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Evaluating Conformation and Growth of Commercial Dairy Heifers

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Introduction

The landscape of the U.S. dairy industry has changed greatly over the past 50 years. Farm size has increased while the number of dairy farms has decreased, with tightening profit margins largely driving this shift. With these tight margins, producers focus on feed and milk prices while reducing programs and strategies that do not yield financial returns.

One such reduction in many herd management programs involved moving away from the registration of animals. Though many were still comprised of purebred genetics, others chose to integrate crossbreeding programs. Whether unregistered, purebreds, or crossbreds, they all are referred to as commercial animals. In these herds, the animal's merits are found to a greater degree in herd-level performance, where cows that are both feed- and milk-efficient with longevity are prioritized.

Milk and feed efficiency are long-standing trademarks of a productive cow, while the concept of cow longevity is reemerging as a focal point. This longevity is more commonly referred to as *productive life* and describes the time from when an animal first enters the lactating herd until she is ultimately culled from it. Therefore, animals with higher productive lives are less likely to be removed from the herd for common culling reasons, which include poor production, reproduction, and mastitis. As a result, herds with a greater average productive life have a reduced need for replacements and a greater percentage of the herd milking at a mature age; both of which are economically beneficial. The question then becomes how to identify replacements with the potential for greater productive lives.

While some of this is left to chance, a large portion is answered in genomics and still more answered by following familial lines and evaluating physical type traits. Producers have resources to help decode genomics, and there's a general understanding about familial lines, but there is little information to help farmers identify functional type traits of commercial replacements that equate to longer productive lives. This publication provides that guidance by explaining conformation and growth parameters that should be evaluated when selecting commercial dairy heifers to retain for future productivity and longevity.

The Role of the Crossbred in Commercial Herds

A reduced focus on registered animals brought a concurrent rise in the number of farmers

looking at crossbreeding to meet their farms' goals. Farmers also took a harder look at the weaknesses highlighted by focusing on purebred genetic lines—including the impact of inbreeding depression on valued production traits, identification of defective haplotypes, and decreases in fertility and disease resistance. Although the predominant commercial dairy animal remains purebred Holstein, the number of crossbred animals and herds is increasing.

Data from the Dairy Herd Information Association (DHIA) and reported by the Council on Dairy Cattle Breeding (CDCB; Guinan, 2020) shows the growth in less-utilized dairy breeds as well as the crossbred population from 1990–2018. Table 1 provides information related to these trends over time. As a result, the CDCB extended genomic evaluations to crossbreds in 2019.

Table 1. Number of DHI Cows by Breed in Selected Years.

Breed	1990 Population	1990 % of Total	2013 Population	2013 % of Total	2018 Population	2018 % of Total
Ayrshire	16,803	0.70	9,167	0.23	6,487	0.16
Brown Swiss	25,954	1.09	25,319	0.64	20,786	0.52
Dutch Belted	0	0.00	693	0.02	1,215	0.03
Guernsey	32,375	1.36	7,449	0.19	6,169	0.15
Holstein	2,161,579	90.58	3,402,735	85.72	3,243,490	81.45
Jersey	135,374	5.67	367,830	9.27	485,849	12.20
Milking Shorthorn	3,698	0.15	4,917	0.12	3,688	0.09
Norwegian Red	0	0.00	212	0.01	2,825	0.07
Simmental/Fleckvieh	0	0.00	1,002	0.03	1,657	0.04
Red and White	7,711	0.32	4,193	0.11	2,423	0.06
Crossbred	2,971	0.12	146,262	3.68	207,368	5.21

Table 1 adapted from "Changes in the breed composition of U.S. dairy herds," by F. Guinan, 2020, Council on Dairy Cattle Breeding (https://uscdcb.com/wp-content/uploads/2020/01/CDCB-Guinan-US-Dairy-Breed-Composition.pdf).

In 2023, the CDCB reported the percentage of crossbreds contributing to the U.S. dairy cow population rose to 6.5% (213,252) of total animals, while Holsteins decreased to 80.7%. Of note is that the CDCB reports (in its quarterly evaluations) breed averages and the impacts of inbreeding and *heterosis* (also called hybrid vigor, or when offspring have improved traits over either of their parents) on production, fertility, and wellness traits. Heterosis is highly favorable for traits such as milk components (fat, protein), fertility (DPR, CCR, and HCR), and productive life.

Conformation of the Commercial Dairy Heifer

Producers should seek the fundamentals of a good, functional type animal during the phenotypic evaluation of all replacement heifers. Though emphasis may vary from farm to farm based on preferences and goals, there are core traits that should be prioritized across dairy farms. These priorities include animals that exhibit dairyness, are of adequate body, and are robust and sturdy in bone, with functional and strong feet and legs. All of these traits speak to the animal's future ability to effectively and efficiently convert feed into milk (*dairyness*).

Additionally, the selection and partial rearing of these replacements is a large youth project in the state of Georgia. Therefore, the descriptive trait information below should serve as a resource for both on-farm selection and retention of heifers and a resource for youth involved in this project.

Characteristics of the Animal's Frame

The frame sets the structural character of the animal. Factors included in this discussion influence total animal frame size, structural correctness, and comfort while lying, standing, and moving. In combination, these tend to drive fitness for living environments and long-term livability.

Rump

Long, wide rumps are preferred. Long, wide rumps are indicative of total frame length and width. Increases in body length and width should allow for increases in feed intake, which could be positively correlated with milk production potential. Additionally, a longer and wider rump allows for increased area for mammary development. As it relates to reproduction, animals that are wider through the rump would have fewer issues with *dystocia* (difficult birth) caused by incompatibilities between the fetus and dam.

A slight drop from hips to pins (*rump angle*) is preferred. That angle should not be greater than 5–15 degrees, or more than approximately 1 in. of drop from hips to pins. The rump angle serves functions for reproduction and rear-leg set. The appropriate drop to the rump from hips to pins promotes cleanliness of the reproductive tract and facilitates easier calving, as opposed to the pins being higher than the hips.

The set of the rear leg is important to lameness prevention. If the rump angle is too steep (hips higher than 1 in.), typically the leg is set too far under the animal, which may cause the hock to have too much set or angulation. If there is too much set to the hock of an animal, it could cause them to wear down the heel faster and result in lameness. If the animal is higher in the pins than the hips, typically the leg moves back or is straighter, putting greater strain on the hock and wearing down the toe, which again could result in lameness. Any causes of lameness not only represent an animal welfare issue but also will lead to decreased feed intake and performance

and reduced heat expression, which is necessary for many reproductive programs.

Topline (includes the chine, back, and loin)

Animals should be strong and straight across the topline. A strong topline enables an animal to more correctly support the weight of their body and their future udder. Weaknesses in the topline may lead to reduced mobility, pain, and increased udder injuries. The topline can also impact the rump and placement of the rear legs.

Weaknesses in the topline may result in the hips dropping, which reduces the rump angle and causes the rear leg to straighten. This straightening of the rear leg puts additional pressure on the hock joint and wears down the toe quicker, which may cause pain when standing and walking.

Characteristics of a Dairy Animal That Combines Dairyness with Strength

Dairyness is an overarching term used to describe an animal whose physical appearance indicates that **feed energy is used primarily for milk production**, rather than for developing muscle or depositing fat. However, the dairyness of an animal should not come at the expense of strength, which can influence an animal's ability to sustain productivity in the herd.

Favor animals that are broad, wide, and have a good substance of bone while being flat through the bone and clean over it. Animals that combine a strong and sturdy body while exhibiting a predisposition to putting feed energy into milk over fat and muscle are preferred.

Ribs

Ribs should be wide, flat, openly spaced, and rear-sweeping while exhibiting depth to both the fore and rear rib. Ribs that are flat and rear-sweeping give dairy character, which shows a promotion of energy to support milk production. The openness of the ribs allows for more length of body, while the depth of the fore and rear rib provides a second dimension for the overall capacity of the abdominal cavity. This dimension is related to increased capacity for feed intake, which should translate to increased milk production.

Chest

Animals should be **wide in the front end and deep in the chest floor**. Width in the front end typically corresponds with width through the body and the rump. While this has the potential to promote feed intake—and subsequently milk production—perhaps more important is it increases the capacity of the thoracic cavity. The thorax houses the heart and lungs, so larger dimensions increase the capacity of both the circulatory and respiratory systems.

Additionally, it is often indicative of total body cavity size and end-to-end volume for feeding capacity.

Cleanliness along the neck, dewlap, and brisket are an indication of adequate condition (not too conditioned) as well as the desirable predisposition in dairy genetics to not carry excess flesh.

Neck

The neck should be **long and clean without additional flesh/fat in the dewlap and brisket**. Long, lean necks are associated with dairy breeds and are one of the markers for dairyness in an animal. Additionally, this trait is associated with overall body balance, with a long, lean neck generally followed by greater length through the body. Reduced thickness in the dewlap and brisket contribute to the neck but also serve as a signal to body conditioning or flesh covering, described further below. Serving as fat reservoirs, a heavy dewlap and brisket would decrease the dairyness of an animal.

Condition and Flesh Coverage

Condition and coverage should be appropriate for age and reproductive status with excess or underconditioning discriminated against. *Conditioning* is essentially the amount of fat covering distributed across the body. Conditioning too high early in life can cause reproductive issues, fat deposition in the mammary gland that can inhibit tissue development, metabolic issues at calving, and set the animal up for a long-term inclination to convert feed energy to fat. Too little condition is often indicative of fragility and/or poor nutrition, and should also be discriminated against. Much like their overconditioned counterparts, these animals may suffer reproductive issues, reduced thriftiness or longevity, and increased metabolic disorders upon calving. Appropriate fleshing is indicative of nutritional plane but may also be influenced by genetics.

Bone

An ideal animal is **flat but substantive in the bone**. The shoulder, ribs, and legs are generally evaluated in this discussion. A *flat bone* is indicative of dairyness with round bones often found in beef breeds. However, a round appearance may also be the result of fat covering. Animals that have substantive bone that is flat are preferred to couple longevity with genetic dairy qualities.

Feet and Legs

The comfort of the foot and leg of a dairy animal influences her desire to feed, ability to move freely to and from the milking parlor, and show signs of heat or reproductive estrus. Therefore, dairy heifers with comfortable movement alongside structural correctness (for the longevity of that movement) are highly favored for increased productive herd life. Poor foot and leg

conformation with comfort is predictive of increased issues when lactating, particularly when heifers are housed on concrete.

Movement

The animal should **walk freely and easily** with an appropriate and straight stride. Often referred to as "filling her tracks," a dairy animal whose hind feet land almost exactly in the tracks left by her front feet when walking generally indicates an animal with correct leg conformation and comfort when walking. Short or cumbersome strides may indicate a conformation issue, often with varying degrees of discomfort or pain associated with movement. Movement should also be evaluated by watching the animal's back when walking. Arched backs are often indicative of discomfort with movement.

Rear legs

Her hocks should exhibit the **appropriate amount of set** and **have adequate flex** as she moves. *Set* is a term used to describe the angle of the hock. The hock has some curvature to it, which is necessary to allow flex as she moves. Deviations from normal may begin at the hock or further up the hind leg at the rump. Though issues associated with improper angles may not be seen in heifers, the impact will become evident with age. When the curvature of the hock becomes too extreme or the hock angle takes on the appearance of a "sickle," the heel of the hoof will wear at a faster rate than the toe and put additional pressure on the hock joint. This opens the heel to damage and bacterial infection.

On the other hand, when the hock angle is too straight or the leg takes on the appearance of a "post," the toe will wear unevenly and there will be additional pressure on the hock joint because of the reduced ability to flex when moving—this is similar to how a person might walk if they can't bend fully at the knee. When viewed from behind, the hocks should be straight with toes facing forward.

Hooves and Pasterns

Hooves should have **adequate depth of heel** and the **pasterns should be strong but flexible**. The ideal heel depth is at least 1.5 in. from the sole to the hairline. Lower heel depth risks the exposure of the soft tissue at the back of the hoof to the ground, which may cause abrasions and/or infections.

Depth of heel relative to toe is also evaluated by looking at the *hoof angle*, where the angle of the toe relative to the ground is assessed. An angle of approximately 45 degrees is most desirable. The pasterns need to be strong—not providing much flexion. A strong pastern keeps the majority of the wear on the toe when walking, as the toe can withstand more wear compared to the heel. However, pasterns still need to have some flex when walking to prevent stiff movements.

Stiffness over time may result in pain when moving. Many factors associated with the hoof can be exacerbated by the rump but corrected—to an extent—through appropriate trimming.

The animals in Figures 1–8 provide visual examples of several conformational traits described above.

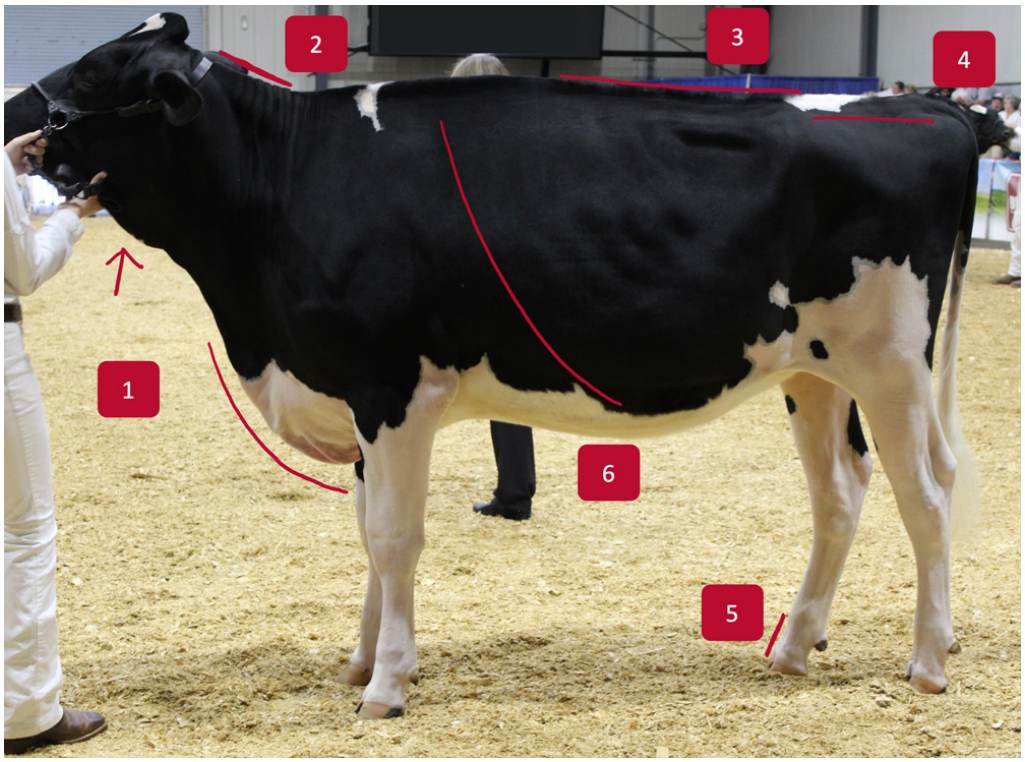

Figure 1. Left Side View of Several Undesirable Traits and a Couple of Desirable Traits. Markers 1–4 are the *undesirable* traits.
1: Excess flesh through the chin, dewlap, and brisket;
2: short in the neck;
3: mild weakness across the top, particularly in the loin. This is likely a result of Marker 4.
4: level from hooks (hips) to pins. The pins are elevated slightly above the desirable angle, which drops the hips. This drop to the hips is part of the weakness across the loin.
5: The *desirable* traits are strong in the pastern and
6: long, rear-sweeping rib.

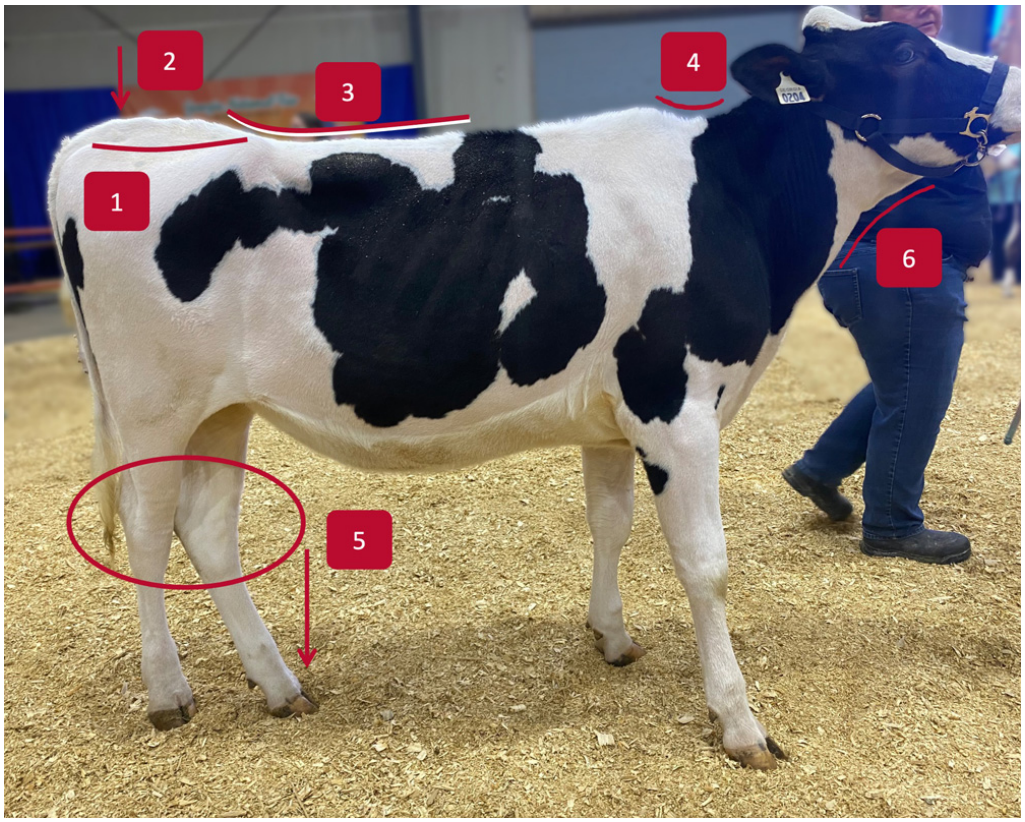

Figure 2. Right Side View of Mostly Undesirable Traits. Markers 1–5 are the *undesirable* traits.
1: Level hooks (hips) to pins, which is likely affecting Markers 2 and 3;
2: the tailhead does not sit nicely between the pin bones;
3: there is weakness over the top, particularly in the loin;
4: the neck is short and not smoothly attached, giving a "U" shape; and
5: although the ideal view would be from the rear, this animal's hocks appear to be close together, which is causing the toes to point out. Therefore, it's likely that this animal does not stand straight nor square in the rear legs.
6: The *desirable* trait: clean through the neck.


1
2

Figure 3. Front View of *Desirable* Traits.
1: Though moderate in this picture, there is evidence that this animal has “spring” of rib. This spring to the rib is indicative of capacity.
2: Stands straight through the front legs, with toes pointed forward.

Figure 4. Rear View of *Desirable* Traits in Two Animals. Markers 1 and 2 indicate the same locations on both animals.
1: Both are straight through the rear leg, which places their feet beneath them and pointed forward; and
2: both exhibit width, though with a slight variation in degree, between the rear legs, which is often the result of width at the rump and being straight through the rear leg.

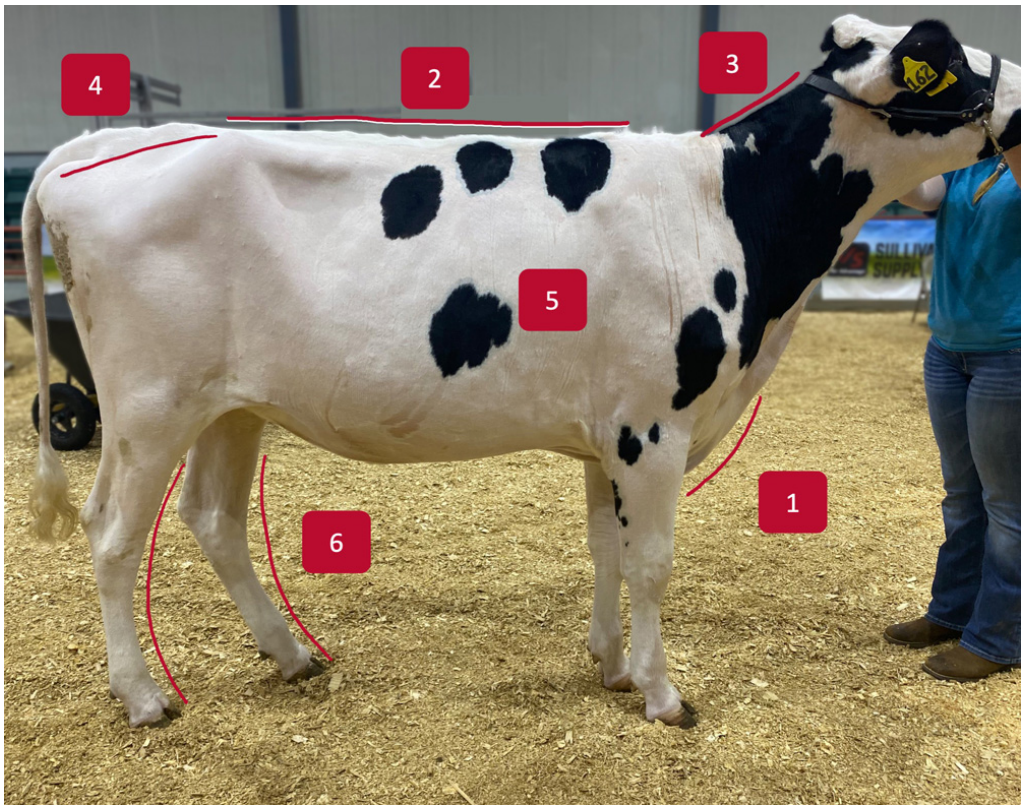

Figure 5. Right Side View of an Animal with Several Desirable and Undesirable Traits. Markers 1–3 are *desirable*:
1: She is clean through the brisket;
2: she's long, strong, and straight across the top; and
3: there is a smooth transition from shoulder to neck, and she is long and lean in the neck.
Markers 4–6 are *undesirable*:
4: She exhibits too much drop or slope to the rump from hooks (hips) to pins. This is likely the reason for the undesirable leg set (Marker 6);
5: though she has a uniform depth of body, this animal tends to be shallow-bodied. Also of note is the mild excess condition across the ribs and the appearance of being round versus flat through those ribs; and
6: there is too much set or "sickle" appearance to the hock. In this same view, there is some weakness to the pastern. As this animal walks and the pastern flexes, those dewclaws may come close to touching the ground.

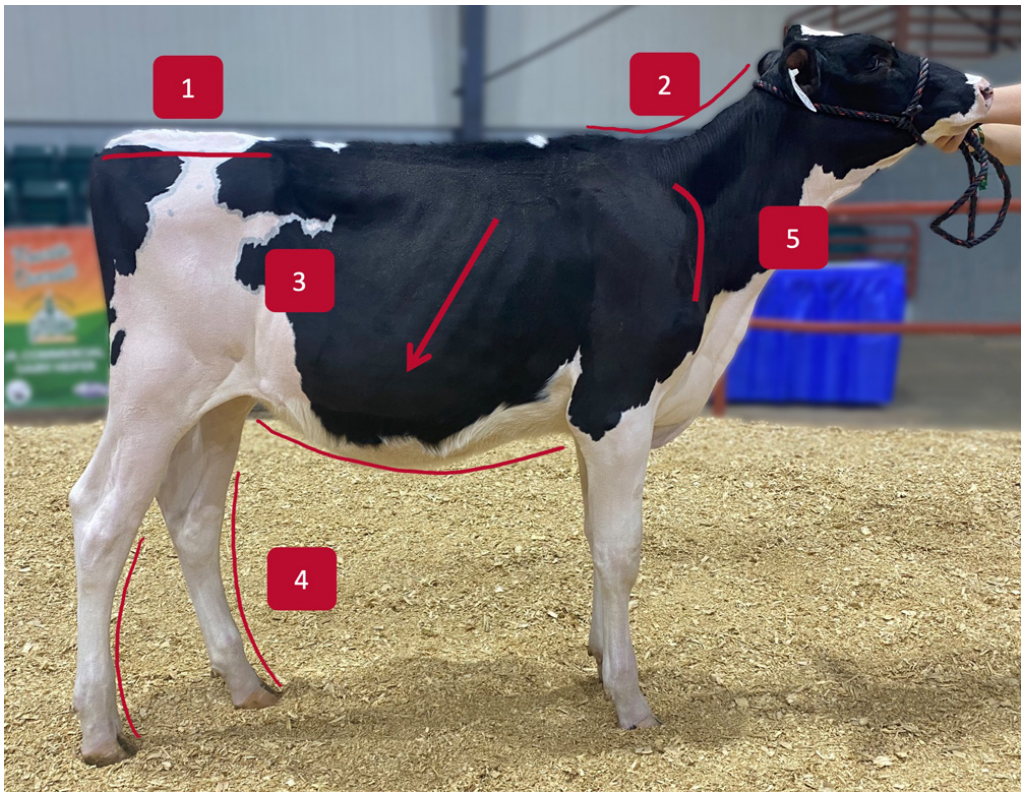

Figure 6. Right Side View of an Animal With Mostly Desirable Traits. Markers 1–4 are all *desirable:*
1: Level from hooks to pins. Although this trait had undesirable effects on animals in previous figures, in this case, the back remains strong and straight and the leg set is acceptable.
2: Long and lean in the neck, although the neck does not blend smoothly;
3: rear-sweeping and flat in the rib, with depth of rear rib; and
4: there is adequate set to the hock with strength of pastern.
5: The *undesirable* trait is that the animal's neck does not smoothly blend to the shoulder. While some of the pronounced shoulder may be caused by a lack of condition, there also are issues with the shoulder being tied tightly to the body wall.
The general observation is that this animal appears slightly frail. The combination of dairyness, i.e., her long, lean neck and flat, rear-sweeping ribs should be accompanied by strength.

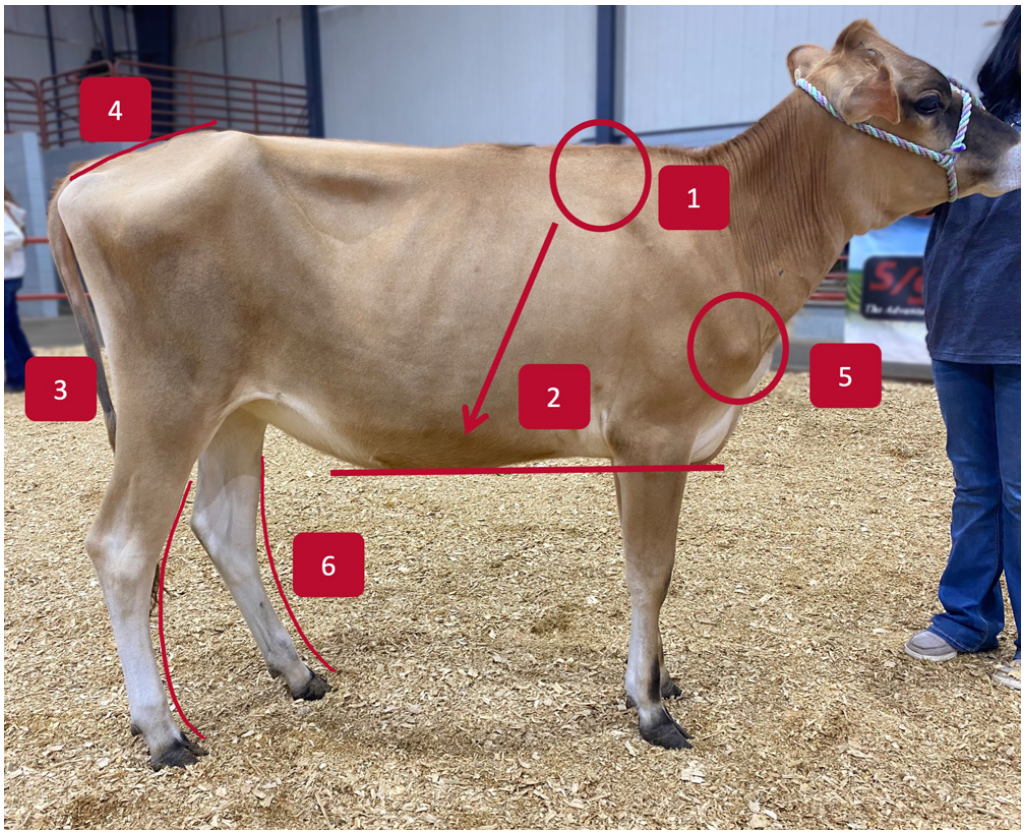

Figure 7. Right Side View of an Animal With a Mix of Desirable/Undesirable Traits. Her *desirable* traits are Markers 1–3:
1: she's full behind the shoulder;
2: there is uniform depth of body, especially at the heart, although this animal is mildly shallow in depth of body and does not have a desirable rear-rib sweep; and
3: there is incurving in the thigh, a sign of dairyness.
Markers 4–6 show *undesirable* traits:
4: There's too much slope or drop to the rump;
5: an obvious point to the shoulder—some would call this “winged”—which often accompanies poor front-end structure; and
6: a slight curving inward at the hock, but this is a mild discrimination.

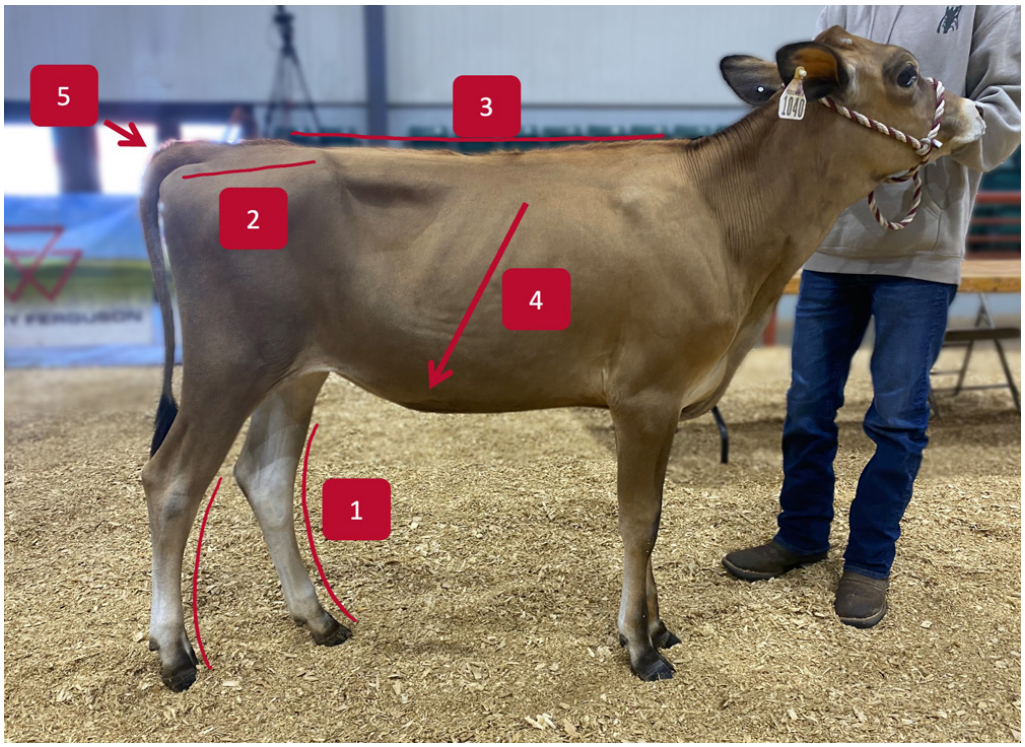

Figure 8. Right Side View of a Smaller Animal With a Mix of Traits. Markers 1–3 show her *desirable* traits:
1: an adequate set to the hock;
2: an ideal slope to the rump; and
3: she's straight and strong across the top.
The *undesirable* traits are:
4: this animal lacks depth of body and likely would lack spring of rib when viewed from behind; and
5: the body is raised at the tailhead, instead of the tailhead sitting neatly between the pins as preferred.

Growth Profile for the Commercial Dairy Heifer

The growth and development of a commercial heifer are also important pieces of her current and future success on the farm. Calves that experience setbacks in growth expectations often have reduced reproductive ability, experience higher rates of morbidity, and perform below their genetic capabilities once in the lactating herd.

The basic guidelines for body weight of commercial dairy heifers are:

- double their birthweight by weaning;
- at or above 55% of their mature weight at breeding; and
- at or above 85% of their mature weight at calving.

Though these guidelines represent critically important benchmarks, they are one-dimensional. To truly assess if a heifer has adequate growth, we also have to evaluate her frame size.

Frame size often is evaluated by height at the hip. While "ideal" heights are subjective and highly breed-specific, assessing your farm's "ideal height" is important, and you should create individualized farm benchmarks for height.

The basic guidelines for structural growth (frame height) metrics of commercial dairy heifers are:

- 60%–62% of mature height at weaning;
- 86%–90% of mature height at breeding; and
- 95%–97% of mature height at calving.

Breeding Evaluation Example

In order to understand the importance of combining the evaluation of weight with height, imagine you are getting ready to breed a group of dairy heifers. They are of breeding age, but you also want to assess their physical readiness to breed.

It is estimated that 55% of their mature weight is approximately 750 lb. Next, imagine:

- 750 lb on a small-framed animal;
- 750 lb on an animal with an average frame; and
- 750 lb on a large-framed animal.

Determining which heifers are ready to breed becomes more complex. On the one hand, they have all met the minimum recommended percentage bodyweight, but on the other hand, they are using it very differently.

It's easy to confirm that the average-framed heifer is ready for breeding. However, using this simple evaluation of weight relative to frame size, there might be reproductive concerns about the small-framed animal. If she does successfully carry a calf to term, there would be concerns with dystocia, metabolic issues, and poor milk production.

What issues, if any, does the large-framed heifer represent? This is most appropriately answered by bringing in the third dimension for evaluating growth, which is body condition.

Body condition is evaluated using a process called body condition scoring (BCS). In this 1 to 5 numerical scoring system, there are 0.25 increments between whole scores. A score of 1 is considered thin and emaciated, while a score of 5 is considered obese.

In the above situation, the large-framed heifer has grown nicely but has possibly energetically

outperformed her rations and would likely have a low body condition score. Many would not view this as negatively as the small-framed heifer, but there still are a few considerations.

First, heifers with a low BCS often have reproductive issues that may cause a producer to delay their first breeding. Secondly, both high and low BCS animals are at a higher risk for dystocia and postpartum metabolic diseases that can influence milk production and herd life. Therefore, to get the ideal commercial heifer in and working for the farm, BCS is an important factor in evaluating heifer growth. Table 2 represents the ideal BCS for growing heifers.

Table 2. Target Body Condition Scores by Developmental Stage and Age.

Stage	Age (months)	Ideal Body Condition Score (BCS)	Range
Breeding	13–15	3.00	2.75–3.25
Bred	15–21	3.25	3.00–3.50
Calving	22–24	3.50	3.25–3.50

In summary, assessing commercial heifer weight, height, and BCS all are important aspects of evaluating growth in heifers. As a reminder, poor growth and over- or underconditioning can lead to heifers that are delayed breeders, suffer more issues during and after calving, and have reduced milk performance. These developmental issues lead to reduced productive herd life.

References

Guinan, F. (2020). *Changes in the breed composition of U.S. dairy herds*. Council on Dairy Cattle Breeding. https://uscdcb.com/wp-content/uploads/2020/01/CDCB-Guinan-US-Dairy-Breed-Composition.pdf

Heinrichs, J., & Jones, C. M. (2022). *Monitoring dairy heifer growth*. PennState Extension.https://extension.psu.edu/monitoring-dairy-heifer-growth

Roche, J. R., Friggens, N. C., Kay, J. K., Fisher, M. W., Stafford, K. J., & Berry, D. P. (2009). Invited review: Body condition score and its association with dairy cow productivity, health, and welfare. *Journal of Dairy Science, 92*(12), 5769–5801. https://doi.org/10.3168/jds.2009-2431

Silva, L. F. P., VandeHaar, M. J., Whitlock, B. K., Radcliff, R. P., & Tucker, H. A. (2002). Short communication: Relationship between body growth and mammary development in dairy heifers. *Journal of Dairy Science, 85*(10), 2600–2602. https://doi.org/10.3168/jds.S0022-0302(02)74344-0

Wiggans, G., & Nicolazzi, E. (2019). *CDCB extends genomic evaluations to crossbreds*. Council

on Dairy Cattle Breeding. https://uscdcb.com/wp-content/uploads/2024/05/CDCB-Connection-Genomic-Evaluations-Crossbred-Animals-03_2019.pdf

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