

Lesson C3–4

Using Crossbreeding and Hybrids

Unit C. Basic Principles of Agricultural/Horticultural Science

Problem Area 3. Understanding Cells, Genetics, and Reproduction

Lesson 4. Using Crossbreeding and Hybrids

New Mexico Content Standard:

Pathway Strand: Animal Systems

Standard: IV: Know the factors that influence an animal's reproductive cycle to explain species response.

Benchmark: IV-C: Evaluate an animal to determine its breeding soundness.

Performance Standard: 1. Describe the procedure for determining an animal's breeding readiness. 2. Identify and prevent problems associated with reproduction. 3. Select animals based on breeding soundness.

Student Learning Objectives. Instruction in this lesson should result in students achieving the following objectives:

1. Discuss the importance of improved organisms to agriculture.
2. Identify methods used in agriscience to improve organisms.
3. Identify breeding systems used in animal science

List of Resources. The following resources may be useful in teaching this lesson:

Recommended Resources. One of the following resources should be selected to accompany the lesson:

Baker, MeeCee and Robert E. Mikesell. *Animal Science Biology & Technology*. Danville, Illinois: Interstate Publishers, Inc., 1996. (Textbook, Chapter 6)

Lee, Jasper S. and Diana L. Turner. *AgriScience*, Third Edition. Danville, Illinois: Interstate Publishers, Inc., 2003. (Textbook and Activity Manual, Chapter 5)

Other Resources. The following resources will be useful to students and teachers:

Biondo, Ronald J. and Jasper S. Lee. *Introduction to Plant and Soil Science and Technology*, Second Edition. Danville, Illinois: Interstate Publishers, Inc., 2003. (Textbook and Activity Manual, Chapter 4)

List of Equipment, Tools, Supplies, and Facilities

Writing surface

Overhead projector

Transparencies from attached masters

Note: Related records from student SAE record books may also be useful.

Terms. The following terms are presented in this lesson (shown in bold italics):

Controlled breeding

Crossbreeding

Gene splicing

Genetic manipulation

Heterosis

Homozygous

Hybridization

Inbreeding

Linebreeding

Outbreeding

Selection

Interest Approach. Use an interest approach that will prepare the students for the lesson. Teachers often develop approaches for their unique class and student situations. A possible approach is included here:

Ask students if they believe plants and animals have been improved over time. Use this question to begin a discussion on how producers and scientists are using breeding methods to improve their products. Relate it

to the fact that consumers want leaner meats and better fruits and vegetables that grow faster and last longer. Use the discussion as a means for introducing the lesson's learning objectives.

Summary of Content and Teaching Strategies

Objective 1: Discuss the importance of improved organisms to agriculture.

Anticipated Problem: Why is improving organisms important to agriculture?

- I. Scientists are continuously searching for improved organisms. A common goal for all of those involved in the agriculture industry is to find ways to produce more products by using fewer resources, such as land, labor, feed, seed, etc.
 - A. There are three main factors driving this goal.
 1. Rising World Population – This is especially important as the world's population continues to rise. As life expectancy continues to rise and infant mortality rates continue to drop, more people are living longer. All of these people need to eat. It is the job of agriculture to make sure there is enough food produced.
 2. Urbanization – As the world's population increases, people need places to live, work and play. The world's cities continue to grow, swallowing up more and more land that was used for farming. Because of this, producers are expected to produce more food using less land.
 3. Fewer people in production agriculture – In addition to these other problems faced by agriculture in feeding the world, we have seen a trend of fewer people becoming involved in production agriculture. Because of this, we have placed the burden of feeding the world on fewer and fewer people. We are also seeing that the average age of the producer is very high.
 - B. One example of a major breakthrough in organism improvement occurred in the 1930s with the development of hybrid seed. Hybrids produce 25% to 50% greater yields than traditional corn varieties and are fairly tolerant to varying soil and climatic conditions. Another example of organism improvement can be found in the animal industry. Today cattle and hogs can reach market weight several days sooner using less feed. This allows for the producer to raise more animals in a shorter period of time with less inputs.

A variety of techniques can be used to help students understand the information in this objective. Students need text materials to help understand the different breeding systems used. Chapter 6 of Animal Science Biology and Technology is recommended.

Objective 2: Identify methods used in agriscience to improve organisms.

Anticipated Problem: What methods are used in agriscience to improve organisms?

- II. It has always been and always will be the goal of agriculturists to improve the animals and plants around us. Two major approaches are used: controlled breeding and genetic manipulation.
- A. **Controlled breeding** is breeding plants or animals to achieve certain characteristics in the offspring. This is considered a natural method of improving plants and animals. In this method scientists control the natural breeding process. There are three kinds of controlled breeding:
1. **Selection** involves choosing a few parents with the desired traits with the intent of increasing the amount of desired qualities in the offspring.
 2. **Inbreeding** involves breeding offspring of the same parents to each other. This is done in both plants and animals; however, it is done somewhat differently in plants than animals. The purpose of this method is to produce a new generation without the introduction of any new genes.
 3. **Hybridization** involves the crossing of two different plants or animals. This method combines the traits of different parent strains. Many hybrids are not able to reproduce.
- B. **Genetic manipulation** is an artificial means of producing desirable traits. Genes can be moved from one species to another. **Gene splicing** is the moving of hereditary characteristics from one organism to another often unrelated organism.

A variety of techniques can be used to help students understand the information in this objective. Students need text materials to help understand methods used to improve organisms. Chapter 5 of AgriScience is recommended. Also use TM: C3–4A to aid in discussion.

Objective 3: Identify breeding systems used in animal science

Anticipated Problem: What are the different breeding systems used in animal science?

- III. Livestock producers have learned that through the manipulation of animal breeding, traits of livestock can be improved. There are two basic breeding systems used by animal breeders:
- A. Inbreeding is the mating of closely related animals. Mating of these individuals allows for the concentration of genes to make animals more **homozygous** for all traits. A specific type of inbreeding is called **linebreeding**. Linebreeding is the mating of related animals that are not immediate family members.
- B. **Crossbreeding** or **outbreeding** is the mating of animals that are not related. In general, crossbred animals have a greater proportion of heterozygous genes than non-crossbred animals. The phenomenon of **heterosis** is often observed in crossbred animals. Heterosis or hybrid vigor, is the increase in a performance trait that exceeds the average of the parents.

A variety of techniques can be used to help students understand the information in this objective. Students need text materials to help understand the different breeding systems used. Chapter 6 of Animal Science Biology and Technology is recommended.

Review/Summary. Use the student learning objective to summarize the lesson. Have students explain the content associated with each objective. Student responses can be used in determining which objectives need to be reviewed or taught from a different angle. Questions at the end of each chapter in the recommended textbooks may also be used in the review/summary.

Application. Application can involve the following student activity.

Laboratory Activity, Part One: Heterosis on page 96 of Animal Science Biology and Technology.

Evaluation. Evaluation should focus on student achievement of the objectives for the lesson. Various techniques can be used, such as student performance on the application activity. A sample written test is attached.

Answers to Sample Test:

Part One: Matching

1=a, 2=e, 3=i, 4=b, 5=h, 6=d, 7=g, 8=f, 9=c

Part Two: Completion

10. gene splicing
11. homozygous
12. heterosis

Part Three: Short Answer

13. Answers will vary. Should contain something dealing with the fact that inbreeding is the mating of closely related organisms while linebreeding is the mating of distant relatives.
14. Answers will vary. Should discuss that controlled breeding is controlling a natural process.

Test

Lesson C3–4: Using Crossbreeding and Hybrids

Part One: Matching

Instructions. Match the term with the correct response. Write the letter of the term by the definition.

- | | | |
|----------------|------------------|-------------------------|
| a. inbreeding | b. linebreeding | c. crossbreeding |
| d. outbreeding | e. heterosis | f. controlled breeding |
| g. selection | h. hybridization | i. genetic manipulation |

- _____ 1. Mating of closely related animals.
- _____ 2. Increase in performance trait that exceeds the average of the parents.
- _____ 3. Artificial means of producing desirable traits.
- _____ 4. Mating distant relatives.
- _____ 5. Method of controlled breeding that involves crossing two different plants or animals.
- _____ 6. Same as crossbreeding.
- _____ 7. Involves choosing a few parents with the desired traits.
- _____ 8. Breeding plants or animals to achieve certain characteristics in the offspring.
- _____ 9. Mating of unrelated animals.

Part Two: Completion

Instructions. Provide the word or words to complete the following statements.

10. _____ is the moving of hereditary characteristics from one organism to another often unrelated organism.
11. Inbreeding allows for the concentration of genes to make animals more _____ for all traits.
12. The phenomenon of _____ is often observed in crossbred animals.

Methods Used to Improve Organisms

Controlled Breeding

- Selection
- Inbreeding
- Hybridization

Genetic Manipulation