Gene and Chromosome Mutation Worksheet

(reference pgs. 239-240 in *Modern Biology* textbook)

Name_____ Date_____ Per_____

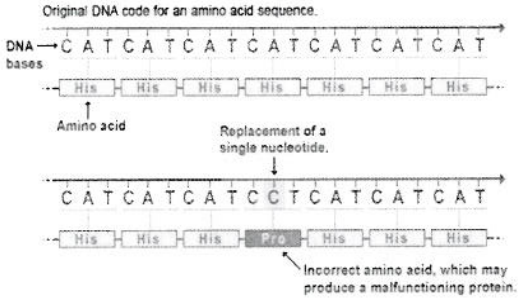
Look at the diagrams, then answer the questions.

Gene Mutations affect a single gene by changing its base sequence, resulting in an incorrect, or nonfunctional, protein being made.

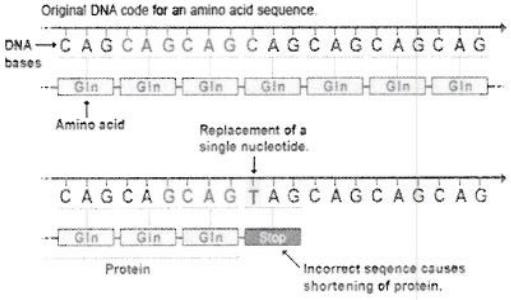
(a) A **SUBSTITUTION** mutation, occurs where one nucleotide base is replaced by another. These are often called "**point mutations**", because a **single base** is changed, at one **point** in the gene.

SOMETIMES, these base (A,T,C,G) substitutions lead to "**Missense**" or "**Nonsense**" mutations:

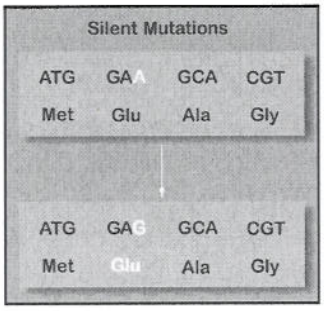
Missense mutation



Nonsense mutation

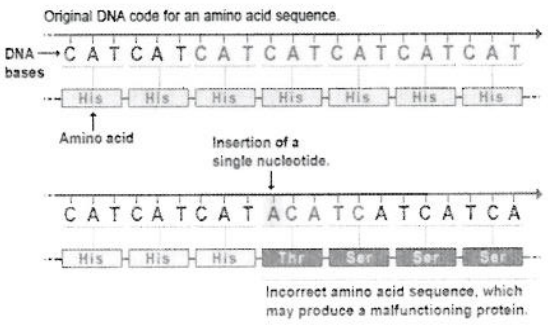


…and sometimes, because there is more than one codon for each amino acid, these mutations can be **SILENT**:

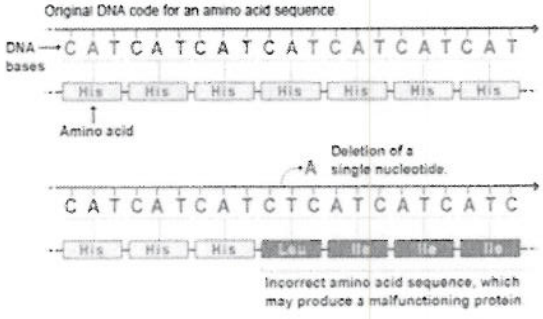


(b) Other types of mutations (insertions or deletions on nucleotide bases) cause **FRAMESHIFTS**:

Insertion mutation



Deletion mutation



Gene and Chromosome Mutation Worksheet
(reference pgs. 239-240 in *Modern Biology* textbook)

1. There are several types of gene mutations. List two. What do they have in common? How are they different?

2. A geneticist found that a particular mutation had no effect on the protein coded by a gene. What do you think is the most likely type of mutation in this gene? Why?

3. Name one amino acid that has more than one codon. Name an amino acid that has only one codon

Use Codon chart

4. Look at the following sequence: THE FAT CAT ATE THE RAT. Delete the first H and regroup the letters in groups of three- write out the new groups of three. Does the sentence still make sense? What type of mutation is this an example of?

5. You have a DNA sequence that codes for a protein and is 105 nucleotides long. A frameshift mutation occurs at the 85th base- how many amino acids will be correct in this protein?

6. Given the following three mRNA sequences, TWO code for the same protein. Which two?

Use Codon Chart

#1. AGU UUA GCA ACG AGA UCA

#2 UCG CUA GCG ACC AGU UCA

#3 AGC CUC GCC ACU CGU AGU

7. What kind of mutation is *more likely* to result in a nonfunctional protein, a **frameshift** (resulting from an insertion or deletion) or a **point mutation**?

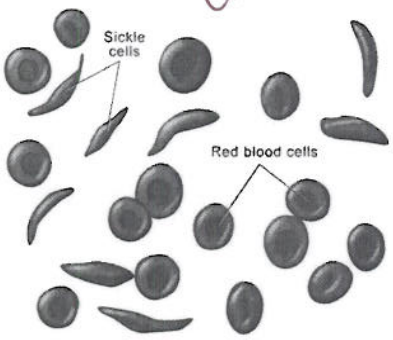
Why?

Gene and Chromosome Mutation Worksheet

(reference pgs. 239-240 in *Modern Biology* textbook)

8. Below is the DNA base sequence for the normal protein for normal hemoglobin and the base sequence for (abnormal) sickle cell hemoglobin:

Use Codon Chart



Normal GGG CTT CTT TTT
Sickle GGG CAT CTT TTT

A. *Transcribe* and *translate* the normal and sickle cell DNA.

B. Identify this as a point or frameshift mutation. Explain.

C. If the base sequence read GGG CTT CTT AAA instead, would this result in sickle cell hemoglobin? Explain.

Chromosomal Mutations

- Alterations of chromosome number or structure cause some genetic disorders
- Large-scale chromosomal alterations often lead to spontaneous abortions or cause a variety of developmental disorders, or even cancers.
- Breakage of a chromosome can lead to four types of changes in chromosome structure:

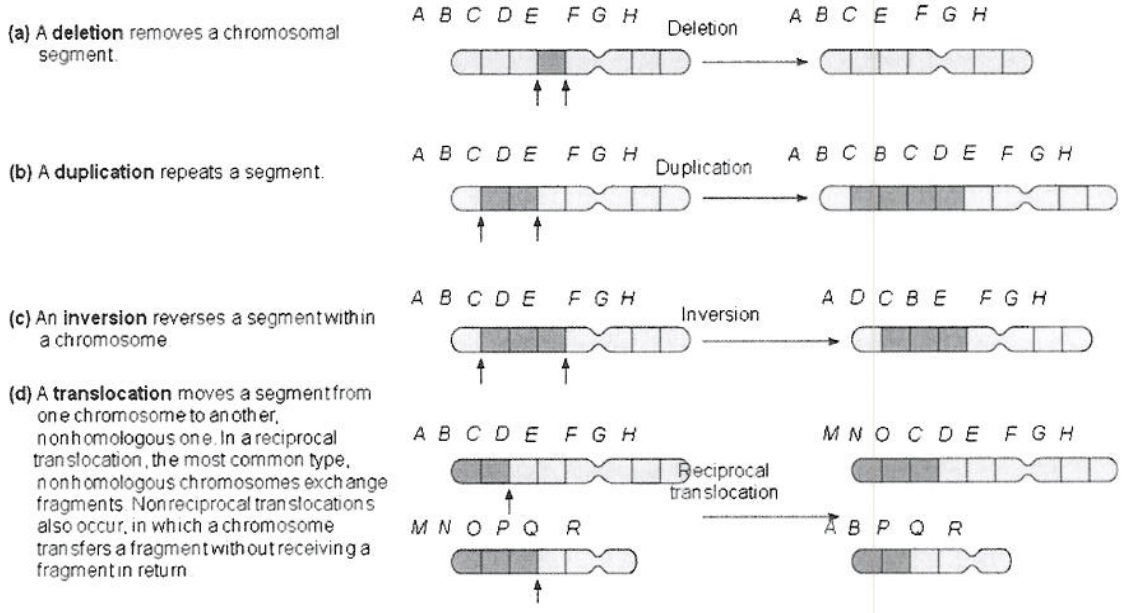


Figure 15.14a–d

Gene and Chromosome Mutation Worksheet
(reference pgs. 239-240 in *Modern Biology* textbook)

9. *Match the chromosome mutation with its description.*

____1. Translocation ____2. Inversion ____3. Deletion ____4. Duplication	A). A portion of the chromosome is missing or deleted. Known disorders in humans include Wolf-Hirschhorn syndrome, which is caused by partial deletion of the short arm of chromosome 4; Cri du chat syndrome is due to a partial deletion of the short arm of chromosome number 5. B). A portion of the chromosome is duplicated, resulting in extra genetic material. Known human disorders include Charcot-Marie-Tooth disease type 1A which may be caused by duplication of the gene encoding peripheral myelin protein 22 (PMP22) on chromosome 17. C). When a portion of one chromosome is transferred to another chromosome. Sometimes, parts of different chromosomes switch places (reciprocal exchange). D). A portion of the chromosome has broken off, turned upside down and reattached, therefore the genetic material is backward.

10. Why are chromosome mutations potentially more serious than gene mutations?

Codons in mRNA

First base	Second base U	Second base C	Second base A	Second base G	Third base
U	UUU Phenylalanine	UCU Serine	UAU Tyrosine	UGU Cysteine	U
	UUC Phenylalanine	UCC Serine	UAC Tyrosine	UGC Cysteine	C
	UUA Leucine	UCA Serine	UAA Stop	UGA Stop	A
	UUG Leucine	UCG Serine	UAG Stop	UGG Tryptophan	G
C	CUU Leucine	CCU Proline	CAU Histidine	CGU Arginine	U
	CUC Leucine	CCC Proline	CAC Histidine	CGC Arginine	C
	CUA Leucine	CCA Proline	CAA Glutamine	CGA Arginine	A
	CUG Leucine	CCG Proline	CAG Glutamine	CGG Arginine	G
A	AUU Isolecine	ACU Threonine	AAU Asparagine	AGU Serine	U
	AUC Isolecine	ACC Threonine	AAC Asparagine	AGC Serine	C
	AUA Isolecine	ACA Threonine	AAA Lysine	AGA Arginine	A
	AUG Methionine (Start)	ACG Threonine	AAG Lysine	AGG Arginine	G
G	GUU Valine	GCU Alanine	GAU Aspartic acid	GGU Glycine	U
	GUC Valine	GCC Alanine	GAC Aspartic acid	GGC Glycine	C
	GUA Valine	GCA Alanine	GAA Glutamic acid	GGA Glycine	A
	GUG Valine	GCG Alanine	GAG Glutamic acid	GGG Glycine	G