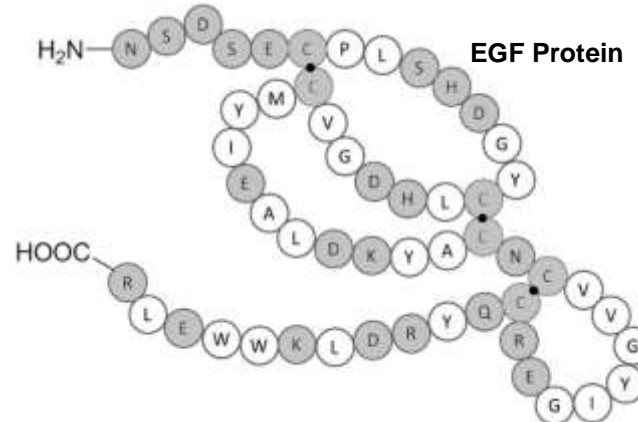


Mutations & Change - Summative Assessment

Name: _____ Hour _____ Date: _____ Score: _____ / _____

Directions: A 3x5 notecard with *handwritten* notes can be used. Underline required words in responses.

Background: The *EGF* gene (below) provides the information needed to assemble the *EGF* protein. This protein limits **cell division** and is needed for **tooth formation**. The *EGF* protein is shown here → Each circle with a letter represents an individual amino acid. Use this information to answer the following questions.



EGF Gene (5' → 3')
 AAC-AGC-GAT-AGC-
 GAA-TGC-CCG-CTG-
 AGC-CAT-GAT-GGC-
 TAT-TGC-CTG-CAT-
 GAT-GGC-GTG-TGC-
 ATG-TAT-ATT-GAA-
 GCG-CTG-GAT-AAA-
 TAT-GCG-TGC-AAC-
 TGC-GTG-GTG-GGC-
 TAT-ATT-GGC-GAA-
 CGC-TGC-CAG-TAT-
 CGC-GAT-CTG-AAA-
 TGG-TGG-GAA-CTG-
 CGC-TGA

Amino Acid	Code	Charge	Hydrophobicity	Amino Acid	Code	Charge	Hydrophobicity		
Alanine	Ala	A	Neutral	Hydrophobic	Leucine	Leu	L	Neutral	Hydrophobic
Arginine	Arg	R	Positive	Hydrophilic	Lysine	Lys	K	Positive	Hydrophilic
Asparagine	Asn	N	Neutral	Hydrophilic	Methionine	Met	M	Neutral	Hydrophobic
Aspartic acid	Asp	D	Negative	Hydrophilic	Phenylalanine	Phe	F	Neutral	Hydrophobic
Cysteine	Cys	C	Neutral	Hydrophilic	Proline	Pro	P	Neutral	Hydrophobic
Glutamine	Glu	Q	Positive	Hydrophilic	Serine	Ser	S	Neutral	Hydrophilic
Glutamic acid	Gln	E	Negative	Hydrophilic	Threonine	Thr	T	Neutral	Hydrophilic
Glycine	Gly	G	Neutral	Hydrophobic	Tryptophan	Trp	W	Neutral	Hydrophobic
Histidine	His	H	Positive	Hydrophilic	Tyrosine	Tyr	Y	Neutral	Hydrophobic
Isoleucine	Ile	I	Neutral	Hydrophobic	Valine	Val	V	Neutral	Hydrophobic

1. How does the order of bases in the *EGF* gene affect the shape and function of the *EGF* protein?

Include & underline the following: *mRNA, ribosome, codons, amino acids.*

Score _____ /3
 Complete
 Accurate
 Precise

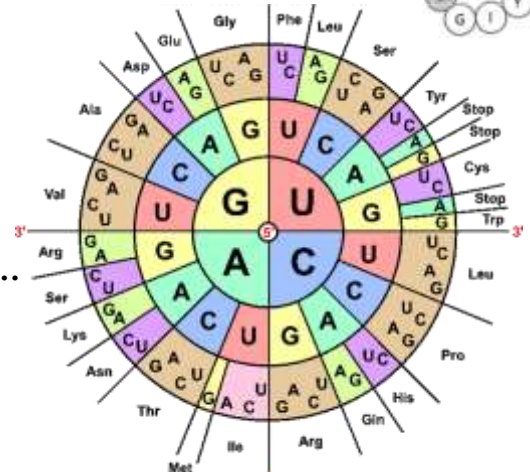
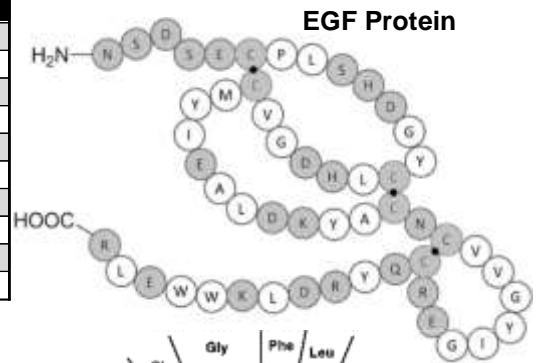
Comments:

2. Summarize three properties of amino acids that determine the shape and function of the protein.

Score _____ /3
 Complete
 Accurate
 Precise

Comments:

Amino Acid	Code	Charge	Hydrophobicity	Amino Acid	Code	Charge	Hydrophobicity		
Alanine	Ala	A	Neutral	Hydrophobic	Leucine	Leu	L	Neutral	Hydrophobic
Arginine	Arg	R	Positive	Hydrophilic	Lysine	Lys	K	Positive	Hydrophilic
Asparagine	Asn	N	Neutral	Hydrophilic	Methionine	Met	M	Neutral	Hydrophobic
Aspartic acid	Asp	D	Negative	Hydrophilic	Phenylalanine	Phe	F	Neutral	Hydrophobic
Cysteine	Cys	C	Neutral	Hydrophilic	Proline	Pro	P	Neutral	Hydrophobic
Glutamine	Glu	Q	Positive	Hydrophilic	Serine	Ser	S	Neutral	Hydrophilic
Glutamic acid	Gln	E	Negative	Hydrophilic	Threonine	Thr	T	Neutral	Hydrophilic
Glycine	Gly	G	Neutral	Hydrophobic	Tryptophan	Trp	W	Neutral	Hydrophobic
Histidine	His	H	Positive	Hydrophilic	Tyrosine	Tyr	Y	Neutral	Hydrophobic
Isoleucine	Ile	I	Neutral	Hydrophobic	Valine	Val	V	Neutral	Hydrophobic



EGF Gene (5' → 3')
AAC-AGC-GAT-AGC-
GAA-TGC-CCG-CTG-
AGC-CAT-GAT-GGC-
TAT-TGC-CTG-CAT-
GAT-GGC-GTG-TGC-
ATG-TAT-ATT-GAA-
GCG-CTG-GAT-AAA-
TAT-GCG-TGC-AAC-
TGC-GTG-GTG-GGC-
TAT-ATT-GGC-GAA-
CGC-TGC-CAG-TAT-
CGC-GAT-CTG-AAA-
TGG-TGG-GAA-CTG-
CGC-TGA

3. Based on the information in the table, **the lighter colored amino acids in EGF protein most likely represent...**

Score _____ /1

- Negatively-charged amino acids.
- Positively-charged amino acids.
- Hydrophilic amino acids.
- Hydrophobic amino acids.

4. **The amino acids that are connected with black dots represent...**

Score _____ /1

- Oppositely-charged amino acids.
- Similarly-charged amino acids.
- Cysteine amino acids.
- Hydrophobic amino acids.

5. **If an arginine (R) is replaced by aspartic acid (D), what would happen?**

Score _____ /1

- The new amino acid is now found on the outside of the protein.
- The new amino acid is now found on the inside of the protein.
- The new amino acid will be attracted to positively-charged amino acids.
- The new amino acid will be attracted to negatively-charged amino acids.

6. The EGF protein is important for limiting mitosis and for tooth formation. **If a mutation in the EGF gene changes the fifth codon (GAA) into TAA, predict how this will change the traits of the affected organism.** Defend your prediction with evidence and reasoning. (Note – GAA codes for glutamine).

Score _____ /3

Complete

Accurate

Precise

Comments:

7. **Based on information in the previous question, this mutation is most likely which of the following?**

_____ /1

- Substitution
- Insertion Frameshift
- Deletion Frameshift
- Chromosomal

8. **If this mutation is passed on from parents to offspring, it can be best described as _____**

_____ /1

- Acquired
- Chromosomal
- Hereditary
- Silent

9. The data here compare the size of the four largest species in two different orders of whales. These whales are grouped as either *odontocetes* (toothed) or *mysticetes* (toothless). The whales in bold are those over 10 m (33 feet). **Which of the following claims is best supported by this data?**

Order	Species	Size (m)
Odontocetes	<i>Monodon monoceros</i>	5.0
	<i>Globicephala melas</i>	5.7
	<i>Orcinus orca</i>	8.0
Mysticetes	<i>Physeter catodon</i>	20.0
	<i>Balaena mysticetus</i>	17.0
	<i>Megaptera novaeangliae</i>	19.0
	<i>Balaenoptera physalus</i>	25.0
	<i>Balaenoptera musculus</i>	30.0

Score
_____/1

- The *odontocetes* whales (toothed) are all under 10 m.
- The *mysticetes* whales (toothless) are all under 10 m.
- Most *odontocetes* whales are under 10 m; all *mysticetes* are over 10 m.
- There is no correlation between size and whether a whale has teeth.

10. **What explains the relationship between size and whether or not a whale has teeth?** Reference the *EGF* data provided on earlier pages if relevant.

Score
_____/3
 Complete
 Accurate
 Precise

Comments:

11. All whales descended from a dog-sized mammal called *Pakicetus* (shown here). **Summarize how A) mutations and B) natural selection enabled the evolution of whales from this four-legged land animal.** [\(Image Source\)](#)



Score
_____/3
 Complete
 Accurate
 Precise

Comments:

12. Whales have changed dramatically over millions of years, but sharks have remained largely unchanged in that same timeframe. Why? **Summarize four factors that determine the pace of evolution.**

Score
_____/3
 Complete
 Accurate
 Precise

Comments:

