

Lesson B4–3

Understanding Animal Reproduction Technology

Unit B. Animal Science and the Industry

Problem Area 4. Understanding Animal Reproduction and Biotechnology

Lesson 3. Understanding Animal Reproduction Technology

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-B. Discuss reproductive cycles to show how they differ from species to species.

Performance Standard: 1. Discuss the pros and cons of breeding through natural cover and artificial insemination. 2. Discuss the implications of genetic variation. 3. Describe techniques of artificial insemination. 4. Identify reproduction management practices (e.g., male to female ratios, age and weight for breeding, fertility and soundness for breeding, heat synchronization, flushing).

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

1. Explain the process of artificial insemination.
2. Discuss the advantages and disadvantages of artificial insemination.
3. Define the processes of estrous synchronization, embryo transfer, cloning and genetic engineering.

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)

Ensminger, M.E. *Animal Science*, 9th Edition. Danville, IL: Interstate Publishers, Inc. 1991. (Chapter 3)

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):

Artificial insemination

Cloning

Donor female

Embryo transfer

Estrous synchronization

Genetic engineering

Progesterin

Prostaglandin

Recipient female

Sexed semen

Standing heat

Superovulation

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.

Place some of the various equipment needed to perform artificial insemination in the front of the classroom. Ask students if they can identify the uses of the various tools. Lead this discussion into the first objective of the lesson.

Summary of Content and Teaching Strategies

Objective I: Explain the process of artificial insemination.

Anticipated Problem: What are the steps involved in artificial insemination?

- I. **Artificial insemination** is the placing of semen in the female reproductive tract by artificial techniques. The use this technique has increased over the past several years. There are several different segments of this process. Some of the major parts are:
 - A. Semen Collection— Artificial insemination requires that semen be collected from the male. Semen may be collected via manual stimulation, or use of an artificial vagina. The technique used depends on the species from which the semen is being collected. Semen collection is generally improved if time is given for the male to become stimulated. After the semen is collected from the male, it is evaluated, slowly cooled and frozen at a temperature of -320°F (-196°C). Liquid nitrogen is used to obtain these extreme temperatures. Properly frozen and stored semen can remain viable and be used 30 to 40 years later.
 - B. Sexed Semen—The sex of the offspring produced through artificial insemination can be controlled by the producer by the use of sexed semen. **Sexed semen** is semen that has been prepared to produce all male or all female offspring. It is collected in the same manner as other semen used in artificial insemination. Generally sexed semen will predict sex with approximately 90 percent accuracy. The cost of sexed semen is normally about four times higher than the cost of unsexed semen.
 - C. Detecting Estrus—In order to insure high conception rates, the artificial insemination technician must be able to detect when the female is in estrus or heat. Estrus signs vary between species. The best indication of estrus for most species is standing heat. **Standing heat** is the stage of estrus when a female stands when mounted by another animal. Many animals display extra mucus and redness in the vulva.
 - D. Insemination—The timing and the placement of semen vary depending on the species. All require that frozen semen be thawed properly to 95 to 98°F (33 to 34°C). Fresh semen should be used within an acceptable time, depending on species.

There are many techniques that can be used to assist students in mastering this material. Students need text material to aid in understanding the process of artificial insemination. Chapter 5 in Introduction to

Livestock and Companion Animals is recommended. Use TM: B4–3A thru TM: B4–3C to aid in the discussion on this topic.

Objective 2: Discuss the advantages and disadvantages of artificial insemination.

Anticipated Problem: What are some of the advantages and disadvantages of artificial insemination?

- II. As with all management practices in livestock production, there are several advantages and disadvantages of using artificial insemination.
- A. Some of the advantages of utilizing artificial insemination are:
1. Increases the use of outstanding sires—Through artificial insemination, many producers can use an outstanding sire to breed their females. The actual sire does not need to be present.
 2. Eliminate danger of keeping a sire—Some hazards are usually involved in keeping a sire on site. Also sires, when not breeding, are typically kept in separate facilities. This need is eliminated with the use of artificial insemination.
 3. Reduce sire costs—in smaller herds, artificial insemination is usually less expensive than the ownership of a quality sire including building, feed, and labor costs.
 4. Increase number of different sires in herd—Through artificial insemination, it is possible to introduce several different genetic lines into the herd through the use of different sires.
- B. Some of the disadvantages or limitations of artificial insemination are:
1. Requires skilled technician—in order to be successful, artificial insemination must be carried out by a person that has received training and had experience.
 2. High initial investment—Considerable money is necessary to begin an artificial insemination operation.
 3. Equipment costs can be high along with paying of training needed to conduct procedure.
 4. Increase management—to be successful, the level of observation and management by the producer must increase in an artificial insemination operation.

There are many techniques that can be used to assist students in mastering this material. Students need text material to aid in understanding the advantages and disadvantages of artificial insemination. Chapter 3 in Animal Science is recommended.

Objective 3: Define the processes of estrous synchronization, embryo transfer, cloning, and genetic engineering.

Anticipated Problem: What are estrous synchronization, embryo transfer, cloning, and genetic engineering?

III. There are several other techniques used in animal reproduction in addition to artificial insemination. Some of the more common techniques are:

- A. Estrous synchronization—**Estrous synchronization** is bringing a group of animals into heat simultaneously. This is done to assist the producer in scheduling animal breeding and birthing. Synchronization usually involves the use of prostaglandin, progestin, or a combination of the two. **Prostaglandin** causes the corpus luteum to stop producing progesterone. This allows the animal to come into estrus. **Progestin** has the effect of keeping progesterone levels high, holding animals in an extended diestrus. When the progestin source is removed, the animal quickly comes into estrus.
- B. Embryo transfer—**Embryo transfer** is moving embryos from one female, called the **donor female**, to the reproductive tract of another female called the **recipient female**. Donor females usually carry extraordinary genetics. Recipient animals have far less worth and are used as surrogate mothers. Embryo transfer is used following superovulation. **Superovulation** involves getting a female to release more than the usual number of eggs during a single estrous cycle. Embryos can be frozen in liquid nitrogen and transferred later; however, the success rate is higher when transferring fresh embryos.
- C. Cloning—**Cloning** is the production of one or more exact genetic copies of an animal.
 1. There are several methods of cloning animals.
 2. One method of cloning involves letting embryos grow to the 32-cell stage before splitting into 32 identical embryos.
 3. Another method takes a cell from an adult animal. This method was used in creation of the famous sheep Dolly.
 4. A third technique involves taking cells from primordial germ cells during fetal development. These are more stable cells and can be cultured and frozen for indefinite periods of time.
- D. Genetic engineering—**Genetic engineering** is removing, modifying, or adding genes to DNA. Genetic engineering using gene-splicing or recombinant DNA along with other reproductive technology will have a great deal of impact on future animal production.

There are many techniques that can be used to assist students in mastering this material. Students need text material to aid in understanding the processes of estrous synchronization, embryo transfer, cloning, and genetic engineering. Chapter 5 in Introduction to Livestock and Companion Animals is recommended.

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 de-

termining 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 Artificial Insemination exercise described on pages 35–37 and the Flushing a Cow exercise on pages 45–48 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 = g, 2 = e, 3 = f, 4 = d, 5 = h, 6 = b, 7 = c, 8 = a

Part Two: Completion

1. -320°F (-196°C)
2. liquid nitrogen
3. Estrous synchronization
4. training

Part Three: Short Answer

Refer to Objective 2 in this lesson for scoring this question.

Test

**Lesson B4–3: Understanding
Animal Reproduction Technology****Part One: Matching**

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

- | | |
|------------------------|----------------------------|
| a. Cloning | e. Progestin |
| b. Prostaglandin | f. Superovulation |
| c. Embryo transfer | g. Estrous synchronization |
| d. Genetic engineering | h. Standing heat |

- _____ 1. Bringing a group of animals into heat simultaneously.
_____ 2. Has the effect of keeping progesterone levels high, holding animals in an extended diestrus.
_____ 3. Getting a female to release more than the usual number of eggs during a single estrous cycle.
_____ 4. Removing, modifying, or adding genes to DNA.
_____ 5. The stage of estrus when a female stands when mounted by another animal.
_____ 6. Causes the corpus luteum to stop producing progesterone.
_____ 7. Moving embryos from one female to the reproductive tract of another female.
_____ 8. The production of one or more exact genetic copies of an animal.

Part Two: Completion

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

1. After the semen is collected from the male, it is evaluated, slowly cooled and frozen at a temperature of _____.
2. Embryos can be frozen in _____ and transferred later; however, the success rate is higher when transferring fresh embryos.
3. _____ is done to assist the producer in scheduling animal breeding and birthing.
4. In order to be successful, artificial insemination must be carried out by a person that has received _____ .

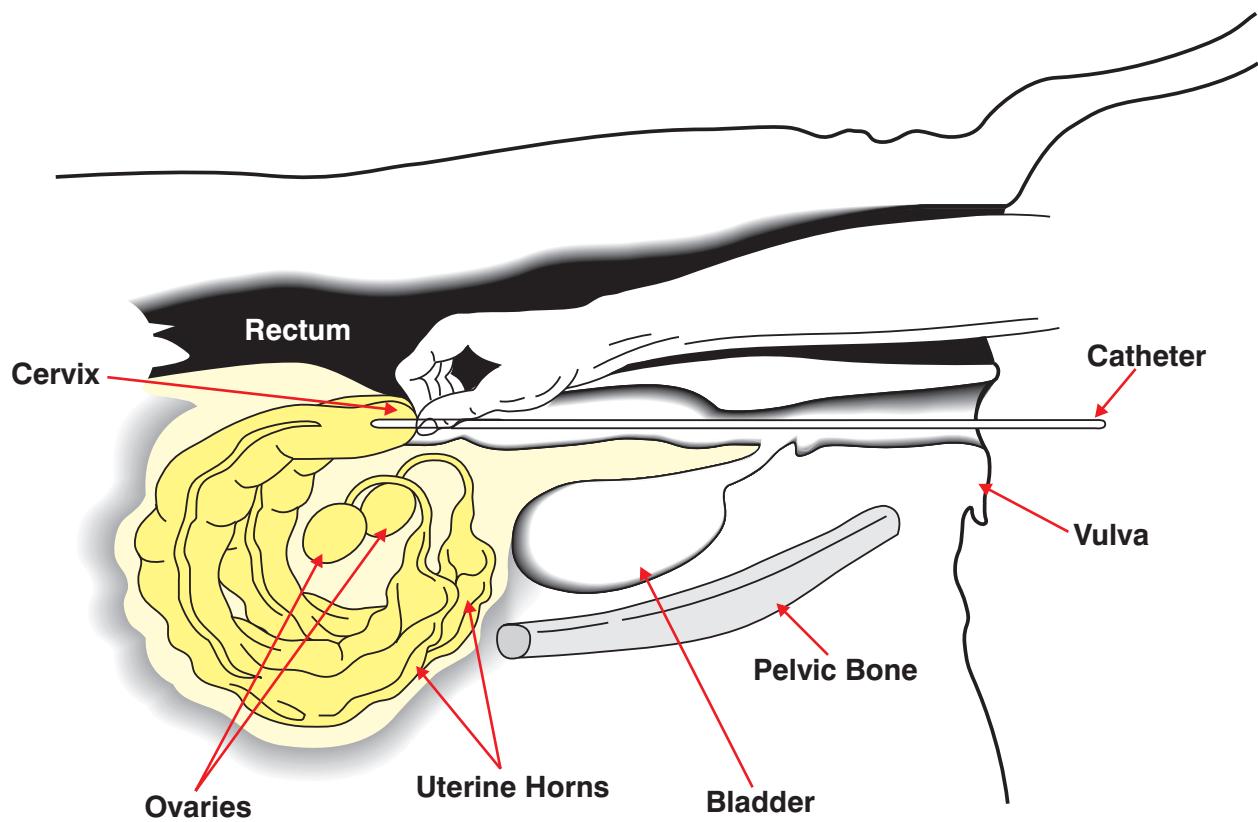
Part Three: Short Answer

Instructions. Provide information to answer the following question.

Identify and discuss two advantages and two disadvantages of artificial insemination.

TM: B4-3A

ARTIFICIAL INSEMINATION IN COWS



ESTRUS CYCLES AND REPRODUCTIVE TRAITS

	Cattle	Swine	Sheep	Goats	Horses
Puberty Age	4–12 months (6–8 more common)	4–7 months	4–8 months (16–20 Merino)	1 st autumn	10–12 months
Length of Cycle	16–24 days (21 average)	18–24 days (21 average)	14–20 days (16 average)	12–30 days (22 average)	10–37 days (22 average)
Length of Estrus	6–35 hours (16–18 average)	1–5 days (3 average)	1–3 days (30 hours average)	2–3 days (2½ average)	1–37 days (6 days average)
Time of Ovulation	20–40 hours from beginning of estrus; 10–14 hours after end of estrus	18–60 hours after start of estrus (24 hours before end of estrus)	Near end of estrus	Near end of estrus	1 to 2 days before end of estrus
Best Time to Breed	First, early in estrus; second, 12–20 hours after start of estrus	Sows: last ½ of estrus; Gilts: 2 nd day		Last ½ of estrus	3 rd day; 2 nd time; if still in heat, 3 days later
Length of Gestation	278–289 days (283 average)	111–115 days (114 average)	144–152 days (148 average)	140–160 days (151 average)	310–370 days (336 average)

SIGNS OF ESTRUS

Cattle	Swine
Standing when mounted by another cow	Frequent mounting of other sows
Nervousness	Restless activity
Swelling of the vulva	Swelling of the vulva
Inflamed appearance around lips of the vulva	Discharge from the vulva
Frequent urination	Frequent urination
Mucus discharge from the vulva	Occasional loud grunting
Trying to mount other cattle	

Goats	Horses
Nervousness	Raised tail
Riding other animals and standing when ridden	Relaxation of the vulva
Shaking the tail	Teasing of other mares
Frequent urination	Frequent urination
Bleating	Apparent desire for company of other horses
Swelling, red appearance of the vulva	Slight mucus discharge from the vulva
Mucus discharge from the vulva	