

NEED TO KNOW



Things you need to know about breeding livestock.

Genetics & heredity in sheep

The health of livestock can be influenced by the way that breeds have been developed over time. Breeders know that desirable characteristics and traits can be passed on from parents to their offspring. They select animals with those desirable characteristics and traits to breed with each other. The practice of selective breeding can have important consequences – both negative and positive – for animal welfare.

“The productivity of domestic livestock... has almost tripled in the last 100 years through the use of both improved feeding methods and genetic selection.... [Some] are concerned that in the future, the most serious animal welfare problems may be caused by overselection for production traits...”

Grandin, T. & Deesing, M.J. (1999) *Genetics and Animal Welfare*. Department of Animal Science, Colorado State University: pp. 319-341. www.grandin.com/welfare/genetics.animal.welfare.html



DO YOU KNOW

about selection and breeding systems? Find out what selective breeding, cross-breeding and inbreeding mean in **Selection & breeding systems** in this inquiry topic. Find out more about artificial insemination and embryo transfer in **Reproductive technologies**, also in this inquiry topic.

KNOW HOW HEREDITY WORKS

It is important to understand how principles of heredity apply to breeding practices and the results of genetic selection. Sheep breeds raised for their wool are different than the breeds that were used for agricultural activities decades ago. Many domestic animal breeds have been developed through applications of genetics such as selective breeding.

Selective breeding involves the cross-breeding of two parent animals, each with desirable traits, to produce offspring that carry these desirable traits. Selective breeding in livestock can be carried out by means of artificial insemination and embryo transfer. Selective breeding has benefits, including better resistance to disease and improved nutritional values.

In some cases, livestock within a breed can be closely related to each other, or **inbred**. Inbreeding can have positive and negative effects on an animal's health. If a breed's strengths are passed on to its offspring, more animals within the breed will have these superior abilities. However, there is also a higher chance that **genetic disorders**, diseases or illnesses that are inherited will be passed on from generation to generation.



LINK

Animal welfare issues include the effects of trait selection in livestock. Search an industry publication, such as *The Western Producer* at www.producer.com, using the search keywords "genetic effects livestock." What concerns about animal welfare do some of these articles raise?

Variations within a breed and between individual animals are influenced by both heredity and environment.

- **Heredity** is the passing of traits from parents or ancestors to their offspring. It is influenced by **genes**, which are biochemical structures made of DNA that reside in chromosomes.
- Chromosomes are passed from both parents to their offspring, therefore passing on genetic material from each parent.
- Since specific chromosomes are passed on randomly, offspring have a unique set of their own chromosomes and a unique combination of traits.
- A gene gives only the potential for the development of a trait. The extent to which this potential is achieved depends partly on the interaction of the gene with other genes.
- However, this potential is also affected by the environment. For example, a person may have a genetic tendency toward a certain weight. But the person's actual weight is influenced by environmental factors such as food choices, availability and consumption as well as the exercise that person does. The same general principles apply to livestock breeding.
- The environment can influence such characteristics as weight and muscle, which will vary according to nutrition and exercise.

- An animal's temperament may also depend on various environmental factors, including nutrition and exercise.
- Accident is another form of environmental influence that can affect an animal's appearance.



DO YOU KNOW

Sheep are often bred for specific traits, such as wool production or carcass weight. Scientists have also looked at genes that increase resistance to disease. However, some selective breeding has resulted in problems, such as increased wool weight, changes in natural shedding and increased skin wrinkling, which can encourage pests and infections around the tail and lead to painful practices like tail docking.



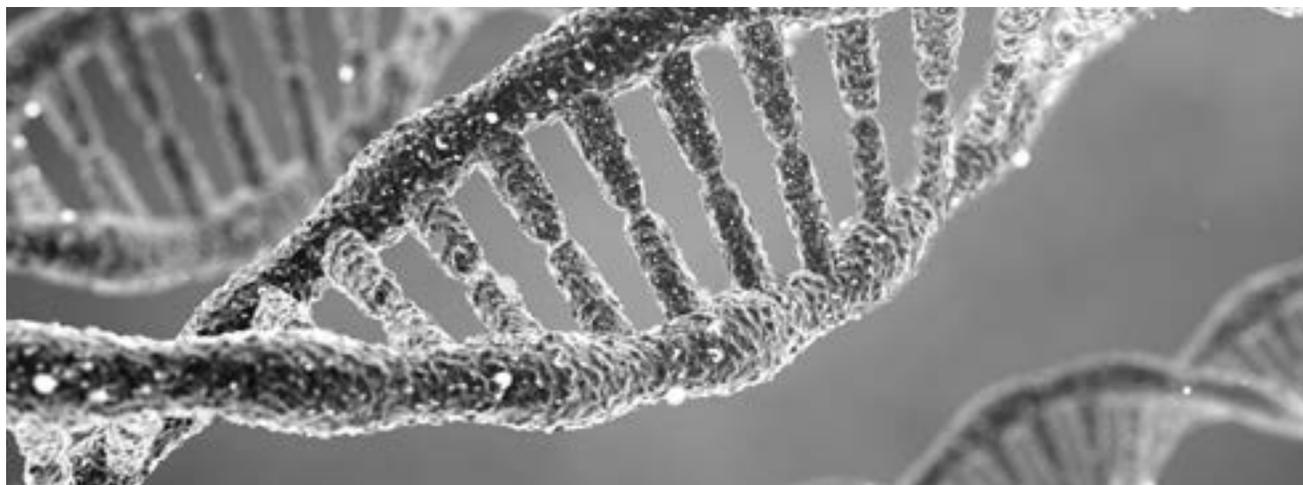
LINK

Read *Study of sheep genetics reveals large diversity* at www.producer.com/2012/08/study-of-sheep-genetics-reveals-large-diversity/ on *The Western Producer* website. What are some other examples of the positive and negative effects of selective breeding?

KNOW HOW DOMINANT & RECESSIVE TRAITS AFFECT BREEDING

Some of a lamb's characteristics, such as their wool colour, are determined based on the genetics passed on from its mother, or **ewe**, and father, or **ram**. Each parent contributes half of the genes towards the lamb. The colour and pattern of the wool depends on what is passed on from either parent, and whether these traits are dominant or recessive.

A **dominant** gene will express itself over a recessive gene. This means that the trait represented by the dominant gene will always be expressed if it is present. A **recessive** trait will only be expressed if both parents pass on the recessive gene to their offspring. The offspring will now carry two recessive genes.



Upper case or lower case letters stand for different genes. Upper case letters stand for the dominant, or "on" gene; lower case stands for the recessive, or "off" gene.

Colour genetics in sheep can be quite complicated. Very simply, all sheep have either a black or brown gene that affects the pigmentation or colouration of their wool or hair coat. This is true even if their actual wool colour is white.

The gene for black colouration is dominant. The gene for brown colouration, often called **moorit**, is recessive.

A different gene controls the pattern, or distribution, of the black/brown colouration. This gene is called the **Agouti gene**. Its dominant form causes a white pattern that "overlays" the black or brown colouration.

The Agouti gene controls the distribution or patterning of the wool colour. The "white" Agouti gene, written as AWt, is dominant. It "overrides" the black or brown colouration of wool or hair fibres.

If this dominant Agouti gene is present, the sheep's wool colour pattern will be white, even though it may also have the black or brown gene. If the lamb has a recessive Agouti gene, the colouration of the hair and wool fibres will be black or brown.

There are three possible expressions for any specific gene.

- 1. The gene is in dominant form. For example, a dominant black gene would be written as BB. This means that the lamb will have black pigmentation or colouration.*
- 2. The gene is in recessive form. For example, a recessive black gene would be written as bb. This means the lamb will have brown pigmentation or colouration.*
- 3. A gene combination includes both dominant and recessive genes. For example, a gene combination could be Bb. However, because the dominant gene is present, the lamb will have black colouration.*

As an example, if two black sheep were bred, their lambs may not necessarily all be black. This is because the parents may have both dominant and recessive genes in their genetic profile.

