



# Got Dairy?

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A brief introduction to dairy cattle genetics

# Essential Information

## External Anatomy

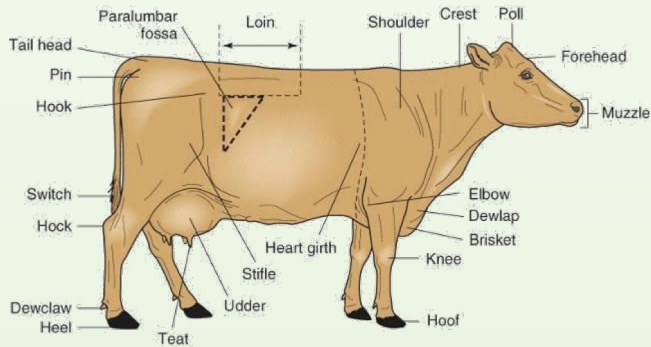


Figure 1. These are various body parts that one should know.

## Digestive System

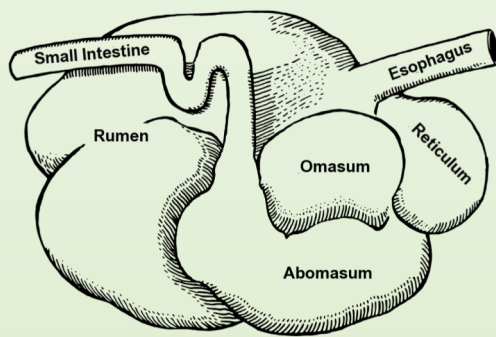


Figure 2. The cow has one stomach with four different components. The first part is the **rumen**, which is the largest component that helps break down complex products, such as grass. The second part is the **reticulum** (honeycomb), where the food mixes with the cows saliva, to make cud. The cud is then sent back to the mouth for further chewing. In the **omasum**, the water is absorbed from the food. The **abomasum** is much similar to the human stomach and is where the food is digested.<sup>1</sup>

## Breeds



**Holstein.** They are the most popular breed in the US. They also dominate the dairy industry, producing on average over 23000lbs of milk a year. These cows are typically white and black or red and white.<sup>2</sup>

**Jersey.** Said to have the highest quality milk: 15-20% more protein, 15-18% more calcium. The cow is typically smaller and uses less resources.<sup>3</sup>



**Brown Swiss.** Can be grey, dark brown, tan or even almost white. They are often very friendly and produce around 20,000lbs of milk. Brown Swiss cows are the second highest producing cows in the US.<sup>4</sup>

**Sahiwal.** One of the best dairy breeds in India and Pakistan. It is tick-resistant, heat tolerant and can fight off parasites. They remain sturdy in undesirable climates.<sup>5</sup>



## Dairy Cattle Body Condition Score

Body Condition Score	Vertebrae at the middle of the back	Rear view (cross-section) of the hook bones	Side view of the line between the hook and pinbones	Cavity between tailhead and pinbone	
				Rear view	Angled view
1 Severe underconditioning					
2 Frame obvious					
3 Frame and covering well balanced					
4 Frame not as visible as covering					
5 Severe overconditioning					

Figure 3. A system used to evaluate the nutritional status of a cow. Typically, the skinnier animals show more bone and are considered unhealthy. These are considered to have a score of 1 or 2. Overweight animals are very thick and have much more fat. These have a score of 5. The ideal, healthy cow will have a score of 3.<sup>6</sup> It is important to note that the scoring for beef cattle is different.

# Genetics



## DNA

DNA stands for deoxyribonucleic acid. It stores the hereditary information of all organisms. DNA is made up of chemical bases; Adenine (A) & Guanine (G), which pair with each other and Cytosine (C) & Thymine (T), who pair with each other. These bases determine the information available for building and maintaining an organism.<sup>7</sup>

## Chromosomes

These are structures in which the DNA is packaged/stored. Cows have 30 pairs of chromosomes (60 in total). 29 of these are autosomes, which are chromosomes that are not sex chromosomes. They typically hold the genetic information for certain traits, mutations, etc. The last pair of chromosomes can be XY, which will result in a male or XX, which will result in a female.

## Definitions to Know

*Phenotype:* An organism's observable characteristics/traits.

*Genotype:* The genetic makeup of a cell

*GWAS:* Genome Wide Association Study. Rapid scans of DNA of many individuals to find genetic variations associated with a particular trait or disease.<sup>8</sup>

*IBD:* Identical by descent. Matching segment of DNA shared by two or more people that has been inherited from a recent common ancestor.

*IBS:* Identical by state. This is when two segments of DNA are identical.

*Linkage Mapping:* A genetic map of a species that shows the position of genes/genetic markers, which are genes with known locations on a chromosome.

*Linkage Disequilibrium:* The nonrandom association between two or more alleles (gene variants). Certain allelic combinations are more likely to occur together on a chromosome than other combinations.

*QTL:* Quantitative Trait Loci. These are stretches of DNA that contain genes that for a quantitative trait.

## Genetic Diseases

While some diseases, mutations and illnesses occur due to environmental factors, there are many diseases that are traced back to genetics.

*Weaver Syndrome:* Disorder characterized by skeletal abnormalities and developmental delay.<sup>9</sup>

*Syndactyly:* Most common genetic malformation of the limb. The digits in the foot are fused and they have one claw. Most common in Holstein.<sup>10</sup>

*BLAD:* Bovine leukocyte adhesion deficiency. It affects white blood cell function, which makes animals more susceptible to infection.<sup>11</sup>

*CVM:* Complex Vertebral Malformation. Causes embryonic death, abortion and stillborn calves.<sup>12</sup>

# Genetic Evaluations



*“Our genomic testing procedure helps beef and dairy cattle or sheep producers make informed decisions and manage their livestock more effectively. By anticipating breeding results and identifying animals with the best genetic potential, we help producers optimize their profitability and yields.”*

*-Zoetis*

## Genetic Evaluations

These provide accurate information about the genetic merit of cattle. Genetic evaluations provide both genetic and performance information. For example, you can find information about milk yield, reproduction, potential diseases/disorders and conformation. The overall goal is to improve the quality of the herd with each calf that is born. <sup>13</sup>

## Genetic Companies

**zoetis**

The largest animal health company. They provide various medical, diagnostic and genetic tests for animals. CLARIFIDIE is a popular dairy genetic service. This genetic test allows for producers to select heifers with high genetic potential that will improve profitability on the farm. <sup>14</sup>

**NEOGEN**

Genotypes animals, providing a complete portfolio of genetic. Through their services, they aim to Increase genetic gain, verify parentage, manage inbreeding, make confident mating decisions, and identify the best replacement heifers. <sup>15</sup>

## Definitions to Know

**Breed association:** Organizations that focus on one particular breed. They tend to have different purposes and goals, as some focus on providing basic information, while some focus more on improving certain aspects of the breed. An example is the Holstein Association.

**Council for Dairy Cattle Breeding:** conducts genetic evaluations for economically important traits of dairy cattle.

**USDA-AIPL:** U.S. Department of Agriculture Animal Genomics and Improvement Laboratory. Works on discovery and development of improved methods for genetic and genomic evaluation of economically important traits of dairy animals.

## Valuable Genetic Scores

**Daughter Pregnancy Rate (DPR):** percentage of a bull's daughter that become pregnant during each 21-day period.

**Somatic Cell Count (SCC):** Important to measure for production and udder health. Avg: 200,000. High SCC levels mean decreased production and probable infection.

**Haplotypes:** DNA Variations that are inherited together. For example, Holstein Haplotype (HH) 1-5 all negatively impact fertility. Other breed haplotypes also exist.

**Fertility Index:** Accounts for various reproductive components. Tells us how fertile a cow is.

# Mating

Mating decisions are an important part of the production industry. In order to be successful, one wants to have sturdy, top producing animals. Selecting promising bulls to mate cows with ensures that the heifers in your next generation will be healthy and productive. Most producers use artificial insemination companies for their breeding services. This allows for improved profitability on their farm.

# Stud Companies



“Genex offers high-quality semen from profitable sires along with a customized approach to genetic and reproductive programs. Genex is your partner in improving farm profits by getting more cows pregnant and more genetically-superior calves on the ground.”<sup>16</sup>



“To enhance the productivity and profitability of dairy and beef producers, Select Sires is committed to be the premier provider of highly fertile, superior genetics accompanied by effective reproductive- and herd-management products and services.”<sup>12</sup>



“A global provider of bovine genetics and research, reproductive services and solution-based animal health products”<sup>18</sup>.



“We do more than produce and market semen from high caliber sires. We aim to create value for you by striving to understand your farm’s individual needs and goals. Our innovative programs and reproductive services make the difference at the farm level. Using customized programs, specific to your needs, we promise to tangibly improve your individual herd profitability.”<sup>17</sup>



If you need further clarification on any of the information presented in this booklet, feel free to check out our webpage at <http://blogs.cornell.edu/dairygenetics/evaluations/>. There are tons of other resources which further elaborate these topics. If you have any further questions, feel free to email the author at ([md652@cornell.edu](mailto:md652@cornell.edu)).

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