Biotechnology - Unit 2 - DNA/Protein Structure and Function

Unit Focus

This unit will begin with an overview of macromolecules with a focus on nucleic acids including both their structure and function. Students will then take a closer look at the mechanisms of both DNA replication and protein synthesis. Students will perform lab experiments which apply this content, such as an examination of the molecular basis for Drosophila (fruit-fly) eye color. The unit ends with a holistic look at how DNA and proteins play a role in the genetic flow of information, known as the Central Dogma (DNA → RNA → Protein → Trait).

Stage 1: Desired Results - Key Understandings

Standard(s)

Next Generation Science Standards (DCI)
Science: 9

- All cells contain genetic information in the form of DNA molecules. Genes are regions in the DNA that contain the instructions that code for the formation of proteins. (LS1.9.A2)
- Each chromosome consists of a single very long DNA molecule, and each gene on the chromosome is a particular segment of that DNA. The instructions for forming species' characteristics are carried in DNA. All cells in an organism have the same genetic content, but the genes used (expressed) by the cell may be regulated in different ways. Not all DNA codes for a protein; some segments of DNA are involved in regulatory or structural functions, and some have no as-yet known function. (LS3.9.A1)
- In sexual reproduction, chromosomes can sometimes swap sections during the process of meiosis (cell division), thereby creating new genetic combinations and thus more genetic variation. Although DNA replication is tightly regulated and remarkably accurate, errors do occur and result in mutations, which are also a source of genetic variation. Environmental factors can also cause mutations in genes, and viable mutations are inherited. (LS3.9.B1)

Transfer

Students will be able to independently use their learning to...
T1 Use the scientific process to generate evidence that addresses the original questions.
T2 Analyze qualitative and quantitative data to interpret patterns, draw conclusions, and/or make predictions.

Meaning

Understanding(s)

Students will understand that...
U1 Before cells divide, DNA is copied in a process known as semiconservative replication, resulting in two identical daughter DNA molecules
U2 DNA is a template for RNA which codes for amino acids which make up proteins that ultimately determine traits. (The Central Dogma)
U3 Genetic mutations contribute to variations in phenotypes observed in organisms.
U4 Genetic information can be altered because of mutations, which may result in beneficial, negative, or no change to the proteins and traits of an organism.

Essential Question(s)

Students will keep considering...
Q1 How does DNA copy itself precisely?
Q2 How are genes, proteins, and traits related?
Q3 How do genetic and environmental factors introduce new traits in organisms?
Q4 What impact can mutations have on living things?

Acquisition of Knowledge and Skill

Knowledge

Students will know...
K1 The Central Dogma describes the process by which DNA leads to traits.
K2 The major macromolecules found in a cell are carbohydrates, lipids, nucleic acids, and proteins.

Skill(s)

Students will be skilled at...
S1 Students will be able to identify and analyze genetic mutations to determine the molecular and system implications on an organism.

Stage 1: Desired Results - Key Understandings		
Next Generation Science Standards (content standards) High School Life Sciences: 9 - 12 • 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-LS1-1) **Madison Public Schools Profile of a Graduate** • Analyzing: Examining information/data/ evidence from multiple sources to identify possible underlying assumptions, patterns, and relationships in order to make inferences. (POG.1.2)	**K3** Nucleic acids are made-up of nucleotides of which there are four: adenine, thymine, guanine, and cytosine. **K4** Proteins are made-up of amino acids. Amino acids are coded for by codons. RNA, which is essentially a sequence of codons, is the set of instructions for the creation of a protein. **K5** In order for a protein to be functional it must fold into a 3D structure. There are four levels of protein structure: primary, secondary, tertiary, and quaternary. **K6** Genetic mutations that occur in DNA can/will have an effect on the eventual protein coded for by the DNA. **K7** Vocabulary: DNA, RNA, protein, nucleic acid, nucleotide, base, codon, amino acid, primary structure, secondary structure, tertiary structure, quaternary structure, mutation, genotype, phenotype.	