

## UNIT V - ANIMAL TECHNOLOGIES

### Lesson 1: Artificial Insemination

Objective/Competency: Describe the process of artificial insemination.

#### Study Questions

1. **What is artificial insemination?**
2. **What are the benefits of artificial insemination compared to natural breeding?**
3. **What equipment is needed for artificial insemination?**
4. **What steps are involved in artificial insemination?**
5. **How can the estrous cycle be manipulated to aid in artificial insemination?**

#### References

1. *Biotechnology: Applications in Agriculture (Student Reference)*. University of Missouri-Columbia: Instructional Materials Laboratory, 1998, Unit V.
2. Activity Sheet
  - a) AS 1.1: Evaluating Semen



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#### TEACHING PROCEDURES

##### A. Introduction

Biotechnology has been used in the animal industry for many years. Animal biotechnology has its foundation in selective breeding practices. In the early twentieth century, animal biotechnology included artificial insemination. In the late 1970s, embryo transfer technology emerged in the animal industry. In 1997 animal cloning was performed using an adult sheep, and biotechnology continues to open new opportunities in animal production. This lesson will examine the technology of artificial insemination.

##### B. Motivation

The livestock industry is becoming an industry that demands a more uniform product. How does a producer achieve this improved level of product quality? Many producers are using artificial insemination to accomplish this goal. Purebred producers who want exceptional breeding stock but view buying superior male animals as too expensive commonly use artificial insemination. Artificial insemination technology has also made the international exchange of breeding stock economically feasible.

##### C. Assignment

##### D. Supervised Study

##### E. Discussion

1. Ask students to define artificial insemination in their own words.

#### **What is artificial insemination?**

Artificial insemination is the process of collecting semen from a male animal and placing it in the reproductive tract of a female animal.

2. Ask students what the benefits of artificial insemination are.

#### **What are the benefits of artificial insemination compared to natural breeding?**

- a) AI allows for the selection and use of male animals regardless of where the animals are physically located.
- b) AI helps reduce the spread of reproductive or venereal diseases.
- c) AI reduces or eliminates the cost of owning and maintaining a male animal.
- d) The genetic improvement of livestock through the use of superior animals occurs more quickly due to a dramatic increase in the number of offspring a male animal can produce (sire) per year.

3. Show students the actual equipment used in AI or pictures of the equipment.

#### **What equipment is needed for artificial insemination?**

- a) Dummy - female replica mounted by male so that semen can be collected
- b) Artificial vagina - water-filled plastic sheath used to collect the semen
- c) Microscope - to check the quality of the semen

- d) Semen straw - thin plastic tube used to store the amount of semen needed to inseminate one female
  - e) Semen tank - aluminum tank used to store semen in liquid nitrogen
  - f) Insemination instrument - syringe-like tool that holds the straw and deposits the semen into the reproductive tract
4. Ask students to describe the process of artificial insemination. Have students complete AS 1.1. Students must be given pictures of primary, secondary, and tertiary sperm abnormalities to complete the activity. These pictures may be available in reproductive physiology or veterinary husbandry textbooks. Point out that the activity only addresses a few factors that affect the quality of sperm and does not provide an absolute measure of fertility.

**What steps are involved in artificial insemination?**

- a) Semen is collected using an artificial vagina.
  - b) The semen is tested for quality, which is determined by the motility, shape, and quantity of the sperm.
  - c) Extenders are added to increase the volume. The extenders that are most commonly used are citrate, egg-yolk phosphate, and homogenized milk.
  - d) The semen is placed in straws and frozen in liquid nitrogen at -320 degrees Fahrenheit.
  - e) The timing of insemination must be carefully managed; generally, insemination should occur shortly before ovulation.
  - f) The semen must be properly thawed.
  - g) A trained technician should inseminate the female by placing the straw in the inseminating instrument, which is inserted into the vagina and guided through the cervix; the semen is placed at the end of the cervix or the beginning of the uterus.
5. Ask students why one would want to manipulate the estrous cycle of animals. Explain that if producers can breed all of the animals at once management costs will be reduced and the resulting offspring will be more uniform in age.

**How can the estrous cycle be manipulated to aid in artificial insemination?**

- a) Through the injection of certain hormones that affect the estrous cycle, a producer can cause females to begin estrous as a group.
- b) This process, which is called estrous synchronization, simplifies the management of an artificial insemination program because animals in the group can all be bred within one or two days of each other.

**F. Other Activities**

1. Obtain a cow's reproductive tract from a slaughterhouse and demonstrate the insemination process.
2. Invite a local AI technician to bring AI equipment and talk to the class.
3. Arrange a field trip to observe a technician performing AI.

**G. Conclusion**

Artificial insemination is an important management practice for livestock producers. The availability of a wide selection of animals for breeding and accurate performance records motivates producers to use artificial insemination. The dairy industry most commonly uses AI. However, beef cattle producers, dog breeders, horse breeders, and swine producers are using AI more frequently.

H. Answers to the Activity Sheet

AS 1.1

Answers will vary.

I. Answers to the Evaluation

1. b
2. d

3. Based on the motility, shape, and quantity of the sperm

4. Students may list any three of the following: dummy, artificial vagina, microscope, semen straws, semen tank, or insemination instrument.

5. Students may list any of two of the following.

- AI allows for the selection and use of male animals regardless of where the animals are physically located.
- AI helps reduce the spread of reproductive and venereal diseases.
- AI reduces or eliminates the cost of owning and maintaining a male animal.
- The genetic improvement of livestock through the use of superior animals occurs more quickly due to a dramatic increase in the number of offspring a male animal can have per year.



EVALUATION

**Circle the letter that corresponds to the best answer.**

1. Artificial insemination (AI) can be defined as the:
  - a. Process of depositing sperm.
  - b. Process of collecting sperm from a male animal and placing it in the female reproductive tract.
  - c. Process of collecting an egg from a female animal, fertilizing it, and placing it in the reproductive tract of another female animal.
  - d. Process of fusing a sperm and an egg.
2. How is the estrous cycle manipulated?
  - a. Through the injection of vitamins
  - b. By using artificial insemination
  - c. By placing a group of females together
  - d. Through the injection of hormones

**Complete the following short answer questions.**

3. How is the quality of semen evaluated?
4. What are three pieces of equipment used in artificial insemination?
  - a.
  - b.
  - c.
5. What are two benefits of artificial insemination?
  - a.
  - b.





**Evaluating Semen**

**Objective:** Visually examine semen to evaluate semen quality.

**Materials and Equipment:**

- Microscope with a 100x oil immersion objective
- Small amount of immersion oil
- Hot water bath (at approximately 98°F)
- Several glass test tubes
- Microscope slides and cover slips
- Frozen semen samples
- Semen stain (Blom’s Esin-Nigrosin stain)
- Several eye droppers

**Procedure:**

1. Place the semen sample in test tubes in the water bath.
2. Place the microscope slides and cover slips in the water bath; they should be warm when used.

Evaluation of Individual Motility

3. Place one drop of semen on a slide and place a cover slip over it. Using a 40x objective, focus the microscope and observe the sample. Select an individual sperm cell and observe the speed at which it moves. Observe ten different sperm cells and use the chart below to find the score for each of these sperm cells based on how long it takes for each of them to move across the viewing field. Total the scores and divide by ten to calculate the individual motility score for the semen sample.

<u>Observed Behavior</u>	<u>Points</u>
Very rapid forward motion that may be hard to follow	5
Rapid forward progression	4
Steady forward progression at a moderate speed	3
Slow progression or slightly erratic (stop and start) motion	2
Weak rocking movement without forward motion	1
No motion	0

Average score \_\_\_\_\_

Evaluation of Sperm Morphology (Sperm Structure)

4. Place one drop of semen on a slide and add one drop of semen stain. Mix the semen and stain together and place the cover slip on the solution.
5. Using oil immersion, focus the microscope. Next, search for an area that has at least five sperm cells in the viewing field. Count and record the number of sperm in the field. Use the pictures of sperm abnormalities provided by your instructor to help you identify abnormal sperm cells. Count and record the number of abnormal cells that have primary abnormalities (those relating to the sperm head and the caplike structure at its tip) and the number with secondary (involving droplets on the tail) or tertiary

(other defects of the tail) abnormalities. Select a new group of sperm cells and repeat this process until 100 cells have been observed.

6. Score the morphology of the semen sample.

<u>Primary Abnormalities</u>	<u>Points</u>
less than 10	20
10 to 19	15
20 to 29	10
more than 29	5

<u>Secondary and Tertiary Abnormalities</u>	<u>Points</u>
less than 25	20
26 to 39	15
40 to 59	10
more than 59	5

7. Calculate the average morphology by finding the sum of the primary abnormalities and the secondary and tertiary abnormalities and dividing by two.

Primary abnormalities score \_\_\_\_\_

Secondary and tertiary abnormalities score \_\_\_\_\_

Total \_\_\_\_\_ ÷ 2

Average score \_\_\_\_\_