Name: ___________________________________ Date: ________ Period: ____

Non-Mendelian Genetics Practice Packet

Most genetic traits have a stronger, dominant allele and a weaker, recessive allele. In an individual with a heterozygous genotype, the dominant allele shows up in the offspring and the recessive allele gets covered up and doesn't show; we call this **complete dominance**.
However, some alleles don't completely dominate others. In fact, some heterozygous genotypes allow both alleles to partially show by blending together how they are expressed; this is called **incomplete dominance**. Other heterozygous genotypes allow both alleles to be completely expressed at the same time like spots or stripes; this is called **codominance**. Examples of each are listed below.
Write what each type would be if they were heterozygous.

1. Complete dominance = If a Red (RR) and White flower (rr) were crossbred, resulting in 100% Rr, what phenotype would been seen according to the rules of COMPLETE dominance?

2. Incomplete dominance = If a Red (RR) and White flower (rr) were crossbred, resulting in 100% Rr, what phenotype(s) would been seen according to the rules of IN-complete dominance?

3. Codominance = If a Red (RR) and White flower (WW) were crossbred, resulting in 100% RW, what phenotype(s) would been seen according to the rules of CO-dominance?

Incomplete Dominance Practice Problems

4-6. Snapdragons are incompletely dominant for color; they have phenotypes red, pink, or white. The red flowers are homozygous dominant, the white flowers are homozygous recessive, and the pink flowers are heterozygous. Give the genotypes for each of the phenotypes, using the letters "R" and " r " for alleles:

a. Red snapdragon genotype: ______

b. Pink snapdragon genotype: ______

c. White snapdragon genotype: ______

Show genetic crosses between the following snapdragon parents, using the punnett squares provided, and record the genotypic and phenotypic %s below:

a. pink x pink

Genotypic %: ________________
Phenotypic %: ________________

b. red x white

Genotypic %: ________________
Phenotypic %: ________________

c. pink x white

Genotypic %: ________________
Phenotypic %: ________________

7-9. In horses, some of the genes for hair color are incompletely dominant. Genotypes are as follows: brown horses are BB, white horses are bb and a Bb genotype creates a yellow-tannish colored horse with a white mane and tail, which is called "palomino". Show the genetic crosses between the following horses and record the genotypic and phenotypic percentages:

a. brown x white   b. brown x palomino   c. palomino x palomino

Genotypic %: ________________   Genotypic %: ________________   Genotypic %: ________________

Phenotypic %: ________________   Phenotypic %: ________________   Phenotypic %: ________________

10. Can palominos be considered a purebred line of horses? Why or why not?

11. Which two colors of horse would you want to breed if you wanted to produce the maximum numbers of palomi in the shortest amount of time?

12. In Smileys, eye shape can be starred (SS), circular (CC), or a circle with a star (CS). Write the genotypes for the pictured phenotypes


____


____


____

13. Show the cross between a star-eyed and a circle eyed.
What are the phenotypes of the offspring? ____________
What are the genotypes? __________

14. Show the cross between a circle-star eyed, and a circle eyed.
How many of the offspring are circle-eyed? ____________
How many of the offspring are circle-star eyed? ____________

15. Show the cross between two circle-star eyed.
How many of the offspring are circle-eyed? ____________
How many of the offspring are circle-star eyed? ____________
How many are star eyed? ____________

Codominance Worksheet (Blood types)

Name___________________________
Period ____________ Date ________

Human blood types are determined by genes that follow the **CODOMINANCE** pattern of inheritance.
There are two dominant alleles (A & B) and one recessive allele (O).

Blood Type (Phenotype)	Genotype	Can donate blood to:	Can receive blood from:
O	ii **(OO)**	A,B,AB and O (universal donor)	O
AB	I^AI^B **(AB)**	AB	A,B,AB and O (universal receiver)
A	I^AI^A or I^Ai **(AO)**	AB, A	O,A
B	I^BI^B or I^Bi **(BO)**	AB,B	O,B

1. Write the genotype for each person based on the description:
   a. Homozygous for the "B" allele __________
   b. Heterozygous for the "A" allele __________
   c. Type O __________
   d. Type "A" and had a type "O" parent __________
   e. Type "AB" __________
   f. Blood can be donated to anybody __________
   g. Can only get blood from a type "O" donor __________

2. Pretend that Brad Pitt is homozygous for the type B allele, and Angelina Jolie is type "O." **What are all the possible blood types of their baby?** *(Do the punnett square)*

   ____

3. Complete the punnett square showing all the possible blood types for the offspring produced by a type "O" mother and an a Type "AB" father. **What are percentages of each offspring?**

   ____

4. Mrs. Essy is type "A" and Mr. Essy is type "O." They have three children named Matthew, Mark, and Luke. Mark is type "O," Matthew is type "A," and Luke is type "AB." Based on this information:
   a. Mr. Essy must have the genotype ______
   b. Mrs. Essy must have the genotype ______ because ___________ has blood type ______
   c. Luke cannot be the child of these parents because neither parent has the allele _____.

5. Two parents think their baby was switched at the hospital. Its 1968, so DNA fingerprinting technology does not exist yet. The mother has blood type "O," the father has blood type "AB," and the baby has blood type "B."
   a. Mother's genotype: _______
   b. Father's genotype: _______
   c. Baby's genotype: ______ or ________
   d. Punnett square showing all possible genotypes for children produced by this couple.

e. Was the baby switched? ________________________

6. Two other parents think their baby was switched at the hospital. Amy the mother has blood type "A," Linville the father has blood type "B," and Priscilla the baby has blood type "AB."

a. Mother's genotype: _______ or ________

b. Father's genotype: _______ or ________

c. Baby's genotype: ______

d. Punnett square that shows the baby's genotype as a possibility

e. Could the baby actually be theirs? __________________________

7. Based on the information in this table, which men **could not** be the father of the baby?

*(hint… look at the baby's blood type only…)*_____________________________________
You can use the Punnett square if you need help figuring it out.

Name	Blood Type
Mother	Type A
Baby	Type B
The mailman	Type O
The butcher	Type AB
The waiter	Type A
The cable guy	Type B

8. The sister of the mom above also had issues with finding out who the father of her baby was. She had the state take a blood test of potential fathers. Based on the information in this table, why was the baby taken away by the state after the test?

*(hint… look at the baby's blood type only…)*____

Name	Blood Type
Mother	Type O
Baby	Type AB
Bartender	Type O
Guy at the club	Type AB
Cabdriver	Type A
Flight attendant	Type B

BLOOD TYPE & INHERITANCE Homework

In blood typing, the gene for type A and the gene for type B are codominant. The gene for type O is recessive. Using Punnett squares, determine the possible blood types of the offspring when:

1. Father is type O, Mother is type O

___________% O
___________% A
___________% B
___________% AB

2. Father is type A, homozygous; Mother is type B, homozygous

___________% O
___________% A
___________% B
___________% AB

4. Father is type A, heterozygous; Mother is type B, heterozygous

___________% O
___________% A
___________% B
___________% AB

5. Father is type O, Mother is type AB

___________% O
___________% A
___________% B
___________% AB

6. Father and Mother are both type AB

___________% O
___________% A
___________% B
___________% AB

Genetics: X Linked Genes

In fruit flies, eye color is a sex linked trait. Red is dominant to white.

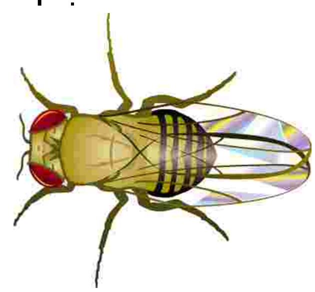
1. What are the sexes and eye colors of flies with the following genotypes:

$X^R X^r$ ________________ $X^R Y$ ________________
$X^R X^R$ ________________ $X^r Y$ ________________

2. What are the genotypes of these flies:

white eyed, male ____________ red eyed female (heterozygous) ________
white eyed, female ___________ red eyed, male ___________

3. Show the cross of a white eyed female $X^r X^r$ with a red-eyed male $X^R Y$.



4. Show a cross between a pure red eyed female and a white eyed male.
What are the genotypes of the parents:
___________& _______________

How many are:
white eyed, male___
white eyed, female ___
red eyed, male ____
red eyed, female ____

5. Show the cross of a red eyed female (heterozygous) and a red eyed male. What are the genotypes of the parents?
___________ & ________________

How many are:
white eyed, male___white eyed, female ___
red eyed, male ____ red eyed, female ____

Math: What if in the above cross, 100 males were produced and 200 females. (think about the percentage of the total #)
How many total red-eyed flies would there be?
6. ____________

7. In humans, hemophilia is a sex linked trait. Females can be normal, carriers, or have the disease. Males will either have the disease or not (but they won't ever be carriers)

$X^H X^H$ = female, normal

$X^H X^h$ = female, carrier

$X^h X^h$ = female, hemophiliac

$X^H Y$ = male, normal

$X^h Y$ = male, hemophiliac

Show the cross of a man who has hemophilia with a woman who is a carrier.

8. What is the probability that their children will have the disease? __________

9. A woman who is a carrier marries a normal man. Show the cross. What is the probability that their children will have hemophilia? What sex will a child in the family with hemophilia be?

10. A woman who has hemophilia marries a normal man. How many of their children will have hemophilia, and what is their sex?

How to set up dihybrid crosses

A) Figure out the genotypes of both traits for both parents.

B) Write out the parents' genotypes together ex. AaBb X AAbb

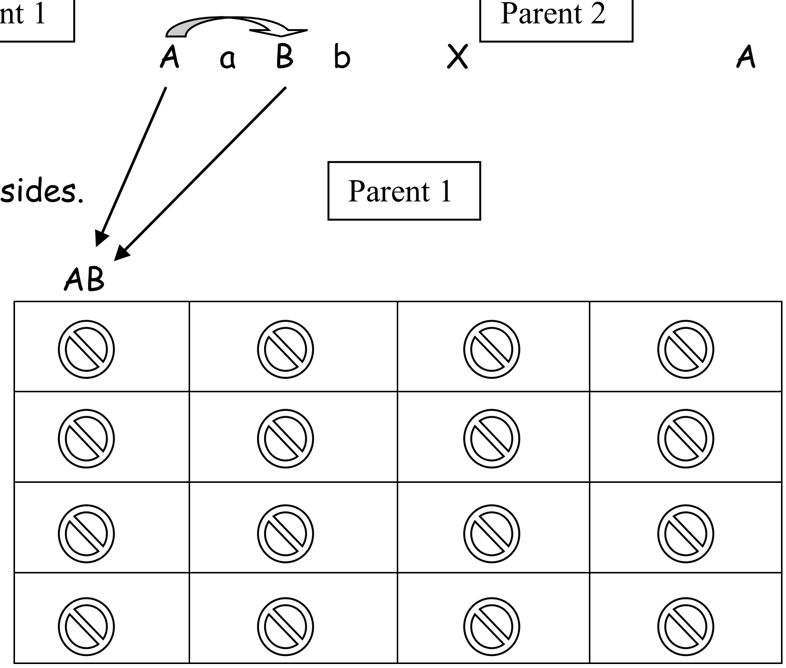
C) Use the **F**irst **O**utside **I**nside **L**ast method to set up the test cross

1) Draw the arrows for each parent for the FOIL method. An example is given below.

Parent 1 — Parent 2

A a B b X A A b b

2) Set up the cross for both sides.



Parent 2

3) Practice filling in the probable offspring below.

	AB	Ab	aB	ab
Ab	AABb			
Ab				
Ab				
Ab				

4) To figure the phenotypic ratio, count the number of individuals with either the dominant or recesssive phenotype for both traits! Then that ratio would be something like 4:4:4:4 or 9:3:3:1

PTC-taster- TT, Tt	Attached earlobes- EE, Ee	Can roll tongue- RR, Rr
Non-PTC taster – tt	Free earlobes – ee	Can't roll tongue - rr
Hitchhikers thumb- HH, Hh	Straight pinky- PP, Pp	
Straight thumb – hh	Bent pinky- pp	
Hair on mid-digit – MM, Mm	Widow's peak- WW, Ww	
No hair on mid-digit- mm	No widow's peak- ww	

Now practice!

Dihybrid Crosses. Set up the crosses using the rules and the letters from the other page.

1. If a woman who is a non-PTC taster (recessive) with heterozygous hitchhikers thumb has children with a man who is a heterozygous PTC taster with straight thumbs (recessive), what is the probability of them having each of the following types of children? (Fill in the Punnett Square and the blanks).

   Parents' genotypes ____________ X ____________

   a. How many PTC taster, Hitchhikers thumb_________
   b. How many PTC taster, straight thumb____________
   c. How many Non-PTC taster, Hitchhikers thumb____________
   d. How many Non- PTC taster, straight thumb________
   e. What is the phenotypic ratio?___________________

2. If a woman who has no hair on her mid-digit (recessive)and is homozygous attached earlobes (dominant) has children with a man who has hair on his mid-digit and has attached earlobes (heterozygous for both traits), what is the probability of them having each of the following types of children? (Fill in the Punnett Square and the blanks).

   Parents' genotypes ____________ X ____________

   a. How many hair, attached earlobes_________
   b. How many hair, not attached earlobes_____________
   c. How many hairless, attached earlobes_____________
   d. How many hairless, not attached earlobes__________
   e. What is the phenotypic ratio?___________________

3. John Doe and Jane Doe want to have children and are thinking about how their childrens' hands might look. What would their children look like if they are both heterozygous for straight pinky and hitchhikers thumb? (Fill in the Punnett Square and the blanks).

   Parents' genotypes ____________ X ____________

   a. Straight pinky, hitchhikers thumb_________
   b. Straight pinky, Straight thumbs___________
   c. bent pinky, hitchhikers thumb____________
   d. bent pinky, Straight thumbs______________
   e. What is the phenotypic ratio?___________________

4. Dohn Joe and Dane Joe want to have children and are thinking about how their childrens' hair line and tongues will turn out. They are both circus performers and want their children to follow in their footsteps. Their circus only accepts people with a Widow's Peak and who can roll their tongues. What would their children look like if Dohn is heterozygous for both Widow's peak and tongue rolling, and Dane is homozygous dominant for Widow's peak and heterozygous for tongue rolling? (Fill in the Punnett Square and the blanks).

   Parents' genotypes ____________ X ____________

   a. Widow's Peak, Tongue Roller____________
   b. Widow's Peak, non tongue roller__________
   c. Straight hair line, Tongue Roller__________
   d. Straight hair line, non tongue roller________
   e. What is the phenotypic ratio?____________________
   f. What are the chances of their child being able to join the circus?

      ____

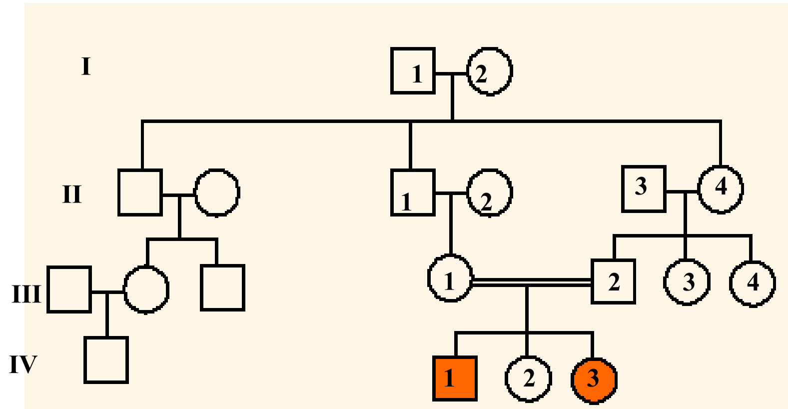
This problem will involve both a test cross and a Dihybrid Punnett Square   BONUS POINTS!!!!!!!
Background information:

1. You are a pigeon breeder. In order to make the most money as a pigeon breeder, you must sell mainly checkered winged, red feather pigeons. Lucky for you checkered wings and red feathers are dominant in pigeons (plain wings and brown feathers are recessive). To breed as many checkered winged, red feather pigeons as possible, you need to breed homozygous checkered winged, red feather pigeons with each other (because all of the offspring would be checkered winged, red feather pigeons). You know you have a female homozygous checkered winged, red feathered pigeon (you bred her yourself!) She is so beautiful that she has won prizes in several pigeon beauty contests.
   a. The Problem: You recently purchased a male pigeon that has checkered wings and red feathers from a shady pigeon dealer, who claimed it was homozygous. Before you breed this male with your prize winning female, you want to be sure that it is homozygous for both traits. Describe how you will be able to tell what the genotype for both traits of your pigeon in 1 generation. (test cross here) **5 points**

   b. Illustrate the probable outcomes if your pigeon is homozygous for both traits. (using a Punnett Square)

Pedigree Worksheet

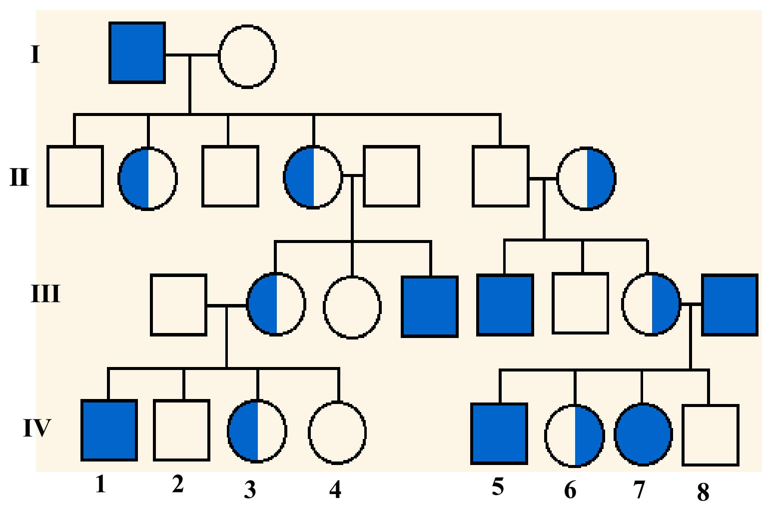
Use the given pedigrees to answer the following questions:



The pedigree to the right shows the passing on of straight thumbs (recessive) and Hitchhiker's Thumb (dominant) in a family. Shaded shapes mean the person has a straight thumb

1. What is the genotype of IV-1?_______
2. What is the genotype IV-3?_________
3. What is the genotype of III-1?_______
4. What is the genotype III-2?_________
5. What is the genotype II-3?__________
6. Is it possible for individual IV-2 to be a carrier? ____________ Why?_______

____

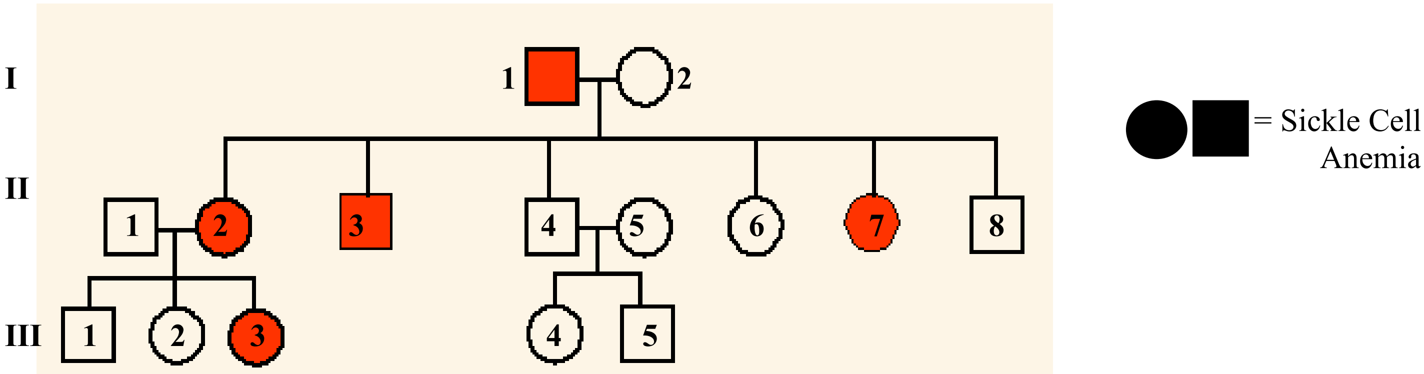


7. The pedigree to the right shows the passing on of colorblindness (a recessive, ***sex-linked trait***). Fill in the numbers for each generation (generation IV is done for you).
8. What do the half shaded circles mean?_______

   ____
9. What is the ONLY sex carriers of colorblindness can be?

   ____
10. Which individuals are colorblind?________________

    ____
11. What is the genotype of person II-2?________
12. What is the genotype of person I-1?_________
13. What is the genotype of person III-3?_______
14. If person IV-1 marries a female who is not colorblind and is not a carrier, what are the chances of their male offspring being colorblind?_____________What about their female offspring?______________



NOTE- carriers are not shown on this pedigree although Sickle Cell Anemia IS A RECESSIVE DISORDER.

15. Which members of the family above are afflicted with sickle cell anemia? ___________________________
16. How are individuals III-4 and III-5 related?____
17. How are individuals I-1 and I-2 related?____
18. How are individuals II-7 and III-2 related?____
19. How are individuals I-2 and III-5 related? ______________________________________
20. How many children did individuals I-1 and I-2 have? ________
21. How many girls did II-1 and II-2 have? ___________ How many have sickle cell anemia? _______________
22. Label the possible genotypes for all individuals in the pedigree. One person can have more than one possible genotype