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

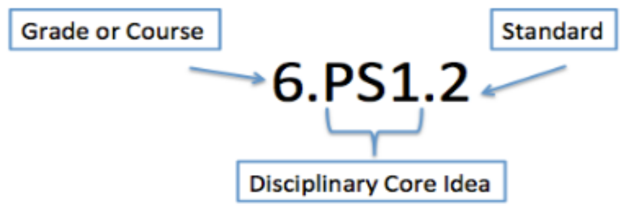
At the end of the elementary science experience, students can observe and measure phenomena using appropriate tools. They are able to organize objects and ideas into broad concepts first by single properties and later by multiple properties. They can create and interpret graphs and models that explain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

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.

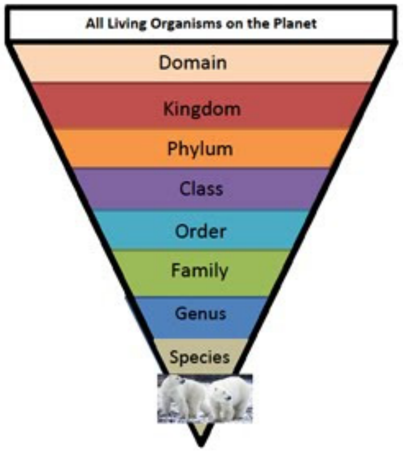
Ecology Quarter 1/Quarter 3 Curriculum Map ***ECOLOGY IS A SEMESTER LONG COURSE*** Quarter 1/3 Curriculum Map Feedback Survey				
Quarter 1/Quarter 3			Quarter 2/Quarter 4	
Unit 1 ECOLOGY OF ORGANISMS	Unit 2 POPULATION ECOLOGY	Unit 3 COMMUNITY ECOLOGY	Unit 4 ECOSYSTEM ECOLOGY	Unit 5 BIOSPHERE ECOLOGY
3 Weeks	3 Weeks	3 Weeks	5 Weeks	4 Weeks
UNIT 1: Ecology of Organisms (3 weeks)				
Overarching Question(s)				
How can there be so many similarities among organisms yet so many different kinds of plants, animals, and microorganisms?				
Unit, Lesson	**Lesson Length**	**Essential Question**	**Vocabulary**	
Unit 1 ECOLOGY OF ORGANISMS	**3 weeks**	• How is natural selection related to the process of evolution? • What determines the survival of individuals in a population? • What are some characteristics of populations?	Environment, Ecology, Organism, Ecological System, Dichotomous, Diversity, Keystone Species, Native Species, Invasive Species, Altruistic Behavior, Kin Selection, Sexual Selection, Sexual Dimorphism, Fixed Action Patterns, Imprinting, Imitation, Habituation, Trial-and-Error, Associative Learning, Classical Conditioning, Operant Conditioning, Kinesis, Taxis, Tropisms	
Standards and Related Background Information		**Instructional Focus**	**Instructional Resources**	
DCI(s) ETS2: Links Among Engineering Technology and Science on Society and the Natural World LS1: From Molecules to Organisms: Structures and Process LS3: Heredity: Inheritance and Variation of Traits **Standard(s)** ECO.ETS2.2 Research and communicate information on a career in ecology. Analyze the role of engineering, technology, and science in that career. ECO.LS4.1 Develop and revise a system for classifying organisms. Justify choice of information (morphology,		**Learning Outcomes** • Illustrate the major characteristics of the six kingdoms. • Use a dichotomous key to identify at least five species found in a local ecosystem. • Distinguish among primary, secondary and tertiary consumers. • Distinguish among herbivores, carnivores, and omnivores. • Distinguish between photosynthesis and chemosynthesis and describe organisms that occupy these niches in both terrestrial and aquatic habitats.	**Curricular Resources** **Engage** Lesson 2.1 • Ready to Go: Systematic Investigation (TE pg. 47) Lesson 3.2 • Brainstorm-Ecosystems (TE pg. 72) Lesson 4.2 • Science Talk-Ecosystem Niches (Te pg. 111) Lesson 4.3 • Brainstorm Changing Organisms (TE pg. 116)	

molecular data, energy acquisition, habitat, niche, trophic level, reproduction, etc.) used in developing your system. ECO.LS4.5 Construct an explanation for the importance of keystone species in ecosystem stability. ECO.LS4.6 Compare resource needs of specialists versus generalists. Construct an explanation regarding the vulnerability of specialists when faced with ecosystem disturbances. ECO.LS4.3 Design and carry out an investigation examining the importance of animal behaviors and plant tropisms for survival. ECO.LS4.7 Research and evaluate the effectiveness of strategies for maintenance of biodiversity. ECO.ESS3.3 Construct an argument in support of protection of native species. Develop responses to anticipated counterarguments. ECO.LS2.20 Plan and carry out an investigation examining kinesis and taxis in a simple organism. Construct and share explanations regarding observations. ECO.LS2.21 Gather information regarding types of learned behaviors (fixed action patterns, imprinting, imitation, habituation, trial-and-error, associative learning – classical conditioning, operant conditioning). Ask questions regarding the importance of these behaviors in species survival. ECO.LS2.22 Construct an explanation for the relationship between sexual selection and sexual dimorphism.	• Investigate animal behavior by observing common invertebrates: termites, isopods, mealworms or Bess beetles. • Using simple materials create a living display of photo-, hydro- and geo-tropisms. • Investigate techniques and findings of the All Taxa Biodiversity Inventories (ATBI) underway in the Great Smoky Mountains National Park and Tennessee State Parks. • Explore careers in conservation biology and bioinformatics. • Create a chart to compare specialist and generalist species and describe environmental conditions that favor these two approaches. **Phenomenon** Surface Tension  There's a simple reason you can't walk on water: Humans are so big that the force of gravity overcomes the so-called surface tension of water, making us sink. But for tiny creatures, surface tension—the force created	**Explore** Lesson 2.1 • Science Talk-Practices of Science (TE pg. 47) Lesson 3.2 • Ready to Go-Aspects of Ecology (TE pg. 72) Lesson 4.2 • Differentiated Instruction-Specialist Species (TE pg. 112) Lesson 4.3 • Science Talk **Explain** Lesson 2.1 • Misconception-Hypothesis or Theory (TE pg. 47) • Quick Hands On-Mathematics Connection (TE pg. 48) • Ready To Go-Engineering Solutions (TE pg. 48) • Brainstorm-Engineering for Efficiency (TE pg. 48) • Brainstorm-Theories and Laws (TE pg. 51) • Science Talk-Bias (TE pg. 51) Lesson 3.2 • Science Talk-Word Roots and Trophic Levels (TE pg. 72) • Science Talk-Ecosystem Interactions (TE pg. 73) • Science Talk-Describe Roles (TE pg. 73)

ECO.LS2.23 Obtain and evaluate information regarding the relationship between altruistic behavior and kin selection.

Misconceptions(s)

1. **Classifying Organisms**



Students tend to classify animals (including mammals) using criteria such as movement, number of legs, body covering, and habitat. These criteria can lead students to classify some animals incorrectly. For example, marine mammals such as whales are often believed to be fish. Some students might believe that only large land mammals are animals.

Students also often form animal groups by different status (organisms that fly, organisms that live in the water) and do not use a hierarchical system of classification. Students may likewise think spiders, centipedes, ticks, mites, and other "creepy crawlies" are insects. These organisms may belong to the same phylum as insects but not the same class.

2. Dangerous Animals

when water molecules cling together—becomes dominant, allowing insects and other small animals to walk effortlessly over ponds and other liquid bodies.
By vigorously rowing along the surface, water striders create swirls that help propel them forward, all without rupturing the water surface. Striders can even take off and land on water without breaking through.

Now imagine you must bury a seed but lack a trowel or even the fingers to dig a hole. Surface tension can solve that problem as well. A few seeds have long projections called awns that coil and uncoil with the changing humidity. The awns of some wild plants effectively self-cultivate by propelling themselves mechanically into soils. During a period of increased humidity during the night, the awns become erect and draw together, and in the process push the grain into the soil. During the daytime the humidity drops, and the awns slacken back again.

- Ready to Go-Construct Food Chains (Te pg. 73)
- Interpret Visuals-Matter on the Move (TE pg. 73)
- Science Talk-Biodiversity and Ecosystem Components (TE pg. 75)
- Ready to Go-Contrast Conditions (TE pg. 75)
- Ready to Go-Local Habitats (TE pg. 75)
- Interpret Visuals-Decomposers in an Ecosystem (TE pg. 76)
- Analogy-A Human Ecosystem (TE pg. 76)
- Interpret Visuals-Make Connections (TE pg. 76)

Lesson 4.2

- Misconceptions-Niche and Habitat (TE pg. 112)
- Interpret Visuals-Niches and Resource Use (TE pg. 112)
- Interpret Visuals-Specialized Niches for Birds (TE pg. 113)
- Science Talk-Nonnative Species (TE pg. 113)
- Analogy-Keystone Species (TE pg. 113)
- Tech it Out-Keystone Species (TE pg. 113)

Lesson 4.3

- Science Talk-Beneficial Mutations (TE pg. 117)
- Quick Hands On-Natural Selection (TE pg. 118)

Elaborate

Ask students to name the most dangerous animal in Africa and list their responses. Most students will likely mention lions or hippos. While the hippo is in fact the most dangerous *mammal* in Africa, the animal that causes the most death is the mosquito. Certain mosquito species spread diseases such as dengue fever and malaria. Malaria kills more than 1 million Africans every year, more than half of who are under the age of five.

Science and Engineering Practice(s)
Developing and Using Models
Analyzing and Interpreting Data
Using Mathematics and Computations Thinking
Engaging in Argument from Evidence

Crosscutting Concepts(s)
Cause and Effect
System and System Models
Stability and Change

Lesson 2.1
- Science Talk-Peer Review (TE. 51)

Lesson 3.2
- Ready to Go-Ecosystems of Interest (TE pg. 78)

Lesson 4.2
- Impact of Policy-Saving Keystone Species (TE pg. 114-115)

Evaluate
Lesson 2.1 (TE pg. 52)
Lesson 3.2 (TE pg. 78)
Lesson 4.2 (TE pg. 115)
Lesson 4.3 (TE pg. 119)

Websites
The Six Kingdoms of Life
Ecology of Organisms and Population
Organismal Biology
Evolution and Ecology
Organisms and The Environment
Animal Behavior Lesson Plans
Studying Animal Behavior
Physical & Behavioral Adaptations of Plants & Animals
Biogeography
Evolution and Ecology
Ecology Lesson Plans
Khan Academy: Animal Behavior

Textbook:
NGL/Cengage *Environmental Science: Sustaining Your World*, G. Tyler Miller and Scott E. Spoolman
- Lesson 2.1 What do Scientist Do? Pgs. 47; Engineering Focus 2.1 pg. 48

		• Lesson 3.2. What Are the Major Ecosystem Components pgs.72-78 • Lesson 4.2. What Roles Do Species Play in Ecosystems? pp 111-115 • Lesson 4.3. How Does Life on Earth Change Overtime? pp. 116- 119 • Chapter 7 - Saving Species and Ecosystem Services pp. 202-235 **Additional Resources:** **ACT & SAT** TN ACT Information & Resources SAT Connections SAT Practice from Khan Academy

Ecology Quarter 1/Quarter 3 Curriculum Map ***ECOLOGY IS A SEMESTER LONG COURSE***				
Quarter 1/Quarter3			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	9 weeks	9 weeks
UNIT 2: Population Ecology (3 weeks)				
Overarching Question(s)				
• How is natural selection related to the process of evolution? • What determines the survival of individuals in a population? • What are some characteristics of populations?				
Unit, Lesson	**Lesson Length**	**Essential Question**	**Vocabulary**	
Unit 2 Population Ecology	**3 Weeks**	• Under what conditions does exponential population growth take place? • What strategies might a government use to limit human population growth?	Age Structure, Range of Tolerance, Limiting Factor, Population Density, Environmental Resistance, Carrying Capacity, Population Crash, R-Selected Species, K-Selected Species, Survivorship Curve, Birth Rate, Death Rate, Population Growth,	

		• What factors increased Earth's carrying capacity for us?	Exponential Growth, Logistic Growth, Immigration, Emigration

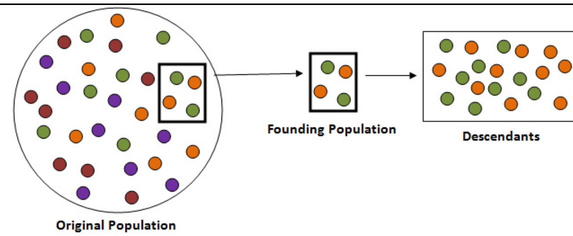
Standards and Related Background Information	Instructional Focus	Instructional Resources
DCI(s) LS2: Ecosystems: Interactions, Energy, and Dynamics LS4L Biological Change: Unity and Diversity **Standard(s)** ECO.LS2.12 Use mathematical models to construct an explanation for population growth patterns, and rates observed in ecosystems. Account for both density-dependent and density-independent factors in your explanation. ECO.LS2.13 Analyze data regarding exponential and logistic population growth patterns. Use the data to create mathematical models to make predictions regarding carrying capacity. ECO.LS2.14 Obtain information regarding survivorship curves and reproductive strategies of various species. Choose one of these strategies and construct an argument regarding its effectiveness. ECO.LS2.11 Obtain information regarding distribution patterns (clumped, uniform, random) and make predictions regarding types of organisms that will exhibit each type. ECO.LS4.2 Construct an argument, citing evidence, supporting the influence of natural selection on changes in populations over time. **Misconceptions** **The Situation is Not Hopeless**	**Learning Outcomes** • Explain population growth patterns and rates. • Define population and describe several examples of populations in different ecosystems. • Identify distribution patterns (random, uniform, clumped with groups random) and populations that exhibit each of these patterns. • Using a population of yeast, duckweed or other suitable species, design and conduct an experiment to evaluate population growth and carrying capacity. • Categorize limiting factors as density dependent or density independent, human influenced, or non-human influenced, and biotic or abiotic when given scenarios. • Evaluate populations based on age structure, distribution, and density. • Draw and/or label population growth curves representing exponential growth, logistic growth and carrying capacity. • Illustrate the type of survivorship curves created by r-strategists and K-strategists. • Research case studies (Tasmanian sheep, St. Matthew's Island reindeer, Isle Royale) to illustrate the consequences of logistic and exponential growth. • Compare case studies of evolution such as Galapagos finches, peppered moths, and salamanders in the Smoky Mountains. **Phenomenon**	**Curricular Resources** **Engage** Lesson 5.3 • Brainstorm-Population Limits (TE pg. 141) Lesson 14.1 • Science Talk-Human Population (TE pg. 465) Lesson 14.2 • Science Talk-Factors that Affect Population Growth (TE pg. 467) Lesson 14.3 • Brainstorm-Urbanization (TE pg. 473) **Explore** Lesson 5.3 • Arts in Science-Range of Tolerance (TE pg. 141) Lesson 14.2 • Misconception-Distribution of Men and Women Worldwide (TE pg. 467) • Differentiated Instruction-Statistics (TE pg. 467) • Differentiated Instruction-Factors That Affect Birth and Fertility (TE pg. 468) • Science Talk-Factors that Affect Death Rates 9TE pg. 468) • Tech it Out-Population Simulator (TE pg. 469)

In 1798, Thomas Robert Malthus wrote that any human population, when unchecked, doubles in a certain unit of time, and then keeps on doubling in the same unit of time. For example, according to his statistics, in the US, the population was found to double itself in 25 years.

The fact is that hardly any human populations keep doubling in the same
unit of time for very long. Two thousand years ago, there were about 250 million people on the planet. It took about 1,650 years for the population to double to 500 million. But the next doubling took less than 200 years--by 1830 Earth's human population had passed 1 billion. After that the doubling time continued to shrink: just another 100 years to reach 2 billion, then only 45 years more to get to 4 billion. Never the twentieth century had any human being lived through a doubling of Earth's population.

But things have begun to change. In 1965 the global population growth rate peaked at around 2 percent per year (a rate sufficient to double the global population in 35 years, if it were sustained) and then began to fall. It has now dropped to 1.5 percent per year, which yields a doubling time of 46 years. For the first time in human history, the population growth slowed, despite a continuing drop in death rates, because people were having fewer children. The myth of exponential growth misses this human triumph.

Population Size, Growth Rate, and Density
Students may confuse the concepts of population size, population growth rates, and population density. Remind students that large populations - as well as small ones - may have a high growth rate, a low growth rate, or a zero-growth rate. The growth rate is not necessarily dependent on the size of the population unless the population has reached the carrying capacity of the environment. Population density is measured over a defined area.



There is a small population effect known as "Founder Principle" or "Founder Effect". This occurs when a small amount of people has many descendants surviving after several generations. The result for a population is often high frequencies of specific genetic traits inherited from the few common ancestors who first had them.

In the Lake Maracaibo region of northwest Venezuela, for instance, there is an extraordinarily high frequency of a severe genetically inherited degenerative nerve disorder known as **Huntington's disease**. Approximately 150 people in the area during the 1990's had this rare fatal condition. This disease usually does not strike until early middle age, after most people have had their children. There is no cure for this disease, but there has been a test for its genetic marker available since 1993. All the Lake Maracaibo region Huntington's disease victims trace their ancestry to a woman named Maria Concepción Soto who moved into the area in the 19th century. She had an unusually large number of descendants and was therefore the "founder" of what is now a population of about 20,000 people with a high risk of having this unpleasant genetically inherited trait.

- Science Talk-Generations in the United States (TE pg. 469)

Lesson 14.3
- Interpret Visuals-Urban Settings (TE pg. 473)

<u>Explain</u>
Lesson 5.3
- Ready to Go-Population Density (TE pg. 142)
- Science Talk-Limiting Factors and Megafish (TE pg. 143)
- Tech it Out-Mathematics Connection (TE pg. 143)
- Interpret Visuals-Population Growth Patterns (TE pg. 143)
- Differentiated Instruction-Population Crash (TE pg. 145)
- Interpret Visuals-K-selected Species (TE pg. 146)

Lesson 14.1
- Science Talk-Recent Trends in the Human Population (TE pg. 465)

Lesson 14.2
- Science Talk-Population Decline (TE pg. 470)

Lesson 14.3
- Differentiated Instruction-Urbanization (TE pg. 473)
- Differentiated Instruction-Advantages and Disadvantages of Urbanization 9TE pg. 474)
- Ready to Go-Pollution and Human Health (TE pg. 475)

Science and Engineering Practice Developing and using models Analyzing and Interpreting Data Using mathematics and computational thinking Constructing Explanations and Designing Solutions Engaging in argument from evidence Obtaining, evaluating, and communicating information **Crosscutting Concepts** Structure and Function Scale, Proportion, and Quantity System and System Models Stability and Change		• Tech it Out-Reducing Noise Pollution (TE pg. 475) • Science Talk-Slums (TE pg. 477) Elaborate Lesson 5.3 • Ready to Go-Reindeer of St. Matthew (TE pg. 146) • Arts in Science-Limiting Factors to Human Population (TE pg. 147) Lesson 14.2 • Ready to Go-China's Population (TE pg. 470) Lesson 14.3 • Science Talk-Urban Planning (TE pg. 478) Evaluate Lesson 5.3 (TE pg. 147) Lesson 14.1 (TE pg. 466) Lesson 14.2 (TE pg. 472) Lesson 14.3 (TE pg. 478) **Websites:** World in The Balance Population Ecology Random Sampling: How Many Fish? Random Sampling and Estimation: Lake Victoria Human Numbers Through Time Be A Demographer Earth in Peril Humanity from Space Video The Texas Mosquito Mystery The Peopling of Our Planet A Demographically Divided World The Human-Made Landscape

		Population Education Resources Population Lesson Plans The Human Population and The Environment Ecology Lesson Plans Interpreting Ecological Data **Textbook:** NGL/Cengage *Environmental Science: Sustaining Your World*, G. Tyler Miller and Scott E. Spoolman • Section 5.3 What Limits the Growth of Populations? pp. 141-148 • Chapter 14. Human Population and Urbanization pp. 460-487 **Additional Resources:** **ACT & SAT** TN ACT Information & Resources SAT Connections SAT Practice from Khan Academy

Ecology Quarter 1/Quarter 3 Curriculum Map ***ECOLOGY IS A SEMESTER LONG COURSE***				
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 3: Community Ecology (3 weeks)				
Overarching Question(s)				
• How and why do organisms interact with their environment and what are the effects of these interactions? • How can there be so many similarities among organisms yet so many different kinds of plants, animals, and microorganisms? • How does biodiversity affect humans?				
Unit, Lesson	**Lesson Length**	**Essential Question(s)**	**Vocabulary**	

Unit 3 **Community Ecology**	**5 weeks**	• How do unfavorable abiotic and biotic factors affect species? • How do ranges of tolerance affect the distribution of organisms? • What are the stages of primary and secondary succession? • How does competition affect population density?	Community, Interspecific Competition, Resource Partitioning, Predation, Coevolution, Parasitism, Mutualism, Commensalism, Prey, Predator, Niche, Climax Community

Standards and Related Background Information	**Instructional Focus**	**Instructional Resources**
DCI(s) LS2: Ecosystems: Interactions, Energy, and Dynamics LS4L Biological Change: Unity and Diversity **Standard(s)** ECO.LS2.3 Create a model of an ecosystem depicting the interrelationships among organisms with a variety of niches. Use the model to explain resource needs of these organisms. ECO.LS2.6 Compare pyramids of energy, numbers, and biomass to calculate rates of productivity within food chains and food webs among various biomes. Using mathematics, explain the relationship between biomass and trophic levels. ECO.LS2.15 Compare types of competition and construct an explanation for the importance of niche differentiation in response to competition. ECO.LS2.16 Use a mathematical model to examine predator-prey interactions. Based on the model, construct an argument regarding the importance of predators in maintaining stability of prey populations.	**Learning Outcomes** • Describe the difference between a fundamental niche and a realized niche. • Distinguish among the following roles and cite Tennessee examples of each: native species, non-native species, invasive species, indicator species, and "keystone" species. • Discuss how competition and predation regulate population size. • Summarize the principles of competitive exclusion and resource partitioning. • Distinguish among the three forms of symbiotic relationships. • Describe structural and behavioral adaptations for survival used by predators and prey. • Explain energy pyramids and the "Rule of 10" as they relate to the	**Curricular Resources** **Engage** Lesson 3.3 • Science Talk-Energy Flow (TE pg. 79) Lesson 5.1 • Ready to Go-Interspecies Relationship (TE pg. 133) **Explore** Lesson 3.3 • Science Talk-Limiting Factors (TE pg. 79) Lesson 5.1 • Science Talk-Factors Influencing Evolution (TE pg. 133) **Explain** Lesson 3.3 • Quick Hands On-Food Webs (TE pg. 79) • ELL-Food Webs (TE pg. 80) Lesson 5.1 • Interpret Visuals-Resource Partitioning (TE pg. 133) • ELL-Avoiding Predators (TE pg. 134)

ECO.LS2.17 Based on information obtained from research, construct explanations regarding mechanisms by which prey protect themselves from predation (including herbivory).

ECO.LS2.18 Use models to explain the impacts of types of symbiosis on the species involved in the relationship.

ECO.LS4.4 Engage in argument from evidence regarding the importance of coevolution in species interactions (competition, predation, symbiosis).

Explanation

An ecological community is a group of or potentially interacting species living in the same location. Communities are bound together by a shared environment and a network of influence each species has on the other.

Community ecology is an expanding and rich subfield of ecology. Ecologists investigate the factors that influence biodiversity, community structure, and the distribution and abundance of species. These factors include interactions with the abiotic world and the diverse array of interactions that occur between species. Species interactions, including competition, predation, herbivory, parasitism and mutualisms, are the basic for most of the research in community ecology. Questions of interest include: What are the feeding relationships among species? Who competes with whom and for what resources? Does the presence of some species benefit others?

Food webs are a graphical depiction of the interconnections among species based on feeding relationships and are a

first and second laws of thermodynamics.
- Create a food web characteristic of a Tennessee ecoregion composed of at least four trophic levels.

Phenomenon

Some color mimicry is called **Cryptic Coloration**. The lizards and butterfly almost disappear into the background. Cryptic means "secret" or "hidden," and many animals use cryptic color and patterns to hide. Chameleons and treefrogs are very good at disappearing. The Katydid easily disappears among leaves. Many animals use camouflage, spots and stripes, to blend into their habitat.

- Misconception-Survival Strategies (TE pg. 134)
- Differentiated Instruction-Making Analogies (TE pg. 135)

Elaborate

Lesson 3.3
- Tech it Out-Create an Ecosystem Video Game (TE pg. 80)

Lesson 5.1
- Science Talk-Adaptation (TE pg. 135)

Evaluate

Lesson 3.3 (TE pg. 81)
Lesson 5.1 (TE pg. 137)

Websites:

World in The Balance
Biological Communities Lesson Plans
Ecology Lesson Plans
Global Sustainability Lesson Plans
Predator-Prey Simulation
Building an Energy Pyramid
Flow Of Energy Through Trophic Levels
Energy And Biomass Pyramids
Community Ecology
Community Ecology 2

Textbook

NGL/Cengage *Environmental Science: Sustaining Your World*, G. Tyler Miller and Scott E. Spoolman
- Section 3.3. What Happens to Energy in An Ecosystem pgs.79-81

core concept of the field. The role of keystone species in communities is another important tenet, and one of the best-known ideas in community ecology. Keystone species are those whose presence or absence profoundly affects other species in the community, disproportionately to its abundance. Community ecologists not only study the structure of communities but also change in that structure. What do volcanoes; glaciers, sand dunes, storms, agriculture, and fire have in common? They all initiate the process of change in communities. **<u>Explanation</u>** An ecological community is a group of or potentially interacting species living in the same location. Communities are bound together by a shared environment and a network of influence each species has on the other. Community ecology is an expanding and rich subfield of ecology. Ecologists investigate the factors that influence biodiversity, community structure, and the distribution and abundance of species. These factors include interactions with the abiotic world and the diverse array of interactions that occur between species. Species interactions, including competition, predation, herbivory, parasitism and mutualisms, are the basic for most of the research in community ecology. Questions of interest include: What are the feeding relationships among species? Who competes with whom and for what resources? Does the presence of some species benefit others? Food webs are a graphical depiction of the interconnections among species based on feeding relationships and are a	Plants use mimicry too, not just animals. Orchid mimicry is of both form and chemistry. Many orchids mimic the shapes of certain flying insect females, and at the same time mimic the lure of her mating scent, so the bewildered male arrives and "mates with the orchid flower that looks and smells just right, and in the process pollinates the flower.  Many kinds of animals will play dead if they see no escape. The classic folk name for this is "playing possum." Nestling birds and just-fledged birds will play dead for predators. It confuses them. Predators' attack sequences depend on movement.	• Section 5.1. How Do Species Interact pgs. 133-136 **<u>Additional Resources</u>** **ACT & SAT** TN ACT Information & Resources SAT Connections SAT Practice from Khan Academy

core concept of the field. The role of keystone species in communities is another important tenet, and one of the best-known ideas in community ecology. Keystone species are those whose presence or absence profoundly affects other species in the community, disproportionately to its abundance. **<u>Misconceptions</u>** Not all species compete for the same resources in an ecosystem. Some species actually work together in ways that benefit both species. Organisms can have mutualistic or commensal relationships, which help them maximize their use of limited resources. **<u>Science & Engineering Practices</u>** 2. Developing and using models 5. Using mathematics and computational thinking 7. Engaging in argument from evidence 8. Obtaining, evaluating, and communicating information **<u>Cross Cutting Concepts</u>** 2. Cause and Effect 4.System and System Models 7. Stability and Change		

Curriculum and Instruction- Science			
RESOURCE TOOLKIT			
Quarter 1		Ecology	
Textbook Resources: NGL/Cengage *Environmental Science: Sustaining Your World*, G. Tyler Miller and Scott E. Spoolman Section 3.2. What Are the Major Ecosystem Components pp. 72-78 Section 4.2. What Roles Do Species Play in Ecosystems? pp 111-115 Section 4.3. How Does Life on Earth Change Overtime? pp. 116- 119 Chapter 7 - Saving Species and Ecosystem Services pp. 202-235 Section 5.3 What Limits the Growth of Populations? pp. 141-148 Chapter 14. Human Population and Urbanization pp. 460-487	**DCIs and Standards** **DCI(s)** ETS2: Links Among Engineering Technology and Science on Society and the Natural World LS1: From Molecules to Organisms: Structures and Process LS3: Heredity: Inheritance and Variation of Traits **Standard(s)** ECO.ETS2.2 ECO.LS4.1 ECO.LS4.5 ECO.LS4.6 ECO.LS4.3 ECO.LS4.7 ECO.ESS3.3 ECO.LS2.20 ECO.LS2.21 ECO.LS2.22 ECO.LS2.23 ECO.LS2.12 ECO.LS2.13 ECO.LS2.14 ECO.LS2.11 ECO.LS4.2 ECO.LS2.3 ECO.LS2.6	**Videos and Websites:** Khan Academy Illuminations (NCTM) Discovery Education The Futures Channel The Teaching Channel Teachertube.com **Websites:** The Six Kingdoms of Life Ecology of Organisms and Population Organismal Biology Evolution and Ecology Organisms and The Environment Animal Behavior Lesson Plans Studying Animal Behavior Physical & Behavioral Adaptations of Plants & Animals Biogeography Evolution and Ecology Ecology Lesson Plans World in The Balance Population Ecology Random Sampling: How Many Fish? Random Sampling and Estimation: Lake Victoria Human Numbers Through Time Be A Demographer Earth in Peril	**Additional Resources:** ACT & SAT TN ACT Information & Resources ACT College & Career Readiness Mathematics Standards SAT Connections SAT Practice from Khan Academy

Section 3.3. What Happens to Energy in An Ecosystem pp. 79-81 Section 5.1. How Do Species Interact pp. 133-136	ECO.LS2.15 ECO.LS2.16 ECO.LS2.17 ECO.LS2.18 ECO.LS4.4	Humanity from Space Video The Texas Mosquito Mystery The Peopling of Our Planet A Demographically Divided World The Human-Made Landscape Population Education Resources Population Lesson Plans The Human Population and The Environment Ecology Lesson Plans Interpreting Ecological Data World in The Balance Biological Communities Lesson Plans Ecology Lesson Plans Global Sustainability Lesson Plans Predator-Prey Simulation Building an Energy Pyramid Flow Of Energy Through Trophic Levels Energy And Biomass Pyramids Community Ecology Community Ecology 2	