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 meaningful curricula 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 curricula 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

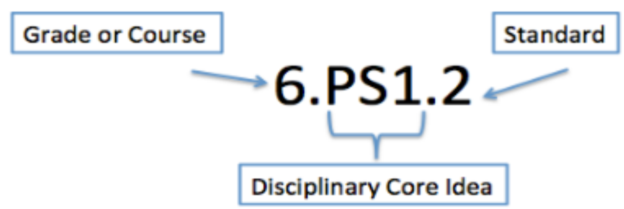
At the end of the elementary science experience, students can observe and measure phenomena using appropriate tools. They are able to organize objects and ideas into broad concepts first by single properties and later by multiple properties. They can create and interpret graphs and models that explain 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 define 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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Ecology Quarter 2/Quarter 4 Curriculum Map *****ECOLOGY is a Semester Course***** Quarter 2/Quarter 4 Curriculum Map Feedback Survey				
Quarter 1/Quarter 3			**Quarter 2/Quarter 4**	
Unit 1 ECOLOGY OF ORGANISMS	Unit 2 POPULATION ECOLOGY	Unit 3 COMMUNITY ECOLOGY	**Unit 4** **ECOSYSTEM ECOLOGY**	Unit 5 BIOSPHERE ECOLOGY
3 Weeks	3 Weeks	3 Weeks	**5 Weeks**	4 weeks
UNIT 4: Ecosystem Ecology (5 weeks)				
Overarching Question(s)				
How do organisms interact with the living and nonliving environments to obtain matter and energy?				
Unit, Lesson	**Lesson Length**	**Essential Question**		**Vocabulary**
Unit 4 **Ecosystem Ecology**	**9 weeks**	• How are the abiotic and biotic components of an ecosystem connected? • How do ecosystems change over time? • How are ecosystems related to biomes? • How are earth's biomes distributed?		Terrestrial Biome, Aquatic Biome, Climate. Vegetation, Latitude, Altitude, Adaptations, Species Diversity, Primary Succession, Secondary Succession, Tropical Rain Forest, Savanna, Desert, Grasslands, Temperate Deciduous Forest, Mediterranean Climate, Northern Coniferous Forest, Tundra, Taiga, Freshwater Regions, Marine Regions, Coral Reefs, Estuaries, Wetlands
Standards and Related Background Information		**Instructional Focus**		**Instructional Resources**
DCI **LS2: Ecosystems: Interactions, Energy, and Dynamics** **Standards**		**Learning Outcomes** • Evaluate the interactions between organisms in ecosystem according to the stable or changing conditions.		**Curricular Resources** Engage Explore

ECO.ETS2.1 Engage in argument from evidence regarding the impact engineering and technology have on biodiversity. **ECO.LS2.1** Construct explanations for patterns relating to climate, flora, and fauna found in major terrestrial biomes (deserts, temperate grasslands, temperate forests, tropical grasslands, tropical forests, taiga, and tundra). **ECO.LS2.2** Research examples of adaptations of organisms in major marine and freshwater ecosystems. Develop an explanation for the formation of these adaptations and predict how the organisms would be affected by environmental disturbances or long-term ecological changes. **ECO.LS2.4** Compare patterns of stratification and zonation in various terrestrial and aquatic ecosystems. Construct an argument regarding the importance of these patterns in ecosystem diversity. **ECO.LS2.10** Plan and carry out an investigation measuring species diversity (richness and evenness) and density in a local ecosystem. **ECO.LS2.19** Carry out an investigation of stability and change within a local	• Summarize the process through which an ecosystem is established. • Identify patterns in the characteristics of aquatic communities. **Phenomenon**  **Kelp Deforestation** Sea urchins eat the holdfasts of kelp plants, killing the kelp. When natural predators sea urchins, like sea otters, are absent from a kelp ecosystem, the sea urchin population grows quickly, destroying the kelp forest. This leads to a series of changes in the ecosystem that seems in a new stable state called an urchin barren. The phenomenon highlights the relationships between species and the result of their interaction on maintenance and stability of Marine Environment (change, maintenance/stability growth, destruction) **Dancing With The Devil** The Thorny Devil has multiple adaptations, that allow it to survive in the arid deserts of Australia. An interesting adaptation is the method by which this lizard stores, captures, and drinks water.	Explain Elaborate Evaluate ***Websites:*** Terrestrial Biomes https://ng.cengage.com/static/nb/ui/evo/index.html?eISBN=9781337112475&id=340330502&snapshotId=879384& https://ng.cengage.com/static/nb/ui/evo/index.html?eISBN=9781337112475&snapshotId=879384&id=340330503& https://www.cengage.com/mindtap http://www.ucmp.berkeley.edu/glossary/gloss5/biome/ https://www.youtube.com/watch?v=1WoopaCZKao https://www.youtube.com/watch?v=555EG8Vzs_I https://www.pbslearningmedia.org/resource/lsps07.sci.life.eco.lpexpecosystems/exploring-the-systems-in-ecosystems/#.W0vmEdJKiUk http://www.discoveryeducation.com/teachers/free-lesson-plans/ecosystems.cfm#mat https://www.scholastic.com/teachers/activities/teaching-content/ecosystems-11-studyjams-interactive-science-activities/ http://studyjams.scholastic.com/studyjams/jams/science/ecosystems/aquatic-ecosystems.htm http://studyjams.scholastic.com/studyjams/jams/science/ecosystems/biomes.htm https://bio.libretexts.org/TextMaps/Introductory_and_General_Biology/Book%3A_General_Biology_

ecosystem. Identify signs of succession (primary or secondary). Based on investigation findings, make predictions regarding future changes in this ecosystem. **ECO.ESS3.1** Research and evaluate the effectiveness of public lands (state parks, national parks, wildlife refuges, wilderness areas) in sustaining biodiversity. **<u>Explanation</u>** What powers life? How do sunlight and nutrients affect the plants we depend on? How do greenhouse gases and other contaminants degrade the interactions among the plant, animal, and microbial populations that comprise ecosystems? Ecosystem ecology is the study of these and other questions about the living and nonliving components within the environment, how these factors interact with each other, and how both natural and human-induced changes affect how they function. Understanding how ecosystems work begins with an understanding of how sunlight is converted into usable energy, the importance of nutrient cycling, and the impact mankind has on the environment. Plants convert sunlight into usable forms of energy that are carbon based. Primary and secondary production in populations can be used to determine energy flow in ecosystems. Studying the effects of	 Scientists have determined that rainfall is captured by an intricate design of layered scales all over the lizard's body. Between each scale is a hinge joint that allows the lizard to collect water and transport it to the back of its mouth through a tubular system under its skin. Performing tongue movements allows the lizard to create enough pressure to draw water towards the back of its mouth. The Thorny Devil has developed a specialized tongue much like the common anteater that is fast and allows for quick capture of prey. Along with this tongue a reduction of mandibular teeth is seen because the teeth it has are specialized for crushing the body of its prey for quick digestion.  A unique trait that the Thorny Devil possesses for encounters with predators is the development of a "false head," which is made from a bony mass on the top of its real head. When threatened by a predator, the Thorny Devil will tuck its real head between its legs and	(OpenStax)/8%3A_Ecology/44%3A_Ecology_and_the_Biosphere/44.3%3A_Terrestrial_Biomes https://www.khanacademy.org/science/high-school-biology/hs-ecology/hs-human-impact-on-ecosystems/v/human-activities-that-threaten-biodiversity **<u>Textbook</u>** NGL/Cengage *Environmental Science: Sustaining Your World*, G. Tyler Miller and Scott E. Spoolman • Chapter 4 Biodiversity and Evolution pp. 100-127 • Section 6.2 What Are the Major Types of Terrestrial Ecosystems? pp. 163-175 • Section 6.3 What Are the Major Types of Marine Ecosystems? pp. 176-181 • Section 6.4 What Are the Major Types of Freshwater Systems? pp. 182-185 • Chapter 7 Saving Species and Ecosystem Services pp. 202-235 • Chapter 8 Sustaining Biodiversity: An Ecosystem Approach pp. 236-269 **Additional Resources:** **ACT & SAT** TN ACT Information & Resources SAT Connections SAT Practice from Khan Academy

atmospheric? CO2 will have future implications for agricultural production and food quality. A new focus in ecosystem ecology has been climate change. The world is being altered at an alarming pace from greater to lesser precipitation in some areas to change in ecosystems from grasslands to desert (desertification) or forests to grasslands (increased aridity). Ecosystem ecologists are now studying the causes and effects of climate change, hoping to one day minimize our impact on the planet and preserve natural ecosystems, as we know them today. **<u>Misconceptions</u>** **Interrelationships** An ecosystem and its components (plants, animals, their interactions, and their surroundings) are all topics prone to misconceptions. Students may give human characteristics to, or anthropomorphize, plants and 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	expose its false head and thorny body, which makes it look bigger and thus harder to swallow to the potential predator. The structures that this lizard possesses suit it well for its environment. The combination of the scalar water transport system, its camouflaged body, and its cautious personality make it a hardy survivor.	

change because of natural and human-influenced processes. **Desert Biodiversity** Some students may think those deserts are barren wastelands with low biodiversity. However, deserts provide habitat for many species of plants and animals. For example, the Sonoran Desert, in the southwestern United States, is home to 2,000 species of plants, 100 reptile species, 350 different types of birds, and 60 species of mammals. **Primate Diversity**  Students probably believe that a primate is basically a monkey – but every animal in this picture is a primate. Students will probably be surprised but the diversity of species within this group of animals. Although primates share general characteristics, they range from the tree-dwelling aye-aye, with its large ears and long fur to human beings. **The Aye-Aye**		

 **Science and Engineering** 3. Planning and carrying out investigations 6. Constructing explanations and designing solutions 7. Engaging in argument from evidence 8. Obtaining, evaluating, and communicating information **Crosscutting Concepts** 1. Patterns 2. Cause and Effect 4. Systems and System Models 7. Stability and Change		

Ecology Quarter 2/4 Curriculum Map				
Quarter 1/Quarter 3			**Quarter 2/Quarter 4**	
Unit 1 ECOLOGY OF ORGANISMS	Unit 2 POPULATION ECOLOGY	Unit 3 COMMUNITY ECOLOGY	Unit 4 ECOSYSTEM ECOLOGY	**Unit 5** **BIOSPHERE ECOLOGY**
3 Weeks	3 Weeks	3 Weeks	5 Weeks	**4 Weeks**
UNIT 5: Biosphere Ecology (5 weeks)				
Overarching Question(s)				

- How do matter and energy move through an ecosystem?
- What happens to ecosystems when the environment changes?
- How do food and fuel provide energy? If energy is conserved, why do people say it is produced or used?
- How do living organisms alter Earth's processes and structures?

- How do humans change the planet?

Unit, Lesson	Lesson Length	Essential Question	Vocabulary
Unit 5 **Biosphere Ecology**	**9 weeks**	• What role do humans play in the loss of species and ecosystem services? • Why should we try to sustain wild species and the ecosystem services they provide? • How do humans accelerate species extinction and degradation of ecosystem services? • How can we sustain wild species and the ecosystem services they provide?	Absorb, archaea, biosphere, biosphere reserve, carbon dioxide, fossil fuels, nutrient cycle, decomposition, cellular respiration, photosynthesis, glycolysis, Krebs cycle, combustion, algal bloom, evapotranspiration, surface runoff, weathering, erosion, precipitation, infiltration, micronutrients, macronutrients, biofuels

Standards and Related Background Information	Instructional Focus	Instructional Resources
DCI(s) LS2: Ecosystems: Interactions, Energy, and Dynamics ESS3: Earth and Human Activity **Standard(s)** **ECO.LS2.5** Using the laws of conservation of energy, create a model of energy flow through the biosphere. Use the model to explain limitations in energy transfer and the need for ongoing energy input. **ECO.LS2.7** Use models to explain relationships among biogeochemical cycles (water, carbon, nitrogen, phosphorus). **ECO.LS2.8** Create a diagram tracing carbon through the processes of photosynthesis and respiration. Use the diagram to construct an explanation for the importance of photosynthesis and respiration in the carbon cycle.	• How do water and nutrients cycle through the environment? • What are the processes, features, and significance of water? • carbon, nitrogen, and phosphorus cycles? • How do different organisms obtain and use energy to survive in their environment? • How do the processes of photosynthesis and cellular respiration create and release energy? • How do bacteria use nitrogen during cellular respiration? • What are the roles of decomposers in nutrient cycling?	**Curricular Resources** Engage Explore Explain Elaborate Evaluate **Websites:** https://www.youtube.com/watch?v=qLkNg3W5L9Q https://www.khanacademy.org/science/biology/ecology/biogeochemical-cycles/a/introduction-to-biogeochemical-cycles

ECO.LS2.9 Construct an argument from evidence regarding the importance of the microbial community in nutrient cycling.

ECO.ESS3.3 Engage in argument from evidence regarding the impacts of human activity on climate change. Design solutions to address these impacts.

Explanation

The Biosphere

The biosphere is made up of the parts of Earth where life exists. The biosphere extends from the deepest root systems of trees, to the dark environment of ocean trenches, to lush rain forests and high mountaintops. Scientists describe the Earth in terms of spheres. The solid surface layer of the Earth is the lithosphere.
The atmosphere is the layer of air that stretches above the lithosphere. The Earth's water—on the surface, in the ground, and in the air—makes up the hydrosphere.

Since life exists on the ground, in the air, and in the water, the biosphere overlaps all these spheres. Although the biosphere measures about 20 kilometers (12 miles) from top to bottom, almost all life exists between about 500 meters (1,640 feet) below the ocean's surface to about 6 kilometers (3.75 miles) above sea level.

The biosphere has existed for about 3.5 billion years. The biosphere's earliest life-forms, called prokaryotes, survived without oxygen. Ancient prokaryotes included single-celled organisms such as bacteria and archaea. Some prokaryotes developed a unique chemical process. They were able to use sunlight to make simple sugars and oxygen out of water and carbon dioxide, a process

Learning Outcomes

- Examine the exchange between living systems and their environment.
- Explain the cycling of matter and flow of energy among organisms in an ecosystem using mathematical representations.
- Model the processes, features, and significance of water, carbon, nitrogen, and phosphorus cycles.

Phenomenon

Algal Bloom

Too much nitrogen and phosphorus in the water causes algae to grow faster than ecosystems can handle. Significant increases in algae harm water quality, food resources and habitats, and decrease the oxygen that fish and other aquatic life need to survive. Large growths of algae are called algal blooms and they can severely reduce or eliminate oxygen in the water, leading to illnesses in fish and

https://www.khanacademy.org/science/high-school-biology/hs-ecology/hs-biogeochemical-cycles/v/biogeochemical-cycles
https://enviroliteracy.org/air-climate-weather/biogeochemical-cycles/
https://enviroliteracy.org/land-use/
https://www.ck12.org/biology/cellular-respiration-and-photosynthesis/lesson/Connecting-Cellular-Respiration-and-Photosynthesis-MS-LS/
https://www.youtube.com/watch?v=JUmT24R8CyA

Textbook

NGL/Cengage *Environmental Science: Sustaining Your World*, G. Tyler Miller and Scott E. Spoolman

- Chapter 3 Ecosystem Dynamics pp. 64-97

Additional Resources

ACT & SAT

TN ACT Information & Resources

SAT Connections

SAT Practice from Khan Academy

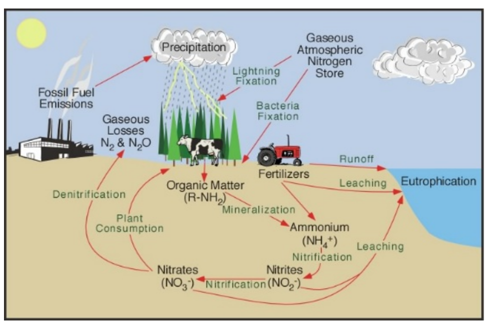
called photosynthesis. These photosynthetic organisms were so plentiful that they changed the biosphere. Over a long period of time, the atmosphere developed a mix of oxygen and other gases that could sustain new forms of life.

The addition of oxygen to the biosphere allowed more complex life forms to evolve. Millions of different plants and other photosynthetic species developed. Animals, which consume plants (and other animals) evolved. Bacteria and other organisms evolved to decompose, or break down, dead animals and plants.

The biosphere benefits from this food web. The remains of dead plants and animals release nutrients into the soil and ocean. These nutrients are re-absorbed by growing plants. This exchange of food and energy makes the biosphere a self-supporting and self-regulating system.

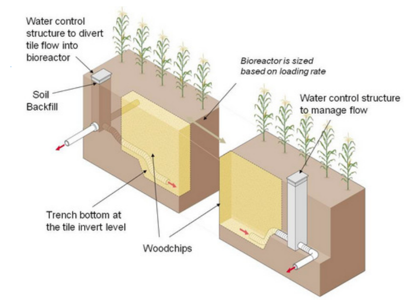
The biosphere is sometimes thought of as one large ecosystem—a complex community of living and nonliving things functioning as a single unit. More often, however, the biosphere is described as having many ecosystems.

Misconceptions



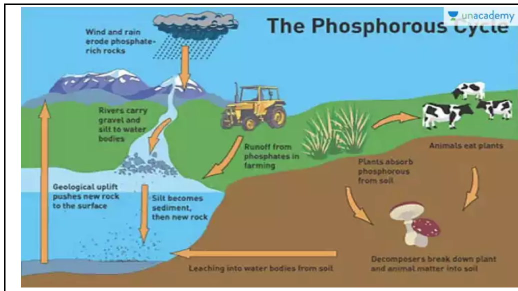
the death of large numbers of fish. Some algal blooms are harmful to humans because they produce elevated toxins and bacterial growth that can make people sick if they come into contact with polluted water, consume tainted fish or shellfish, or drink contaminated water.

Denitrifying Bioreactor

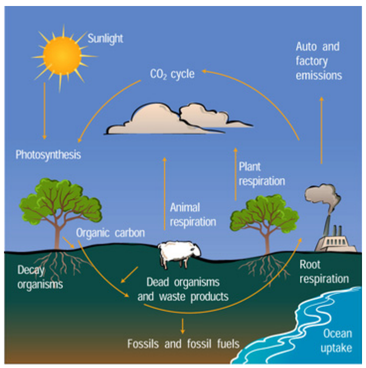


Denitrifying Bioreactors are essentially subsurface trenches filled with a carbon source, mainly wood chips, through which water is allowed to flow just before leaving the drain to enter a surface water body. The carbon source in the trench serves as a substrate for bacteria that break down the nitrate through DE nitrification or other biochemical processes. Bioreactors provide many advantages:

- They use proven technology.
- They require no modification of current practices
- No land needs to be taken out of production



Students may think that because nitrogen and phosphorus are nutrients, adding more to the environment must always be beneficial to the environment. In excess, nitrogen and phosphorus as well as atmospheric carbon can disrupt the flow of nutrient cycles and cause harm to living things.



Students may think that the carbon cycle consists only of photosynthesis and respiration, and that only animals carry out cellular respiration. The carbon cycle involves many processes in addition to photosynthesis and cellular respiration, such as combustion and decomposition. Organisms such as plans undergo both photosynthesis and cellular respiration.

<u>Science and Engineering</u>
2. Developing and Using Models

- There is no decrease in drainage effectiveness
- They require little or no maintenance
- They last for up to 20 years.

How do bioreactors work? Organisms from the soil colonize the woodchips. Some of them break down the woodchips into smaller organic particles. Others "eat" the carbon produced by the woodchips, and "breathe" the nitrate from the water. Just as humans breathe in oxygen and breathe out carbon dioxide, these microorganisms breathe in nitrate and breathe out nitrogen gas, which exits the bioreactor into the atmosphere. Through this mechanism, nitrate is removed from the tile water before it can enter surface waters.

6. Constructing explanations and designing solutions 7. Engaging in argument from evidence **Crosscutting Concepts** 1. Patterns 2. Cause and Effect 4. Systems and System Models 7. Stability and Change		

Curriculum and Instruction- Science			
RESOURCE TOOLKIT			
Quarter 2/4		Ecology	
Textbook Resources: ***Textbook:*** **Environmental Science: Sustaining Your World** **Chapter 4 Biodiversity and Evolution pp. 100-127** **Section 6.2 What Are the Major Types of Terrestrial Ecosystems? pp. 163-175** **Section 6.3 What Are the Major Types of Marine Ecosystems? pp. 176-181** **Section 6.4 What Are the Major Types of Freshwater Systems? pp. 182-185** **Chapter 7 Saving Species and Ecosystem Services pp. 202-235** **Chapter 8 Sustaining Biodiversity: An Ecosystem Approach pp. 236-269**	**DCIs and Standards** **DCI** LS2: Ecosystems: Interactions, Energy, and Dynamics LS4L Biological Change: Unity and Diversity **Standards**	**Videos and Websites:** Khan Academy Illuminations (NCTM) Discovery Education The Futures Channel The TeachingChannel Teachertube.com ***Websites:*** https://www.nature.com/scitable/knowledge/library/terrestrial-biomes-13236757 https://ng.cengage.com/static/nb/ui/evo/index.html?eISBN=9781337112475&id=340330502&snapshotId=879384& https://ng.cengage.com/static/nb/ui/evo/index.html?eISBN=9781337112475&snapshotId=879384&id=340330503& https://www.cengage.com/mindtap http://www.ucmp.berkeley.edu/glossary/gloss5/biome/ https://www.youtube.com/watch?v=1WoopaCZKao https://www.youtube.com/watch?v=555EG8Vzs_I https://www.pbslearningmedia.org/resource/lsps07.sci.life.eco.lpexpecosystems/exploring-the-systems-in-ecosystems/#.W0vmEdJKiUk	**Additional Resources:** ACT & SAT TN ACT Information & Resources ACT College & Career Readiness Mathematics Standards SAT Connections SAT Practice from Khan Academy

Textbook: **Environmental Science: Sustaining Your World** **Chapter 3 Ecosystem Dynamics pp. 64-97**		http://www.discoveryeducation.com/teachers/free-lesson-plans/ecosystems.cfm#mat https://www.scholastic.com/teachers/activities/teaching-content/ecosystems-11-studyjams-interactive-science-activities/ http://studyjams.scholastic.com/studyjams/jams/science/ecosystems/aquatic-ecosystems.htm http://studyjams.scholastic.com/studyjams/jams/science/ecosystems/biomes.htm https://bio.libretexts.org/TextMaps/Introductory_and_General_Biology/Book%3A_General_Biology_(OpenStax)/8%3A_Ecology/44%3A_Ecology_and_the_Biosphere/44.3%3A_Terrestrial_Biomes https://www.khanacademy.org/science/high-school-biology/hs-ecology/hs-human-impact-on-ecosystems/v/human-activities-that-threaten-biodiversity ***Websites:*** https://www.youtube.com/watch?v=qLkNg3W5L9Q https://www.khanacademy.org/science/biology/ecology/biogeochemical-cycles/a/introduction-to-biogeochemical-cycles https://www.khanacademy.org/science/high-school-biology/hs-ecology/hs-biogeochemical-cycles/v/biogeochemical-cycles	

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