

Double Muscle: Using Pedigrees

Name _____

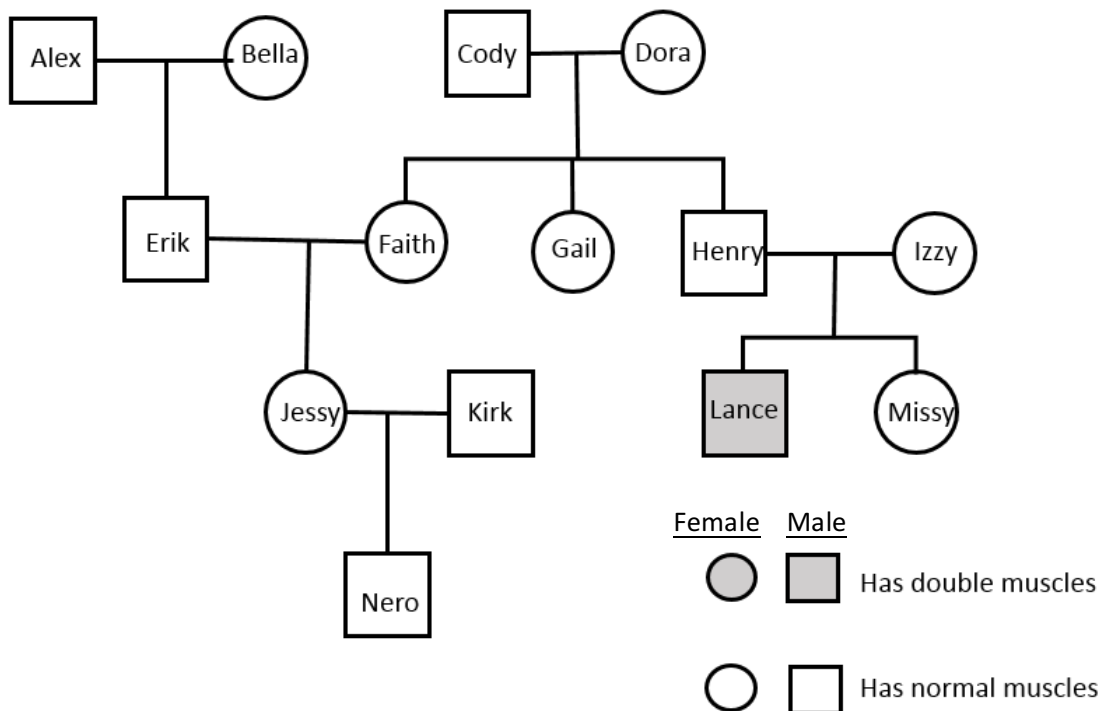
Introduction to Pedigrees

Geneticists use pedigrees to understand the genetic relationship between organisms in a family. In this worksheet, we will practice creating a pedigree relating to double muscling and making predictions from the pedigree.

A beef rancher, Walter, recently had a calf born to his herd with unusually large muscles. Lance, another one of his cattle, seems to have the same condition. Out of curiosity and concern, Walter searched the Internet for an explanation of the calf's condition.

Soon, Walter discovered a genetic condition that causes double muscling in cattle when two recessive (dd) genes are present. To Walter's relief, the condition itself is not fatal. Walter learns that the double muscle trait has advantages and disadvantages. Double-muscled cattle have a higher birth weight, rib eye area, feed efficiency, and improved retail product yield. However, cows delivering double-muscled calves have difficulty with labor due to the larger size of the calf and the double-muscled cows show decreased female fertility and lower stress tolerance.

In light of this information, Walter decides to start tracking double-muscling in his cattle via a pedigree. Walter needs some help with updating his current pedigree for the cattle on his land. Below is the pedigree with limited information recorded.



Using Pedigrees (continued)

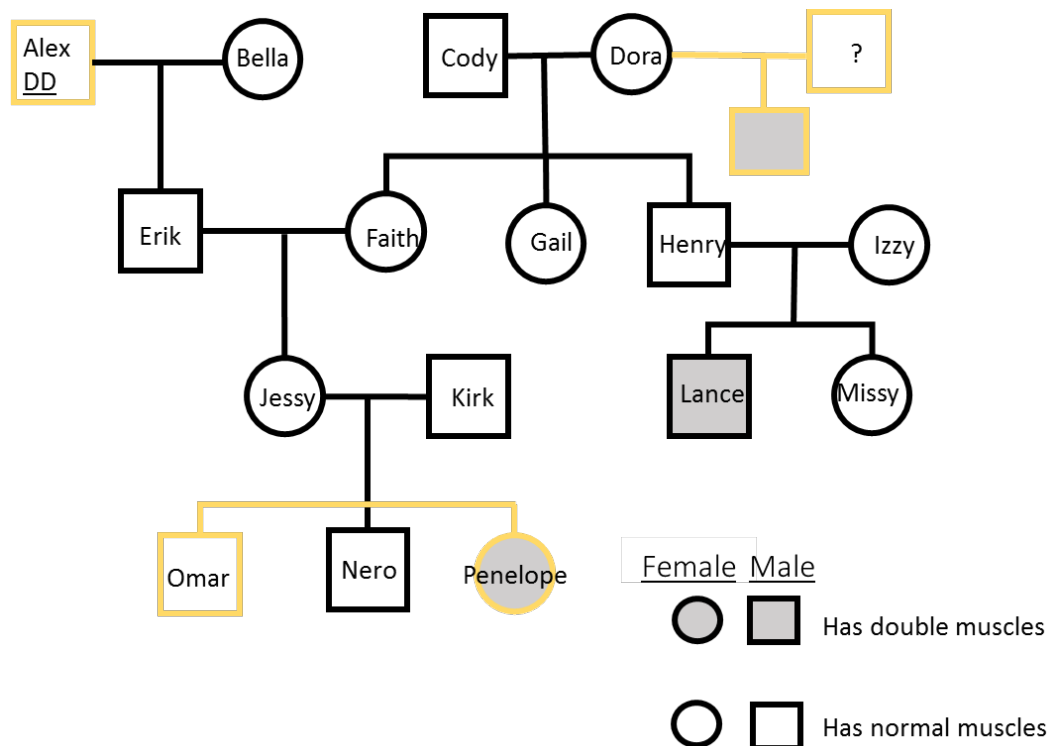
Activity 2: Amending the Pedigree and Determining Genotypes

Help Walter out by adding the following information to the pedigree:

1. Jessy and Kirk had two more calves after Nero: Omar (a male) and Penelope (a female).
2. Penelope is the young female calf who is double-muscled.
3. Walter talked with the previous owners of Dora. According to the previous owners, Dora once had a male calf that was double-muscled.
4. Walter also reveals that Alex has never been on his farm. Walter had Bella artificially inseminated with sperm from Alex. Amidst the paperwork telling Walter about Alex's genetic history, he sees that double-muscling is NOT something Alex is a carrier for.

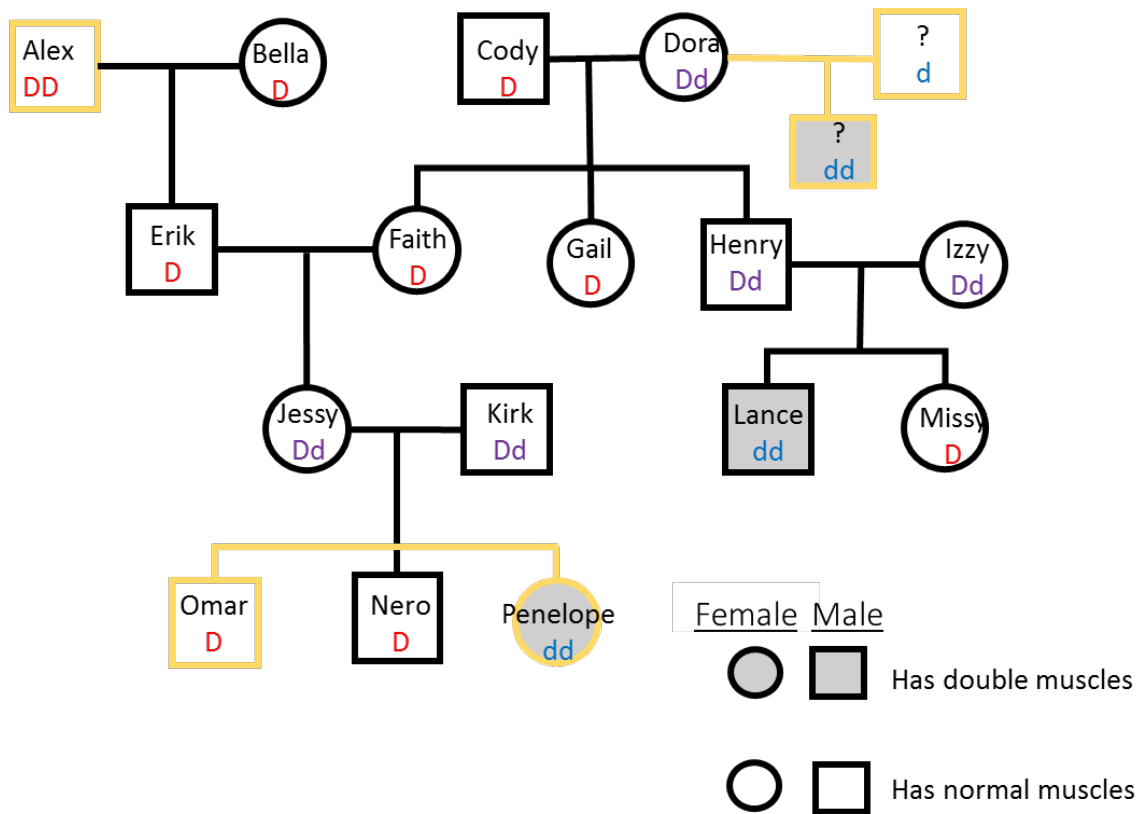
Teacher note: The fact that Bella was artificially inseminated may mean Walter, the farmer, has less phenotypic or genotypic information about the bull than other bulls he has raised himself. Walter took the initiative to ask about the bull's genotype or the phenotypic information of his offspring to get additional information about the bull which will help Walter make predictions about his herd.

Updated Pedigree



Using Pedigrees (continued)

Known and Unknown Genotypes



Teacher refresher:

Genotype is the allelic composition of a cell or organism, usually represented with a mix of capital and lower case letters (such as DD, Dd, and dd).

Phenotype is the physical appearance of an animal. In this instance, you can see if the animal has double muscles or is normal.

The shaded symbols in the pedigree above provide you with phenotypic information that you can use to help determine genotypic information.

In pedigrees, the males are squares and the females are circles. A horizontal line going from a male to a female is a mating. Horizontal lines with small vertical lines attached to squares or circles indicate offspring that are siblings.

Answer the following questions about the genotypes of the cattle in Walter's herd.

1. What do you know about Penelope's genotype?

dd

Using Pedigrees (continued)

2. What do you know about Kirk's genotype?

Dd

3. What do you know about Jessie's genotype?

Dd

4. What do you know about Faith's genotype?

DD or Dd

5. What do you know about Erik's genotype?

DD or Dd

6. What do you know about Nero's genotype?

DD or Dd

7. Could Gail be a carrier of the double-muscle gene? Draw a Punnett square to justify your answer.

Yes. Cody is either Dd or DD. Whether he's DD or Dd, Gail can still be a carrier.

		Cody	
		D	d
Dora	D	DD	Dd
	d	Dd	dd

		Cody	
		D	D
Dora	D	DD	DD
	d	Dd	Dd

8. Could Missy be a carrier of the double-muscle gene? Draw a Punnett square to justify your answer.

Yes.

Students will need to show a Punnett square of Missy's parents, Henry and Izzy.

		Henry	
		D	d
Izzy	D	DD	Dd
	d	Dd	dd

Using Pedigrees (continued)

9. Which cattle in Walter's herd could be crossed to guarantee a double-musclcd offspring?

Penelope and Lance are both dd for the double muscle mutation. If they were crossed, they would have a 100% chance of producing only double-musclcd offspring.

10. If Walter wants to avoid double-musclcd offspring, which cattle should he cross? Why?

Alex is the only known bull that is not a carrier. Therefore, crossing Alex with any cow that is not double-musclcd will produce offspring that are not double musclcd.