Name _____ Date _____

Mutations Quick Check: Substitutions, Frameshifts and Their Effects on Proteins

Directions: Answer each of the eight questions about gene mutations. One group of questions uses a few codons from the standard genetic code.

1. Fill in each blank with the kind of mutation the sentence describes.

Word bank
deletions • substitutions • translations • insertions • replications

Mutations that swap one base for another are _____. Mutations that add one or more bases are _____, and mutations that remove one or more bases are _____.

2. Each of these mutations changes one base in a codon. Match each type to what happens to the codon.

Write the letter of the matching answer on each line.

1. _____ Nonsense mutation
2. _____ Silent mutation
3. _____ Missense mutation

A. The codon now codes for a different amino acid.
B. The codon becomes a stop codon, so the protein ends early.
C. The codon still codes for the same amino acid.
D. The codon now codes for two amino acids at once.

One Codon, Three Possible Changes

At one spot in a gene, the mRNA codon is GAA. The table shows what GAA and three codons that differ from it by one base code for, from the standard genetic code.

Part of the standard genetic code: the codon GAA and three codons that each differ from it by one base

mRNA codon	Amino acid or signal
GAA	Glutamic acid
GAG	Glutamic acid
GUA	Valine
UAA	Stop

3. Based on the table, which change to the GAA codon would be a nonsense mutation?

A. GAA to UAA B. GAA to GUA C. GAA to GAG

4. A mutation changes this codon from GAA to GUA in the gene for an enzyme. Which statement about the effect fits what is known about mutations?

A. It changes every amino acid that comes after this codon, all the way to the end of the enzyme.

B. It changes one amino acid, which may or may not affect how well the enzyme works.

C. Any change to one amino acid always stops an enzyme from working.

D. Changing a single base can never affect how well an enzyme works.

5. A single base is deleted from a codon near the beginning of a gene. Why does this usually change the protein much more than a single-base substitution does?

A. It shifts the reading frame, so the bases after it are grouped into different codons.

B. It removes exactly one amino acid and leaves the rest of the protein unchanged.

C. Deletions always switch the whole gene off, no matter where in the gene they happen to occur.

D. The ribosome skips the entire gene whenever a single base is missing from it.

6. Scientists who study many mutations find that their effects vary widely. Which description of that range is accurate?

A. Every mutation harms the organism that carries it in some way.

B. Most mutations are helpful, which is how organisms get the traits they need.

C. Many mutations have little or no effect, some are harmful and a few are helpful.

D. Mutations have an effect only when an organism's environment changes.

7. Bacteria in a population are treated with an antibiotic, and a few survive because they carry a mutation that protects them. Which statement about how that mutation arose fits what is known about mutations?

A. Each survivor gained the mutation because it needed the change to live through the treatment.

B. It arose by chance as a random change in DNA, most likely before the treatment began.

C. The antibiotic caused exactly the mutation each bacterium needed to survive.

D. The bacteria changed their own DNA on purpose once they sensed the antibiotic.

8. A mutation happens in one skin cell on a person's arm. Could the person pass this mutation to their children?

A. Yes, because every mutation anywhere in the body is soon copied into the person's eggs or sperm.

B. No, because only mutations in eggs, sperm or the cells that make them are inherited.

C. Yes, but only if the mutation turns out to be harmful rather than helpful.

D. No, because a mutation in a skin cell disappears as soon as that cell divides.