

*Physiology of  
Reproductive System  
(females)  
Part Two*

*By*

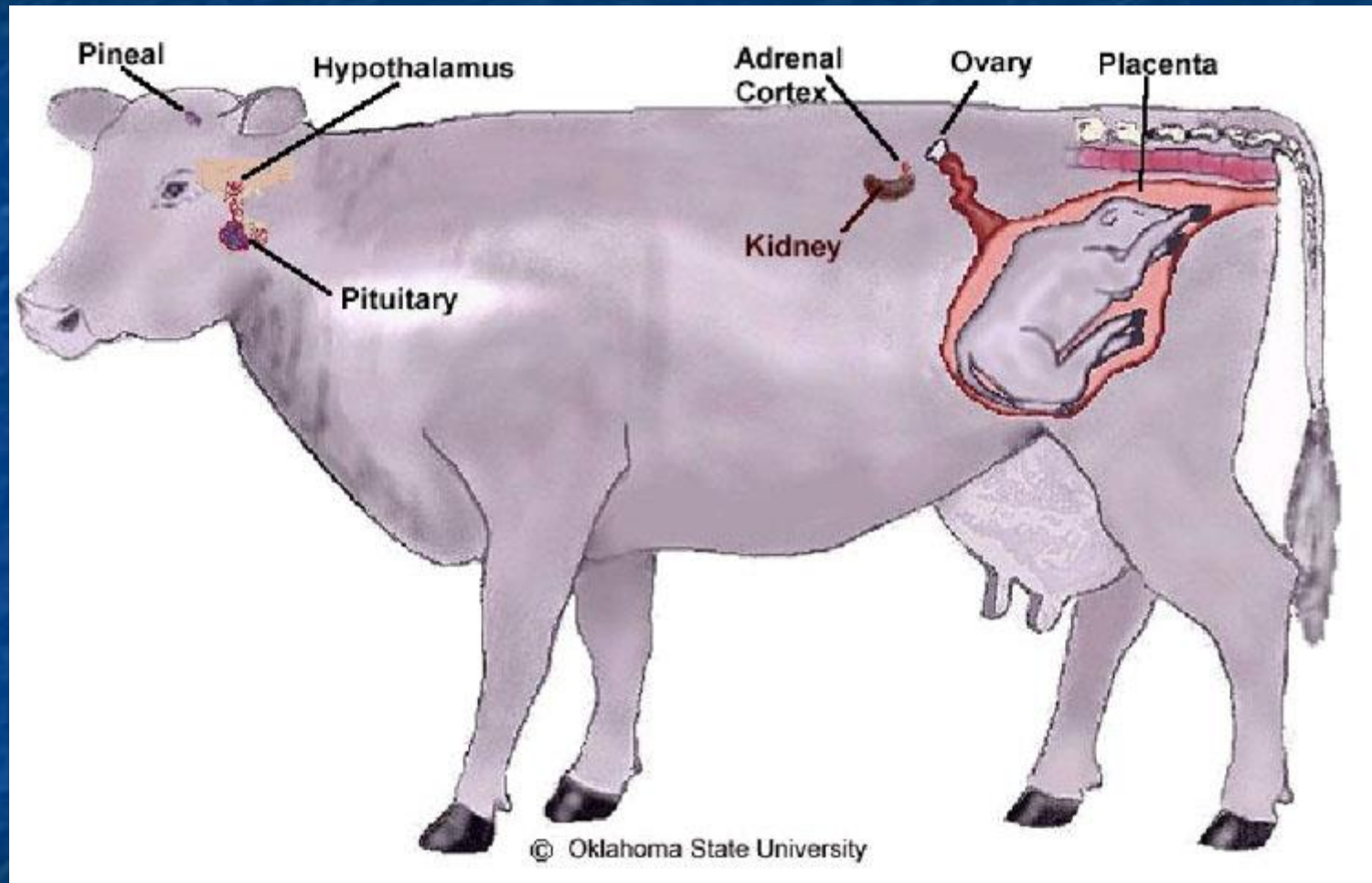
*Dr. A. K. Goudarzi, D.V.M. Ph.D*

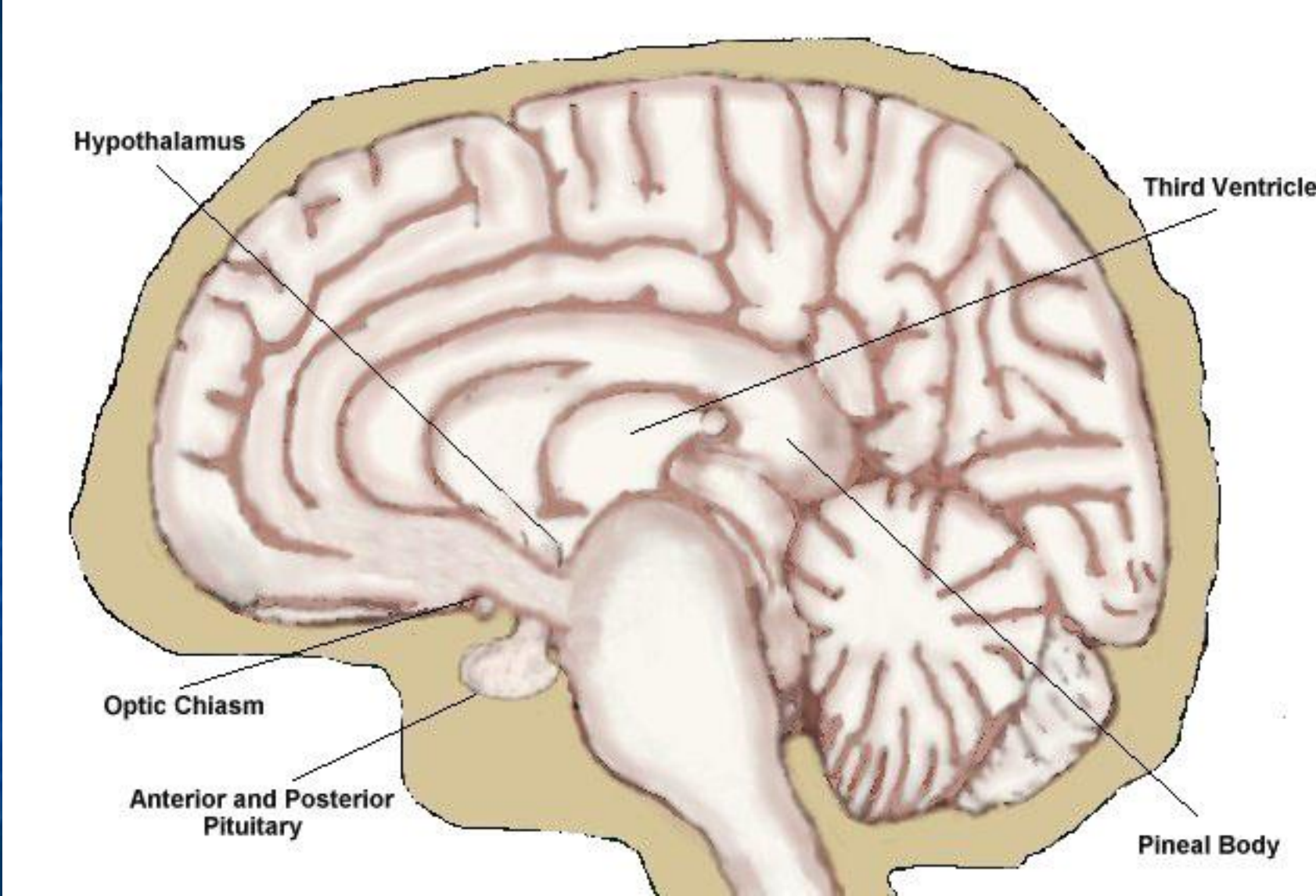
# Puberty

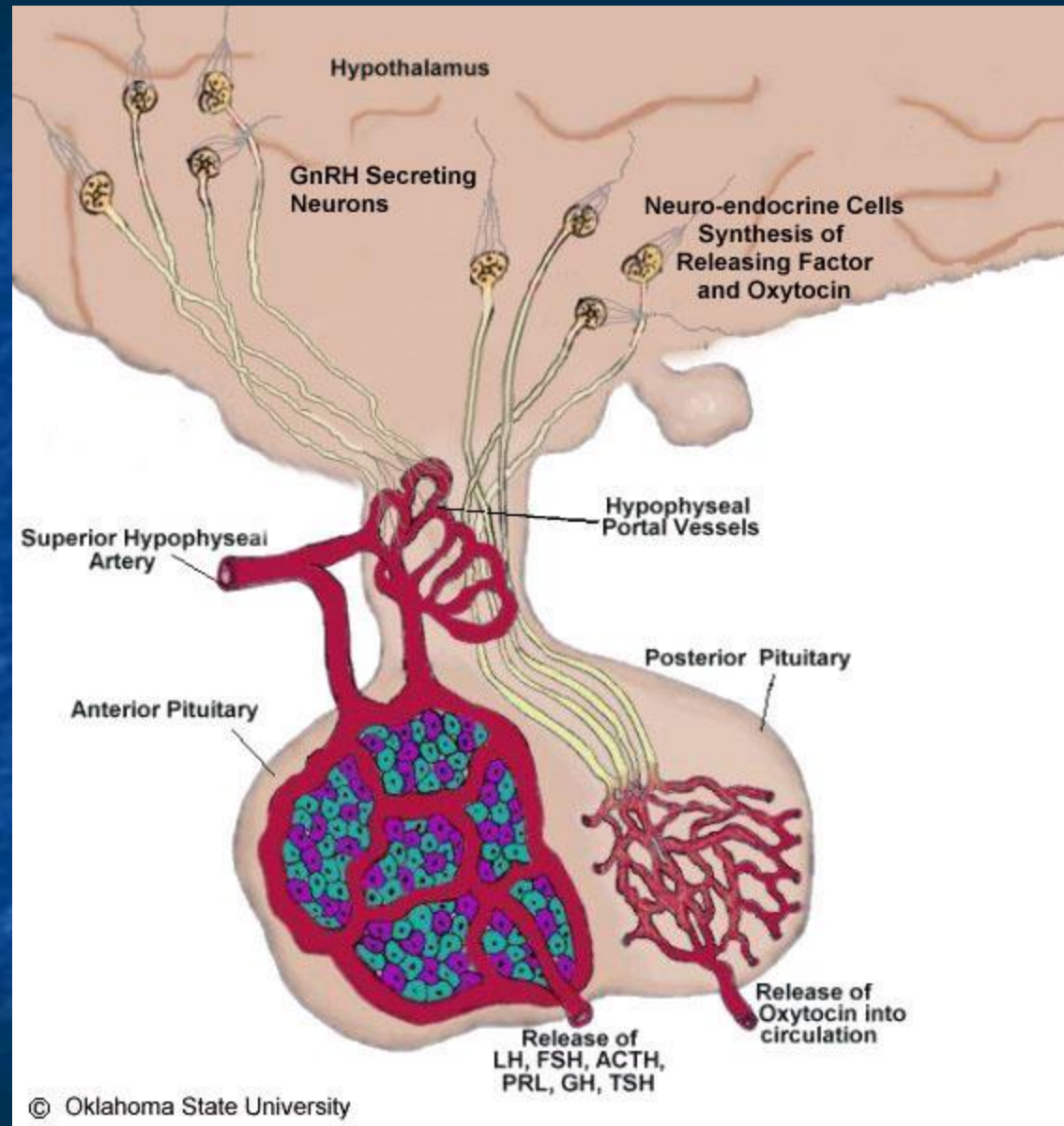
- For all species, there is a critical requirement for the attainment of a certain size in order for puberty to be initiated
- Cattle about 275 kg, in sheep about 40 kg

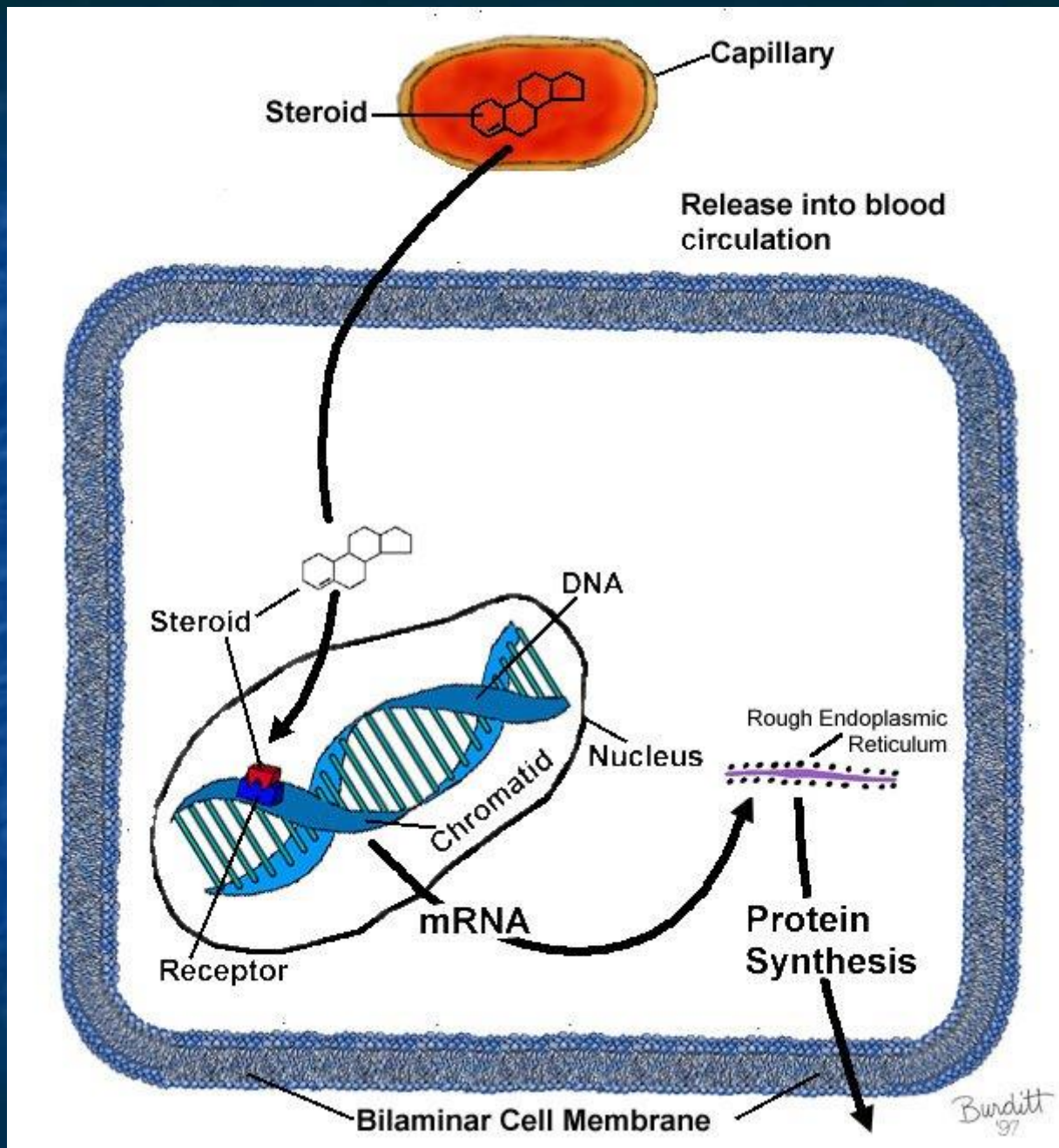
# The most important hormones influencing ovarian activity

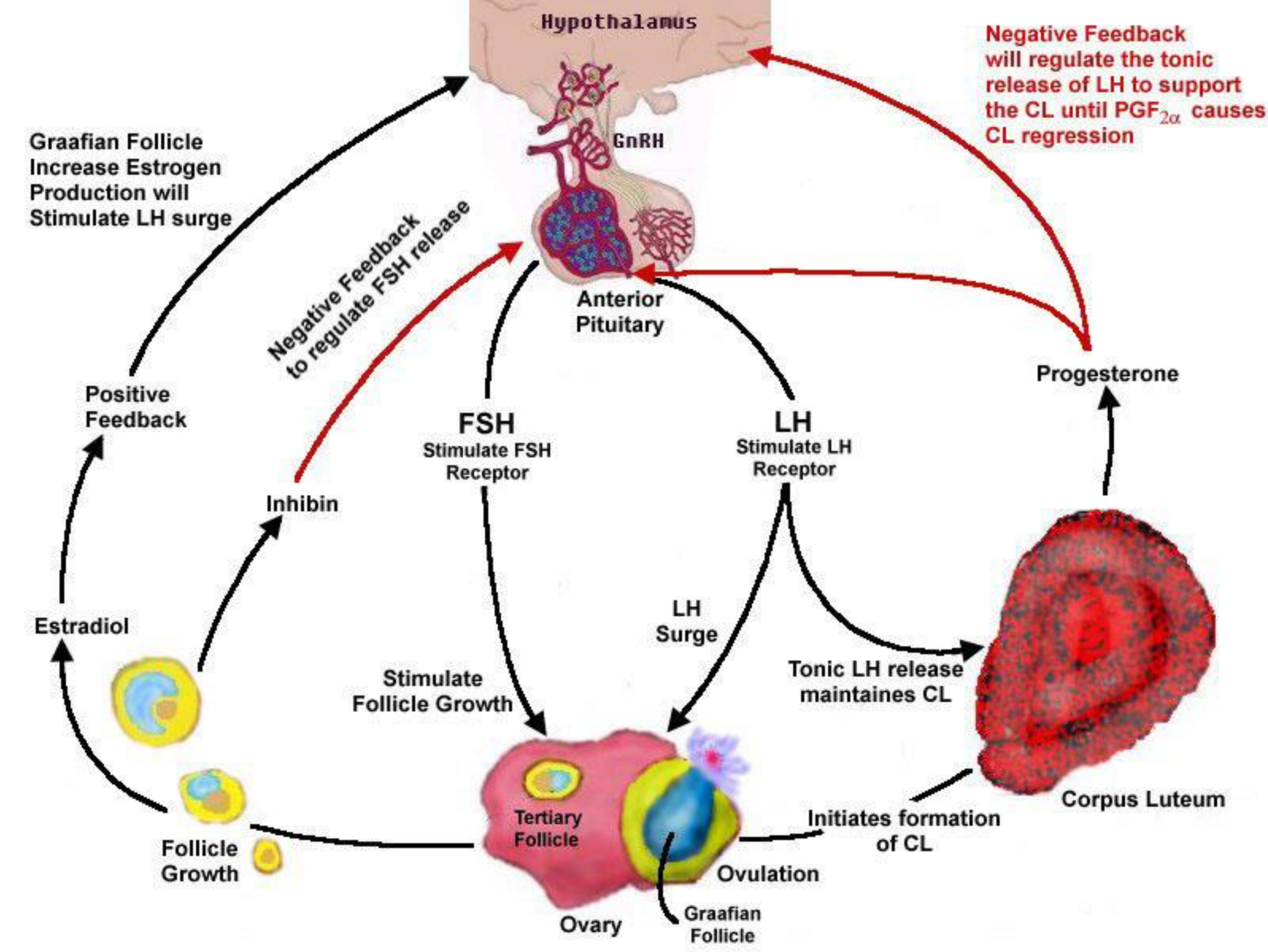
Hormone	Biochemical classification	Source	Action in female	Effect on ovary
GnRH	Decapeptide	Hypothalamus	Release FSH and LH	Follicular development; ovulation
LH	Glycoprotein	Pituitary	Stimulates ovulation and P4 secretion	Formation of CL
FSH	Glycoprotein	Pituitary	Follicular development, E2 synthesis	Development of follicles
Progesterone	Steroid	CL, placenta	Maintenance of pregnancy	Inhibits GnRH release
Estradiol	Steroid	Follicle, placenta	Sexual behavior	-
hCG	Glycoprotein	Chorion	ovarian P4 synthesis	-
eCG	Glycoprotein	Chorion	Formation of accessory CL's	-
PGF <sub>2a</sub>	Prostaglandin	Endometrium	Destruction of CL	Luteolysis
Inhibin	Glycoprotein	Granulosal cells	Inhibits FSH secretion	Inhibits follicle development













**TABLE 15-1 FACTORS RELATED TO FEMALE REPRODUCTION**

ANIMAL	ONSET OF PUBERTY (MO)	AGE FIRST SERVICE (AVERAGE)	LENGTH OF ESTROUS CYCLE (D)	LENGTH OF ESTROUS	GESTATION PERIOD (D)
Mare	18 (10-24)	2-3 yr	21 (19-21)	5 d (4.5-7.5 d)	336 (323-341)
Cow	4-24	14-22 mo	21 (18-24)	18 h (12-28 h)	282 (274-291)
Ewe	4-12 (first fall)	12-18 mo	16-1/2 (14-20)	24-48 h	150 (140-160)
Sow	3-7	8-10 mo	21 (18-24)	2 d (1-5 d)	114 (110-116)
Bitch	6-24	12-18 mo	6-12 mo	9 d (5-19 d)	63 (60-65)
	TIME OF OVULATION	OPTIMUM TIME FOR SERVICE	ADVISABLE TIME TO BREED AFTER PARTURITION		
Mare	1-2 d before end of estrous	3-4 d before end of estrous; or 2nd or 3rd d of estrous	About 25-35 d or second estrous; about 9 d or first estrous only if normal in every way		
Cow	10-15 h after end of estrous	Just before middle of estrous to end of estrous	60-90 d		
Ewe	12-24 h before end of estrous	18-24 h after onset of estrous	Usually the next fall		
Sow	30-36 h after onset of estrous	12-30 h after onset of estrous	First estrous 3-9 d after weaning pigs		
Bitch	1-2 d after onset of true estrous	2-3 d after onset of estrous; or 10-14 d after onset of proestrous bleeding	Usually first estrous or 2-3 mo after weaning pups		

From Frandson RD, Spurgeon TL. *Anatomy and Physiology of Farm Animals*. 5th Ed. Philadelphia: Lea & Febiger, 1992.

# Ovarian cycle

1. Follicular phase
2. Ovulation
3. Luteal phase
4. luteolysis

# Phases of Folliculogenesis

**Folliculogenesis** involves 2 phases:-

▶ An initial **hormone-independent** phase

--occurs in the neonatal and prepuberal ovary.

--the oocyte increases in size and activity and follicular cells undergo mitosis and become granulosa cells

--primordial and primary follicles form

▶ **Hormone-dependent** phase-->

--begins at puberty

-- granulosa cells acquire FSH and oestrogen receptors

--theca cells acquire LH receptors

--mitogenic effects of oestrogen → proliferation.

# Ovulation

## ▶ Mechanisms →

--hormonal surge leads to increase in enzyme activity; collagenase

--increased intrafollicular pressure.

--neural

▶ **Ovulation** → rupture of ovarian wall and follicle → releases gamete.

▶ **Gamete** transported and fertilised in uterine tube.

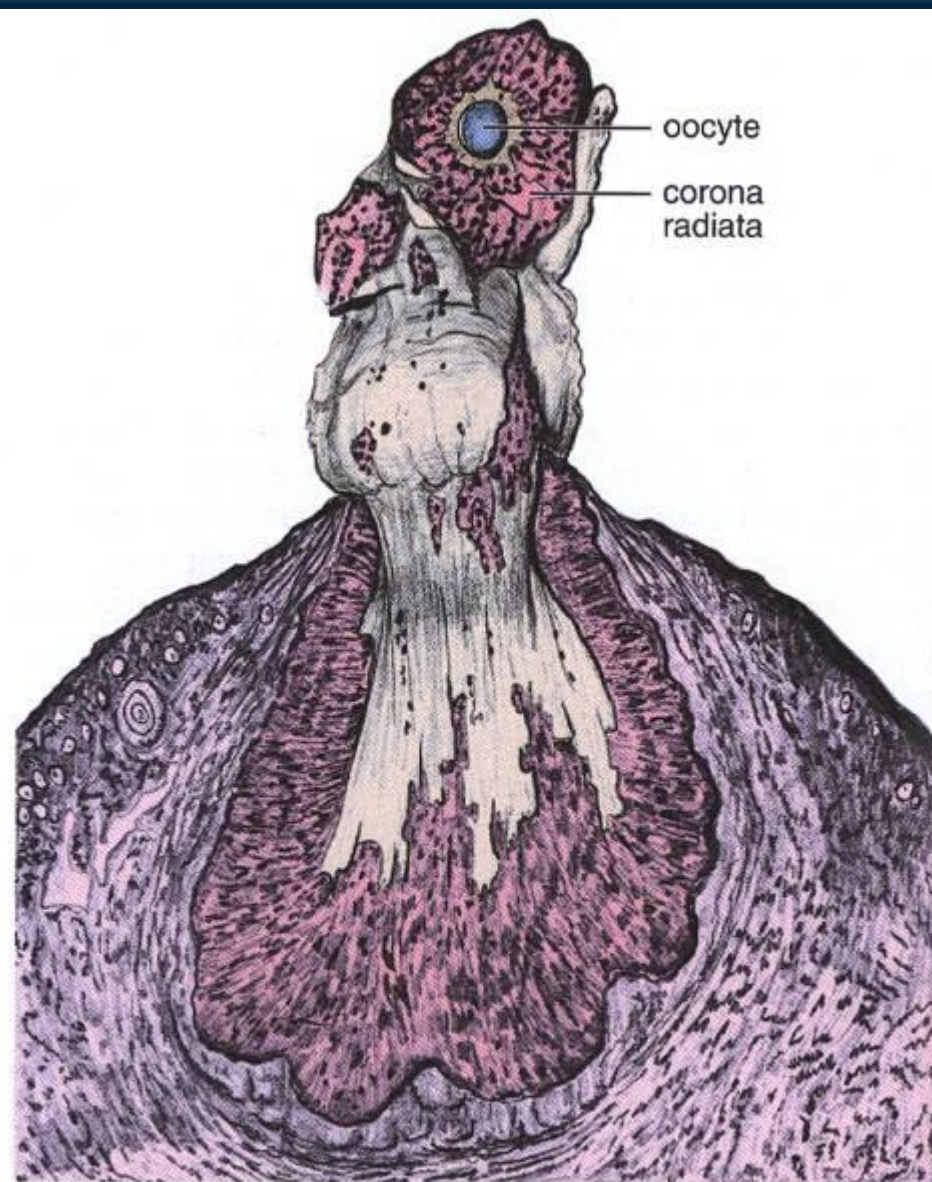
▶ Meiosis complete and polar bodies formed at ovulation

▶ Granulosa cells and theca interna become luteinised → form **corpus luteum** (CL), a transitory endocrine organ.

▶ **Luteal phase** → progesterone secretion.

▶ Formation, maintenance and regression of CL under **hormonal control**.

▶ Life span of CL dependent on luteotropic LH and luteolytic PG2a.



**Ovulation.** This drawing shows a rabbit oocyte, surrounded by the cumulus oophorus, being expelled from the ruptured ovarian follicle. (Based on Weiss L, Greep RO. *Histology*. 4th ed. New York: McGraw-Hill, 1977.) Fig.18

# Ovulation



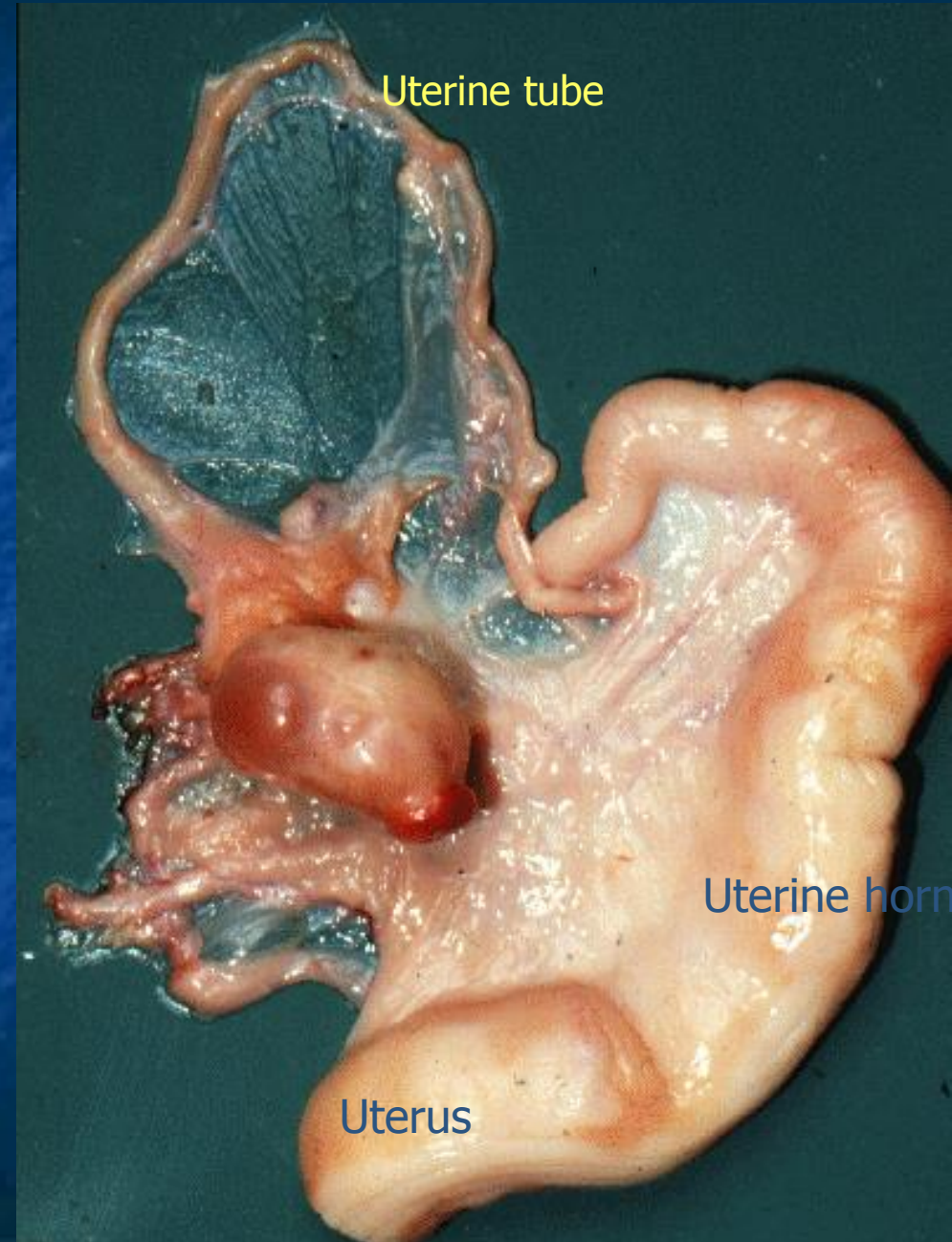
← EGG

- ▶ CL formed by **Luteinization** of stratum granulosa and theca interna cells
- ▶ The cells proliferate, hypertrophy and become luteinised by deposition of yellow **carotenoid** pigment
- ▶ Lutein-->transforming into luteal cells.
- ▶ **Maintenance of corpus luteum**

#### **Luteotrophic** substances

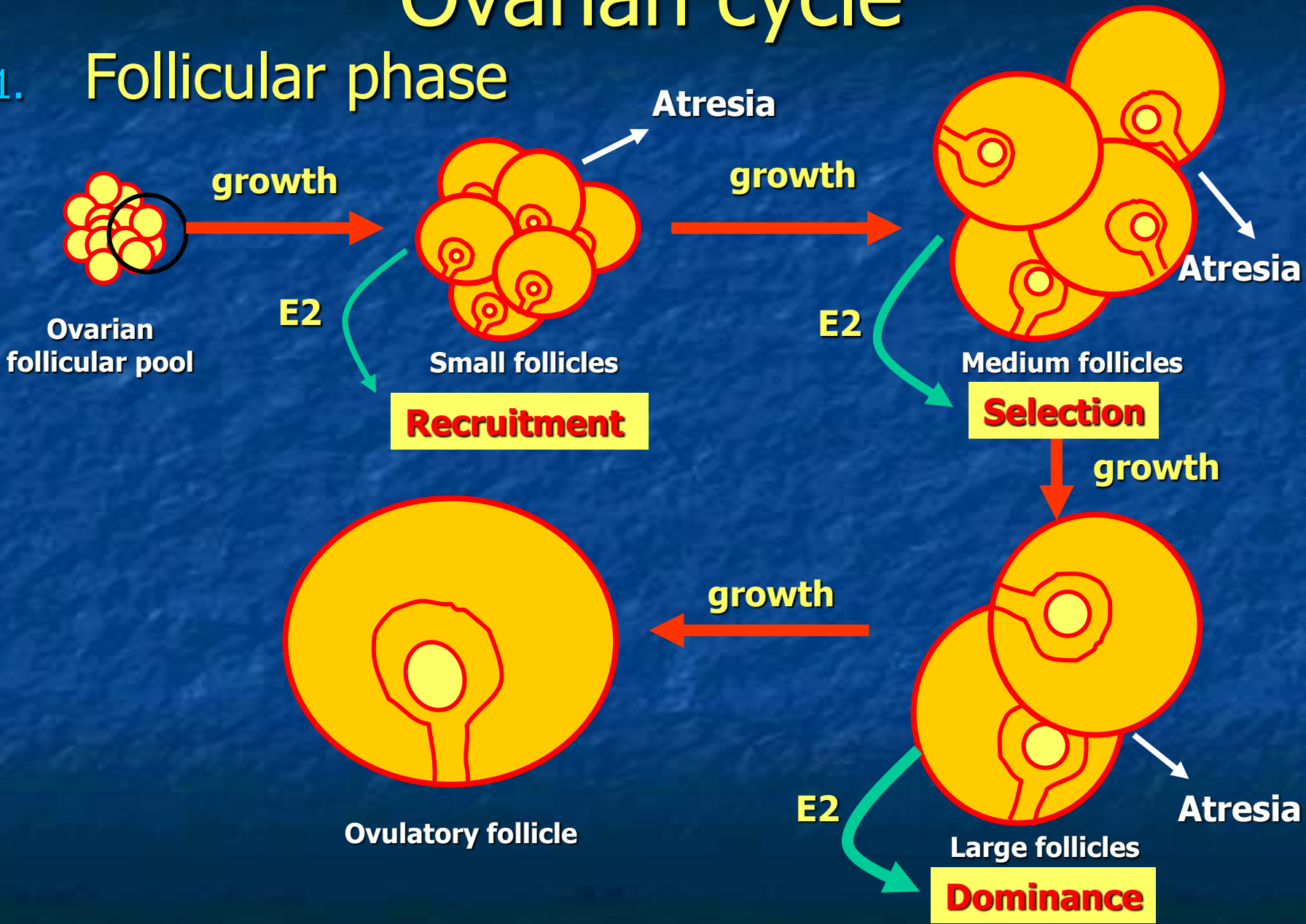
- ▶ In pregnancy the functional CL is maintained by **LH** from the pituitary and placenta chronic gonadotrophin.
- ▶ LH is luteotrophic in most species. The preovulatory LH surge induces formation and maintenance of the CL.
- ▶ Species differences in life of CL and production of **progesterone**.
- ▶ Luteolytic  $PG2\alpha$  from uterus regresses CL
- ▶ Embryo of **ewe** produces LH and an **antiluteolytic** factor (PGE<sub>2</sub>) that overcomes the luteolytic effect of the uterus.

## **Formation of the corpus luteum**



# Ovarian cycle

## 1. Follicular phase



# Ovarian cycle

## 2. Ovulation :

- LH surge → progesterone ↑
- PG synthesis ↑ , Histamine ↑
- Follicular rupture in stigma
- *Reflex ovulation* in rabbit , queen , camel
- *Spontaneous ovulation* in rat , cow , mare , bitch , . . .

## 3. Luteal phase :

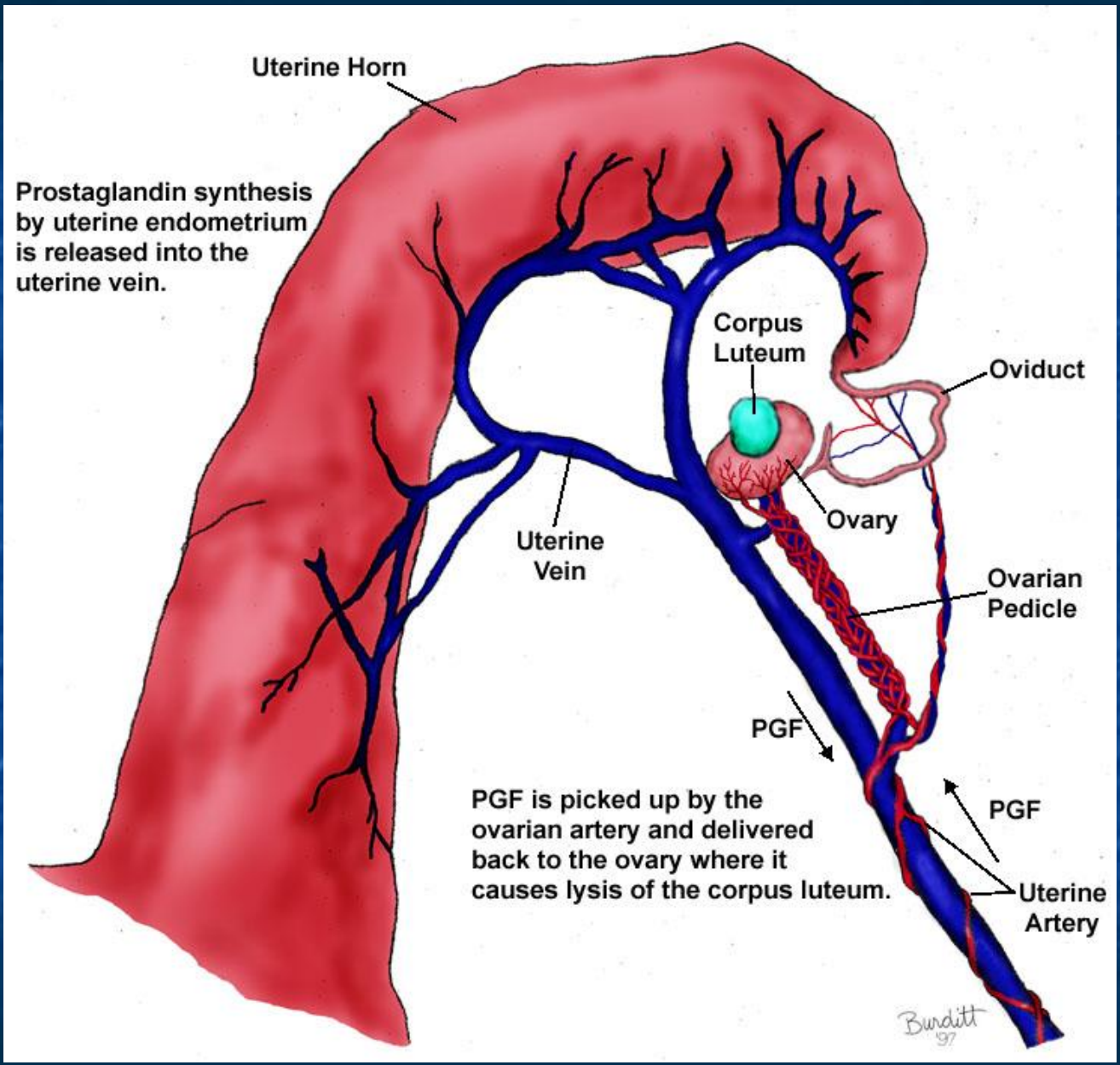
- Corpus luteum formation
- Progesterone production

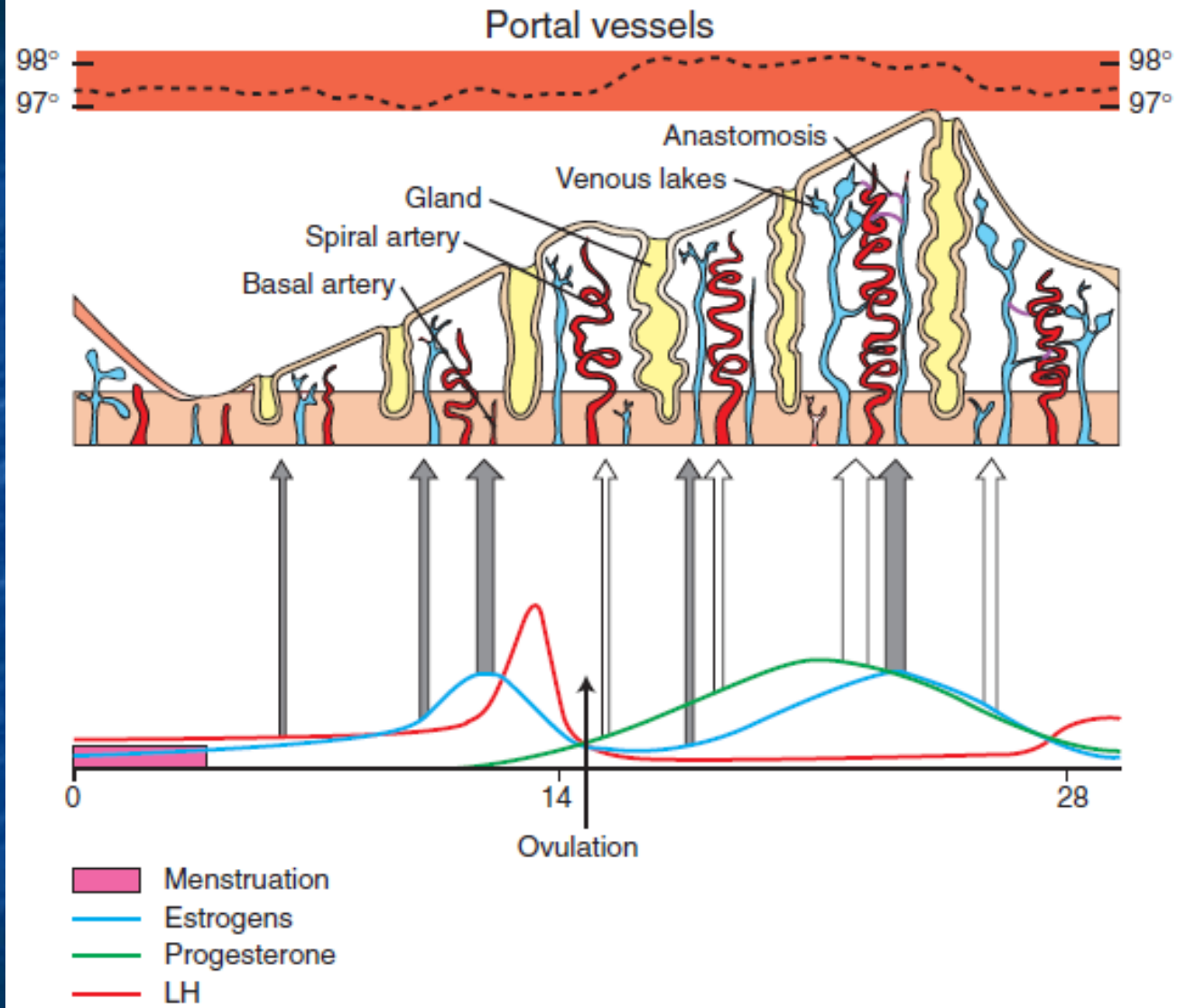


# Ovarian cycle

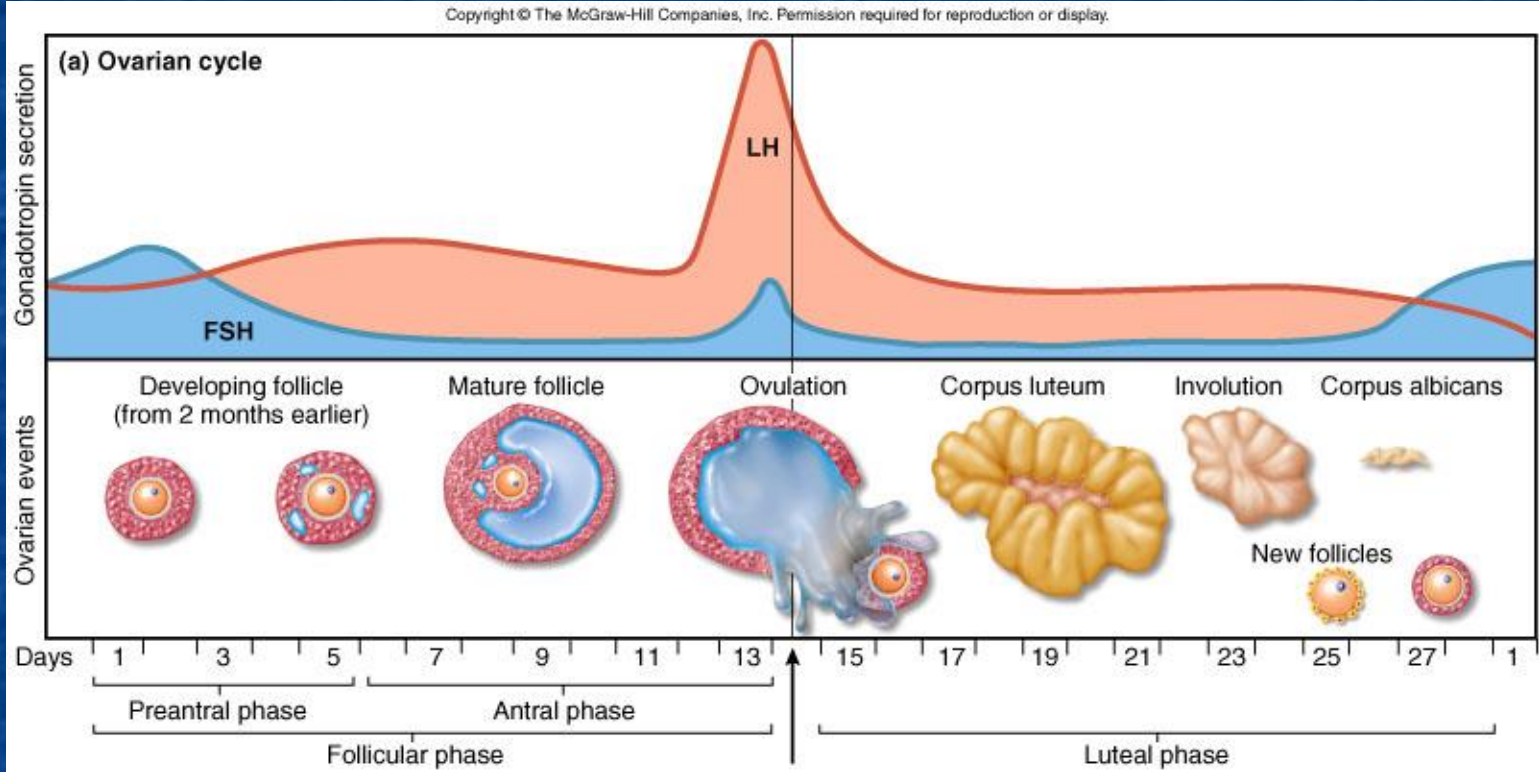
## 4. Luteolysis :

- Secretion of  $PG_{F2\alpha}$  from uterus
- No general circulation of  $PG_{F2\alpha}$  → ( from ut. vein to ov. artery )
- Keeping the PG from metabolizing in lungs
- Prog. in foll. phase → Ot. receptors in uterus ↓
- After 10 – 12 days : inhibition removes
- Positive feedback between Ot. &  $PG_{F2\alpha}$

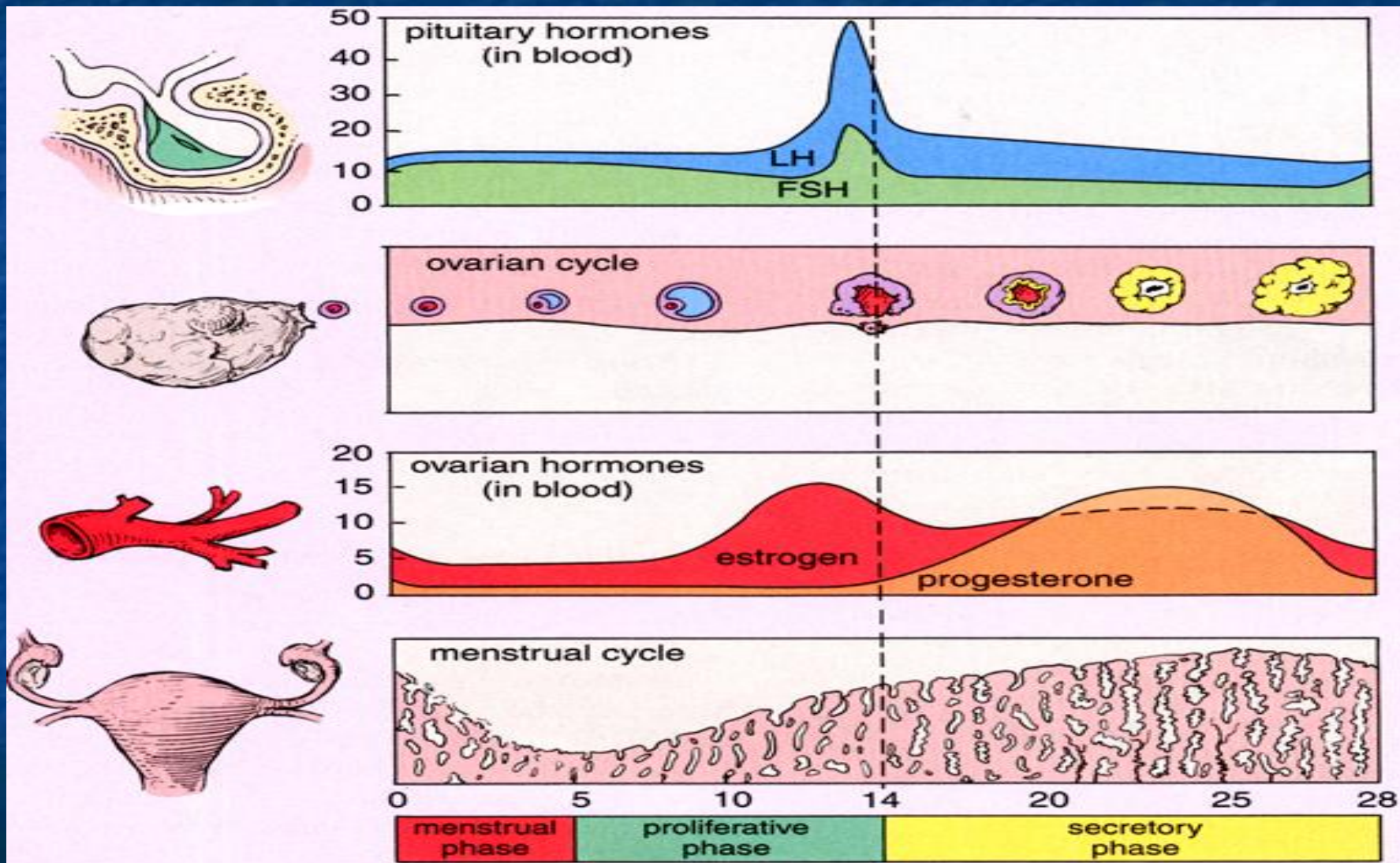




# Ovarian cycle (human)

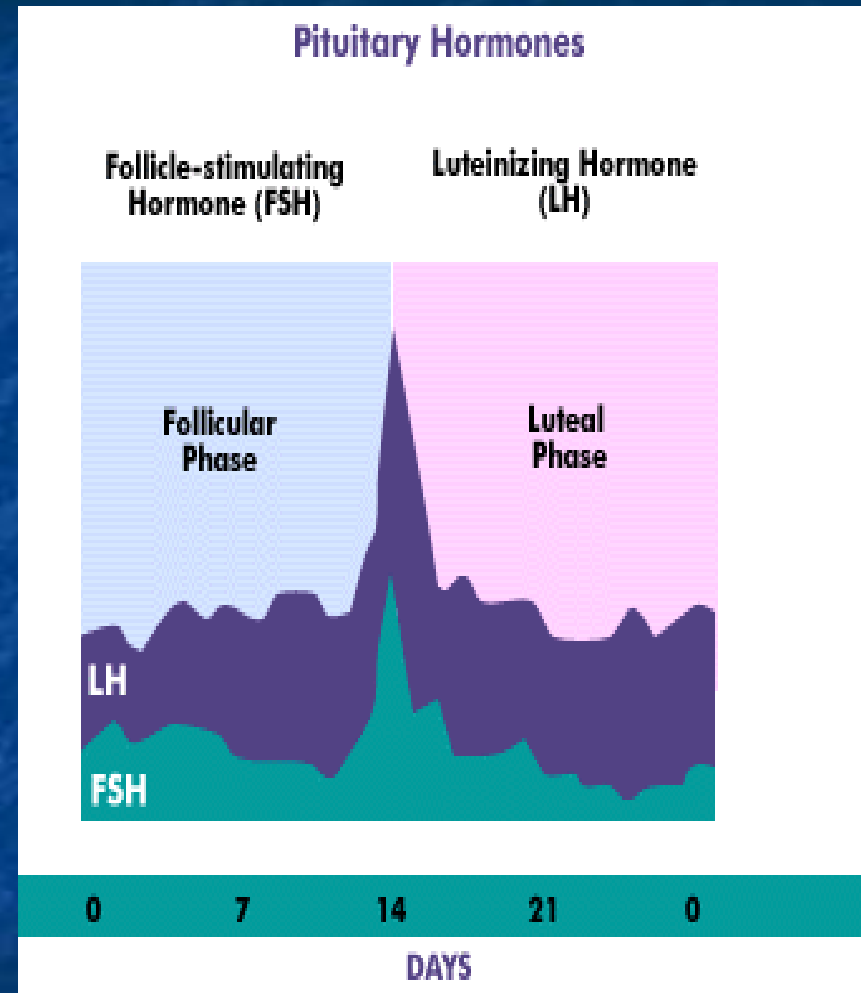


# Ovarian cycle (human)



# Ovarian cycle (human)

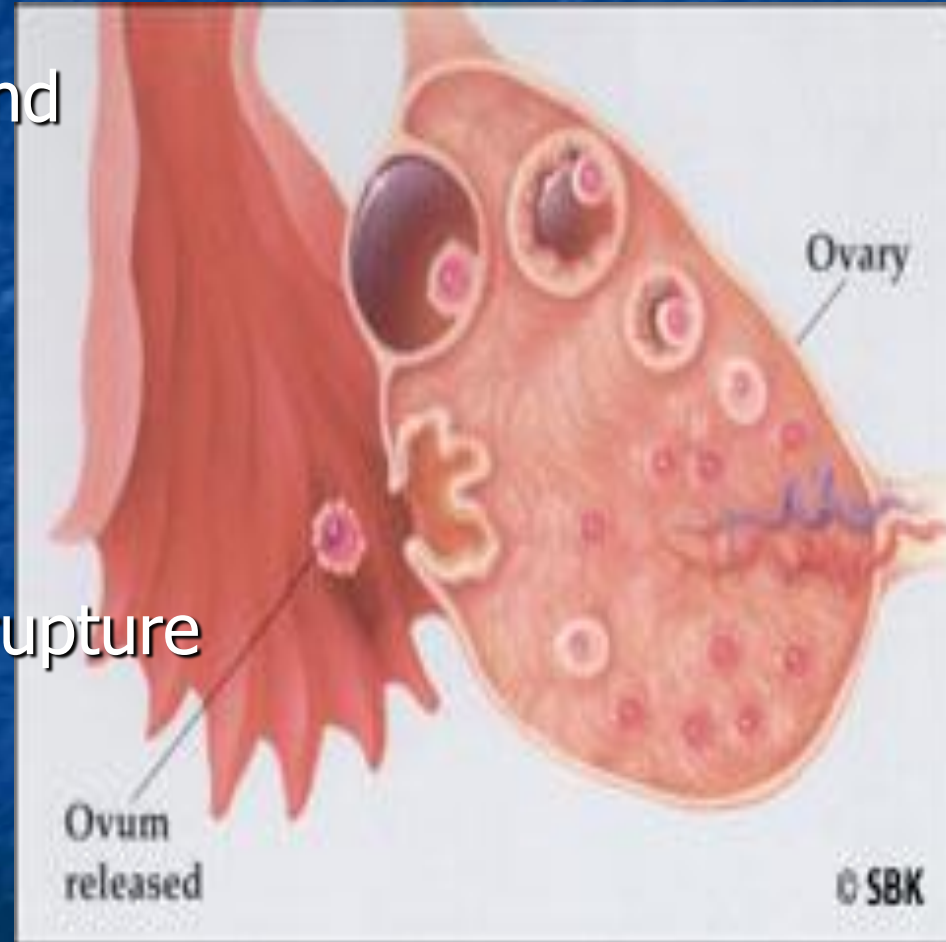
- Follicular Phase (9-20 days)
  1. Rising levels of **FSH** activates a follicle
  2. Follicle matures and secretes **estrogen**
  3. Hypothalamus detects rising levels of **estrogen** and slows **RH** secretion
  4. ↓ **RH** ↓ **FSH** ↓ **LH** ↓ **Estrogen**
  5. Only 1 follicle develops an egg per 28 days



# Ovarian cycle (human)

## ■ Ovulation (About day 12)

1. Follicle reaches maturity and releases much **estrogen**
2. ↑ **Estrogen** causes a  
↑ **LH** spike
3. ↑ **LH** causes the follicle to rupture and release  $2n$  egg



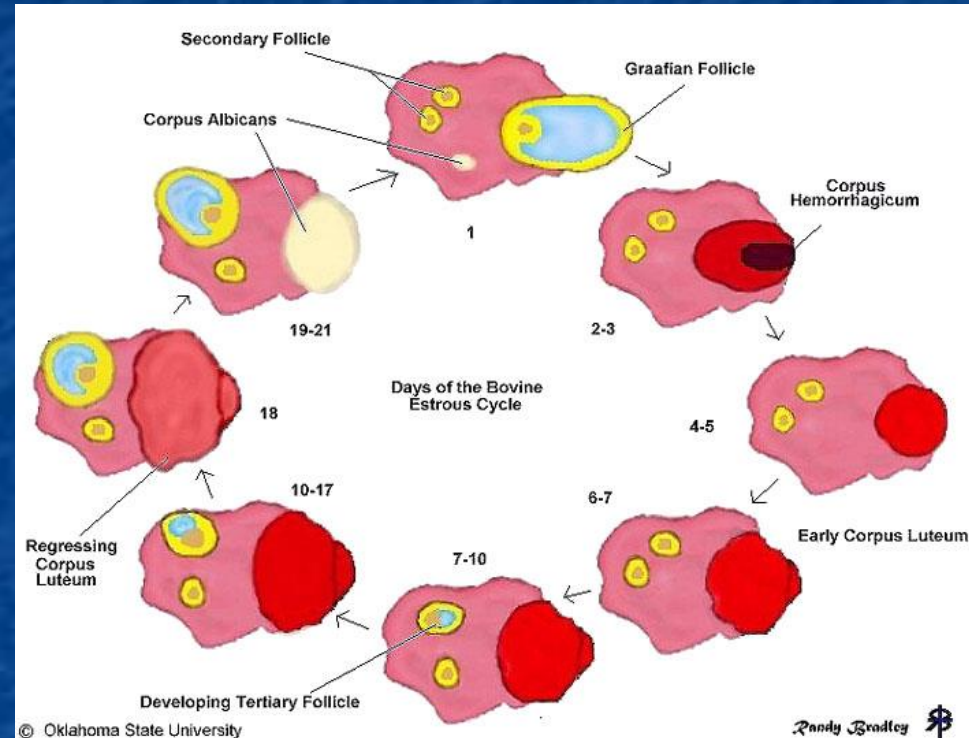
# Oestrus cycle

## 1. Pro-estrus :

- After luteolysis
- Follicular growth
- Tonic levels of Gonadotrophin

## 2. Estrus :

- Gonadotrophin surge
- Standing heat sexual behavior





# Oestrus cycle

- Estrus – Part of the estrous cycle, the periodic state of sexual excitement in the female of most mammals, excluding humans, that immediately precedes ovulation and during which the female is most receptive to mating; “heat”.
- The majority of mammals become sexually-receptive (express *estrus*) and ovulate spontaneously at defined intervals. This is sometimes referred as being “in heat”
- The female will only allow the male to mate during a restricted time coinciding with **ovulation**.
- Mammals exhibit a wide range in the length and frequency of their estrous cycles.

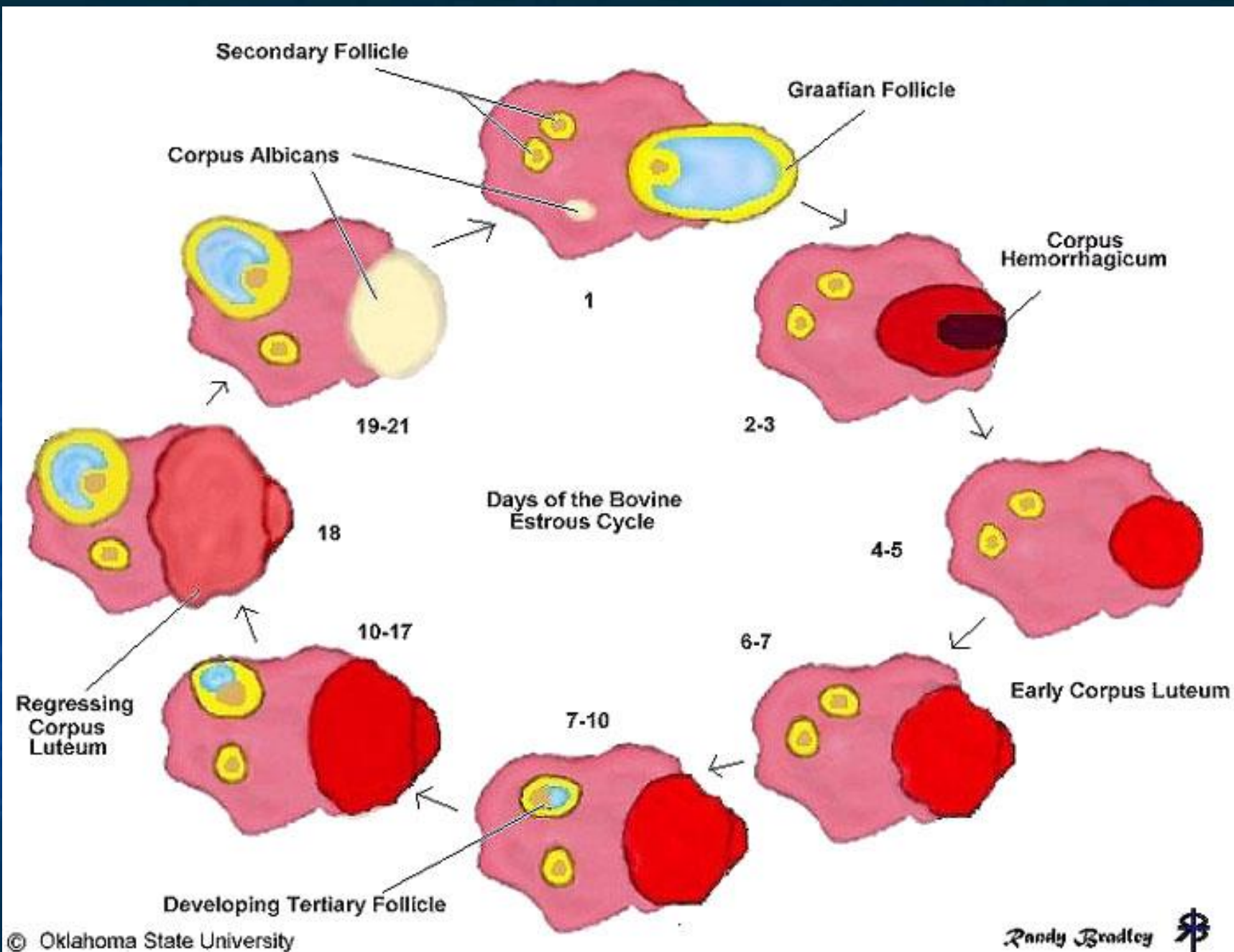
# Oestrus cycle

## 3. Met- estrus :

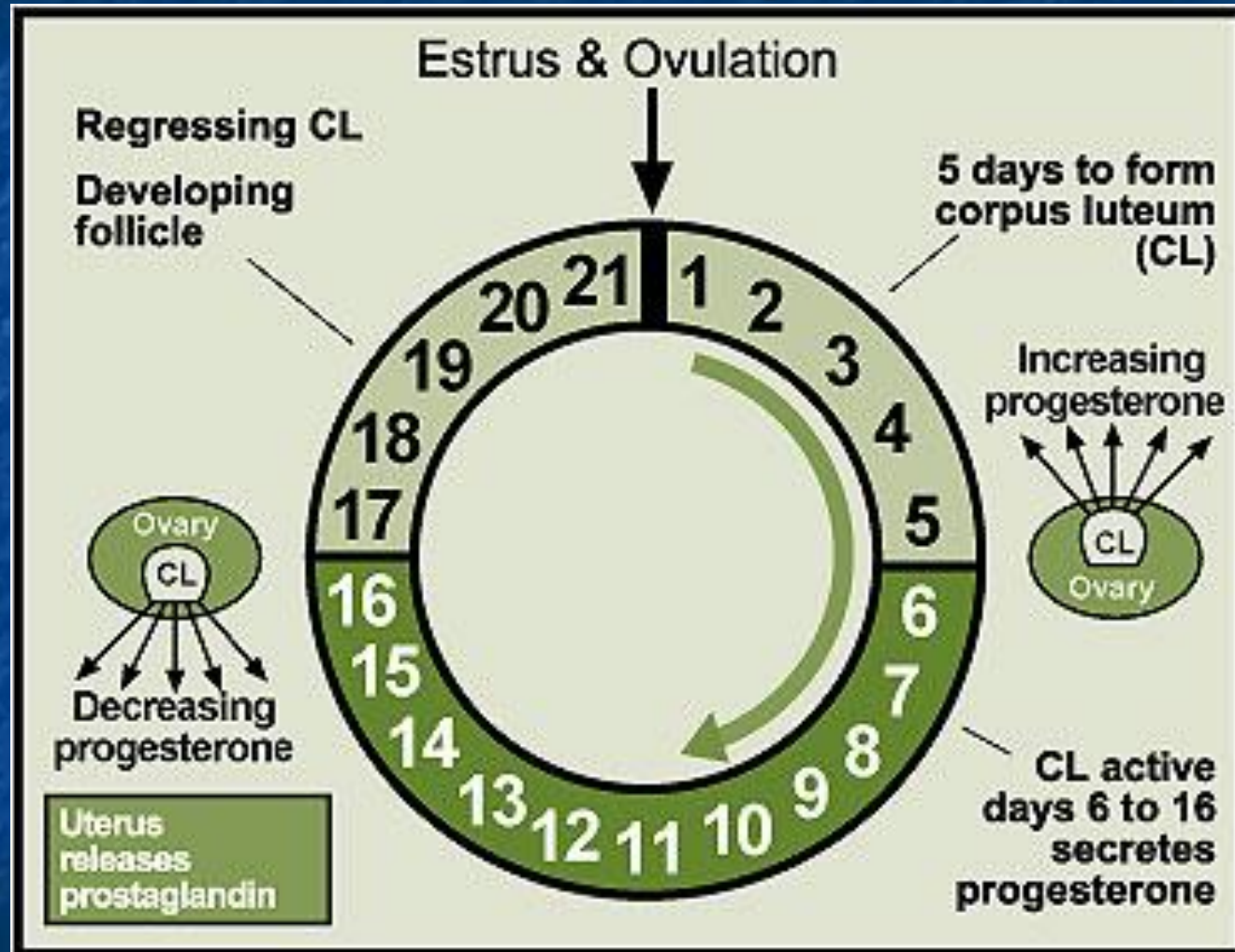
- From ovulation to formation of CL.
- Progesterone production

## 4. Die-estrus :

- Active CL.
- Ended with luteolysis

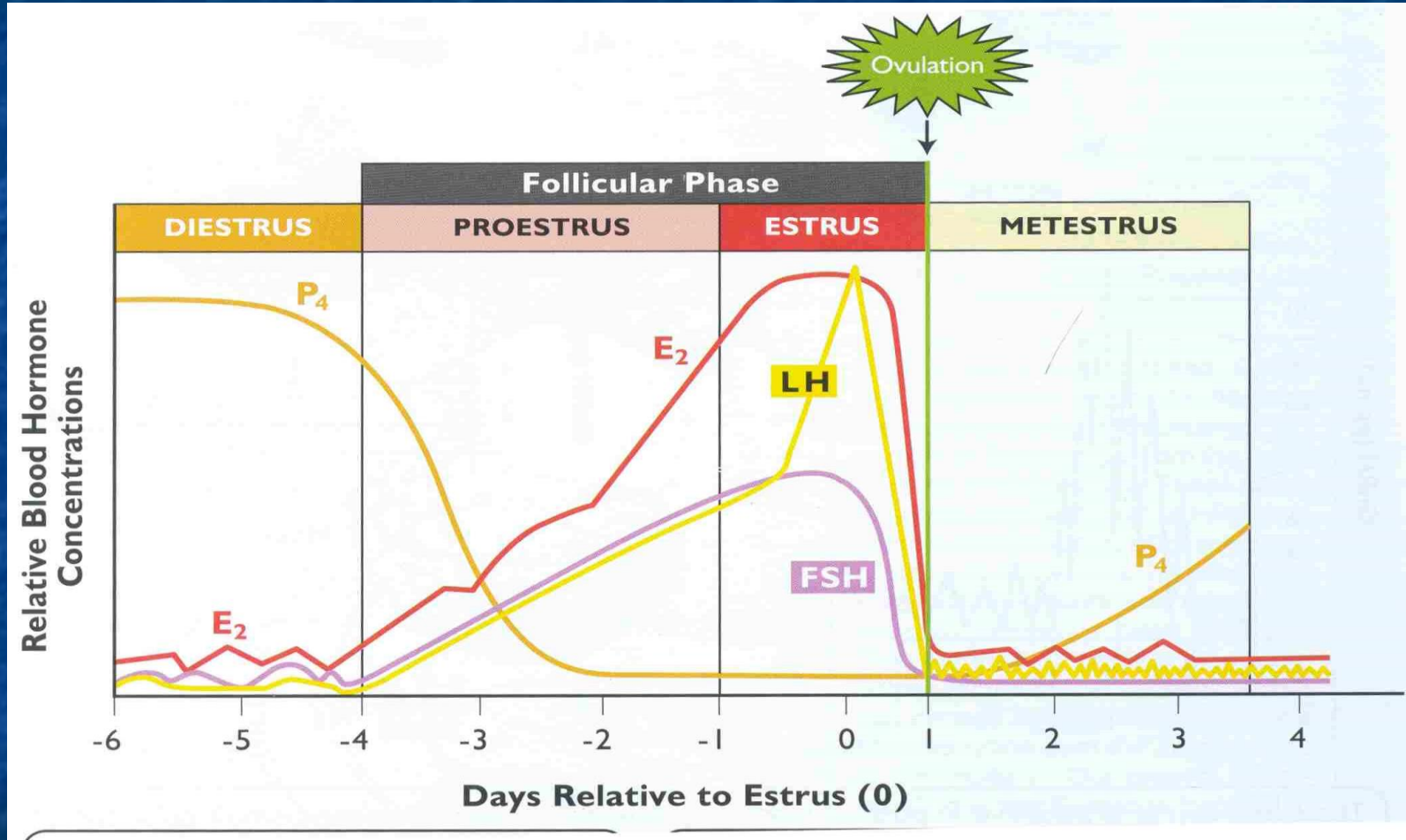


# Oestrus cycle

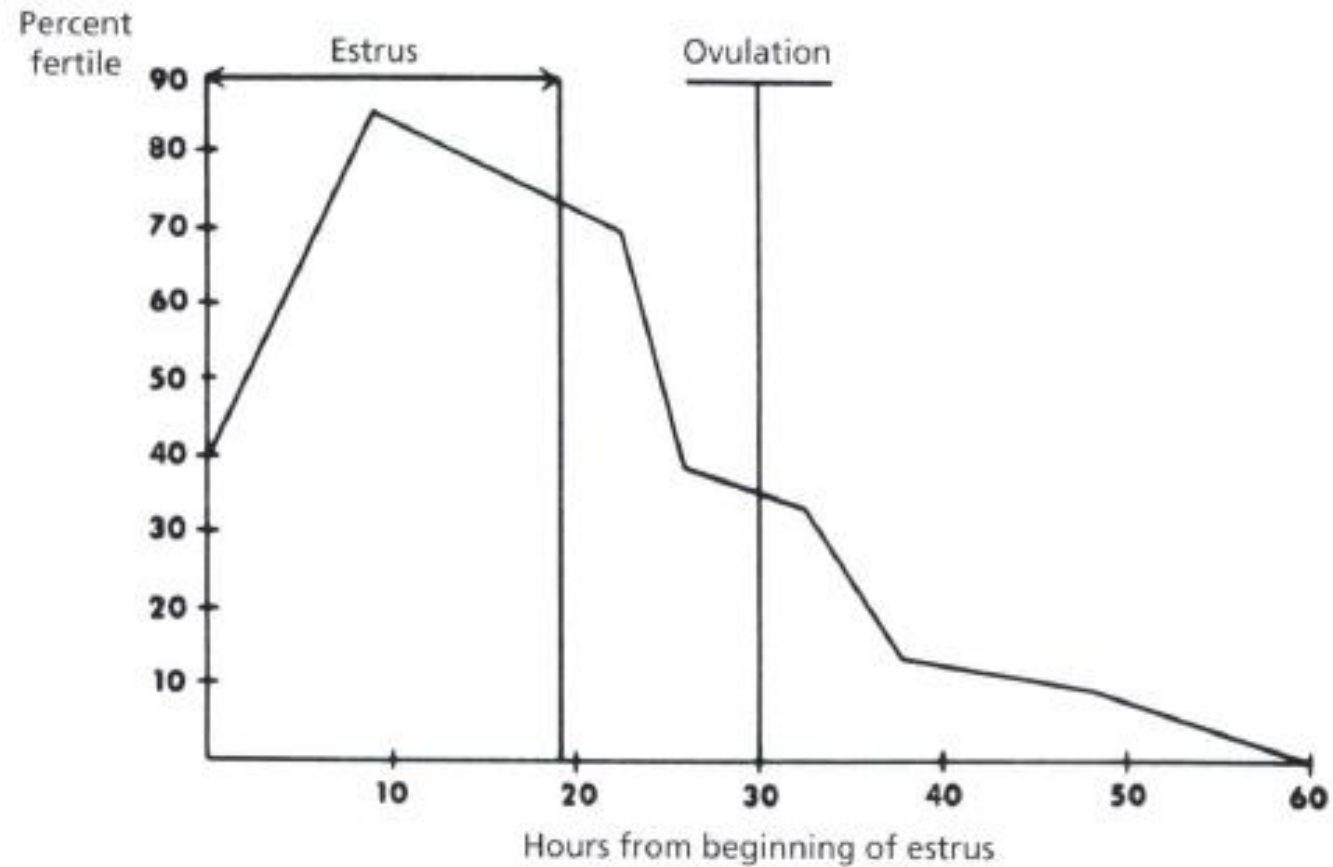


Cow Estrous Cycle

# Oestrus cycle



Cow Estrous Cycle



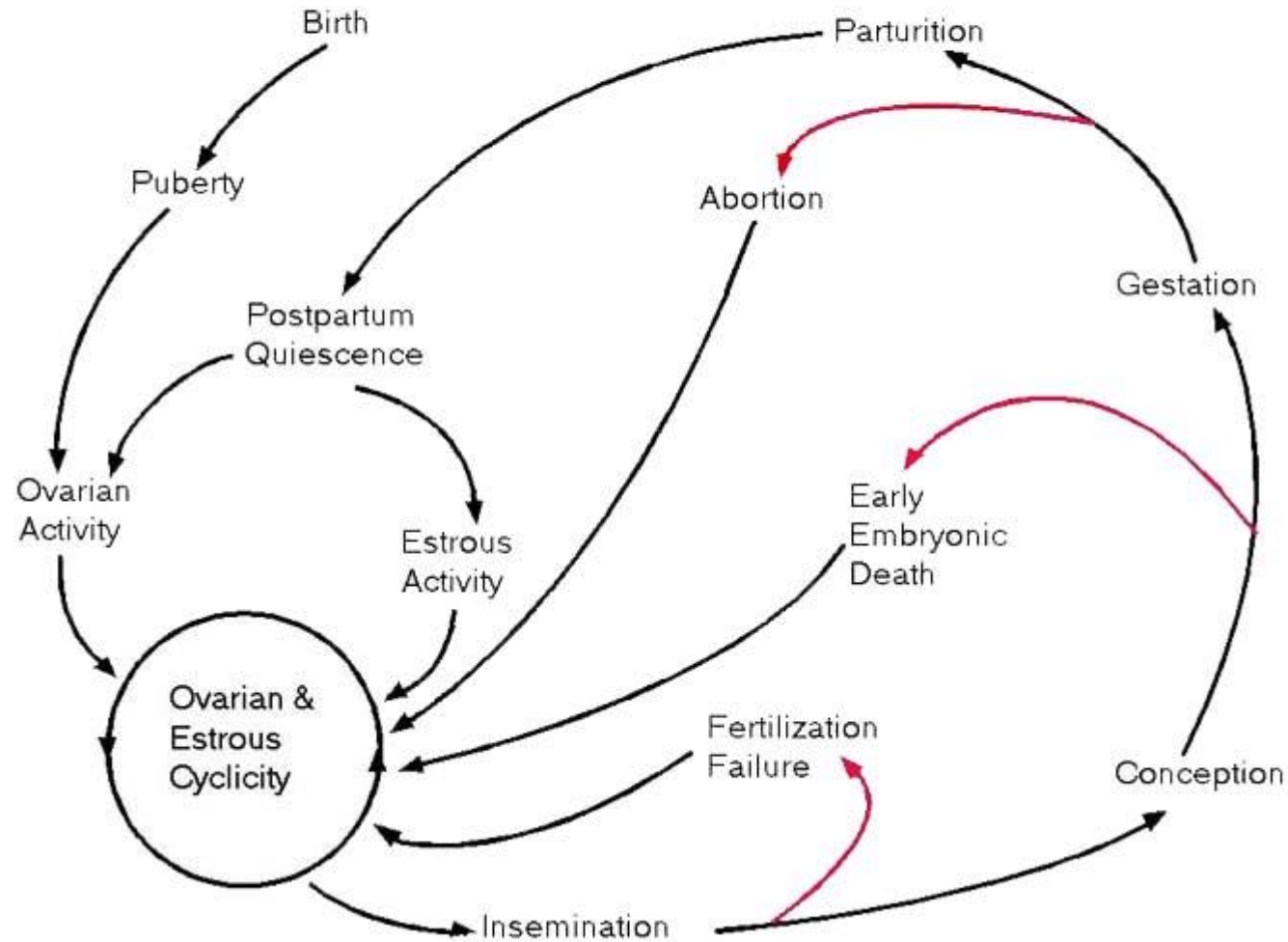
■ **FIGURE 15-19** The effect of time of insemination on conception rate in cattle. Conception rate is best when inseminated about 10 hours from beginning of estrus. (From Stabenfeldt GH, Edqvist L. Female reproductive processes. In: Swenson MJ, Reece WO, eds. Dukes' Physiology of Domestic Animals. 11th Ed. Ithaca, NY: Cornell University Press, 1993.)

**TABLE 15-1 FACTORS RELATED TO FEMALE REPRODUCTION**

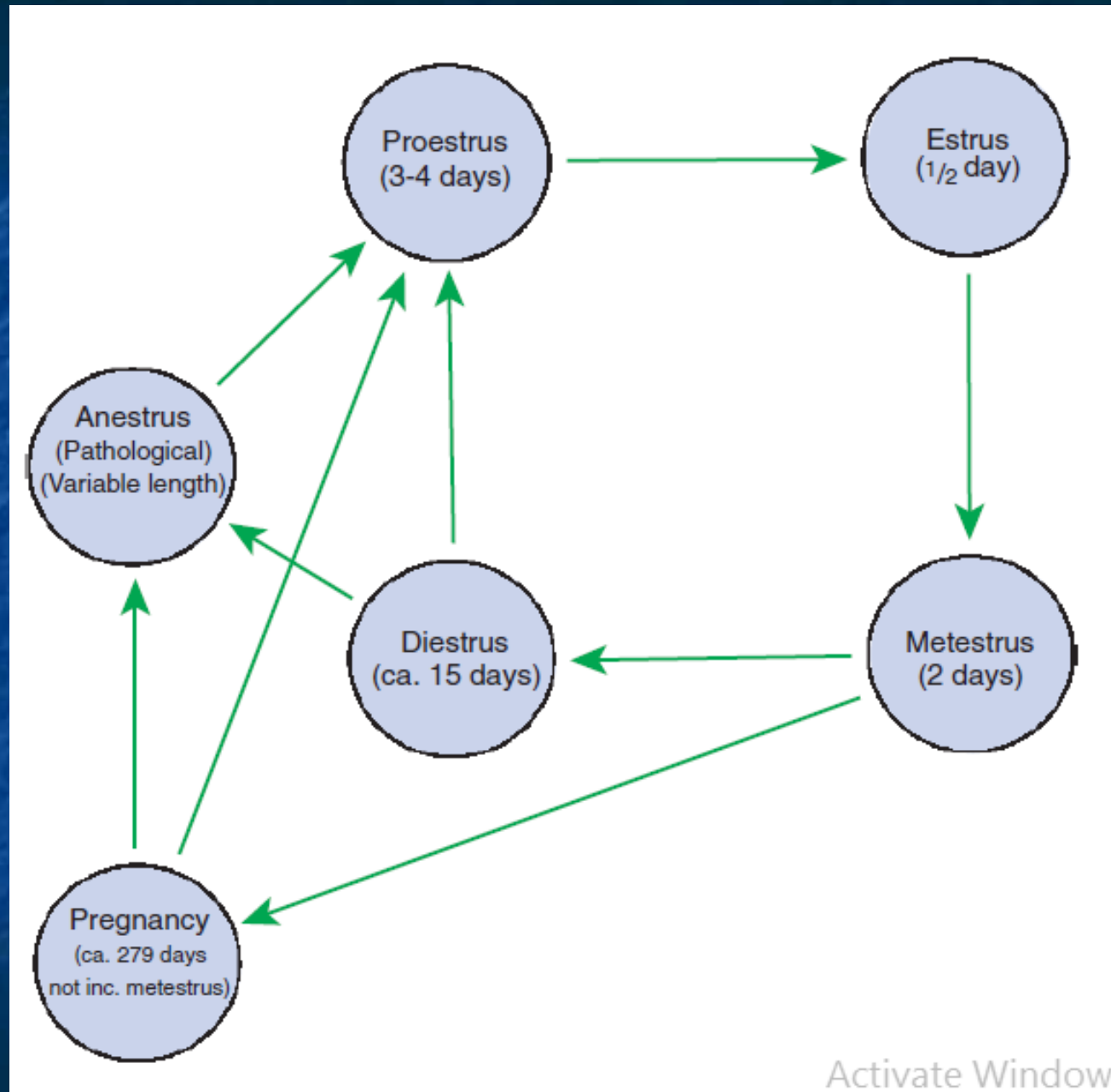
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## Schematic of Bovine Reproductive Cycle (Female)







# Equine Estrous Cycle

- Photosensitive cycling
- Seasonally polyestrous

## **ESTRUS**

- 5-7 days
- Estrogen increases
- Mare is receptive to the stallion
- Ovulation happens between the last 24-48 hours of estrus

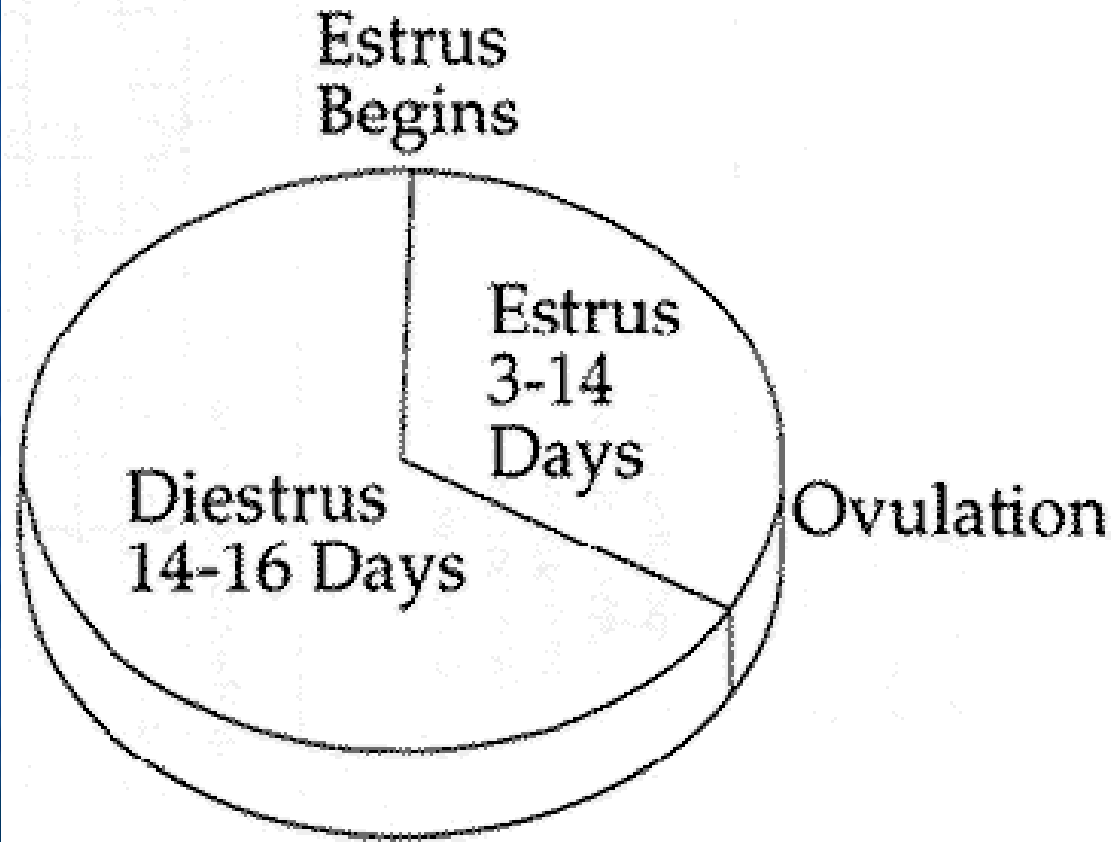
## **DIESTRUS**

- 14-15 days
- Progesterone increases
- Mare not receptive to the stallion



# Oestrus cycle

## The Mare's Estrous Cycle



# Oestrus cycle

Species	Oestrus cycle (Day)	Pro-estrus (Day)	estrus	Met-estrus (Day)	Die-estrus (Day)	Ovulation time
<b>Cow</b>	17-24 (21)	3-4	6-24 (15)hrs.	3-4 (days)	10-14	10-12hrs. After ovu.
<b>Sheep</b>	14-19 (17)	2-3	18-48 (30)hrs.	2- 3 (days)	10-12	Mid-end of estrus
<b>Mare</b>	19-25 (22)	2-3	2-12 (7) days	2-3 (days)	13-14	1-2days prior to end of est.
<b>Bitch</b>	15-56 weeks	-	9-10 days	-	-	24-42 hrs. after est.

# Heat detection

- Standing heat : other cows
- Flehman phenomenon
- Vaginal discharge
- Vulva inflammation
- Met-estrus bleeding

Cow - Estrus



Ewe - Estrus



Mare - Estrus



# Heat detection

- Recording
- Heat mount detection
- Tail paste
- Video camera
- Teaser
- Pedometer
- Temp. taking : infrared
- Electrical resistance of vagina : decreasing during heat

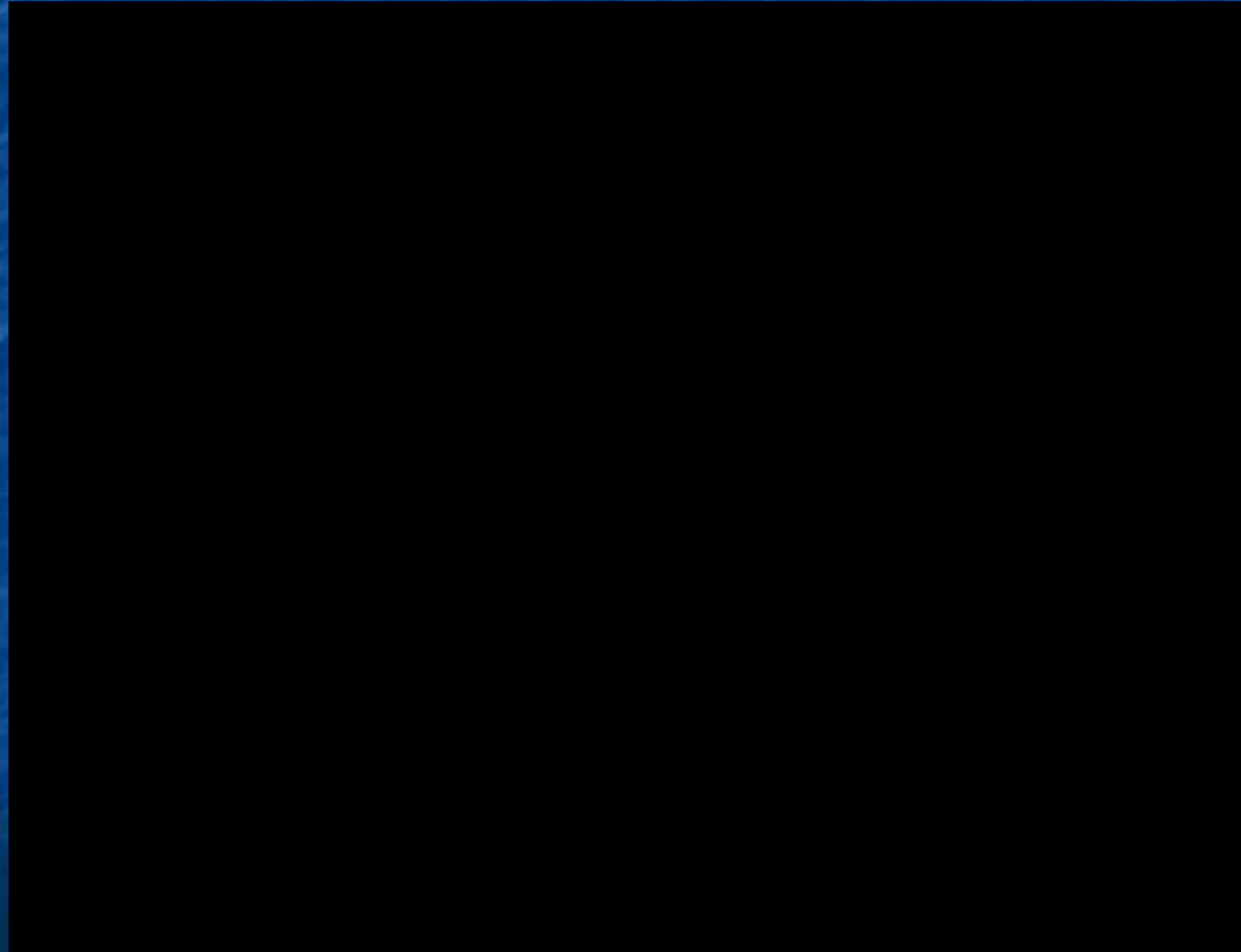
HeatWatch Transmitter within Patch

Heat Detection Aids - Chalk

HeatWatch Estrus Detection



# Heat detection methods



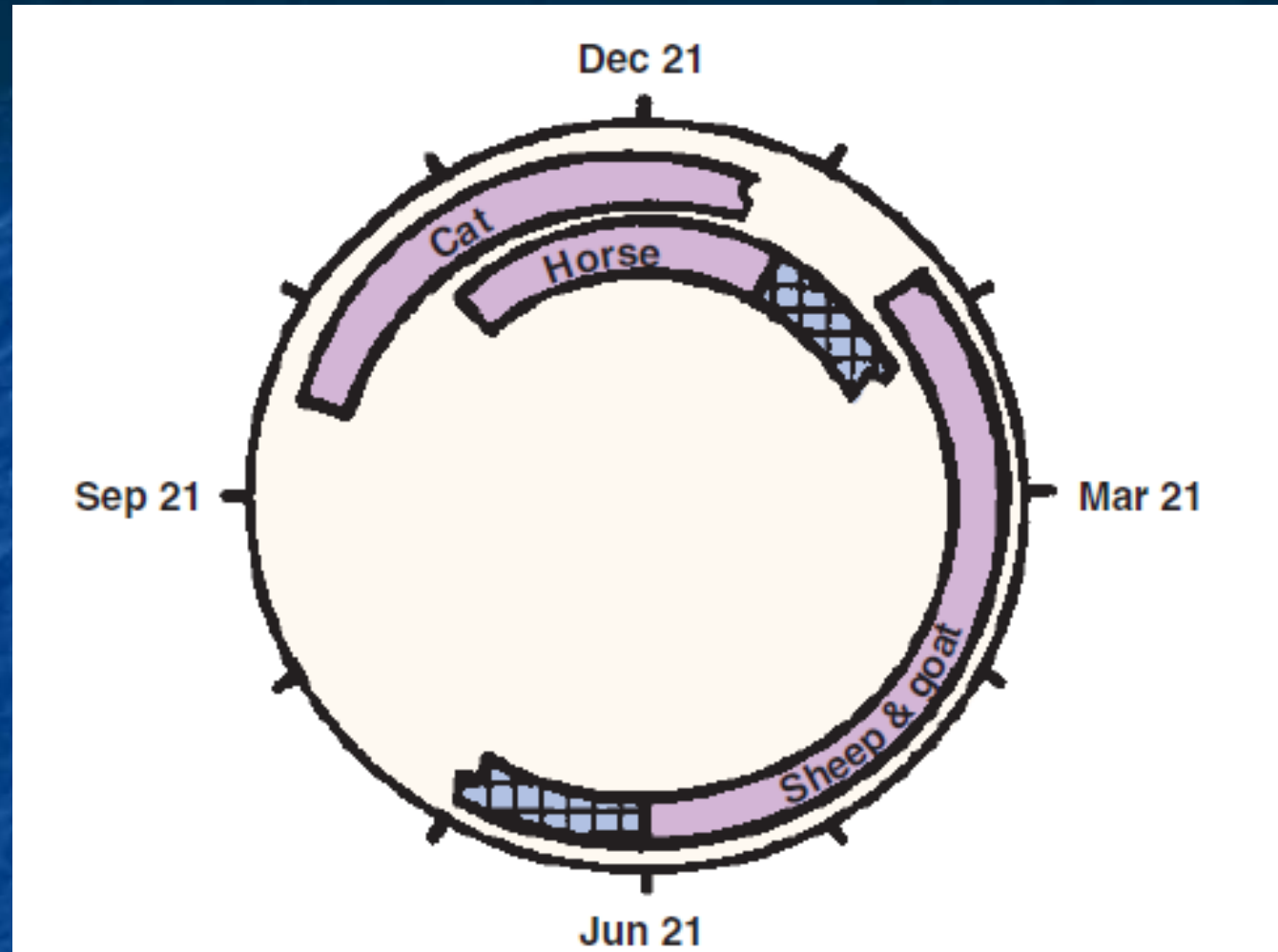
# Seasonal breeding

- **Poly estrus** : all year long oestrus cycle  
( cow , sow , rat , mice )
- **Mono estrus** : one oestrus cycle in season  
( wild mammals , some dog breeds )
- **Bi estrus** : two oestrus cycles in season  
( most breeds of bitches & queens )
- **Seasonally poly estrus** : several oestrus cycle in each season ( ewe , mare , queen , camel , hamster , deer )

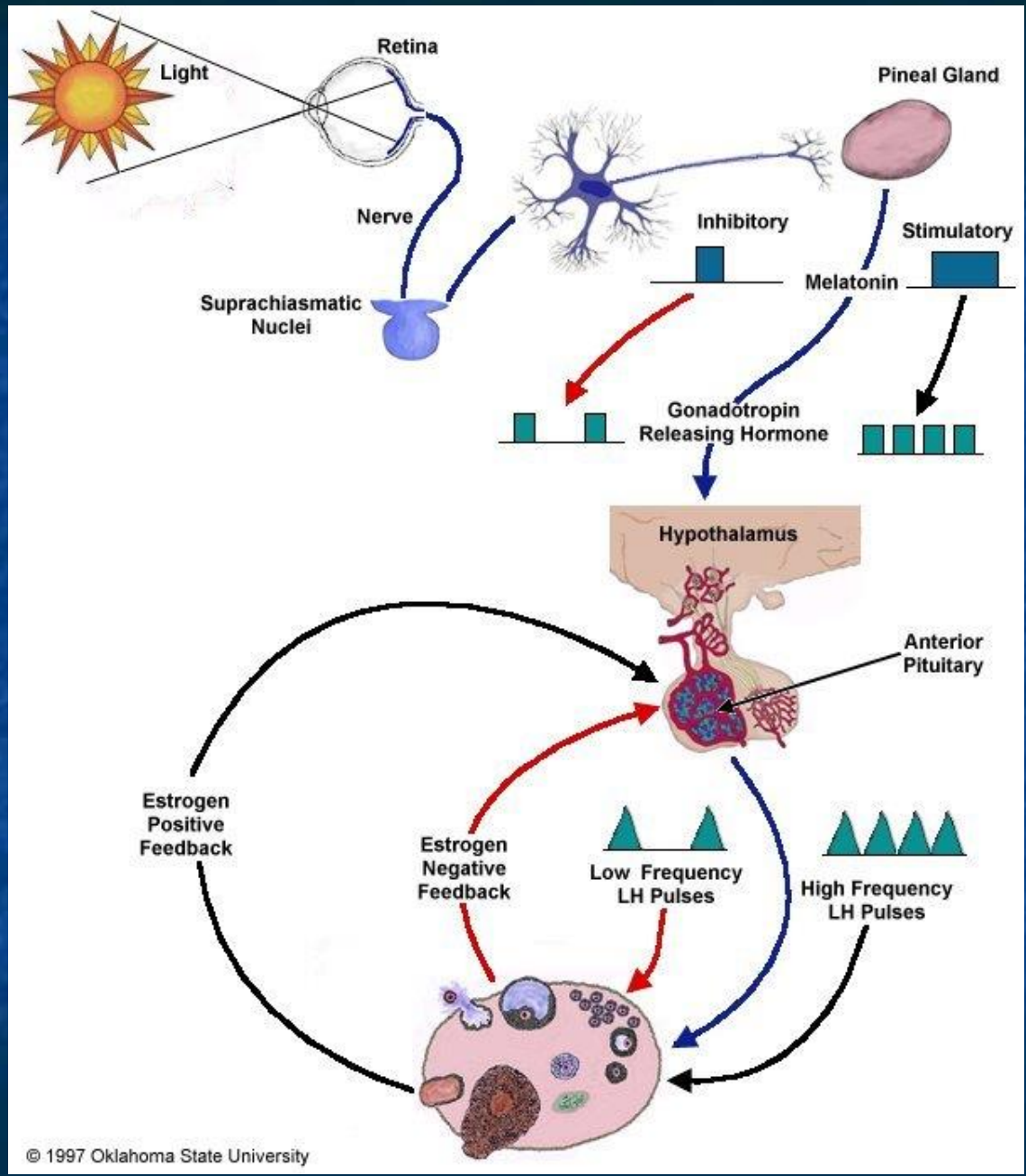


# Seasonal breeding

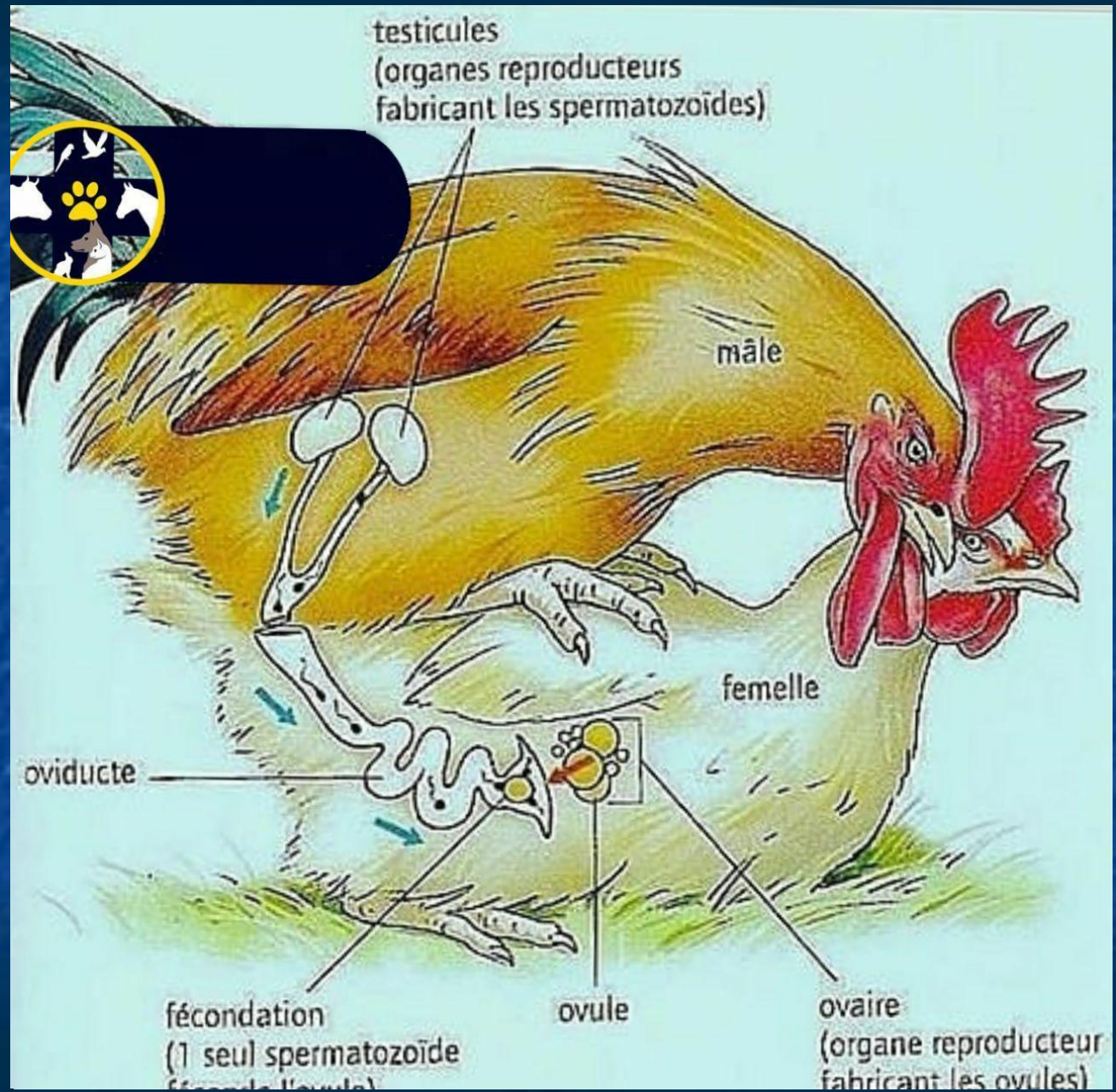
- **Short-day breeder** : ( sheep & goat )  
decreasing the negative feedback of steroids on brain → GnRH↑ → Gonadotrophins↑
- **Long-day breeder** : ( mare , queen )  
decreasing the negative effect of melatonin on Gonadotrophin releasing



Diagrammatic representation of the effect of photoperiod on ovarian activity in the typical cat, horse, sheep, and goat. The bars represent periods of ovarian inactivity (anestrus). The transitional periods for the horse, sheep, and goat are shown by the hatched portions of the bars.



# **REPRODUCTION IN POULTRY**



# Reproduction in Poultry

