



BUILD THEM BETTER: UNDERSTANDING CATTLE GENETICS



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LESSON PLAN:

BUILD THEM BETTER: UNDERSTANDING CATTLE GENETICS

GRADE LEVEL: 6-12
TIME: 50 MINUTES

MATERIALS

- White board and markers
- *Build Them Better Trait Selection* handout (one per student)

STANDARDS

MS-LS3-2: Develop and use a model to describe why asexual reproduction results in offspring with identical genetic information and sexual reproduction results in offspring with genetic variation.

HS-LS3-3: Apply concepts of statistics and probability to explain the variation and distribution of expressed traits in a population.

LESSON OBJECTIVES

- ✓ Students will understand the importance of genetics in beef cattle production.
- ✓ Students will identify desirable traits in beef cattle.
- ✓ Students will identify undesirable traits in beef cattle.

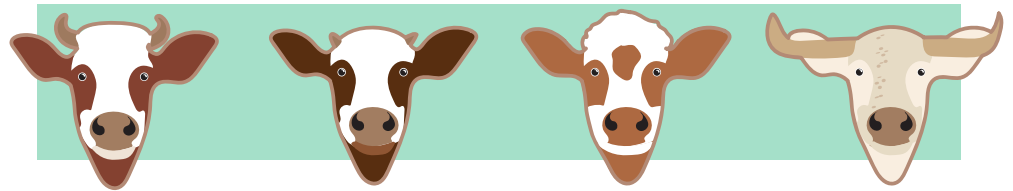
BACKGROUND INFORMATION

In 1911, Danish scientist Wilhelm Johannsen was studying genetically identical beans and discovered variations among them. He determined the differences were from environmental influences, leading him to develop the idea of genotype and phenotype.

Genotype is an individual organism's genetic makeup. All living things have a unique genotype. Genotype is the instructions your body uses to grow and it's the foundation for your genetics, including specific traits, such as hair color.

Genotype determines your hair color, but the resulting brunette is the phenotype. Phenotype is the individual's observable characteristics, determined by environmental influences and genetic makeup. In cattle, most phenotypes can be categorized as desirable or undesirable traits.

CATTLE PHENOTYPES



PROCEDURE

Before the lesson write the names of the following athletes on the board:

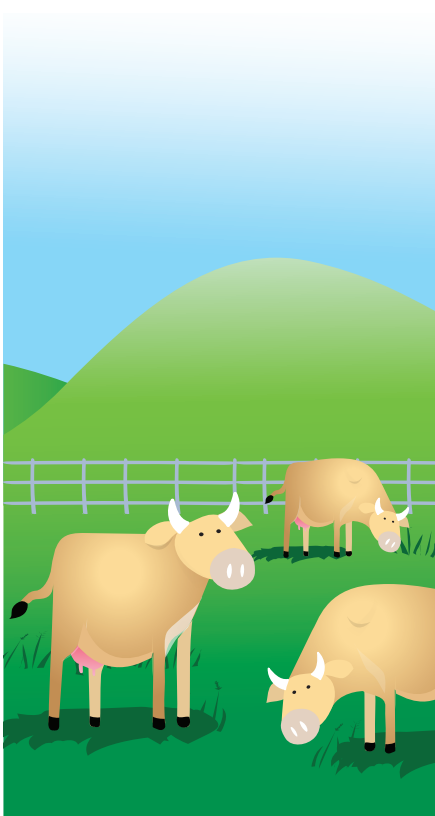
- Archie, Peyton, and Eli Manning
- Venus and Serena Williams
- Mario, Michael, Jeff, and Marco Andretti

Explain to students that becoming a professional athlete is almost impossible.

Less than one percent of high school athletes will ever attain their dreams on a professional level. Yet even more uncommon than a professional athlete is a family of professional athletes. Ask students, do you recognize these talented families written on the board?

- Archie (dad), Peyton (son), and Eli (son) Manning: NFL quarterbacks that have completed nearly 150,000 passing yards combined.
- Venus and Serena Williams: Sister tennis superstars that have competed against each other in nine Grand Slam singles finals.
- Mario (dad), Michael (son), Jeff (son), and Marco (grandson) Andretti: Three generations of Andretti's have won the Indy 500 Rookie of the Year award for auto racing.

Discuss possible explanations for this phenomenon. Tell students that scientists believe athletic performance is a complex trait that is influenced by both genetic and environmental factors. Say, "Today we'll be looking at another group strongly



influenced by genetic and environmental factors: beef cattle. We will explore the genetic traits that make beef cattle more productive and profitable, and how cattle with superior genetics are like the professional athletes of the animal world.”

Review the difference between genotype and phenotype (see background information). Explain that the phenotype of an animal can typically be observed by the animal’s characteristics, or traits.

Draw a t-chart on the board. On one side, write “desirable traits.” On the other side, write “undesirable traits.” Ask students to identify traits that might make a baseball player more successful. Record these under desirable traits. Ask students to identify traits that might cause a baseball player to be less successful. Record these under undesirable traits. Explain to students that just like a professional athlete, there are traits in beef cattle that are desirable and undesirable.

Repeat the process, but this time use a beef cow as the example. Brainstorm desirable traits and undesirable traits. Use the examples below to guide your questioning, but it’s not important for students to list every trait.

Desirable traits: reproductive performance, milk production, mothering abilities, feed efficiency (pounds of feed required per pound of weight gain), carcass quality, carcass yield, longevity, docile temperament

Undesirable traits: genetic defects, anxious temperament, not adapted to certain climates, too large or too small, horns, poor carcass quality, low carcass yield, reproductive problems, poor milk production, poor feed efficiency

Tell students that each cow and bull bred together will equally contribute their genetic material to their calf, determining the calf’s genotypes and phenotypes.

There are hundreds of genetic traits that contribute to a successful beef operation. And just like athletes, environmental factors, such as proper care and nutrition, also play a significant role.

Assign one side of the classroom as “undesirable traits,” and the other side as “desirable traits.” Label each end of the whiteboard accordingly. Tell students they will vote with their feet by moving to the side of the room that best matches each trait. Randomly read each of the examples listed above under desirable and undesirable traits. Encourage discussion about any traits that were difficult for the class to determine.

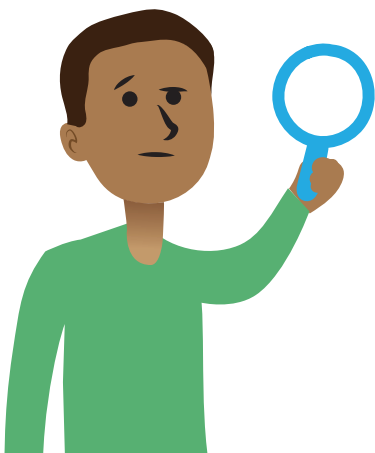
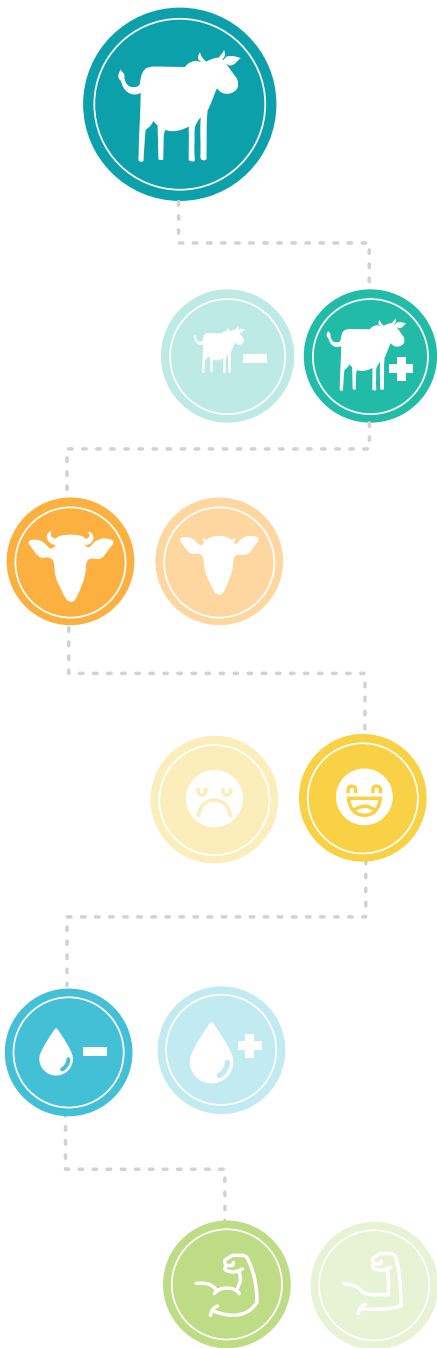
Divide students into groups of 3-5. Distribute the student handout, *Build Them Better: Trait Selection*. Read the introduction together. Assign each group a scenario. Allow 20 minutes for students to complete their handout. Review the handouts together or assess the handouts independently.

AT THE END OF THE LESSON REFLECT ON THESE QUESTIONS:

- 1 Which traits were the hardest to choose for your bull? Why?
- 2 Why is the intended purpose of an animal important to consider when identifying the desirable traits?
- 3 How do superior genetics benefit the consumer?
- 4 How do superior genetics benefit the producer?

CONCLUSION

Advances in animal genetics have significantly improved the quality of meat for the consumer, while increasing the profitability for producers. Next time you see cattle grazing in a pasture, look carefully and consider the traits that have been carefully selected to “build them better.”





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VARIATIONS:

- Students can bring in their own examples of talented families that benefit from strong genetics and the right environmental factors. Have them make a list of traits that make each family member famous.
- Have each group complete a separate worksheet for each of the three scenarios. Plan to conduct the lesson over several class periods.

EXTENSIONS:

Bull seeking eligible heifer with just the right traits—create an online dating profile for a bull looking for the perfect mate. Use an online graphic design platform, such as Canva or Google Slides, to create and share profiles with the classroom community.

Pair this lesson with the California Foundation for Agriculture in the Classroom lesson, *Roll of the Genes*. In this lesson, students will practice using a Punnett square to determine the probability of a calf inheriting its parents' quirky traits.

KEY TERMS

Genotype: Genetic identity of an individual that does not show as outward characteristics.

Phenotype: Observable traits or characteristics of an organism, for example hair color, size, or the presence or absence of a disease.

Trait: A characteristic that is determined by the genes of an organism.

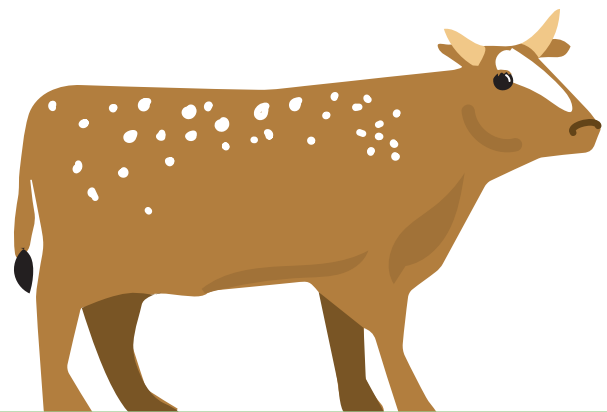
Desired traits: A characteristic that leads to increased productivity or profitability in livestock production.

Undesired traits: A characteristic that leads to decreased productivity or profitability in livestock production.



Genotype

Genetic identity of an individual that does not show as outward characteristics.



Phenotype

Observable traits or characteristics of an organism, for example hair color, size, or the presence or absence of a disease.



BUILD THEM BETTER: TRAIT SELECTION

Introduction: Bull selection is a primary area in which producers can make improvements in their herd genetics. When replacing a bull in the herd, a commercial producer must first consider the appropriate breed (or breeds) for the ranch. Once breeds are chosen, the producer must determine what the animal will be used for. Finally, the genetics of the bull should be considered. What traits does the animal possess that will be passed on to its offspring?

In this activity, your group will be given the task of selecting a new bull for your herd. Given the intended purpose of the individual animal, determine what genetic traits would be most desirable. Your instructor will assign you one of the following scenarios. Circle your scenario below:



SCENARIO #1

You need a terminal sire to use in a breeding program, which means that the offspring of the bull will be harvested for meat. This bull's primary use will be to produce good quality market animals. He will be bred with mature cows.

SCENARIO #2

You need a new bull to breed heifers. A heifer is a young cow that has not yet been bred. They are often bred at 15 months of age. Their offspring may be used for meat or for breeding stock.

SCENARIO #3

You need a bull to breed with mature cows to produce replacement heifers. Replacement heifers are the genetic building blocks for the herd. The producer hopes that a replacement heifer will become a fertile cow that produces a calf, annually, for a long time.

Directions: Read your assigned scenario carefully. For each category, circle the most desirable trait considering the intended purpose of the bull. Describe how the trait you chose will positively affect herd productivity and profitability.

CATEGORY: BREED SIZE
Reflects the general size of a mature animal.

Circle one →

SMALL TO MEDIUM MEDIUM LARGE

EFFECTS:

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CATEGORY: BIRTH WEIGHT

Measures the weight of offspring at birth.

Circle one



LOW

LOW TO MODERATE

NOT TOO HIGH

EFFECTS:

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CATEGORY: WEANING WEIGHT

Reflects the milking and mothering abilities of the cow and the growth rate of the calf.

Circle one



MODERATE

MODERATE TO HIGH

HIGH

EFFECTS:

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CATEGORY: YEARLING WEIGHT

Measures post-weaning weight gain which may take place on a pasture or feedlot.

Circle one



MODERATE

MODERATE TO HIGH

LARGE

EFFECTS:

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CATEGORY: MILK PRODUCTION

Reflects the quantity and quality of milk produced by female offspring.

Circle one



NOT RELEVANT

MAYBE RELEVANT

MODERATE TO HIGH

EFFECTS:

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