

Unit B: Understanding Animal Reproduction

Lesson 4: Understanding Genetics

Terms

- Alleles
- Chromosome
- Co dominance
- Crossover
- Deoxyribonucleic acid
- DNA
- Dominant
- Genetic code
- Genome
- Genotype
- Heredity
- Heritability
- Heritability estimate
- Heterozygous
- Homozygous
- Incomplete dominance

Terms Cont.

- Linkage
- Mutation
- Phenotype
- Probability
- Punnett Square
- Qualitative traits
- Quantitative traits
- Recessive
- Sex chromosomes

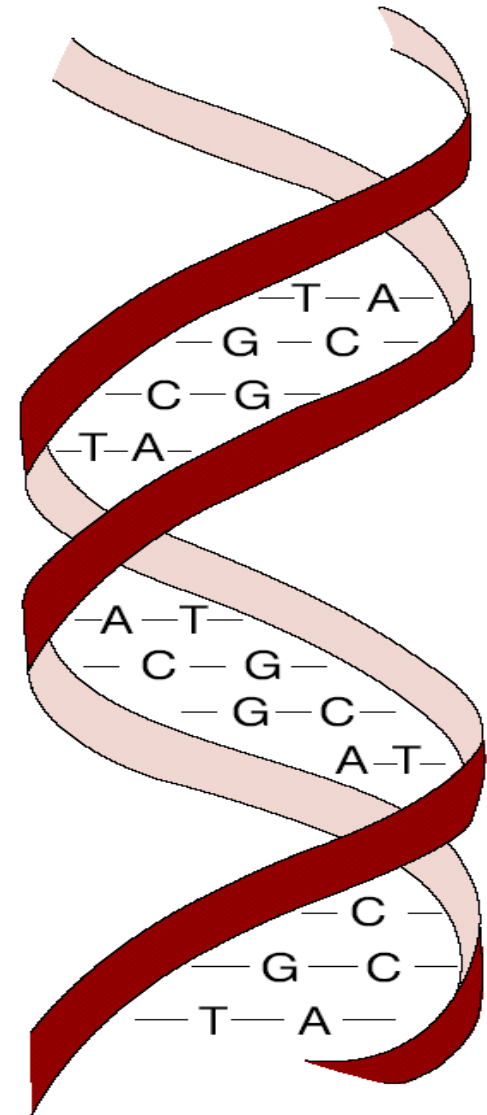
Why is it important for a livestock producer to understand genetics?

- ▣ The study of genetics is concerned with the transfer of traits.
- ▣ Gregor Mendel discovered that these traits are inherited through units called genes. Genes were found in pairs and half of the inherited traits come from the father and half from the mother.
- ▣ This passing of traits from parents to offspring is called *heredity*. Not all differences in animals are caused by genetics. Some are caused by the conditions under which the animal is raised.

- A **chromosome** is a tiny threadlike part in a cell that contains the genetic material found in the nucleus.
- The genetic material found in the chromosomes is called the **genome** of the organism.

DNA STRUCTURE

- Chromosomes are made of genes that consist of DNA. **DNA** is a protein-like nucleic acid on genes that controls inheritance.
- Each DNA molecule consists of two stands shaped as a double helix
- There are 4 nitrogen bases found in DNA. They are: cytosine, guanine, adenine, and thymine.
- The **genetic code** is the sequence of nitrogen bases in the DNA molecule. Replicating itself allows for the molecule to pass genetic information from one cell generation to the next.



How do genotype and phenotype differ?

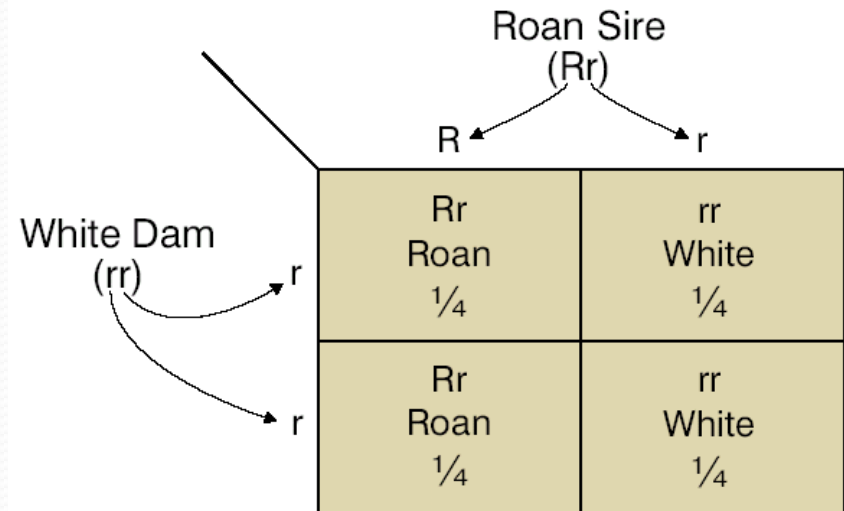
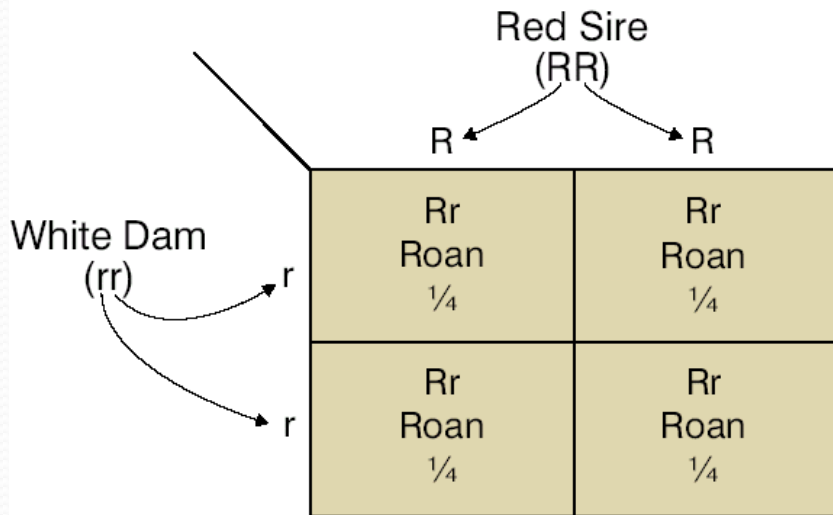
- **Genotype** is the actual genetic code. It controls physical and performance traits. The genotype of an organism cannot be changed by environmental factors.
- **Phenotype** is the organism's physical or outward appearance. This is the part of the genotype the organism expresses or shows. In some instances, phenotype may be altered by the organism's environment.
- A **homozygous** organism is one having similar **alleles** or genes on the DNA molecule for a particular trait. While a **heterozygous** organism is one having different alleles for a particular trait.

How can I estimate which traits will be inherited by offspring?

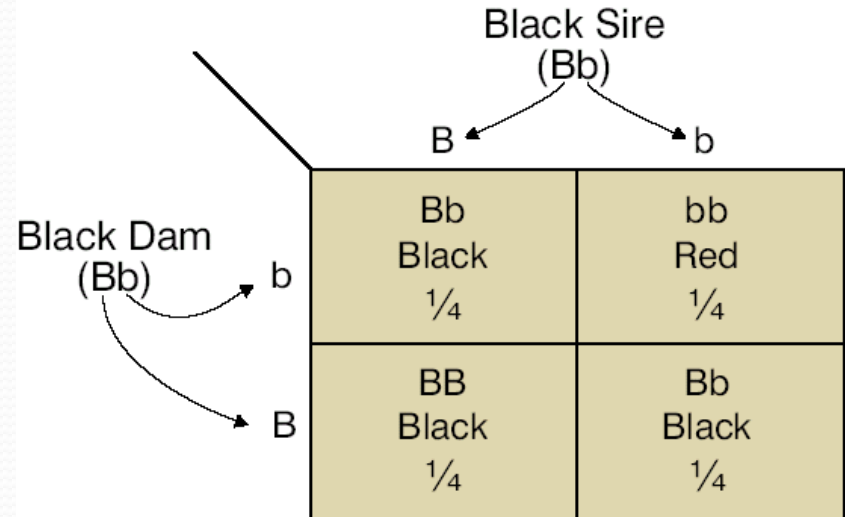
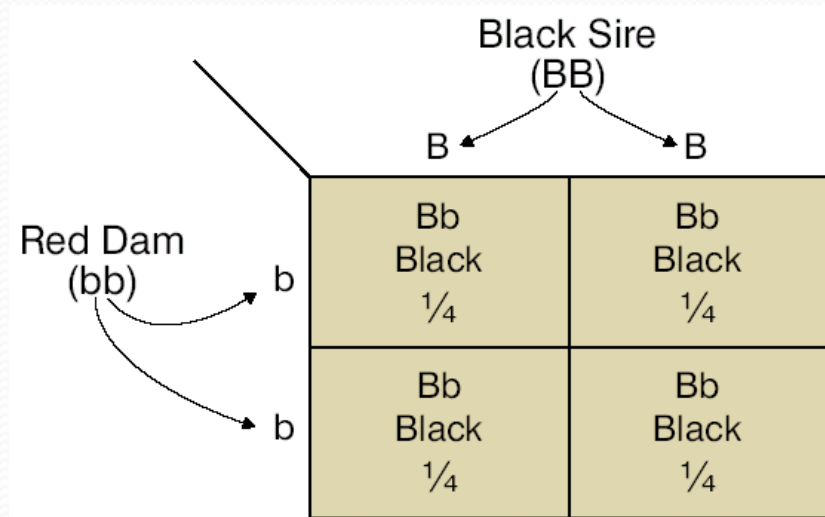
- Estimating is based on probability. **Probability** is the likelihood or chance that a trait will occur.
- Mating animals of particular traits does not guarantee that the traits will be expressed in offspring.
- **Heritability** is the proportion of the total variation (genetic and environmental) that is due to additive gene effects.

- A *heritability estimate* expresses the likelihood of a trait being passed on from parent to offspring. If a trait has a high heritability, the offspring are more likely to express that same trait

Estimating the Heritability of Certain Traits



Estimating the Heritability of Certain Traits



The genes contained in an animal control traits of that animal. Some traits are controlled by only one pair of genes, while others require several pairs.

- **Qualitative traits** are traits controlled only by a single pair of genes & cannot be altered by the environment. Their phenotype is either one thing or the other. These traits most easily show how genes are inherited. An example is coat color.
- **Quantitative traits** are traits controlled by several pairs of genes. These traits are expressed across a range. These traits can also be altered by environment. Examples include rate of gain, growth rate, back fat depth, etc.

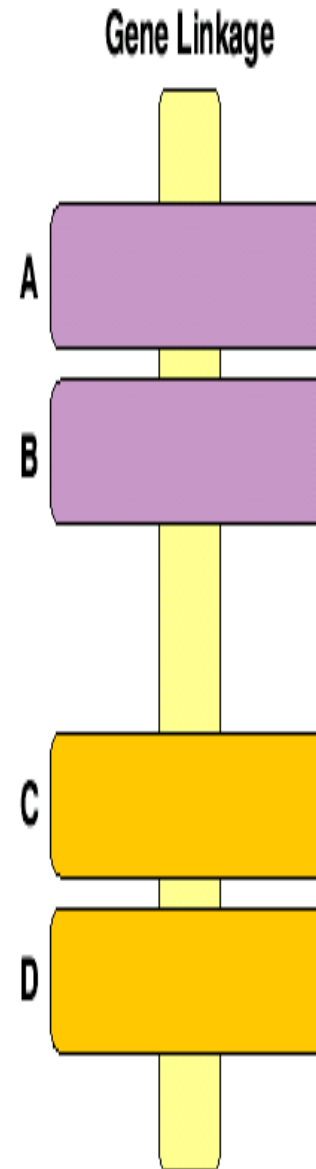
- Not all traits contained within an organism are expressed.
- **Dominant** traits cover up or mask the alleles for **recessive** traits. In some organisms there are cases of **co dominance** of traits in which both dominant and recessive genes are expressed. **Incomplete dominance** happens when a blending of the allele pair is expressed.
- The **Punnett Square** is a technique for predicting genotype. It considers the dominant and recessive genes of the male and female parents for one trait.

What are sex determination, linkage, crossover, and mutation and why are they important?

- There are several other factors that are important for livestock producers to understand.
- Sex determination—Determination of the sex of zygote depends on the **sex chromosomes**.

- Cattle—Male sex chromosomes are either X or Y. A zygote that receives a Y chromosome from sperm will be male and a zygote that receives an X chromosome from sperm will be female. The male makes sex determination as all eggs from female receive an X chromosome.
- Therefore, a female zygote will have two X chromosomes (XX) while a male zygote will have one X and one Y chromosome (XY).

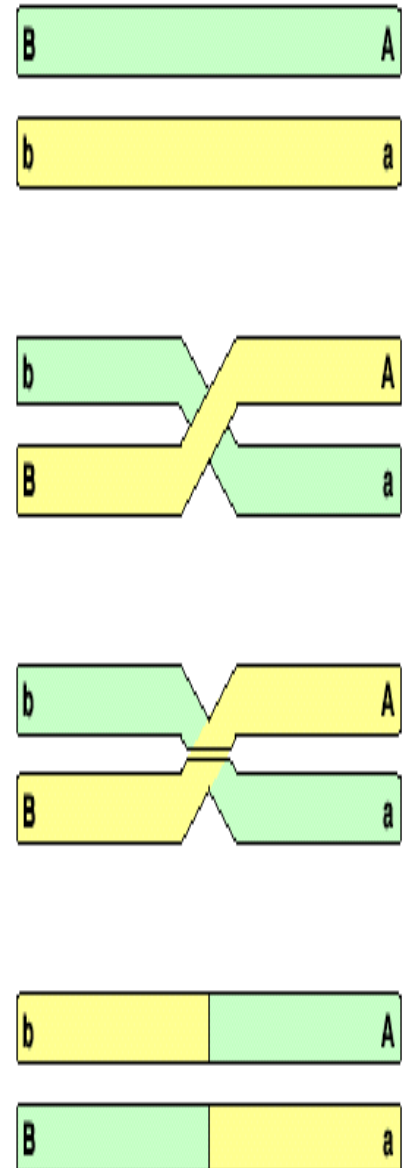
- ▣ The tendency for certain traits to appear in groups in the offspring is called ***linkage***.
- ▣ Early studies in genetics were based on the idea that all genes are redistributed in each mating. It was found, however, that some groups of traits seemed to stay together in the offspring.



Genes A and B will tend to stay together when the chromosomes divide, as will genes C and D. Genes A and D are not as likely to stay together because they are farther apart.

- ▣ **Crossover** is the formation of new chromosomes resulting from the splitting and rejoining of the original chromosome. This forms new chromosomes with different combinations of genes.
- ▣ **Mutation** is the appearance of a new trait in the offspring that did not exist in the genetic makeup of the parents.

New combinations of genes are formed when chromosomes cross over and split.



Review/Summary

- How are genotypes and phenotypes different?
- How is heritability estimated in animals?
- What happens during crossover and mutation?