

Activity 7.2.1 Black + Black = Red**Purpose**

As you learned in *Lesson 7.1 A New Pair of Genes*, offspring inherit genes from their parents. Black or red coat color, polled or horned, and even wing type in insects are derived from genes contributed by each parent. How do those genes determine specific phenotypes? Imagine, you went out to visit an Angus farm last night and the farmer was perplexed. His polled black bull and polled black cow had a horned red calf. He says he has been using that bull for years and the cow has always birthed polled black calves. How could this happen and could it happen again?

Phenotypes or the qualitative traits observed in the animals are dependent on dominant, recessive, and codominant genes. A dominant gene will express itself over a recessive gene. To observe a recessive trait the genotype must be homozygous. Codominance occurs when both traits are observable.

The Punnett Square method may be used to predict the probability of the occurrence of qualitative traits. Some qualitative traits are of importance to beef producers because of market premiums and management practices. Many producers strive to breed slaughter cattle with black coloring for advantages when marketing their cattle. How can you use the Punnett Square to determine the possibility of qualitative traits in calves?

Materials**Per student:**

- Pencil
- *Agriscience Notebook*

Procedure

In this activity, you will use the Punnett Square method to predict the probability of offspring having the qualities you desire.

Part One – Heterozygous Cross

The bull and cow in question are both heterozygous for coat color and horned traits. Determine the probability of traits in the offspring using a Punnett Square.

1. Review the genetic codes for coat color and polled or horned in Angus cattle.

Coat Color Gene

B = Black

b = Red

Black (B) is dominant to red (b)

Horned or Polled Gene

P = Polled

p = Horned

Polled (P) is dominant to horned (p)

2. Complete the Punnett Square in Table 1 of *Activity 7.2.1 Student Worksheet*, for a heterozygous black polled bull (BbPp) mated to a heterozygous black polled cow (BbPp).
3. Using the results of your Punnett Square, determine the frequency of genotypes and the possible phenotypes of the offspring. Complete in the chart in Table 2.

4. Determine the frequency of each phenotype occurring. Next, express the probability as a percentage in Table 2 of *Activity 7.2.1 Student Worksheet*. To calculate the percentage uses the following formula.

$$\frac{\text{Number of phenotype}}{16} \times 100$$

Part Two – Homozygous and Heterozygous Cross

Using a Punnett Square, determine what percentage of offspring could be red or horned when you cross the red horned calf with a bull heterozygous for both traits.

1. What are the genotypes of the heifer and bull?
 - Horned red heifer: _____
 - Polled black bull: _____
2. Complete the Punnett Square for this mating in Table 3 of *Activity 7.2.1 Student Worksheet*.
3. Using the results of your Punnett Square determine the frequency of genotypes and the possible phenotypes of the offspring. Record your findings in Table 4.
4. Determine the frequency of each phenotype occurring. Next, express the probability as a percentage in Table 4.
5. Answer the analysis questions under the tables.

Conclusion

1. How might livestock producers use the Punnett Square method when selecting animals?

2. What are the limitations of using the Punnett Square method when predicting inheritance?

Name: _____

Activity 7.2.1 Student Worksheet

Table 1. Heterozygous Cross

	Genes From the Bull (BbPp)			
Genes From the Cow (BbPp)	_____	_____	_____	_____

Table 2. Findings

Genotype	Frequency	Phenotype
BBPP		
Phenotype	Probability of Phenotype	Probability As a Percentage
	$\frac{\text{Number of phenotype}}{16} \times 100$	
Black and polled		
Black and horned		
Red and polled		
Red and horned		

- What was the probability of the farmer's bull and cow having a horned red calf?
- What are two changes the farmer should make to ensure he does not produce a horned red calf again?
- What factors make these phenotypes qualitative?

Table 3. Heterozygous and Homozygous Cross

Genes From the Cow (<u> </u>)		Genes From the Bull (<u> </u>)			
		<u> </u>	<u> </u>	<u> </u>	<u> </u>
<u> </u>					
<u> </u>					
<u> </u>					
<u> </u>					

Table 4. Findings

Genotype	Frequency	Phenotype
BBPP		
Phenotype	Probability of Phenotype	Probability As a Percentage
	$\frac{\text{Number of phenotype}}{16} \times 100$	
Black and Polled		
Black and Horned		
Red and Polled		
Red and Horned		

- What is the probability of the farmer's new bull and horned red heifer having a horned red calf?
- What happens in any situation if one parent is homozygous dominant for both traits?