Essential Question: How do living things inherit their genetic characteristics?

Activity 6 – Analyzing Genetic Data

Purpose: To learn *how to predict the outcome of genetic crosses with Punnett Squares*

Instructions: Follow the directions step by step to predict the outcome of genetic crosses.

Vclip Reference: https://www.youtube.com/watch?v=_kslajiPUAU

Backgound: A team of scientist buys two Beebop terriers to study. One is a male, Ocean, the other a female, Lucy. The scientists are interested in analyzing inheritance patterns in Beebops tail color.

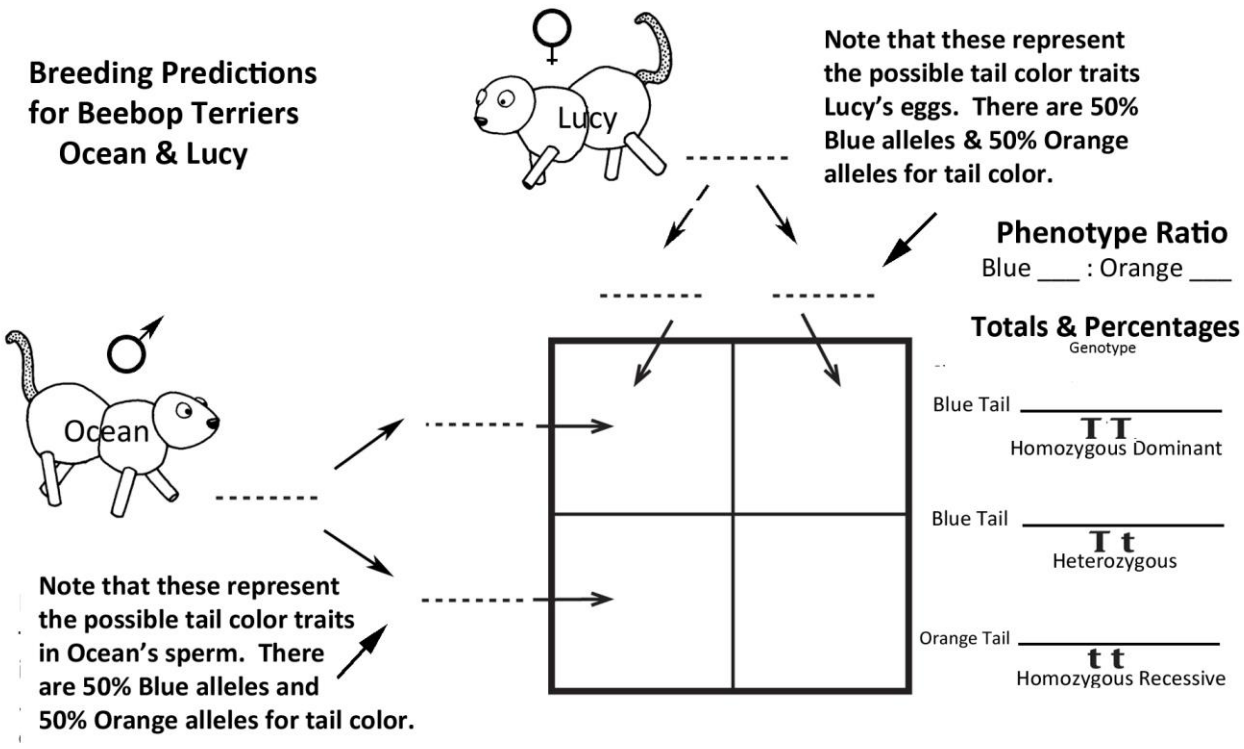
The scientists want to mate Ocean and Lucy. They know that **Ocean and Lucy have heterozygous traits for tail color.** In other words **their genotype is Tt.** Their tails are both **blue = the phenotype**.
Here is a summary of all the possible Beebop tail color genotypes and phenotypes:

Data Table One: Summary of Beebop tail color data & terminology

Characteristic	Traits for Tail Color	Genotypes	Phenotypes	Type of gene combination
Tail Color	T, t T = Blue t = Orange	TT = Tt = tt =	Blue tail color Blue tail color Orange tail color	TT = Homozygous Dominant Tt = Heterozygous tt = Homozygous Recessive

A. Help the scientists by completing a Punnett Square below and predict the possible results of this experiment.
Use this 5 step procedure for each Punnett Square analysis.

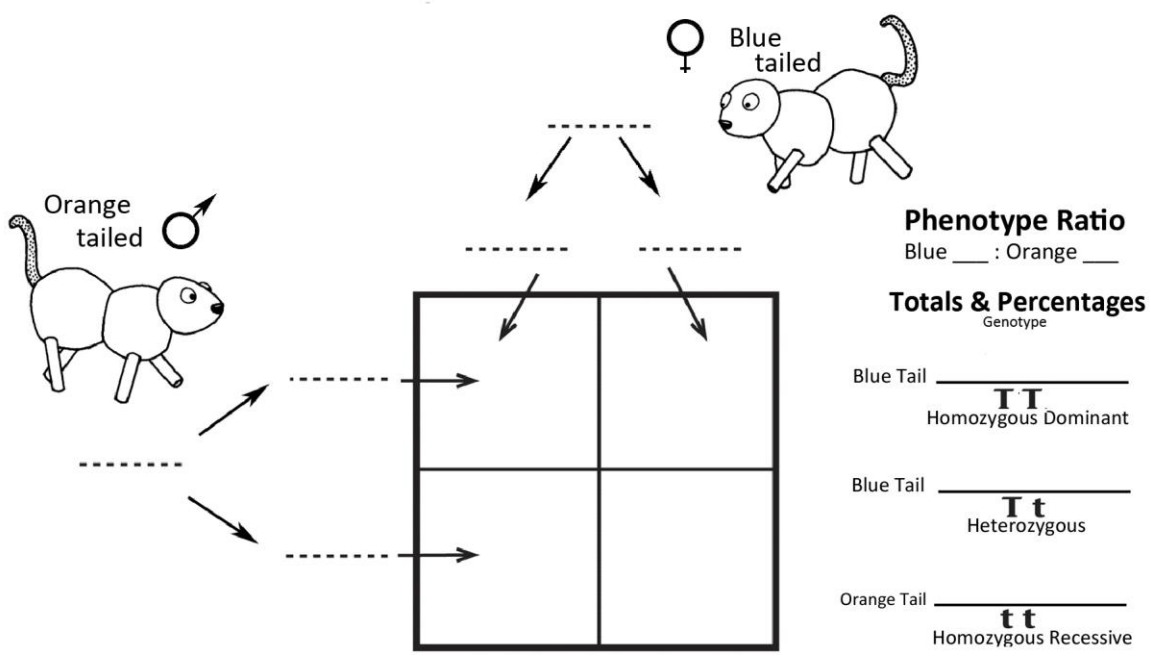
1. **Determine the alleles present in the male & female.** Write these by the Beebop.
2. **Prepare for Mating.** Create the possible sperm and egg combinations by separating both alleles Write each allele on the spaces next to the Punnett Square.
3. **Mate!** Write each allele in the <u>two boxes</u> either below or beside sperm and egg spaces. Be sure to write the capital letter first. (Tt not tT!)
4. **Collect data:** Add up the like combinations (TT, Tt, or tt) and write the totals in the analysis section.
5. **Analyze:** Calculate the percentage of each total by dividing each total by the total number of squares.



Student Review: 1-Below Standard, 2-Approaching Standard, 3-Standard, 4-Above Standard Use the scale to evaluate completeness & correctness of the job. Put score, Initial & date in boxes.	Score	Initial/Date

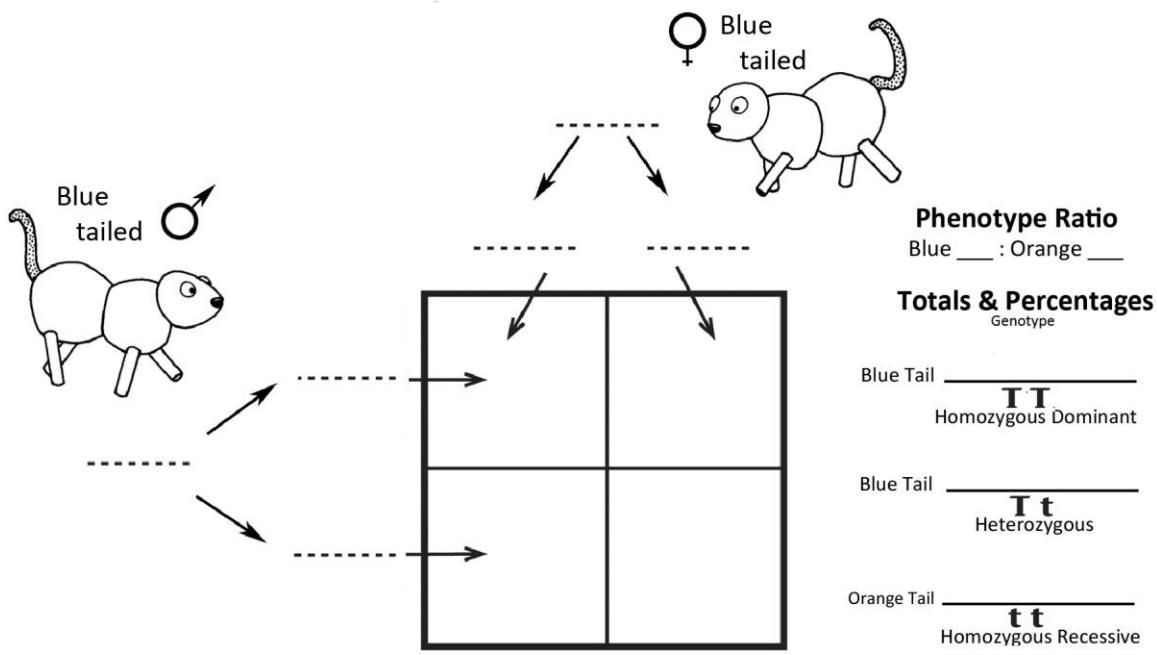
B. The scientists are really excited about the results and have learned a lot about Beebop Terrier heredity! Now the scientists want to find out what will happen if they cross breed:

- the male offspring with the homozygous recessive genotype for Orange tails (tt) and
- the female offspring who have heterozygous genotype for Blue tails (Tt).



C. These were unexpected results! Our scientists need to learn a lot more about breeding Beebop Terriers. So the scientists decide that they need to do another experiment where they cross:

- the male offspring with the homozygous dominant genotype for Blue tails (TT) and
- the female offspring that have heterozygous Blue tails (Tt).



Essential Question: How do living things inherit their genetic characteristics?

Instructions: Complete the next four genetic cross problems to determine the genotypes of Fruit Fly offspring across five generations. Be sure to answer questions 1-3 thoroughly afterwards.

Cross 1. Homozygous Dominant to Homozygous Recessive Second Generation offspring analysis.

A Homozygous Dominant male Red-Eyed fruit fly (RR) crosses with a Homozygous female White-Eyed fruit fly (rr)

- Red eye is dominant –
- White eye trait is recessive.

According to Mendel, each gene is **randomly segregated**. Each fruit fly has two genes, which separate into different ***gametes***:

- Male gamete is a *sperm cell*
- Female gamete is an *egg cell*

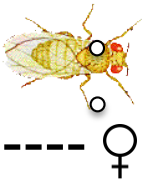
1. Write the genotype for the male and female fruit flies on the lines.

2. Then write the alleles for each gamete (sperm & egg) in the proper spaces.

3. Show the results of each cross in the Punnett square.

4. Show the results of this cross as a ratio of red-eyed homozygous (RR), to red-eyed heterozygous (Rr – do not write rR), to white-eyed homozygous (rr).

Punnett Square



Number / Percent	Number / Percent	Number / Percent
_____:	_____ :	_____
Red Eye (RR) Homozygous D	**Red Eye (Rr) Heterozygous**	**White Eye (rr) Homozygous D**

Phenotype Ratio: Red ____ : White____

Cross 2. Heterozygous to Heterozygous Third Generation offspring analysis

Next let's cross the offspring (Rr) from the above experiment (the second generation) with each other to produce a 3rd generation.

1. In this second cross, let's assume that two of the offspring from Cross 1. were to mate (be crossed).

2. Both offspring are **heterozygous** for the eye color characteristic.

3. Please complete steps 1-4 from Cross 1 for this combination on the Punnett square to the right.
(Use Rr – do not write rR), to white-eyed homozygous (rr).

Punnett Square

Number / Percent	Number / Percent	Number / Percent
_____:	_____ :	_____
Red Eye (RR) Homozygous D	**Red Eye (Rr) Heterozygous**	**White Eye (rr) Homozygous D**

Phenotype Ratio: Red ____ : White____

Student Review: 1-Below Standard, 2-Approaching Standard, 3-Standard, 4-Above Standard Use the scale to evaluate completeness & correctness of the job. Put score, Initial & date in boxes.	Score	Initial/Date

Fourth Generation offspring analysis
Cross 3. Homozygous Dominant to Heterozygous

Let's cross some of the offspring of the third generation (cross 2) above.

1. Cross a male homozygous dominant fruit fly with a female heterozygous fruit fly.

2. Next, please complete steps 1-4 from Cross 1 for this combination on the Punnett square to the right.

Punnett Square

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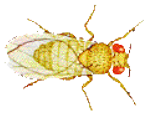

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Number / Percent _____: **Red Eye (RR)** **Homozygous D**	Number / Percent _____ : **Red Eye (Rr)** **Heterozygous**	Number / Percent _____ **White Eye (rr)** **Homozygous D**

Phenotype Ratio: Red ____ : White____

Cross 4. Homozygous Recessive to Heterozygous
Fifth Generation Offspring analysis

Finally, let's cross a male homozygous recessive (rr) fruit fly with a female heterozygous fruit fly (Rr) from the fourth generation (cross 3) above.

1. Each fruit fly has two alleles for the eye color gene so separate these into different gametes - male to sperm cell and female to the egg cell.

2. Next, please complete steps 1-4 from Cross 1 for this combination on the Punnett square to the right.

3. Show the results of this cross as a ratio of red-eyed homozygous (RR), to red-eyed heterozygous (Use Rr – do not write rR), to white-eyed homozygous (rr).

Punnett Square

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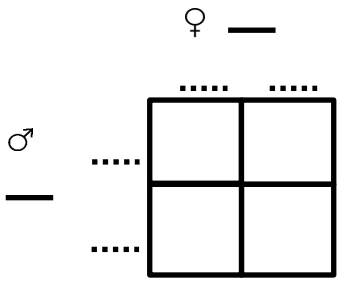
Number / Percent _____: **Red Eye (RR)** **Homozygous D**	Number / Percent _____ : **Red Eye (Rr)** **Heterozygous**	Number / Percent _____ **White Eye (rr)** **Homozygous D**

Phenotype Ratio: Red ____ : White ____

Student Review: 1-Below Standard, 2-Approaching Standard, 3-Standard, 4-Above Standard Use the scale to evaluate completeness & correctness of the job. Put score, Initial & date in boxes.	Score	Initial/Date

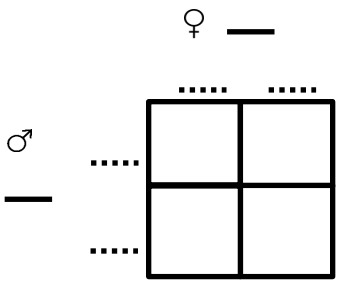
EC/Challenge Analysis Questions: Answer the following questions in complete, quality, and correct sentences and examples using facts, reasons, evidence, <u>and data from the crosses you've performed.</u>

1. Explain why, using a punnett square as an example and words to tell why it is impossible for offspring to show a recessive trait if one parent is homozygous (BB) for the dominant trait for eye color (BB).



_____ : _____ : _____
Homozygous Dominant BGH | Heterozygous BGH | Homozygous Recessive BLUE

Phenotype Ratio BGH _____ : BLUE _____



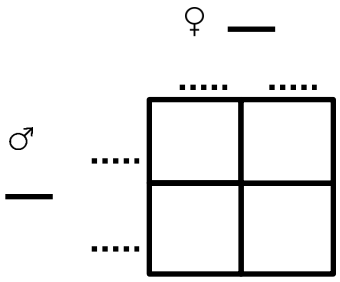
_____ : _____ : _____
Homozygous Dominant BGH | Heterozygous BGH | Homozygous Recessive BLUE

Phenotype Ratio BGH _____ : BLUE _____

Explain here: _____

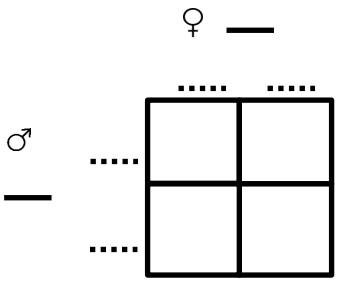
2. A scientist gets some unlabeled red-eyed fruit flies. The scientist knows that the red eye trait is dominant over the white eye trait. But she wants to find out if the fruit flies are <u>homozygous</u> or heterozygous for the red eye color.

- Determine using the Punnett Squares below, which type of cross (RR, Rr, or rr) she will have to use to tell if the red-eyed fruit flies are homozygous (RR), or heterozygous (Rr).



_____ : _____ : _____
Homozygous Dominant Red | Heterozygous Red | Homozygous Recessive White

Phenotype Ratio: RED _____ : WHITE _____



_____ : _____ : _____
Homozygous Dominant Red | Heterozygous Red | Homozygous Recessive White

Phenotype Ratio: RED _____ : WHITE _____

What will you cross to determine if the Fruit flies are RR or Rr? Be specific._____

3. Consider a population that started from a homozygous dominant X homozygous recessive cross. How often over the generations do you actually see a homozygous recessive trait, like white eyes, appearing?
Hint : Look for a pattern in the punnett square results from Fruit fly Crosses 1-4.

Student Review: 1-Below Standard, 2-Approaching Standard, 3-Standard, 4-Above Standard Use the scale to evaluate completeness & correctness of the job. Put score, Initial & date in boxes.	Score	Initial/Date

Mendelian Genetics – Let's use what we know to solve some fun genetics crosses!!

Cross 1. Homozygous Dominant to Homozygous Recessive Second Generation offspring analysis.

A Homozygous Dominant male Tall pea plant (TT) with a Homozygous short pep plant (tt) –

- Tall is dominant –
- Short is recessive.

According to Mendel, each gene is **<u>randomly segregated</u>**. Each fruit fly has two genes, which separate into different ***gametes***:

- Male gamete is a *pollen cell*
- Female gamete is an egg (*ova) cell*

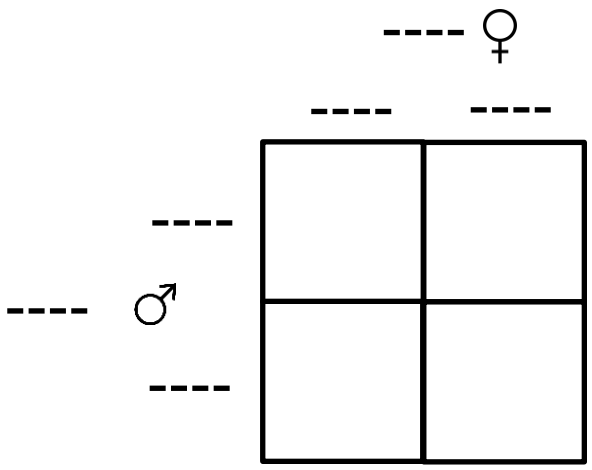
1. Write the genotype for the male and female fruit flies on the lines.

2. Then write the alleles for each gamete (sperm & egg) in the proper spaces.

3. Show the results of each cross in the Punnett square.

4. Show the results of this cross as a ratio of Tall homozygous (TT), to Tall heterozygous (Tt – do not write tT), to white-eyed homozygous (tt).

Punnett Square



Number / Percent	Number / Percent	Number / Percent
_____:	_____ :	_____
Tall Pea (TT) Homozygous D	**Tall Pea (Tt) Heterozygous**	**Short Pea (tt) Homozygous R**

Phenotype Ratio Tall ____ : Short____

Cross 2. Heterozygous to Heterozygous Third Generation offspring analysis

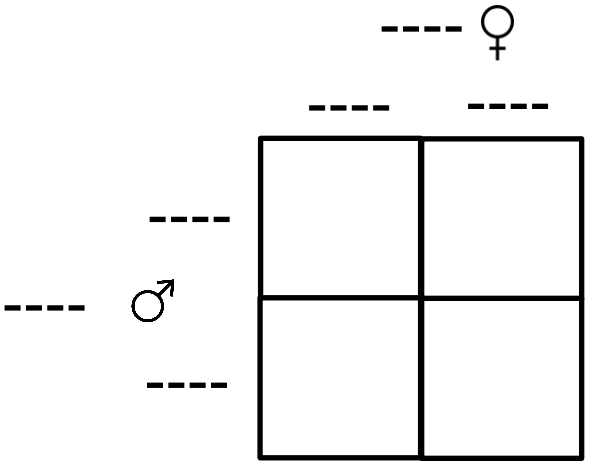
Next let's cross the offspring (Tt) from the above experiment (the second generation) <u>with each other</u> to produce a 3rd generation.

1. In this second cross, let's assume that two of the offspring from Cross 1. were to mate (be crossed).

2. Both offspring are **heterozygous** for the eye color characteristic.

3. Please complete steps 1-4 from Cross 1 for this combination on the Punnett square to the right. (Tt – do not write tT), to white-eyed homozygous (tt).

Punnett Square



Number / Percent	Number / Percent	Number / Percent
_____:	_____ :	_____
Tall Pea (TT) Homozygous D	**Tall Pea (Tt) Heterozygous**	**Short Pea (tt) Homozygous R**

Phenotype Ratio Tall ____ : Short____

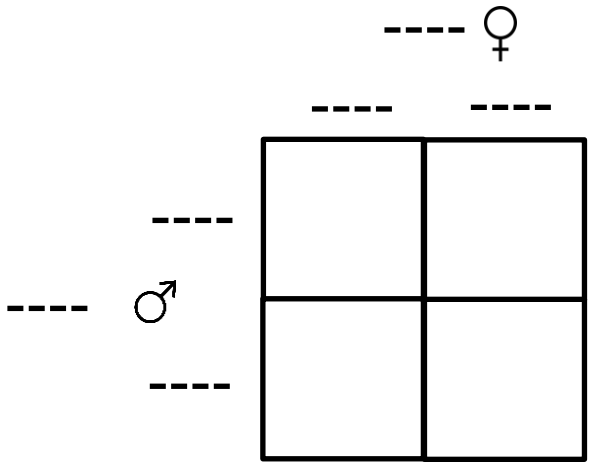
Student Review: 1-Below Standard, 2-Approaching Standard, 3-Standard, 4-Above Standard Use the scale to evaluate completeness & correctness of the job. Put score, Initial & date in boxes.	Score	Initial/Date

Fourth Generation offspring analysis
Cross 3. Homozygous Dominant to Heterozygous

1. Let's cross a:
   - Homozygous Dominant Purple Flowered Pea (PP) with a
   - Heterozygous Purple flowered Pea (Pp)
   - Make the Heterozygous female.
   - Note the Homozygous Recessive Pea (pp) is White Flowered.

2. Next, please complete steps 1-4 from Cross 1 for his combination on the Punnett square to the right.

Punnett Square



Number / Percent _____: **Purple (PP) Homozygous D**

Number / Percent _____ : **Purple (Pp) Heterozygous**

Number / Percent _____ **White (pp) Homozygous R**

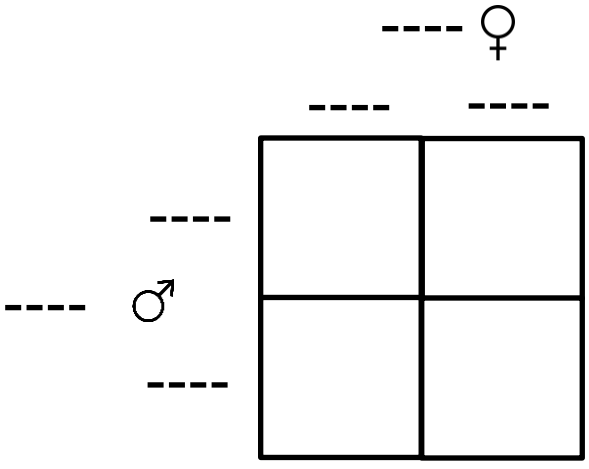
Phenotype Ratio Purple ____ : White____

Punnett Square

Cross 4. Homozygous Recessive to Heterozygous
Fifth Generation Offspring analysis

1. Finally, let's cross a:
   - Heterozygous Yellow Colored Pea (Yy) with a
   - Homozygous Recessive Green Colored Pea (yy)
   - Make the Homozygous female.

2. Next, please complete steps 1-4 from Cross 1 for this combination on the Punnett square to the right



Number / Percent _____: **Yellow Pea (YY) Homozygous D**

Number / Percent _____ : **Yellow Pea (Yy) Heterozygous**

Number / Percent _____ **Green Pea (yy) Homozygous R**

Phenotype Ratio Yellow ____ : Green____

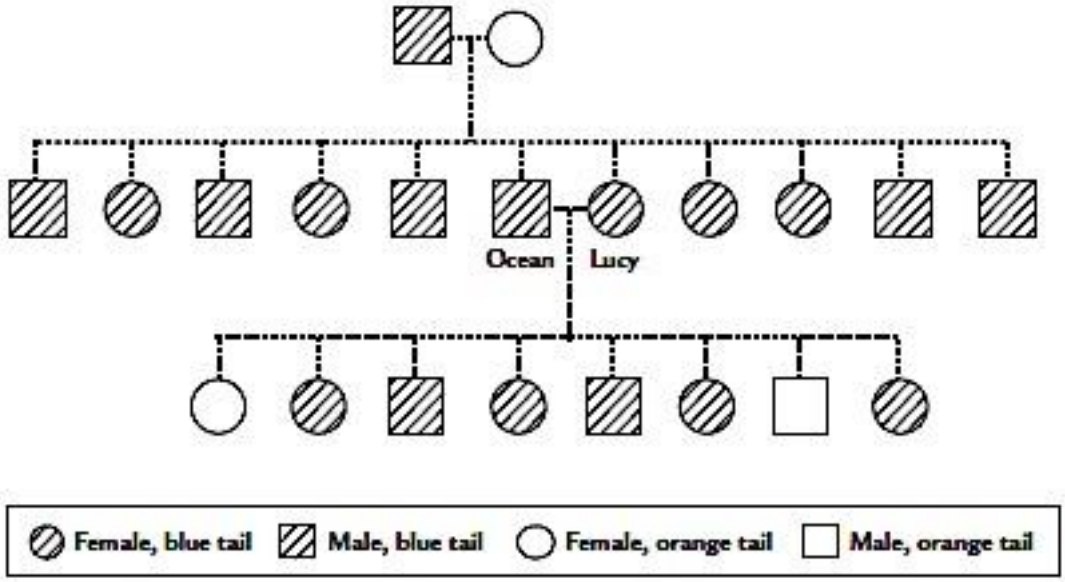
Student Review: 1-Below Standard, 2-Approaching Standard, 3-Standard, 4-Above Standard Use the scale to evaluate completeness & correctness of the job. Put score, Initial & date in boxes.	Score	Initial/Date

Pedigree Puzzles. Puzzled? Refer to ACT 66 and vclip https://www.youtube.com/watch?v=Ir1t9awmUl4

1. Scientists are studying the orange tail trait and were worried when the trait was lost in the 2nd generation. However this trait appeared in the 3rd generation. (Assign your own letters)

a. Explain how the information in this pedigree tells you whether orange tail color is dominant or recessive.

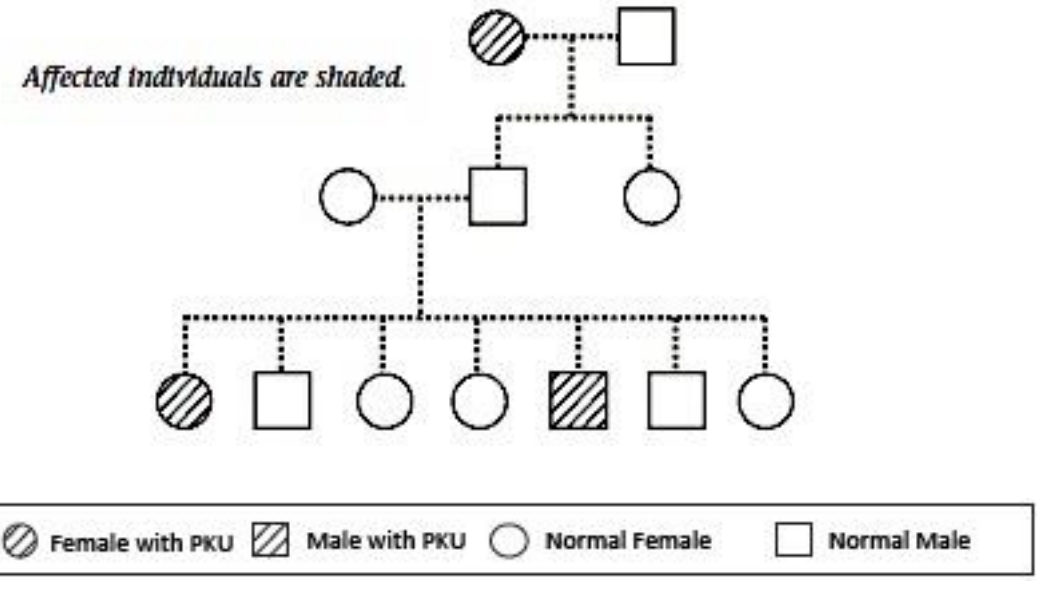
b. Label each Beebop Terrier's genotypes in the figure below.



2. The figure below shows a pedigree of a family with PKU, or phenylketonuria. People with PKU can not break down protien normally. This leads to a buid up that leads to mental disability. If PKU is diagnosed just after birth a special diet is given to the affected individual until puberty that will avoid the build and the child is normal.

a. Based upon the information below, is PKU likely to be a dominant or recessive trait?

b. Label each individual's genotype in the figure below.

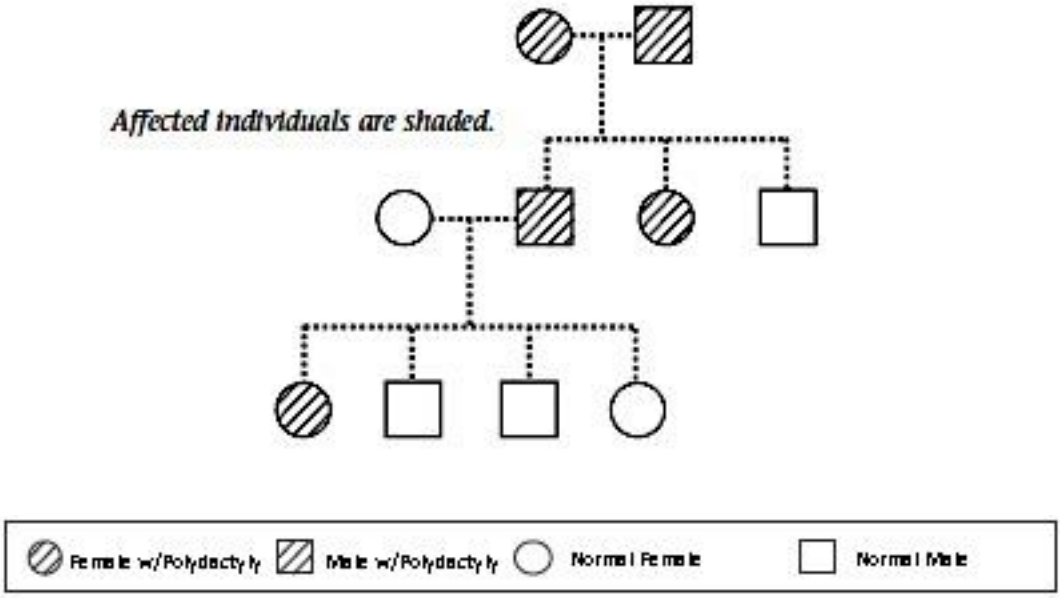


Student Review: 1-Below Standard, 2-Approaching Standard, 3-Standard, 4-Above Standard Use the scale to evaluate completeness & correctness of the job. Put score, Initial & date in boxes.	Score	Initial/Date

3. The figure below shows a family pedigree in which individuals are affected with Polydactyly, which causes individuals to have an extra finger or toe on each hand or foot. Individuals are otherwise completely normal.

a. Is polydactyly likely to be a dominant or a recessive trait? Explain.

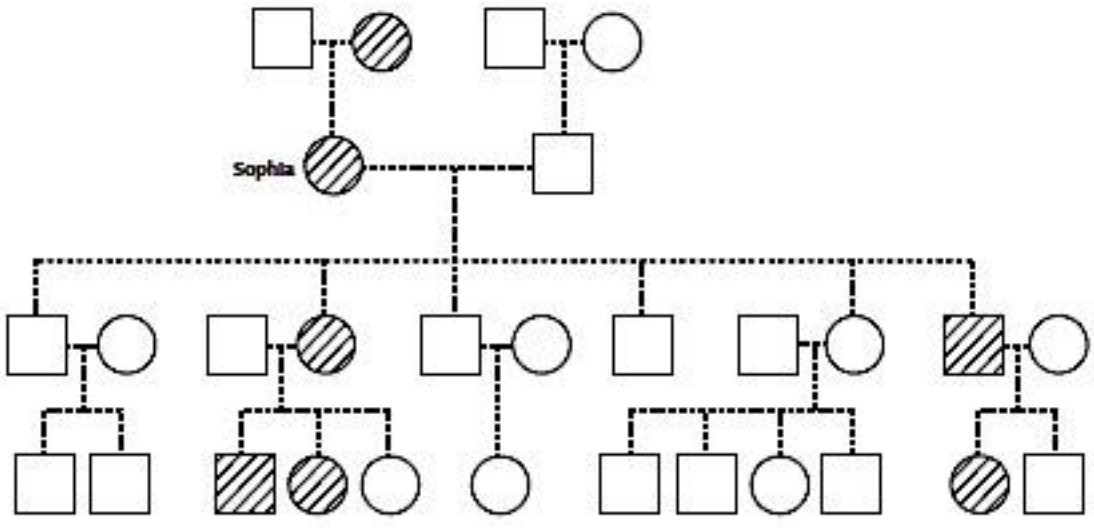
b. Label each individual with the appropriate genotype on the figure below. (Assign your own letters)



4. The Pedigree shown below represents a Genetic Condition. (Assign your own letters)

a. Is this Genetic Condition a Dominant Trait or a Recessive Trait? Explain.

b. Is Sophia most likely homozygous dominant, heterozygous, or homozygous recessive? Explain.



Student Review: 1-Below Standard, 2-Approaching Standard, 3-Standard, 4-Above Standard Use the scale to evaluate completeness & correctness of the job. Put score, Initial & date in boxes.	Score	Initial/Date