REPRODUCTIVE CYCLES

1. Estrous cycle 2. Menstrual cycle

In domestic animals, we have limited period of estrus (sexual receptivity) and the term estrous cycle is used. The onset of proestrus defines the start of the cycle. In primates who are sexually receptive during most of the reproductive cycle, we use the term menstrual cycle. The onset of menstruation (vaginal discharge of blood tinged fluids and tissue) is designated as the start of the cycle. The first day of the cycle for estrus and menstrual cycles in many species begins shortly after the end of the luteal phase.

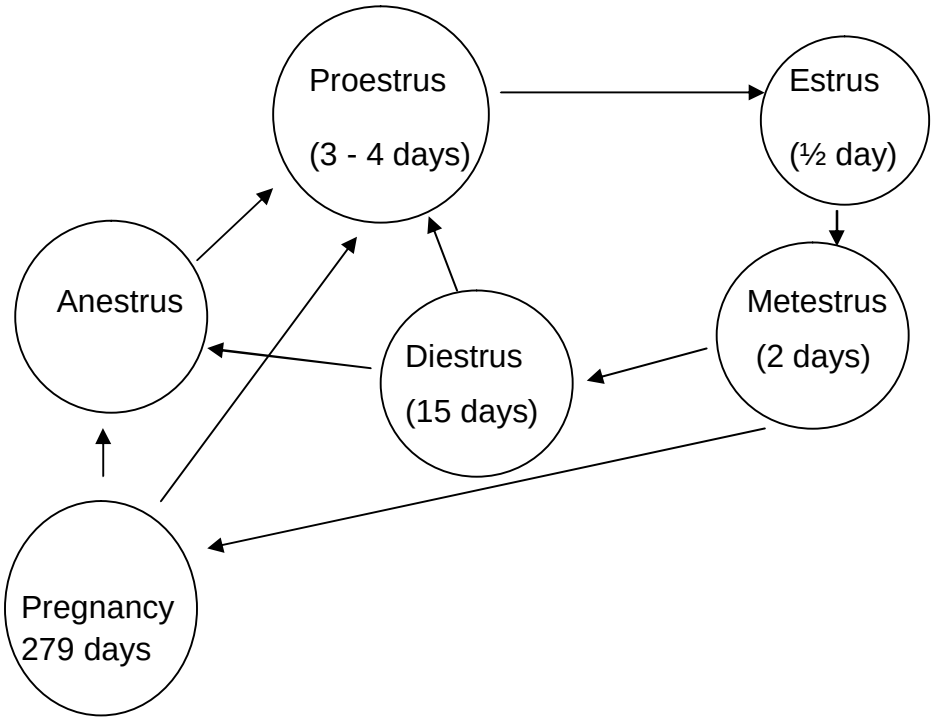
In the dog, a normal anestrus period lasting approximately 3 months separates diestrus and proestrus. In domestic animals, proestrus usually begins 48 hours after the end of the luteal phase. The dog and pig are exceptions, with proestrus in the pig not occurring for 5-6 days. In primates, menstruation usually begins within 24 hours of the end of the luteal phase. The time of ovulation differs even though both cycles begin at the same time in relation to the luteal phase. This is due to the fact that luteal and follicular phases are separated in primates by ovulation occurring at a minimum of 12-13 days after the onset of menses.

In most domestic animals, the follicular phase overlaps the luteal phase and therefore occurs relatively early in the estrous cycle. The estrous cycle has been divided into stages that represent either behavioural or gonadal events.

1. **Proestrus**: This is a period of follicular development occurring subsequent to luteal regression and ending at estrus.
2. **Estrus**: time of sexual receptivity with ovulation usually occuring at the end of estrus
3. **Metestrus** : This is a period of initial development of the corpus luteum

4. **Diestrus**: This is the period of the mature phase of the CL. This term was originally developed for the guinea pig, rats and mouse.

The common terms used for domestic animals involved behavioural or gonadal activities.



Various stages of the ovarian cycle of the cow.

The cycle can be described in a behavioural manner by indicating whether animals are in oestrus or not, including the stage of proestrus, metestrus and diestrus. The cycles can also be described with reference to gonadal activities if differentiation of follicles and CL is possible.

Animals can be in the folliculars phase (proestrus and estrus) or the luteal phase (metestrus and diestrus). Because the equine corpus luteum is relatively difficult to identify by rectal palpation, horses are usually classified by sexual behaviour into estrus or non-estrus (on heat/not on heat). Also, because of the difficulty in determining ovarian status in domestic species like goat, pig and sheep, behavourial classification is used. In the cow, ovarian status can be determined

accurately by rectal palpation and are classified as follicular of luteal. In dogs and cats measurement of serum progresterone levels is used to determine their ovarian status.

N.B: If a corpus luteum can be identified, judgment can be made that ovarian activity is normal in the particular animal because it represents the culmination of follicular growth and ovulation.

Read up – External factors controlling reproductive cycle

Check up – puberty

\- Senescence

AVIAN REPRODUCTION

ANATOMY OF THE FEMALE REPRODUCTIVE SYSTEM

The reproductive organ of the adult hen includes the left ovary and the left oviduct. The right ovary and oviduct formed in embryonic life do not persist in adult life.

A persistent right ovary and oviduct have been reported but they are rare. The ovary of an immature bird is made up of a mass of small ova. This enlarges rapidly during sexual development and attains a diameter of about 40 mm before they are ovulated.

The oviduct is quite long and convoluted and is made up of 5 distinct areas viz,

- the in fundibulum or funnel
- the magnum (largest part of the oviduct)
- the isthmus
- the shell gland (uterus) and
- the vagina which is the part leading from the uterus to the cloaca

Located at the uterovaginal junction are tubular glands in which are stored spermatozoa from the male. The functional lifespan of the spermatozoa is greatly prolonged by the storage.

LAYING HABIT

Laying behaviour of birds is influenced by:

1. the sequence in which the eggs are laid
2. lengths of time or interval between breaks/ interruptions in the sequence
3. by whether or not the birds incubate their eggs after laying

*Find out the interval between the laying of an egg and another in commercial birds.

A sequence represents a number of eggs laid on successive days before there is an interruption or a skip. Wild birds usually lay a number of eggs in sequence and then stop laying and sit on their eggs, these are often named clutches. Most hens lay during the daylight hours and the better laying ones lay in the early hours.

Rate of laying or frequency represents the number of eggs laid over a given period of time and is expressed as a percentage. The rate of egg laying in highly bred flocks of chicken averages about 25 eggs per bird per year and may be higher in laying breeds of ducks.

Hormonal Control of Oviposition

The uterus must contract to expel the egg via the vagina and the cloaca. There is evidence that the hormone from the posterior pituitary called vasotocin may initiate the contraction of the uterus which leads to oviposition (dropping of the egg).

The posterior lobe of the chicken contains arginine, vasotocin and the chicken uterus is very sensitive to this hormone.

Other factors that influence oviposition:-

- Acehylcholine increases uterine contractions and causes oviposition or explusion
- Sodium pentobarbital and foreign bodies in the uterus also cause premature expulsion of the egg from the uterus

FORMATION AND GROWTH OF OVA

As sexual maturity is approached the ova begin to grow at a rapid rate and in the chicken may be fully matured between 9-10 days. The matured ovulated ovum weights 16-18 grams.

FSH of the anterior pituitary is responsible for the growth and maturation of the ovarian follicle. The size of the egg yoke is influenced in part by the laying sequence because the first egg of the sequence has a larger yolk than the succeeding one.The yellow pigment **xanthophyll** is responsible for the colour of the yolk.

OVULATION

The release of the ovum from the ovarian follicle (ovulation) is caused by the rupture of the follicular membrane at the **stigma** (a relatively avascular area of the follicle). Ovulation occurs in the chickens usually within 15 to 45 minutes after oviposition.

Daylight or artificial light affects ovulation and laying rates by stimulating the pituitary to release ovulatory hormones. Maximum stimulation is produced in chickens by continuous lighting for 12 to 14 hours.

Light is not the only factor which may affect the release of ovulating hormones.

ANATOMY

The reproductive organs of the male includes the testes, penis, vasa differentia and the epididymis. The paired testes are located in the abdominal cavity and just cephalic to the kidneys and below the kidneys. Birds have no seminal vesicles and bulbourethral glands as in mammals.

The testes are without septa and lobules but consist of seminiferous tubules, rete tubules and vasa efferentia. The penis of roosters is quite small and when erected is engorged with lymph from the

lymph nodes. This lymph fluid is added to the semen in the vas deferens and both are ejected simultaneously along the longitudinal groove of the phallus.

Reproductive organs of the turkey are similar to the chicken. Duck and goose have well developed phallus which are spiral and which act as intromitant organs. The sperm passes from the seminiferous tubules via the rete tubules by way of the vasa efferntia and finally via the vasa differentia. Sperm are not usually stored in the epididymis or other accessory organs in the chicken.

The stages of spermatogenesis vary according to the age and growth rate of the bird, but in the chicken, the first stage appears at about 5 weeks of age.

At this stage, there are numerous spermatogonal cells which have undergone organization and multiplication. At about the 6^{th} week and the next week or two thereafter, the primary spermatocytes begin to appear.

By 10 weeks of age, the secondary spermatocytes begin to appear and immature spermatozoa (spermatids) first appear at about 14 weeks of age in the seminiferous tubules. They are present in all tubules at the 20th week.

Testis weight may approach 30 to 40 grams in old males. There is a great deal of variation in size and shape of spermatozoa of different birds. The spermatozoon of the chicken has a long head piece with a pointed acrosome and a short mid-piece to which is attached a long tail.

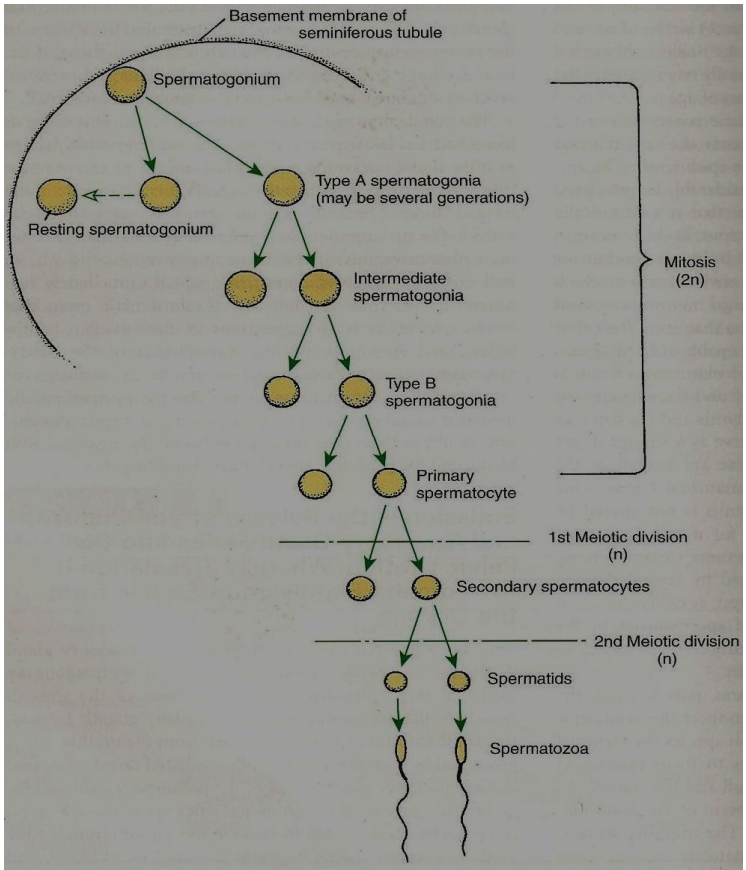
* Note: Search for the different variations in the size an shape of spermatozoa of different birds – Guinea fowl, pigeon, ostrich, penguin

Growth and development of the testis and spermatogenesis are stimulated by FSH of the anterior pituitary. The interstitial cell of the mature testis secretes androgens (testosterone) which is the

male hormone. Chicken semen is usually white and opaque but it may be clear and watery depending on the concentration of the sperm.

The number of spermatozoa in a given ejaculate ranges from about 1.7 to 3.5 billion. Mating frequency of a normal male may range from 25 to 41 times per day or higher.

Among the many factors affecting fertility in chicken is nutrition, state of health, light, season and age of the males and females.



A) Reproductive hormones
a. **Follicle-stimulating hormone** regulates gamete formation.
b. **Luteinizing hormone** plays a key role in controlling breeding because it regulates the secretion of reproductive hormones in the testes and the development of mature ova in the ovaries.
c. **Testosterone** and **estrogen** are produced by the gonads of both males and females, but the relative concentrations of these two hormones differ between the sexes and determine their effects. In many birds, increased testosterone levels in the blood cause the development of secondary sexual characteristics, such as breeding plumage, bright bill and foot colors, growth of skin ornaments, etc.
B) Male reproductive system
a. Male birds have paired testes, which become greatly enlarged during the breeding season.
b. Sperm are produced at night, when body temperatures are slightly lower, and then stored in seminal vesicles which cause a distinct **cloacal protuberance** in breeding males.
C) Female reproductive system
a. Most female birds have only one ovary.

b. In birds, females are the **heterogametic** sex. This means that their sex chromosomes differ as do those of male (but not female) mammals. In birds, females are said to have ZW sex chromosomes, while males are **homogametic** (ZZ).
c. Female birds can store sperm for later use in special tubules in their reproductive tracts.
D) Benefits of oviparity
a. Can produce a larger number of large offspring.
b. Viviparity may be impossible due to the high body temperature of birds.