratory investigations, field investigations, and case studies. Students integrate and evaluate multiple sources of authentic information to address issues or suggest possible solutions to problems in the environment based on current findings. The academic language of the core idea is used to context to communicate claims, evidence, and reasoning for phenomena and to engage in argument from evidence to justify and defend claims. Students are encouraged to use creativity in designing engineering solutions to solve various problems affecting Earth and its environment.

The Environmental Science content standards provide a depth of conceptual understanding to adequately prepare students for college, career, and citizenship with an appropriate level of scientific literacy. The foundation of the course is based upon Earth and Human Activity, one of the disciplinary core ideas in the Earth and Space Science domain. This core idea involves areas of study that include natural resources, natural hazards, human impacts on Earth systems, and global climate change. Integrated within the disciplinary core ideas of Environmental Science are the Engineering, Technology, and Applications of Science (ETS) core ideas, which are denoted with an asterisk (*). The ETS core ideas require students to use tools and materials to solve simple problems and to use representations to convey design solutions to a problem and determine which is most appropriate.

Reading Standards for Grades 11-12 Students

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.
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.
3. Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks; analyze the specific results based on explanations in the text.
4. Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to Grades 11-12 texts and topics.
5. Analyze how the text structures information or ideas into categories or hierarchies, demonstrating understanding of the information or ideas.
6. Analyze the author's purpose in providing an explanation, describing a procedure, or discussing an experiment in a text, identifying important issues that remain unresolved.
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.
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.
9. Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible.

Writing Standards for Grades 11-12 Students

1. Write arguments focused on discipline-specific content (additional detail in the Course of Study)
2. Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes (additional detail in the Course of Study).
3. Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.
4. 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.
5. Use technology, including the Internet, to produce, publish, and update individual or shared writing products in response to ongoing feedback, including new arguments or information.
6. Conduct short as well as more sustained research projects to answer a question (including a self-generated questions_ or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.
7. 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.
8. Draw evidence from informational texts to support analysis, reflection, and research.
9. Write routinely over extended time frames (time for reflection and revision) and shorter time frames (a single sitting or a day or two) for a range of discipline-specific tasks, purposes, and audiences.

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First Nine Weeks

By the end of the **first nine weeks** students should be able to understand, but is not limited to, the following topics:

- Evolution
- Population Ecology
- Community Ecology
- Biodiversity and Conservation
- Human Population
- Urbanization
- Waste Management

Students are expected to not only explain and describe the above topics but be able to perform mathematical calculations, analyze graphs, and engage in analytical reading and writing in order to apply the standards.

Second Nine Weeks

By the end of the **second nine weeks** students should be able to understand, but is not limited to, the following topics:

- Earth's Environmental Systems
- Biomes
- Biogeochemical Cycles

Students are expected to not only explain and describe the above topics but be able to perform mathematical calculations, analyze graphs, and engage in analytical reading and writing in order to apply the standards.

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First Nine Weeks

Standard	Resources	Approximate Pacing Number of Days
ALCOS 3 Use mathematics and graphic models to compare factors affecting biodiversity and populations in ecosystems.	**Pearson Environmental Science Textbook** • **Chapter 4: Population Ecology** • **Chapter 8: Human Population** **ASIM Labs** • **Limiting Factors** (Distinguish between density dependent and density independent limiting factors) • **Exponential Population Growth** (Students examine exponential population growth using mathematical models) • **Exponential Population Growth** (Linear and exponential growth, limiting factors, carrying capacity, the rule of 70, mathematical modeling). • **Bluegill Limiting Factors** (density dependent and density independent limiting factors). **LTF Labs** • I'm Depending on You: Determining the Role of Biotic Factors in Ecological Systems • White-tailed Rising: Modeling Exponential Growth • Tragedy in the Making **Carolina Biological Supply** • Population Density Activity **Additional Suggestions** • **Construct** a T-chart with levels of organization (individual – biosphere) on one side and descriptions on the other. ****Review*** with students the correct way to write/type a scientific name. • **Go Outside**: Abiotic and Biotic Factors • **Central Case**: Finding Gold in a Costa Rican Cloud Forest Pearson • **Sketch** a model for each of the major population distribution patterns and **give examples** of species with each pattern. • **Interpret** an age-structure diagram	**12 hours**

	• **Math connection**: **Interpret** a graph showing the three survivorship curves. (Fig. 8) • **Math connection**: **Calculate** ***population growth*** and ***doubling time (70/rate of growth)***. • **Math connection**: **Interpret** graphs illustrating *exponential* and *logistic* growth. (Figs. 11 – 13) *What does the graph look like when a population reaches carrying capacity?* • **Quick Lab**: Build and Compare Age Structure Diagrams • **Compare** age-structure diagrams: **create** an age-structure diagram using Canada or Madagascar (2010) as countries. (Fig. 9) • **Math connection**: Basic Statistics: **calculate** *percentage*, *population growth*, *growth rate*, and *doubling time*. • **Interpret** the Demographic Transition Graph (Fig. 10) • Ecological Footprint, **calculate** yours! • **Compare** the populations of China, India, and USA. • Writing connection: **Research** China's "one-child" policy. *Provide a rubric.	
ALCOS 4 Engage in argument from evidence to evaluate how biological or physical changes within ecosystems (e.g., ecological succession, seasonal flooding, volcanic eruptions) affect the number and types of organisms, and that changing conditions may result in a new or altered ecosystem.	**Pearson Environmental Science Textbook** • **Chapter 5: Evolution and Community Ecology** **ASIM Labs** • **Food Chain, Food Webs and Energy** (This lab covers food chains, food webs and energy flow through an ecosystem, including the influence and contribution of abiotic and biotic factors). **LTF Labs** • Ecotones: Investigating ecosystems using CBLs **Carolina Biological Supply** • Build a Maintenance-Free Ecosystem • Living Minipod Ecosystem Kit • Simulating Succession Ecosystems Activity • Invasion! (Pair w/ Carolina EcoKits Invasive Species) • Case Study: The Impact of Honeybee Populations • Bees, Butterflies, and Flowers • Inquiries in Science: Sustaining Ecosystems Kit • Inquiries in Science: Simulating Succession Kit **Additional Suggestions** • **Draw** and **color** the visible light spectrum; **explain** its role *in photosynthesis*. • **Write** the equations for *photosynthesis/respiration* and **explain** the purpose of each process. • **Math connection**:	**4 hours**

	Real Data – Energy Flow in Communities • **Illustrate** the *10% Rule* by constructing an energy pyramid; **explain** what happens to energy that is *not captured* by the organisms in the food-chain? • **Math connection**: **Draw** an *energy pyramid* that ***illustrates*** the flow of energy (in kilograms) as it moves **UP** through trophic levels in a food chain. • **Construct** a food web that consists of at least *two* food chains (***one*** of the food chains should contain a ***keystone species***). • **Writing connection**: How can an environmental disturbance change an ecosystem? • **List** some natural disturbances that lead to succession in both terrestrial and aquatic systems. • **Central Case**: Black and White, and Spread All Over (***Zebra Mussels***) • **Technology connection**: **Develop** a storyboard or brochure that **describes** the influence of one of the top 5 nonnative invasive animal species in the USA or Alabama's 10 Worst Invasive Weeds. *Provide a rubric. (Individual research project using ***primary sources only*** and ***documenting sources of information***.)	
ALCOS 5 Engage in argument from evidence to compare how individual versus group behavior (e.g., flocking, cooperative behaviors such as hunting, migrating, and swarming) may affect a species' chance to survive and reproduce over time.	**Pearson Environmental Science Textbook** • **Chapter 5: Evolution and Community Ecology** **ASIM Labs** • **Predator-Prey Populations** (This lab covers predator-prey population relationships, factors affecting those relationships, and density-dependent and density-independent limiting factors). **LTF Labs** • Chi Critters • Paramecium Food and Frolic • Call of the Wild: Investigating Predator-prey Relationships **Carolina Biological Supply** • Carolina EcoKits: Predator-Prey Relationships • Carolina EcoKits: Species Interactions **Additional Suggestions** • **Brief review** of ***basic principles of evolution***; **relate** artificial selection to demographic transition of humans. • **Interpret** a graph of the *5 mass extinction* events. (Fig. 5)	**4 hours**

	• **Define** *niche* and **identify** factors that influence an organism's niche **(tolerance, competition, *competitive exclusion, fundamental niche, realized niche, resource partitioning, character displacement*).** • **State** similarities/differences in feeding patterns: predation, parasitism, and herbivory. • **List** and **describe** examples of each type of symbiotic relationship. • **Construct** a chart to **record** the definitions of various feeding relationships. • **Interpret** a graph of the *5 mass extinction* events	
ALCOS 6 Obtain, evaluate, and communicate information to describe how human activity may affect biodiversity and genetic variation of organisms, including threatened and endangered species. **ALCOS 17.a** Analyze and interpret data collected through geographic research and field investigations (e.g., relief, topographic, and physiographic maps; rivers; forest types; watersheds) to describe the biodiversity for the state of Alabama (e.g. terrestrial, freshwater, marine, endangered, invasive).	**Pearson Environmental Science Textbook** • **Chapter 7: Biodiversity and Conservation** **LTF Labs** • Paramecium Food and Frolic • Ecotones: Investigating Ecosystems using CBLs • Biodiversity in the Wetlands **Additional Suggestions** • **Make** a list of at least 5 ecosystem services provided by Earth (water, air, pest/disease control, decomposition of wastes, food, fuel, fiber). • **Writing connection**: **Write** a report on Edward O. Wilson, a native of Alabama, who first used the term biodiversity in a publication in 1988 or Rachel Carson, the first scientist to publish a documentary on the ill effects of biocides on species. • **Describe** the current rate of extinction worldwide and **state** the cause. • **Construct** a T-chart: **list** 5 endangered species in Alabama and 5 extinct species in the world. • **Prepare** a presentation on an endangered species. • **List** ways the Endangered Species Act and CITES have helped to reduce species loss.	**3 hours**
ALCOS 15 Construct an explanation based on evidence to determine	**Pearson Environmental Science Textbook** • **Chapter 10: Urbanization** • **Chapter 19: Waste Management**	**10.5 hours**

the relationships among management of natural resources, human sustainability, and biodiversity (e,g,, resources, waste management, per capita consumption, agricultural efficiency, urban planning). **ALCOS 17.a** Analyze and interpret data collected through geographic research and field investigations (e.g., relief, topographic, and physiographic maps; rivers; forest types; watersheds) to describe the biodiversity for the state of Alabama (e.g. terrestrial, freshwater, marine, endangered, invasive).	**Additional Suggestions** • **Construct** a T-chart to **record** types of land cover and land use. (Fig 1) • **Math connection: State** the three major uses of land in the United States. (Fig. 2) • **Invite the city planner to talk to your classes about the infrastructure of Huntsville and policies that promote sustainability.** • **Math connection:** Real Data Population Density and Carbon Emissions • **LAB**: **Classify** Your Garbage! Ask students to **collect** their personal garbage for one or two days and separate it into categories: biodegradable/nonbiodegradable. As a class, **determine** the category of most household garbage. *Extension: Ask students to locate the recycle symbol on each piece of garbage and explain its meaning. • **Construct** a T-chart: on one side of the chart, **make** a list of five organic wastes that are biodegradable and on the other side, 5 organic wastes that are not biodegradable. • **Writing connection**: **Assign** a one-two page report on RCRA and CERCLA (Superfund) Acts. • **Writing connection**: **Report** on the history of Love Canal "then and now"**. Use** historical events that led to the enactment of RCRA as a law. • **Map Study**: **Use** a map to locate the landfills, recycle facilities, and compost facilities of Huntsville, AL • Interview a representative of the *public works office*; find out how municipal and household wastes are managed in Huntsville.	

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Second Nine Weeks

Standard	Resources	Approximate Pacing Number of Days
ALCOS 2 Use models to illustrate and communicate the role of photosynthesis and cellular respiration as carbon cycles through the biosphere, atmosphere, hydrosphere, and geosphere. **ALCOS 8** Engage in an evidence based-argument to explain how over time Earth's systems affect the biosphere and the biosphere affects Earth's systems (e.g., microbial life increasing the formation of soil; corals creating reefs that alter patterns of erosion and deposition along coastlines).	**Pearson Environmental Science Textbook** • **Chapter 3: Earth's Environmental Systems** **ASIM Labs** • **Global Carbon Storage in Biomes** (Students complete computer-based exercises using NASA satellite data and Google Earth to visualize global patterns of terrestrial carbon storage among biomes, the relationship between primary productivity and atmospheric CO2, and illustrate the effects of land use changes on global carbon storage). **Carolina Biological Supply** • Carolina EcoKits: Contributors to the Carbon Cycle **Additional Suggestions** • **Draw/annotate** a composite of Earth's spheres. • **Earth's Spheres** https://www.classzone.com/books/earth_science/terc/content/investigations/es0103/es0103page02.cfm • **Activity:** The Life and Times of Carbon	**6 hours**
ALCOS 9 Develop and use models to trace the flow of water, nitrogen, and phosphorous through the hydrosphere, atmosphere, geosphere, and biosphere.	**Pearson Environmental Science Textbook** • **Chapter 3: Earth's Environmental System** **Carolina Biological Supply** • Biogeochemical Cycles 8-Station Kit **Additional Suggestions**	**12 hours**

ALCOS 8 Engage in an evidence based-argument to explain how over time Earth's systems affect the biosphere and the biosphere affects Earth's systems (e.g., microbial life increasing the formation of soil; corals creating reefs that alter patterns of erosion and deposition along coastlines).	• **Draw/annotate** the *biogeochemical cycles* (4) with information on how *humanity* has *altered* the natural processes of *each cycle*. • **Lab:** There's Something Fishy (Nitrogen Cycle) • **Sketch** a pie graph that describes the distribution of water on Earth.	
ALCOS 17 Obtain, evaluate, and communicate geological and biological information to determine the types of organisms that live in major biomes. a. Analyze and interpret data collected through geographic research and field investigations (e.g., relief, topographic, and physiographic maps; rivers; forest types; watersheds) to describe the biodiversity for the state of Alabama (e.g. terrestrial, freshwater, marine, endangered, invasive).	**Pearson Environmental Science Textbook** • **Chapter 6: Biomes and Aquatic Ecosystems** **ASIM Labs** • **Biome Bags** (The study of biomes including geological and biological information and how they fit into ecological hierarchy). **Additional Suggestions** • **Biomes Online Activity** http://www.pbslearningmedia.org/resource/tdc02.sci.life.eco.lp_biomes/biomes/ • **Project:** Assign a biomes group project with a rubric • **Research project:** Soil profiles of the World Biomes **– Assign** a different biome to each student group: (tundra, boreal forest, temperate deciduous forest, grassland, tropical rainforest). Provide a rubric to students. • **LAB**: **Interpret** climatographs of the major biomes. • **Math connection**: **Construct** a climate graph (National Geographic http://images.nationalgeographic.com/wpf/media-live/file/martha-5-graph-climate-cb1288399317.pdf)	**12 hours**

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Third Nine Weeks

By the end of the **third nine weeks** students should be able to understand, but is not limited to, the following topics:

- Soil and Agriculture (connect this topic back to biomes and biogeochemical cycles)
- Water Resources (connect this topic back to biomes and biogeochemical cycles)
- The Atmosphere

Students are expected to not only explain and describe the above topics but be able to perform mathematical calculations, analyze graphs, and engage in analytical reading and writing in order to apply the standards.

Fourth Nine Weeks

By the end of the **fourth nine weeks** students should be able to understand, but is not limited to, the following topics:

- Nonrenewable Energy Resources
- Renewable Energy Resources
- Mineral Resources and Mining
- Global Climate Change

Students are expected to not only explain and describe the above topics but be able to perform mathematical calculations, analyze graphs, and engage in analytical reading and writing in order to apply the standards.

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Third Nine Weeks

Standard	Resources	Approximate Pacing Number of Days
ALCOS 7 Analyze and interpret data to investigate how a single change on Earth's surface may cause changes to other Earth systems (e.g., loss of ground vegetation causing an increase in water runoff and soil erosion).	**Pearson Environmental Science Textbook** • **Chapter 12: Soil and Agriculture** **ASIM Labs** • **Pests** • **Soil Quality: Nitrogen, Potassium, Phosphorus, pH** **Additional Suggestions** • **Writing connection: Write an opinion paper on the use of genetically modified organisms (GMOs) as food sources; use primary sources to support your opinions.** • **Contact Hudson-Alpha; request a speaker to present a session on GMOs in the "grocery basket" and their implications.** • **Construct a T-chart and list the pros and cons organic agriculture.** • **I can explain the processes that form most of Earth's soils** (weathering, deposition, decomposition) • **Describe the horizons that make up a soil profile.** • **List the 4 characteristics used to classify soil (color, texture, structure, pH)** • **Sketch** the soil profile of a "typical" mature soil (Fig. 4) – **describe** the composition of each horizon (O, A, B, and C only). • **LAB**: Porosity • **LAB**: Soils texture (use the Soils Texture Triangle) • **LAB**: **Identifying** soil types, mixtures	**9 hours**
ALCOS 8 Engage in an evidence based-argument to explain how over time Earth's systems affect the biosphere and the biosphere affects Earth's systems (e.g., microbial life increasing the formation of	**Pearson Environmental Science Textbook** • **Chapter 3: Earth's Environmental Systems** • **Chapter 6: Biomes and Ecosystems** • **Chapter 12: Soil and Agriculture** • **Chapter 14: Water Resources**	**12 hours**

soil; corals creating reefs that alter patterns of erosion and deposition along coastlines). **ALCOS 10** Design solutions for protection of natural water resources (e.g., bioassessment, methods of water treatment and conservation) considering properties, uses, and pollutants (e.g., eutrophication, industrial effluents, agricultural runoffs, point and nonpoint pollution resources).* **ALCOS 11** Engage in argument from evidence to defend how coastal, marine, and freshwater sources (e.g., estuaries, marshes, tidal pools, wetlands, beaches, inlets, rivers, lakes, oceans, coral reefs) support biodiversity, economic stability, and human recreation. **ALCOS 14** Analyze cost-benefit ratios of competing solutions for developing, conserving, managing, recycling, and reusing energy and mineral resources to minimize impacts in natural systems (e.g. determining best practices for agricultural soil use, mining for coal, and exploring for petroleum and natural gas sources).*	**ASIM Labs** • Bio assess Game (manipulative) and AWW Water Quality Assessment (chemical) **LTF Labs** • Wonderful Pond Water • Biodiversity in the Wetlands **Carolina Biological Supply** • Make an Environmental Connect Through Water Quality Monitoring • Using the Concepts Associated with Providing Clean Drinking Water to Teach Science: An Interdisciplinary Approach **Additional Suggestions** • **Dissolved Oxygen Lab** http://www.phschool.com/science/biology_place/labbench/lab12/intro.html • **LAB**: Chemical Water Tests (any set of protocols that include: DO, pH, N, total hardness and alkalinity) • **Take** a field trip: **Visit** one of Huntsville's water treatment facilities and **find out** where the drinking water for the city originates. • **Math connection**: Find out how much of the western USA uses the Ogallala Aquifer for its water supply • **Sketch** a drinking water treatment plant and **annotate** the roles of each component of the facility. (Fig. 24) • **Sketch** a wastewater treatment plant and **annotate** the roles of each component of the facility (A Closer Look) • **Survey** your school campus for landmarks that provide for management of surface water. **List** the landmarks and **identify** their function. • **Group Project**: **Identify** at least 10 major residential, industrial, and agricultural water consumers and **indicate** their locations on a map of Huntsville, AL/Tennessee River Watershed. • **Map Study**: **View** the locations of major residential, industrial, and agricultural areas on a topographic map. • List 10 ways water is used in homes. For each item on the list, state one way to conserve water during its use. • **Visit** Guntersville Dam • Construct a T-chart to record the costs and benefits of dams. (Fig. 10) • **Writing/Research connection**: **Visit** the EPA website and read about the Safe Drinking Water Act.	

	• **Quick Lab**: Cultural Eutrophication • **Review** human influences on the nitrogen cycle that cause eutrophication. • Construct a cause-effect diagram and describe the major categories of water pollution. • **Construct** a T-chart and **list** various examples of point and nonpoint pollution. • **Research** one of the following: • PCB contamination of Choccolocco Creek in Anniston, AL • Progress in the toxic wastes removal at Redstone Arsenal. • Fly ash spill in Scottsboro, AL • Construct a T-chart and **list** organic chemical pollutants /inorganic chemical pollutants. • **Build** a mobile or **design** a Travel Brochure of one of the 10 most popular tidal pools or beaches in the USA. *Provide a rubric. • **State** at least 4 ecosystem services that wetlands provide. • **Field Trip**: **Visit** Wheeler Wildlife Refuge to experience a bald cypress swamp. • **Visit** a grocery store; make a list of food products that originate in freshwater and marine ecosystems. • **Research** the role of riparian zones in urban environments and forest ecosystems. • **LAB**: **Take a field trip** to a local body of water and **perform** an environmental assessment, bioassessment, and chemical water quality assessment. • **Research** one of the following major river systems to **determine** the extent of influence and *human impact* on *biodiversity* and *water quality*: Colorado River Mississippi River Missouri River Mobile River Ohio River Tennessee River • **Sketch** the major zones of the ocean and **annotate** the productive areas of each zone. • **Research** the ecological and economic importance of kelp forests and coral reefs.	
ALCOS 16 Obtain and evaluate information from published results of scientific computational models to illustrate the relationships among Earth's systems and how these relationships may be impacted by human activity (e.g.,	**Pearson Environmental Science Textbook** • **Chapter 14: Water Resources** • **Chapter 15: The Atmosphere** **Carolina Biological Supply** • Experiencing Air Pollution Through Inquiry • Air Pollution Awareness Demonstration	**9 hours**

effects of an increase in atmospheric carbon dioxide on photosynthetic biomass, effect of ocean acidification on marine populations).	• Air Pollution Assay Kit **Additional Suggestions** • **Ocean Acidification Lab- Shell Protocol** • **Construct** a T-chart to **relate** the effect of ozone in the stratosphere contrasted with its effects in the troposphere. • Writing connection: Research the effects of acid rain on the Black Triangle in Europe. Provide a rubric. • **Sketch** the four layers of the atmosphere (insert the ozone layer) and annotate the composition of each. • **Central Case**: Charging Toward Cleaner Air in London • **Compare/contrast** industrial smog/photochemical smog • **Writing connection**: **Research** the effects of particulate matter in the environment on human health (COPD, Asthma, and Lung Cancer). • **Lab:** How have the atmosphere and living things interacted over time?	

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Fourth Nine Weeks

Standard	Resources	Approximate Pacing Number of Days
ALCOS 1 Investigate and analyze the use of nonrenewable energy sources (e.g., fossil fuels, nuclear, natural gas) and renewable energy sources (e.g., solar, wind, hydroelectric, geothermal) and propose solutions for their impact on the environment.	**Pearson Environmental Science Textbook** • **Chapter 17: Nonrenewable Energy** • **Chapter 18: Renewable Energy Alternatives** **Additional Suggestions** • **Writing connection**: **Research** how coal changes to kerogen, oil, and natural gas. Explain how crude oil is refined. *Evaluate the four forms of coal: lignite, sub-bituminous, bituminous, and anthracite. • **Quick Lab**: Where's the Energy? • **Discuss** in class Figure 12 on page 463. Students should be able to **recall** the sources of the byproducts of fossil fuel combustion. *Direct students to EPA's Vocabulary Catalog at: http://ofmpub.epa.gov/sor_internet/registry/termreg/searchandretrieve/glossariesandkeywordlists/search.do?details=&vocabName=Clean%20Energy%20Glossary • **Math connection**: **Write** the basic equation for combustion; **identify** the reactants/products; explain the process of combustion • **Construct** a Venn diagram and use it to **differentiate** between nuclear fission and fusion. • **Understand** how a nuclear power plant is designed and used to produce electricity. • **Construct** a T-chart; **list** renewable energy resources on the left and nonrenewable energy resources on the right. • **Construct** a Venn diagram and **compare/contrast** renewable and nonrenewable resources. • **Lab:** How is Natural Gas Formed? • **Research Project:** Alternative Energy Solutions Project	**13.5 hours**
ALCOS 14 Analyze cost-benefit ratios of competing solutions	**Pearson Environmental Science Textbook** • **Chapter 13: Mineral Resources and Mining** • **Chapter 17: Nonrenewable Energy**	**4.5 hours**

for developing, conserving, managing, recycling, and reusing energy and mineral resources to minimize impacts in natural systems (e.g. determining best practices for agricultural soil use, mining for coal, and exploring for petroleum and natural gas sources).*	**Additional Suggestions** • **Conduct** a debate: Use Point Counterpoint: Are Biofuels Better for the Environment? • **Lab:** Strip Mining • **Lab:** Cookie Mining • **Research Project:** To Conserve or Not to Conserve • **Debate:** The Great Energy Debate	
ALCOS 13 Obtain, evaluate, and communicate information based on evidence to explain how key natural resources (e.g. water sources, fertile soils, concentrations of minerals and fossil fuels), natural hazards, and climate changes influence human activity (e.g., mass migrations).	**Pearson Environmental Science Textbook** • **Chapter 13: Mineral Resources and Mining** • **Chapter 16: Global Climate Change** **Additional Suggestions** • **Writing connection**: **Research** the "brown haze/brown cloud" phenomena in Los Angeles, Denver, Africa and Asia. Provide a rubric. • **Math connection**: **Interpret** *Figure 10* on page 496; study three greenhouse gases and how their rates have changed since scientists have been keeping records. • **Research** the significance of the Kyoto Protocol, Montreal Protocol, and Copenhagen Accord. *Provide a rubric.	**3 hours**
ALCOS 12 Analyze and interpret data and climate models to predict how global or regional climate change can affect Earth's systems (e.g. precipitation and temperature and their associated impacts on sea level, glacial ice volumes, and atmosphere and ocean composition).	**Pearson Environmental Science Textbook** • **Chapter 16: Global Climate Change** **Carolina Biological Supply** • Inquiries in Science: Understanding Climate Change **Additional Resources** • **Research Project:** Research global climate change *Provide a rubric. • **Connection:** Carbon Cycle and the Greenhouse Effect http://www.esrl.noaa.gov/gmd/education/carbon_toolkit/basics.html • **Climate Change Videos** http://www.climatecentral.org/videos/web_features/nasa-finds-2011-ninth-warmest-year-on-record • **Lab:** Modeling the Greenhouse Effect • **Lab:** Life in a Bag	**10.5 hours**