CATTLE

CLASSIFICATION

<table>
<thead>
<tr>
<th>Kingdom</th>
<th>Animal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phylum</td>
<td>Chordata</td>
</tr>
<tr>
<td>Class</td>
<td>Mammalia</td>
</tr>
<tr>
<td>Order</td>
<td>Artiodactyla</td>
</tr>
<tr>
<td>Family</td>
<td>Bovidae</td>
</tr>
<tr>
<td>Genus</td>
<td>Bos</td>
</tr>
<tr>
<td>Species</td>
<td>indicus Asian humped cattle</td>
</tr>
<tr>
<td></td>
<td>taurus European non-humped cattle</td>
</tr>
</tbody>
</table>

TERMINOLOGY

<table>
<thead>
<tr>
<th>Bull</th>
<th>adult, intact male</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cow</td>
<td>mature female that has had at least one calf</td>
</tr>
<tr>
<td>Calf</td>
<td>young of either sex, under one year of age</td>
</tr>
<tr>
<td>Heifer</td>
<td>young female that has not yet had her first calf</td>
</tr>
<tr>
<td>Steer</td>
<td>castrated male over one year of age</td>
</tr>
</tbody>
</table>

HISTORY

In prehistoric times man hunted a cow like creature known as an auroch, these animals had large horns and huge fore-quarters. Cave paintings depict early man hunting these large animals with spears and arrows. The aurochs gave rise to the wild cattle found in the middle east some 8,000 to 10,000 years ago. Domestication of these wild cattle began and they were used for the production of meat and milk as well as a source of draught power. Along with early domestiction cattle also became a religious symbol in many parts of the middle east. The Egyptians especially worshipped cattle as they were seen to represent fertility, strength and aggression. As the Hebrew culture changed from being warriors to becoming farmers the image of the bull changed from aggressive to virility. In India the cow became a major religious significance so much that they were used only for draught animals and never eaten.

When Christopher Columbus came to America he found virgin pastures that would support vast numbers of cattle much better than his native Spain could. The Longhorn cattle brought over to the new world thrived on the lush pastures and lack of predators. By 1870 there were over 13 million cattle on the plains of Argentina alone.

In the late 19th century as British and American pioneers began to tame the wild west they found huge open pastures waiting for their cattle. After the slaughter of the buffalo from 1856 to 1875 there was no competition left and the vast grazing lands were left to the pioneers and their cattle. Today the U.S. is one of the largest producers and importers of beef in the world.
In Canada our large grazing areas and cheap source of grain has led to beef production becoming one of our main, and most economical exports. It is estimated that there are over 13 million beef cattle in Canada with 26% of them living here in Saskatchewan. Canada is the 3rd largest exporter of beef in the world with 813,000 tonnes being shipped out each year. In the year 2000 the beef industry was responsible for 25 billion dollars of income going into the Canadian economy. The recent scare with the “mad cow disease” will definitely have some effect on these numbers in the near future, how long that will last is yet to be seen. The one area that has not been affected by the scare is our consumption of beef. In 2000 Canadians ate 50.5 lbs of beef per person, this amount will likely increase in the near future as Canadians try to support the local economy.

STATISTICS

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Value</th>
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</thead>
<tbody>
<tr>
<td>Lifespan (yrs)</td>
<td>15-20</td>
</tr>
<tr>
<td>Body weight Adult female</td>
<td>400-800 kg</td>
</tr>
<tr>
<td>Body weight Adult male</td>
<td>600-1000kg</td>
</tr>
<tr>
<td>Body weight Newborn</td>
<td>50-80 kg</td>
</tr>
<tr>
<td>Body temperature</td>
<td>38.5 C</td>
</tr>
<tr>
<td>Heart rate</td>
<td>50-70 beats/ min</td>
</tr>
<tr>
<td>Respiration rate</td>
<td>15-30 breaths/ min</td>
</tr>
</tbody>
</table>

BEHAVIOR

Cattle like sheep, are a gregarious animal meaning that they like to live and form groups with others of their own kind. Most herds of cattle will consist of a group of females that have a social hierarchy that is structured by age, weight, presence of horns, sex and breed. The older cows (larger) will occupy the top of the hierarchy while the younger (smaller) cows will fill in the lower positions. Once the hierarchy is established it will remain stable until new cows are added. The group of cows may have their young with them up until weaning age (100-120 days), as well as an attending bull for breeding purposes. The remaining younger bulls or steers will form their own smaller and unstable herds.

Cattle seem to have very good memories and quickly become creatures of habit. Milking cows very quickly learn the routine of entering the milking parlor and going through the milking process. Range cattle can learn to recognize certain vehicles or certain sounds if they relate it to food or treats. The cows’ good memory makes it much easier to handle these large animals in experimental studies. Quite often the animals are run through chutes or held in crates, the cow can be trained to become accustomed to the manipulations and do not become stressed during the experiment.

The flight zone of cattle varies quite a lot depending on how much interaction the animal has had with people. Cattle that live on the range most of the time will probably be very wary of people and have a very large flight zone, you don’t have to get very close to make the animal move. Dairy cattle that have contact with people every day will
likely have a very small flight zone and you will have to be very close to the animal to make it move. Cattle are generally very docile creatures and with a little training can be very easy to handle even though they are very large animals. Bulls can be protective of their females and you should always be aware of where the bull is in the pen or out in a pasture. Cows may also be protective of their newborn calf for the first few days and should be given extra space during this time. Both bulls and protective cows will lower their head and paw the ground as they try to demonstrate dominance over the perceived threat.

ANATOMY AND PHYSIOLOGY

Dentition

Cattle do not have any upper incisors and like sheep have a tough dental pad that is used in conjunction with the 4 lower incisors to hold and tear grass. There are no canines present in cattle leaving an open space or diastema between the incisors and premolars. There are 3 premolars and 3 molars on each side of the top and bottom jaw for a total of 28 teeth in a mature cow.

The premolars and molars are used for grinding up the consumed plant material and also when the animal is “chewing its cud” during the rumination process. The second chewing or grinding of the plant material helps to break down the cellulose and provide a greater surface area for digestion to occur. Cattle teeth do not erupt continuously and will eventually wear down and lead to malocclusion.

Digestive System

Cattle are a grazing and browsing animal that will spend an average of 8 hours each day eating grass and browse. During the grazing time the cow will consume up to 90 kg of grass, clover and browse and walk up to 2 km. Being a ruminant the cow will spend a considerable amount of time chewing its cud or ruminating. Like sheep the rumination process involves five steps:

1) Regurgitation  
2) Re-insalivation  
3) Re-mastication  
4) Re-swallowing  
5) Fermentation

A bolus of food is brought back up to the mouth, mixed with saliva and re-chewed. The bolus is then swallowed back down into the rumen where fermentation occurs and the microbial breakdown of cellulose begins. If the cow is consuming very succulent feed such as grass and clover the amount of time spent ruminating will be less than if it is consuming course feed such as straw or certain kinds of hay.

Being a ruminant also means that the cow has four stomachs that help in the digestion of cellulose:

1) The rumen: the largest of the four stomachs where the anaerobic microbes break down cellulose into volatile fatty acids occurs.
2) The **reticulum**: the smallest of the four stomachs, the mucous membrane is folded into a hexagonal pattern that resembles a honey comb.

3) The **omasum**: another small stomach with a complex mucous membrane, sometimes called the bible because of its many leaves or folds used to absorb nutrients.

4) The **abomasum**: the stomach where about 70% of the water is absorbed so that the material passing into the small intestine is a pasty consistency. Breakdown and absorption of the food material takes place mostly in the small intestine. The absorbed food particles pass across the intestinal lining into the blood stream where they are used by the cells of the body or stored for later use. Any food particles not absorbed pass into the large intestine where water, minerals, sodium and vitamins are absorbed before the waste materials are voided from the body as feces.

**Thermoregulation**

Cattle due to their large size and production of large amounts of heat caused by the microbial digestion in the rumen are able to withstand a wide range of temperatures. The thermoneutral zone of full-grown cattle can range from -20 to +26°C. New born calves are born with relatively high amounts of brown adipose tissue (BAT) that can produce heat for the calf. New born piglets have no BAT and must be born into an environment that is similar to that of its mothers womb. Lambs are born with a small amount of BAT and can only survive cold environments for a short period of time before succumbing to hypothermia. The calf can be born into an environment that may differ by 30°C from that of the mothers womb.

The different species of cattle have developed certain adaptations to survive in their respective climates. In colder climates a longer, dull looking coat such as that seen in the Scottish Highland provides insulation from the cold and rain while reducing the heat reflection from the body. In warmer climates the *Bos indicus* have developed long legs, short hair coats, large ears and pronounced dewlaps to help the body rid itself of excess heat. The dewlaps and large ears give the body extra surface area from which heat can be lost. Fat reserves are stored in a hump similar to a camel so that the fat does not restrict heat loss from the body.

In general cattle are better able to withstand colder temperatures better than hot temperatures. As long as cattle are given an area to avoid the wind and ad libitum access to food they can survive very cold temperatures for extended periods of time. The limited ability of the cow to lose heat makes them susceptible to overheating. Providing access to shade and making water available are the best ways to prevent heat stress in cattle. Animals housed in a controlled environment prefer a temperature around 20°C at a humidity of about 50%.

**Reproduction**

Cattle are **polyestrus**, meaning they will come into heat or be receptive to a bull at all times of the year. A cow will come into heat every 20-21 days until she becomes pregnant. A cows heat will be the strongest and last the longest during the summer when a heat can last for up to 36 hours. In the winter a heat may only last for 8 hours and if
conditions are poor may not happen at all. On average a cow will come into heat for 12 to 18 hours every 21 days. Detecting a cow in heat becomes quite simple once you know what to look for. A cow in heat may bellow trying to attract the attention of the bull, she will become restless and the vulva lips may become swollen. A cow in full heat will adopt a standing position and be mounted by other cows if there is no bull around. Groups of cows should be observed a couple of times each day to be able to detect those that are in heat.

Determining when a cow is in heat is especially important if a producer is trying to artificially inseminate (AI) the herd. A cow can be artificially inseminated 12 hours after the first signs of heat are detected. There are a few devices that can help a producer tell which of the cows are in heat:

1) **Heat patch**: a plastic patch that contains a vial of colored dye is glued to the top of the backbone between the tail head and the hip bones. When the cow is mounted the plastic vial is broken and the dye causes the plastic patch to change color. The behavior signs of estrus should be looked for to ensure that the patch was not accidentally ruptured.

2) **Colored wax marker**: a thick deposit of colored wax is place on the tail head of the cow. When the cow is mounted the wax is smeared down the sides of the tail head and onto the rump of the animal. Again also look for the behavior signs as well.

3) **Gomer Bulls**: also known as “teaser” or “marker” bulls have been vasectomized or otherwise altered so that they are unable to breed the cow in heat. The marker bull is outfitted with either a wax crayon marker on the chest or a paint marker placed under the chin. Both marking devices will leave proof that the cow was mounted and is therefore in heat.

If a producer is going to artificially inseminate his herd the cows can all be brought into estrus at the same time by injecting them with prostaglandins. This synchronizing of the estrus cycle means that all the cows come into heat at the same time and they can all be artificially inseminated at the same time. Most producers will have their vet or a trained technician to do the AI technique so the synchronization also saves money on vet calls. The other advantage to synchronizing the cows is that they should all have their calves at approximately the same time.

The most common way of breeding cattle is to have a proven bull in with the herd so he can service the cows as they come into heat. The bull is usually fitted with a marker so the producer knows when a cow was bred and when she can be expected to have her calf. Some producers who want to have the calves at certain times of the year will only turn the bull out when its time to breed.

Parturition in cattle is known as **calving** and in most cases there is very little trouble or need for human interference. The normal delivery position is for the head and both front feet to come out first and once the front shoulders have passed the rest of the body will quickly follow. Some signs that the cow is going to have her calf soon are:

1) Swelling of the udder and stiffening of the teats.
2) Slackening of the ligaments on either side of the tail.
3) The vulva may become swollen.
4) Drops of honey colored colostrum may appear on the teats.
Breeding age 12-15 months
Length of estrus cycle 20-21 days
Duration of estrus 12-14 hours
Breeding life span 12-15 years
Gestation length 280 days
Average birth weight 25-45 kg
Age at weaning 6-8 months (can be sooner for pail fed calves)

Senses
Cattle have well developed eyes that can see color but probably not as well as we can. They have nearly 360 degree field of vision with just one small blind spot directly behind them, their binocular vision is limited to around 30 degrees in front of them. Their wide peripheral vision allows them to keep track of the rest of the herd while grazing.

The sense of smell is well developed in cattle and is probably the main way to detect predators. Social dominance and reproductive behavior is also closely connected to the strong sense of smell found in cattle. Bulls can sense or smell when a cow is coming into heat and will sample the air surrounding a female to determine her reproductive stage. The bull will extend his head, dilate his nostrils, and curl his upper lip allowing the air to pass over the roof of the mouth. The bulls’ curious stance is known as “The Flehman expression” and can also be used as a non-threatening display. Cattle are very sensitive to the smell of blood and will often become nervous or stressed if they detect blood in the air or on the ground.

A sense not often thought of when dealing with animals is the sense of touch. In cattle this sense can be used in a very positive way especially among dairy cattle that are handled twice a day. If they are petted or caressed as they are being milked the cow will learn to associate the milking parlor with something positive and will not be stressed out by her experience. Touching and talking to cows also lets them know where you are so as not to startle them. Mutual grooming is often seen among cattle and may be part of the social hierarchy of the herd. Cows have very sensitive skin and can localize individual flies and flick them off with her tail if the fly is causing discomfort.

HUSBANDRY AND ENVIRONMENT

Housing
The way that cattle are housed will depend on the type of cattle being housed and what the cattle are being used for. Most beef cattle are kept outdoors in a feedlot or out on a pasture while dairy cows are housed for the most part indoors or in small outdoor pens. Most cattle that are used in the research setting are housed in outdoor pens if
possible but some experiments may require individual penning or even individual crates if metabolism work is being done.

Cattle that are kept out on a pasture will require very little in the way of housing even during our worst winter weather. A source of shelter whether it be man made (a shed) or natural (trees or brush) as long as the cows are able to get out of the wind is the most important thing. A source of food and water are the main concerns when housing cattle outdoors. Most producers will either time calving to occur in the spring-time or bring the expectant mothers in so that the calves are not dropped in the really cold weather when hypothermia can become a concern.

Cattle may also be housed outside in a feedlot operation. Feedlots are used to take weaned animals and grow them up to market weight. They are intensively fed a high concentrated diet and housed in large pens. There is usually some sort of man-made shelter or windbreak provided for protection from the wind. The animals are generally fairly intensively housed but there should be sufficient space to allow for Brambles five freedoms: each animal should be able to readily stand up, lie down, turn round, stretch its limbs and groom itself. Guidelines in the CCAC require 8 to 9 square meters of space per animal housed in outdoor pens.

When housing cattle indoors there are a number of options available to producers or research staff. Most often an individual tie up stall is used which provides each cattle with a bedded area, a trench for urine and feces, a source of water and a feeding area. A cow will enter the tie stall and be restrained in a head gate. The head gate will still allow the cow to stand and move forward to reach the feeding area and to allow the cow to stand. A mature dairy cow will require 70 cm of forward space in order to be able to stand as the cow lunges forward to get her rear feet under her. Individual pens are a high maintenance means of housing cows indoors but necessary if doing feed trials. The pens should be well bedded or have rubber mats to prevent the cow from slipping, if possible the cows should still be able to see one another. Metabolism crates are sometimes used to collect urine and feces during a trial. These crates are designed to hold one animal and have slatted floors will areas to collect the urine and feces. Animals can only be held in these crates for short lengths of time.

**Nutrition**

Due to the economic importance of both beef and dairy cattle there is lots of information available on cattle nutrition. The nutrient requirements of the cow will vary depending on the age, breed and reproductive stage of the animal. Dairy cattle while producing milk will require a higher energy diet than that of a beef cow the same age and size. On average grazing cattle will consume up to 90 kg of grass per day, if housed indoors the cow will need up to 70 kg of silage per day or 15 kg of good quality hay to meet their dietary requirements. All feeding regimes can be supplemented with good quality concentrates that can supply additional energy, vitamins and minerals. All cattle should have access to a salt lick especially when they are on pasture. A clean source of water should always be available as cattle will require 40-50 litres of water per day with lactating cows requiring even higher amounts. Contaminated water sources can be a major site for disease infestation and if at all possible a clean (treated) source of water should be available at all times.
Identification

The easiest and most widely used system for identifying individual animals is plastic or metal ear tags. The large colored and numbered tags are easy to read and are a fairly permanent method of identification. The use of brisket tags and branding with hot irons is used very infrequently now based on animal welfare concerns. Freeze branding which permanently damages the pigment forming cells in the skin causing the affected area to grow white hair is the only acceptable way of branding cattle these days. Collars that contain a microchip are being used in modern dairies, these collars not only identify the animal but also regulates how much food the cow receives and keeps track of how much milk the animal produces.

New federal regulations in Canada require all cattle to have tags with a bar code embedded in the tag. The idea is that animals can be easily tracked as they move from one producer to the next, through auctions or eventually the meat packers. Hopefully the time required to check the background of a disease carrying animal and all the animals it may have come in contact with will be greatly reduced. The bar code unfortunately can be difficult to read as the tag must be clean and directly face the scanner. Tags with electronic implants are available that are easy to scan but they are much more expensive and few producers can justify the extra cost.

Handling and Sexing

As mentioned earlier cattle have very good memory and can be trained quite easily. Halter training cattle is best done while the animal is still young and allows even the smallest of people to be able to handle the largest of cattle. A chute and head gate are probably the two most important pieces of equipment to have when performing most manipulations of cattle. The chute system should be curved and allow the passage of only one animal at a time. Quite often injections, deworming and other quick manipulations can be done with the animal right in the chute. Blood collection, ear tagging, dehorning and many small operations require the head of the animal to be controlled, this is achieved with the head gate. A head gate catches the head of the animal as it passes through the end of the chute, once the head is controlled a halter can be placed on the animal to further restrain the head. Once the manipulation has been preformed the head gate is opened to allow the animal to pass through and return to the herd.

Determining the sex of the animal can be done quite easily with a quick visual inspection. Even day old bull calves have a scrotum and testes that are easily seen. The female calves obviously lack the scrotum and testes and instead will have a vulva that can be seen once the tail is lifted. Steers can sometimes be difficult to sex as they have had their testes removed but there should still be a visible tuft of hair where the urethra expels urine.
Zoonotic Disease

One of the most common conditions seen in cattle is Ringworm. Ringworm is caused by several different types of fungi that attach themselves to the base of the hair follicles. The fungi are dermatophytes living off the dead skin cells and cause the cattle to rub the infected areas resulting in hair loss or alopecia. Raised, round or oval areas of crusty lesions accompanied by hair loss are the classical signs of a ringworm infection. The fungi can live in the environment for an extended period of time (up to a year) until an unsuspecting host comes along. The disease is spread by direct contact and is zoonotic, meaning it can be passed on to people. Ringworm is a very common condition found in dairy herdsmen due to the high level of contact between the worker and the cow. The disease is self-limiting meaning that the body builds up immunity to the fungi and eventually the body will rid itself of the infestation. Once an animal or person has had ringworm they are protected from future infections due to the immunity built up in the body.

USES IN THE LAB

Because of their economic importance there is a lot studies done to improve the production and well being of cattle. Most of the studies carried out are in the areas of nutrition, reproduction and production (beef and milk). A lot of work is also done to look at the diseases affecting cattle as well as the environmental preferences of the animals. They are not a very good model for human conditions due to their large size and very different physiology. There is some interest in zoonotic diseases such as tuberculosis as well as bovine spongiform encephalopathy (BSE) also known as “mad cow disease.” Certainly with the recent confirmed diagnosis in Canada there will be further research done to determine how and if this disease can be passed on people.