Artificial insemination and hatching eggs storage

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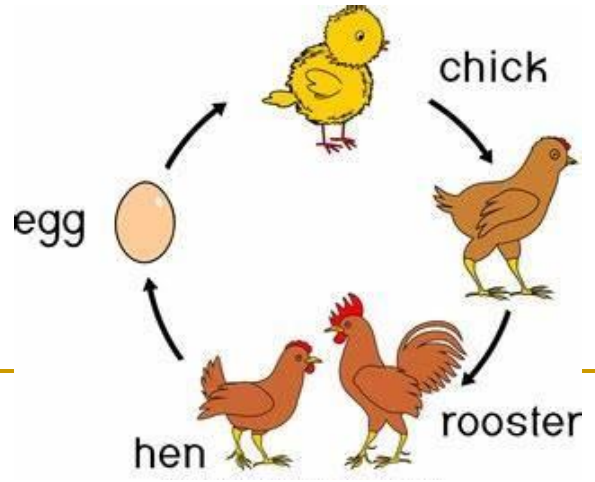
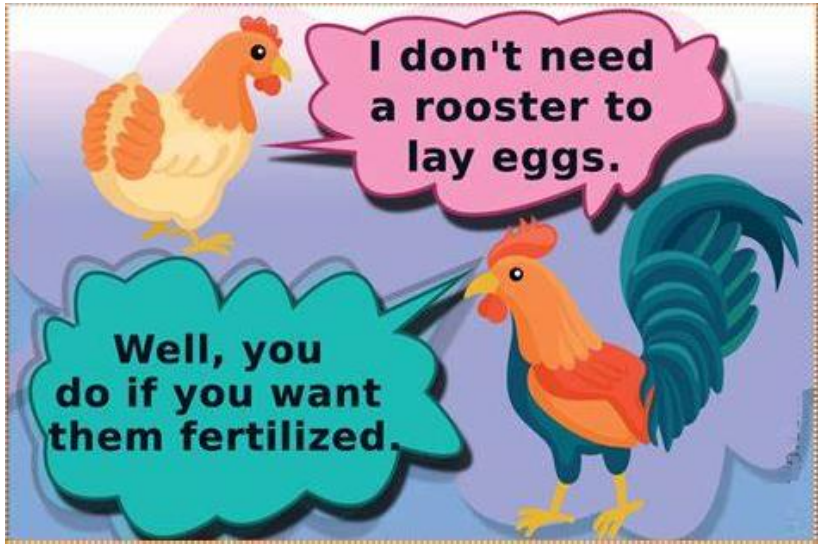
Which came first: the chicken or the egg?

- **There is an old riddle that sparks many arguments through the ages.**
- **It's such a tricky question because you need a chicken to lay an egg, but *chickens come from eggs*, leaving us with an intractable circle.**



Hatching Eggs

- **Also called fertile eggs, which means the egg has been fertilized by a rooster and can develop into a baby chicken.**

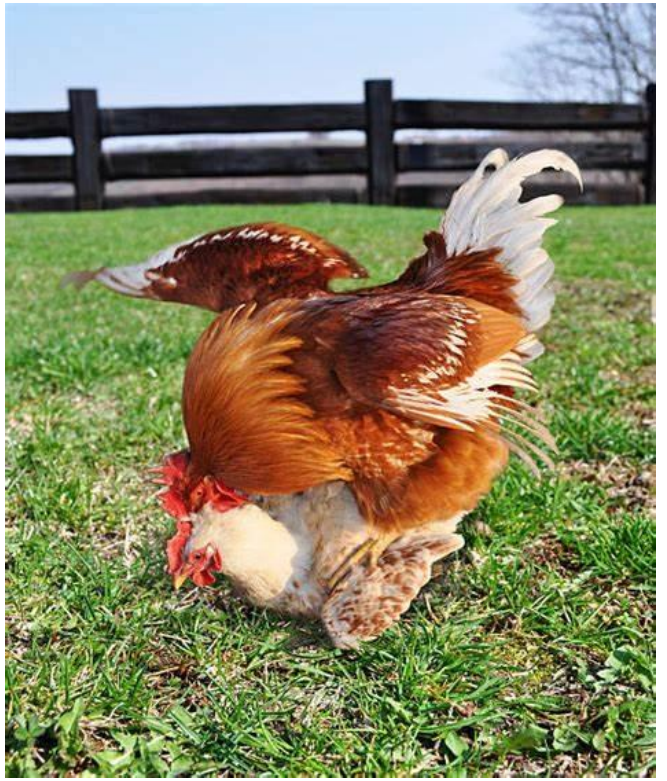


Two ways to get hatching eggs

- Natural mating
- Artificial insemination

Natural mating

In natural, when spring comes, the days get longer and brighter and the temperatures start to rise, hormone levels in the birds increase, and the flock will start to feel the pull of the mating season.



Natural mating

- **The rooster tries to impress a female.**
  - **He will tuk tuk the hens and keep picking up the food and dropping it ready for the hen's inspection.**
  - **The head bobbing behavior is thought to be a ploy to attract attention to his wattles and comb.**

- **If the hen likes what the rooster has found, she will eat.**
- **The rooster will start to get a bit more active and the hen will start to become more receptive to his advances.**
- **If the rooster and the hen are ready, the mating behavior will happen.**

Natural mating method generally used in practices

- Random mating
- Pen mating
- Flock mating
- Stud mating
- Shift mating

Random mating

- **Males and females** are raised together outside or inside.
- They can mate randomly and freely.
- The male percentage is **8% to 10%** or more.
- A rooster may mate **from 10 to 30 or more times per day**, and usually ejaculates **between 100 billion and five billion sperms at a time** according to his mating times.

Pen mating

- A group of hens are allowed to mate with a cock in a pen.
- The male to female ratio is 1:10 or 12 for light breeds and 1:8 or 10 for heavy breeds.
- Usual mating method used for pedigree hatching.

- The fertility is low in this mating due to preferential mating. i.e. a rooster may mate more frequently with certain hens than with others.

Flock mating

- Mass mating system
- Two or more roosters in a pen, mating with several hens.
- This method provides an opportunity for hens to mate with the roosters of their choice.
- The fertility is generally high.
- Sometimes, aggressive males scare away other males to prevent them from mating.
- In this system, eggs cannot be identified for their parentage.
- Much desirable for producing chicks meant for commercial purpose.

Stud mating

- **Roosters are kept separately in a coop or pen.**
- **The hens are picked up from the pen and put into the coop one by one. After mating finished, replace the hen with another one.**
- **Have high fertility, and more offsprings can be obtained.**
- **But involving more work and labor.**

Shift mating

- **Roosters are shifted in breeding pens**
- **By shifting the roosters, a hen can be mated with several roosters.**
- **Even after removing the cock, the fertility of eggs the hen laid can be maintained for 2-3 weeks.**
- **Discarding the eggs for one week after the change of males.**

Natural mating

- **Benefits：**
  - **Good animal welfare**
- **Risks:**
  - **Need many cocks.**
  - **Battles among cocks often happen.**
  - **Sometimes, hens may get injured because of:**
    Over mating
    Inexperienced roosters
    Roosters with long spurs
  - **Not suitable for certain cage rearing systems**

Artificial insemination

- **Artificial insemination (AI) is the manual transfer of semen into the female reproductive tract.**
- **AI is an important tool to improve the reproductive performance of birds, especially:**
  - **Broiler breeders and turkey breeders, where fertility is low under natural mating due to heavy body weight**
- **Nowadays, this technique is extensively practiced in broiler and layer breeders worldwide.**

Advantages of artificial insemination in chicken

- **Efficient use of males: in natural mating, ratio 1:10, with AI this ratio can reach 1:20 or 40**
- **Accurate recording of pedigree is possible**
- **Fertility is 5-10% higher in AI than in natural mating**
- **Avoidance of preferential mating**
- **Allow physical incompatible individuals to mate: use of large male with small female or vice versa**
- **Allow for better use of the cage feeding system in hatchery operations**

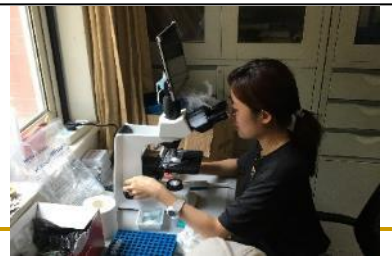
The process of artificial insemination

1. Preparation of males and females

2. Preparation of equipments

3. Collection of semen from males

4. Evaluation of semen



5. Dilution of semen

6. Deposition of semen into females

1. Points for selection of male/female

- Male should be fully sexually matured. (after 22 weeks of age)
- There should be no physical or genital defects.
- Free from any external parasites.
- Male should be superior in flock.
- Not terrified when being restrained or handled.

- Female should be fully sexually matured.
- Be free from defects.
- Must be healthy.
- Must be in production.

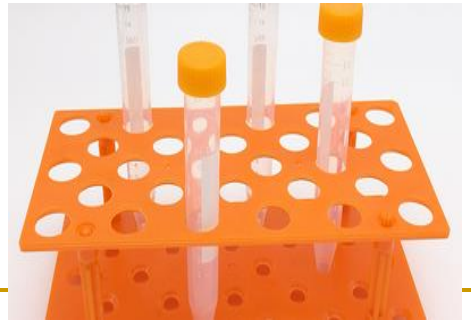
For good semen collection and convenient insemination, keep males apart from, but preferably in sight of females in a house.

2. Preparation of equipments

- **Semen collection funnels/cups/tubes, glass or plastic**

- **Glass tuberculin syringe, or insemination gun**

- **Glass tube stand/rack for holding of funnels or cups**



3. Collection of semen from a male

- **Training the cocks (back massage) to adapt to the semen collection operation**
- **The feathers around the male's vent should be clipped off to obtain the semen easily**
- **Thrice a week for semen collection will give maximum number of sperm cells.**

3. Collection of semen from a male

- For semen collection, a team of two members are generally involved. One for restraining the male and the other for collecting semen.

3. Collection of semen from a male

Chicken restraining

- Grab the cock’s legs with both hands
- The cock’s head extends under the arm
- The cock is held in horizontal position at a height convenient to the other operator.

3. Collection of semen from a male

Back Massage：

- **Place the thumb and index finger of the left hand on either side of the cloaca and massage the back gently from the middle of the cock’s back to the end of his tail.**

3. Collection of semen from a male

- **The massage of cocks back should be applied on the pelvic bones and must toward one direction, to the bird's tail only.**

3. Collection of semen from a male

Semen collecting

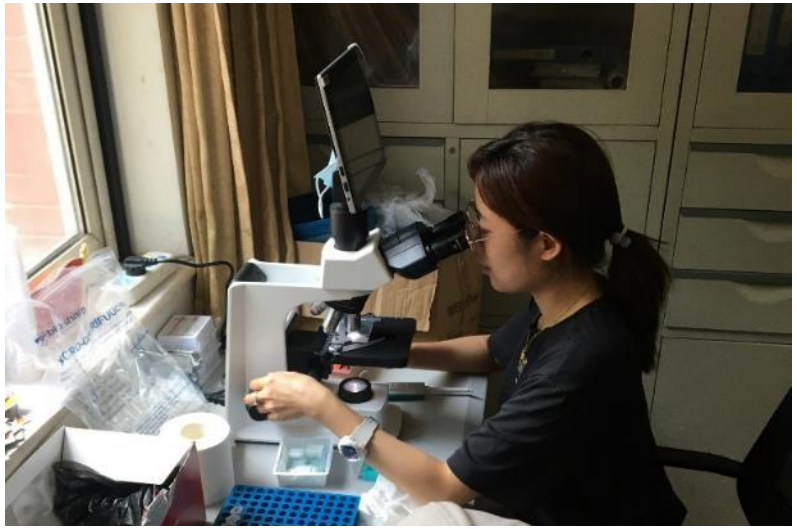
- With a stimulus like this, the cock's penis will turn into an erection and evert or protrude the vent region.
- Stop massage, and use the thumb and index finger of the left hand to squeeze at a point just above the vent
- As semen flows out, use the right hand to collect the semen with an AI funnel by holding it under the vent.

4. Evaluation of semen

With eyes

- The normal semen volume is 0.5-1 mL/ ejaculate
- Normal color of the semen is pearly white or cream colored.
- Semen contaminated with blood, urates, feaces or other urinary tract wastes should be avoided.

With machines



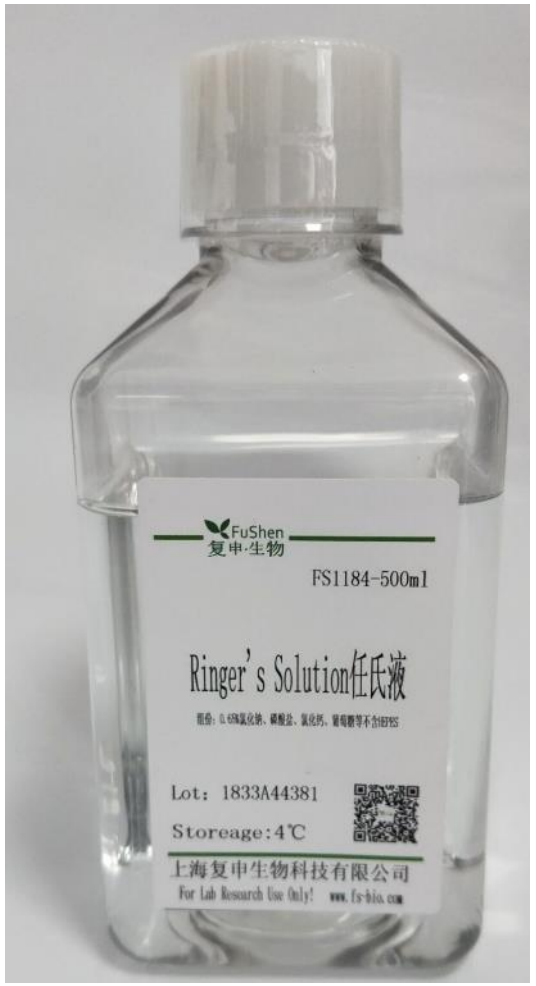
- The sperm concentration, percentage of live, dead and abnormal sperms, pH, etc.

5. Dilution of semen if necessary

- **In general, chicken semen begins to lose fertilizing ability when stored for more than 1 hour. Therefore, it must be deposited in the hen within one hour of collection.**
- **If semen has to be stored beyond 1 hour after collection, dilution is essential.**
- **Diluents increase the volume of semen, retain cell integrity and buffer the detrimental affect arising on storage.**
- **With most types of diluents, chicken sperms survive best when kept cool (5-15℃).**

5. Dilution of semen if necessary

- **Diluents used in chicken semen:**
  - **Ringer's solution**
  - **Simple saline diluent**
  - **Sodiun citrate buffer**
  - **Glucose citrate solution**
  - **Lake's diluent**
  - **……**
- **Diluent be added at a ratio of 1:2 - 4.**



5. Dilution of semen if necessary

- **Long-term preservation of frozen chicken semen:**

- **Because the fertility of frozen semen is still very low**
- **Chicken semen freezing is only used for conservation of selected germplasm, instead of commercial practices**

6. Insemination of semen to female

- **The process of insemination requires two persons.**
- **One operate the hen (eversion of vagina) and the other inseminate (deposition of semen).**

6. Insemination of semen to female

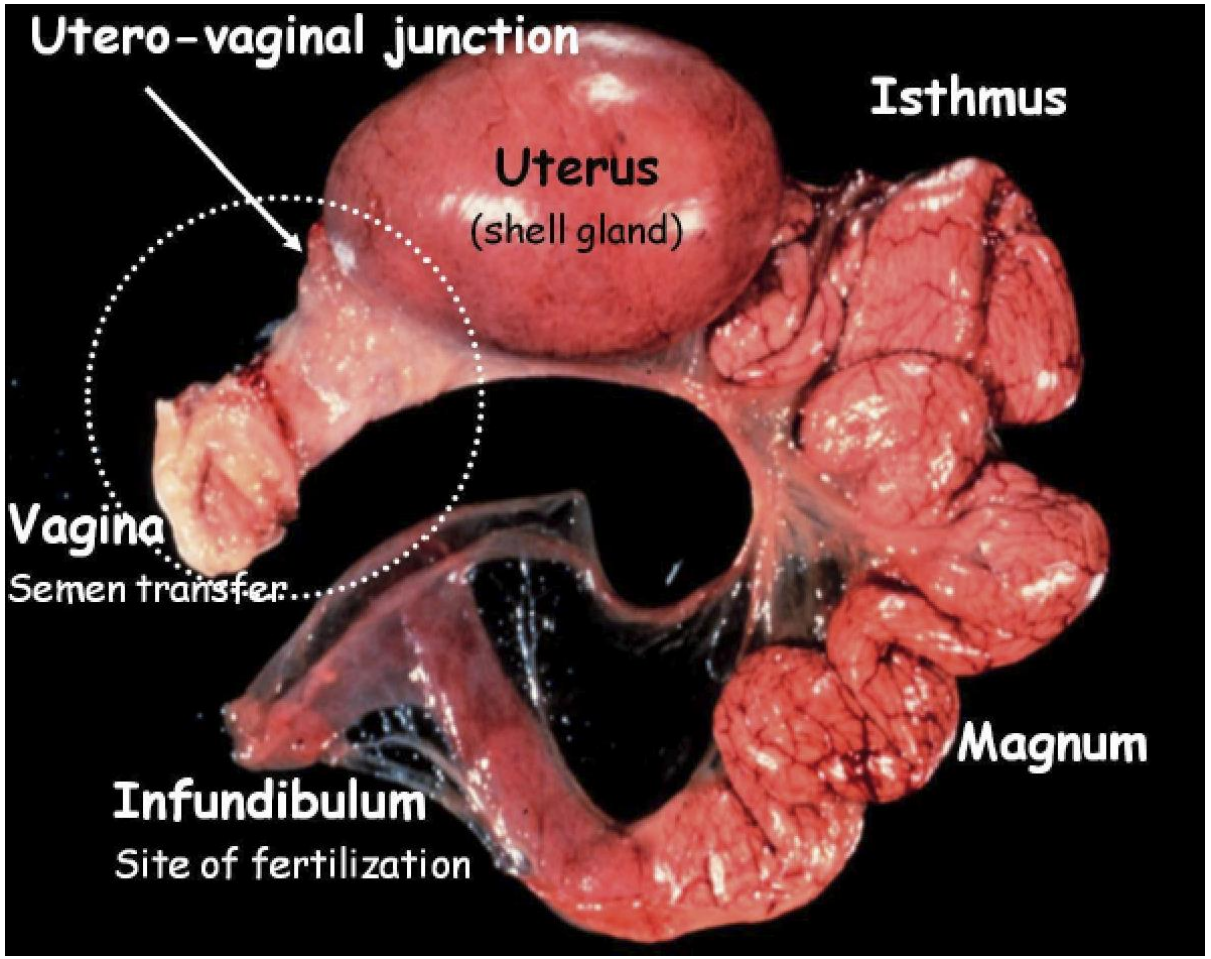
Chicken operating

- Hold the hen firmly with her right hand grasping the hen’s two legs
- With the left hand, press on the abdomen below the cloaca to evert the vagina

Semen depositing

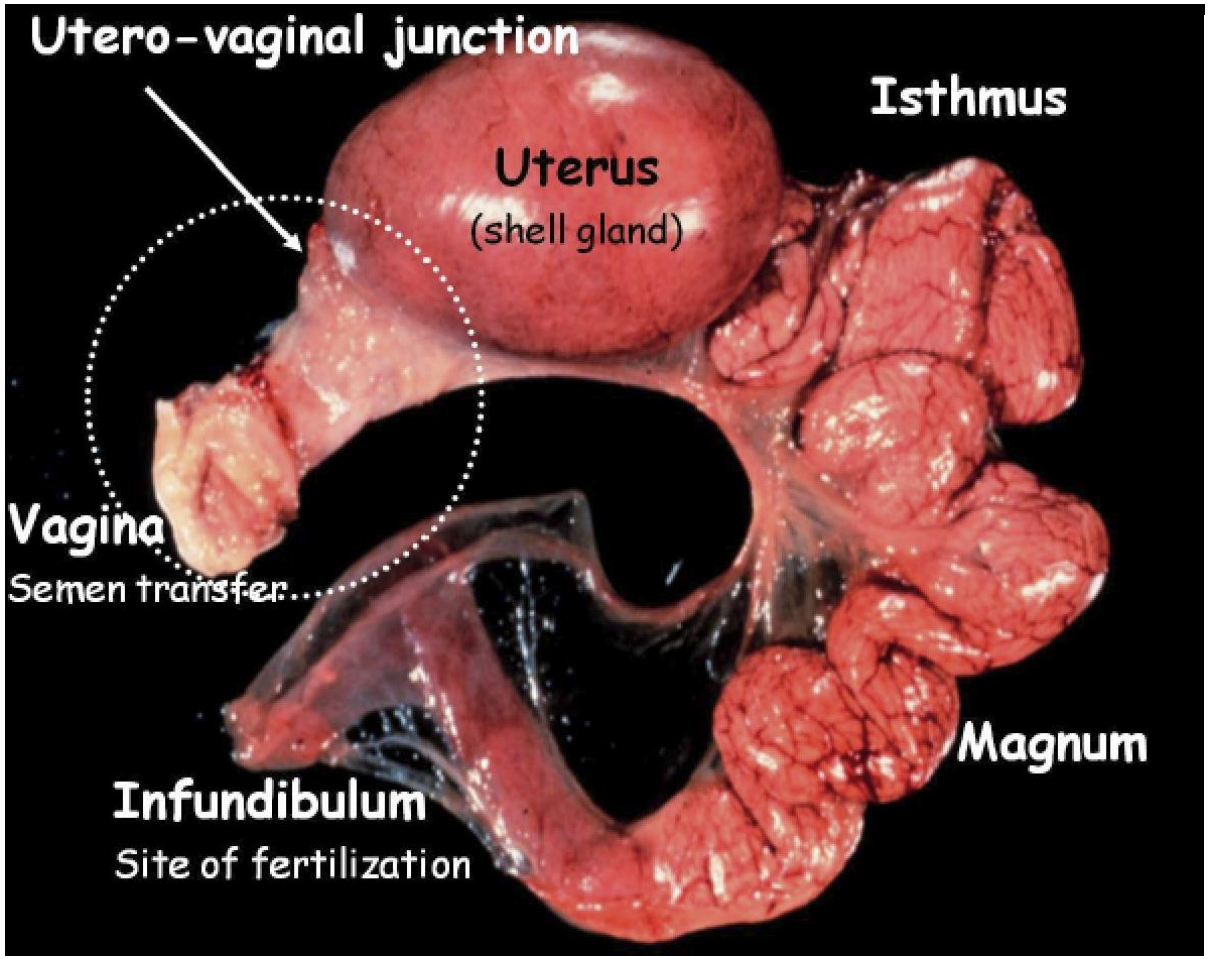
- Gently insert the inseminating gun to a depth of 2.5-3 cm into the oviduct
- Release the semen
- Simultaneously, left person release the pressure on the abdomen, to allow the oviduct to resume its normal position

6. Insemination of semen to female



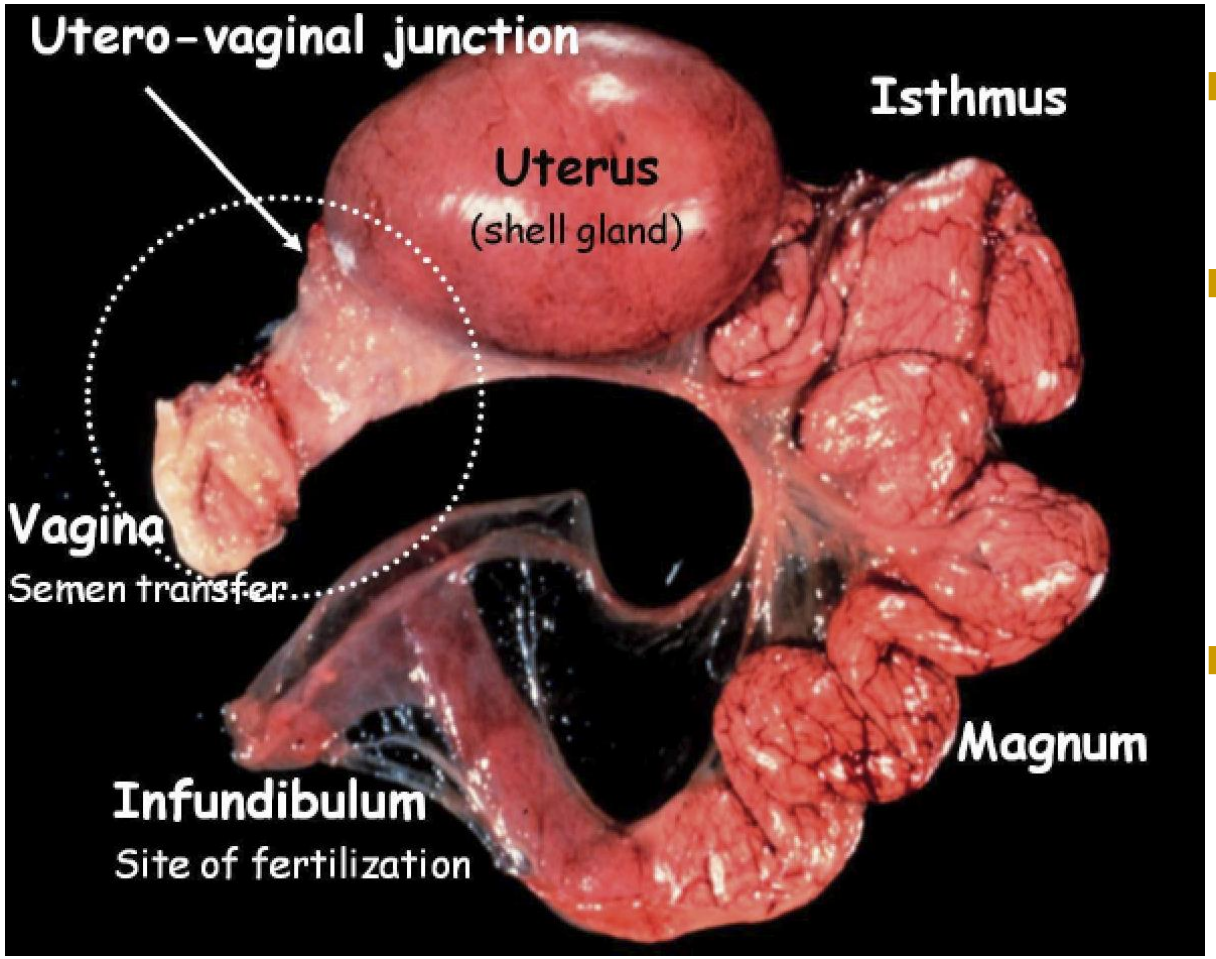
- **The insemination site is the utero-vaginal junction.**
- **Fertilization of egg takes place in infundibulum.**
- **Hence, the sperms have a long way to go and travel up to a distance about 25 inches.**

6. Insemination of semen to female



- **The best time for insemination is the late afternoon (2:00 pm- 4:00 pm) .**
- **Since in the morning hours, hens often have an egg in the oviduct, making it difficult for the sperms to swim up to the fertilization site.**

6. Insemination of semen to female



- **After insemination, not all sperms travel up to the infundibulum.**
- **Optimum number of sperms enter the sperm storage glands at the utero-vaginal junction, and stay alive for about 14 days.**
- **After a single mating or insemination, eggs will be kept fertile for up to 3-4 weeks.**

6. Insemination of semen to female

- **The recommended dose for undiluted, good quality semen is 0.03 mL, but for diluted semen dose varies from 0.03 to 0.05 mL according to the concentration.**
- **If a cock ejaculates 0.5mL semen, we may inseminate 16 hens with dilution. If the semen is diluted with a ratio of 1:2, we may inseminated more than 40 hens.**
- **To obtain optimum fertility, 80-100 millions sperms/mL is recommended.**

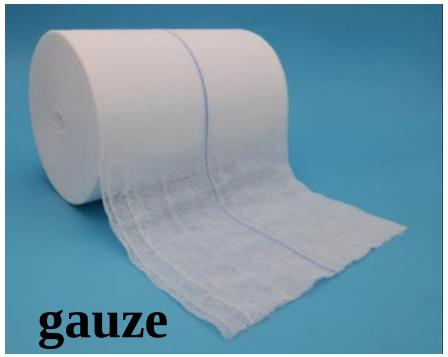
6. Insemination of semen to female

- **Usually, insemination is done when the flock reaches 25% egg production.**
- **Hens are inseminated once a day in the first two days, and then once a week or 4 days per time.**

Clean and sanitize the equipment




- **Cleaning in water with a brush**
- **Sanitizing with disinfectant**
- **Washing twice with distilled water saline solution, or boiled water**
- **Packaging**
- **Sterilizing with an autoclave or steam fumigation for 15 minutes**
- **Dry them**


gauze


Autoclave

Hatching eggs collection and storage

- With natural mating or artificial insemination, fertile eggs can be obtained 48 hours after mating or insemination till to three weeks later.
- Egg-breakout analysis may be carried out to determine egg fertility.

Egg-breakout analysis

Infertile and Fertile eggs

Single cell
2-3mm

Infertile egg with blastodisc
= small white

Fertile egg with blastoderm
= bullseye appearance

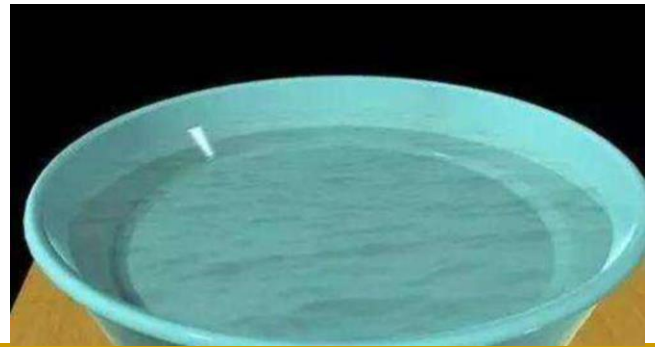
20-60 thousand cells
4-5mm

Eggs collection and storage

- Fertile eggs should be collected frequently, twice a day in winter, and four times a day in summer.
- After collecting, discard contaminated, misshaped or cracked eggs.
- Fumigate the eggs before transferring to egg storage room.

Storage temperature and humidity

- **Fertile eggs should be stored between 12-18℃.**
- **The relative humidity should be 70-80%.**
- **If the temperature is above 22℃, the embryos will begin to develop abnormally, weaken, and die.**
- **To keep the temperature and humidity, place an air conditioner and a pan of water in the storage room.**



Storage temperature and humidity

- **Temperature and humidity should be adjusted according to storage time**

Storage time Days	Temperature °C	Humidity %
1-6	15-18	75
7-10	12-15	80
>11	12	80

The impact of storage time of hatchability

- **Hatchability is optimal with eggs stored between 3-6 days under correct conditions.**
- **Prolonged storage decreases hatchability.**
- **Storage prolongs incubation time.**

Storage time Days	Hatchability loss %	Incubation time
1-6	0	No change
7-10	0.5% per day	Add 1 hour to incubation time (incubate 1 hour early)
>11	1.0-1.5% per day	Add 2-3 hours to incubation time

Reminders for egg storage

- Store less than 10 days
- Maintain temperature between 12-18℃ according to the storage time
- Keep relative humidity at 75%
- Turn eggs stored more than a week
- Handle eggs with care!

Thanks for your attention!
Any Questions?