

## Unit 4: DNA and Gene Expression

### AP Biology

8 Class Meetings

*Revised June 2019*

#### Essential Questions

- How do changes in DNA affect genetic diversity?

#### Enduring Understandings with Unit Goals

**EU 1:** DNA provides the instructions for life's operations.

- Explain the structure and function of the DNA molecule.
- Describe the process of semi-conservative replication.

**EU 2:** Genes code for specific proteins, and the expression of genes is strictly regulated in organisms.

- Describe the process of transcription and translation.
- Evaluate the roles of regulatory molecules in gene expression.

**EU 3:** Differential gene expression leads to the different cell types in multicellular organisms, while abnormal regulation of genes can lead to problems with human health.

- Explain the process of gene expression during cellular differentiation.
- Analyze human health problems associated with abnormal gene expression, particularly cancer and viruses.

#### Standards

##### Next Generation Science Standards (NGSS):

- **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.

##### Common Core State Standards:

- **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.
- **RST.11-12.1** Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account.
- **WHST.9-12.2** Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes.
- **WHST.9-12.9** Draw evidence from informational texts to support analysis, reflection, and research.

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- **MP.4** Model with mathematics.
- **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.
- **HSN-Q.A.2** Define appropriate quantities for the purpose of descriptive modeling.
- **HSN-Q.A.3** Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.

### 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

- History of DNA
- DNA molecule
- Base pairing
- DNA replication
- Genetic engineering
- DNA cloning, recombinant DNA, PCR, gel electrophoresis
- Genes
- Transcription
- Translation
- Mutations
- Regulation of gene expression
- Stem cells
- Cellular differentiation
- Embryonic development
- Cancer
- Viruses

#### Interdisciplinary Connections

- AP Statistics: probability

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#### Daily Learning Objectives with TWPS Activities

Students will be able to...

- Explain the structure and function of the DNA molecule.
  - *What role does base pairing play in DNA replication?*
- Discuss the benefits and concerns of cloning.
  - *Should we bring back extinct species using cloning techniques?*
- Describe the process of transcription and translation.
  - *In a research article about alkaptonuria published in 1902, Garrod suggested that humans inherit two “characters” for a particular enzyme and that both parents must contribute a faulty version for the offspring to have this disorder. What would we consider this to be today? Use appropriate unit vocabulary in your answer.*
  - *Individuals heterozygous for the sickle-cell allele show effects of the allele under some circumstances. Explain this in terms of gene expression.*
- Evaluate the roles of regulatory molecules in gene expression.
  - *A certain mutation in *E. coli* changes the *lac* operator so that the active repressor cannot bind. How would this affect the cell’s production of  $\beta$ -galactosidase?*
- Explain the process of gene expression during cellular differentiation.
  - *As you have previously learned, mitosis gives rise to two daughter cells that are genetically identical to the parent cell. Yet you, the product of many mitotic divisions, are not composed of identical cells. Why?*
  - *Explain how the types of mutations that lead to cancer are different for a proto-oncogene and a tumor-suppressor gene in terms of the effect of the mutation on the activity of the gene product.*
- Analyze human health problems associated with abnormal gene expression, particularly cancer and viruses.
  - *Bacteriophages were used to provide evidence that DNA carries genetic information. Briefly describe the experiment carried out by Hershey and Chase, including in your description why the researchers chose to use phages.*
  - *TMV has been isolated from virtually all commercial tobacco products. Why, then, is TMV infection not an additional hazard for smokers?*

#### Instructional Strategies/Differentiated Instruction

- **HLP:** Academically Productive Talk
- **HLP:** Writing to Learn (TWPS)
- **HLP:** Effective Feedback
- Daily Warm Up Activities
- Power Point Lecture with note-taking
- Flexible grouping

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- Foldables
- Exit slips
- Graphic Organizers
- Creating authentic connections for students
- Rephrasing and restatement of information and concepts
- Student use of headphones
- Independent reading
- Outlining of text
- Reading and Accountable Talk Discussion of Text
- Laboratory exercises

### Assessments

#### **FORMATIVE ASSESSMENTS:**

- Cloning Discussion
  - MSMHS Rubric 2: Accountable Talk
- Close reading and interpretation of text
- Outlining of textbook
- Warm Up Activities
- Exit slips
- Oral questioning
- Accountable Talk Discussions
- Daily Think-Write-Pair-Share (TWPS)
- Daily check-ins with students
- Practice FRQs
- Practice MCQs
- Homework/Reading checks

#### **SUMMATIVE ASSESSMENTS:**

- Quiz on EU 1
- Quiz on EU 2
- Quiz on EU 3
- Cloning Discussion Reflection
- Unit Test

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#### Unit Task

**Unit Task Name:** Cloning Discussion

**Description:** Students will use information from this unit on the DNA molecule (EU 1), and gene expression (EU 2 and EU 3) to form an opinion on whether or not scientists should use cloning techniques to bring back extinct animal species. They will also use prior knowledge of ecology and ecosystem functioning when forming their stance. Students will be required to support their opinions with evidence during a round-table discussion. Students will be assessed on both the quality of their evidence and their use of Accountable Talk when presenting it.

**Evaluation:** MSMHS Rubric 2: Accountable Talk

#### Unit Resources

- Textbook (Biology in Focus AP Edition. Campbell et al. 2014. Pearson Education, Inc)
- Interactive Science Notebook
- MSMHS School-wide Rubrics
- Lab Supplies
- Graphing calculators
- Internet databases
- Laptops