# Chapter 14 – Genetic Variations

I. Introduction

A. Genes control \_\_\_\_\_ Traits through the Synthesis of \_\_\_\_\_

1. \_\_\_\_\_ specifies Traits by dictating Protein Synthesis.
2. Proteins are the links between genotype and phenotype.
3. The molecular chain of command is from
4. \_\_\_\_\_ in the nucleus to \_\_\_\_\_
5. \_\_\_\_\_ in the \_\_\_\_\_ to \_\_\_\_\_
6. where \_\_\_\_\_ acids 🡪 \_\_\_\_\_

B. \_\_\_\_\_ of Traits

1. \_\_\_\_\_ only determine potential capacities.
2. \_\_\_\_\_ factors play a large role in genetic expression.

\_\_\_\_\_ + \_\_\_\_\_ = Expression of Trait

C. Genetic \_\_\_\_\_

1. Normal and Abnormal types of genetic variation exist.
2. Variation is critical for the \_\_\_\_\_ of a population (e.g. \_\_\_\_\_).
3. Occurs as a result of different \_\_\_\_\_ for a trait.

D. Normal Genetic Variation

* 1. Occurs in \_\_\_\_\_ by
     1. Independent Assortment
     2. \_\_\_\_\_ \_\_\_\_\_ occurs when homologous chromosomes \_\_\_\_\_ pieces of the chromosomes as they are twisted around one another
     3. This results in an equal swap of the \_\_\_\_\_ involved.

E. \_\_\_\_\_ Genetic Variation – \_\_\_\_\_

1. May occur in \_\_\_\_\_ cells (are \_\_\_\_\_ passed to offspring).
2. May occur in \_\_\_\_\_ (germ cells) (eggs and sperm) and be passed to \_\_\_\_\_.
3. Can affect one \_\_\_\_\_ only or larger \_\_\_\_\_ of chromosomes.
4. A mutation is any \_\_\_\_\_ in structure or genetic material.
5. Any change in a cell can be considered a mutation and may NOT be inherited or passed on to offspring. Tumors, warts, moles.
6. A \_\_\_\_\_ mutation is a change in the \_\_\_\_\_ and will be \_\_\_\_\_ or passed onto offspring. However, many mutations involved \_\_\_\_\_ traits and are \_\_\_\_\_.

II. Gene Mutations

A. Introduction

1. Changes in the normal \_\_\_\_\_ sequence of a gene.
2. Almost all cause \_\_\_\_\_ or death to the organism.
3. They arise from a number of different mechanisms.

B. Types of Gene Mutations

1. Change in Chromosome \_\_\_\_\_
   * 1. \_\_\_\_\_ Non-disjunction
     2. Having more or less chromosomes
   1. \_\_\_\_\_
      1. \_\_\_\_\_ of the 2n (\_\_\_\_\_) number
   2. Somatic Cells (not inherited) vs Sex Cells (inherited)
2. Change in Chromosome \_\_\_\_\_
   1. Deletions, Translocations, Duplications, Inversions
   2. Point Mutations

C. \_\_\_\_\_ Mutations

1. \_\_\_\_\_
2. Silent
3. Missense – new protein (Amino Acid Substitutions)
4. Nonsense – stop codon
5. \_\_\_\_\_ and \_\_\_\_\_
6. Triplet Repeats
7. \_\_\_\_\_ Mutations
8. General Information
9. Change of a \_\_\_\_\_ nucleotide.
10. Includes the deletion, addition, or substitution of ONE nucleotide in a gene.
11. Occurs when \_\_\_\_\_ is replicated during \_\_\_\_\_ and \_\_\_\_\_, and a mistake occurs.

D. Point Mutations: \_\_\_\_\_

1. An incorrect nucleotide is inserted into the DNA instead of the correct one.
2. Example:

A-T-A-G-G-G-C

A-T-A-**A**-G-G-C

1. \_\_\_\_\_ Mutation
2. A substitution mutation that does \_\_\_\_\_ cause any observable change in the protein or the function of the protein that the gene codes for.
3. Example:
   * Both AAA and AAG code for phenylalanine.
   * If the third A in AAA undergoes a substitution mutation so that A is changed to a G, then it still codes for phenylalanine
4. A substitution mutation can occur that alters a group of nucleotides in such a way that the amino acid is changed.
5. But, if the new amino acid has similar \_\_\_\_\_ to the original amino acid, then the protein may still function normally.
6. \_\_\_\_\_ Mutation
7. Caused by Substitutions
8. It changes the group of nucleotides and results in the insertion of the \_\_\_\_\_ amino acid into the protein during protein synthesis.
9. The results could be \_\_\_\_\_ or silent.
10. Sickle Cell Disease is the result of one nucleotide substitution.

* Occurs in the hemoglobin gene.
* Hemoglobin is a protein that carries oxygen to our cells and carbon dioxide away from the cells. Exists inside our red blood cells.
* This mutation changes the “A” in “GAG” to a “T”.
* During translation, this results in the amino acid valine being inserted into the protein instead of the correct amino acid: glutamic acid.
* Because of this “minor” change a completely dysfunctional hemoglobin molecule is formed.
* Causes Sickle Cell Disease, a very severe blood disease that mainly affects people of African descent.

1. \_\_\_\_\_ Mutations
2. Caused by Substitutions
3. It alters an amino acid encoding group of nucleotides into a \_\_\_\_\_ signaling group.
4. When the message is read by the ribosome, the protein will stop being made too early.
5. It will be smaller and minimally functional.

E. Deletion and Addition Point Mutations

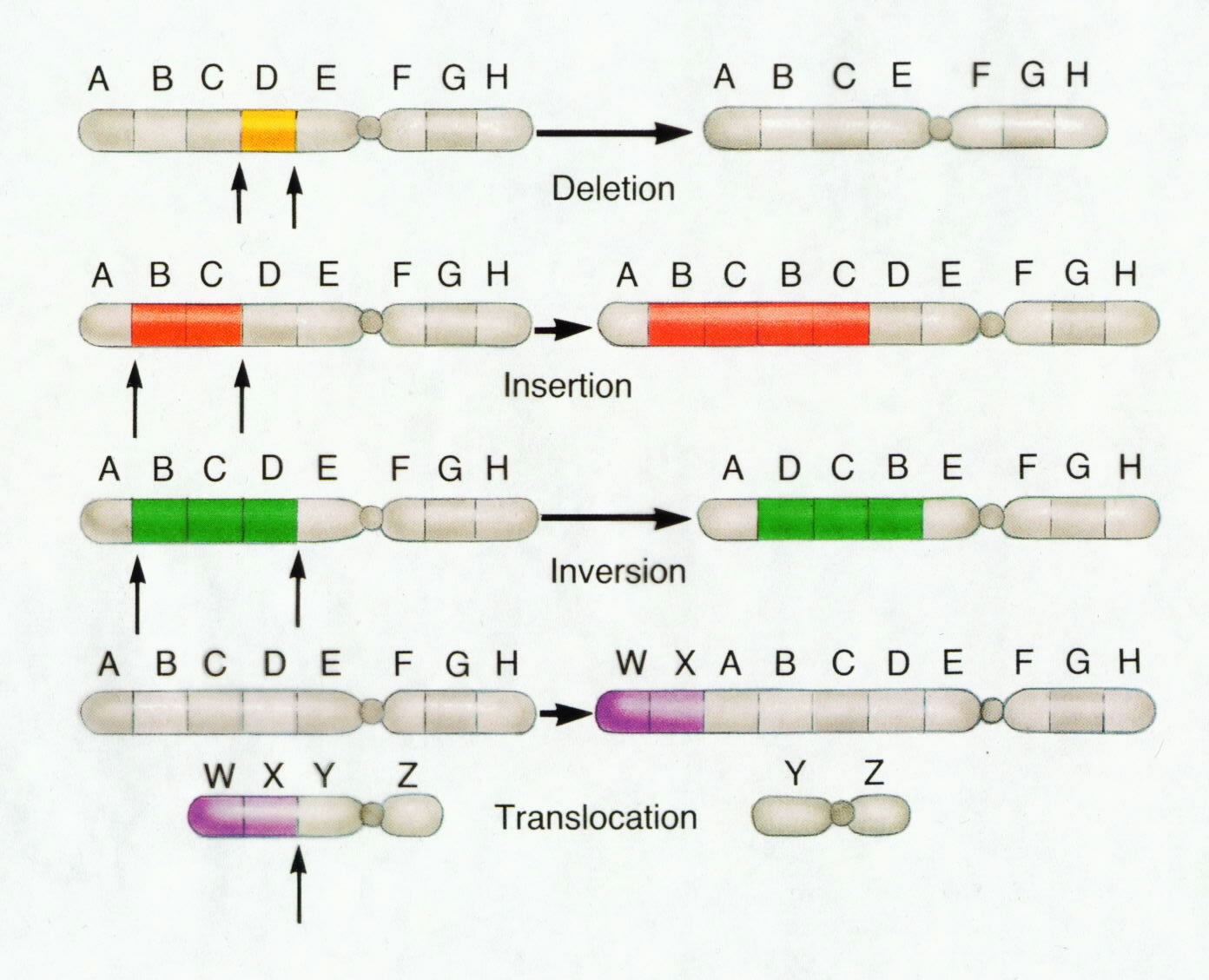
1. \_\_\_\_\_: occur when a nucleotide is \_\_\_\_\_ of its proper sequence
2. \_\_\_\_\_: occur when a single nucleotide is added during replication
3. Since RNA translates DNA 3 base sequences (\_\_\_\_\_), the exact sequence must be maintained = \_\_\_\_\_ \_\_\_\_\_.
4. \_\_\_\_\_ mutations DO \_\_\_\_\_ alter the reading frame.
5. \_\_\_\_\_ and \_\_\_\_\_ mutations alter the reading frame.

F. \_\_\_\_\_ shift mutations

1. Result from \_\_\_\_\_ or \_\_\_\_\_ point mutations.
2. These are usually more harmful than substitution mutations.
3. Example
4. Normal: THE DOG RAN AND ATE THE PIG
5. Mutated: THE DGR ANA NDA TET HEP IG
6. This is a \_\_\_\_\_ mutation (“O” in DOG)
7. Example
8. Original: THE FAT CAT ATE THE WEE RAT
9. Frame Shift (“a” added): THE FAT CAA TET HEW EER AT
10. This was due to an \_\_\_\_\_ point mutation.

III. Chromosome \_\_\_\_\_ Mutations

1. General Information
2. May Involve changing the STRUCTURE of a chromosome.
3. The \_\_\_\_\_ or \_\_\_\_\_ of part of a chromosome.
4. Most occur during mitosis and \_\_\_\_\_.
5. Five types exist:



1. Deletion
2. Inversion
3. Duplication
4. Translocation
5. Nondisjunction
6. Structural \_\_\_\_\_ Mutation
7. Due to \_\_\_\_\_.
8. A piece of a chromosome is lost.
9. Usually results in \_\_\_\_\_ of organism.
10. Structural \_\_\_\_\_ Mutation
11. Chromosome segment breaks off.
12. Segment \_\_\_\_\_ around backwards.
13. Segment \_\_\_\_\_ into the same chromosome.
14. Structural \_\_\_\_\_ Mutation
15. Occurs when a piece of one homologous chromosome breaks off and is inserted into the other \_\_\_\_\_ chromosome.
16. Since the chromosomes are homologues, the chromosome that donated the segment has undergone a deletion mutation and the chromosome that receives the segment has duplication of genes.
17. Structural \_\_\_\_\_ Mutation
18. Involves two chromosomes that aren’t homologous.
19. A \_\_\_\_\_ of a chromosome breaks off of one chromosome and inserts into a \_\_\_\_\_-\_\_\_\_\_ chromosome.
20. \_\_\_\_\_ Chromosomal Mutation
21. \_\_\_\_\_ of chromosomes to \_\_\_\_\_ during \_\_\_\_\_
22. Causes gamete to have too many or too few chromosomes
23. E.g. Down Syndrome (\_\_\_\_\_ -21)

IV. M\_\_\_\_\_

1. Factors that are known to cause mutations (changes in DNA which lead to cancer)
2. \_\_\_\_\_ conditions might trigger a cell to become cancerous.
3. R\_\_\_\_\_
4. D\_\_\_\_\_ & M\_\_\_\_\_
5. V\_\_\_\_\_
6. C\_\_\_\_\_
7. Materials (e.g. asbestos)

V. How is genetics used to produce desired traits in an organism?

A. \_\_\_\_\_ Breeding & Society

1. The world food supply has been greatly enhanced by selective breeding and \_\_\_\_\_ engineering.
2. Hybridization is very important in producing new varieties of organisms.
3. Selective \_\_\_\_\_ produced many kinds of flowers, pets, and other organisms.
4. \_\_\_\_\_ selection
5. Selective breeding is the same as artificial selection.
6. Human intervention in animal or plant reproduction to \_\_\_\_\_ that certain \_\_\_\_\_ traits or combinations of traits are \_\_\_\_\_ on to future generations.
7. Artificial selection is goal-directed and purposeful.
8. Natural selection is directed by survival in the environment.
9. Selective Breeding of Organisms for Food
10. Plants:
11. Faster \_\_\_\_\_
12. Higher \_\_\_\_\_
13. Disease \_\_\_\_\_
14. Higher \_\_\_\_\_ value
15. Animals:
16. Faster growth
17. Greater \_\_\_\_\_ (less aggression)
18. Higher milk, egg, honey, or meat production
19. Process of Selective Breeding
20. Step 1 Choose which \_\_\_\_\_ to breed for.
21. Step 2 \_\_\_\_\_ individuals having those characteristics.
22. Step 3 Choose which characteristics to breed for.
23. Step 4 Breed individuals having those characteristics.
24. Selective Breeding
25. Selective breeding is a form of \_\_\_\_\_ selection to produce plants and animals with more \_\_\_\_\_ traits.
26. Selective breeding is goal-directed, not \_\_\_\_\_ like natural selection.
27. The process involves choosing the best parents to breed, then breeding offspring to build up traits in a population.
28. Some problems include \_\_\_\_\_ — buildup of \_\_\_\_\_ genes — and decreased population \_\_\_\_\_.
29. Wild mustard and wild cattle have been extensively selected.
30. H\_\_\_\_\_
31. Breeding between individual organisms with different parentage; reproduction between organisms that are \_\_\_\_\_ \_\_\_\_\_.
32. Mendel is the best-known early plant hybridizer.
33. Many crops are hybrids, combining good traits from different sources to restore “hybrid \_\_\_\_\_.”
34. Potential Problems with Artificial Selection – \_\_\_\_\_
35. Breeding between individual organisms who share \_\_\_\_\_ genetic makeup or parentage; reproduction between organisms that are \_\_\_\_\_ \_\_\_\_\_.
36. Inbreeding causes unintended \_\_\_\_\_:
37. Negative, \_\_\_\_\_ traits build up in the population.
38. The population becomes weaker and has less \_\_\_\_\_.
39. \_\_\_\_\_ decreases in populations.
40. E.g. hemophilia
41. Identifying Future Traits for Breeding
42. \_\_\_\_\_ to pesticides
43. addition of genes to make animal protein
44. resistance to insects, fungi, and other pests
45. addition of genes to \_\_\_\_\_ color and taste
46. \_\_\_\_\_ for specific climates (heat, cold, drought)
47. addition of genes to \_\_\_\_\_ concentrations of essential vitamins
48. modification of food’s appearance to make it more \_\_\_\_\_ to consumers