rock by rock

3.9: THE SPIDER BITE: EXPLORING MUTATIONS
ANSWER KEY

Exploring Mutations

omega-Agatoxin DNA	ATG	GCT	TGG	TGC	GAA	TGC	CCT	GAC	CAA	GGA	TAA
Amino Acid Sequence	M	A	W	C	E	C	P	D	Q	G	STOP

Mutation #1	ATG	GCT	TGG	TGC	GAA	TGC	CCT	GAC	AAA	GGA	TAA
Amino Acid Sequence	M	A	W	C	E	C	P	D	K	G	STOP

How is the mutated DNA different from the original DNA? What happened to the amino acid sequence as a result of the mutation?	The mutated DNA has a different codon in the ninth box. The codon changed from CAA to AAA. This changed the amino acid from Q to K.
Do you think this will affect the production of omega-Agatoxin? Why or why not?	This might affect the production of omega-Agatoxin because there is a different amino acid in the sequence. The protein will be different, so it might mean that the spider does not make omega-Agatoxin for its venom.

Mutation #2	ATG	GCT	TGG	TGC	GAA	TGC	CCC	GAC	CAA	GGA	TAA
Amino Acid Sequence	M	A	W	C	E	C	P	D	Q	G	STOP
How is the mutated DNA different from the original DNA? What happened to the amino acid sequence as a result of the mutation?	The mutated DNA has a different codon in the seventh box. Instead of the original CCT, the codon is CCC. Both CCT and CCC code for the amino acid P, so there is no change to the amino acid sequence.										
Do you think this will affect the production of omega-Agatoxin? Why or why not?	This won't affect the production of omega-Agatoxin. The DNA sequence is different, but the amino acids are the same, so the protein will also be the same. Since the amino acid sequence is the same, the spider should still be able to produce the normal omega-Agatoxin.										

Mutation #3	ATG	GCT	TGG	TGC	GAA	TGA	CCT	GAC	CAA	GGA	TAA
Amino Acid Sequence	M	A	W	C	E	STOP					
How is the mutated DNA different from the original DNA? What happened to the amino acid sequence as a result of the mutation?	The mutated DNA has a TGA codon in the sixth box, and the original DNA had TGC. TGA is like a "STOP" button that signals the end of a protein. With this mutation, the amino acid chain ends early. Instead of getting a full protein, the chain stops after only five amino acids (M-A-W-C-E). The rest of the sequence doesn't get translated into amino acids.										
Do you think this will affect the production of omega-Agatoxin? Why or why not?	Yes, this would definitely affect the production of omega-Agatoxin. The protein is incomplete because of the early stop codon. Without the full amino acid chain, the spider might not be able to paralyze prey as effectively, or the venom might be useless.										

Mutation #4	ATG	GCT	TGT	GCG	AAT	GCC	CTG	ACC	AAG	GAT	TAA
Amino Acid Sequence	M	A	C	A	N	A	L	T	K	D	?
How is the mutated DNA different from the original DNA? What happened to the amino acid sequence as a result of the mutation?	In this mutation, one base (a G) was deleted near the start of the sequence. That caused a change to every codon after that point. Instead of making the original protein, the spider now makes a completely different type of amino acid. The amino acids are all scrambled, and the codon at the end only has two bases instead of three.										
Do you think this will affect the production of omega-Agatoxin? Why or why not?	Yes, this mutation would almost definitely stop the spider from producing the real omega-Agatoxin. The protein depends on the exact order of amino acids, and this mutation changes almost all of the amino acids. The new protein probably doesn't work, meaning the spider venom probably doesn't work.										

Investigation Reflection

1. What is special about the first codon in a gene? What do you think might happen if there is a mutation in this codon?
   The first codon is usually ATG, which translates to the amino acid M. This codon tells the cell where to begin making the protein. If there is a mutation in the first codon, the protein might not be made at all.

2. How could a small change in DNA affect how an animal survives in its environment?
   A small change in DNA can lead to big effects in an organism's traits. For example, a single base being changed or deleted from a DNA sequence can change the sequence of amino acids. If an amino acid sequence changes, the protein may not be made correctly. For example, in Mutation #4, a single base was deleted, and all the other amino acids in the chain changed. This change may mean the spider's venom doesn't work, and the spider may not be able to catch food.

3. Why don't all mutations lead to visible changes?
   Some mutations change the sequence of DNA, but they do not change the sequence of amino acids. A spider with a mutation like Mutation #2 could still make poisonous venom, so the mutation wouldn't be noticeable.

4. Are mutations always "bad"? Can you think of situations where they might help?
   Some mutations could make a protein even more useful than the original protein. For example, it's possible that a mutation to the omega-Agatoxin DNA could make a spider's venom even more harmful. The venom could paralyze more types of insects, or it could paralyze the insects more quickly. This would be a helpful mutation for the spider, and it could help the spider survive.