What is Genetic Variation?

Worksheet

Genetic variation is the diversity in gene sequences between individuals of the same species, caused mainly by mutations, meiotic recombination, and random fertilization.

Questions

1. Which of the following is NOT a source of genetic variation?

A) Mutation
B) Crossing over
C) Mitosis
D) Independent assortment

2. A mutation that changes one amino acid in a protein is called a

A) Silent mutation
B) Missense mutation
C) Nonsense mutation
D) Frameshift mutation

3. During which phase of meiosis does crossing over occur?

A) Prophase I
B) Metaphase II
C) Anaphase I
D) Telophase II

4. What is the main evolutionary significance of genetic variation?

A) It guarantees survival of all individuals
B) It provides material for natural selection to act on
C) It prevents mutation
D) It stops gene flow

5. A single nucleotide change turns a codon from GAG (glutamic acid) to GTG (valine), causing sickle-cell hemoglobin. What type of mutation is this and what is its effect?

6. Two homologous chromosomes carrying alleles Ab and aB cross over. What new chromosome combinations can result?

7. A human has 23 pairs of chromosomes. Ignoring crossing over, how many chromosomally distinct gametes can one person produce through independent assortment alone?

8. Define: What is genetic variation?

9. Define: Name three sources of genetic variation.

10. Define: What is a point mutation?

Answer Key

1. C) Mitosis - Mitosis produces genetically identical cells; it does not create new variation.

2. B) Missense mutation - A missense mutation changes the codon so it codes for a different amino acid.

3. A) Prophase I - Crossing over happens between homologous chromosomes during prophase I.

4. B) It provides material for natural selection to act on - Variation gives natural selection something to select among, driving adaptation.

5. This is a point (substitution) mutation - one base pair is changed. Because it changes only one amino acid, it is a missense mutation. The altered protein (hemoglobin S) folds abnormally, causing red blood cells to sickle.

6. Before crossing over: chromosome 1 = Ab, chromosome 2 = aB. Crossing over exchanges segments between non-sister chromatids. After crossing over, recombinant chromosomes AB and ab can form alongside the original Ab and aB - four possible gamete genotypes.

7. Each of the 23 homologous pairs can independently send either the maternal or paternal chromosome to a gamete. Number of combinations = 2^23. 2^23 = 8,388,608 possible distinct gametes.

8. Differences in DNA sequence among individuals of the same species.

9. Mutation, meiotic recombination (crossing over and independent assortment), and random fertilization.

10. A change in a single nucleotide base pair in DNA, which can be silent, missense, or nonsense.