Shelby County Schools Science Vision

Shelby County Schools' vision of science education is to ensure that from early childhood to the end of the 12th grade, all students have heightened curiosity and an increased wonder of science; possess sufficient knowledge of science and engineering to engage in discussions; are able to learn and apply scientific and technological information in their everyday lives; and have the skills such as critical thinking, problem solving, and communication to enter careers of their choice, while having access to connections to science, engineering, and technology.

To achieve this, Shelby County Schools has employed The Tennessee Academic Standards for Science to craft a meaningful curriculum that is innovative and provide a myriad of learning opportunities that extend beyond mastery of basic scientific principles.

Introduction

In 2014, the Shelby County Schools Board of Education adopted a set of ambitious, yet attainable goals for school and student performance. The District is committed to these goals, as further described in our strategic plan, Destination 2025. In order to achieve these ambitious goals, we must collectively work to provide our students with high quality standards aligned instruction. The Tennessee Academic Standards for Science provide a common set of expectations for what students will know and be able to do at the end of each grade, can be located in the Tennessee Science Standards Reference. Tennessee Academic Standards for Science are rooted in the knowledge and skills that students need to succeed in post-secondary study or careers. While the academic standards establish desired learning outcomes, the curriculum provides instructional planning designed to help students reach these outcomes. The curriculum maps contain components to ensure that instruction focuses students toward college and career readiness. Educators will use this guide and the standards as a roadmap for curriculum and instruction. The sequence of learning is strategically positioned so that necessary foundational skills are spiraled in order to facilitate student mastery of the standards.

Our collective goal is to ensure our students graduate ready for college and career. Being College and Career Ready entails, many aspects of teaching and learning. We want our students to apply their scientific learning in the classroom and beyond. These valuable experiences include students being facilitators of their own learning through problem solving and thinking critically. The Science and Engineering Practices are valuable tools used by students to engage in understanding how scientific knowledge develops. These practices rest on important "processes and proficiencies" with longstanding importance in science education. The science maps contain components to ensure that instruction focuses students toward understanding how science and engineering can contribute to meeting many of the major challenges that confront society today. The maps are centered around five basic components: the Tennessee Academic Standards for Science, Science and Engineering Practices, Disciplinary Core Ideas, Crosscutting Concepts, and Phenomena.

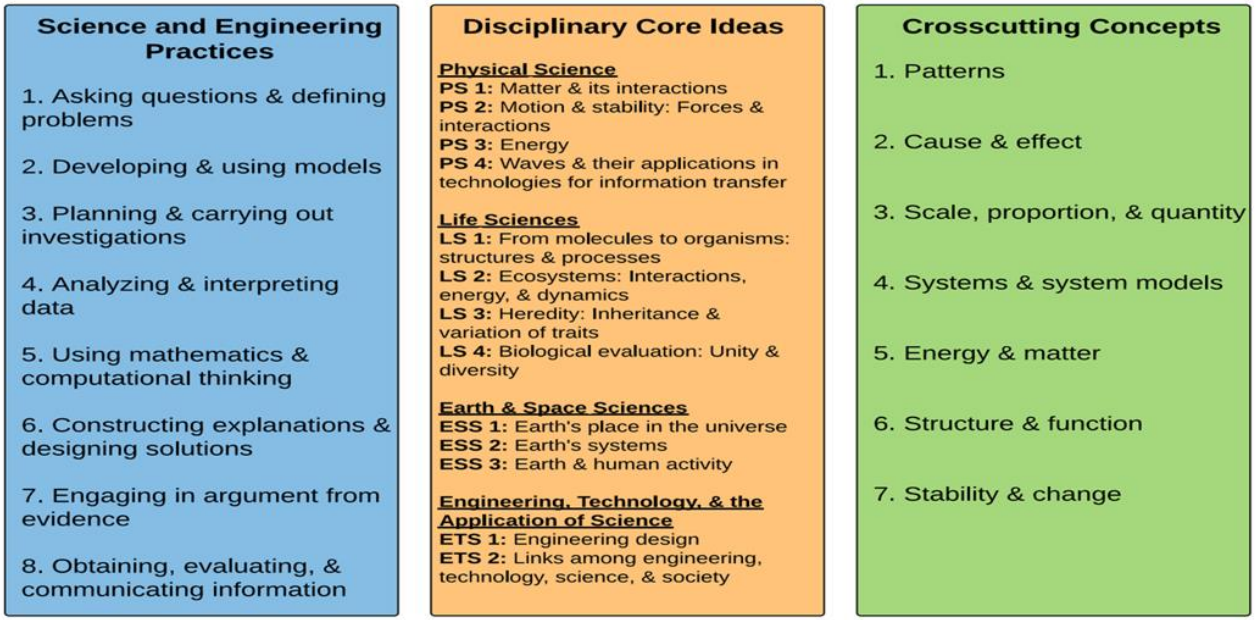
The Tennessee Academic Standards for Science were developed using the National Research Council's 2012 publication, A Framework for K-12 Science Education as their foundation. The framework presents a new model for science instruction that is a stark contrast to what has come to be the norm in science classrooms. Thinking about science had

become memorizing concepts and solving mathematical formulae. Practicing science had become prescribed lab situations with predetermined outcomes. The framework proposes a three-dimensional approach to science education that capitalizes on a child's natural curiosity. The Science Framework for K-12 Science Education provides the blueprint for developing the effective science practices. The *Framework* expresses a vision in science education that requires students to operate at the nexus of three dimensions of learning: Science and Engineering Practices, Crosscutting Concepts, and Disciplinary Core Ideas. The *Framework* identified a small number of disciplinary core ideas that all students should learn with increasing depth and sophistication, from Kindergarten through grade twelve. Key to the vision expressed in the *Framework* is for students to learn these disciplinary core ideas in the context of science and engineering practices. The importance of combining Science and Engineering Practices, Crosscutting Concepts and Disciplinary Core Ideas is stated in the *Framework* as follows:

Standards and performance expectations that are aligned to the framework must take into account that students cannot fully understand scientific and engineering ideas without engaging in the practices of inquiry and the discourses by which such ideas are developed and refined. At the same time, they cannot learn or show competence in practices except in the context of specific content. (NRC Framework, 2012, p. 218)

To develop the skills and dispositions to use scientific and engineering practices needed to further their learning and to solve problems, students need to experience instruction in which they use multiple practices in developing a particular core idea and apply each practice in the context of multiple core ideas. We use the term "practices" instead of a term such as "skills" to emphasize that engaging in scientific investigation requires not only skill but also knowledge that is specific to each practice. Students in grades K-12 should engage in all eight practices over each grade band**.** Crosscutting concepts have application across all domains of science. As such, they are a way of linking the different domains of science. Crosscutting concepts have value because they provide students with connections and intellectual tools that are related across the differing areas of disciplinary content and can enrich their application of practices and their understanding of core ideas. There are seven crosscutting concepts that bridge disciplinary boundaries, uniting core ideas throughout the fields of science and engineering. Their purpose is to help students deepen their understanding of the disciplinary core ideas and develop a coherent and scientifically based view of the world.

The map is meant to support effective planning and instruction to rigorous standards. It is *not* meant to replace teacher planning, prescribe pacing or instructional practice. In fact, our goal is not to merely "cover the curriculum," but rather to "uncover" it by developing students' deep understanding of the content and mastery of the standards. Teachers who are knowledgeable about and intentionally align the learning target (standards and objectives), topic, text(s), task, and needs (and assessment) of the learners are best-positioned to make decisions about how to support student learning toward such mastery. Teachers are therefore expected--with the support of their colleagues, coaches, leaders, and other support providers--to exercise their professional judgment aligned to our shared vision of effective instruction, the Teacher Effectiveness Measure (TEM) and related best practices. However, while the framework allows for flexibility and encourages each teacher/teacher team to make it their own, our expectations for student learning are non-negotiable. We must ensure all of our children have access to rigor—high-quality teaching and learning to grade level specific standards, including purposeful support of literacy and language learning across the content areas.



Learning Progression

At the end of the elementary science experience, students can observe and measure phenomena using appropriate tools. They are able to organize objects and ideas into broad concepts first by single properties and later by multiple properties. They can create and interpret graphs and models that explain phenomena. Students can keep notebooks to record sequential observations and identify simple patterns. They are able to design and conduct investigations, analyze results, and communicate the results to others. Students will carry their curiosity, interest and enjoyment of the scientific world view, scientific inquiry, and the scientific enterprise into middle school.

At the end of the middle school science experience, students can discover relationships by making observations and by the systematic gathering of data. They can identify relevant evidence and valid arguments. Their focus has shifted from the general to the specific and from the simple to the complex. They use scientific information to make wise decision related to conservation of the natural world. They recognize that there are both negative and positive implications to new technologies.

As an SCS graduate, former students should be literate in science, understand key science ideas, aware that science and technology are interdependent human enterprises with strengths and limitations, familiar with the natural world and recognizes both its diversity and unity, and able to apply scientific knowledge and ways of thinking for individual and social purposes.

Structure of the Standards

- Grade Level/Course Overview: An overview that describes that specific content and themes for each grade level or high school course.
- Disciplinary Core Idea: Scientific and foundational ideas that permeate all grades and connect common themes that bridge scientific disciplines.
- Standard: Statements of what students can do to demonstrate knowledge of the conceptual understanding. Each performance indicator includes a specific science and engineering practice paired with the content knowledge and skills that students should demonstrate to meet the grade level or high school course standards.

Purpose of Science Curriculum Maps

This map is a guide to help teachers and their support providers (e.g., coaches, leaders) on their path to effective, college and career ready (CCR) aligned instruction and our

pursuit of Destination 2025. It is a resource for organizing instruction around the Tennessee Academic Standards for Science, which defines what to teach and what students need to learn at each grade level. The map is designed to reinforce the grade/course-specific standards and content (scope) and provides *suggested* sequencing, pacing, time frames, and aligned resources. Our hope is that by curating and organizing a variety of standards-aligned resources, teachers will be able to spend less time wondering what to teach and searching for quality materials (though they may both select from and/or supplement those included here) and have more time to plan, teach, assess, and reflect with colleagues to continuously improve practice and best meet the needs of their students.

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Environmental Science
Quarter 4 Curriculum Map

Quarter 4 Curriculum Map Feedback					
Quarter 1		**Quarter 2**		**Quarter 3**	**Quarter 4**
Unit 1 Ecology	Unit 2 Biodiversity	Unit 3 Biodiversity	Unit 4 Earth's Systems	Unit 5 Earth and Human Activity I	Unit 6 Earth and Human Activity II
6 weeks	3 weeks	3 Weeks	6 weeks	9 weeks	9 weeks

UNIT 6: Earth and Human Activity II [9 weeks]			
Overarching Question(s)			
How do humans depend on Earth's resources?			
Unit	**Lesson Length**	**Essential Question**	**Vocabulary**
Unit 6	9 Weeks	• What impact do humans have on forests ecosystems? • How can forests be better managed?	Old-growth forest, second-growth forest, tree plantation, deforestation, prescribed burn, debt-for-nature swap, conservation concession

DCI EVSC.ESS3: Earth and Human Activity **Standard** EVSC.ESS3.9 Evaluate ecosystem services provided by forests ecosystems. Construct an explanation for human impact on these services. **Explanation** Forests cover one-third of Earth's landmass. While forests may look very different from region to region, these ecosystems all provide vital ecosystem and economic services. For example, forests remove carbon dioxide (CO_2) from the atmosphere through photosynthesis and store it in organic compounds. By performing this ecosystem service, forests help stabilize average atmospheric	**Learning Outcomes** • Identify examples of ecosystem and economic services forests provide. • Describe ways scientists classify forests based on their age and structure. • Identify various methods of harvesting timber and their impacts on forests and explain how deforestation impacts forests. • Describe management solutions that help reduce impacts of timber harvesting, fires, and deforestation. **Phenomenon** **Human Impact** **View the following image.** https://encrypted-tbn3.gstatic.com/images?q=tbn:ANd9GcTy_-ruFOt2FuMyENUEoupvOYMxO68GpuHve0rC0azxREFT-tOwH5Tw_gI In the following NASA time lapse video, satellite images show the	**Curricular Resources** **Engage** **Human Impact on the Forest** https://www.youtube.com/watch?v=Y5aYBdFO4JY **Sustaining Forest Ecosystem Services** https://www.youtube.com/watch?v=gnW5MQ_9DXc **Explore** **Climate and Forest Ecosystem Services** https://www.chicagobotanic.org/downloads/nasa/Unit_3_Grades_10-12_Activity_3.3_ClimateForestEcosystemServices.pdf **Finding My Forests** https://www.fs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb5201734.pdf **Explain** **Introduction to forest ecosystem services** https://www.youtube.com/watch?v=JKms0W7sMUM **Deforestation Facts, Information, and Effects - National Geographic** https://www.nationalgeographic.com/environment/global-

temperatures and climate conditions. Forests also provide habitats for about two-thirds of Earth's terrestrial species. And they are home to more than 300 million people. About 1 billion people living in extreme poverty depend on forests for their survival. Forests also play a role in maintaining human health. Traditional medicines, used by 80% of the world's people, are mostly made from plant species native to forests. Chemicals found in a number of tropical forest plants serve as the basis for making most prescription drugs. (*Environmental Science: Sustaining Your World, 249)* **Misconceptions** **Dead Trees** Old-growth forests often contain stands of dead trees–called snags–and students may incorrectly believe such trees are "useless." Have students share their thoughts about what happens to trees after they die to gauge their understanding of the value of these unique components of old-growth forests. Then share with students that snags serve as important places for animals to nest (especially hollows, or cavities), store food, perch, and take shelter. In fact, standing dead trees may provide more types of habitat in this condition than when they are alive. Have students use their own words to summarize the value of	rapid deforestation of the Amazonian rain forest from 1975 to 2010. https://www.youtube.com/watch?v=hllU9NEcJyg Students will be introduced to the phenomena via video. Students will individually record their observations, hypothesize about what, why, how it is happening, and record any questions they may have about the phenomena. Students will share their work with a partner and then within their group, and finally, contribute to whole class discussion. Students will then watch a video: Rain forest Deforestation and its Effects to access and make meaning of content/science ideas such consequences for sustainability of civilizations; CO2 and climate change, responsible resource management. Students will read the article "Amazon rain forest losses impact on climate change, study shows" to further examine the global effects from deforestation as a consequence for the sustainability of civilizations. Students will examine data sets from the website Wood for Trees and continue their exploration of deforestation effects on climate. **Resources** Rainforest Deforestation and its Effects Amazon rainforest losses impact on climate change, study shows. Wood for Trees: Deforestation effects on Climate	warming/deforestation/ **Elaborate** **Seeing the Wood for the Trees** https://www.natureworkseverywhere.org/asset/resources/SeeingtheWood_v4_5_17_2018.pdf **Evaluate** **Section 8.1 Assessment, Questions 1 – 4** **Textbook Resource** **Environmental Science: Sustaining Your World – Chapter 8, Section 1, Page 248**

snags in one sentence. **Science and Engineering Practices** Constructing Explanations and Designing Solutions **Cross-Cutting Concepts** Stability and Change		

Environmental Science
Quarter 4 Curriculum Map
Quarter 4 Curriculum Map Feedback

Quarter 1		Quarter 2		Quarter 3	Quarter 4
Unit 1 Ecology	Unit 2 Biodiversity	Unit 3 Biodiversity	Unit 4 Earth's Systems	Unit 5 Earth and Human Activity I	Unit 6 Earth and Human Activity II
6 weeks	3 weeks	3 Weeks	6 weeks	9 weeks	9 weeks

UNIT 6: Earth and Human Activity II [9 weeks]

Overarching Question(s)

How do humans depend on Earth's resources?

Unit	Lesson Length	Essential Question	Vocabulary
Unit 6	9 Weeks	• What are the trends in human population growth? • How fast is the population growing? • Has it always grown at this rate, and how can we predict the population in the future? • Are the populations of different countries growing at different rates? • What do factors like human population density, movement, and composition mean for the sustainability of the planet? • What is meant by the Earth's carrying capacity? Will the earth's population increase to a level that could lead to a global crisis? • What patterns exist in the earth's population densities and distribution? • Why are populations growing faster in some areas of the world than in others? • How have governments and religions attempted to influence population growth trends? • How do geographers measure and study human population patterns? • What are the current and past patterns of population migration and movements? • What political, economic, and social factors influence	Fertility, Mortality, Population Change, Total Fertility Rate (TFR), Life Expectancy, Infant Mortality Rate, Urbanization, Urban Sprawl

		population migration streams?	
DCI EVSC.ESS3: Earth and Human Activity **Standard** EVSC.ESS3.2 Interpret graphical data representing global human population growth over time. Look for patterns within this data and construct possible explanations for the patterns. Revise the explanations as needed based on research. EVSC.ESS3.3 Obtain and evaluate information regarding demographics for a variety of countries. Construct an explanation for varying fertility rates and life expectancies between countries and throughout human history. Taking into account demographic transition, predict what trends are likely to occur in various countries over time. **Explanation** Human population dynamics is a field that tracks factors related to changes in population such as fertility rate and life expectancy. Predicting population changes is important because these demographic trends impact economic, social, and environmental systems. An increase in human population can impact the quality of natural resources like biodiversity, air, land, and water. Rising populations		**Learning Outcomes** • Identify trends in human population growth. • Calculate population change. • Identify total fertility rate as a key factor affecting • human population growth or decline. • Describe the effect of age structure on a population's • growth rate. • Discuss ways to slow human population growth. • Describe three trends in urbanization and the effects of urban sprawl. • Explain the advantages and disadvantages of urbanization. • Recognize the plight of poor people in urban areas. **Phenomenon** **How Many People Can Our Planet Really Support?** Have the students read the following article. Have them discuss what they believe to be true versus what is stated in the article. The class can then participate in a debate on the carrying capacity of Earth. http://www.bbc.com/earth/story/20160311-how-many-people-can-our-planet-really-support	**Curricular Resources** **Engage** **Factors Affecting Population Size** https://www.woodstown.org/cms/lib4/nj01001783/centricity/domain/8/texts/acs/resources/ab/ch9/act4.pdf **Food for Thought** https://assets.prb.org/pdf07/FoodForThought.pdf **Explore** **World Population Map Activity Guide** http://populationeducation.org/sites/default/files/world_population_map_activity_guide.pdf **Population Calculation Worksheet** http://ogoapes.weebly.com/uploads/3/2/3/9/3239894/population_calculation_worksheet.pdf **Explain** **Videos** **9 Billion? A Whirlwind Trip Through Population Trends** https://www.youtube.com/watch?v=DCPCQrxBUOU **Factors that affect Population Size** https://www.youtube.com/watch?v=Ldfuo8n2ztc **FERTILITY RATES - Global trends** https://www.youtube.com/watch?v=ar8XOhu3zGI **Elaborate** **Shanghai** Have students compare population density maps of China and the United States and discuss where people tend to congregate. Prompts: • Comparisons about the total population of the two countries include . . . • In both countries, people tend to live ____, which I think is because . . . • One reason many people may not live in western China is

put increasing demands on natural resources such as land, water, and energy supplies. However, the intensity of consumption and the technologies involved also must be considered. Changes in population size, age, and distribution affect issues ranging from food security to climate change. Population variables interact with consumption patterns, technologies, and political and economic structures to influence environmental change. This interaction helps explain why environmental conditions can deteriorate even as the growth of population slows. Carrying capacity is considered to be the population that the Earth can support on a continuing basis. Carrying capacity depends on much more than food production; it also involves subjective measures like quality of life. This is why the term "ecological footprint" is important as humans consider their impact on the planet's resources and ecosystems. **Misconceptions** There are many different kinds of misconceptions related to understanding human population issues, some of which result from lack of clarity about terms. Whenever the term "human population growth" is used, misunderstandings arise. Population		because . . . **Fertility Rate** Have students review the following article to discuss fertility rates among various countries and possible contributing factors to the variation of those rates. https://ourworldindata.org/fertility-rate **Evaluate** **Section 14.1 Assessment, Questions 1 – 4** **Section 14.2 Assessment, Questions 1 – 5** **Section 14.3 Assessment, Questions 1 – 4** **Textbook Resources** **Environmental Science: Sustaining Your World – Chapter 14, Page 466 , Page 472 , Page 478**

growth is defined as the limiting of population increase to the number of live births needed to replace the existing population. However, focus on "population growth" can be perceived to be a need to control human reproduction rights and use of the word "control" sets off a red flag, especially for countries based on democratic principles. There can also be a lack of clarity when people use the term rate of population growth or decline. People need to be aware that the rate of human population growth can decline, while the absolute number of people on Earth can continue to increase. Also, important to recognize is that areas experiencing rapid population growth are also often areas where the majority of Earth's remaining biodiversity can be found. Another misconception about population growth occurs when people assume that developing countries must go through the same processes, steps, or trends that developed countries have gone through. "Leapfrogging," a concept that developing countries can adopt modern systems without going through all the intermediary steps, is an important process when thinking about global development and population issues.		

The idea that population problems of developing countries are not a problem for the United States is a misconception. The scale of human activities is now so large that humans are appreciably affecting the climate and ecosystems in the U.S. and the world. The total impact of people on the environment is proportional to the number of people and the average impact of each person. If we are to reduce the total impact of people on the global environment, we must address both factors. Another popular misconception is that the world's worst population problem is found in developing countries. The United States has a high per capita resource consumption. Some estimates say a person in the United States has 30 times or more impact on world resources than does a person in an underdeveloped nation. The notion that all growth is good is a misconception. Steady growth of towns and cities has often been the goal to which communities aspire. If a town's population is growing, the town is said to be "healthy" or "vibrant," and if the population is not growing the town is said to be "stagnant." However, something that is not growing could alternately be viewed as "stable" and good.		

Environmental Science
Quarter 4 Curriculum Map
Quarter 4 Curriculum Map Feedback

Quarter 1		Quarter 2		Quarter 3	Quarter 4
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UNIT 6: Earth and Human Activity II [9 weeks]

Overarching Question(s)

How do humans depend on Earth's resources?

Unit	Lesson Length	Essential Question	Vocabulary
Unit 6	9 Weeks	**Essential Questions** • What causes air pollution? • How can we reduce air pollution? • What are the five primary air pollutants, and what are the sources of them? • What is ozone? • How do human activities affect the ozone layer? • What factors, human and non-human, affect changes in climate patterns? • What factors determine Earth's climate? • What evidence shows that global climate change is occurring, and why is it happening? • What are the effects of climate change? • How can we respond to climate change?	ozone layer, air pollution, temperature inversion, smog, acid deposition, climate change, carbon footprint, drought, mitigation, climate change tipping point, carbon capture and storage (CCS), geo-engineering, chlorofluorocarbon (CFC)

DCI	Learning Outcomes	Curricular Resources
EVSC.ESS3: Earth and Human Activity **Standard** EVSC.ESS3.16 Obtain, evaluate, and communicate scientific information tracing the breakdown of ozone caused by chlorofluorocarbons and the effectiveness of efforts to address this environmental problem. EVSC.ESS3.17 Using mathematics and computational thinking, analyze data linking human activity to climate change. Design solutions to address human impacts on climate change. **Explanation** The "greenhouse effect" keeps Earth's surface warmer than it would be otherwise. To maintain any average temperature over time, energy inputs from the sun and from radioactive decay in Earth's interior must be balanced by energy loss due to radiation from the upper atmosphere. However, what determines the temperature at which this balance occurs is a complex set of absorption, reflection, transmission, and redistribution processes in the atmosphere and oceans that determine how long energy stays trapped in these systems before being radiated away. Certain gases in the atmosphere (water vapor, carbon dioxide, methane, and nitrous	• Identify the layers of the atmosphere. • Explain the causes and effects of outdoor and indoor air pollution. • Describe factors that increase and decrease air pollution. • Identify actions that people and governments can take to reduce air pollution. • Define climate change. • Describe evidence that indicates Earth's climate is undergoing rapid change. • Explain how models are used to estimate future climate change. • Describe the effects of present and projected future climate change. • Explain the concept of a climate change tipping point. • Describe ways people and governments can slow atmospheric warming. • List the pros and cons of geoengineering strategies to counteract climate change. • Explain the causes and effects of stratospheric ozone depletion. • Describe how people can reverse ozone depletion. **Phenomenon** **THE OZONE DEPLETION PHENOMENON** **View the following picture.** https://www.nap.edu/openbook/NI000196/xhtml/images/p20003209g1001.jpg Like an infection that grows more and more virulent, the continent-size hole in Earth's ozone layer keeps getting bigger and bigger. Each year since the late 1970s, much of the protective layer of stratospheric ozone above Antarctica has disappeared during September, creating what is popularly known as the ozone hole. The Antarctic hole now measures about 9 million square miles,	**Engage** **Videos** **Air Pollution – National Geographic** https://www.nationalgeographic.com/environment/global-warming/pollution/ **How air pollution affects your health - infographic - The Guardian** https://www.theguardian.com/sustainable-business/2016/jul/05/how-air-pollution-affects-your-health-infographic **Chlorofluorocarbons** https://www.youtube.com/watch?v=s7TtvK9bYyE **How Chlorofluorocarbons Destroy Ozone** https://www.youtube.com/watch?v=IniJx-vRHG0 **What Ever Happened to The Hole In The Ozone Layer?** https://www.youtube.com/watch?v=0ZfBgjUnXIs **Climate 101: Ozone Depletion | National Geographic** https://www.youtube.com/watch?v=aU6pxSNDPhs **2016 Antarctic Ozone Hole Reaches Moderate Size | NASA** https://www.nasa.gov/feature/Goddard/2016/antarctic-ozone-hole-attains-moderate-size **UV: Chemistry of Ozone Depletion** http://www.teo.unt.edu/ecoplex/curricula/uv/eighth_grade/lesson.pdf **AIR POLLUTION 101** https://scied.ucar.edu/sites/default/files/images/long-content-page/Air+Pollution+101.pdf **Explore/Explaine/Elaborate** **Activities/Performance Tasks** **Sea-Level Rise** Display a sea-level rise map such as the Rising Seas interactive "If All the Ice Melted" at http://ngm.nationalgeographic.com/2013/09/rising-seas/if-ice-melted-map. Toggle to see what would happen to present-day coastal cities

oxides), which absorb and retain energy that radiates from Earth's surface, essentially insulate the planet. Without this phenomenon, Earth's surface would be too cold to be habitable. However, changes in the atmosphere, such as increases in carbon dioxide, can make regions of Earth too hot to be habitable by many species. **<u>Misconceptions</u>** **Stratospheric and Ground-Level Ozone** Some students are confused by encountering ozone as a harmful pollutant as well as a beneficial atmospheric gas that helps protect the planet. Emphasize that the ozone found in the stratosphere is the same three-oxygen-atom molecule that forms smog. The difference is that in the stratosphere, living organisms don't breathe it, and the ozone is beneficial because it blocks harmful UV radiation from the sun. Ozone forms at ground level when nitrogen oxides and volatile organic compounds emitted primarily from power plants and motor vehicles react chemically in the presence of sunlight. *Ask:* If you wanted to reduce the amount of ozone in the air at ground level, where would you concentrate your efforts?	nearly the size of North America. Less dramatic, but still significant, depletion of ozone levels has been recorded around the globe. With less ozone in the atmosphere, more ultraviolet radiation strikes Earth, causing more skin cancer, eye damage, and possible harm to crops. What is ozone? How did researchers discover its role in Earth's atmosphere and the devastating consequences of its depletion? The following article, adapted from an account by Dr. F. Sherwood Rowland, a pioneering researcher in the field who shared the 1995 Nobel Prize in Chemistry for his work, attempts to answer these and other questions. In doing so, it dramatically illustrates how science works and, in particular, how basic research—motivated by a desire to understand nature—often leads to practical results of immense societal benefit that could not have been anticipated when the research first began.	around the world after all the ice melts. Have students share their questions and concerns. Prompts: • I am/am not surprised by what the map shows because . . . • Places I have visited/would like to visit that would be under water include . . . • A question that I would ask a climate-change expert is . . . **Chlorofluorocarbons** Point out that CFC production has been banned in the United States since December 31, 1995 because of the damage this group of compounds causes to the ozone layer. Unfortunately, CFCs can remain in the stratosphere for decades or longer. CFCs have largely been replaced by another group of compounds called hydrofluorocarbons, which are ozone-safe. *Ask*: Did the ban on CFCs repair the ozone layer? *Explain*. (The repair of the ozone hole is a slow process. Since CFCs can persist in the stratosphere for decades or longer, CFCs released into the atmosphere before 1995 have continued to do damage for many years.) **What Pollutes the Air?** Gather print images from publications or the Internet, or project digital images of air pollution and its effects, such as exhaust from a bus or truck tailpipe; smoke from a power plant cooling tower; a volcano spewing gases and ash into the air; a dust storm; a burning forest; oil refinery emissions; or factory emissions. Have students brainstorm to determine whether each source is natural or the result of human activities. Have students further brainstorm to think about the effects air pollutants might have on people and other living things. **Ozone depletion: Uncovering**

Science and Engineering Practices • Constructing Explanations and Designing Solutions • Engaging in Argument from Evidence • Obtaining, Evaluating, and Communicating Information **Cross-Cutting Concepts** • Patterns • Cause and Effect • Systems and System Models		**the hidden hazard of hairspray** Have students review this case study and create their own question set. https://undsci.berkeley.edu/lessons/pdfs/ozone_depletion_complex.pdf **Evaluate** **Textbook Resources** **Environmental Science: Sustaining Your World – Chapter 16**

Environmental Science
Quarter 4 Curriculum Map
Quarter 4 Curriculum Map Feedback

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UNIT 6: Earth and Human Activity II [9 weeks]

Overarching Question(s)

How do humans depend on Earth's resources?

Unit	Lesson Length	Essential Question	Vocabulary
Unit 6	9 Weeks	**Essential Questions** • What is hazardous waste and what produces it? What is the best way to dispose of waste with the least amount of environmental impact? • What are the environmental impacts of landfills and incinerators? • What are the environmental impacts of recovering and reusing waste? • How does the disposal of hazardous waste differ from municipal waste? • What makes up MSW in the U.S.? • How are the terms reduce, reuse, recycle different from one another?	Solid waste, industrial solid waste, municipal solid waste (MSW), hazardous waste, waste management, waste reduction, integrated waste management, sanitary landfill, primary recycling, secondary recycling, composting, bioremediation, phytoremediation, deep-well disposal, surface impoundment, biomimicry

DCI EVSC.ESS3: Earth and Human Activity **Standard** EVSC.ESS3.15 Evaluate current methods of waste management and reduction and design possible improvements. **Explanation** Proper waste disposal is critical due to the fact that certain types of wastes can be hazardous and can contaminate the environment if not handled properly. These types of waste also have the potential to cause disease or get into water supplies. There are rules and regulations in place for how specific types of waste should be disposed of. Following them allows for toxic waste to be safely discarded without the risk of environmental contamination. Hazardous wastes that are not properly disposed of can leak and contaminate soil and water, which can lead to issues with both the environment and human health. Burning the wrong types of waste can release gases into the atmosphere. When waste is properly discarded, special liners are used to prevent toxic chemicals from leaking out and precautions are taken so that any methane related to burning trash is safely contained.	**Learning Outcomes** • Define and give examples of solid waste. • Explain what happens to solid waste after its disposal. • Define and give examples of hazardous waste and understand why hazardous waste requires special handling. • Understand how waste management, waste reduction, and integrated waste management differ in their approaches to dealing with solid waste. • Describe the process of landfilling waste, as well as its advantages and disadvantages. • Describe the process of incinerating waste, as well as its advantages and disadvantages. • Define the Four Rs approach to dealing with solid waste and identify ways individuals, industries, and communities can use this approach to limit waste and pollution. • Describe how hazardous waste can be managed by producing less of it. • Describe the advantages and disadvantages of recycling, treating, and storing hazardous waste. • Identify the regulations that apply to hazardous waste. • Explain how grassroots action leads to better solid waste management and encourages reuse, recycling, and composting. • Understand how international treaties have reduced hazardous waste. • Explain ways to transition to a low-waste economy. **Phenomenon** **The build-up of fat in the sewer system of a large city.** View the following image. http://www.baltimoresun.com/news/maryland/baltimore-city/bs-md-ci-fatberg-20170925-story.html 'Fatberg' of congealed fat, wet wipes and waste discovered under Baltimore's streets, causing sewer overflows.	**Lessons** **Environmental Science: Sustaining Your World – Chapter 17** **Page 576 – Section 17.1 Assessment, Questions 1 – 4** **Page 586 – Section 17.2 Assessment, Questions 1 – 5** **Page 594 – Section 17.3 Assessment, Questions 1 – 4** **Page 597 – Section 17.4 Assessment, Questions 1 – 5** **Videos** **Hazardous Solid Municipal Waste Management & Disposal** http://watershedgeo.com/environmental/waste-management/ **Solid and Hazardous Waste** https://www.youtube.com/watch?v=TkG_C3pv7Ic **San Francisco leads the world when it comes to waste management** https://www.cnbc.com/2018/07/13/how-san-francisco-became-a-global-leader-in-waste-management.html **How to keep recycling from turning into 'wishcycling'** https://www.cnbc.com/2018/11/16/how-to-keep-recycling-from-turning-into-wishcycling.html **5 recycling myths busted - National Geographic** https://www.nationalgeographic.com/environment/2018/10/5-recycling-myths-busted-plastic/ **How Plastic Recycling Actually Works** https://www.youtube.com/watch?v=zO3jFKiqmHo **Why recycling may be going to waste in the US** https://www.today.com/video/why-recycling-may-be-going-to-

When waste is disposed of properly, it helps to prevent additional pollution which can improve public health. Polluted air increases the risk of respiratory illness. Waste that is properly disposed of has a lesser chance of getting into the water supply and causing illness. **Misconceptions** **Recycling Misconceptions** The things that are new to us and the concepts we find hard to fathom often raise to misconceptions. Not many people are aware about the simplicity of recycling. They are either misinformed or have very little knowledge about recycling. As a result, they are unable to adapt recycling in their life as an important and essential custom. The recycling methods have advanced and the techniques have changed. If you are not aware of these changes then you will make several wrong decisions while recycling. Knowledge and correct information should be your guide when you start walking on the path of recycling. In the following, some common recycling myths have been busted and mistakes have been sorted for your help. **A single person is all it takes** Most people have a wrong attitude		waste-in-the-us-1311532611642?v=railb& **Activities/Performance Tasks** **Lessons in Sustainable Waste Management** http://www.cafr.org/pdf/resources/SWMP%202006.pdf **Solid Waste Activities** http://cwmi.css.cornell.edu/TrashGoesToSchool/Activities9-12.html **Landfills Near Me** Elicit from students the kinds of things they throw into the trash every day. Then have students use Google maps to begin a search for local landfills and add locations for those they know of that are closed. Have them measure the distance between the nearest landfill and their school or homes. *Prompts:* • I am/am not surprised that a landfill is located that close to us because . . . • I think the landfill is/is not active because . . . • Seeing the landfill does/does not make me think about what I throw away because . . . • If I threw away less ____ it might prolong the life of the landfill because . . . • I would like to see the landfill near me become a ____ because . . . **Environmental Science: Sustaining Your World, Page 570 –** CASE STUDY:E-Waste—An Exploding Problem Before students read this feature, find out what they know about electronic waste, or e-waste, and what they think happens to electronic devices they discard. *Prompts:* • Electronic devices that you think the average person uses daily include . . .

towards recycling. They avoid it thinking that the good works done by one person cannot bring major changes. The truth is that your attempts and endeavors can inspire ten more people. You should try to set example for others by adapting recycling as a part of your lifestyle. Your friends and colleagues and more may follow suit. Each person you inspire will motivate many others and make recycling a habit. **No need of sorting** Several recyclers believe that they need to sort the scrapped items by hand before throwing them into separate bins for plastic caps, bottles and papers. The truth is that most of the modern recycling plants use single stream recycling system which sorts out the different materials on its own. So, you can throw plastic cans and bottles with the cap on in the same bin as paper bags. **Throwing plastic bags into recycling bins** It is a great mistake to throw the plastic bags into the recycling bins. The recycling plants do not want plastic bags because there is not much they can do with the wet and unclean bags. If you want to recycle the plastic bags then keep them clean and dry. Collect lots of bags and then		• I think that electronic devices that I've discarded go to . . . • I think the problem of e-waste probably involves . . . • Improvements to the problem of e-waste might include . . . Use students' answers to help them relate to other areas of waste streams and the effects they can have on multiple levels, including society, other organisms in the environment, and the planet itself.

give them to the local grocers for reuse. **Landfills are not harmless** Not many urban dwellers recognize the adverse effects of landfills on our society and surrounding environment. The landfills emit harmful toxins and gases that pollute the air, groundwater and soil. This can lead to severe health disorders in humans and animals that live near such areas. Landfills occupy too much space and the gases emitted in these areas make it difficult to breathe. Recycling is the only way of tackling this problem. **Learn to read recycling symbols** Lack of knowledge about the recycling symbols make people believe that they can recycle about anything. The truth is that despite of the presence of the recycling symbol some items can be difficult to recycle. Check the number inside the recycling symbol to find out if it can actually get recycled. In US, only the items with recycling numbers 1 and 2 can be recycled. **Biodegradable wastes also need recycling** People interested in recycling also make the mistake of believing that the biodegradable waste need not be		

recycled. The truth is far different from this misconception. The biodegradable wastes emit methane and carbon dioxide, two of the biggest culprits in Green House emissions. They are harmful for the environment. By recycling this sort of waste, we can prevent these gases from mingling with the air. **Recycling is very tough** Well, there is toil behind every successful and good job but when it comes to recycling your toil amounts to nothing more than throwing the recyclables into the recycling bins. The local recycling plants collect the wastes once every week. **Science and Engineering Practices** • Asking Questions and Defining Problems • Developing and Using Models • Planning and Carrying Out Investigations **Cross-Cutting Concepts** • Cause and Effect • Scale, Proportion, and Quantity • Systems and System Models • Energy and Matter		

Environmental Science
Quarter 4 Curriculum Map
Quarter 4 Curriculum Map Feedback

Quarter 1		Quarter 2		Quarter 3	Quarter 4
Unit 1 Ecology	Unit 2 Biodiversity	Unit 3 Biodiversity	Unit 4 Earth's Systems	Unit 5 Earth and Human Activity I	Unit 6 Earth and Human Activity II
6 weeks	3 weeks	3 Weeks	6 weeks	9 weeks	9 weeks

UNIT 6: Earth and Human Activity II [9 weeks]

Overarching Question(s)

How do humans depend on Earth's resources?

Unit	Lesson Length	Essential Question	Vocabulary
Unit 6	9 Weeks	**Essential Questions** • What is hazardous waste and what produces it? What is the best way to dispose of waste with the least amount of environmental impact? • What are the environmental impacts of landfills and incinerators? • What are the environmental impacts of recovering and reusing waste? • How does the disposal of hazardous waste differ from municipal waste? • What makes up MSW in the U.S.? • How are the terms reduce, reuse, recycle different from one another?	Preservation, conservation, economic growth, human capital, regulation, economics, law, environmental justice, economic development, politics, policies, manufacturing capital

DCI	Learning Outcomes	Lessons
EVSC.ESS3: Earth and Human Activity **Standard** EVSC.ESS3.10 Using scientific data, analyze effectiveness of conservation versus preservation efforts. Obtain and communicate information on organizations involved in protecting natural resources. EVSC.ESS3.14 Obtain and communicate information on environmental laws pertaining to the regulation of pollution and on regulatory agencies. Provide a specific example of how a given business/industry would comply with such regulations. **Explanation** The federal government passes laws to protect human health and the environment and creates regulations to enforce those laws. The federal government may also delegate responsibility of certain environmental issues to the state level. For example, state government regulates wastewater management, including sewage. The state can then create its own laws and regulations that may be stricter than federal regulations but cannot be weaker. At the local level, environmental laws and regulations are called ordinances. **Misconceptions** Conservation and preservation are	• Describe the rise of environmental conservation and protection in the United States. • Explain the basic difference between preservation and conservation. • Discuss how people can achieve an environmentally sustainable society. • Summarize the politics of environmental law. • Describe how public land can be protected. • Identify seven guiding principles of the environmental justice movement. • Recognize the influence citizens have on environmental policies. **Phenomenon** **Hand crank device charges cell phone.** A handheld device with a crank handle is used to charge a cell phone. Multiple energy transfer/transformations are involved as well as the conservation of energy. Students investigate types of energy, the transfer of energy, and energy conservation through simulations, hands-on activities, videos, and reading. **Resources** How do we convert Mechanical Energy to Electrical Energy Phet Energy Transfer Simulation Energy and how it becomes Electrical Power	**Environmental Science: Sustaining Your World – Chapter 1, *Section 1.4*** **Page 37 – Section 1.4 Assessment, Questions 1 – 5** **Environmental Science: Sustaining Your World – Chapter 18** **Page 610 – Section 18.1 Assessment, Questions 1 – 5** **Page 615 – Section 18.2 Assessment, Questions 1 – 6** **Page 624 – Section 18.3 Assessment, Questions 1 – 5** **Page 628 – Section 18.4 Assessment, Questions 1 – 4** **Videos** **Environmental Conservation and Preservation** https://www.youtube.com/watch?v=XQoImcUJdag **Conservation vs Preservation** https://www.youtube.com/watch?v=RwOo7CGKvaA **What are environmental laws?** https://blog.oup.com/2018/09/what-are-environmental-laws/ **Environmental Justice | US EPA** https://www.epa.gov/environmentaljustice **Environmental laws and their implementation** https://www.youtube.com/watch?v=-RRX1Bss0Cs **Environmental Justice and National Environmental Policy Act** https://www.epa.gov/environmentaljustice/environmental-justice-and-national-environmental-policy-act **Environmental Policy** https://www.youtube.com/watch?v=bmgJMUgYPp4

closely linked and may indeed seem to mean the same thing. Both terms involve a degree of protection, but how that is protection is carried out is the key difference. Conservation is generally associated with the protection of natural resources, while preservation is associated with the protection of buildings, objects, and landscapes. Put simply conservation seeks the proper use of nature, while preservation seeks protection of nature from use. Students may conclude that conservation and preservation are very closely linked ideas and that people in both camps seek the same goals. While it is true that both schools of thought focus on how humans interact with nature, their goals do differ. Conservationists believe natural resources can be used for economic gain as long as such use is regulated. Preservationists seek to protect nature from any use by humans that might negatively impact it in any way. Discuss these differences with students and have them think about how these differing goals would impact approaches to environmental problems. Instruct students to create a Venn diagram showing how the two schools of thought are similar and different. **Science and Engineering Practices**		**Activities/Performance Tasks** **Debate: Two Views of Conservation** Review how the original conservation movement split into two schools of thought: the preservationist view and the conservationist view. Tell students an intense disagreement broke out between preservationists and conservationists from 1908 to 1913. During those years, the public was debating construction of a dam on the Tuolumne River in California's Yosemite National Park. The dam would create a reservoir in Hetch Hetchy Valley to supply water for San Francisco. Preservationists argued the valley was intended to be preserved as part of the national park. Conservationists argued the dam could be constructed to benefit people without destroying the valley (construction of the dam was approved). Have students imagine living near Yosemite during this period and hold a class debate about the dam. Debate Question: Should public lands be left untouched for use by future generations, or should they be managed for their economic benefits? Organize the class into three groups—preservationists, conservationists, and town hall participants who will question and evaluate the debaters' arguments. **Environmental Timeline** Review the environmental events that happened during the 1970s, 1980s, and 1990s by creating a chart on the board with bullet points for the main events from each decade. Have students add these events to the timeline you started at the beginning of the lesson. Then have students conduct online research to identify contemporary people or events associated with the environmental movement. Have students add this information to their timelines. • Struggling Students: Provide a list of events in the environmental movement or provide specific

• Asking Questions and Defining Problems • Using Mathematics and Computational Thinking • Constructing Explanations and Designing Solutions • Engaging in Argument from Evidence • Obtaining, Evaluating, and Communicating Information **Cross-Cutting Concepts** • Systems and System Models		websites to help these students complete their timelines. • Advanced Learners: Ask these students to focus on one environmental organization and create a comprehensive timeline that highlights the organization's key people, milestones in its history, and any significant contributions it has made to the overall environmental movement. **Government Lands** Ask students to create a graphic organizer that explains the role of each of the five major governmental agencies listed on page 617. Direct students to describe each agency, explain its function, and list how the lands under its auspices are used. • Struggling Students: Provide struggling students with a partially completed skeleton of the organizer and have them work in pairs to complete it. • Advanced Learners: Challenge these students to find at least two or three specific examples of land governed by each agency to include on their organizers. **Current Environmental Laws and Regulations** Have small groups of students explore the EPA's Laws and Regulations webpage at https://epa.gov/laws-regulations to find out about some of the current issues on this topic. Have each group choose a law or topic and present its findings to the rest of class. **The Environmental Decade: Impacts and Legislation** https://weta.org/files/2Legislation_Lesson%20Planw_chapters.pdf

Environmental Science
Quarter 4 Curriculum Map
Quarter 4 Curriculum Map Feedback

Quarter 1		Quarter 2		Quarter 3	Quarter 4
Unit 1 Ecology	Unit 2 Biodiversity	Unit 3 Biodiversity	Unit 4 Earth's Systems	Unit 5 Earth and Human Activity I	Unit 6 Earth and Human Activity II
6 weeks	3 weeks	3 Weeks	6 weeks	9 weeks	9 weeks

UNIT 6: Earth and Human Activity II [9 weeks]

Overarching Question(s)

How do humans depend on Earth's resources?

Unit	Lesson Length	Essential Question	Vocabulary
Unit 6	9 Weeks	**Essential Questions** • How are our ecological footprints affecting Earth? • What is your ecological footprint? • What is an ecological overshoot? When did this happen? • Why do Americans have one of the highest ecological footprints? • How can you lessen your Ecological Footprint and achieve a sustainable development?	Environmental degradation, pollution, point source, nonpoint source, ecological footprint
DCI EVSC.ESS3: Earth and Human Activity **Standard** EVSC.ESS3.10 Using scientific data, analyze effectiveness of conservation versus preservation efforts. Obtain and communicate information on organizations involved in protecting natural resources. EVSC.ESS3.14 Obtain and communicate information on	**Learning Outcomes** • Recognize some major environmental problems that lead to natural capital degradation. • Describe the purpose of the ecological footprint and IPAT models. • Discuss the major causes of environmental problems. • Describe the different forms of environmental degradation that can result from affluence and • from poverty. • Explain how one's environmental worldview affects one's attitude toward living sustainably. • Compare the three major categories of environmental worldviews.	**Lessons** **Environmental Science: Sustaining Your World – Chapter 1, *Section 1.2*** **Page 26, Section 1.2 Assessment, Questions 1 – 3** **Videos** **Ecological Footprint - Global Footprint Network** https://www.footprintnetwork.org/our-work/ecological-footprint/ **The Ecological Footprint Explained** https://www.youtube.com/watch?v=fACkb2u1ULY

environmental laws pertaining to the regulation of pollution and on regulatory agencies. Provide a specific example of how a given business/industry would comply with such regulations. **Explanation** The federal government passes laws to protect human health and the environment and creates regulations to enforce those laws. The federal government may also delegate responsibility of certain environmental issues to the state level. For example, state government regulates wastewater management, including sewage. The state can then create its own laws and regulations that may be stricter than federal regulations but cannot be weaker. At the local level, environmental laws and regulations are called ordinances. **Misconceptions** Conservation and preservation are closely linked and may indeed seem to mean the same thing. Both terms involve a degree of protection, but how that is protection is carried out is the key difference. Conservation is generally associated with the protection of natural resources, while preservation is associated with the protection of buildings, objects, and landscapes. Put simply conservation seeks the proper use of nature, while preservation seeks protection of nature from use.	**Phenomenon** **Sea Otter Populations are Threatened** View the following image. https://c2.staticflickr.com/2/1171/4731744179_b05ed0d774_z.jpg Sea otters are threatened despite conservation efforts. Human impact is a contributing factor. Some of the ways sea otter populations have been negatively impacted by humans are oil spills, polluted water, and entanglements in fishing gear. Through the study of this phenomenon students will understand the impact that humans have on wildlife, specifically sea otters. Students will investigate why the sea otter is still on the threatened species list after many years of conservation efforts and how human activity has posed a threat to their habitats. Although the sea otter population has increased in some areas, the range of the animal is more limited than in the past. After viewing the image of a scientist examining a dead sea otter students will investigate threats to sea otters. One key resource is the website Seaotters.com. According to the site Seaotters.com is, "dedicated to raising awareness about California's threatened sea otters. It's a collaboration of the Monterey Bay Aquarium and University of California Santa Cruz among others." This website is a key resource for students to start their investigation. There are informational videos, charts, graphs, and texts. Teachers may also have students do a lab activity in which they simulate an oil spill to gain understanding of one of the major threats to wild sea otters. Teachers can modify the activity to focus on the threat to sea otters. A third resource is a sea otter fact sheet that includes various threats to sea otter populations. **Resources** **Sea Otters** **Oil Spill Activity**	**Ecological footprint: Do we fit on our planet?** https://www.youtube.com/watch?v=g_aguo7V0Q4 **Measuring your Ecological Footprint** https://www.youtube.com/watch?v=MAKFdaJ3i3c **5 Steps to Reduce Your Ecological Footprint** https://www.youtube.com/watch?v=JgarIJz4orw **Activities/Performance Tasks** **Ecological Footprint** https://www.greeneducationfoundation.org/institute/lesson-clearinghouse/download/file.html?fid=19.382 **Ecological Footprint Game** http://environmentalsociety.ca/wp-content/uploads/2015/07/Ecological-Footprint-Game-Lesson-PLan.pdf **How Big is My Ecological Footprint?** http://www.earthrangers.org/wp-content/uploads/2016/08/how_big_is_my_ecological_footprint.pdf **Ecological Footprint Calculator** https://www3.epa.gov/airnow/workshop_teachers/calculating_carbon_footprint.pdf

Students may conclude that conservation and preservation are very closely linked ideas and that people in both camps seek the same goals. While it is true that both schools of thought focus on how humans interact with nature, their goals do differ. Conservationists believe natural resources can be used for economic gain as long as such use is regulated. Preservationists seek to protect nature from any use by humans that might negatively impact it in any way. Discuss these differences with students and have them think about how these differing goals would impact approaches to environmental problems. Instruct students to create a Venn diagram showing how the two schools of thought are similar and different. **Science and Engineering Practices** • Asking Questions and Defining Problems • Using Mathematics and Computational Thinking • Constructing Explanations and Designing Solutions • Engaging in Argument from Evidence • Obtaining, Evaluating, and Communicating Information **Cross-Cutting Concepts** • Systems and System Models	**Sea Otter Fact Sheet**	

Environmental Science Quarter 4 Curriculum Map Quarter 4 Curriculum Map Feedback					
Quarter 1		**Quarter 2**		**Quarter 3**	**Quarter 4**
Unit 1 Ecology	Unit 2 Biodiversity	Unit 3 Biodiversity	Unit 4 Earth's Systems	Unit 5 Earth and Human Activity I	Unit 6 Earth and Human Activity II
6 weeks	3 weeks	3 Weeks	6 weeks	9 weeks	9 weeks

UNIT 6: Earth and Human Activity II [9 weeks]			
Overarching Question(s)			
How do humans depend on Earth's resources?			
Unit	**Lesson Length**	**Essential Question**	**Vocabulary**
Unit 6	9 Weeks	**Essential Questions** • What are some key factors of sustainability? • What is an environmentally sustainable society? • How can cities become more sustainable? • How can society live more sustainably?	Environmentally sustainable society, sustainability

DCI EVSC.ETS2: Links Among Engineering, Technology, Science, and Society **Standard** EVSC.ETS2.1 Engage in argument from evidence on the role engineering and technology play in a sustainable human society. EVSC.ETS2.2 Research and communicate information on an environmental science career. Analyze the role of society, engineering, technology, and science in that career. **Explanation** The sustainability of human societies and the biodiversity that supports them requires responsible management of natural resources. Scientists and engineers can make major contributions—for example, by developing technologies that produce less pollution and waste and that preclude ecosystem degradation. When the source of an environmental problem is understood and international agreement can be reached, human activities can be regulated to mitigate global impacts (e.g., acid rain and the ozone hole near Antarctica). **Misconceptions** Students may believe sustainability is all about the environment.	**Learning Outcomes** • Identify the types of capital used by most economies. • Describe environmentally sustainable economic development. • Identify three economic ways in which society can use resources more sustainably. • Define environmental regulation. • Describe international goals for poverty reduction and sustainable development. • Describe environmental literacy. • Identify ways society can live more sustainably. • Revisit the concept of environmental worldviews. **Phenomenon** **Shark Tracking** View the following image. http://www.whoi.edu/cms/images/mediarelations/Screen_Shot_2_750_350853.jpg The WHOI REMUS Shark Cam shows a white shark attacking the tracking device. This phenomenon is used as a spring board to help students better understand how biologists apply understanding of physics (specifically, waves), computer programming, and engineering to better understand shark behavior and life history and the status of populations. ***Students can explore the following:*** Sharks have the ability to detect electric fields that help in detecting objects and navigation by geomagnetic fields. Waves can give scientists information, understanding properties of waves. Waves allow scientists to understand shark populations, shark behavior, and human impacts on sharks; wave application in acoustic and satellite telemetry gives us greater understanding of sharks and how human activity has impacted populations – in the case of white sharks, policies enacted off California waters have been effective in protecting populations. Scientists ability to tag a shark in water require understanding of properties of water and	**Lessons** **Environmental Science: Sustaining Your World – Chapter 1, *Section 1.4*** **Page 37, Section 1.4 Assessment, Questions 1 – 5** **Videos** **Life Cycle Engineering: Technology-Based Solution to Sustainability** https://www.youtube.com/watch?v=Ub2TLg03IlU **Incorporating Sustainability in the U.S. Environmental Protection Agency** http://sites.nationalacademies.org/pga/sustainability/epa/index.htm **Creating Sustainable Communities: The Role of the Civil Engineer** https://www.youtube.com/watch?v=btrQqIQW7t0 **Future career paths in the Environmental Science Field!** https://www.youtube.com/watch?v=WtJKDK99vnQ **Environmental Sciences: Careers That Shape the World Around Us** https://www.youtube.com/watch?v=RKP3g66gt9w **What Kind of Careers Can You Pursue in Environmental Sciences** https://www.youtube.com/watch?v=17FJ1Z6l06Q **14 Exciting Environmental Careers that Make a Difference** https://www.youtube.com/watch?v=QmAAEoc6_sE **Activities/Performance Tasks** **Connect Concepts – Occupations and Avocations** Have students read about these exciting careers highlighted in each chapter. They can then write a brief essay on one of these careers and demonstrate how engineering, technology, and

Have students read the article “Is the Planet Really in Danger of Running Out of Resources?”. They can have an informal debate on the topic. The teacher can choose the teams. https://www.forbes.com/sites/quora/2017/12/29/is-the-planet-really-in-danger-of-running-out-of-resources/#1745b532188d **Science and Engineering Practices** • Engaging in Argument from Evidence • Obtaining, Evaluating, and Communicating Information • Planning and Carrying Out Investigations **Cross-Cutting Concepts** • Cause and Effect • Energy and Matter	propagation of light. Tracking devices have signals encoded in waves and transmit information to receivers.(**Resources** **Phenomena are Jawsome: CA NGSS K-8 Early Implementation Initiative 8th grade teachers explore shark tracking** **WHOI REMUS Shark Cam Video** **Resources from the CSULB SharkLab (check out "publications")**	science play a role in each of these careers. **Sustainable Careers** Have individuals or pairs of students choose one of the careers in Figure 18-5 (*Environmental Science: Sustaining Your World, Page 609)* and ask them to prepare a short presentation that describes the job and some specific tasks a person with that job might do in a typical day. **Environmental Science: Sustaining Your World, Page 606 – CASE STUDY: The United States, China, and Sustainability** ***Ecological Footprints*** Before students begin, find out what they already know about ecological footprints in large economies. Prompts: • An ecological footprint is . . . • I think larger economies create larger ecological footprints because . . . • I think it is possible for larger economies to reduce their ecological footprints if . . . • Economic growth generally leads to a larger ecological footprint in that . . . ***Analyzing Graphs*** Ask students to examine the two bar graphs in Figure 18-1. Then conduct a discussion of what the graphs show. Ask: • How does the total ecological footprint of the United States compare with that of China? (The United States has a greater total footprint than China.) • How does the per capita footprint of the two countries compare? (The U.S. per capita footprint is more than 6 times that of China’s per capita footprint.)

Curriculum and Instruction- Science			
RESOURCE TOOLKIT			
Quarter 4		**Environmental Science**	
Textbook Resources **Will add quarter 2 textbook resources** 5E Lesson Resource Link	**DCIs and Standards** **DCI** Biological Change: Unity and Diversity Applications of Science Ecosystems: Interactions, Energy, and Dynamics Earth's Systems **Standard** EVSC.ETS3: EVSC.LS4: EVSC.LS2: EVSC.ESS2.6 EVSC.ESS2:	**Websites/Videos** **Earth's Atmosphere: Composition, Climate & Weather** https://www.space.com/17683-earth-atmosphere.html **Composition of the Atmosphere** https://www.youtube.com/watch?v=n_HlWovib3Y **The Coriolis Effect** https://www.youtube.com/watch?v=i2mec3vgeal **Energy from the Sun and Earth** https://www.youtube.com/watch?v=zsVkfxjaezk **Heat Transfer: Conduction, Convection, Radiation** https://www.youtube.com/watch?v=U3ee3rSg7xs **Earth's Atmosphere: Composition, Climate & Weather** https://www.space.com/17683-earth-atmosphere.html **Composition of the Atmosphere**	**Additional Resources** **ACT & SAT** TN ACT Information & Resources ACT College & Career Readiness Mathematics Standards SAT Connections SAT Practice from Khan Academy Khan Academy Illuminations (NCTM) Discovery Education The Futures Channel The TeachingChannel Teachertube.com

		https://www.youtube.com/watch?v=n_HlWovib3Y **The Coriolis Effect** https://www.youtube.com/watch?v=i2mec3vgeaI **Energy from the Sun and Earth** https://www.youtube.com/watch?v=zsVkfxjaezk **Heat Transfer: Conduction, Convection, Radiation** https://www.youtube.com/watch?v=U3ee3rSg7xs **Weather and Climate** https://video.nationalgeographic.com/video/climate-weather-sci **Weather vs. Climate** https://www.youtube.com/watch?v=SosJzEn1G0s **What are El Niño and La Niña?** https://oceanservice.noaa.gov/facts/ninonina.html **Effects on Climate Playlist** https://www.youtube.com/playlist?list=PLOE0-QYfoFlKyWrinfoSTTnHAKn_qfk4P **World Geography Unit 1 Lesson 5 World Climate Patterns** https://www.youtube.com/watch?v=AO_lv8zc1Uk	

		Activities/Performance Tasks **Ecological Succession Activity** http://hereausclasses.weebly.com/uploads/1/3/0/9/13099600/ecological_succession_reading_and_activity.doc **The Ups and Downs of Populations** http://science4inquiry.com/LessonPlans/LifeScience/Populations_MS/UpsDownsPopulationsMSFinal.pdf **Population and Limiting Factor Lab** http://blogs.fcps.net/mrswoods/files/2015/08/Population-Limiting-Factors-Owl-Mouse-LAB.pdf http://earthwatch.org/portals/0/downloads/education/lesson-plans/go_fish.pdf http://sepuplhs.org/high/sgi/teachers/fishery_sim.html https://www.youtube.com/watch?v=eVJ7Prt5OdA **National Geographic – Weather and Climate** https://video.nationalgeographic.com/video/climate-weather-sci **Weather vs. Climate: What's the difference?** https://youtu.be/SosJzEn1G0s **Five Factors that Affect Climate** https://youtu.be/E7DLLxrrBV8 **Factors that Affect Climate** https://youtu.be/rcVee8qVWZI **Terrestrial Ecosystems** https://youtu.be/LXF9VW5G0xU **Marine Ecosystems** https://youtu.be/se_sj0nL3Xk **The Basics of Freshwater**	

		https://youtu.be/oaQCiwzjnCM **Activities/Performance Tasks** **Weather Scope Activities** http://www.k12science.org/curriculum/weatherproj2/en/activities.shtml **Ecosystems & Energy in Ecosystems** http://www.esc3.net/cms/lib/TX00001506/Centricity/Domain/14/NEISDEnviron.%20Systems%201st%20Nine%20Weeks%20Group%201.pdf **Crafting an Aquatic Ecosystem** https://www.fws.gov/columbiariver/ANS/Activities/Activity_3.pdf http://nationalgeographic.org/activity/earths-changing-climates/ http://nationalgeographic.org/encyclopedia/climate-change/ http://authoring.concord.org/sequences/47/activities/278?show_index=true	