

Activity: Agriculture – Build a Calf

Activity Level: Intermediate

Source: Iowa Agriculture Literacy Foundation

PURPOSE

Students will explore heredity in the context of beef cattle.

EXAMPLE TOPICS IT SUPPLEMENTS

Traits, heredity, analyzing and interpreting data.

ACTIVITY SNAPSHOT

1. Organize and Prepare Supplies
2. Read Background Information
3. Interest Approach
4. Conduct Activity

Students will understand how traits are passed through beef cattle and which traits farmers and ranchers search for by playing a game. Students will flip a coin through a series to decide which traits their calf will receive. At the end, they will be able to color their calf and learn which breed the calf is.

5. Ask follow-up questions and make the connection to agriculture
 - What traits might ranchers select for?
 - How do these traits affect the consumer?
 - How do genetics relate to efficiency on a farm or ranch?
 - Are beef farmers/ranchers the only farmers/ranchers that need to know about genetics?

STATE STANDARDS IT SUPPORTS

SC.3.9.3B Analyze and interpret data to provide evidence that plants and animals have traits inherited from parents and that variations of these traits exist in a small group of similar organisms.

SC.3.9.3.C Use evidence to support the explanation that traits can be influenced by the environment.

SC3.9.3D Use evidence to construct an explanation for how the variation in characteristics among individuals of the same species may provide advantages in surviving, finding mates, and reproducing.

MATERIALS

- Genes worksheet
- Calf color page
- A coin to flip
- Instruction Sheet
- Breed pictures

WHAT'S THE CONNECTION TO AGRICULTURE?

Agriculture Literacy Outcomes

Science, Technology, Engineering & Math (STEM)

Identify examples of how the knowledge of inherited traits is applied to farmed plants and animals in order to meet specific objectives (i.e. increased yields or better nutrition.)

Provide examples of science being applied in farming for food, clothing and shelter products.

PROCEDURES:

1. Organize and Prepare Supplies

Each group will need a game set, including a coin, instructions sheet, breed pictures, and a copy of the genes worksheet and calf color page for each group member.

2. Background Information

The study of genetics and heredity are incredibly important to agriculturalists. For centuries, farmers and ranchers have selected plant varieties and livestock for specific beneficial traits. Livestock producers select animals with increased milk production, ample muscle mass or structural correctness, among other things. Selecting for these traits allows farmers to produce a higher quality and more abundant food supply.

Most plants and animals have two of every kind of gene. One comes from their mother, and one comes from their father. Only one gene from each parent is passed to each offspring for a particular trait. There are different forms of a gene that are referred to as alleles. Alleles are forms of the same gene with small differences in their DNA sequence. These small differences contribute to each organism's unique physical features, which are called "phenotypes."

Alleles can be either dominant or recessive. Dominant alleles overpower recessive alleles and are always expressed in offspring. Recessive alleles are only expressed if a recessive allele is inherited from both parents, because they are overpowered by even one dominant allele. For example, the allele in cattle that causes horns to grow is recessive. The hornless, or polled, allele is dominant, so more cattle are polled than horned. Dominant alleles are denoted by an uppercase letter, and recessive alleles are denoted by a lower-case letter. When both dominant and recessive genes are present (one parent contributed a dominant gene and one contributed a recessive gene), the condition is called "heterozygous." This would look like an "Aa." When both genes are either dominant or recessive, the condition is called "homozygous." This would look like "aa" or "AA."

Understanding genetics is crucial for farmers. Beef producers try to breed for good characteristics, such as good marbling (intramuscular fat that contributes tenderness, juiciness and flavor), abundant muscle mass, and structural correctness. Beef producers try not to breed cattle to have horns, because they can be dangerous, small bodied, or have a bad temperament. Breeders also have to pay attention to any genetic diseases that may be passed on from dams (females) and sires (males) to offspring.

There are several beef breeds that have distinguishing characteristics that are transferrable to their offspring. Angus cattle are generally smaller bodied, less muscular cattle with good marbling and poor disposition. They are polled and either all red or all black. Hereford cattle are reddish brown, with a white face and underbelly. They are larger framed with abundant muscle, but have less marbling than Angus cattle. Herefords can be either polled or horned, and have calm dispositions. Angus and Hereford cattle are often bred together to get the best of both worlds: a large bodied, heavily muscled animal with good meat characteristics. A Black Angus-Hereford cross can be identified by a white face and all black body, usually with no horns, which is usually called a Black Baldy. These are usually a product of an Angus cow bred with a Hereford bull. Crossbred cattle have been shown to have up to 20% more lifetime productivity over purebreds, which leads to an economic advantage for farmers or ranchers.

Vocabulary

Trait—a genetically determined characteristic.

Gene—a unit of heredity that is transferred from a parent to offspring and is held to determine some characteristic of the offspring.

Inherit—derive a quality or characteristic genetically from one's parent or ancestors.

Heredity – the passing on of physical or mental characteristics genetically from one generation to another.

Dominant—a trait that can be expressed when just one copy of the gene is present.

Recessive—a trait that can be expressed only when two copies of the gene is present.

Hereford—an English breed of beef cattle with a red body and white face and stomach.

Angus—Scottish breed of beef cattle known for their good meat quality.

Linked genes—genes that are inherited together or do not assort independently.

Phenotype—physical features of an animal.

3. Interest Approach

Ask students: “Does chocolate milk come from a brown cow?” If it doesn't, why not?

Because genetically, coat color doesn't reflect body color (or the color of milk). Most of the characteristics of cattle are inherited from their dam and sire, but if we want chocolate milk, we have to add chocolate.

What are some characteristics of humans that are inherited?

Hair color, eye color, or height.

What do you think some characteristics of cattle that can be inherited might be? Why does that matter?

Coat color, weight, muscles, polled or horned, and temperament.

4. Conduct Activity

- a. Break students up into the desired groups. A group should not have more than four students. Pass out materials to students.
- b. Have the students read the instructions to themselves, and then work in groups to play the game.
 - Students should flip the coin to determine if the dominant or recessive allele is being passed on from the dam. If the coin lands heads up, the dominant gene is passed on. If the coin lands heads down, the recessive gene is passed on. Students should record the gene that they flipped on their gene worksheet, and then flip again to see if the dominant or recessive allele is being passed on from the sire. Once they have determined the allele from each parent, they should select the correct homozygous or heterozygous pairing on the gene worksheet.
- c. Repeat this process for all of the traits represented.
- d. Then, color in the calf on the calf color page to reflect the genes passed on from the parents to the offspring.
- e. Have students compare their offspring to the breed pictures. Does their calf look more like an Angus or a Hereford? Does it look like a cross? What genes determined that?
 - *Color would determine the breed. Black = Angus and Red = Hereford*
- f. In their groups, have students calculate the percent of animals that look like Herefords, Angus or crossbreds. Is there an even number of each? Why or why not?

5. Ask Follow-Up Questions and Make the Connection to Agriculture

As a group, have students discuss:

- What are some objectives of ranchers selectively breeding cattle? What traits might they want to select for or against? How does this affect the consumer?

Beef cattle are raised for meat. More muscle equals more meat, therefore the ranchers would raise for a large muscle mass.

a. Example: Angus are known for good marbling and meat quality

b. Example: Hereford are known for feed efficiency (turning food into muscle)

c. The more muscle there is on the animal, the more meat there would be available for the consumer.

The rancher would also raise for good maternal (mother) traits. The rancher will want a cow that could care for its calf (baby) by protecting it from predators.

The rancher could be seeking good temperament from the beef cow. The rancher would prefer to work with his beef cow and not have something that is upset and angry all of the time.

- How do genetics relate to the efficiency of the animal? How does that effect consumers?

The more a rancher can predict genetics, the easier it will be for them to care for their animal. When the rancher knows how to care for his herd, consumers will receive a better product.

- If an animal lives in an arid desert, what traits might you select for? What might help your animal be more successful in that environment?

The farmer/rancher would select for traits that require less water and can withstand the heat. Cattle with big, long ears are better for arid environments because their ears expel the heat, but if they lived in the cold their ears would get frostbite. Example Breed: Brahman

- Do the traits we played the game for directly affect the animal's use for consumers? What are some traits that might? Is there a way to select for traits that would focus on nutrition or healthfulness?

No, the traits for gender, color, and horned do not directly affect the animals use for the consumer.

Traits that may affect the animals use for consumers would be marbling capability, muscle capacity, and growth rates. All of these affect the meat that comes from the beef cow.

These could also focus on nutrition and healthfulness. Lean protein is needed in a healthy diet, therefore the more muscular the meat is, the better it is for the consumer.

VOLUNTEER ENRICHING ACTIVITY

- Are beef farmers and ranchers the only farmers and ranchers that need to know about genetics? Are there traits in crops or other livestock that are affected by heredity?

All farmers and ranchers need to know about genetics. They are important for all livestock that farmers and ranchers care for to provide the best product for the consumer.

Plant farmers should also know about genetics. An example is a corn farmer should know about genetics to find crops that have traits that can fight off diseases and pests, use less water and nutrients, or need less space to grow.

ANGUS



POLLED HEREFORD



RED ANGUS



BALDY ANGUS



VOLUNTEER ENRICHING ACTIVITY

Build a Calf Instruction Sheet

Flip a coin to determine what genes your offspring will carry. Match the genetic traits each parent will pass onto his/her offspring by recording the uppercase or lowercase letter from each coin flip in your chart.

| Mother's Traits | Heads = Dominant Trait | Tails = Recessive Trait |
|---|-------------------------------|--------------------------------|
| Male/Female | X = Female | X |
| Polled/Horned | P = Polled | p |
| Black Coat/ Red Coat | B = Black | b |
| Face Color Matches Coat Color/ White Face Color | F = Coat Color Face | f |

| Father's Traits | Heads = Dominant Trait | Tails = Recessive Trait |
|---|-------------------------------|--------------------------------|
| Male/Female | X | Y = Male |
| Polled/Horned | P = Polled | p |
| Black Coat/ Red Coat | B = Black | b |
| Face Color Matches Coat Color/ White Face Color | F = Coat Color Face | f |

VOLUNTEER ENRICHING ACTIVITY

Genes Worksheet

| | Mother's Trait | Father's Trait | Circle the appropriate trait combination | | |
|--|----------------|----------------|--|------------------|----------------|
| Sample | B | b | BB | Bb | bb |
| Male/Female X or Y | X | | Male XY | Female XX | n/a |
| Polled/Horned P or P | | | Polled PP | Polled Pp | Horned PP |
| Black Coat/Red Coat B or b | | | Black Coat BB | Black Coat Bb | Red Coat bb |
| Face Color Matches Coat Color/ White Face Color F or f | | | Solid FF | Solid Ff | White ff |

| | Mother's Trait | Father's Trait | Circle the appropriate trait combination | | |
|--|----------------|----------------|--|------------------|----------------|
| Sample | B | b | BB | Bb | bb |
| Male/Female X or Y | X | | Male XY | Female XX | n/a |
| Polled/Horned P or P | | | Polled PP | Polled Pp | Horned PP |
| Black Coat/Red Coat B or b | | | Black Coat BB | Black Coat Bb | Red Coat bb |
| Face Color Matches Coat Color/ White Face Color F or f | | | Solid FF | Solid Ff | White ff |

VOLUNTEER ENRICHING ACTIVITY

Example Answers

| Build a Calf | Mother's Traits | Father's Traits |
|---|-----------------|-----------------|
| Male/Female | X | X |
| Polled/ Horned | p | p |
| Black Coat/ Red Coat | B | B |
| Face Color Matches Coat Color/ White Face Color | f | f |

This is a: Female, horned, black, White Face Calf/ Breed= Baldy Angus

| Build a Calf | Mother's Traits | Father's Traits |
|---|-----------------|-----------------|
| Male/Female | X | X |
| Polled/ Horned | P | p |
| Black Coat/ Red Coat | B | b |
| Face Color Matches Coat Color/ White Face Color | F | f |

This is a: Male, Polled, Red, White Face Calf/ Breed= Polled Hereford

| Build a Calf | Mother's Traits | Father's Traits |
|---|-----------------|-----------------|
| Male/Female | X | X |
| Polled/ Horned | P | p |
| Black Coat/ Red Coat | B | b |
| Face Color Matches Coat Color/ White Face Color | F | f |

This is a: Female, Polled, Solid Black Calf/ Breed = Angus

| Build a Calf | Mother's Traits | Father's Traits |
|---|-----------------|-----------------|
| Male/Female | X | Y |
| Polled/ Horned | p | P |
| Black Coat/ Red Coat | b | b |
| Face Color Matches Coat Color/ White Face Color | f | F |

This is a: Male, Polled, Solid Red Calf/ Breed = Red Angus

*Any other combination would be a cross-bred calf.

CONGRATULATIONS

You, Rancher _____, have successfully bred a
_____ breed beef calf.

