

CHAPTER 10: More Genetics Problems

Solve these genetics problems. Be sure to complete the Punnett square to show how you derived your solution.

Simple Dominance

1. In humans the allele for albinism is recessive to the allele for normal skin pigmentation. If two heterozygotes have children, what is the chance that a child will have normal skin pigment? What is the chance that a child will be albino?

normal pigment

albino

- a) **If the child is normal**, what is the chance that it is a carrier(heterozygous) for the albino allele?

2. In purple people eaters, one-horn is dominant and no horns is recessive. Show the cross of a purple people eater that is heterozygous for horns with a purple people eater that does not have horns. Summarize the genotypes & phenotypes of the possible offspring?

3. In humans, the brown-eye (B) allele is dominant to the blue-eye allele (b). If two heterozygotes mate, what will be the likely genotype and phenotype ratios of the offspring.

4. In seals, the gene for the length of the whiskers has two alleles. The dominant allele (W) codes long whiskers & the recessive allele (w) codes for short whiskers. What percentage of offspring would be expected to have short whiskers from the cross of two long-whiskered seals, one that is homozygous dominant and one that is heterozygous?

5. In pea plants, the green color allele (G) is dominant over yellow color allele (g) for seed color and tall (T) is the dominant allele in plant height. Parents heterozygous for both traits are cross-pollinated. Determine the frequency for the four different phenotypes of the offspring.

Tall plant, green seeds:

Tall plant, yellow seeds:

Short plant, green seeds:

Short plant, yellow seeds:

6. Now let's try a shortcut way of solving that same dihybrid cross. Because of Mendel's (2nd) Law of Independent Assortment, you can work with the color gene and the height gene separately... so set up two separate monohybrid crosses from those same parents:

Now use the laws of probability to calculate your frequencies of each trait alone and combined:

	height	color	= P		height	color	= P
Tall plant, green seeds				Short plant, green seeds			
Tall plant, yellow seeds				Short plant, yellow seeds			

Incomplete Dominance

7. In radishes, the gene that controls color exhibits incomplete dominance. Pure-breeding red radishes crossed with pure-breeding white radishes make purple radishes. What are the genotypic and phenotypic ratios when you cross a purple radish with a white radish?

8. Certain breeds of cattle show incomplete dominance in coat color. When pure breeding red cows are bred with pure breeding white cows, the offspring are roan (a pinkish coat color). Summarize the genotypes & phenotypes of the possible offspring when a roan cow is mated with a roan bull.

Co-Dominance

9. A man with type AB blood marries a woman with type B blood. Her mother has type O blood. List the expected phenotype & genotype frequencies of their children.

10. The father of a child has type AB blood. The mother has type A. Which blood types can their children NOT have?
11. A woman with type A blood and a man with type B blood could potentially have offspring with what blood types?
12. The mother has type A blood. Her husband has type B blood. Their child has type O blood. The father claims the child can't be his. Is he right?
13. The mother has type B blood. Her husband has type AB blood. Their child has type O blood. The father claims the child can't be his. Is he right?
14. The mother has type AB blood. The father has type B blood. His mother has type O blood. What are all the possibilities of blood type for their children?

Lethal Dominant

15. Achondroplasia (dwarfism) is caused by a dominant gene. A woman and a man both with dwarfism marry. If homozygous achondroplasia results in death of embryos, list the genotypes and phenotypes of all potential live-birth offspring.

What is the expected ratio of dwarfism to normal offspring?

Sex-Linked

16. The genes for hemophilia are located on the X chromosome. List the possible genotypes and phenotypes of the children from a man normal for blood clotting and a woman who is a carrier. (HINT: You have to keep track of what sex the children are!)

Probability Practice

17. In humans, curly hair is dominant over straight hair. A woman heterozygous for hair curl marries a man with straight hair and they have children.

- a. What is the genotype of the mother? _____
- b. What gametes can she produce? _____
- c. What is the genotype of the father? _____
- d. What gametes can he produce? _____
- e. What is the probability that the 1st child will have curly hair? _____
- f. What is the probability that the 2nd child will have curly hair? _____

18. List all the gametes that are possible with each of the following genotypes:

- a. Aabb _____
- b. AaBB _____
- c. AaBb _____
- d. AABb _____
- e. AAbb _____
- f. aabb _____

19. What is the probability of getting the gamete (**ab**) from each of the following parents?

- a. Aabb _____
- b. aaBb _____
- c. AaBb _____
- d. AABb _____
- e. AAbb _____

20. In a certain strain of mice, black coat (B) is dominant over white coat (b). Describe what you would do to determine the genotype of a male with a black coat and how this would give you your answer.

21. What is the probability of each of the following sets of parents producing the given genotypes in their offspring?

Parental Genoytpe	Offspring Genotype	Probability
Aa X Aa	Aa	
Aa X aa	Aa	
AaBb X AaBB	AABB	
AaBb X AABb	aabb	
AaBb X AaBb	AaBb	

22. If an offspring has the genotype Aa, what possible combinations of parental genotypes could have produced this offspring?

23. In corn, the trait for tall plants (T) is dominant to the trait for dwarf plants (t) and the trait for colored kernels (C) is dominant to the trait for white kernels (c). In a particular cross of corn plants, the probability of an offspring being tall is $1/2$ and the probability of a kernel being colored is $3/4$. Which of the following most probably represents the parental genotype? Include your work to show how you derived your solution.

- TtCc x ttCc
- TtCc x TtCc
- TtCc x ttcc
- TTCc x ttCc
- TTCc x TtCC

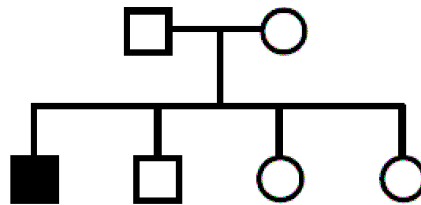
24. In humans, the allele for albinism (lack of pigment) is recessive to the allele for normal skin pigmentation.

- a. If two heterozygous parents have children what is the chance that a child will be albino?
- b. If the child is normal, what is the chance that it is a carrier (heterozygous) for the albino allele?
- c. If normal parents have an albino child, what is the probability that their next child will be normal for pigment?

25. In a cross between a female **AaBbccDdee** and a male **AabbCcDdee**, what proportion of the progeny will be the same **phenotype** as the female parent? (Assume independent assortment of all genes and complete dominance).

Probability Practice

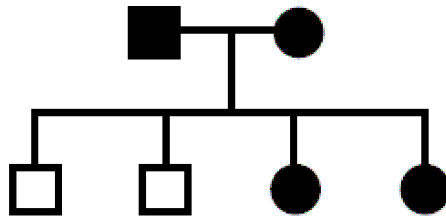
26. Could the following pedigree be inherited as a simple...



If "YES", then suggested genotypes of **father** **mother**

- | | | | |
|-------------------------|------------|-----------|----------------------|
| a. autosomal recessive? | YES | NO | _____ X _____ |
| b. autosomal dominant? | YES | NO | _____ X _____ |
| c. X-linked recessive? | YES | NO | _____ X _____ |
| d. X-linked dominant? | YES | NO | _____ X _____ |
| e. Y-linked trait? | YES | NO | _____ X _____ |

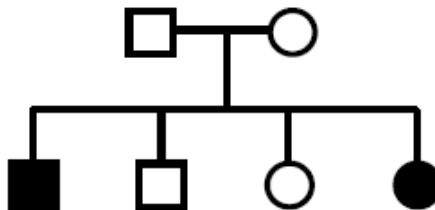
27. Could the following pedigree be inherited as a simple...



If "YES", then
suggested genotypes of
father **mother**

- | | | | |
|-------------------------|------------|-----------|----------------------|
| a. autosomal recessive? | YES | NO | _____ X _____ |
| b. autosomal dominant? | YES | NO | _____ X _____ |
| c. X-linked recessive? | YES | NO | _____ X _____ |
| d. X-linked dominant? | YES | NO | _____ X _____ |
| e. Y-linked trait? | YES | NO | _____ X _____ |

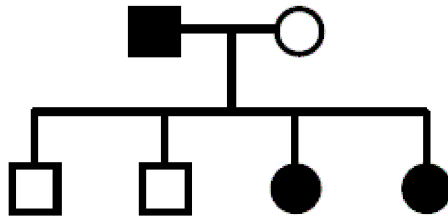
28. Could the following pedigree be inherited as a simple...



If "YES", then
suggested genotypes of
father **mother**

- | | | | |
|-------------------------|------------|-----------|----------------------|
| a. autosomal recessive? | YES | NO | _____ X _____ |
| b. autosomal dominant? | YES | NO | _____ X _____ |
| c. X-linked recessive? | YES | NO | _____ X _____ |
| d. X-linked dominant? | YES | NO | _____ X _____ |
| e. Y-linked trait? | YES | NO | _____ X _____ |

29. Could the following pedigree be inherited as a simple...



If "**YES**", then
suggested genotypes of
father **mother**

- | | | | |
|-------------------------|------------|-----------|----------------------|
| a. autosomal recessive? | YES | NO | _____ X _____ |
| b. autosomal dominant? | YES | NO | _____ X _____ |
| c. X-linked recessive? | YES | NO | _____ X _____ |
| d. X-linked dominant? | YES | NO | _____ X _____ |
| e. Y-linked trait? | YES | NO | _____ X _____ |

30. Try this pedigree out. It involves two families and tongue rolling: (R=dominant, a roller; r=recessive, non-roller). On the next page, fill out the pedigree and in each shape, list the genotype of each individual.

Narly Story

Fred Narly, a tongue roller, broke with family tradition and married a non-tongue rolling person, Joan Fool in 1944. Fred and Joan proceeded to have two children: Fred Jr. and Mary. Fred Jr. carried on the Narly tradition of tongue rolling while Mary was often chastised and berated for her inability to roll her tongue.

Fred Jr. married a tongue rolling woman named Jean Gueeba, while Mary tried to redeem herself and marry a tongue rolling man named Steve Dorhoff.

Fred Jr. and Jean had two children: Nancy and Frank. Nancy was a true tongue rolling Narly. While Frank was almost disinherited from his dad's will because he could not roll his tongue.

Mary and Steve Dorhoff had a daughter, Sarah. Unfortunately, Sarah couldn't roll her tongue.

Frank eventually ran away from home because he didn't want to bring shame to the family. Nancy Narly settled down with Bill Quiff. After the wedding, the Narly's discovered that Bill could not roll his tongue.

Sarah Dorhoff married a man named Ted Goof. Ted was accepted into the family due to the fact that he could roll his tongue. Unfortunately, Ted died when he choked on a bad Chalupa. After Ted's death, Sarah never remarried and did charity work to help non-tongue rollers. But before Ted's death, Sarah became pregnant and eventually had Craig Goof. Much to everyone's relief, Craig could roll his tongue.

Meanwhile, Bill and Nancy Quiff also had a child named Candice Quiff. Again, everyone was relieved when Candice could roll her tongue.

At a party in college, Candice Quiff and Craig Goof met and fell in love.

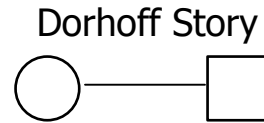
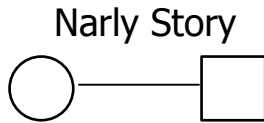
Dorhoff Story

In 1945, Neil Dorhoff and Marie Shoo, both tongue rollers, had a whirlwind affair and married. They had three children, Steve, Maureen, and Tom. Steve was always the favorite son because he could roll his tongue, while Maureen and Tom could not. Unfortunately, Tom died in a bizarre gardening accident.

Steve Dorhoff married Mary Narly and had a child named Sarah.

Maureen met and married Bob Lee, a person who took his tongue rolling seriously. Bob and Maureen had a child named Clarence. Luckily for the Lee's, Clarence could roll his tongue.

Place the persons genotype in their respective shapes (RR=homozygous dominant, Rr=heterozygous, R_=if the person is a tongue roller but you do not know if they are homozygous or heterozygous, and rr=a non tongue roller). List each individual's name below their shape.



Questions:

a. Can Candice and Craig marry legally in the US? Why or why not?

b. If Candice and Craig did have a child, what is the possibility that the child could roll his/her tongue? Show the Punnett square.