Dairy Cow Evolution

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Grade Level
9-12

Lesson Length
3 periods x 180 Minutes

Agriculture Careers
Microbiologist, Food Scientist, and Animal Nutritionist

Nebraska Science Standards
SC.HSP.9.4.E
SC.HSP.9.4.F
SC.HSP.10

Next Generation Science Standards
HS-LS4

Nebraska Agricultural Science Standards
AFNR.HS.2.1
AFNR.HS.2.6
AFNR.HS.2.8

Learning Environments Alignment

These lessons aim to help students make the connection between scientific, business, economic, environmental, and social issues and a degree in agriculture.

Learning Objectives

By the end of the unit, students should be able to:

- Identify and evaluate dairy cattle breeds and their history
- Construct and simulate how traits can affect the use of dairy cattle
- Compare and contrast how phenotype and genotypes can be shown

Materials List

- Edvotek Electrophoresis kit
- Dairy Cattle DNA Samples (Holstein and Jersey or two other breeds)
- DNA/Genetic Information PowerPoint
- DNA Worksheet
- Dairy Cattle Cards
- Dairy Cow Flip Worksheet

Investigation

Students will be assigned a dairy breed and explore, evaluate, and simulate how that breed could have changed over time due to evolutional needs of that animal.

Research Question(s)

- How has diversity and genetic information changed the animals we have today in the agricultural industry?
- How have traits and environment impacted the uses of livestock animals we have today in the in agricultural industry?
- How could phenotypes and genotypes be influenced by traits?

Day 1: Dairy DNA

Teacher Does: Students will be shown two images of two of the common dairy breeds. Students will then be asked to determine what each of these two breeds has in common, and how they differ. The teacher will then guide the discussion to the traits of these dairy cattle (height, color, frame, etc). The teacher will then ask the students to create a list of characteristic and traits they think the original ancestor of each of the two breeds had. The teacher will then discuss with students how livestock animals have been selectively bred to develop specific uses of each breed.

Student Does: Students will use the two images to make inferences about what each of the two breeds has in common and how they differ. Students will discuss those findings and then create a list of traits and characteristics they think the common ancestor of the two breeds had.

Interactive Lecture
Teacher does: The teacher will transition from the introduction to presenting the DNA/Genetic Information PowerPoint, which includes the necessary discipline-specific vocabulary needed for the DNA Comparison Lab.

Student does: Students will be active listeners and participants throughout the lecture by answering questions and completing guided notes.

Dairy Cow DNA Electrophoresis Lab
Teacher does: The teacher will help facilitate the lab and guide students through each step of the DNA sequencing of the two different dairy breeds. The teacher will also have a scientist from Midwest Laboratories to help explain to the students the results of the gel electrophoresis.

Student does: Students will work together in a peer group of four to complete the electrophoresis lab utilizing the lab step-by-step check points. Students will discuss about possible hypotheses for the experiment before the start of the lab. At the conclusion of the lab, students will explain their results and formulate their conclusions.

Reflect (Formative Assessment)

Students will write down 2 things they learned today as an exit ticket.

Day 2: Dicey Dairy

Teacher Does: Begin by asking students what they learned about the previous day. Then the teacher will introduce how specific traits impact how we use animals for different purposes. The teacher will show two pictures on the board, one a cow and one a goat, and explain how we use both animals for dairy purposes by pointing out dairy characteristics of each animal. The teacher will then ask the students to pick out traits about the two animals that differentiate them.

Student Do: Students will look at the pictures presented by the teacher and select traits of each animal that make them different from one another.

Teacher Does: The teacher will provide students with the beginning steps of the activity for the dairy cow breeding simulation that will be played twice. The first simulation will incorporate blind breeding practices. The teacher will go through the basic arithmetic of how to calculate the new trait score totals for each round that will be carried over to the following round. The teacher will have students draw dairy breed cards and assist students with inputting information onto worksheet for round 1. The teacher will monitor and assist as needed for each round all the way to round 10. At the end of the game, the teacher will lead a discussion over how the cow they have at the end of the simulation is different from the cow they began the game with. The teacher will have the same responsibilities for the second simulation using selective breeding practices.

Student Do: Students will listen to the steps and do the practice arithmetic to best understand how to work through the simulation. Students will draw a dairy breed card to begin the simulation with and record the trait information on their worksheets. For each round, students will match up with other students and write down what progeny are produced from the mating of the two parents until the end of the simulation at the conclusion of round 10. After the simulation, students will discuss with their partners and the class the difference between the cow they began with and the cow they ended up with. For the second game, the students will have the same responsibilities as the first game, however, they will try to breed their cow with a purpose using selective purposes.

Reflect (Formative Assessment)

Reflection Journal

Teacher does: The teacher will lead students in a verbal discussion of the dairy breeding game to assess what was similar and different between the two different rounds of the game played in class. They should lead the discussion towards the conclusion how some traits would change based on specific breeds they would interact with, especially when breeding randomly. When breeding for a purpose, the specific traits that were being bred may have been maxed out, but other traits would have suffered instead.

Student does: The students will participate in the discussion lead by the teacher, following talking points that may be laid out by teacher if student discussion doesn't happen naturally in classroom. At the conclusion of the discussion, students will write a reflection on the activity and how it would relate to selection of different types of animals as pets, for meat, or even wool.

Day 3: Fun with Punnets

Teacher does: Teacher will ask students what the difference between phenotypic and genotypic trait is. Students should come to consensus and then the teacher will explain the following definition:

Genotype and phenotype are two fundamental terms in the science of genetics. The two terms are often used at the same time to describe the same organism, but there is a difference between genotype and phenotype:

- An organism's genotype is the set of genes in its DNA responsible for a particular trait.
- An organism's phenotype is the physical expression of those genes.

Teacher will write the difference between the two on the board for students to record.

Teacher will have each student share one phenotype trait that they are most proud of. Teacher will ask for students to share if the phenotype they chose is one that they received from a parent or share with a sibling.

Student does: Students will engage with conversation about phenotypes and genotypes and then record the definition in their notes, so they have it.

Students will respond to the teacher's question about their phenotypic traits and share with the class.

Teacher Does: Teacher will have the different types of genotype possibilities on the PowerPoint and students will need to identify if these genotypes are heterozygous or homozygous traits. On the following slide, the teacher will explain an example of genotype and phenotype, heterozygous and homozygous traits in the form of eye color. Teacher will ask students to draw a Punnett square for if a homozygous dominant eyed person would mate with a homozygous recessive eyed person. The teacher will ask the students to come up to the board and draw their example. The teacher will lead a discussion about how to make the Punnett squares and then show the correct way to draw one.

Student Do: Students will create columns with the headings: Heterozygous, Homozygous, Dominant and Recessive. They will look at the genotypes that are displayed on the board and record under which column the genotype belongs (each will be used twice). The students will attempt to draw a Punnett square for the mating of a homozygous dominant and homozygous recessive and then one student will draw it on the board.

Flip Coin Activity

Teacher Does: Teacher will hand out a lab worksheet for students to complete with a partner. The teacher will explain to the students that they are working through the worksheet to see how randomized heterozygous/homozygous traits can impact the genotype and phenotype of different animals. The teacher will circulate while students are working and assist with any questions that they have during lab.

Student Do: The students will work through lab with a partner, flipping coins to determine the random traits for their dairy cow. After the traits have been determined, the students will sketch their cow and then answer the questions on the back page.

Reflect (Formative Assessment)

Students will write down 2 findings from the lab that surprised them and explain why they think the findings turned out the way they did.

Summative Assessment


Students will construct a short poster board that compiles all of the information that they learned within the three-day lesson. The poster will be constructed in an agriscience-board fashion that would allow them to present the information learned over the three days to a parent, teacher or student not currently in the class, as if they know nothing about the subject matter. Students will use information from notes, data, lab reports, or any additional research done to answer the question: Why do genetics matter in animals?

Unit References

[List reference citations in APA format.]

Cow Flip Genetics Worksheet **Name:**

Directions: Complete this lab in your assigned groups of 2. Use two pennies to determine the genotype and phenotype of your dairy cow. Each gene mentioned in this lab is a simply inherited trait, meaning every cow has only two alleles for that trait. For each trait, you will flip two coins. Each coin represents an allele. Heads on each coin represents an allele for the dominant trait and tails represents the recessive allele. Perform two coin flips for each trait and record the genotype of your dairy cow for each trait. Then record the phenotype created by the genotype. Finally, draw your cow created by its genotype and phenotype and answer the questions in back.

Traits:

- Horns: Dominant: no horns (polled); Recessive: horns
- Udder Attachment (connection to underbelly): Dominant: strong attachment; Recessive: weak attachment
- Udder Fill (how much milk the udder can hold): Dominant: large fill; Recessive: small fill
- Behavior: Dominant: Nervous; Recessive: Docile (tame)
- Markings: Dominant: Spotted; Recessive: Solid colored

1. **Horns**: Coin 1: Heads Tails Coin 2: Heads Tails

   Genotype: HH Hh hh Phenotype: _____

2. **Udder Attachment**: Coin 1: Heads Tails Coin 2: Heads Tails

   Genotype: UU Uu uu Phenotype: _____

3. **Udder Fill**: Coin 1: Heads Tails Coin 2: Heads Tails

   Genotype: FF Ff ff Phenotype: _____

4. **Behavior**: Coin 1: Heads Tails Coin 2: Heads Tails

   Genotype: BB Bb bb Phenotype: _____

5. **Markings**: Coin 1: Heads Tails Coin 2: Heads Tails

   Genotype: MM Mm mm Phenotype: _____

6. Sketch your cow in the space below, based on the information you flipped for.

7. Next, identify two traits that you think are most valuable in your goats and list them below. State whether this trait is a dominant or recessive trait next to it.

   Trait_____

   Trait _____

8. Next, choose another person's cow to mate with (keeping in mind the "selecting with purpose" lesson from the day before). List the genotypes and phenotypes for your cow's mate below for all five traits:

   Phenotype_____ Genotype_____

   Phenotype_____ Genotype_____

   Phenotype_____ Genotype_____

   Phenotype_____ Genotype_____

   Phenotype_____ Genotype_____

9. In the space below, create a Punnett Square for the two traits you chose above. Use the genotype of your cow and the genotype of the mate of your cow (a cow from another group).

10. How does predicting the genotype help to know the phenotype of an offspring?

11. What is the benefits and drawbacks of Punnett squares in predicting the offspring traits of specific animals?

Name:

Lab Report

Please complete the following report during the design and implementation of your experiment.

Research Problem
- Describe what you are investigating and justify why you are investigating the problem.

Hypothesis
- Formulate one or more hypotheses for your experiment.

Procedures
- Create the steps you will follow for your experiment.

Data Collection
- Describe the data that you will collect during your experiment.
- Provide graphs, tables, charts, and raw data as necessary.

Results
- Explain your results.

Conclusion
- Based on your data:
    - What can you conclude?
    - Were your hypotheses supported?
    - Were their limitations to your experiment?
    - What are new research questions that derived from this study?