

Animal Reproduction, Chromosomes and Genetics

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Coalville, Utah
2006**

Student Objectives:

Students will apply the principles of genetics and breeding

1. Identify the anatomy and terminology of chromosomes.
2. Understand how chromosomes determine gender.
3. Identify chromosome structure, identify chromosome mutations, and understand genetic disorders in livestock.

Background:

Unit: Animal Reproduction, Reproductive Technologies

LK Precept: Personal Growth, Social Growth,

-Acknowledge differences exist among people

Key Terms:

Chromosome	Centromere	Diploid
Homologous Chromosome	Haploid	Zygote
Gametes	Somatic Cells	Autosomes
Sex Chromosomes		

Logistical Information:

Time: 50 Minutes

Resources: Colorado Agriscience Curriculum
Scientific Farm Animal Production Text
Biology Principles and Exploration Text
Strategies for Great Teaching

Tools, Equipment, Supplies

Crayons, colored pencils or markers
Unit 4, Lesson 10 Chromosomes and Genetics PowerPoint Slides 1-13 from the Colorado Agriscience Curriculum
LCD projector with computer access to internet or computer lab access

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Interest Approach

Set the stage for students to become involved in the following reflective thinking exercise. Require the students to keep their eyes closed during reflection and think individually about the example you are about to read to the students.

What makes the “Ideal FFA Member”? With more than 500,000 members, we have many different types of students in FFA. Think of the ideal FFA member. Let’s close our eyes and think about what qualities make up the “Ideal FFA Member.” Keep your eyes closed for 30 seconds.

Allow 30 seconds for reflective thinking. You may provide soft music while reflection occurs.

Let’s think to ourselves for a moment, What makes a person the ideal FFA member? When I say “Go,” list these traits on a sheet of scratch paper. Ready - Go!

Pause one minute.

When I say “Move,” assemble into groups of four with three other people whose birthdays are in different months. You have two minutes to share your answers with the group. Ready - Move!

Allow two minutes for sharing within small groups. Each group will need to share three attributes of the ideal member and copy their responses on a writing surface.

As we go around the room, each group needs to share three items from your list that comprise the ideal FFA member.

Typical responses: dedication; fun; energetic; good speaker; studies nightly; completes homework; asks questions. After gathering all of the responses, ask the following series of questions.

What are some commonalities about the answers shared?

Typical responses: very active; smart; intelligent; friendly

In visualizing the member, did we associate a certain face with the ideal FFA member?

Typical response: no

Examining the list, notice we did not mention if the FFA member was male or female. We didn’t mention if this FFA member came from a rich family or poorer family. We didn’t mention the skin color of the perfect FFA member. Why did we not focus on the physical attributes of the ideal FFA member?

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Typical response: the perfect FFA member can look like anyone in this room or anyone across the nation

Each of us is different because of our history, upbringing, and physical attributes. None of the physical attributes define what the ideal member is. In fact, these differences make FFA a strong organization.

If I asked you what an ideal student looked like, what would you say? What makes us different? Physically? (*Precept Integration*)

On the board, PowerPoint, overhead, or handout, display for the students the three questions of a “Descartes Moment.” Ask students to give examples after each question to stimulate other students in this activity.

Chromosomes & Genetics

- What do I know about chromosomes?
- What do I think I know about chromosomes?
- What don't I know about chromosomes?

Ladies and gentlemen, today we are beginning a new unit, genetics. Genetics is an extremely fascinating field. Genetics determine both what we look like and many other factors that make each of us unique. We will begin to explore the exciting world of genetics during this class period.

I want to begin by determining what prior knowledge you bring to this class regarding chromosomes and genetics. We will use a Descartes Moment to see what you know.

(Unit 4, Lesson 10 Chromosomes and Genetics Assessment 3)
Display the first question or pass out the handout.

When I say “Chromosome,” take 45 seconds to think back to all you have previously learned about chromosomes. I want you to compose a letter to yourself, with the first paragraph consisting of all the things you have learned about chromosomes and how they apply to genetics. “Chromosome.”

(Count down the last 10 seconds, and then proceed.)

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Very good, class. Would anyone like to share what you know about chromosomes?

(Take responses and write on writing surface.)

Thank you for sharing the wonderful things you already know. Good job.

When I say “Chromosome” for the second time, I want you to continue writing the letter to yourself, but in the second paragraph, I would like you to write about what you think you know about chromosomes. You will again have 45 seconds. “Chromosome.”

You all worked very diligently. Thank you. Finally, I want you to think to yourselves about what you don’t understand about chromosomes and how they apply to genetics, but that you want to know. Take one minute to contemplate this question.

When I say “Chromosome,” I want you to complete the letter to yourselves with a third paragraph about what you don’t know about “Chromosomes.”

Fabulous job! Now, select a representative from each of your groups. Representatives, when I call you up, I want you to write the best question or answer from each of the paragraphs.

Thanks for sharing. We will work toward answering those great questions.

Objective 1

Identify the anatomy and terminology of chromosomes.

Prepare overheads or PowerPoints. Each slide is animated to show only one line at a time to allow for students to write the notes and for the instructor to emphasize the important points.

I. Chromosome Terminology

- *A) Self-replicating genetic structure of cells containing DNA that bears genes*

As the cell prepares to divide, the DNA and the proteins associated with the DNA coil into a structure called a chromosome. Before the DNA coils up, the DNA is copied. The two exact copies of DNA that make up each chromosome are called chromatids.

*Push space bar or slide down the overhead to show point B) **Chromatids.***

- *B) Chromatids*

–1. 2 Exact copies of DNA that makes up a chromosome

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Chromatids are two exact copies of DNA.

*Push space bar or slide down the overhead to show point C) **Centromere**. Draw a chromosome on the board illustrating each of the different parts.*

▪ *C) **Centromere***

–*Place where chromatids are attached to form a chromosome*

The two chromatids or bodies of a chromosome are attached at a point called a centromere. The chromatids, which become separated during cell division, are placed into each new cell, ensuring that each new cell will have the same genetic information as the original cell.

*Move to the next point on the slide show or overhead, D) **Homologous Chromosome**. Allow students to copy information into their notebooks.*

▪ *D) **Homologous Chromosome***

– *1. Chromosomes that are similar in size, shape, and genetic content*

The two members of each typical pair of chromosomes in a cell are alike in size and shape and carry genes that affect the same hereditary characteristics. Such chromosomes are said to be homologous.

*Move to the next line of notes, E) **Genes**.*

▪ *E) **Genes***

– *1. Fundamental physical and functional unit of heredity*

The genes are points of activity found in each of the chromosomes that govern the way in which traits develop. The genes form the coding system that directs enzyme and protein production. Thus, they control the development of traits.

*Move to the next line of notes, F) **Gametes**.*

▪ *F) **Gametes***

– *1. Organisms' reproductive cells (sperm/egg)*

Gametes are organisms' reproductive cells or the male and female sex cells (in mammals, sperm and egg).

*Move to the next line of notes, G) **Somatic cells**.*

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- **G) Somatic cells**
- *1. All cells besides sex cells*

All of the cells in the body, other than gametes, are somatic cells. When a cell such as a somatic cell contains two sets of chromosomes, it is said to be diploid. Unlike somatic cells, mammal gametes contain only one set of chromosomes. When a cell such as a gamete contains one set of chromosomes, it is said to be haploid.

*(Unit 4, Lesson 10 Chromosomes and Genetics Assessment 7)
Move to the next two lines, H) Diploid and I) Haploid.*

- **H) Diploid**
- *1. A cell that contains two sets of like chromosomes*
- **I) Haploid**
- *1. A cell that contains one set of like chromosomes*

What is a fertilized egg or ovum called? Once the sperm and the ovum have united, the fertilized egg is referred to as a **zygote**.

Move to the next line of notes, J) Zygote.

- **J) Zygote**
- *1. A fertilized ovum*

E-Moment – Hieroglyphic Moment

Once students have completed the notes, pass out crayons or colored pencils. Instruct students that we are now going to do a Hieroglyphic Moment. Brainstorm ideas with students of different icons to represent each of the vocabulary words just covered in the notes (may be helpful to draw some of the suggestions on the board). Once students have some examples of different icons, have them draw these icons or icons of their own in the margins of their notes. Allow 3-5 minutes for them to create their own icons. When most are complete, ask them to share their ideas with the person beside them.

Objective 2

Understand how chromosomes determine gender.

Now that we know the terminology of chromosomes, let's look at what they do. What determines the sex of a mammal? Does the male or female determine the sex?

Allow students time to respond.

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Very good. Thank you for your participation. Some of you said correctly that the male controls the sex of the offspring because the male can contribute an X or a Y chromosome. Are all chromosomes involved in determining sex?

(Lead to the answer, "No-only one set.")

Good. Only one pair of chromosomes, one from each parent, is involved in determining the sex of the offspring.

(Unit 4, Lesson 10 Chromosomes and Genetics Assessment 9)

II. Gender, A) Autosomes. Allow students time to copy information into their notes.

II. Gender

▪ *A) Autosomes*

–1. Chromosomes that are not involved in determining the gender of an individual

Autosomes make up the vast majority of the genes in our bodies and the bodies of the livestock we care for. Autosomes control all of the traits not tied to sex. Growth rates, hair and eye color, and height can all be contributed to autosomes.

Show the next point, B) Sex Chromosomes.

▪ *B) Sex Chromosomes*

–1. One pair of chromosomes that determine gender

▪ *A. X chromosome = FM = XX*

▪ *B. Y chromosome = M = XY*

Each human has 46 chromosomes. Forty-four of these are autosomes; two are gametes or sex chromosomes. One half of the total chromosomes present in your body were contributed by your mother, one half by your father. In mammals, males control the sex of the offspring. They have the ability of contributing an X or Y chromosome. The female always contributes an X. If the male contributes an X, it will combine with the female's X resulting in an XX or female offspring. If the male contributes a Y, it will combine with the female's X resulting in an XY, which is a male offspring.

III. Number of Chromosomes

▪ *Humans = 46*

▪ *Cattle = 60*

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- *Sheep = 54*
- *Swine = 38*
- *Horses = 64*
- *Corn = 20*

- *2 chromosomes are sex chromosomes*
- *½ of the total # of chromosomes is contributed by the male & ½ by the female*

Objective 3

Identify chromosome structure, identify chromosome mutations, and understand genetic disorders in livestock.

Allow students to draw and label a picture in their notes. Move to the next slide, chromosome mutations.

V. Chromosome Structure

- *Download or scan picture*

VI: Chromosome Mutations

- *A) change in an organism's chromosome structure*
 - 1. *Deletion*
 - *A) piece of a chromosome breaks off (often fatal)*
 - 2. *Duplication*
 - *A) fragment of a chromosome attaches to its homologue*
 - 3. *Inversion*
 - *Fragment reattaches to its chrom. ??? Is placed there backwards*

Ladies and gentlemen, do our chromosomes change over time? What causes them to change? A change in the structure of the chromosome is a genetic mutation. There are three ways chromosomes are generally mutated. All result in the organism losing the ability to function normally. An example of a mutation in humans would be cancer. Cancer is the uncontrolled growth of cells.

The first type of a chromosome mutation is called deletion. Deletion occurs when an end of a chromosome breaks off. This is usually fatal to the organism. The second type is called duplication; this is a result of two copies being made of a portion of a chromosome. The third type is called inversion. Inversion results when a chromosome fragment is placed backwards in the chain.

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Does anyone know of a genetic disorder that occurs in goats? This is a defect that causes a condition similar to tetanus or paralysis for a short period of time. Good. Fainting goats have a defect in their muscle tissue that causes them to “faint” when startled or under a high amount of stress. Let’s investigate this disorder further. Go to the website www.faintinggoat.com. Let’s discover how and why the breed developed and look more in depth at the specific disorder these goats have.

Allow students about 10 minutes to look at the website that explains the origin of the breed and what causes these goats to faint. If you do not have access to a computer lab, use computer projection to take the entire class through the site.

IV. Genetic Disorders

- *A. Usually caused by mutations*

- 1. *Fainting Goats*

- *a. defect in muscle tissue that causes temporary tetanus when under stress*

- 2. *www.faintinggoat.com*

- *Research history of the breed to decide if all genetic mutations are bad.*

Review/Summary

Chromosomes are self-replicating genetic structures that contain DNA and thus genes. The anatomy of a chromosome is made up of chromatids, which are two exact copies of DNA to make up a chromosome. The centromere attaches the chromatids in the center to complete the chromosome. Homologous chromosomes are similar in size, shape, and genetic content. The two major categories of cells are gametes, which in animals is the sperm and egg or reproductive cells, and somatic cells, which are all the cells in the body excluding sex cells. Autosomes are the chromosomes that are found in somatic cells, whereas sex chromosomes determine the sex of the individual. When chromosomes are mutated, genetic disorders occur such as cancer or fainting in goats. The three major ways chromosomes are mutated is by deletion, duplication, or inversion.

Evaluation

Reproduction, Chromosomes and Genetics Assessment

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(Unit 4 Reproduction and Genetics, Lesson 10 Chromosomes and Genetics Assessment Key)

Answers to Assessment:

NAME: _____ **KEY** _____

DATE: _____

Quiz: Chromosomes and Genetics
Agricultural Biology

1. A chromatid is:
 - a. Two exact copies of genes
 - b. Two exact copies of chromosomes**
 - c. Two exact copies of RNA
 - d. Two exact copies of DNA

2. What is the difference between a diploid and a haploid cell?
 - a. A haploid cell contains two sets of like chromosomes and a diploid contains one set.
 - b. A diploid cell contains two sets of like chromosomes and haploid contains only one.**
 - c. A haploid cell contains DNA and diploid cell contains RNA.
 - d. A diploid cell is somatic and haploid is a sex cell.

3. Describe what a gene is.

Fundamental physical and functional unit of heredity found in DNA on Chromosomes.

4. A male will result from _____ and a female result from _____ pairing of chromosomes.
 - a. XX, XY
 - b. XX, YY
 - c. XY, XX**
 - d. YY, XX

5. An autosome is:
 - a. Chromosome not involved in determining the sex of an individual.**
 - b. Chromosome involved in determining the sex of an individual.
 - c. The sperm and egg cells.
 - d. Chromosomes that reproduce automatically.

6. What are two things that can occur from genetic mutations?

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Cancer and fainting in goats.

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(Reproduction, Chromosomes and Genetics Assessment)

NAME: _____

DATE: _____

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Advanced Animal Science

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