Name: _____ Note Set 25

# CHAPTER 10.2—10.5, 17.1, 17.5: Beyond Mendel/Genetic Diseases

1. Define and give an example of pleiotropy.

_____

_____

2. Describe and give an example of incomplete dominance.

_____

_____

3. Describe and give an example of environmental effects on gene expression.

_____

_____

4. Define and give an example of epistasis.

_____

_____

5. Explain what a quantitative trait is. Give an example. What causes a trait to exhibit continuous variation?

_____

_____

6. Describe and give an example of codominance.

_____

_____

7. How is blood type an example of multiple alleles?

_____

_____

8. Describe Thomas Hunt Morgan's first mutant fruit fly. Why was this fly so significant?

_____

_____

9. Show the cross P, F1, F2 for the white-eyed male mutant, with a wild type female.

10. What is meant by a trait being sex-linked?

_____

_____

11. Why are sex-linked recessive traits more common in males than females?

_____

_____

12. What happens when we trace the inheritance of traits found on the same chromosome?

_____

_____

13. Explain how two genes on the same chromosome can still assort independently.

_____

_____

_____

14. What is genetic recombination and when does it occur?

_____

_____

15. How is recombination frequency used to develop a genetic map?

_____

_____

16. Explain the difference between autosomal chromosomes and sex chromosomes.

_____

_____

17. What determines sex in humans? _____

_____

18. How many X chromosomes are typically expressed in humans? _____

19. List and describe a few specific examples of non-disjunctions that occur in humans.

a. _____

b. _____

c. _____

d. _____

20. How can a parent learn the risks of having a child with a genetic disorder?

_____

_____

_____

21. Explain procedures that can be used to detect genetic defects early in pregnancy.

a. _____

_____

b. _____

_____

22. Briefly describe each of the following genetic disorders:

a. Tay-Sachs _____

_____

b. Huntington disease _____

_____

c. Hemophilia _____

_____

d. Sickle cell anemia _____

_____

23. Why are most genetic defects related to enzyme function recessive disorders?

_____

24. Are all genetic disorders recessive? _____

## END OF CHAPTER 10 MULTIPLE CHOICE

1. In a simple Mendelian monohybrid cross, tall plants are crossed with short plants, and the $F_1$ plants are allowed to self-pollinate. What fraction of the $F_2$ generation are both tall and heterozygous?
   A) 1/8
   B) 1/4
   C) 1/3
   D) 2/3
   E) 1/2

2. The phenotype of an individual
   A) depends at least in part on the genotype.
   B) is either homozygous or heterozygous.
   C) determines the genotype.
   D) is the genetic constitution of the organism.
   E) is either monohybrid or dihybrid.

3. The ABO blood groups in humans are determined by a multiple-allele system in which $I^A$ and $I^B$ are codominant and dominant to $i^O$. A newborn infant is type A. The mother is type O. Possible genotypes of the father are
   A) A, B, or AB
   B) A, B, or O
   C) O only
   D) A or AB
   E) A or O

4. Which statement about an individual that is homozygous for an allele is not true?
   A) Each of its cells possesses two copies of that allele.
   B) Each of its gametes contains one copy of that allele.
   C) It is true-breeding with respect to that allele.
   D) Its parents were necessarily homozygous for that allele.
   E) It can pass that allele to its offspring.

5. Which statement about a test cross is not true?
   A) It tests whether an unknown individual is homozygous or heterozygous.
   B) The test individual is crossed with a homozygous recessive individual.
   C) If the test individual is heterozygous, the progeny will have a 1:1 ratio.
   D) If the test individual is homozygous, the progeny will have a 3:1 ratio.
   E) Test cross results are consistent with Mendel's model of inheritance.

6. Linked genes
   A) must be immediately adjacent to one another on a chromosome.
   B) have alleles that assort independently of one another.
   C) never show crossing over.
   D) are on the same chromosome.
   E) always have multiple alleles.

7. In the $F_2$ generation of a dihybrid cross
   A) four phenotypes appear in the ratio 9:3:3:1 if the loci are linked.
   B) four phenotypes appear in the ratio 9:3:3:1 if the loci are unlinked.
   C) two phenotypes appear in the ratio 3:1 if the loci are unlinked.
   D) three phenotypes appear in the ratio 1:2:1 if the loci are unlinked.
   E) two phenotypes appear in the ratio 1:1 whether or not the loci are linked.

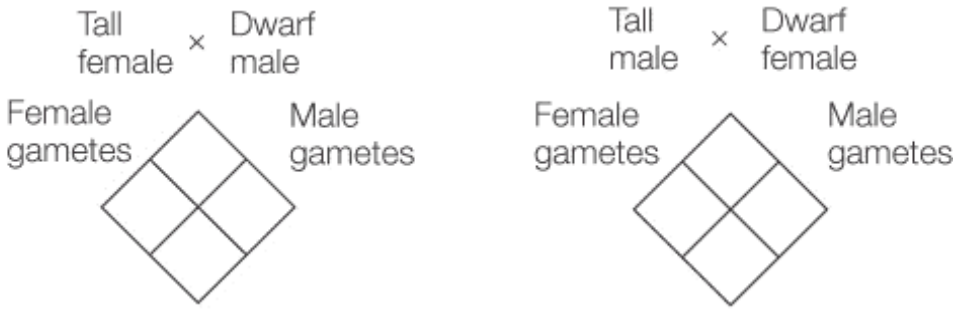
8. The genetic sex of a human is determined by
   A) ploidy, with the male being haploid.
   B) the Y chromosome.
   C) X and Y chromosomes, the male being XX.
   D) the number of X chromosomes, the male being XO.
   E) Z and W chromosomes, the male being ZZ.

9. In epistasis
   A) nothing changes from generation to generation.
   B) one gene alters the effect of another.
   C) a portion of a chromosome is deleted.
   D) a portion of a chromosome is inverted.
   E) the behavior of two genes is entirely independent.

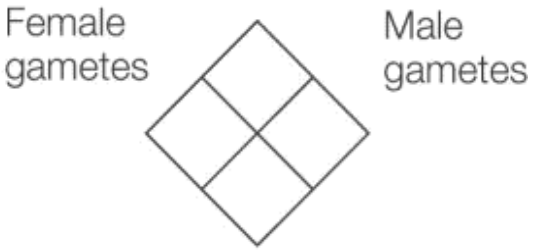
10. In humans, spotted teeth are caused by a dominant sex-linked gene. A man with spotted teeth whose mother had normal teeth marries a woman with normal teeth. Therefore,
    A) all of their daughters will have normal teeth.
    B) all of their daughters will have spotted teeth.
    C) all of their children will have spotted teeth.
    D) half of their sons will have spotted teeth.
    E) all of their sons will have spotted teeth.

## END OF CHAPTER 10 GENETICS QUESTIONS

11. Using the Punnett squares below, show that for typical dominant and recessive autosomal traits, it does not matter which parent contributes the dominant allele and which the recessive allele. Cross true-breeding tall plants (*TT*) with true-breeding dwarf plants (*tt*).




12. Show diagrammatically what occurs when the $F_1$ offspring of the cross in Question 1 self-pollinate.



13. A new student of genetics suspects that a particular recessive trait in fruit flies (dumpy wings, which are somewhat smaller and more bell-shaped than the wild type) is sex-linked. A single mating between a fly with dumpy wings (*dp*; female) and a fly with wild-type wings (*Dp*; male) produces three dumpy-winged females and two wild-type males in the $F_1$ generation. On the basis of these data, is the trait sex-linked or autosomal? What were the genotypes of the parents? Explain how these conclusions can be reached on the basis of so few data.

14. The photograph shows the shells of 15 bay scallops, *Argopecten irradians*. These scallops are hermaphroditic; that is, a single individual can reproduce sexually, as did the pea plants of the $F_1$ generation in Mendel's experiments. Three color schemes are evident: yellow, orange, and black and white. The color-determining gene has three alleles. The top row shows a yellow scallop and a representative sample of its offspring, the middle row shows a black-and-white scallop and its offspring, and the bottom row shows an orange scallop and its offspring. Assign a suitable symbol to each of the three alleles participating in color control; then determine the genotype of each of the three parent individuals and tell what you can about the genotypes of the different offspring. Explain your results carefully.

15. The sex of some fishes is determined by the same XY system as in humans. An allele of one locus on the Y chromosome of the fish *Lebistes* causes a pigmented spot to appear on the dorsal fin. A male fish that has a spotted dorsal fin is mated with a female fish that has an unspotted fin. Describe the phenotypes of the $F_1$ and the $F_2$ generations from this cross.

16. In *Drosophila melanogaster*, the recessive allele *p*, when homo zygous, determines pink eyes. *Pp* or *PP* results in wild-type eye color. Another gene, on another chromosome, has a recessive allele, *sw*, that produces short wings when homozygous. Consider a cross between females of genotype *PPSwSw* and males of genotype *ppswsw*. Describe the phenotypes and genotypes of the $F_1$ generation and of the $F_2$ generation produced by allowing the $F_1$ progeny to mate with one another.

17. On the same chromosome of *Drosophila melanogaster* that carries the *p* (pink eyes) locus, there is another locus that affects the wings. Homozygous recessives, *byby*, have blistery wings, while the dominant allele *By* produces wild-type wings. The *P* and *By* loci are very close together on the chromosome; that is, the two loci are tightly linked. In answering these questions, assume that no crossing over occurs.
*a*. For the cross *PPByBy* × *ppbyby*, give the phenotypes and genotypes of the $F_1$ and of the $F_2$ generations produced by interbreeding of the $F_1$ progeny.
*b*. For the cross *PPbyby* × *ppByBy*, give the phenotypes and genotypes of the $F_1$ and of the $F_2$ generations.
*c*. For the cross of Question 7*b*, what further phenotype(s) would appear in the $F_2$ generation if crossing over occurred?
*d*. Draw a nucleus undergoing meiosis at the stage in which the crossing over (Question 7*c*) occurred. In which generation (P, $F_1$, or $F_2$) did this crossing over take place?

18. Consider the following cross of *Drosophila melanogaster* (alleles are as described in Question 6): Males with genotype *Ppswsw* are crossed with females of genotype *ppSwsw*. Describe the phenotypes and genotypes of the $F_1$ generation.

19. In the Andalusian fowl, a single pair of alleles for one gene controls the color of the feathers. Three colors are observed: blue, black, and splashed white. Crosses among these three types yield the following results:

| **Parents** | **Progeny** |
|---|---|
| Black × blue | Blue and black (1:1) |
| Black × splashed white | Blue |
| Blue × splashed white | Blue and splashed white (1:1) |
| Black × ?black | Black |
| Splashed white × | Splashed white |
| splashed white | |

a. What progeny would result from the cross blue ? blue?
b. If you wanted to sell eggs, all of which would yield blue fowl, how should you proceed?

20. In *Drosophila melanogaster*, white (*w*), eosin ($w^e$), and wild-type red ($w^+$) are multiple alleles at a single locus for eye color. This locus is on the X chromosome. A female that has eosin (pale orange) eyes is crossed with a male that has wild-type eyes. All the female progeny are red-eyed; half the male offspring have eosin eyes, and half have white eyes.
    *a*. What is the order of dominance of these alleles?
    *b*. What are the genotypes of the parents and progeny?

21. Red-green color blindness is a recessive trait. Two people with normal vision have two sons, one color-blind and one with normal vision. If the couple also has daughters, what proportion of them will have normal vision? Explain.

22. A mouse with an agouti coat is mated with an albino mouse of genotype *aabb*. Half of the offspring are albino, one-fourth are black, and one-fourth are agouti. What are the genotypes of the agouti parents and of the various kinds of offspring? (Hint: See the section on epistasis.)

23. The disease Leber's optic neuropathy is caused by a mutation in a gene carried on mitochondrial DNA. What would be the phenotype of their first child if a man with this disease married a woman who did not have the disease? What would be the result if the wife had the disease and the husband did not?

# Answer Key to CHAPTER 10 GENETICS PROBLEMS

11. Each of the eight boxes in the Punnett squares should contain the genotype *Tt*, regardless of which parent was tall and which dwarf.
12. See Figure 10.4, page 212.
13. The trait is autosomal. Mother *dp dp*, father *Dp dp*. If the trait were sexlinked, all daughters would be wild-type and sons would be *dumpy*.
14. Yellow parent = $s^{Y}s^{b}$; offspring 3 yellow ($s^{Y}$–): 1 black ($s^{b}s^{b}$). Black parent = $s^{b}s^{b}$; offspring all black ($s^{b}s^{b}$). Orange parent = $s^{O}s^{b}$; offspring 3 orange ($s^{O}$–): 1 black ($s^{b}s^{b}$). Both $s^{O}$ and $s^{Y}$ are dominant to $s^{b}$.
15. All females wild-type; all males spotted.
16. F1 all wild-type, *PpSwsw*; F2 9:3:3:1 in phenotypes. See Figure 10.7, page 214, for analogous genotypes.
17. *a*. Ratio of phenotypes in F2 is 3:1 (double dominant to double recessive).
    *b*.The F1 are *Pby pBY*; they produce just two kinds of gametes (*Pby* and *pBy*). Combine them carefully and see the 1:2:1 phenotypic ratio fall out in the F2.
    *c*. Pink-blistery.
    *d*. See Figures 9.16 and 9.18 (pages 196–198). Crossing over took place in the F1 generation.
18. The genotypes are:
    *PpSwsw*
    *Ppswsw*
    *ppSwsw*
    *ppswsw*
    Ratio: 1:1:1:1
    The phenotypes are:
    wild eye, long wing  pink eye, long wing
    wild eye, short wing  pink eye, short wing
    Ratio: 1:1:1:1
19. *a*. 1 black:2 blue:1 splashed white
    *b*.Always cross black with splashed white.
20. *a*. $w^{+} > w^{e} > w$
    *b*. Parents $w^{e}w$ and $w^{+Y}$. Progeny $w^{+}w^{e}$, $w^{+}w$, $w^{eY}$, and $w^{Y}$.
21. All will have normal vision because they inherit dad's wild-type X chromosome, but half of them will be carriers.
22. Agouti parent *AaBb*. Albino offspring *aaBb* and *aabb*; black offspring *Aabb*; agouti offspring *AaBb*.
23. Because the gene is carried on mitochondrial DNA, it is passed through the mother only. Thus if the woman does not have the disease but her husband does, their child will not be affected. On the other hand, if the woman has the disease but her husband does not, their child *will* have the disease.