

Unit 4: DNA and the Cell Cycle

Biology

12 Class Meetings

Rev. June 2019

Essential Questions

- How does the structure of DNA relate to its function?
- Why is it important that cells divide?

Enduring Understandings with Unit Goals

EU 1: Cells divide in an ordered and systematic sequence.

- Compare and contrast the phases of mitosis and the cell before and after mitosis.

EU 2: The structure of the DNA molecule is a double helix composed of nucleotides.

- Relate the structure of DNA to its function.

EU 3: Describe the Central Dogma of Genetics: DNA replication, Transcription and Translation and final makeup of individuals.

- Explain the processes of DNA replication, transcription and translation.

Standards

Next Generation Science Standards

- **HS-LS1-1.** Construct an explanation based on evidence for how the structure of DNA determines the structure of proteins which carry out the essential functions of life through systems of specialized cells.
- **HS-LS1-4.** Use a model to illustrate the role of cellular division (mitosis) and differentiation in producing and maintaining complex organisms.
- **HS-LS3-2:** Make and defend a claim based on evidence that inheritable genetic variations may result from: (1) new genetic combinations through meiosis, (2) viable errors occurring during replication, and/or (3) mutations caused by environmental factors.

Common Core State Standards

- **CCSS.ELA-Literacy.RST.9-10.1** Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions.

Unit 4: DNA and the Cell Cycle

Biology

12 Class Meetings

- **CCSS.ELA-Literacy.RST.9-10.4** Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to *grades 9-10 texts and topics*.
- **CCSS.ELA-Literacy.RST.9-10.7** Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words.
- **CCSS.Math.Content.HSN.Q.A.1** Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.
- **CCSS.Math.Content.HSS.IC.B.6** Evaluate reports based on data.

MSMHS Academic, Civic, and Social Competencies

Competency 1. Read and write effectively for a variety of purposes

Competency 2. Speak effectively with a variety of audiences in an accountable manner

Competency 3. Make decisions and solve problems independently and collaboratively

Competency 4. Apply scientific knowledge and concepts to a variety of investigative tasks

Competency 5. Contribute to a positive learning environment with respect and responsibility

Unit Content Overview

- Unit Phenomena (such as puppy falling asleep, fingernail growing after injury)
- Cell cycle (G_1 , S, G_2)
- Mitosis – steps, chromosomes, sister chromatids, homologous chromosomes, spindle fiber
- The structure of DNA – deoxyribose sugar, phosphate sugar bilayer, nucleotides, Chargaff rule, double helix
- DNA Replication (DNA \rightarrow DNA) – helicase, polymerase, semiconservative
- Transcription - (DNA \rightarrow RNA) – mRNA, nuclear membrane, single strand, uracil
- Translation - (RNA \rightarrow Amino Acid) – ribosome, tRNA, codon, anticodon
- Protein Synthesis - (Amino Acid \rightarrow Protein)
- Mutations – Substitution, Deletion, Silent, Frameshift
- Cell signaling – cancer
- HeLa cells

Interdisciplinary Connections

- Algebra I - Percentages

Unit 4: DNA and the Cell Cycle

Biology

12 Class Meetings

Daily Learning Objectives with TWPS Activities

The student will be able to...

- Design a model that explains the unit phenomena
 - *Explain why the puppy is constantly falling asleep.*
- Explain the importance of the cell cycle.
 - *Draw how a cell is created. Explain the process of how the cell is created.*
 - *Write a short story that provides an explanation of what the cell cycle is.*
- Explain the significance of mitosis for organisms' survival and homeostasis.
 - *Explain how liver cells are able to produce new cells, but brain cells are unable to produce new cells.*
- Evaluate and debate the ethics of the use of HeLa cells.
 - *If there were an immortal cell, how would they be able to stay alive forever?*
- Describe the structure of DNA.
 - *What is the importance of the structure of DNA to be anti-parallel?*
- Diagram DNA replication, including all enzymes and steps involved.
 - *DNA molecules can be tens of thousands of base pairs in length. Mistakes in DNA replication lead to mutations, which may or may not be harmful to an organism. How does semi-conservative replication help prevent mutations during DNA replication?*
- Demonstrate the major stages of transcription, including where, when and how transcription occurs.
 - *What would happen with the process of transcription if it occurred in the cytoplasm instead of the nucleus?*
- Demonstrate the major stages of translation, including where, when and how translation occurs.
 - *Even though bacterial cells do not contain a nucleus, protein synthesis occurs in a similar way to eukaryotic cells. Describe how transcription and translation works in bacterial cells.*
- Produce a chain of amino acids using a strand of DNA and the genetic code.
 - *Suppose one of the nitrogenous bases changed from an A to a T. How would this change impact the outcome of the protein and the individual?*
- Compare and contrast the types of genetic mutations.
 - *What would cause more damage (or a greater benefit) to an organism, a deletion mutation at the beginning of DNA or at the end of a DNA sequence?*
- Investigate a source of genetic mutations and how they can affect the traits of organisms.
 - *What is the difference between a normal hemoglobin and a sickled hemoglobin? How does this impact a person?*
- Explain the role of mutation and cell signaling in the development of cancer cells.

Unit 4: DNA and the Cell Cycle

Biology

12 Class Meetings

- *Explain how UV radiation can have impacts of DNA, cells, and proteins.*

Instructional Strategies/Differentiated Instruction

- **HLP:** Academically Productive Talk
- **HLP:** Writing to Learn (TWPS)
- **HLP:** Effective Feedback
- Entrance slips/activities
- Lecture with notes
- Close reading with annotations
- Accountable Talk discussions
- Graphic organizers
- Foldables
- Self-assessments
- Daily check ins with students
- Homework
- Student reflection
- Individual response board
- Exit slips
- Laboratory exercises
- Guided notes
- Providing students with completed notes and outlines
- Rephrasing information for students
- Student choice
- Strategic grouping
- Flash cards for vocabulary
- Shortened/modified reading assignments

Assessments

FORMATIVE ASSESSMENTS:

- Guided notes
- Written homework assignments
- Entrance and exit slips
- Accountable Talk Discussions

Unit 4: DNA and the Cell Cycle

Biology

12 Class Meetings

- Daily Think-Write-Pair-Share (TWPS)
- Transcription and Translation manipulative activity
- “Wake Up There’s a Protein for That!”
 - MSMHS Rubric 3: Problem Solving

SUMMATIVE ASSESSMENTS:

- Quiz on EU 1
- Quiz on EU 2
- DNA model
- Wake Up There’s a Protein for That! Project
- Unit Test

Unit Task

Unit Task Name: “Wake Up There’s a Protein for That!”

Description: Students will demonstrate the significance of proteins in the survival of organisms. Students will apply their knowledge about cell division (EU 1), the structure of DNA (EU 2) and protein synthesis (EU 3) to create a poster to educate patients about a narcolepsy. Students will include details of the type of genetic mutation, location of the mutation in the genome and the missteps of protein synthesis.

Evaluation: MSMHS Rubric 3: Problem Solving

Unit Resources

- Microscopes
- POGIL: The Cell Cycle
- POGIL: Mitosis
- Transcription and Translation Activity – manipulative
- DNA Model Project
- Virtual Lab – Structure of DNA
- Codon Charts
- HeLa Cell Articles
- Lecture with guided notes
- Laptops
- Internet databases

Unit 4: DNA and the Cell Cycle
Biology
12 Class Meetings

