

Unit B: Anatomy and Physiology of Poultry

Lesson 4: Artificial Poultry Reproduction

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. Identify equipment needed to artificially inseminate poultry.
4. Demonstrate how to collect semen from male poultry.
5. Demonstrate insemination of female poultry.

Recommended Teaching Time: 2 hours

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

- A PowerPoint has also been developed for use with this lesson plan
- <http://www.bernalpublishing.com/poultry/essays/essay14.shtml>

List of Equipment, Tools, Supplies, and Facilities

Writing surface
PowerPoint Projector
PowerPoint Slides
Tools for artificial insemination

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

Artificial insemination
Sexed semen
Standing heat

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 1: Explain the process of artificial insemination.

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I. **Artificial insemination** is the placing of semen in the female reproductive tract by artificial techniques. The use of this technique has increased over the past several years. There are several different segments of this process. Some of the major parts are:

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A. Semen Collection— Artificial insemination requires that semen be collected from the male.

1. Semen may be collected via manual stimulation, or use of an artificial vagina.
 - a. The technique used depends on the species from which the semen is being collected.
 - i. Poultry receive manual stimulation.
 - b. Semen collection is generally improved if time is given for the male to become stimulated.

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2. After the semen is collected from the male, it is evaluated, slowly cooled and frozen at a temperature of -196°C .

- a. Liquid nitrogen is used to obtain these extreme temperatures.
- b. Properly frozen and stored semen can remain viable and be used 30 to 40 years later.

(PowerPoint Slide #6) This slide shows a picture of a large tank of liquid nitrogen used to hold collected semen.

(PowerPoint Slide #7)

B. The sex of the offspring produced through artificial insemination can be controlled by the producer by the use of sexed semen.

1. **Sexed semen** is semen that has been prepared to produce all male or all female offspring.
2. It is collected in the same manner as other semen used in artificial insemination.
3. Generally sexed semen will predict sex with approximately 90 percent accuracy.
4. The cost of sexed semen is normally about four times higher than the cost of unsexed semen.

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C. In order to insure high conception rates, the artificial insemination technician must be able to detect when the female is in estrus or heat.

1. Estrus signs vary between species.
2. The best indication of estrus for most species is standing heat.
3. **Standing heat** is the stage of estrus when a female stands when mounted by another animal.
4. Many animals display extra mucus and redness in the vulva.

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D. The timing and the placement of semen vary depending on the species.

1. All require that frozen semen be thawed properly to 33 to 34°C .
2. Fresh semen should be used within an acceptable time, depending on species.

Ask the students if any of them have ever seen artificial insemination take place. Ask them, “Why would artificial insemination be beneficial to the poultry industry?” Hold a discussion about artificial insemination and whether they believe it is a good idea or a bad idea.

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

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- II. As with all management practices in livestock production, there are several advantages and disadvantages of using artificial insemination.

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A. Some of the advantages of utilizing artificial insemination are:

1. Increased mating ratio: In a flock it is usually one cockerel mated to six to ten hens.
 - a. With artificial insemination it is claimed this ratio could be increased four times.
 - b. In both cases it depends on the strain and breed of the birds.

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2. Use of older males from outstanding performers: Older male birds that have been flock improvers can be used for several generations.
 - a. Whereas under natural mating their useful life is limited.

(PowerPoint Slide #13)

3. Able to use an injured bird: Valuable male birds that have been injured in the leg can still be used for artificial insemination.
4. Elimination of preferential mating: When there is poor fertility caused by preferential mating it can be eliminated.

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5. Laying cages can be used: Laying cages are no longer a problem when fertile eggs are needed.
6. Selected hens can be inseminated and remain in the cage.
 - a. The exact pedigree of the chickens hatched from these fertile eggs is known.

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7. Successful cross breeding: Usually cross breeding is very successful under natural conditions, but sometimes there is a kind of color discrimination; some hens will not mate with a male of a different color unless they have been reared together.

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8. Some species like turkeys can only reproduce by artificial insemination
 - a. Domesticated turkeys have been bred to have large breasts for meat production.
 - b. This prevents the male from mounting the female, therefore making artificial insemination necessary.

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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.

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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.

Refer back to the discussion held after Objective 2. Ask the students if they can think of any other advantages or disadvantages for artificial insemination.

Objective 3: Identify equipment needed to artificially inseminate poultry.

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III. The equipment for artificial insemination does not need to be fancy or expensive.

A. The following materials can successfully collect semen and inseminate:

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1. Glass or plastic test tube for collecting semen from the male.

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2. 3 cc hypodermic syringe with 0.1 ml graduations.

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3. 0.5 cm external diameter glass inseminating tube 9 cm in length.

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4. Sometimes, a small plastic funnel is used where semen collection may be difficult.

Pass around to the class the tools used for artificial insemination so they can observe them up close.

Objective 4: Demonstrate how to collect semen from male poultry.

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IV. The technique of artificial insemination begins with the collection of the semen.

A. To maximize the percentage of birds producing semen and the volume of semen produced, they should be housed individually.

1. Pens of approximately 2 square meters have been shown to be satisfactory.

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B. To obtain clean semen, the feed should be removed 12 hours before the semen is to be collected.

1. Birds should also be practiced once or twice a few days before starting semen collection.

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C. The person collecting the semen sits on a stool and holds the bird on his or her lap.

1. He or she stimulates the bird by stroking his back from the middle towards the tail, while at the same time stroking the abdomen towards the vent with the other hand.

(PowerPoint Slide #27) This slide shows a picture of a semen collector stimulating a male bird.

(PowerPoint Slide #28)

2. After doing this several times, the thumb and the index finger of the right hand massage the pubic bones lightly.

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3. This causes the bird to extrude the phallus and, if the bird is producing semen, results in ejaculation.

4. A second person is required to collect the semen with a suitable receptacle.

(PowerPoint Slide #30) This slide shows a male bird with its phallus extruded.

(PowerPoint Slide #31)

5. The semen is released at the base of the phallus but it may run along the canal which extends the length of the phallus and be collected anywhere along its length, either through aspiration from the canal, or by collection in a centrifuge tube or other suitable receptacle.

(PowerPoint Slide #32) This slide shows the male bird releasing semen.

(PowerPoint Slide #33)

- D. It should be noted that males in their second or subsequent breeding season are more likely to produce semen than young males in the first breeding season.
- E. Chicken and turkey semen begin to lose fertilizing ability when stored longer than 1 hour.
 - 1. Liquid cold (4°C) storage of turkey and chicken semen can be used to transport semen and maintain spermatozoal viability for about 6-12 hours.

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- 2. When using liquid cold storage for longer than 1 hour, turkey semen must be diluted with a semen extender at least 1:1 and then agitated slowly (150 rpm) to facilitate oxygenation; chicken semen should be diluted and then cooled—agitation is not necessary.

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- 3. Several commercial semen extenders are available and are routinely used, particularly for turkeys.
 - a. Extenders enable more precise control over inseminating dose and facilitate filling of tubes.
 - b. Results may be comparable to those using undiluted semen when product directions are followed.
 - c. Dilution should result in an insemination dose containing ~300 million viable spermatozoa.

Have someone familiar with poultry semen collection demonstrate the procedure to the class. If this person is not available, show the video at <http://www.youtube.com/watch?v=pFXEtUFFgV0> which shows the process of semen collection.

Objective 5: Demonstrate insemination of female poultry.

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- V. For insemination, pressure is applied to the left side of the abdomen around the vent.
 - A. This causes the cloaca to evert and the oviduct to protrude so that a syringe or plastic straw can be inserted 2.5 cm into the oviduct and the appropriate amount of semen delivered.

(PowerPoint Slide #37) This slide shows an inseminator being inserted into the oviduct of a female bird. Here a bulb is used that creates suction on the straw. Once the straw is inserted into the oviduct the bulb is squeezed depositing the semen.

(PowerPoint Slide #38)

- B. As the semen is expelled by the inseminator, pressure around the vent is released, which assists the hen in retaining sperm in the vagina or the oviduct.
- C. Due to the high sperm concentration of turkey semen, 0.025 mL (~2 billion spermatozoa) of undiluted pooled semen, inseminated at regular intervals of 10-14 days, yields optimal fertility.

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- D. In chickens, due to the lower spermatozoon concentration and shorter duration of fertility, 0.05 mL of undiluted pooled semen, at intervals of 7 days, is required.
- E. The hen's squatting behavior indicates receptivity and the time for the first insemination.

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- F. For maximal fertility, inseminations may be started before the initial oviposition.
- G. Fertility tends to decrease later in the season; therefore, it may be justified to inseminate more frequently or use more cells per insemination dose.

Have someone familiar with poultry insemination demonstrate the procedure to the class.

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 to determine which objectives need to be reviewed or re-taught with a different approach. Questions on **PowerPoint Slide #41** can also be used.

Application: Have the students artificially inseminate a bird. Put the students into groups to reduce the amount of supplies needed.

Evaluation: Evaluation should focus on student achievement of this lesson's objectives. A sample written test is attached.

Answers to Sample Test:

Part One: Short Answer

1. Advantages of artificial insemination include:
Increased mating ratio, Use of older males from outstanding performers, Able to use an injured bird, Elimination of preferential mating, Laying cages can be used, Selected hens can be inseminated and remain in the cage, Successful cross breeding, Some species like turkeys can only reproduce by artificial insemination
2. Some of the disadvantages or limitations of artificial insemination are: Requires skilled technician, High initial investment, Equipment costs can be high, Increase management.
3. Newly collected semen should be stored at -196 degrees Celsius in liquid nitrogen.
4. Sexed semen is semen that has been prepared to produce all male or all female offspring.
5. Properly stored and frozen semen can remain viable for 30 to 40 years.
6. The semen straw or tube should be inserted 2.5 cm into the oviduct for proper insemination.

Part Two: True or False

7. True
8. False
9. True
10. True

Test

Unit B Lesson 4: Artificial Poultry Reproduction

Part One: Short Answer

Instructions: Provide a short statement to answer each of the following questions.

1. What are four advantages of using artificial insemination?

2. What are four disadvantages of using artificial insemination?

3. At what temperature should newly collected semen be stored, and what liquid is it stored in?

4. What is sexed semen?

5. How long with properly frozen and stored semen remain viable?

6. How deeply should the straw of semen be inserted into the oviduct?

Part Two: True or False

Instructions: If the statement is true write a T in the blank, if the statement is false write a F in the blank.

- ___7. To obtain clean semen, the males should have their feed removed 12 hours before the semen is to be collected.
- ___8. Males in their second or subsequent breeding season will produce just as much semen as a young male in its first breeding season.
- ___9. Chicken and turkey semen will lose fertilizing ability when stored longer than one hour if it isn't frozen.
- ___10. Fertility will decrease later in the season.