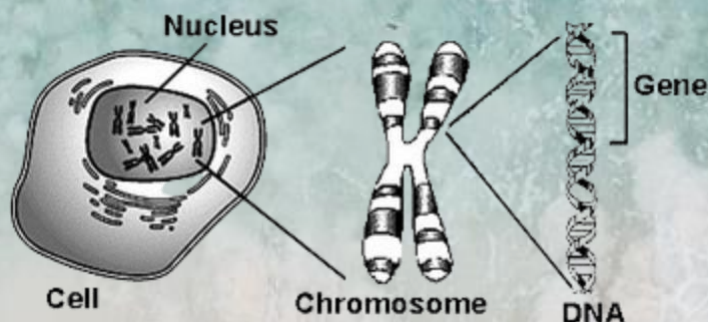


GENETICS 101



Genetics is understanding how traits are inherited. It is an important aspect of sheep and goat production.



The genome is the complete set of DNA instructions within an organism: all its genetic material. DNA is the molecule that carries those instructions. Chromosomes are long strings of DNA. A gene is the fundamental unit of heredity (a segment of DNA). An allele is one of two or more alternative forms of a gene.

The animal's genotype is its genetic make-up, the combination of alleles it carries for each gene. Its phenotype is its observable (and measurable) characteristics resulting from the interaction between its genotype and the environment.

Heritability is the proportion of variation in a trait that is due to genetics. It is expressed as a number between 0 and 1 or as a percentage. Traits with high heritability (> 50% e.g., fleece traits) respond well to selection whereas traits with low heritability (< 20% e.g., litter size) are influenced more by environmental factors and are harder to select for.



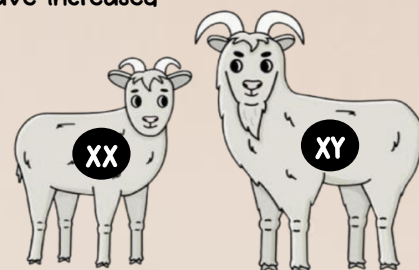
Qualitative traits fall into distinct categories and are affected by one or a few genes. Their inheritance is more predictable. Examples include myotonia congenita, horns, and eye color. Quantitative (or polygenic) traits have a range of values, often following a normal distribution curve. They are controlled by many genes. Most economically important traits (e.g., growth, prolificacy, milk yield) are quantitative.

A dominant allele expresses itself even when paired with a different recessive gene. A recessive allele only expresses itself when the individual inherits two copies of it. Horns are a recessive trait in goats, while blue eyes are a dominant trait. In sheep, white wool is usually dominant over black. Spider lamb syndrome is recessive. Sometimes dominance is incomplete (e.g., coat color).

	W	w
W	WW (Homozygous Dominant)	Ww (Heterozygous)
w	Ww (Heterozygous)	ww (Homozygous Recessive)

Homozygous means having two identical alleles. Heterozygous is having two different alleles. If a lamb inherits the dominant allele for white wool from both of its parents, it will be homozygous (WW) for white wool. If it inherits a different allele from each parent, it will be heterozygous (Ww) but still have white wool. It needs two recessive genes (homozygous, ww) to have black wool. Purebred sheep/goats have higher average homozygosity, whereas crossbreds have increased heterozygosity, which is the basis for heterosis (or hybrid vigor).

Sheep have 54 chromosomes, goats, 60. The difference in chromosome numbers typically prevents successful interspecies breeding. The X and Y chromosomes are sex chromosomes that determine biological sex. Females have two X chromosomes. Males have an X and a Y. Autosomal chromosomes are the numbered chromosomes. While there are some sex-linked traits (e.g., some growth traits), most traits are autosomal.



Genetic mutations are permanent alterations in the DNA sequence that makes up a gene. They can be beneficial or detrimental depending on the specific mutation. Beneficial mutations include increased disease resistance (e.g., scrapie) and enhanced productivity (e.g., double muscling or high fecundity). Detrimental mutations include genetic defects (e.g., myotonia), diseases (e.g., spider lamb) and reduced fertility and viability.