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 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.

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Biology Quarter 2 Curriculum Map Curriculum Map Feedback				
Quarter 1	**Quarter 2**	Quarter 3	Quarter 4	
Unit 1 Cellular Structures & Energy Processes	**Unit 2** **Cell Division** **&** **Reproduction**	Unit 3 Genetics	Unit 4 Evolution	Unit 5 Ecology
9 weeks	**9 Weeks**	9 Weeks	3 Weeks	6 Weeks

Unit 2: Cell Division & Reproduction [9 Weeks]

Overarching Question(s)

How do the structures of organisms enable life's functions?
How do organisms grow and develop?

Unit, Lesson	Lesson Length	Essential Question(s)	Vocabulary
Unit 2 **Cell Division** **&** **Reproduction**	**1 Week**	• What is the basic structure and function of DNA and how do genes and chromosomes relate to their function? • How does DNA define a human individual?	DNA, helix, base pairing

Standards and Related Background Information	Instructional Focus	Instructional Resources
DCI BIO1.LS1: From Molecules to Organisms: Structures and Processes **Standard** BIO1.LS1.3 **Integrate evidence to develop a structural model of a DNA molecule**. Using the model, develop and communicate an explanation for how DNA serves as a template for self-replication and encodes biological information. **emphasis only on the structural model of DNA. The replication portion of this standard will be covered during the Heredity unit.* **Explanation(s) from Updated TN Science Reference Guide**	**Learning Outcomes (*Possible Objectives)*** • Identify the chemical components of DNA. • Describe the clues that helped scientists determine the structure of DNA. • Explain what the double-helix model shows about DNA. **Suggested Phenomenon**  The Case for Junk DNA GENOMES ARE LIKE books of life. But until recently, their covers were locked. Finally we can now open the books and page through them. But	**Curricular Resources** **Textbook** *Miller & Levine TN Biology* Chapter 13: DNA • Lesson 13.2: The Structure of DNA; TE/SE pgs. 418-423 **Engage** Lesson Plan Overview; TE pg. 418 Class Discussions • Shared Structure of DNA; TE pg. 418 Teacher Demo; TE pg. 421 **Explore** Analyzing Data: Chargaff's Rule; TE/SE pg. 419 Interactivity: DNA Structure

In 5th grade, students first encounter the idea of traits, but limit examples primarily to traits with observable manifestations. The concept of a gene is introduced in 7.LS3.1 with a vague inference to the central dogma, but explicitly noting that genes are located in chromosomes and that these genes control the phenotypes of organisms. Biology 1 is the first time where students will specifically discuss that chromosomes are made of DNA, that genes are sequences of DNA, and the structure of a single nucleotide or strand of DNA. Each daughter cell that arises out of the process of mitosis contains an identical copy (not accounting for mutations) of the original cell's genetic information. This is only possible if the genetic information of the original cell is doubled prior to division. The chemical properties of a DNA molecule permit self-replication. Structural models can include regions contained in a strand of DNA, the chemical components of the DNA molecule (sugar, phosphate, nitrogenous base), and the relative strengths of bonds connecting these components. Enrichment can include more detailed discussions of the reactions (e.g. condensation reactions) leading to more specific classifications of bond types, but such discussions are beyond the scope of the standard. For any student, the purpose of communicating the bond strength is to connect to the process of DNA replication. Once compiled, student models should be used to investigate process of DNA replication and phenomena such as gene mutations that may arise during the replication of DNA. For example, students should note that the relatively small strength of the	we only have a modest understanding of what we're actually seeing. We are still not sure how much our genome encodes information that is important to our survival, and how much is just garbled padding. Today is a good day to dip into the debate over what the genome is made of, thanks to the publication of an interesting commentary from Alex Palazzo and Ryan Gregory in *PLOS Genetics*. It's called "The Case for Junk DNA." **Suggested Performance Task(s)** **Case Study: Living Things don't carry ID cards, or do they?** TE/SE pgs. 410-411 Students conduct research on the use of DNA barcodes. Using multiple resources, students research some of the problems in identifying organisms and develop possible solutions for these problems using DNA barcoding.	**Explain** Video: HHMI: The Double Helix Part 1 Video: HHMI: The Double Helix Part 2 Video: HHMI: The Double Helix Part 3 Video: The Double Helix Film Guide/Quiz Interactive Video: Analyzing DNA Structure **Elaborate** Study: DNA Folding Patterns Revealed Discovery of DNA Structure and Function: Watson and Crick *The landmark ideas of Watson and Crick relied heavily on the work of other scientists. What did they duo actually discover? The Structure of DNA: Cooperation and competition *A case study that highlights the following aspects of the nature of science: • Science can test hypotheses about things that are too small for us to observe directly. • Science relies on communication within a diverse scientific community. • scientists are expected to give credit where credit is due. • Scientific discoveries lead to ongoing research. **Evaluate** Lesson 13.2 Quiz Assess on the Spot; TE pg. 420 Demonstrate; TE pg. 423 Lesson 13.2 Review; TE pg. 423 **Additional Resources** New Vision for Public School 5E Plan-DNA Structure

bonds between nitrogenous bases makes it possible for the double stranded DNA molecule to be separated, permitting replication along each single strand. Students should address interactions between genes and proteins that regulate both the shape and reproduction of DNA molecules. It is important to note that not all segments of DNA are transcribed for proteins. Portions of DNA are involved in regulating the expression of genes or affect the structure of the chromosomes (replication origin, centromeres, and telomeres). **<u>Misconceptions</u>** Many students confuse the structure of DNA in these ways: • DNA is a living thing. • Different cells within an organism have different DNA. • Only animal cells have DNA. • DNA is rarely single stranded, while RNA is regularly single stranded. • DNA has thymine, but RNA has uracil. • DNA is found as a double helix, while RNA forms structures from base pairing within the RNA molecule. **<u>Suggested Science and Engineering Practice</u>** **Constructing explanations and designing solutions** *Students form explanations that incorporate sources (including models, peer reviewed publications, their own investigations), invoke scientific theories, and can evaluate the degree to which data and evidence support a given conclusion.*		

<u>Suggested Cross Cutting Concept</u> **Pattern** *Students recognize, classify, and record patterns in quantitative data from empirical research and mathematical representations.*		

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<tr><td colspan="4">Unit 2: Cell Division & Reproduction [9 Weeks]</td></tr>
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<tr><td>Unit, Lesson</td><td>Lesson Length</td><td>Essential Question(s)</td><td>Vocabulary</td></tr>
<tr><td>Unit 2
Cell Division
&
Reproduction</td><td>3 Weeks</td><td>• How do different cell types divide accurately?
• How is cell division controlled?
• How does cell division provide evidence of the relatedness of living things in the world?
• How do differences between and among cell division correlate to specific functions and how is this evidence that living things are uniquely adapted to their environment?</td><td>Cell division, asexual reproduction, sexual reproduction, chromosome, chromatin, cell cycle, interphase mitosis, cytokinesis, prophase, chromatid, centromere, centriole, metaphase, anaphase, telophase, growth factor, cyclin, apoptosis, cancer, tumor, embryo, differentiation, stem cell</td></tr>
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DCI(s)

BIO1.LS1: From Molecules to Organisms: Structures and Processes

BIO1.ETS2: Links Among Engineering, Technology, Science and Society

Standard(s)

BIO1.LS1.6 Create a model for the major events of the eukaryotic cell cycle, including mitosis. Compare and contrast the rates of cell division in various eukaryotic cell types in multicellular organisms.

BIO1.ETS2.3 Analyze scientific and ethical arguments to support the pros and cons of application of a specific biotechnology technique such as stem cell usage, in vitro fertilization, or genetically modified organisms.

Explanation(s) from Updated TN Science Reference Guide

LS1.6: Students should already be familiar with the basic purpose and events of mitosis because of 7.LS1.9 and 7.LS3.2. Those standards emphasize the pattern of events and outcomes of mitosis and comparing and contrasting the cells/gametes that arise from those processes.

Students should address the fundamental question of why mitosis occurs before attempting to retrieve their memories regarding the specific events of mitosis. In seventh grade, it was sufficient to note that mitosis must occur because organisms grow by making more cells. This introductory questioning expands in high school to address an additional question: Why does cell growth also mean that cells

Learning Outcomes

- Describe some of the difficulties a cell faces as it increases in size.
- Describe what happens during the phases of mitosis.
- Investigate how daughter cells split apart after mitosis.
- Compare cancer cells with other cells.
- investigate how the cell cycle is regulated.
- Investigate how cells become specialized for different functions.
- Explain what stem cells are.
- Evaluate some possible benefits and issues associate with stem cell research.

Suggested Phenomenon: Cancer

Cancer, many biologists argue, is an evolutionary disease. It is a burden of being multicellular, and a threat against which natural selection has only managed mediocre defenses. Making matters worse, cancer cells can borrow highly evolved genes for their own deadly purposes. And even within a single tumor, cancer cells get nastier through natural selection.

Suggested Performance Task(s)

Case Study: Role of p53 in the Cell Cycle

In this study, researchers investigated the role of p53 in cell cycle regulation. Students will analyze and interpret data in order to construct an

Curricular Resources

Textbook Materials

Miller & Levine TN Biology

Chapter 11: Cell Growth & Division

- Lesson 11.1: Cell Growth, Division, and Reproduction; TE/SE pgs. 338-342
- Lesson 11.2: The Process of Cell Division; TE/SE pgs. 343-349
- Lesson 11.3: Regulating the Cell Cycle; TE/SE pgs. 350-354
- Lesson 11.4: Cell Differentiation; TE/SE pgs. 355-361

Engage

Inquiry Warm Up: What Limits the Sizes of Cells?
Lesson Plan Overview; TE pg. 338, 343
The Cell Cycle and its Regulation
Class Discussions

- The Cell Cycle
- Knowing When to Stop

Video: Lab Grown Meat

Explore

Interactivity Limits to Cell Size
Quick Lab: Make a Model of Mitosis; TE/SE pg. 347
Cell Cycle: Do Plant and Animal Cells Spend the Same Proportion of Time in Each Stage of the Cell Cycle?
Interactivity: Exploring Mitosis
Analyzing Data: The Rise and Fall of Cyclin, pg. 352
Science Skills Activity: Investigating Cell Regulation
Controls on Cell Division; TE pg. 351
Normal and Abnormal Cell Division: Which of These Patients Could Have Cancer?
Interactivity: Regulating Cell Growth
The Eukaryotic Cell Cycle and Cancer
Cancer: Uncontrolled Cell Growth; TE pg. 353

must divide? Investigations with potato cubes or gelatin infused with phenolphthalein can serve as cell models to explore limitations on cellular transport. These discussions are also an opportunity to connect to Bio1.LS1.7. Students should explore the requirements for cellular division and the events occurring during interphase that fulfill material requirements for cellular division. This may create an opportunity to bundle with Bio1.LS1.7. Students should generally recognize that expression of different genes leads to differentiation of cell types but are not responsible for understanding the mechanisms that affect gene regulation. Discussions should also include varying rates of mitotic division and the relationship between these rates of division and the function of specific cell types within eukaryotic organisms. Examples may include the extremely limited use of mitosis by neurons due to their interconnectedness within neural networks or the rapid rates of mitosis with growing root tips. Models of the eukaryotic cycle in biology 1 should also account for the relative amounts of time a cell spends in the different portions of the cycle. Students should understand that it is possible to account for the relative amounts of time in each stage by observing a collection of cells (e.g., the tip of an onion root) and counting the relative number of cells in each phase of the process. These relative proportions of cells translate to relative durations for each part of the process.	explanation on the role of the p53 protein and what effect is has on cell division. Case Study: Cure for Cancer Case Study Stem Cells – Will stem cells change the future of healing? pgs. 336-337. Students evaluate arguments for and against the use of reprogrammed differentiated cells to treat health problems. Based on the evidence gathered, students will construct an argument on where the technology should be used.	Exploration Lab: Regeneration in Planaria; TE/SE pg. 357 Interactivity: Cell Differentiation Interactive Video: Growing New Limbs **Explain** Differentiation and the Fate of Cells Growing New Limbs Career: Science Journalist Crash Course: Mitosis Simulation: Exploring The Cell Cycle The Eukaryotic Cell Cycle and Cancer **Elaborate** Carry-On Luggage Extra Centrosomes Can Drive Tumor Formation in Mice PBL Interactivity: Optimizing Algal Growth **Evaluate** Assess on the Spot; TE pg. 341, 349, 351, 360 Lesson 11.1 Cell Growth, Division, and Reproduction Quiz Lesson 11.1 Review; TE/SE pg. 342 Demonstrate; TE pgs. 342, 348, 354 Lesson 11.2 Review; TE/SE pg. 348 Lesson 11.2 The Process of Cell Division Quiz Lesson 11.3 Regulating the Cell Cycle Quiz Lesson 11.3 Review; TE/SE pg. 354 Lesson 11.4 Cell Differentiation Quiz Lesson 11.4 Review; TE/SE pg. 361 Chapter 11 Assessment; TE/SE pgs. 368-369 **Additional Resources** Biology Foundations: Chapter 11

BIO.ETS2.3 The utilization of new technologies in any field of science is dependent on both economic and social factors. In addition to evaluating these factors, scientists must also consider long-term consequences that may not be initially apparent. The emphasis should be on the construction of a rationale argument that supports a position on the use of an application with ethical and social impact. Students should begin to appreciate the differences in ethical values that exist and recognize that discussion of these values is imperative as knowledge and technology continue to advance, even when resolutions of differences can be rare. After investigation of a specific biotechnology application, students can write a position paper and/or participate in a classroom debate. **<u>Misconceptions</u>** • Interphases is the resting phase of mitosis • DNA replication occurs in prophase during the process of cell division. • The chromosome number is doubled in the prophase of mitosis and halved in the anaphase of mitosis. • Chromosomes and chromatids are essentially the same thing. • Organelles, such as mitochondria and chloroplasts, dissolve and vanish during cell division and then are reformed. • Apoptosis is programmed cell death and that it is important for the health of an organisms and not necessarily a sign of disease. • Cancer is a defined disease, not a group of related diseases		

• Cancer can be caused by a single gene mutation • Having cancer genes means you are going to get cancer • Stem Cells are not found in adults **<u>Suggested Science and Engineering Practice</u>** **Developing and using models** *Students, from a given model, identify and describe the components of the model relevant for illustrating the role of mitosis and differentiation in producing and maintaining complex organisms.* **<u>Suggested Cross Cutting Concepts</u>** **Energy and Matter** *Students demonstrate and explain conservation of mass and energy in systems including systems with inputs and outputs.*		

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<tr><td>Unit 2
Cell Division
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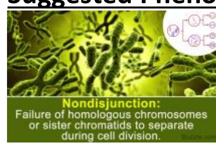
Reproduction</td><td>2 Weeks</td><td>• What processes are responsible for life’s unity and diversity?
• How is genetic information carried from one organism to its offspring?</td><td>Meiosis, homologous, diploid, haploid, tetrad, crossing over</td></tr>
</table>

Standards and Related Background Information	Instructional Focus	Instructional Resources
DCI(s) BIO1.LS3: Heredity **Standard(s)** BIO1.LS3.1 Model chromosome progression through meiosis and fertilization in order to argue how the processes of sexual reproduction lead to both genetic similarities and variation in diploid organisms. Compare and contrast the processes of sexual and asexual reproduction, identifying the advantages and disadvantages of each. **without the introduction of karyotyping, which will be addressed later in this unit.* **Explanation(s) from Updated TN Science Reference Guide** In 5th grade, students first encounter the idea of traits, but limit examples primarily to traits with observable manifestations. The concept of a gene is introduced in 7.LS3.1 with a vague inference to the central dogma, but explicitly noting that genes are located in chromosomes and that these genes control the phenotypes of organisms. Biology 1 is the first time where students will specifically discuss that chromosomes are made of DNA, that genes are sequences of DNA, and the structure of a single nucleotide or strand of DNA. Each daughter cell that arises out of the process of mitosis contains an identical copy (not accounting for mutations) of the original cell's genetic information. This is only possible if the genetic information of the original cell is doubled prior to division. The chemical properties of a DNA molecule permit self-replication.	**Learning Outcomes** • Identify how many sets of genes are found in most adult organisms. • Describe the vents that occur during each phase of meiosis. • Identify the differences between meiosis and mitosis. • Explain how two alleles from different genes can be inherited together. • What are the effects of errors in meiosis? **Suggested Phenomenon**  What is Nondisjunction and What are its Effects? Calvin Bridges and Thomas Hunt Morgan discovered the process of nondisjunction in dividing cells in the year 1910. This is one of the most common forms of chromosomal aberrations that occurs in humans. **Suggested Performance Task** Meiosis: How Does the Process of Meiosis Reduce the Number of Chromosomes in Reproductive Cells? Students develop an explanatory model based on their knowledge of mitosis and how cells divide. With the model, student should be able to explain what happens to the chromosomes inside a cell as it goes through meiosis, why reproductive cells	**Curricular Resources** **Textbook Materials** *Miller & Levine TN Biology* Chapter 11 Cell Growth and Division • Lesson 11.1: Cell Growth, Division, and Reproduction; pg. 340-342 Chapter 12 Introduction to Genetics • Lesson 12.4: Meiosis, pgs. 393-399 Chapter 15 The Human Genome • Lesson 15.2: Human Genetic Disorders, pgs. 480-481 **Engage** Class Discussion: • How Many Chromosomes? Chromosome Number; TE pg. 394 Inquiry Warm-Up Lab: Chromosome Disorders **Explore** Modeling Lab: A Model of Meiosis; TE/SE pg. 396 **Explain** Mitosis vs. Meiosis: Side by Side Comparison Crash Course: Meiosis: Where the Sex Starts Interactive Video: Morgan and Sturtevant Interactivity: The Process of Meiosis HHMI Biointeractive Video: Meiosis Phases of Meiosis; TE pg. 394 Comparing Meiosis and Mitosis; TE pg. 396 Chromosomal Disorders; TE pg. 481 **Elaborate** Gene Linkage and Gene Maps; TE pgs. 398-399

Structural models can include regions contained in a strand of DNA, the chemical components of the DNA molecule (sugar, phosphate, nitrogenous base), and the relative strengths of bonds connecting these components. Enrichment can include more detailed discussions of the reactions (e.g. condensation reactions) leading to more specific classifications of bond types, but such discussions are beyond the scope of the standard. For any student, the purpose of communicating the bond strength is to connect to the process of DNA replication. Once compiled, student models should be used to investigate process of DNA replication and phenomena such as gene mutations that may arise during the replication of DNA. For example, students should note that the relatively small strength of the bonds between nitrogenous bases makes it possible for the double stranded DNA molecule to be separated, permitting replication along each single strand. Students should address interactions between genes and proteins that regulate both the shape and reproduction of DNA molecules. It is important to note that not all segments of DNA are transcribed for proteins. Portions of DNA are involved in regulating the expression of genes or affect the structure of the chromosomes (replication origin, centromeres, and telomeres). **Misconceptions** • Meiosis occurs in all cells. • Meiosis ends in zygote formation.	have half the number of chromosomes of the individuals who produce them, and why there are no pairs of chromosomes in reproductive cells. Students prepare a whiteboard presentation that includes the guiding question, claim, evidence, and justification of evidence and present it to the whole-class using a round-robin format.	**Evaluate** Lesson 12.4 Quiz Assess on the Spot, pg. 395, 481 Lesson 12.4 Review; TE/SE pg. 399 **Additional Resources** **B**iology Foundations: Chapter 12

• Only mammalian life cycles contain meiosis, mitosis and fertilization. **<u>Suggested Science and Engineering Practice</u>** **Constructing explanations and designing solutions** *Students form explanations that incorporate sources (including models, peer reviewed publications, their own investigations), invoke scientific theories, and can evaluate the degree to which data and evidence support a given conclusion.* **<u>Suggested Cross Cutting Concepts</u>** Patterns *Students recognize, classify, and record patterns in quantitative data from empirical research and mathematical representations.*		

Biology Quarter 2 Curriculum Map Curriculum Map Feedback				
Quarter 1	**Quarter 2**	Quarter 3	Quarter 4	
Unit 1 Cellular Structures & Energy Processes	**Unit 2** **Cell Division** **&** **Reproduction**	Unit 3 Genetics	Unit 4 Evolution	Unit 5 Ecology
9 weeks	**9 Weeks**	9 Weeks	3 Weeks	6 Weeks
Unit 2: Cell Division & Reproduction [9 Weeks]				
Overarching Question(s)				
How do the structures of organisms enable life's functions?				

Unit, Lesson	**Lesson Length**	**Essential Question(s)**	**Vocabulary**
Unit 2 **Cell Division** **&** **Reproduction**	**3 Weeks**	• How is the heredity information in genes inherited and expressed? • How does DNA control growth and function of cells?	Transformation, bacteriophage, base pairing, replication, DNA polymerase, telomere, replication fork, RNA, messenger RNA, ribosomal RNA, transfer RNA, transcription, RNA polymerase, promoter, intron, exon
Standards and Related Background Information		**Instructional Focus**	**Instructional Resources**

DCI
BIO1.LS1: From Molecules to Organisms: Structures and Processes

Standard
BIO1.LS1.3 Integrate evidence to develop a structural model of a DNA molecule. **Using the model, develop and communicate an explanation for how DNA serves as a template for self-replication and encodes biological information.**
**with emphasis on the replication portion of this standard.*

Explanation(s) from Updated TN Science Reference Guide
BIO.LS1.3 refer to the TNDOE Updated Biology Reference Guide

Misconceptions
- A DNA sequence can only be replicated in a cell if it originated in the give cell. Students should learn that DNA replication is non-specific.
- Students misunderstand that the unzipping process in DNA replication is the breaking of hydrogen bonds between complementary base pairs to separate the two DNA strands.
- The unwinding process is the untwisting of the DNA double helix.
- The triplet of 3 bases that forms the genetic code is known as base triplet in DNA, codon in mRNA, and anticodon in tRNA.
- DNA polymerase III synthesizes DNA daughter strands in 5' to 3' direction only. Leading strand is formed due to replication towards replication fork, while the lagging

Learning Outcomes
- Explain the role of bacterial viruses played in identifying genetic material.
- Describe the role of DNA heredity.
- Describe the process of transcription and translation are similar in all organisms.
- Explain the role of DNA polymerase in copying DNA.
- Compare DNA replication in prokaryotic cells and in eukaryotic cells.

Suggested Phenomenon

Blood Doping: Hacking your body: Lance Armstrong and the science of doping.
Athletes use drugs, transfusion, and science to perform better. But how do they do it, and how are they caught?

What are the Risk and Benefit of Erythropoietin (EPO)?

Suggested Performance Task(s)
Guided Inquiry: Using DNA to Identify Species
Students simulate use of the technique of DNA barcoding to identify an unknown species of fish from samples. Students will research about other

Curricular Resources
Textbook Materials
- LS1.3: *Miller & Levine TN Biology*, pgs. 424-427

Engage
Inquiry Warm Up: A Perfect Copy
Inquiry Warm Up: The Smallest Scissors in the World

Explore
Interactivity: DNA Replication
Forensics Lab: Using DNA to Identify Species, TE/SE pg. 416
Crash Course: DNA, Hot Pockets & The Longest Word Ever
Quick Lab: Modeling DNA Replications, TE/SE pg. 426

Explain
Science Skills Activity: Replicating DNA and accompanying student handout.
Substance in Genes
Experiments with DNA
Virtual Lab: DNA Replication *will require you to create a free teacher account.
Interactivity: DNA Replication
Science Skills Activity: Replicating DNA
*accompanying handout
DNA Replication (schematic)
DNA Replication (basic detail)

Elaborate
Genes discovered that is essential for the DNA-replication process
Excessive DNA replication and its potential use against cancer

strand is formed due to replication away from replication fork. **<u>Suggested Science and Engineering Practice</u>** **Obtaining, evaluating, and communicating information** *(O/E) Students can critically read scientific literature, integrating, extracting, and accurately simplifying main ideas from multiple sources while maintaining accuracy and validating data whenever possible.* *(C) Students can provide written and oral explanations for phenomena and multi-part systems using models, graphs, data tables, and diagrams.* **<u>Suggested Cross Cutting Concepts</u>** **Structure and Function** *Students infer the function of a component of a system based on its shape and interactions with other components.*	kinds of problems DNA barcodes could solve based on this lab. Pg. 416 Make Your Case: Living things don't carry ID cards, or do they? Pgs. 428-429 This activity is an extension of the previous activity. Students should present their findings on DNA barcoding Technology on the Case: Cracking the Barcode, pg. 429 Performance-Based Assessment: An Eight-Hour Task: How Does DNA Replicate So Quickly; TE/SE pg. 432-433 • Reason Quantitatively • Build Science Skills: Design Solutions • Build Writing Skills: Write Explanatory Texts • Build STEM Skills	<u>This is The First Detailed Footage of DNA Replication, And It Wasn't What We Expected</u> **<u>Evaluate</u>** Ch. 13.3 Lesson Review; TE/SE pg. 427 Ch 13.3 Lesson <u>Quiz</u> **Additional Resources:** New Vision for Public School 5E Plan-<u>Molecular Genetics</u>

Curriculum and Instruction- Science			
RESOURCE TOOLKIT			
Textbook Resources	**DCIs and Standards**	**Website/Videos**	**Additional Resources**
Miller & Levine TN Biology Pearson Realize	**DCI(s)** BIO1.LS1: From Molecules to Organisms: Structures and Processes BIO1.LS3: Heredity BIO1.ETS2: Links Among Engineering, Technology, Science and Society **Standard** BIO1.LS1.3 BIO1.LS1.6 BIO1.LS3.1 BIO1.ETS2.3	Khan Academy Illuminations (NCTM) Discovery Education The Futures Channel The Teaching Channel Teachertube.com	**ACT & SAT** TN ACT Information & Resources ACT Connections SAT Connections SAT Practice from Khan Academy