

Lesson 3: Mutations

Introduction

This lesson is designed to help students explore different types of genetic mutations and how they can affect an organism from the molecular level to the systemic level and even extending into the population.

Student Background Knowledge

Students must understand transcription and translation for this lesson. They must be familiar with mitosis and meiosis, as well as DNA replication.

Teacher Background Knowledge

Mutations are an important player in many issues in biology. They work for populations by increasing genetic diversity and increasing species odds for survival in varying environments. They also work against us in bacterial resistance to antibiotics, sickle cell anemia, and cancer.

Genetic mutations occur when bases of a DNA or RNA sequence are changed.. This often occurs during DNA replication in preparation for cell division or when mistakes are made during transcription and translation in protein synthesis. Point mutations occur when changes in DNA bases do not affect the triplet reading frame of tRNA. Substitution or inversions are point mutations. Though they may change one or two amino acids, the majority of the DNA sequence is unaltered. Silent mutations are point mutations that do not alter the amino acid outcome. Often, more than one codon will code for a certain amino acid, so silent mutations are harmless. Frameshift mutations like deletions and insertions change the entire codon reading frame by shifting each base over one position. Frameshift mutations can be disastrous.

TEKS Objectives:

BIOL.1.05 Organize, analyze, evaluate, make inferences, and predict trends from data.

BIOL.2.02 Interpret the functions of systems in organisms including circulatory, digestive, nervous, endocrine, reproductive, integumentary, skeletal, respiratory, muscular, excretory and immune.

BIOL.2.10 Compare the structures and functions of different biomolecules including carbohydrates, lipids, proteins, and nucleic acids.

BIOL.2.23 Relate cellular functions and processes to specialized structures within cells.

BIOL.2.25 Investigate and identify cellular parts and processes including homeostasis, permeability, energy production, transportation of molecules, disposal of wastes, and synthesis of new molecules.

BIOL.2.35 Describe the components and structure of DNA and illustrate how it carries the information for traits

BIOL.2.38 Compare genetic variations observed in plants and animals

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Materials

Pencils

Paper

Notecards

Mutation Practice Worksheet

Lesson Plan

OPENING:

Play “Mutation Telephone”. Have the class make two lines. Instruct students to whisper and pass a phrase down the line when you say go. (Phrase ideas: “The rain in Spain stays mainly on the plain.” “Archimedes coined the phrase ‘Eureka, I’ve found it!’”) The last student in each line will share the message with the class. Have students journal: “How did the message change as it was passed down each line?”

CONCEPT DEVELOPMENT: Define mutation and discuss how mutations can be harmful (cancer, sickle cell anemia) and helpful (increasing genetic diversity, sickle cell malaria resistance). Mutations occur during DNA replication and cell division. Use nine students from the class to help you demonstrate types of mutations. Line students up in front of the class with a slight separation between every third student. These groups represent a codon. Demonstrate point mutations like substitution (switch a student from the front with a student at their desk) and inversion (switch two students in a codon) Emphasize that the point mutations do not change the frame, or the codon grouping. Illustrate frameshift mutations like deletion (take a student out of the line and redistribute the codons) and insertion (add another student to the line from the students at their desks and redistribute the codons). Ask students to predict the effect frameshift mutations have on the translation of amino acids. Which is more harmful, a point mutation or a frameshift mutation?

GUIDED PRACTICE:

Distribute note cards to each student. Note cards may be cut into smaller pieces to save materials. Students are to write this DNA sequence on their cards, one base pair per card:

G T T C A T T A T A C G C C A

Students will rearrange their cards to demonstrate each type of mutation that you request and identify which mutations are point mutations and which are frameshift mutations.

STUDENT PRACTICE: Mutation Practice Worksheet. Students will write out the sequence of each mutation, given the original sequence.

CLOSURE: Exit Ticket: “What type of a mutation (point or frameshift) causes sickle cell anemia? How do you know?”