**Biology Frameworks Pacing Guide**
**Structure and Function of Molecular Genetics**
**Crosscutting Concepts:** Structure and Function; Systems and System Models; Cause and Effect
**Topics:** Asexual Reproduction; Mitosis and Cell Cycle; Cancer; Structure of DNA; DNA Replication; Synthesizing Proteins; Effects of Gene Mutations; Enzymes; Biotechnology

8-week Instructional Segment

| Anchoring Phenomenon | GSE | Sample Instructional Segments | Disciplinary Core Ideas | Science and Engineering Practices | Instructional Notes |
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| Sickle cell disease is a genetic mutation that may be reversed with gene therapy.<br><br>Resources:<br>Openstax: Sickle Cell Anemia. This is an article titled "Sickle Cell Anemia: A look at the connection between DNA and Phenotype."<br><br>UC Berkeley video: "Gene editing with CRISPR Cas 9."<br><br>UC Berkeley video: | **SB1.** a, b, c, d<br>**SB2.** a, b, c,<br>**SB3.** c<br>**SB6.** d | **Effects of Gene Mutations: The Way We Were**<br>When cellular processes malfunction, mutation may occur some causing disastrous effects, others having no effect at all.<br><br>**Cell Transport: Stay Hydrated or Else**<br>Materials cross the cell membrane passively and actively to help the cell maintain homeostasis. | From *A Framework for K-12 Science Education*:<br>***By the end of grade 12***<br><br>**LS1A: Structure and Function**<br>● Systems of specialized cells within organisms help them perform the essential functions of life, which involve chemical reactions...such as ...proteins, ...and nucleic acids.<br>● All cells contain genetic information in the form of DNA molecules.<br>● Genes are regions in the DNA that contain the instructions that code for the formation of proteins, which carry out most of the work of cells.<br>● Feedback mechanisms maintain a living system's internal conditions within certain limits...and functional even as external conditions change...<br>● Outside that range, the organism cannot survive.<br><br>**LS1B: Growth and Development of Organisms**<br>● In multicellular organisms, individual cells grow and then divide by mitosis, allowing the organism to grow. | Developing and using models<br><br>Engaging in argument from evidence<br><br>Constructing explanations<br><br>Asking questions | Additional notes on topic, focus, and phenomena can be found within instructional segments.<br><br>By the end of this unit, students are using the following language in their speaking and writing during EXPLAIN or ELABORATE:<br>● Structure and function<br>● Cells<br>● Organelles<br>● System<br>● Homeostasis<br>● Genetic continuity<br>● Cellular reproduction (binary fission, mitosis, and |

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| "Using CRISPR to cure Sickle Cell."<br><br>**By the end of this unit, students will explain the phenomenon using the following concepts:**<br>Sickle cell disease is caused by a single point mutation in the DNA sequence.<br><br>Because the mutated DNA sequence undergoes DNA replication, exact copies of the mutated sequence are in all somatic cells produces through mitosis.<br><br>The mutated DNA is transcribed and translated into a misshapen protein that is not able to be used effectively. | | **Enzymes: Bubbly**<br>One major function of proteins is to act as enzymes which speed cellular processes. | • The organism begins as a single cell (fertilized egg) that divides successively to produce many cells, with each parent cell passing identical genetic material (two variants of each chromosome pair) to both daughter cells.<br>• As successive subdivisions of an embryo's cells occur, programmed genetic instructions and small differences in their immediate environments activate or inactivate different genes, which cause the cells to develop differently—a process called differentiation.<br>• Cellular division and differentiation produce and maintain a complex organism, composed of systems of tissues and organs that work together to meet the needs of the whole organism.<br><br>**LS3A: Inheritance of Traits**<br>• In all organisms the genetic instructions for forming species' traits are carried in the chromosomes.<br>• Each chromosome consists of a single very long DNA molecule, and each gene on the chromosome is a particular segment of that DNA that carry instructions for forming species' traits.<br><br>**LS3B: Variations of Traits**<br>• Although DNA replication is tightly regulated and remarkably accurate, errors do occur and result in mutations, which are a source of genetic variation.<br>• Environmental factors can also cause mutations in genes, and viable mutations are inherited. | | meiosis)<br>• Macromolecules<br>• Genetic information<br>• Replication, transcription, and translation<br>• Genetic variation<br>• Crossing over and nondisjunction during meiosis<br>• Mutations<br>• Biotechnology<br>• Asexual and sexual reproduction<br>• Organisms<br>• Viruses<br>• Evolutionary theory<br>• Evidence |

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| Using biotechnology, scientists are attempting to reverse sickle cell disease with gene therapy. | | | | | |

This instructional segment will segue into SB2 and SB3 of Patterns in Heredity and Selection by connecting sexual reproduction to differences among offspring and parents and non-identical in DNA fingerprinting as well as emphasizing the passage of mutated DNA for sickle cell and lactose tolerance that can increase fitness between parents and offspring. Also, it will connect to SB1 in Patterns in Living Systems by connecting the cell theory and macromolecules to DNA. It will also connect to SB6 in Stability and Change in Populations Over Time by connecting the idea that natural selection occurs based on random genetic variations that code for traits that may increase fitness. These more fit traits can be passed to successive generations.