# APS Science Curriculum Unit Planner

## Grade Level/Subject
Biology – DNA / DNA Technology

## Stage 1: Desired Results
### Enduring Understanding
Advancements in our understanding of DNA have both solved and created problems.

### Correlations

| Unifying Understanding | (1) Humans use science to organize their understanding of the natural world through evidence, models, and explanations.
| (3) Form and composition are related to function. |

### VA SOL

| BIO.5 | The student will investigate and understand common mechanisms of inheritance and protein synthesis. Key concepts include g) the structure, function, and replication of nucleic acids; h) events involved in the construction of proteins; i) use, limitations, and misuse of genetic information; and j) exploration of the impact of DNA technologies. |
| BIO.1 | The student will demonstrate an understanding of scientific reasoning, logic, and the nature of science by planning and conducting investigations in which j) research utilizes scientific literature; m) current applications of biological concepts are used. |

### NSES (grade level)

<p>| UCP.2 | Evidence, models, and explanation |
| C.1.3 | Cells store and use information to guide their functions. The genetic information stored in DNA is used to direct the synthesis of the thousands of proteins that each cell requires. |
| C.1.4 | Cell functions are regulated. Regulation occurs both through changes in the activity of the functions performed by proteins and through the selective expression of individual genes |
| C.2.1 | In all organisms, the instructions for specifying the characteristics of the organism are carried in DNA, a large polymer formed from subunits of four kinds (A, G, C, and T). |
| C.2.3 | Changes in DNA (mutations) occur spontaneously at low rates. |
| C.3.4 | The millions of different species of plants, animals, and microorganisms that live on earth today are related by descent from common ancestors. |
| G.1.1 | Individuals and teams have contributed and will continue to contribute to the scientific enterprise. |
| G.3.2 | Usually, changes in science occur as small modifications in extant knowledge. |
| G.3.3 | Occasionally, there are advances in science and technology that |</p>
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Engineers use knowledge of science and technology, together with strategies of design, to solve practical problems. Scientific knowledge provides a means of estimating what the behavior of things will be even before they are made. Moreover, science often suggests new kinds of behavior that had not even been imagined before, and so leads to new technologies. 3A/H4** (SFAA)

Essential Questions
- What is DNA?
- How did scientists cooperate and collaborate to develop our current model of DNA?
- What is an acceptable model?
- How does information encoded in our DNA become expressed in our traits?
- How can we use knowledge of DNA to make our lives better?
- How might DNA technology be misused or abused?
- What are the ethical questions that arise in this age of DNA technology?
- Given the pros and cons, should scientists continue to research DNA?
- Should scientists alter genomes that have existed for thousands of years?

Knowledge and Skills
Students should know:
- DNA is the genetic material that determines an organism’s traits.
- 8.1 DNA was identified as the genetic material through a series of experiments.
- 8.2 DNA structure is the same in all organisms. Students should know the different components of a DNA molecule and the base pairing rules. Students should also know the model of DNA structure was developed by many people.
- 8.3 DNA replication copies the genetic information of a cell. DNA replication occurs during the synthesis stage of the cell cycle. Before a cell divides, the instructions are duplicated so that each of the two new cells gets all the necessary information for carrying on life functions.
- 8.4 Transcription converts a gene into a single-stranded RNA molecule.
- 8.5 Translation converts an mRNA message into a protein.
- 8.6 (Optional) Gene expression is carefully regulated in both prokaryotic and eukaryotic cells.
- 8.7 Mutations are changes in DNA that may or may not affect phenotype.

* Students should have some exposure to the following ideas: (These topics are ideal for student research and presentation as they can be controversial and allow students to apply their knowledge of genetics to a field of genetic engineering of their interest.)
- 9.1 Biotechnology relies on cutting DNA at specific places.
- 9.2 The polymerase chain reaction rapidly copies segments of DNA.
- 9.3 DNA fingerprints identify people at the molecular level.
- 9.4 DNA sequences of organisms can be changed.
- 9.5 Entire genomes are sequenced, studied, and compared.
- 9.6 Genetics provides a basis for new medical treatments.
Students should be able to:

- Construct a model of DNA.
- Describe the events leading to the discovery of the structure of DNA.
- Describe complimentary sequences of DNA from a parent strand.
- Determine the sequence of amino acids in a protein from an mRNA sequence.
- List the steps of replication, transcription, and translation and describe where they happen in the cell.
- Describe how genetic engineering manipulates recombinant DNA.
- Debate the pros and cons of genetic engineering.
- Research and discuss ethical issues surrounding, (or implications of) the technologies developed from the Human Genome Project.
- Recognize duplications, deletions, inversions, and translocation chromosomal mutations. (Pictures from the Dragonfly book are better than current text.)
- Identify frameshift mutations.

Stage 2: Assessment Evidence

Prior Knowledge and Skills

- Experimental design.
- Roles of proteins and nucleic acids in the cell.
- DNA is found in the nucleus of eukaryotic cells and proteins are made on ribosomes.
- Administer Ch 8 Diagnostic Test - Assessment Book pp. 145-146.

Formative Assessment

- Card sort / Time line
- Modeling activities
- Interactive reviews @ClassZone.com
- DNA “Foldable” – using one strand of DNA, students replicate, transcribe, and translate DNA into amino acids
- Section quizzes

Summative Assessment

- Webquest: Transgenic Organisms @ClassZone.com
- Webquest: Animal Cloning
- Performance task: “Show Me the Money” Students take on the role of lobbying for limited government funding of a gene technology of choice. Example, rubric, and links can be found under secondary science resources.
- Unit Test

Stage 3: Learning Plan

References to Adopted Materials

- Use Lesson Plan Ch 8 pp. 56 – 73 and portions of Ch 9 pp. 66-73 for daily plan and suggestions for differentiation both by level and by interest.
- The Lab Binder Unit 3: Genetics offers paper and electronic versions of investigations, mini-labs and practice sheets.

Suggested Investigations

- 8.1 & 8.2 Summarize the events (experiments / scientists involved) leading to the current model of DNA on cards. Have students work in groups and place the cards in order with justification of how each discovery builds on the next. Or, have students use Timeliner to summarize important events. In addition, students could develop their own 3D model of DNA and use it to explain DNA replication and protein synthesis in later sections. Other possibility: students do the Virtual Lab:
Bacterial transformation and discuss Avery’s experiment.

- 8.3 Students use their model of DNA to demonstrate replication and use Animated Biology: DNA Replication as a review. (Explorelearning.com – “Gizmos” – has good, interactive activities for students to practice building a DNA molecule, DNA replication, transcription, and translation. Teachers can get a free 30 day trial membership.)
- 8.4 & 8.5 Use Animated Biology to Build a Protein.
- 8.7 Students model various mutations (include some additional graphics of deletion and inversion since they are not mentioned in this text.) Design your own investigation: UV Light and Skin Cancer pp. 256-257.
- Students use Ch 9 and / or the internet as resources to research and communicate their findings for the tasks in one of the webquests or the “Show Me the Money” Performance Task.

**Outdoor Education Applications**

- None

**Resources**

**Web Sites**

- [http://learn.genetics.utah.edu/units/basics/tour/](http://learn.genetics.utah.edu/units/basics/tour/) Excellent resource for information, activities, and webquests.
- [http://www.iptv.org/exploremore/ge/](http://www.iptv.org/exploremore/ge/)
- [http://www2.edc.org/weblabs/WebLabDirectory1.html](http://www2.edc.org/weblabs/WebLabDirectory1.html)
- Online Biology Resources available after creating a login and password at ClassZone.com. Under Ch 8 & Ch 9:
  - Animated Biology: View DNA Replication, Build a Protein, Restriction Enzymes, and Polymerase Chain Reaction Simulations
  - Virtual Labs: Gel Electrophoresis, Bacterial Transformation and Blood Typing
  - Reviews
  - Quizzes
  - Webquests: Transgenic Organisms and Animal Cloning
  - SciLinks: Interesting links to protein synthesis
  - Biozine: Genetically Modified Foods – Do Potential Problems Outweigh Benefits? (Also found on pp. 690-691 under Unit 7: Plants).

**Videos**


**Online clips**

- United Streaming/Discovery Education: Life Science: Genetics

**Field Trips**

- None

**Other**