

Chapter 12 Project

Let's Create a Dog!

Project + Timeline

In this project, we will be reviewing your knowledge of Mendelian and non-Mendelian inheritance by creating and evaluating a series of hypothetical allele combinations passed down by two dogs to their offspring. This project should be completed by yourself or within a group in a two-hour time frame.

Directions

Part 1: Design Your Dog

In this part, you'll fill out Table 1 to design your dog based on the traits of the parental dogs. You'll use the genotypes of the parents to predict a possible genotype and phenotype for each of the offspring's traits.

For each trait, you are given the genotype of each parent dog. You can assume complete dominance for each of these traits. In cases where the parent dogs are homozygous for a trait, they will pass down that allele to their offspring, so the genotype of the offspring must include that allele. If the parent dogs are heterozygous for a trait, you will flip a coin to determine if they pass down either the dominant or recessive allele to their offspring. If the coin lands on heads, the dominant allele is passed on. If the coin lands on tails, the recessive allele is passed on.

For each trait, draw a Punnett square for the cross of the parents on a separate piece of paper. Use your Punnett square to determine the probability of the genotype and phenotype your offspring ended up with based on the coin toss. Record that information in the table.

Trait	Dominant Phenotype	Recessive Phenotype	Genotype of Parent 1	Genotype of Parent 2	Genotype of Offspring	Probability of Genotype	Phenotype of Offspring	Probability of Phenotype
height	tall (<i>H</i>)	short (<i>h</i>)	<i>Hh</i>	<i>hh</i>				
weight	heavy (<i>W</i>)	thin (<i>w</i>)	<i>WW</i>	<i>ww</i>				
eye color	brown (<i>B</i>)	blue (<i>b</i>)	<i>Bb</i>	<i>Bb</i>				
coat color	black (<i>C</i>)	white (<i>c</i>)	<i>Cc</i>	<i>cc</i>				
coat texture	straight (<i>T</i>)	curly (<i>t</i>)	<i>tt</i>	<i>tt</i>				
snout	long (<i>S</i>)	short (<i>s</i>)	<i>Ss</i>	<i>SS</i>				
ears	floppy (<i>E</i>)	pointed (<i>e</i>)	<i>Ee</i>	<i>Ee</i>				
nose color	black (<i>N</i>)	pink (<i>n</i>)	<i>NN</i>	<i>nn</i>				
nail color	white (<i>A</i>)	black (<i>a</i>)	<i>AA</i>	<i>AA</i>				
tail	short (<i>L</i>)	long (<i>l</i>)	<i>ll</i>	<i>Ll</i>				

After you complete the table, answer the following questions:

1. What is the probability of creating another offspring that has the same genotypes as the one you created?
2. What is the probability of creating another offspring that has the same phenotypes as the one you created?
3. Compare your offspring to the rest of the class. Who has the rarest offspring and why?
4. Draw a picture of your dog!

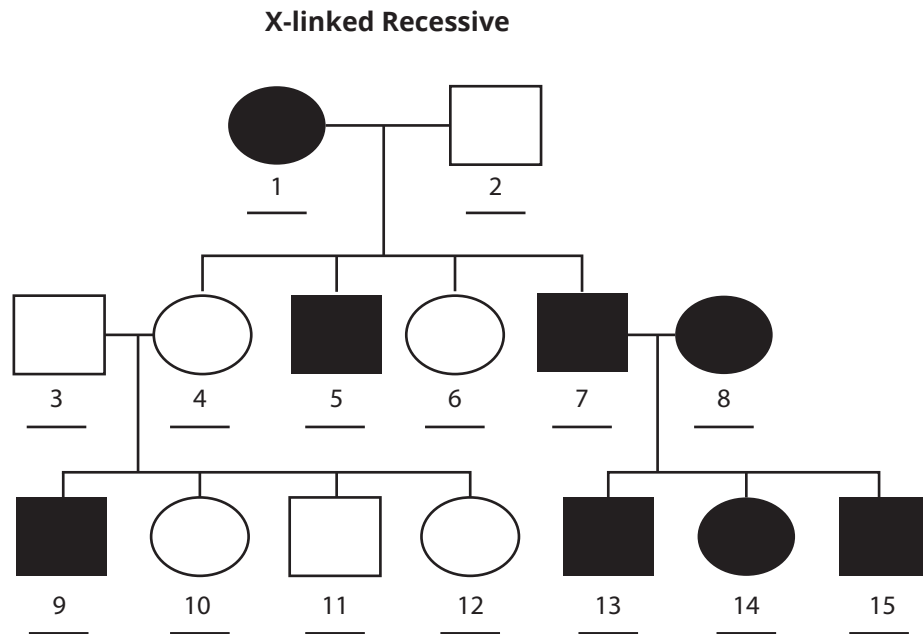
Part 2: Non-Mendelian Genetics

Answer the following questions regarding non-Mendelian genetics:

- Let's say that instead of the allele for the short tail length being completely dominant to the allele for long tail length, it exhibits incomplete dominance. What would the possible genotypes of the offspring of parents 1 and 2 be? What would the possible phenotypes of these offspring be?
- What if the trait for coat color exhibits codominance? What would the possible genotypes and phenotypes of the offspring of parents 1 and 2 be?

Part 3: Pedigree Analysis

The following pedigree shows the inheritance pattern of the trait of wrinkles in dogs. The gene for this trait is carried on the X chromosome. The absence of wrinkles (X^R) is dominant to the presence of wrinkles (X^r). Individuals represented by black circles or squares *have* wrinkles, while individuals represented by white circles or squares do not have wrinkles. Squares represent males, and circles represent females. The first generation is the parents of your created offspring. The second generation represents the dogs you and your classmates designed. The third generation is the future offspring of your dog!



Analyze the pedigree, then answer the following questions:

- Fill in the pedigree to the best of your ability with the possible genotypes of all the individuals. What are the phenotypes of each individual? Mark any heterozygous individuals with a black dot inside of their shape. Hint: Only females without wrinkles (white circles) could be heterozygous, but not all females without wrinkles are heterozygous.
- Which of the following best describes the inheritance pattern of the trait of wrinkles?
 - autosomal recessive
 - autosomal dominant
 - sex-linked recessive
 - sex-linked dominant
- What sex chromosomes would a female dog have? What about a male dog?
- What is the probability that a second-generation male offspring will have wrinkles? What is the probability that a second-generation female offspring will have wrinkles?
- If a male in the second generation has wrinkles, can the male pass this trait along to future offspring (offspring in the third generation)? Could a female offspring without wrinkles in the second generation pass the trait of wrinkles to the third generation?
- Flip your coin one last time. Heads, your dog is a male. Tails, your dog is a female. Given the genotypes of the parents in the first row of the previous pedigree, what is the probability that your dog has wrinkles?

Project Materials

- Data table and corresponding questions
- Blank sheets of paper
- A coin
- Pen or pencil

Student Checklist

- ☐ Complete the table for your dog and answer questions
- ☐ Draw a picture of your dog
- ☐ Answer questions about non-Mendelian inheritance
- ☐ Analyze pedigree and answer questions