Introduction to be read or described to the participants:

When breeding animals, it is important to understand the reasons why the ***offspring*** (foal, lamb, calf, etc.) look a certain way or have the ***traits*** of the parents. A ***gene*** is a segment of genetic material called DNA that dictates what an animal will look like. A gene consists of two parts called ***alleles***. When stallion and a mare mate, each parent gives one half of their genetic information or one of their alleles to their offspring. The allele given to the offspring by each parent is random, meaning, the parents cannot control which allele is passed to the baby.

For today's activity, we are going to simplify the process and look just one trait: coat color for horses or horns in cattle. We are going to imagine a gene only has two alleles-one from each parent. We will use letters to represent alleles. The letter (or allele) can be either a capital letter or a small letter. Remember that each parent gives one letter (allele) to the offspring. What the offspring looks like is decided by the combination of these two letters. For example, if the offspring receives one capital letter from its dad and one capital letter from its mom the gene is called homozygous. A ***homozygous*** gene means that each allele (letter) is the same. The gene is also homozygous if the offspring receives one small letter from its father and one small letter from its mother. The offspring can also receive one capital letter from one parent and one small letter from the other parent. In this case, where the offspring has a gene with one capital letter and one small letter is called a ***heterozygous*** gene. A ***heterozygous*** gene means that each allele (letter) is different.

So how do these alleles (letters) tell us what the animal will look like? Each allele brings with it the code for a certain coat color or other trait. If the alleles are the same, in other words homozygous, than that is the trait one will see on the animal. But if the gene is heterozygous, meaning it has two different alleles, the capital letter will be the trait one will see in the animal. The capital letter is said to be the ***dominant*** trait and the small letter is the ***recessive*** trait.

Activity-steps

1. Each youth will select one card, either male or female.
2. Have the youth find a person with a card of an animal with the opposite sex as their card.
3. The pair will describe the gene that they have created with their alleles (Homozygous or Heterozygous) and what the animal will look like.
4. Instruct the youth to view the poster/whiteboard example pairings to see if they have selected the correct answer.
5. Have the youth find a new partner and repeat Step 2.
6. Have the pair describe the gene that they have created (Homozygous or Heterozygous) and what the animal will look like.

Genetic Activity for Horses

Information for the white board

For horses, black coat color is a recessive trait (a) and the horse will only be black if the gene of the offspring has two recessive alleles (aa). Bay coat color is a dominant trait (A) and the offspring will show this color anytime the gene has the dominant allele in the pair (AA) or (Aa).

First Pairing: male homozygous black horse (aa) and female heterozygous bay horse (Aa)

Have the youth go through steps 1-6 on the introduction sheet.

Possible offspring pairs:

Aa – gene: heterozygous; animal coat color: bay

aa – gene: homozygous; animal coat color: black

If time allows:

Second Pairing: male heterozygous bay horse (Aa) and female heterozygous bay horse (Aa)

Have the youth go through steps 1-6 on the introduction sheet.

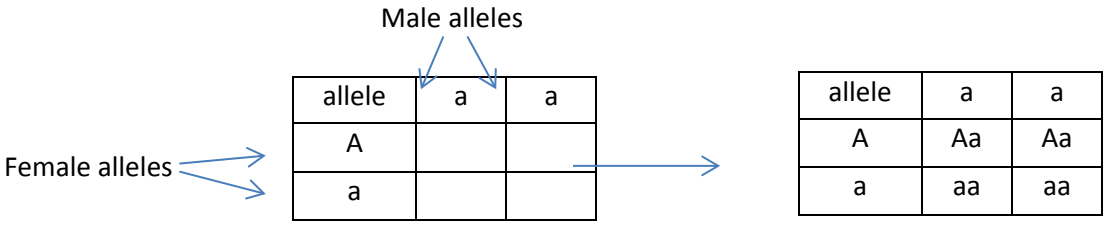
Possible offspring pairs:

AA – gene: homozygous; animal coat color: bay

Aa – gene: heterozygous; animal coat color: bay

aa – gene: homozygous; animal coat color: black

Once youth finish the pairings, ask two older youth to create a Punnet square. The Punnet square tells you the ***probability*** of creating a certain trait. To create a Punnet square, list each allele in a matrix box with the male across the X-axis (along the top) and the female along the Y-axis (along the side). For example, the first pairing of a male homozygous black horse and a female heterozygous bay horse will look like this:



allele	a	a
A		
a		

allele	a	a
A	Aa	Aa
a	aa	aa

In this case, there will be a 50% probability of having a black horse.

Genetic Activity for Cattle

Information for the white board

For cattle, having horns is a recessive trait (p) and the animal will only have horns if the gene of the offspring has two recessive alleles (pp). Polled is a dominant trait (P) and the offspring will be genetically polled anytime the gene has the dominant allele in the pair (PP) or (Pp).

First Pairing: male heterozygous polled (Pp) and female homozygous horned (pp)

Have the youth go through steps 1-6 on the introduction sheet.

Possible offspring pairs:

Pp – gene: heterozygous; animal is polled

pp – gene: homozygous; animal is horned

If time allows:

Second Pairing: male homozygous polled (PP) and female homozygous horned (pp)

Have the youth go through steps 1-6 on the introduction sheet.

Possible offspring pairs:

Pp – gene: heterozygous; animal will be polled. **All offspring will be polled**

Once youth finish the pairings, ask two older youth to create a Punnet square. The Punnet square tells you the ***probability*** of creating a certain trait. To create a Punnet square, list each allele in a matrix box with the male across the X-axis (along the top) and the female along the Y-axis (along the side). For example, the first pairing of a male homozygous black horse and a female heterozygous bay horse will look like this:

Male alleles

Female alleles

allele	P	p
p		
p		

allele	P	p
p	Pp	pp
p	Pp	pp

In this case, there will be a 50% probability of having a polled animal.

Bull

Bull

Bull

Bull

Bull

Bull

P P P

p p p

Cow

Cow

Cow

Cow

Cow

Cow

P P P

p p p

Sandy-Valley Derringer P

Sandy-Valley Derringer P

Sandy-Valley Derringer P

Sandy-Valley Derringer P

Sandy-Valley Derringer P

Sandy-Valley Derringer P

Polled (Pp)
Pedigree designated PC

Polled (Pp)
Pedigree designated PC

Polled (Pp)
Pedigree designated PC

Polled (Pp)
Pedigree designated PC

Polled (Pp)
Pedigree designated PC

Polled (Pp)
Pedigree designated PC

Kulp-Dale Golden PP - Red

Kulp-Dale Golden PP - Red

Kulp-Dale Golden PP - Red

Kulp-Dale Golden PP - Red

Kulp-Dale Golden PP - Red

Kulp-Dale Golden PP - Red

Polled (PP)
Pedigree designated PP

Polled (PP)
Pedigree designated PP

Polled (PP)
Pedigree designated PP

Polled (PP)
Pedigree designated PP

Polled (PP)
Pedigree designated PP

Polled (PP)
Pedigree designated PP

Comestar Lauthority

Comestar Lauthority

Comestar Lauthority

Comestar Lauthority

Comestar Lauthority

Comestar Lauthority

Horned (pp)
No special pedigree designation

Horned (pp)
No special pedigree designation

Horned (pp)
No special pedigree designation

Horned (pp)
No special pedigree designation

Horned (pp)
No special pedigree designation

Horned (pp)
No special pedigree designation

RF Goldwyn Hailey

RF Goldwyn Hailey

RF Goldwyn Hailey

RF Goldwyn Hailey

RF Goldwyn Hailey

RF Goldwyn Hailey

Horned (pp)
No special pedigree designation

Horned (pp)
No special pedigree designation

Horned (pp)
No special pedigree designation

Horned (pp)
No special pedigree designation

Horned (pp)
No special pedigree designation

Horned (pp)
No special pedigree designation

Ri-Val-Re Special-P-Red

Ri-Val-Re Special-P-Red

Ri-Val-Re Special-P-Red

Ri-Val-Re Special-P-Red

Ri-Val-Re Special-P-Red

Ri-Val-Re Special-P-Red

Polled (PP)
Pedigree designated PP

Polled (PP)
Pedigree designated PP

Polled (PP)
Pedigree designated PP

Polled (PP)
Pedigree designated PP

Polled (PP)
Pedigree designated PP

Polled (PP)
Pedigree designated PP

SOUTHLAND LAWN B MASSIA9

SOUTHLAND LAWN B MASSIA9

SOUTHLAND LAWN B MASSIA9

SOUTHLAND LAWN B MASSIA9

SOUTHLAND LAWN B MASSIA9

SOUTHLAND LAWN B MASSIA9

Polled (Pp)
Pedigree designated PC

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Polled (Pp)
Pedigree designated PC

Polled (Pp)
Pedigree designated PC

DID YOU EVER WONDER WHY AN OFFSPRING DOESN'T ALWAYS LOOK LIKE IT'S DAM?

The answer is probably in the **DNA**. DNA (deoxyribonucleic acid) is a long chain of chemicals that carry the code for how an organism will look and function. The genetic code for a trait or characteristic is called the **genotype**. What we see for that trait is the **phenotype**. Long pieces of DNA are arranged in **chromosomes** found in the nucleus of every cell. Half of the chromosomes come from the sire and the other half come from the dam.

Horned
pp

Polled
PP or Pp

WHAT'S IN A CHROMOSOME?

A **trait** is a single characteristic or part of the animal (coat color, presence of horns, tail, etc.)

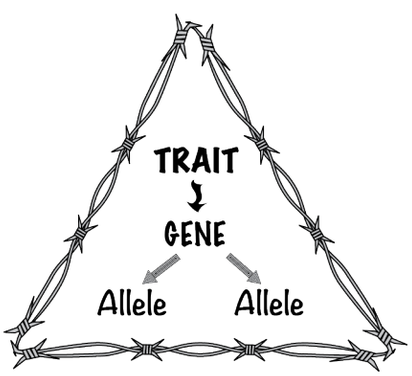
The information on each chromosome is arranged in genes. A **gene** is a chunk of DNA that provides information for a trait.

Fun Fact: Each species has a set number of chromosomes: chicken=78; cow=60; horse=64; human=46; pig=38; sheep=54.

HOW IS THE INFORMATION INHERITED?

Different forms of a gene are called **alleles**. To simplify this activity, we are going to say a gene has only 2 alleles - one from each parent. If it has two of the same alleles, it is called **homozygous**. If it has two differehnt alleles, it is called **heterozygous.** For example, different alleles can produce different coat colors or control the presence of horns.

FUN FACT: If unfolded, the DNA in one cell would be about 6 feet, 6 inches long



DO I LOOK LIKE MOM OR DAD?

Who you look like depends on the combination of alleles the parents randomly contribute.

If an allele is always expressed even if there is only one copy (heterozygous), then the allele is **dominant.** If an allele is only expressed when there are two copies, then the allele is **recessive**.

Scientists shorten the allele names to letters and use a capital letter to indicate a dominant trait and a small letter to indicate a recessive trait.

Plot your way to Knowledge: The Punnett Square

Now that you understand how some simple traits are inherited, it's time for you to figure out how to get the offspring with the trait that you want. Be careful, you can only predict the likelihood of a particular outcome - you can't guarantee what you'll get!

You can use the Punnett square to figure out the ***probability*** of a certain trait. This simple diagram is like a multiplication table for genes. See the example below and then figure out your own mating probabilities.....

1. Draw the table
2. Fill in the sire and dam alleles
3. Do the "multiplication"

Horn alleles - What you need to know:
PP: homozygous - Polled
Pp: heterozygous - Polled
pp: homozygous - Horned

?? Polled, heterozygous bull mated with horned, homozygous cow

		Bull alleles	
		P	**p**
Cow alleles	**p**	**Pp**	**pp**
	p	**Pp**	**pp**

Result: 2 out of 4 (2/4 or 50%) offspring will be Pp (Polled) and 2 out of 4 (2/4 or 50%) offspring will be pp (Horned)

Give this a try.....
Polled, homozygous bull mated with horned, homozygous cow

		Bull alleles	
Cow alleles			

Brainteaser: Your friend's horned cow calved last night and had a polled calf. The bull was polled. Was the bull homozygous or heterozygous? Was the cow homozygous or heterozygous?

Answer: Cow was homozygous, not enough information to tell about the bull

Stallion

Stallion

Stallion

Stallion

Stallion

Stallion

A	A	A
a	a	a

Mare

Mare

Mare

Mare

Mare

Mare

Bay

Bay

Bay

Bay

Bay

Bay

Heterozygous Bay

Heterozygous Bay

Heterozygous Bay

Heterozygous Bay

Heterozygous Bay

Heterozygous Bay

Black

Black

Black

Black

Black

Black

Homozygous Black

Homozygous Black

Homozygous Black

Homozygous Black

Homozygous Black

Homozygous Black

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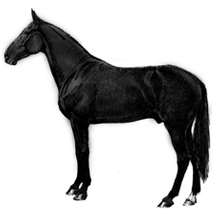

Black
aa

Bay
AA or Aa

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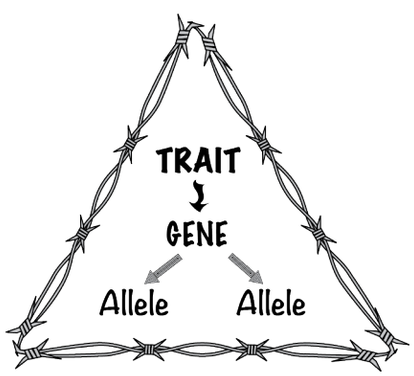

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3. Do the "multiplication"

Coat color alleles - What you need to know:
AA: homozygous - coat color: Bay
Aa: heterozygous - coat color: Bay
aa: homozygous - coat color: Black

?? Black, homozygous stallion mated with Bay, heterozygous mare

		Stallion alleles	
		a	**a**
Mare alleles	**A**	**Aa**	**Aa**
	a	**aa**	**aa**

Result: 2 out of 4 (2/4 or 50%) offspring will be Aa (Bay) and 2 out of 4 (2/4 or 50%) offspring will be aa (Black)

Give this a try.....

Bay, heterozygous stallion mated with Bay, heterozygous mare

		Stallion alleles	
Mare alleles			

Brainteaser: Your friend's bay mare foaled last night and had a black foal. The stallion was bay. Was the stallion homozygous or heterozygous? Was the mare homozygous or heterozygous? WHAT WERE THE ODDS????

Answer: both were heterozygou - 25% (1/4)