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.

Science and Engineering Practices

1. Asking questions & defining problems
2. Developing & using models
3. Planning & carrying out investigations
4. Analyzing & interpreting data
5. Using mathematics & computational thinking
6. Constructing explanations & designing solutions
7. Engaging in argument from evidence
8. Obtaining, evaluating, & communicating information

Disciplinary Core Ideas

Physical Science

PS 1: Matter & its interactions
PS 2: Motion & stability: Forces & interactions
PS 3: Energy
PS 4: Waves & their applications in technologies for information transfer

Life Sciences

LS 1: From molecules to organisms: structures & processes
LS 2: Ecosystems: Interactions, energy, & dynamics
LS 3: Heredity: Inheritance & variation of traits
LS 4: Biological evaluation: Unity & diversity

Earth & Space Sciences

ESS 1: Earth's place in the universe
ESS 2: Earth's systems
ESS 3: Earth & human activity

Engineering, Technology, & the Application of Science

ETS 1: Engineering design
ETS 2: Links among engineering, technology, science, & society

Crosscutting Concepts

1. Patterns
2. Cause & effect
3. Scale, proportion, & quantity
4. Systems & system models
5. Energy & matter
6. Structure & function
7. Stability & change

Learning Progression

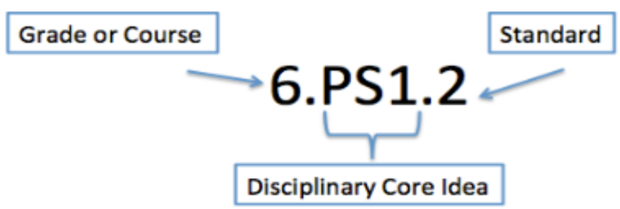
At the end of the elementary science experience, students can observe and measure phenomena using appropriate tools. They are able to organize objects and ideas into broad concepts first by single properties and later by multiple properties. They can create and interpret graphs and models that explain 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.

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.

SCS Environmental Science Curriculum Map

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

The Overarching Question(s)
• Why is it important to preserve all components of an ecosystem? • How and why do organisms interact with their environment and what are the effects of these interactions? • How does society play a role in populations?

DCI, Standard, Explanations, Misconceptions Length [8 days]	**Essential Questions, Learning Outcomes, Phenomena**	**3-Dimensional Instructional Approach (SEPs and CCCs) *Suggestions***	**Vocabulary and Curricular Materials**
DCI EVSC.LS2: Ecosystems: Interactions, Energy, and Dynamics **Standard** EVSC.LS2.5 Use a mathematical model to explain energy flow through an ecosystem. Using the first and second laws of thermodynamics, construct an explanation for: A) necessity for constant energy input; B) limitations on energy transfer from one trophic level to the next; and, C) limitations on number of trophic levels that can be supported. **Explanation** The cycling of matter and the flow of energy within ecosystems occur through	**Essential Questions** • What is an environmentally sustainable society? • What is an ecosystem? • How do matter and energy affect systems? **Learning Outcomes** • Discuss the study of environmental science and its goals. • Recognize the different forms of energy. • Describe trophic levels and how they can be represented in a conceptual model. • Understand the first and second	**Science and Engineering Practices** 2. Developing and using models 5. Using mathematics and computational thinking 6. Constructing explanations and designing solutions **Cross-Cutting Concepts** 4. Systems and System Models 5. Energy and matter	**Vocabulary** Environmental Science, Ecology, Ecosystem, Sustainability, Matter, Energy, Model, First Law of Thermodynamics, Second Law of Thermodynamics, System, Trophic Level **Lessons** **Environmental Science: Sustaining Your World – Chapters 1, 2. & 3** ***Focus Sections – 2.3, 2.4, & 3.3*** **Environmental Science: Sustaining Your World, Page 81 – Question #4** Create a simplified model of a food chain in your region. Include the names of the organisms and their relationship to each other.

interactions among different organisms and between organisms and the physical environment. All living systems need matter and energy. Matter fuels the energy releasing chemical reactions that provide energy for life functions and provides the material for growth and repair of tissue. Energy from light is needed for plants because the chemical reaction that produces plant matter from air and water requires an energy input to occur. Animals acquire matter from food, that is, from plants or other animals. The chemical elements that make up the molecules of organisms pass through food webs and the environment and are combined and recombined in different ways.

<u>Misconceptions</u>

A common misconception about ecosystems is that energy flows through an ecosystem many times. Most of the energy in an ecosystem comes from the Sun. The ultimate fate of all energy in all ecosystems is to be lost as heat. Energy does not recycle. The second law of thermodynamics that deals with the fact that energy cannot be cycled through an ecosystem in the same way that matter is. Natural processes that involve energy transfer must have one direction, and all natural processes are irreversible.

laws of thermodynamics.

- Identify the key components of a system.
- Describe the ways in which systems respond to change.

<u>Phenomenon</u>

Heat Transfer Through Convection

When heat transfers through convection, it generates currents. These currents can be seen throughout the earth and play a huge role in our everyday lives.

Watch the following short clip.
https://youtu.be/LHlD7Cpq1lw

As the heat from the candles transfers to the air above it, the air gets warm and rises because it becomes less dense than the cool air around it. As the air rises, the farther it gets from the candle, it begins to cool off. As it cools, it falls back down because it becomes denser. This creates a continual current of air (wind) that hits the blades of the fan causing them to move. If the air did not cool off and fall back down, then it could be argued that the top of the fan would simply lift off. In this scenario heat transfer (Q) is being used to do work (W).

Indicate the flow of energy, starting with the sun and including producers, consumers, and decomposers.

Environmental Science: Sustaining Your World – Stem Activities, Pages 41 and 63

<u>Videos</u>

Energy Flow in Ecosystems Demonstration -
https://youtu.be/OQj38SxRAhc

Energy Flow in Ecosystems -
https://youtu.be/lnAKICtJIA4

Energy Flow in Ecosystem -
https://youtu.be/5jBV9vJmXZI

<u>Activities/Performance Tasks</u>

The Science Teacher's Activity-a-Day – Page 131
The 10 Percent Rule of Energy Flow

Popcorn Energy Flow Lab
https://nabt.org/files/galleries/Anna_Scott.pdf

Root Beer Activity
www.engr.sjsu.edu/tanagnos/Ecology/Root_Beer_Activity.doc

Environmental Impact Project
https://www.ngsslifescience.com/science.php?/biology/lessonplans/C417/

			Energy Flow in Ecosystems http://hub.rockyview.ab.ca/pluginfile.php/1840/mod_resource/content/1/Energy%20Flow%20in%20Ecosystems%20Tutorial.pdf

DCI, Standard, Explanations, Misconceptions Length [12 days]	Essential Questions, Learning Outcomes, Phenomena	3-Dimensional Instructional Approach (SEPs and CCCs)	Vocabulary and Curricular Materials
DCI EVSC.LS2: Ecosystems: Interactions, Energy, and Dynamics **Standards** EVSC.LS2.4 Compare and contrast production (photosynthesis, chemosynthesis) and respiratory (aerobic respiration, anaerobic respiration, consumption, decomposition) processes responsible for the cycling of matter and flow of energy through an ecosystem. Using evidence, construct an argument regarding the importance of homeostasis in maintaining these processes in ecosystems. EVSC.LS2.6 Evaluate the interdependence among major biogeochemical cycles (water, carbon, nitrogen, phosphorus) in an ecosystem and recognize the importance each cycle has in maintaining ecosystem stability.	**Essential Questions** • What are the major ecosystem components? • What happens to energy in an ecosystem? • What happens to matter in an ecosystem? **Learning Outcomes** • Understand how nutrients cycle and energy flows through ecosystems. • Explain the roles of producers, consumers, and decomposers in an ecosystem. • Identify the different ways in which energy and matter are transformed in an ecosystem. • Summarize the processes of photosynthesis and cellular respiration. • Describe the hydrological cycle. • Describe the nutrient cycles within and among ecosystems	**Science and Engineering Practices** 2. Developing and using models 7. Engage in argument from evidence **Cross-Cutting Concepts** 2. Cause and Effect 4. Systems and system models 5. Energy and Matter	**Vocabulary** Consumers, Producers, Decomposer, Photosynthesis, Cellular Respiration, Chemosynthesis, Aerobic Respiration, Anaerobic Respiration, Nutrient Cycle, Hydrologic Cycle, Carbon Cycle, Nitrogen Cycle, Phosphorus Cycle **Lessons** **Environmental Science: Sustaining Your World – Chapter 3** ***Focus Sections – 3.2 & 3.4*** **Environmental Science: Sustaining Your World, Page 78 – Question #3** How would you revise Figure 3-7 to account for tertiary consumers, photosynthesis, aerobic respiration, and anaerobic respiration? **Environmental Science: Sustaining Your World, Page 90 – Questions #3, 4 & 5** **Environmental Science: Sustaining Your World – Stem Activity, Page 97**

Explanation The carbon cycle provides an example of matter cycling and energy flow in ecosystems. Photosynthesis, digestion of plant matter, respiration, and decomposition are important components of the carbon cycle, in which carbon is exchanged between the biosphere, atmosphere, oceans, and geosphere through chemical, physical, geological, and biological processes. The atoms that make up the organisms in an ecosystem are cycled repeatedly between the living and nonliving parts of the ecosystem. The chemical elements that make up the molecules of organisms pass through food webs and into and out of the atmosphere and soil and are combined and recombined in different ways. At each link in an ecosystem, matter and energy are conserved; some matter reacts to release energy for life functions, some matter is stored in newly made structures, and much is discarded. Competition among species is ultimately competition for the matter and energy needed for life. **Misconceptions** Many students believe that only animals carry out cellular respiration and plants only carry out photosynthesis; they do not understand that plants also need to carry out cellular respiration to provide ATP for cellular processes.	and the biosphere. • Explain how human activities impact nutrient cycles in ecosystems **Phenomenon** **Photosynthesis** *Watch the following YouTube clip.* https://youtu.be/OuVHrMBHDRM Two candles are lit on a lab bench. Both are covered at the same time, one with just the candle and another with the candle and a plant inside (make sure the plant is well watered and has been exposed to sunlight). Students are to make a prediction about which candle will go out first, and then make observations throughout the demo. Afterwards, students will share their observations and then come up with questions they had about the results. This can be used before starting a photosynthesis unit to help explain why the plant helped the flame stay lit longer.		**Videos** **Energy Notes Photosynthesis, Chemosynthesis and Cellular Respiration** http://slideplayer.com/slide/224624/ **Chemosynthesis vs Photosynthesis - Difference Between Chemosynthesis and Photosynthesis** https://youtu.be/9Sk9aE4lzXg **Ecosystem Processes** https://www.youtube.com/playlist?list=PLf6sf0FL4ayiNW6CSozXsuMo4ZIyn6aqd **Biogeochemical Cycles** https://youtu.be/Bn41lXKyVWQ **The Water Cycle** https://pmm.nasa.gov/education/videos/earths-water-cycle **Carbon cycle | Ecology | Khan Academy** https://youtu.be/_dYkByQ9Kmg **Nitrogen Cycle | It's AumSum Time** https://youtu.be/HOpRT8BRGtk **The Phosphorus Cycle** https://www.sciencelearn.org.nz/resources/961-the-phosphorus-cycle **Activities/Performance Tasks** **Candy Chemosynthesis** https://oceanexplorer.noaa.gov/explorations/02fire/background/education/media/ring_candy_chemo_9_12.pdf

			Photosynthesis and Cellular Respiration Activity https://www.umes.edu/uploadedFiles/_WEBSITES/HSUnits/Content/Day%2012%20-%20Photosynthesis%20and%20Cellular%20Respiraiton%20Activity%20Guide%20PART%201.doc **The Biogeochemical Cycle** https://www.st.nmfs.noaa.gov/Assets/Nemo/documents/lessons/Lesson_4/Lesson_4-Teacher's_Guide.pdf **Biogeochemical Cycles** https://www.gov.mb.ca/waterstewardship/fisheries_education_sustain_dev/education/outcomePages/grade10/pdf/cycle.pdf **The Carbon Cycle Game** https://climatechangelive.org/img/fck/file/carbon_cycle_game.pdf

DCI, Standard, Explanations, Misconceptions Length [10 days]	Essential Questions, Learning Outcomes, Phenomena	3-Dimensional Instructional Approach (SEPs and CCCs)	Vocabulary and Curricular Materials
DCI EVSC.LS4: Biological Change: Unity and Diversity **Standards** EVSC.LS4.1 Construct an explanation based on scientific evidence for mechanisms of natural selection that result in behavioral, anatomical, and physiological adaptations in populations.	**Essential Questions** • What is biodiversity and why is it important? • What roles do species plan in ecosystems? • How does life on Earth change over time? • What factors affect biodiversity? **Learning Outcomes**	**Science and Engineering Practices** 6. Constructing explanations and designing solutions 7. Engaging in argument from evidence **Cross-Cutting Concepts** 2. Cause and Effect	**Vocabulary** Biodiversity, Biome, Ecological Niche, Habitat, Biological Evolution, Natural Selection, Genetic Variability, Mutation, Adaptation, Speciation, Biological Extinction, Mass Extinction, Endemic Species, Artificial Selection, Genetic Engineering **Lessons**

EVSC.LS4.2 Justify claims with scientific evidence that changes in environmental conditions lead to speciation and extinction. **<u>Explanation</u>** Genetic variation in a species results in individuals with a range of traits. In any particular environment individuals with particular traits may be more likely than others to survive and produce offspring. This process is called natural selection and may lead to the predominance of certain inherited traits in a population and the suppression of others. Natural selection occurs only if there is variation in the genetic information within a population that is expressed in traits that lead to differences in survival and reproductive ability among individuals under specific environmental conditions. If the trait differences do not affect reproductive success, then natural selection will not favor one trait over others. **<u>Misconceptions</u>** Because natural selection can produce amazing adaptations, it's tempting to think of it as an all-powerful force, urging organisms on, constantly pushing them in the direction of progress — but this is not what natural selection is like at all. First, natural selection is not all-powerful; it does not produce perfection. If your genes are "good enough," you'll get some	• Describe the four components of biodiversity. • Explain how biodiversity leads to more resilient ecosystems. • Explain the scientific theory of biological evolution. • Describe genetic variability and natural selection as mechanisms for evolution. • Understand that natural selection has limits. • Explain how speciation and extinction determine Earth's biodiversity. • Understand how artificial selection and genetic engineering allow humans to select species' traits. **<u>Phenomenon</u>** **Human Skin Color Varies by Latitude** Human skin color variation across the globe is a product of evolution in response to differing environments. In the mid-latitudes, darker pigmentation is explained by the advantage conferred in preserving levels of folate in the body (which can be lowered by an hour of intense exposure to sunlight in individuals with lighter skin). Lower folate levels are linked to birth defects where infants are born without a brain or spinal cord. Additionally, folate is crucial to sperm development. Conversely, individuals in the higher and lower latitudes who are exposed to less ultraviolet radiation have lighter skin. This	.	**Environmental Science: Sustaining Your World – Chapter 4** ***Focus Sections – 4.3 & 4.4*** **Environmental Science: Sustaining Your World, Page 119 – Questions 4 & 5** **Environmental Science: Sustaining Your World, Page 123 – Section 4.4 Assessment** **Environmental Science: Sustaining Your World – Stem Activity, Page 127** **<u>Videos</u>** **Natural Selection - Crash Course Biology #14 -** https://youtu.be/aTftyFboC_M **Organisms and Populations - Adaptations and Population Attributes** https://youtu.be/dNZErD9UrxM **Facts of Evolution: Speciation and Extinction** https://youtu.be/T5kumHLiK4A **<u>Activities/Performance Tasks</u>** **Mechanisms of Evolution** **https://www.amnh.org/content/download/60958/1017810/file/SRMP_Evolution.pdf** **Scavenger Hunt: Simulating Natural Selection** **https://pumas.nasa.gov/files/09_17_03_1.pdf**

offspring into the next generation — you don't have to be perfect. This should be pretty clear just by looking at the populations around us: people may have genes for genetic diseases, plants may not have the genes to survive a drought, a predator may not be quite fast enough to catch her prey every time she is hungry. No population or organism is perfectly adapted. Second, it's more accurate to think of natural selection as a process rather than as a guiding hand. Natural selection is the simple result of variation, differential reproduction, and heredity — it is mindless and mechanistic. It has no goals; it's not striving to produce "progress" or a balanced ecosystem.	allows individuals to absorb a higher amount of UV radiation in order to stimulate production of Vitamin D. This allows the body to absorb calcium and deposit it in the bones which is especially important in fast-growing embryos. Related Resources: http://sciencecases.lib.buffalo.edu/cs/files/skin_pigmentation.pdf http://ed.ted.com/lessons/the-science-of-skin-color-angela-koine-flynn		**Activity: Simulate Natural Selection** https://manoa.hawaii.edu/exploringourfluidearth/?q=biological/what-alive/evolution-natural-selection/activity-simulate-natural-selection **Speciation Lab** http://www.kentschools.net/hmcclure/files/2016/02/Lab-Skittlefish-Natural-Selection-.pdf

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

The Overarching Question(s)

- Why is biodiversity important?
- What positive and negative effects do people have on biodiversity?
- What can be done to protect biodiversity?

DCI, Standard, Explanations, Misconceptions Length [7 days]	Essential Questions, Learning Outcomes, Phenomena	3-Dimensional Instructional Approach (SEPs and CCCs)	Vocabulary and Curricular Materials

DCI	Essential Questions	Science and Engineering Practices	Vocabulary
DCI EVSC.LS2: Ecosystems: Interactions, Energy, and Dynamics **Standard** EVSC.LS2.7 Examine stability and change within an ecosystem by using a model of succession (primary or secondary) to predict impacts of disruption on an ecosystem. EVSC.LS2.3 Using mathematical models, support arguments regarding the effects of biotic and abiotic factors on carrying capacity for populations within an ecosystem. **Explanation** Ecosystems are sustained by the continuous flow of energy, originating primarily from the sun, and the recycling of matter and nutrients within the system, and are dynamic in nature. Their characteristics fluctuate over time, depending on changes in the environment and in the populations of various species. Interactions between organisms may be predatory, competitive, or mutually beneficial. Ecosystems have carrying capacities that limit the number of organisms (within populations) they can support. Individual survival and population sizes depend on such factors as predation, disease, availability of resources, and parameters of the physical environment. **Misconceptions** Students may give human characteristics to, or anthropomorphize, plants and	**Essential Questions** • How do species interact? • How do ecosystems respond to changing conditions? • What limits the growth of populations? **Learning Outcomes** • Explain how species compete with one another for certain resources. • Recognize feeding relationships as a major category of interaction among species. • Understand how interactions between predator and prey species can drive each other's evolution. • Differentiate between parasitism, mutualism, and commensalism. • Understand how the species composition of a community or ecosystem can change. • Recognize that living systems are sustained through constant change. • Identify the variables that govern changes in population size and the factors that limit population size. • Explain reproductive and survivorship patterns of populations. **Phenomenon** **Marine Fish Populations Are Declining**	**Science and Engineering Practices** 2. Developing and using models 5. Using mathematics and computational thinking 7. Engaging in argument from evidence **Cross-Cutting Concepts** 2. Cause and effect 4. Systems and System Models 5. Energy and matter 6. Structure and Function 7. Stability and Change	**Vocabulary** Interspecific Competition, Resource Partitioning, Predation, Predator, Prey, Coevolution, Parasitism, Mutualism, Commensalism, Ecological Succession, Inertia, Resilience, Population, Limiting Factor, Environmental Resistance, Carrying Capacity **Lessons** **Environmental Science: Sustaining Your World – Chapter 5** **Environmental Science: Sustaining Your World, Page 137 – Question 5** Draw a diagram to describe the coevolution between bats and moths. **Environmental Science: Sustaining Your World, Page 140 – Question 5** Describe how a rain forest can reach a point when it cannot be restored by secondary ecological succession. **Environmental Science: Sustaining Your World, Page 147 – Question 6** Describe the types of data needed to provide causal evidence of space as a limiting factor on the size of a fish population. **Environmental Science: Sustaining Your World – Stem Activity, Page 151** **Videos**

animals. They may struggle with ideas like predation, believe that only certain animals get eaten, or think that all organisms within an ecosystem "get along." They may assume certain characteristics about groups of organisms such as carnivores based on a few examples or they may simplify the complex set of relationships represented by a food web. Finally, students may not understand that ecosystems are dynamic and change as a result of natural and human-influenced processes. Another topic prone to misconception is adaptation. Students (and adults) often misinterpret or misuse this word to indicate that individual organisms intentionally change in response to changes in their environment. Many children's books and web sites present some variation of this misleading notion in an attempt to simplify the concept or the reading level of material. As a result, adaptation is an extremely misunderstood scientific concept.	**View the following picture.** https://mrmeyergeography.files.wordpress.com/2014/02/sustainability-fishing.jpg The phenomenon is a comical replica of a fishing vessel trawling a massive net across the sea floor. In this process the net has consumed an entire school of fish, while also destroying the benthic habitat. Two fish are left behind demonstrating the dramatic decrease in population size that occurs instantaneously. This phenomena highlights human impact on marine fisheries. Overfishing in the ocean leads to population decline, which depletes the ecosystem of vital resources for other ocean predators. Conversely, this leads to the overabundance of the reduced population's prey species. Overfishing also decimates habitats, which also reduces population sizes of other marine species. The corresponding resources simulate these conditions and highlight the shifts in carrying capacity that occur as a result of these disruptions. **Related Resources:** 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		**Ecosystem Disturbances vs. Stability** https://youtu.be/KvomuF04Q9A **Ecosystem Stability** http://slideplayer.com/slide/6870135/ **Ecological Succession: Change is Good** https://youtu.be/jZKIHe2LDP8 **Ecological Carrying Capacity** https://youtu.be/XV2-2Ym3IIc **Limiting Factors in an Ecosystem** https://youtu.be/pPw51fDTl68 **Limiting Factors and Carrying Capacity** https://youtu.be/uK_jvGXy9HY **<u>Activities/Performance Tasks</u>** **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

DCI, Standard, Explanations, Misconceptions Length [8 days]	Essential Questions, Learning Outcomes, Phenomena	3-Dimensional Instructional Approach (SEPs and CCCs)	Vocabulary and Curricular Materials
DCI EVSC.LS2: Ecosystems: Interactions, Energy, and Dynamics **Standard** EVSC.LS2.1 Using a variety of data sources, construct an explanation for the impact of climate, latitude, altitude, geology, and hydrology patterns on plant and animal life in various terrestrial biomes. EVSC.LS2.2 Develop an explanation of behavioral and physical adaptations organisms have for life in aquatic habitats with varying chemical and physical features. **Explanation** Weather and climate are influenced by interactions involving sunlight, the ocean, the atmosphere, ice, landforms, and living things. These interactions vary with latitude, altitude, and local and regional geography, all of which can affect oceanic and atmospheric flow patterns. Because these patterns are so complex, weather can be predicted only probabilistically. Water continually cycles among land, ocean, and atmosphere via transpiration, evaporation, condensation and crystallization, and precipitation as well as downhill flows on land. The complex patterns of the changes and the movement of water in the atmosphere, determined by winds,	**Essential Questions** • What factors influence climate? • What are the major types of terrestrial ecosystems? • What are the major types of marine ecosystems? • What are the major types of freshwater systems? **Learning Outcomes** • Understand the difference between weather and climate. • Relate ocean currents and air circulation to Earth's climate zones. • Explain how greenhouse gases enter the atmosphere and how these gases affect Earth and its atmosphere. • Describe how climate and vegetation vary with latitude and elevation. • Identify the types of deserts, grasslands, and forests. • Define the ecological roles of mountains and their importance in ecosystem services. • Describe some ways in which humans alter terrestrial ecosystems. • Define aquatic life zones and explain the difference between	**Science and Engineering Practices** 4. Analyzing and interpreting data 6. Constructing explanations and designing solutions **Cross-Cutting Concepts** 1. Patterns 2. Cause and effect 7. Stability and Change	**Vocabulary** Weather, Climate, Edge Effect, Permafrost, Aquatic Life Zone, Marine Life Zone, Coastal Zone, Estuary, Ocean Acidification, Surface Water, Freshwater Life Zone, Runoff, Watershed, Eutrophication, Delta, Inland Wetland **Lessons** **Environmental Science: Sustaining Your World – Chapter 6** **Environmental Science: Sustaining Your World, Page 162 – Question 6** **Environmental Science: Sustaining Your World, Page 175 – Questions 4 and 5** **Environmental Science: Sustaining Your World, Page 181 – Question 5** **Environmental Science: Sustaining Your World, Page 185 – Questions 5 and 6** **Environmental Science: Sustaining Your World – Stem Activity, Page 189** **Videos** **National Geographic – Weather and Climate** https://video.nationalgeographic.com/vid

landforms, and ocean temperatures and currents, are major determinants of local weather patterns.

Misconceptions

A **biome** is NOT an ecosystem, although in a way it can look like a massive ecosystem. If you take a closer look, you will notice that plants or animals in any of the biomes have special adaptations that make it possible for them to exist in that area. You may find many units of ecosystems within one biome.

Although the word "desert" is normally associated with sand, desertification does not necessarily mean the land is becoming sand-covered. Instead, desertification occurs when a dryland ecosystem, or ecosystem that lacks water, becomes unproductive due to the tolls of the environment or human beings.

marine and freshwater life zones.

- Discuss the difference between the euphotic zone and the bathyal zone of the ocean.
- Explain the causes of ocean acidification.
- Understand that a river typically flows through three zones.
- Describe the seven ecosystem and economic services that inland wetlands provide.
- Describe human activities that are degrading freshwater systems.

Phenomenon

Earth's Changing Climate

View the following picture.
http://media.education.nationalgeographic.com/assets/photos/116/58c/11658cbf-0c13-413a-96a5-3a98ca978b20.jpg

Climate is the long-term pattern of weather in a particular area. Weather can change from hour to hour, day to day, month to month or even from year to year. For periods of 30 years or more, however, distinct weather patterns occur. A desert might experience a rainy week, but over the long term, the region receives very little rainfall. It has a dry climate. Because climates are mostly constant, living things can adapt to them. Polar bears have adapted to stay warm in polar climates, while cacti have evolved to hold onto water in dry climates. The enormous variety of life on Earth results in large part from the variety of climates that exist.

eo/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

	Climates do change, however—they just change very slowly, over hundreds or even thousands of years. As climates change, organisms that live in the area must adapt, relocate, or risk going extinct. Related Resources: http://nationalgeographic.org/activity/earths-changing-climates/ http://nationalgeographic.org/encyclopedia/climate-change/ http://authoring.concord.org/sequences/47/activities/278?show_index=true		