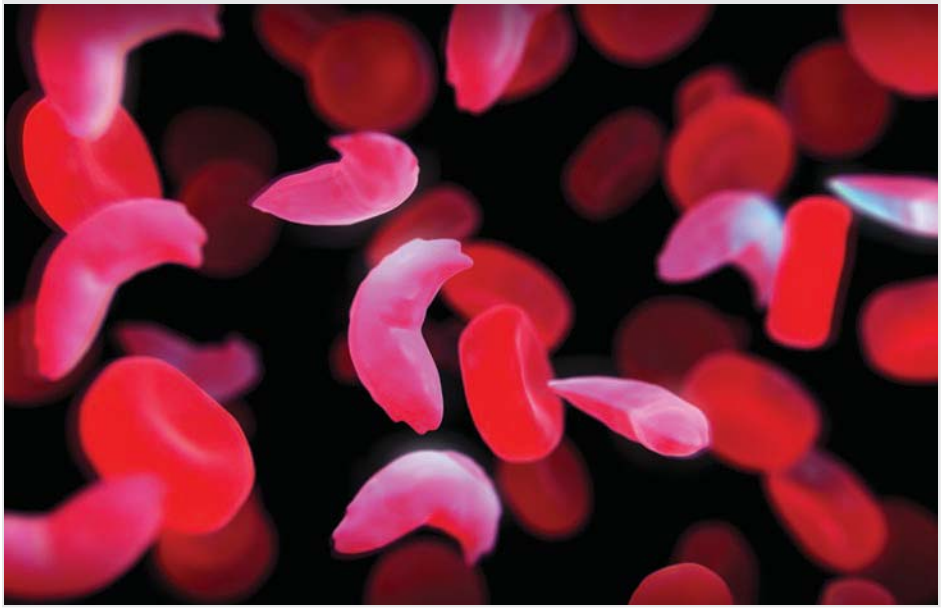
Lesson Self-Check

CAN YOU EXPLAIN IT?

FIGURE 21: "Sickling" of red blood cells occurs when deoxygenated HbS molecules form long chains, or polymers. These polymers force the cell to change shape.



The allele for sickle cell anemia is linked with resistance to malaria, a disease caused by a parasite transmitted from one infected person to another by mosquitoes. Individuals who have this disease may experience swelling of the brain, difficulty in breathing, liver and kidney failure, anemia, and low blood sugar. Although modern medical techniques can diagnose and cure malaria through early treatment, if untreated, the complications of malaria can lead to death.

Individuals who have malaria, but are also carriers of the sickle cell anemia gene (HbS) have been observed to not advance to the serious stage of malaria. Thus, in the absence of modern medical treatment, having one of these genes helps protect them from the fatal consequences of malaria. According to the Centers for Disease Control and Prevention, HbS can provide 60% protection against malaria.

Explain Why is the HbS allele more common in some populations than in others? Answer the following questions in your explanation.

1. How do changes in DNA lead to changes in the structure of red blood cells in people with the HbS allele?
2. Is the phenotype that corresponds to the HbS allele harmful, beneficial, or both? Explain your answer.
3. Why is the frequency of the HbS allele higher in areas near Earth's equator, such as parts of Africa and the Mediterranean?

CHECKPOINTS

Check Your Understanding

1. The results of a study on the effects of a mutagen on bacteria had the following results. Some bacterial cultures were exposed to the mutagen, some were not. Which culture was most likely exposed to the mutagen?

Culture	Number of mutant bacteria
A	0
B	350
C	10
D	4
E	3

2. Epidermolysis bullosa is a disease characterized by very delicate skin that easily blisters upon scratching or being exposed to the slightest friction. The disease is caused by a missense mutation. Which statement describes the mutation that causes epidermolysis bullosa?

a. The mutation is a result of the premature completion of a protein.

b. The mutation is caused by a change in one of the amino acids.

c. This mutation is a result of the reading frame being shifted.

d. This mutation is caused by the duplication of the genome.

3. Before the genetic code could be understood, scientists needed to know that a codon is composed of three nucleotides. This situation is an example of the

a. cumulative nature of scientific evidence.

b. scientists making inferences based on data.

c. way that theories can lead to scientific laws.

d. ability of scientists to make hypotheses.

4. Individuals with trisomy X have three X chromosomes in their cells. Which statement can be used to describe this condition? Select all correct answers.

a. This condition is caused by a chromosomal mutation known as nondisjunction mutation.

b. This condition is a result of the exchange of genetic material between two homologous chromosomes.

c. This mutation is a result of chromosomes not separating during anaphase of mitosis.

d. This mutation is caused by balanced translocation, a type of chromosomal mutation.

5. Which of the following can be changed during meiosis? Select all correct answers.

a. base sequence

b. number of amino acids

c. number of chromosomes

d. gene sequence

6. Which processes are involved in the inheritance of mutated genes? Select all correct answers.

a. meiosis

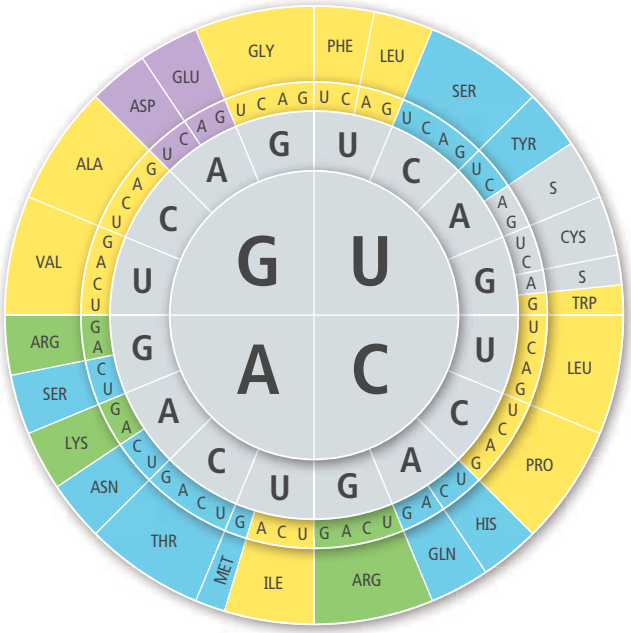
b. fertilization

c. mitosis

7. Watermelons are exposed to a mutagen to produce a variety that has four sets of chromosomes. The new variety is then allowed to mate with a normal watermelon to produce seedless watermelons. What type of mutation is involved in the growing of seedless watermelon?

8. Rachel Carlson was one of the first ecologists to warn against the widespread use of pesticides and other potential mutagens and toxins. How might the presence of a chemical mutagen in the environment affect the genetic makeup and size of a population over time?

FIGURE 22: Codon Chart



ALA = Alanine	GLY = Glycine	PRO = Proline
ARG = Arginine	HIS = Histidine	S = Stop
ASN = Asparagine	ILE = Isoleucine	SER = Serine
ASP = Aspartic acid	LEU = Leucine	THR = Tryptophan
CYS = Cysteine	LYS = Lysine	TYR = Tyrosine
GLN = Glutamine	MET = Methionine	VAL = Valine
GLU = Glutamine acid	PHE = Phenylalanine	

9. Consider this small part of a DNA sequence:

GTG–GAC–TGA–GGA

Use this sequence and the codon chart in Figure 22 to make a model showing how a frameshift mutation happens and how the amino acid sequence is affected.

10. Huntington's disease affects how the brain functions. Individuals who have this disease are not able to control the movement of their bodies. Additionally, they experience emotional problems and loss of cognitive ability. This disease is caused by a trinucleotide repeat involving CAG. What causes this mutation and how does it affect the protein synthesized by the mutated gene?

11. Can a parent pass on a mutation in a kidney cell to his child? Why or why not?

12. Explain how mutations contribute to genetic diversity.

MAKE YOUR OWN STUDY GUIDEW

In your Evidence Notebook, design a study guide that supports the main ideas from this lesson:

A mutation is a change in the sequence of an organism's DNA, and may occur spontaneously or as the result of exposure to a mutagen.

Mutations contribute to genetic diversity because as the genetic makeup of organisms are changed through mutations, variety is produced.

Mutations may or may not affect an organism's phenotype.

Remember to include the following information in your study guide:

- Use examples that model main ideas.
- Record explanations for the phenomena you investigated.
- Use evidence to support your explanations. Your support can include drawings, data, graphs, laboratory conclusions, and other evidence recorded throughout the lesson.

Consider how mutations can lead to changes in DNA at both the cellular and organismal levels, and develop an explanation as to how each of these types of changes may or may not lead to changes in phenotype in real-world situations.