

Lesson B4–2

Understanding Natural Animal Reproduction

Unit B. Animal Science and the Industry

Problem Area 4. Understanding Animal Reproduction and Biotechnology

Lesson 2. Understanding Natural Animal Reproduction

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-A. Analyze elements in the reproductive cycle to explain differences between male and female reproductive systems.

Performance Standard: 1. Identify the parts of male and female reproductive tracts on example animals. 2. Analyze the reproductive cycle of a given animal. 3. Evaluate animal readiness for breeding.

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 livestock production.

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:

Lee, J.S., Hutter, J., Rudd, R., Westrom, L., Bull, A.M., Embry Mohr, C. & Pollock, J. *Introduction to Livestock and Companion Animals*, 2nd Edition. Danville, IL: Interstate Publishers, Inc. 2000. (Chapter 5)

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

Baker, M. & Mikesell, R.E. *Animal Science Biology and Technology*. Danville, IL: Interstate Publishers, Inc. 1996. (Chapter 5)

Gillespie, J.R. *Modern Livestock & Poultry Production*, 6th Edition. Albany, NY: Delmar. 2002. (Unit 10)

Taylor, R.E. *Scientific Farm Animal Production: An Introduction to Animal Science*, 4th Edition. New York: MacMillian Publishing Co. 1992. (Chapter 10)

List of Equipment, Tools, Supplies, and Facilities

Writing surface
Overhead projector
Transparencies from attached masters

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

Anestrus
Artificial insemination
Breed
Breeding
Closebreeding
Copulation
Crossbreeding
Diestrus
Estrous cycle
Estrus
Fertilization
Gestation
Grade animal
Grading up
Heterosis
Hybrid vigor
Inbreeding

Incubation
Insemination
Lactation
Linebreeding
Metestrus
Natural insemination
Outcrossing
Ovulation
Parturition
Proestrus
Progesterone
Puberty
Purebred
Reproduction
Reproductive efficiency
Semen
Spawning
Straightbreeding
Zygote

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.

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

Summary of Content and Teaching Strategies

Objective I: Explain the basics of animal reproduction.

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

- 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.
 - 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** in-

volves a technician collecting semen from a male and placing it in the reproductive tract of a female.

- 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 or hatching. These losses lower reproductive efficiency.

There are many techniques that can be used to assist students in mastering this material. Students need text material to aid in understanding the basics of animal reproduction. Chapter 5 in Introduction to Livestock and Companion Animals is recommended. Use TM: B4–2A to aid in the discussion on this topic.

Objective 2: Describe the phases of the estrous cycle.

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

- II. The **estrous cycle** is the time between periods of estrus. The estrous cycle of female mammals has four periods. These are cyclical, except during gestation or pregnancy, for many animals, such as cattle or swine. 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. Examples of seasonal breeders include sheep, cats, goats, and horses. The four periods of the estrous cycle are:
 - 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. The cat however only ovulates after mating. **Ovulation** is when a mature ovum is released by the ovary. The number of eggs ovulated varies between species.
 - B. Metestrus—The period following estrus is **metestrus**. Ovulation occurs during metestrus in cattle and goats. 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.

There are many techniques that can be used to assist students in mastering this material. Students need text material to aid in understanding the phases of the estrous cycle. Chapter 5 in *Introduction to Livestock and Companion Animals* is recommended. Use TM: B4–2B to aid in the discussion on this topic.

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 effects the success. Some of the important phases in reproductive development are:
 - 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.
 - 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 12 hours. The second stage completes the birth of an animal through strong contractions. The last 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.
 - F. Incubation—**Incubation** is the development of a new animal in the fertile egg of poultry, fish, and other egg-laying species. This occurs outside the body of the female. Four important factors in incubating eggs are:
 - G. Temperature—Temperature should be maintained at 99 to 103°F.
 - H. Humidity—The humidity should be about 60 percent during the first 18 days and 70 percent during the last 3 days.
 - I. Oxygen—Sufficient air exchange to prevent carbon dioxide buildup while maintaining a 21 percent oxygen level.
 - J. Egg rotation—Eggs should be rotated two to five times daily for the first 18 days.

- K. Spawning—**Spawning** is the releasing of eggs by a female fish and the subsequent fertilization by the male. A female may lay thousands of eggs at one spawning. The male fish then fertilizes the eggs by releasing sperm on the mass of eggs.

There are many techniques that can be used to assist students in mastering this material. Students need text material to aid in understanding the phases of reproductive development in the life of an animal. Chapter 5 in Introduction to Livestock and Companion Animals is recommended. Use TM: B4–2C and TM: B4–2D to aid in the discussion on this topic.

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

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

- IV. The system of breeding to be used by a producer depends on the kind of livestock operation. There are two basic systems of breeding used in livestock production. There are several variations of each system available for producers to utilize. The two basic systems are:
- A. Straightbreeding—**Straightbreeding** is mating animals of the same breed. There are several variations of this system. Some of the most common are:
 - B. 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.
 - C. 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.
 - D. 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.
 - E. Linebreeding—**Linebreeding** refers to mating animals that are more distantly related and can be traced back to one common ancestor.
 - F. 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.
 - G. 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.
 - H. 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**.

There are many techniques that can be used to assist students in mastering this material. Students need text material to aid in understanding the common breeding systems used in livestock production. Unit 10

in Modern Livestock & Poultry Production is recommended. Use TM: B4–2E thru TM: B4–2G to aid in the discussion on this topic.

Review/Summary. Use the student learning objectives 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 end of chapters in the textbook may also be used in the review/summary.

Application. Have students complete the Semen Evaluation exercise described on pages 35–37 in the Activity Manual for Introduction to Livestock and Companion Animals.

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

Answers to Sample Test:

Part One: Matching

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

Part Two: Completion

1. ovulation
2. Spawning
3. Grading up
4. Natural

Part Three: Short Answer

Estrus, Metestrus, Diestrus, Proestrus

Straightbreeding, Purebred, Breeding, Inbreeding, Closebreeding, Linebreeding, Outcrossing, Grading Up, or Crossbreeding; See lesson for description of each system for grading.

Test

Lesson B4–2: Understanding Natural Animal Reproduction

Part One: Matching

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

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

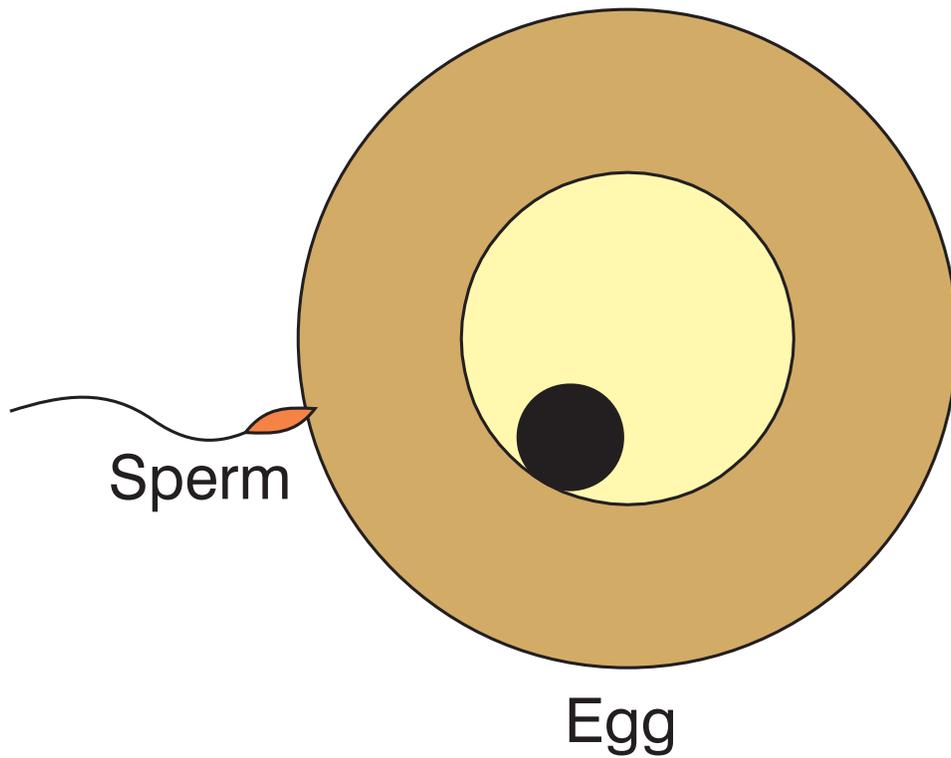
- _____ 1. The period in the cycle in which the system assumes pregnancy.
- _____ 2. The process of giving birth.
- _____ 3. The mating of related animals.
- _____ 4. Superior traits that result from crossbreeding.
- _____ 5. The period of pregnancy.
- _____ 6. The period when the female is receptive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

Part Two: Completion

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

1. Puberty in female animals is the age of the first estrus with _____.
2. _____ is the releasing of eggs by a female fish and the subsequent fertilization by the male.
3. _____ is the mating of purebred sires to grade females.
4. _____ insemination is the process of the male depositing semen in the reproductive tract of the female

BASIC ANIMAL REPRODUCTION



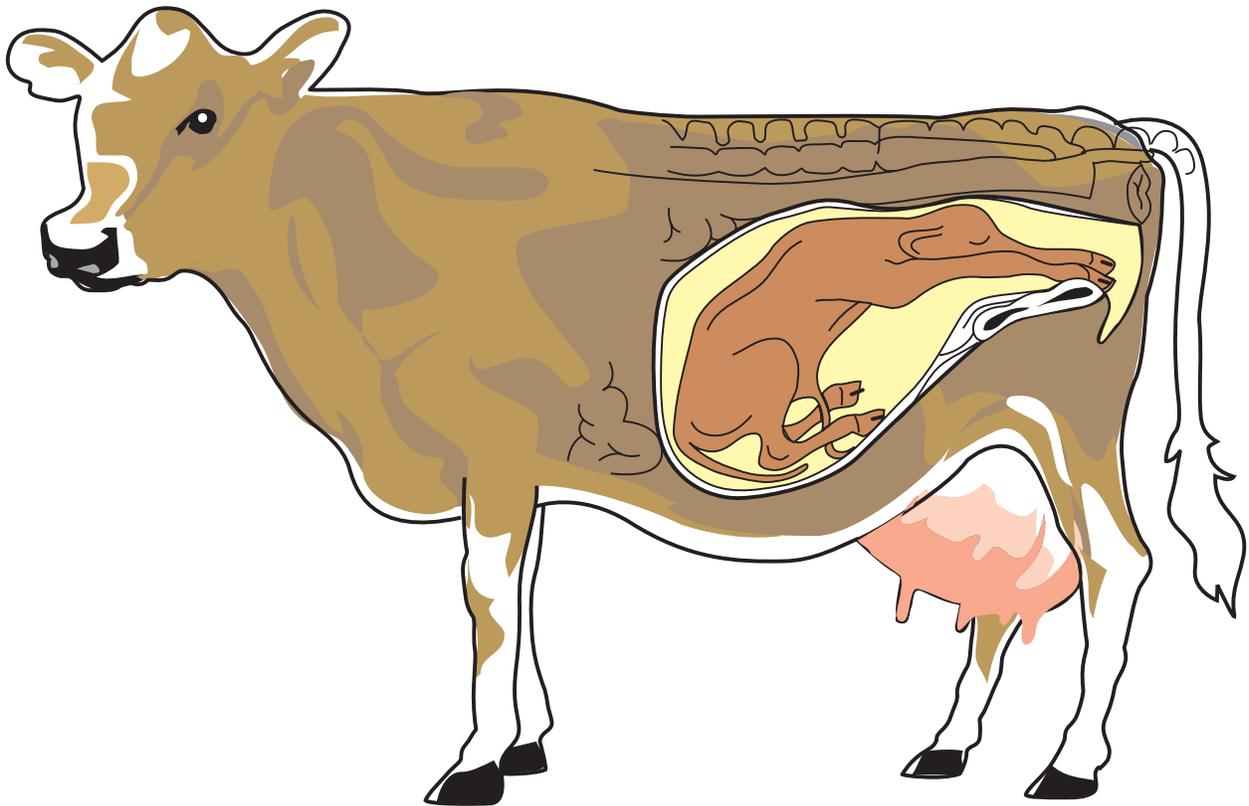
PHASES OF THE ESTROUS CYCLE

Species	Estrous Cycle (days)	Length of Estrus (heat)	Ovulation
Cow	21	12–18 hours	10–14 hours after estrus
Mare	22	6–8 days	1–2 days before estrus ends
Doe (goat)	21	30–40 hours	at the end of or just after estrus
Doe (rabbit)	Constant	Constant	8–10 hours after mating
Sow	20–21	40–72 hours	mid estrus
Ewe	17	24–36 hours	late estrus
Bitch (dog)	—	9 days	1–2 days after estrus begins
Queen (cat)	14–21*	5 days	24 hours after mating

*Estrous cycle influenced by length of daylight, with mating season typically when there are more than 12 hours of daylight in one day.

TM: B4-2C

GESTATION PHASE OF REPRODUCTIVE DEVELOPMENT



POULTRY

INCUBATION TIMES

Common Species Name	Incubation Period (days)
Chicken	21
Pheasant	24
Duck	28
Turkey	28
Goose	28-32
Ostrich	42

CLOSEBREEDING

A represents the male. **B** represents the female.

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

Second Mating	A × $\frac{1}{2}$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 Matings	A × B	A × C
First Generation	$\frac{1}{2}\mathbf{A}$ $\frac{1}{2}\mathbf{B}$	$\frac{1}{2}\mathbf{A}$ $\frac{1}{2}\mathbf{C}$

Second Matings	$\frac{1}{2}\mathbf{A}$ $\frac{1}{2}\mathbf{B}$ × $\frac{1}{2}\mathbf{A}$ $\frac{1}{2}\mathbf{C}$
Second Generation	$\frac{1}{2}\mathbf{A}$ $\frac{1}{4}\mathbf{B}$ $\frac{1}{4}\mathbf{C}$

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

A_1 , A_2 , and A_3 represent purebred sires of a given breed.
 G represents a grade female.

First Matings	$A_1 \times G$
First Generation	$\frac{1}{2}A_1 \frac{1}{2}G$ (50% purebred, 50% grade)
Second Matings	$A_2 \times \frac{1}{2}A_1 \frac{1}{2}G$
Second Generation	$\frac{1}{2}A_2 \frac{1}{4}A_1 \frac{1}{4}G$ (75% purebred, 25% grade)
Third Matings	$A_3 \times \frac{1}{2}A_2 \frac{1}{4}A_1 \frac{1}{4}G$
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)