

Unit B: Understanding Animal Reproduction

Lesson 2: Understanding Natural Animal Reproduction

Student Learning Objectives:

Instruction in this lesson should result in students achieving the following objectives:

1. Explain the basics of animal reproduction.
2. Describe the phases of the estrous cycle.
3. Explain the phases of reproductive development in the life of an animal.
4. List and explain common breeding systems used in cattle production.

Recommended Teaching Time: 1 hour

Recommended Resources: The following resources may be useful in teaching this lesson:

- Baker, M & Mikesell, R.E. *Animal Science Biology and Technology*. Danville, IL: Interstate Publishers, Inc. 1996.
- Gillespie, J.R. *Modern Livestock and Poultry Production, 6th Edition*. Albany, NY: Delmar. 2002.
- Lee, Jasper S., Hutter, J., Rudd R., Westrom, L., Bull, A.M., Embry Mohr, C. & Pollock, J. *Introduction to Livestock and Companion Animals 2nd Edition*. Danville, Illinois: Interstate Publishers, Inc., 2000.
- Taylor, R.E. *Scientific Farm Animal Production: An Introduction to Animal Science, 4th Edition*. New York: MacMillian Publishers Co. 1992.

List of Equipment, Tools, Supplies, and Facilities:

- Writing surface
- PowerPoint Projector
- PowerPoint Slides
- Transparency Masters

Terms: The following terms are presented in this lesson (shown in bold italics and on PowerPoint Slides 2 and 3):

- Anestrus
- Artificial insemination
- Breed
- Breeding
- Closebreeding
- Copulation
- Crossbreeding
- Diestrus
- Estrous cycle
- Estrus
- Fertilization
- Gestation
- Grade animal
- Grading up
- Heterosis
- Hybrid vigor
- Inbreeding
- Insemination
- Lactation
- Linebreeding
- Metestrus
- Natural insemination
- Outcrossing
- Ovulation

- Parturition
- Proestrus
- Progesterone
- Puberty
- Purebred
- Reproduction
- Reproductive efficiency
- Semen
- Straightbreeding
- Zygote

Interest Approach:

Write the words “Animal Reproduction” on the chalkboard. Ask students to tell you what that means. Use this discussion to guide students to the lesson.

SUMMARY OF CONTENT AND TEACHING STRATEGIES

Objective 1: Explain the basics of animal reproduction.

Anticipated Problem: What are some of the basics of animal reproduction?

(PowerPoint Slide 4)

- I. **Reproduction** is the process by which offspring are produced. The offspring are of the same species and have traits similar to their parents. Reproduction is not essential for an organism to live; however, it is essential if a species is to stay in existence. Without reproduction, there would be no new animals. In learning about animal reproduction, there are several basic concepts that a producer must understand.

(PowerPoint Slide 5)

- A. The placing of sperm in the reproductive tract of the female is called **insemination**. **Natural insemination** is the process of the male depositing **semen**, the fluid containing sperm, in the reproductive tract of the female. This occurs during copulation or mating. **Copulation** is the sexual union of a male and female animal. **Artificial insemination** involves a technician collecting semen from a male and placing it in the reproductive tract of a female.

(PowerPoint Slide 6)

- B. **Breeding** is promoting animal reproduction so the desired offspring result. A **breed** is a group of animals of the same species that share common traits.
- C. **Reproductive efficiency** is the timely and prolific replacement of a species. This is the difference between success and failure in animal production. The fertilization of an egg may not always produce a new, healthy individual. The developing animal may die before birth. Those losses lower reproductive efficiency.

Use TM: 2-1 (PowerPoint Slide 7) to aid in the discussion of Basic Animal Reproduction.

Objective 2: Describe the phases of the estrous cycle.

Anticipated Problem: What happens in the various phases of the estrous cycle?

(PowerPoint Slide 8)

II. The **estrous cycle** is the time between periods of estrus. The estrous cycle of female animals has four periods. These are cyclical, except during gestation or pregnancy, for many animals, including cattle. Some animals are seasonal breeders. They may go through periods of cycling and periods of anestrus.

Anestrus is the absence of cycling. Anestrus is often related to the number of hours of light in a day. The four periods of estrous cycle are:

(PowerPoint Slide 9)

A. Estrus—**Estrus**, also known as heat, is the period when the female is receptive to the male and will stand for mating. The length of estrus varies between species. Periods of estrus are triggered by the hormone estrogen. Many changes take place, such as restlessness, mucus discharge, a swollen vulva, and standing to be ridden by other animals. Ovulation takes place during estrus for most species. **Ovulation** is when a mature ovum is released by the ovary. The number of eggs ovulated varies between species.

(PowerPoint Slide 10)

B. Metestrus—The period following estrus is **metestrus**. Ovulation occurs during metestrus in cattle. During this period luteinizing hormone (LH) triggers the corpus lutea (CL) to develop from follicular tissue that remains after release of the ova. The corpus luteum (yellow body) is important in maintaining pregnancy.

C. Diestrus—**Diestrus** is the period in the cycle in which the system assumes pregnancy. A fully functional corpus luteum (yellow body) releases high levels of progesterone. **Progesterone** is the hormone that maintains pregnancy. This is when the uterus is prepared for pregnancy.

D. Proestrus—**Proestrus** begins with the regression of the corpus luteum and a drop in the hormone progesterone. Late in this period, changes in behavior may occur as estrus approaches.

Use TM: 2-2 to highlight the Phases of the Estrous Cycle for a cow.

Objective 3: Explain the phases of reproductive development in the life of an animal.

Anticipated Problem: What are the phases of reproductive development in the life of an animal?

III. Reproduction is a series of events and phases that an animal goes through. Each event takes place in a certain order. Properly timed completion of these phases affects the success. Some of the important phases in reproductive development are:

(PowerPoint Slide 11)

- A. Puberty—**Puberty** is the time at which animals reach a level of sexual development that makes them capable of reproduction. Puberty in female animals is the age of the first estrus with ovulation. Puberty in males is the first ejaculate with fertile sperm. Neither males nor females are sexually mature at puberty. The female is often too small to bear young. The male is not highly fertile nor capable of breeding regularly. Both environmental and genetic factors affect the age at which puberty occurs.

(PowerPoint Slide 12)

- B. Fertilization—**Fertilization** is the union of a sperm and an ovum or egg. The sperm penetrates the ovum and pairs of genetic material are formed. The fertilized ovum is called a **zygote**.
- C. Gestation—**Gestation** is the period of pregnancy. It begins with conception and lasts until parturition or birth. The length of gestation varies between species.
- D. Parturition—**Parturition** is the process of giving birth. Several hormone levels change and initiate the process. Behavior changes can be observed that indicate the animal is nearing parturition. Females can exhibit a “nesting” behavior. They become restless and attempt to separate from the herd. The first stage of parturition includes dilation of the cervix and entry of the fetus into the cervix. This is usually the longest stage; ranging from one to twelve hours. The second stage of parturition is the expulsion of the afterbirth (placenta) from the uterus. This normally occurs shortly after giving birth.
- E. Lactation—**Lactation** is the production of milk. Hormones that trigger the onset of lactation also play an important role in parturition.

Use TM: 2-3 (PowerPoint Slide 13) to aid in the discussion of reproductive development in the life of an animal.

Objective 4: List and explain the common breeding systems used in cattle production.

Anticipated Problem: What are some of the common breeding systems used in cattle production?

IV. The system of breeding to be used by a producer depends of the kind of cattle operation. There are two basic systems of breeding used in cattle production. There are several variations of each system available for producers to utilize. The two basic systems are:

(PowerPoint Slide 14)

- A. Straightbreeding—**Straightbreeding** is mating animals of the same breed. There are several variations of this system. Some of the most common are:
 1. Purebred Breeding—A **purebred** animal is an animal of a breed. Both parents of the animal must have been purebred. The production of purebred animals is a specialized business. These animals provide the foundation stock for crossbreeding to produce market animals.

2. Inbreeding—**Inbreeding** is the mating of related animals. This increases the genetic purity of the stock produced. The pairing of the same genes is increased, and offspring become more genetically homozygous. There are two types of inbreeding:

(PowerPoint Slide 15)

- a. Closebreeding—**Closebreeding** is the most intensive form of inbreeding, in which the animals being mated are very closely related and can be traced back to more than one common ancestor.

(PowerPoint Slide 16)

- b. Linebreeding—**Linebreeding** refers to mating of animals that are more distantly related and can be traced back to one common ancestor.
3. Outcrossing—**Outcrossing** is the mating of animals of different families within the same breed. The purpose of outcrossing is to bring into the breeding program traits that are desirable but not present in the original animals.

(PowerPoint Slide 17)

4. Grading Up—**Grading up** is the mating of purebred sires to grade females. A **grade animal** is any animal not eligible for registry as a purebred. This is done as less expensive way to improve the quality of animals on a farm or ranch.

(PowerPoint Slide 18)

- B. Crossbreeding—**Crossbreeding** is the mating of two animals from different breeds. The resulting offspring is a hybrid. This generally results in improved traits in the offspring. Superior traits that result from crossbreeding are called **hybrid vigor** or **heterosis**.

Use TM: 2-4, TM: 2-5, and TM: 2-6 to aid in the discussion of the three common breeding systems.

Review/Summary: Focus the review and summary of the lesson around the student learning objectives (**PowerPoint Slide 19**). Call on students to explain the content associated with the objectives.

Application: Application can involve having a local veterinarian or cattle producer come to class and discuss cattle reproduction systems used in the area. Students could be prepared to ask questions related to the subject matter discussed in this lesson.

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 included.

Answers to Sample Test:

Matching

1. B
2. D
3. H
4. F
5. A
6. E
7. C
8. G

Fill-in-the-blank

1. Ovulation
2. Grading up
3. Natural

Short Answer

1. Estrus, Metestrus, Diestrus, Proestrus
2. Straightbreeding, Purebred, Inbreeding, Closebreeding, Linebreeding, Outcrossing, Grading up, or Crossbreeding: see lesson for description of each.

Understanding Natural Animal Reproduction

Name: _____

Matching: Match each word with the correct definition.

- | | |
|-----------------|---------------------|
| a. Gestation | e. Estrus |
| b. Diestrus | f. Heterosis |
| c. Progesterone | g. Straightbreeding |
| d. Parturition | h. Inbreeding |

- _____ 1. The period in the cycle in which the system assumes pregnancy.
- _____ 2. The process of giving birth.
- _____ 3. The mating of related animals.
- _____ 4. Superior traits that result from crossbreeding.
- _____ 5. The period of pregnancy.
- _____ 6. The period when the female is receptive to the male and will stand for mating.
- _____ 7. The hormone that maintains pregnancy.
- _____ 8. Mating of animals of the same breed.

Fill-in-the-blank: Complete the following statements.

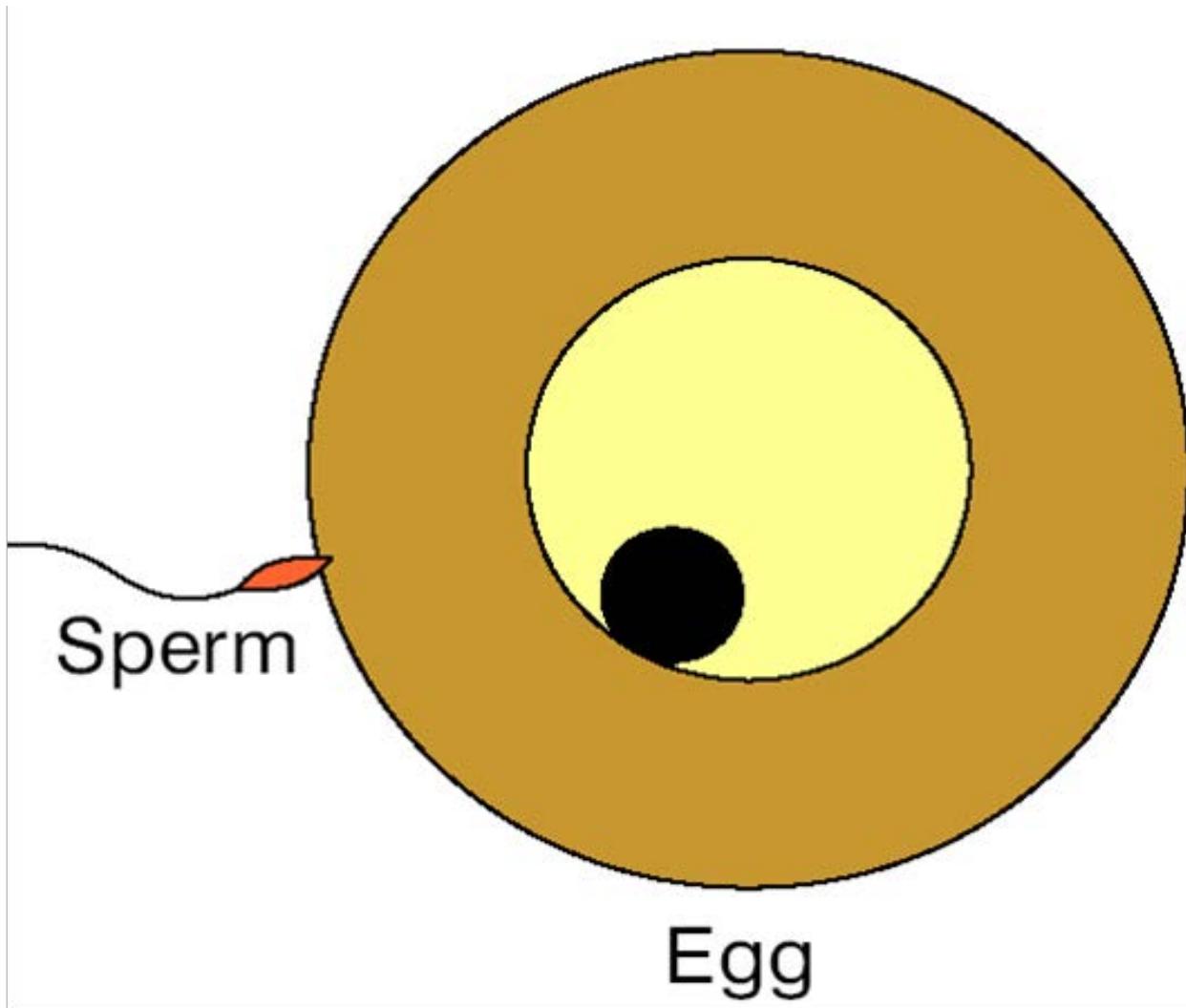
1. Puberty in female animals is the age of the first estrus with _____.
2. _____ is the mating of purebred sires to grade females.
3. _____ insemination is the process of the male depositing semen in the reproductive tract of the female.

Short Answer: Answer the following question.

1. List the four periods of the estrous cycle.
2. Describe three of the breeding systems discussed in this lesson.

TM: 2-1

BASIC ANIMAL REPRODUCTION



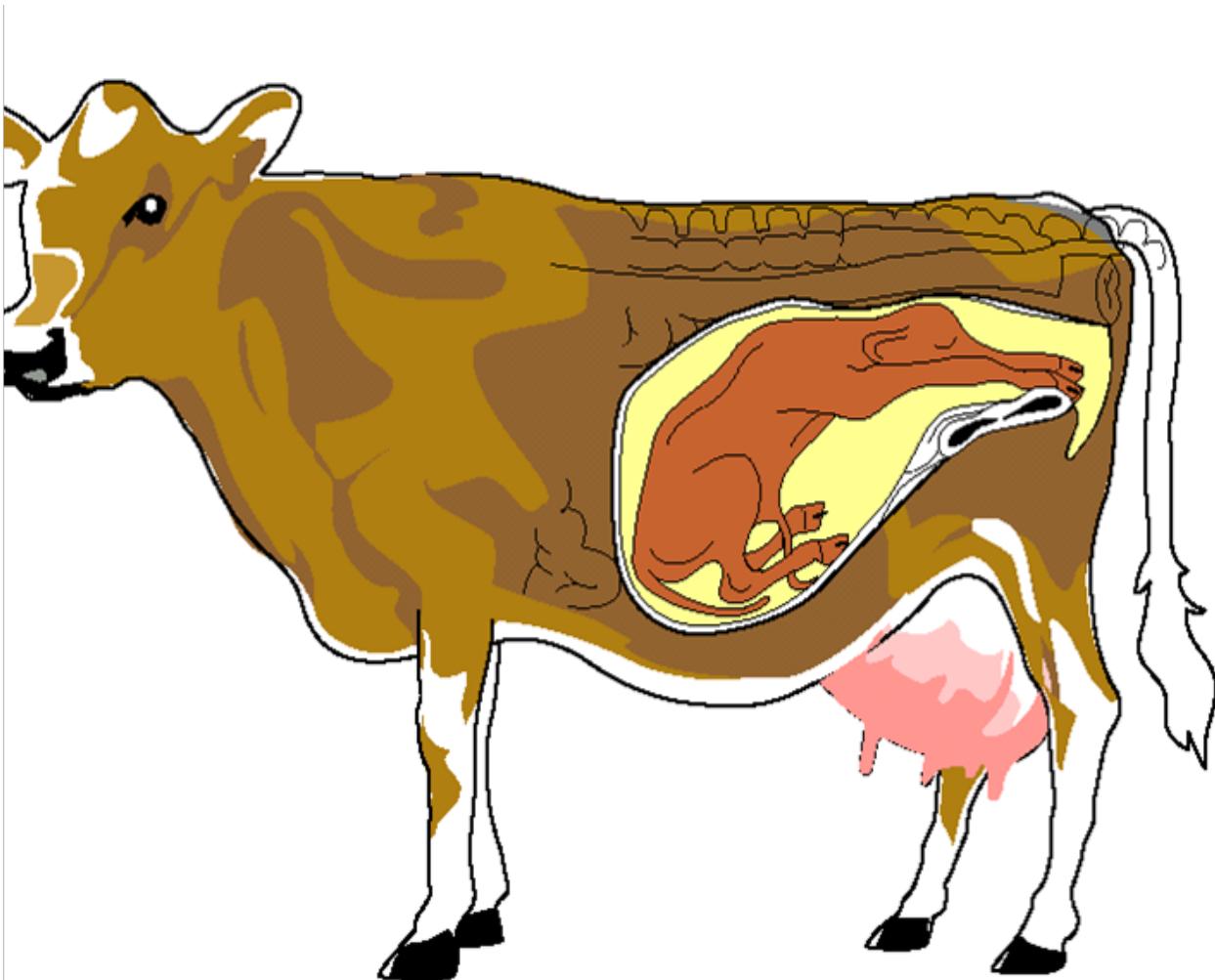
TM: 2-2

PHASES OF THE ESTROUS CYCLE

- ✓ Species: Cow
- ✓ Estrous cycle: 21 days
- ✓ Length of estrus (heat): 12-18 hours
- ✓ Ovulation: 10-14 hours after estrus

TM: 2-3

GESTATION PHASE OF REPRODUCTIVE DEVELOPMENT



CLOSEBREEDING

A represents the male. B represents the female.

First Mating	A x B
First Generation	$\frac{1}{2}$ A $\frac{1}{2}$ B

Second Mating	A x $\frac{1}{2}$ A $\frac{1}{2}$ B
Second Generation	$\frac{3}{4}$ A $\frac{1}{4}$ B

The offspring in the second generation have received $\frac{3}{4}$ (75%) of their genetic inheritance from Sire A because he appears closer in the pedigree to the offspring than he does in linebreeding. The offspring have received only $\frac{1}{4}$ (25%) of their genetic inheritance from Female B.

LINEBREEDING

A represents the male. **B** and **C** represent the females.

First Mating	$A \times B$	$A \times C$
First Generation	$\frac{1}{2} A \frac{1}{2} B$	$\frac{1}{2} A \frac{1}{2} C$
Second Mating	$\frac{1}{2} A \frac{1}{2} B \times \frac{1}{2} A \frac{1}{2} C$	
Second Generation	$\frac{1}{2} A \frac{1}{4} B \frac{1}{4} C$	

The offspring in the second generation have received $\frac{1}{2}$ (50%) of their genetic inheritance from Sire A because he appears twice in their pedigree. They have received only $\frac{1}{4}$ (25%) of their genetic inheritance from each of Females B and C.

GRADING UP

A₁, A₂, and A₃ represent purebred sires of a given breed.
G represents a grade female.

First Mating	A ₁ x G
First Generation	$\frac{1}{2} A_1 \frac{1}{2} G$ (50% purebred, 50% grade)
Second Mating	A ₂ x $\frac{1}{2} A_1 \frac{1}{2} G$
Second Generation	$\frac{1}{2} A_2 \frac{1}{4} A_1 \frac{1}{4} G$ (75% purebred, 25% grade)
Third Mating	A ₃ x $\frac{1}{2} A_2 \frac{1}{4} A_1 \frac{1}{4} G$
Third Generation	$\frac{1}{2} A_3 \frac{1}{4} A_2 \frac{1}{8} A_1 \frac{1}{8} G$ (87.5% purebred, 12.5% grade)