Female Reproduction

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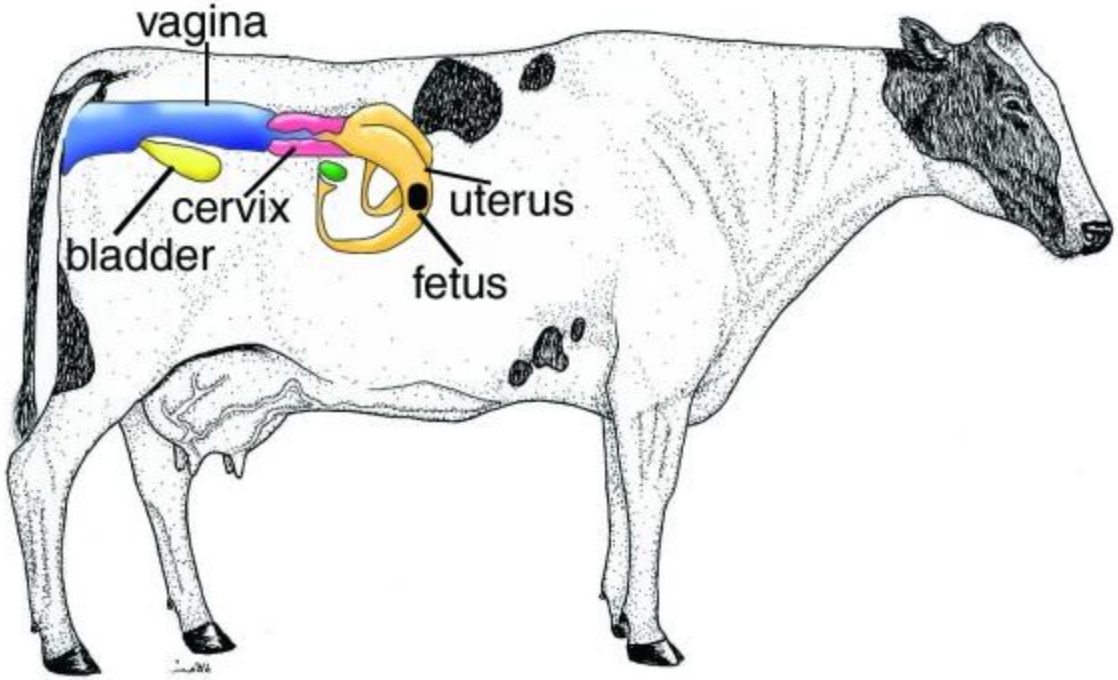
Reproduction

Ability of animal to produce a new generation and maintenance of the species

The female reproductive system consists of :

- Ovaries(exocrine &endocrine function)
- Oviducts or fallopian tubes which transmit the ova to the uterus
- Uterus
- Vagina
- External genitalia(vulva)
- Accessory glands(mammary glands)

Reproductive System

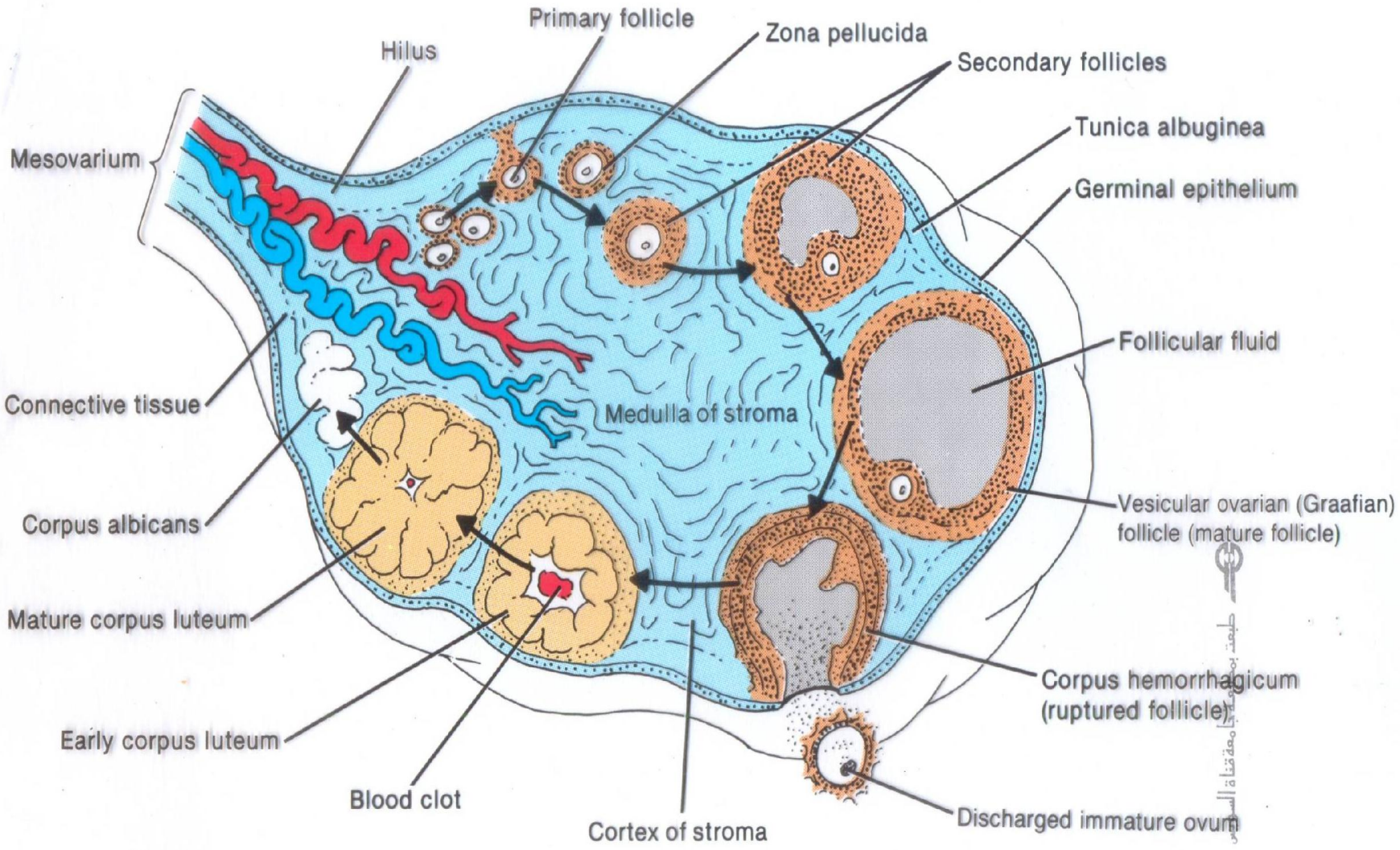


http://cvm.msu.edu/courses/AP/bessie/cowreproorgans3.jpg

Ovaries

- Paired glands(unshelled almonds in size and shape)
- Positioned in the pelvic cavity, one on each side of the uterus.
- They are maintained in position by a series of ligaments(suspensory ligament, mesovarium and ovarian ligament)

Microscopic structure of the ovary



Fallopian tubes:

Two uterine tubes(oviducts) extend laterally from the uterus and transport ova from the ovaries to the uterus.

Fallopian tubes consisted of:

Infundibulum (funnel shaped), trap the ova, surrounded by fimbriae.

Ampulla (site of fertilization).

Isthmus (short, narrow thick walled).

Uterus:

Site of implantation of fertilized ova and development of the fetus.

It is consists of: (horns -- body-- isthmus -- cervix).

The interior of the body (uterine cavity)

The interior of the cervix (cervical canal)

The junction between the isthmus with the cervical canal is the internal os.

The external os is the place where the cervix opens into the vagina.

Vagina:

- Serves as a passage way for the vaginal secretions, receptacle for penis during coitus ,It is the lower portion of the birth canal.
- **Musculo-tubular organ:**
- The **muscularis** is composed of **long.S.M.** that can **stretch**. This distension is important because the vagina receives the penis during sexual intercourse and serves as the lower portion of the birth canal.
- The **mucosa** of the vagina contains large amounts of **glycogen**, On **decomposition** , it produces **organic acids (low pH)** which retards microbial growth, injurious to sperm cells but semen neutralizes this acidity to ensure survival of the sperm.
- **Hymen:** thin fold of vascularized m.m forms a border around the orifice partially closing it.

The exocrine function of the ovary is oogenesis

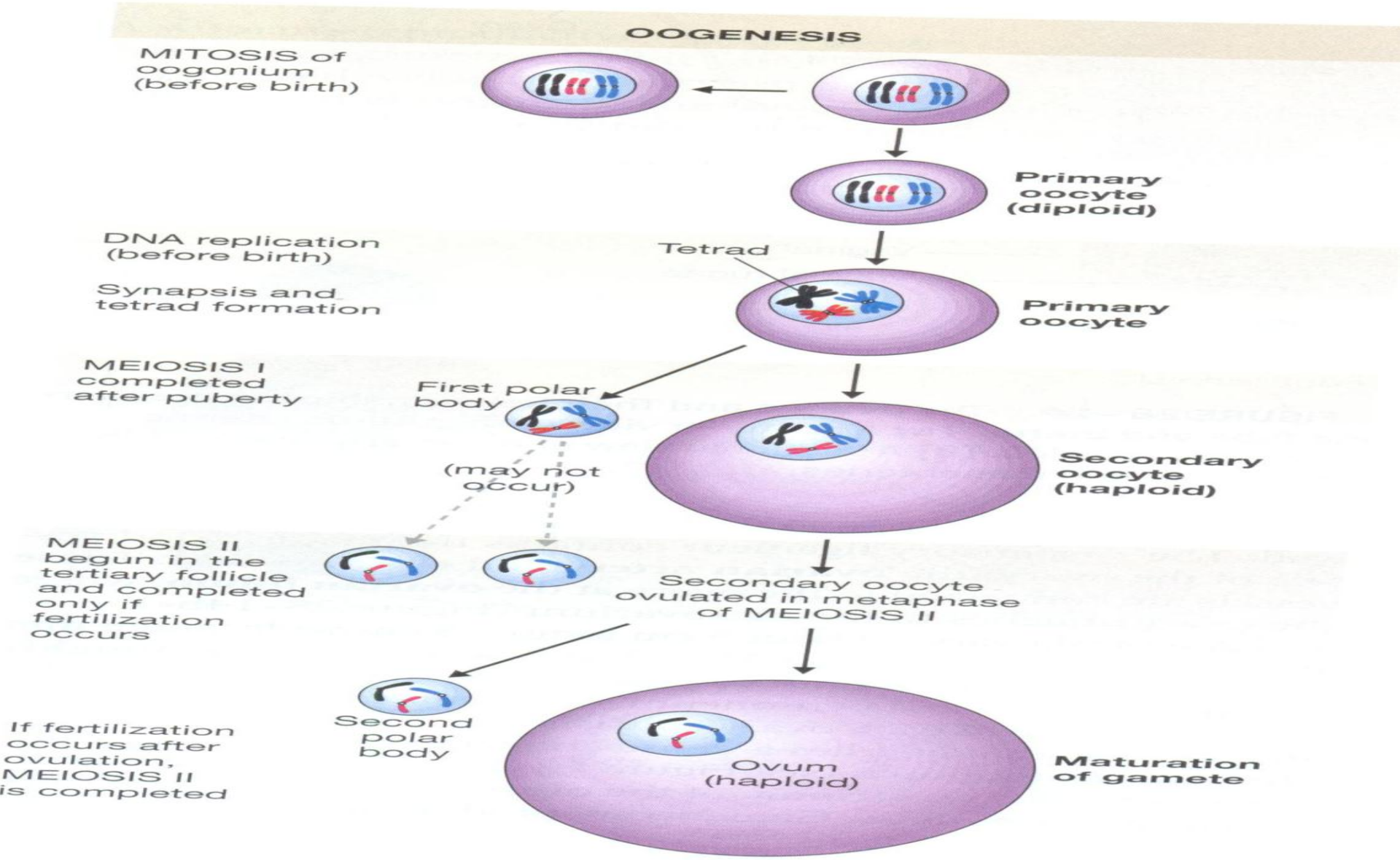
- **In embryo, the oogonia divide rapidly from the second to seventh month of gestation to form 7 million germ cells .**

- **The number of germ cells drops to 2 millions and still till birth.**

- **Most oogonia die during this period while the remaining enter the first meiotic division (primary oocyte).**

- **At puberty 300 000 of oocyte enter meiosis .**

Oogenesis: is the process by which mature oocyte (that is competent for fertilization,) is produced.



During first meiotic

❖One of daughter cell contains hardly cytoplasm (first polar body).

❖The other cell has entire volume of cellular constituents (secondary oocytes).

During second meiotic division mature ovum and second polar body are produced .

Puberty

It is the time at which cyclic gonadal function begins. Onset of the first estrous cycle and sexual desire under the control of C.N.S. and gonadotropins.

The age of puberty is:-

Cows	9-12 months,
Buffaloes	15- 20 months,
Sheep & goats	4-8months,
Mares,	10-12 months,
Cats	7 months,
Bitches	9-14 months.

Theories of puberty:

1-Small amounts of estrogen are secreted by the ovaries before puberty and hold up gonadotropin secretion.

2-Pineal gland secrets melatonin before puberty which inhibits GnRH from the hypothalamus . Its activity gradually diminished as the animal approaches puberty. This leads to an increase in the output of GnRH from hypothalamus and gonadotropins from the interior pituitary gland .

3-Thymus gland contributes with the pineal gland in inhibiting gonadotropin secretion .

4- Before puberty, the brain is very sensitive to the inhibiting effects on gonadotropin secretion

Control of onset of puberty

1-Hereditary factors:

- Uni or bilateral overian hypoplasia
- Aplasia of duct system

2-Nutritional factors .

Protein, carbohydrate, fat ,vitamin and meniral.

3-Environmental factors.

4-Sex:earlier in female human but earlier in male in buffaloes and cattle.

5-Endocrine factors : maturation of CNS and subsequently maturation of hypothalamus lead to release of GnRH lead to Gn lead to steroid release which is responsible for onset of puberty (control growth of genitalia and sexual behavior and gametogenesis)

Types of puberty:

1-Normal

2- Early (precocious :

A-pseudo puberty : development of secondary sexual characters without gametogenesis

B-True puberty

3-Delayed (absent)

Sexual maturity

Complete physical and physiological development of the reproductive tract following puberty by a certain time .

It is the suitable time to start pregnancy and parturition .

Female reproductive cycle

Definition

Certain changes occur in female reproductive tract in a cyclic manner controlled by gonadotropin (from ant. pituitary) and sex hormone (from gonads).

In human beings, it is called menstrual cycle.
In animals, it is called estrous cycle.

REPRODUCTIVE CYCLE

Estrous cycle in domestic animals

A. Ovarian Cycle

1. **Follicular Phase**
   - a- Oogenesis
   - b- Folliculogenesis
2. **Ovulation**
3. **Luteal Phase (Luteonization or Luteolysis)**

B. Interplay between Neuro-endocrine factors in controlling the ovarian and reproductive cycles.

C. Pregnancy Events including:

(1) **Fertilization**
(2) **Maternal recognition of the conceptus**
(3) **Embryonic development and differentiation**
(4) **Implantation**
(5) **Placentation**

D. Parturition

E. Lactation

Oogenesis:

It is the process by which mature oocyte that is competent for fertilization, is produced.

Folliculogenesis:

It is the process by which mature follicles are produced.

These follicles play important roles in Steroidogenesis process by which steroid hormones, mainly estrogens are produced.

Ovulation:

It is the phase in which the dominant follicle (Graafian follicle) can ovulate releasing mature secondary oocyte, and the remaining cellular part changed to corpus luteum.

Luteonization:

It is the process by which corpus luteum is formed during early luteal phase.

Luteolysis:

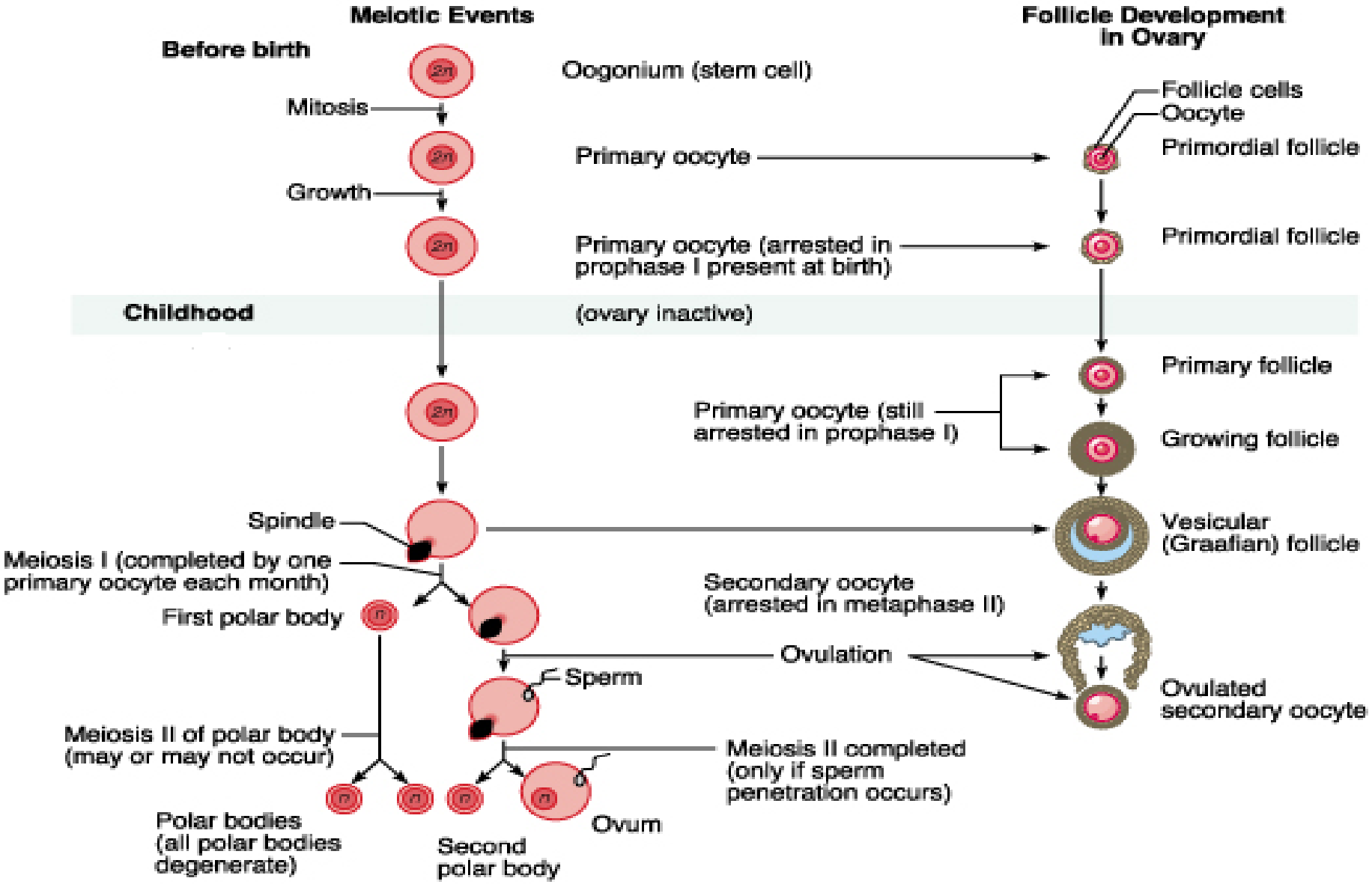
It is the process by which the corpus luteum shrinks during:

Late luteal phase due to failure of fertilization.

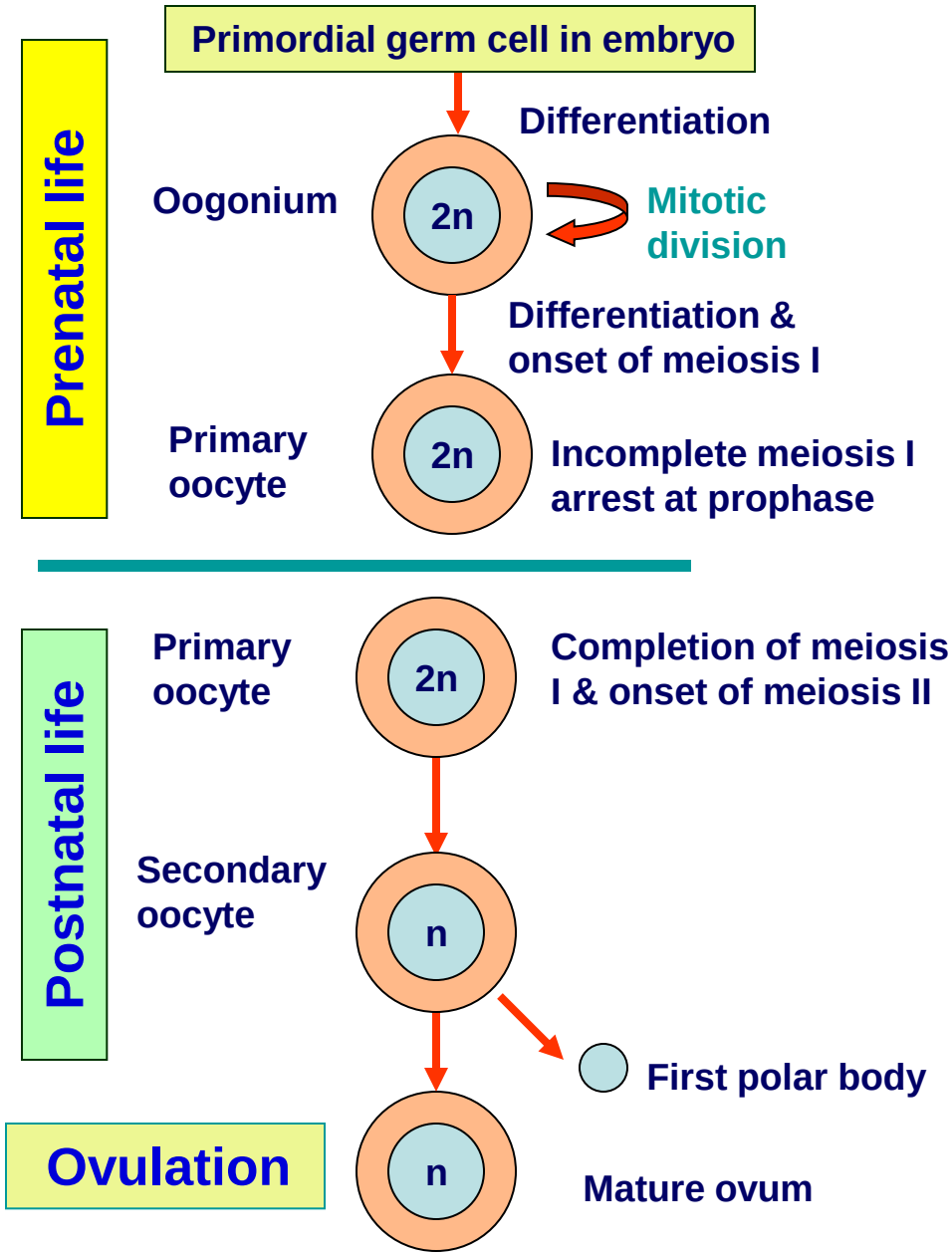
Or at the end of gestation.

Oogenesis

Folliculogenesis



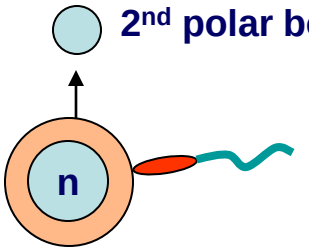
OOGENESIS IN MAMMALS



OOGENESIS differs from spermatogenesis in several ways. Whereas the gamete formed by spermatogenesis is essentially a motile nucleus, the gamete formed by oogenesis contains all the materials needed to initiate and maintain metabolism and development.

Therefore, in addition to forming a haploid nucleus, oogenesis also builds up a store of cytoplasmic enzymes, mRNAs, organelles and metabolic substrates that all are essential for the future embryo nourishment and development.

Fertilization



Entery of sperm triggers completion of meiosis II

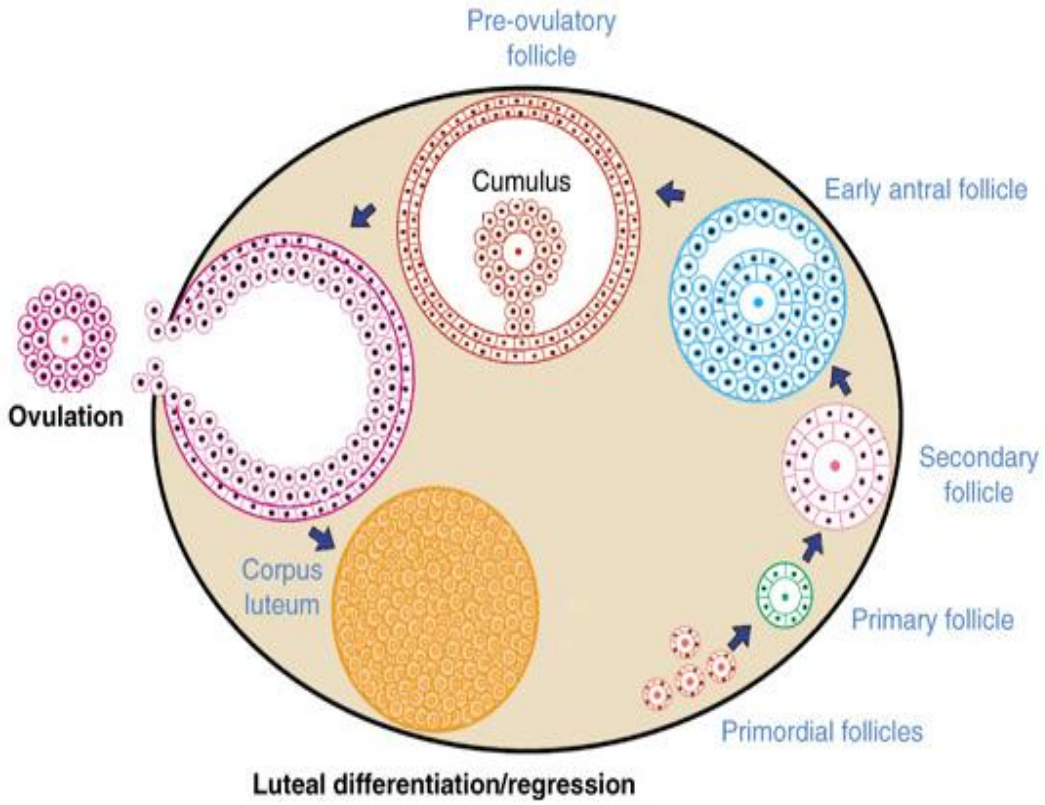
FOLLICULOGENESIS

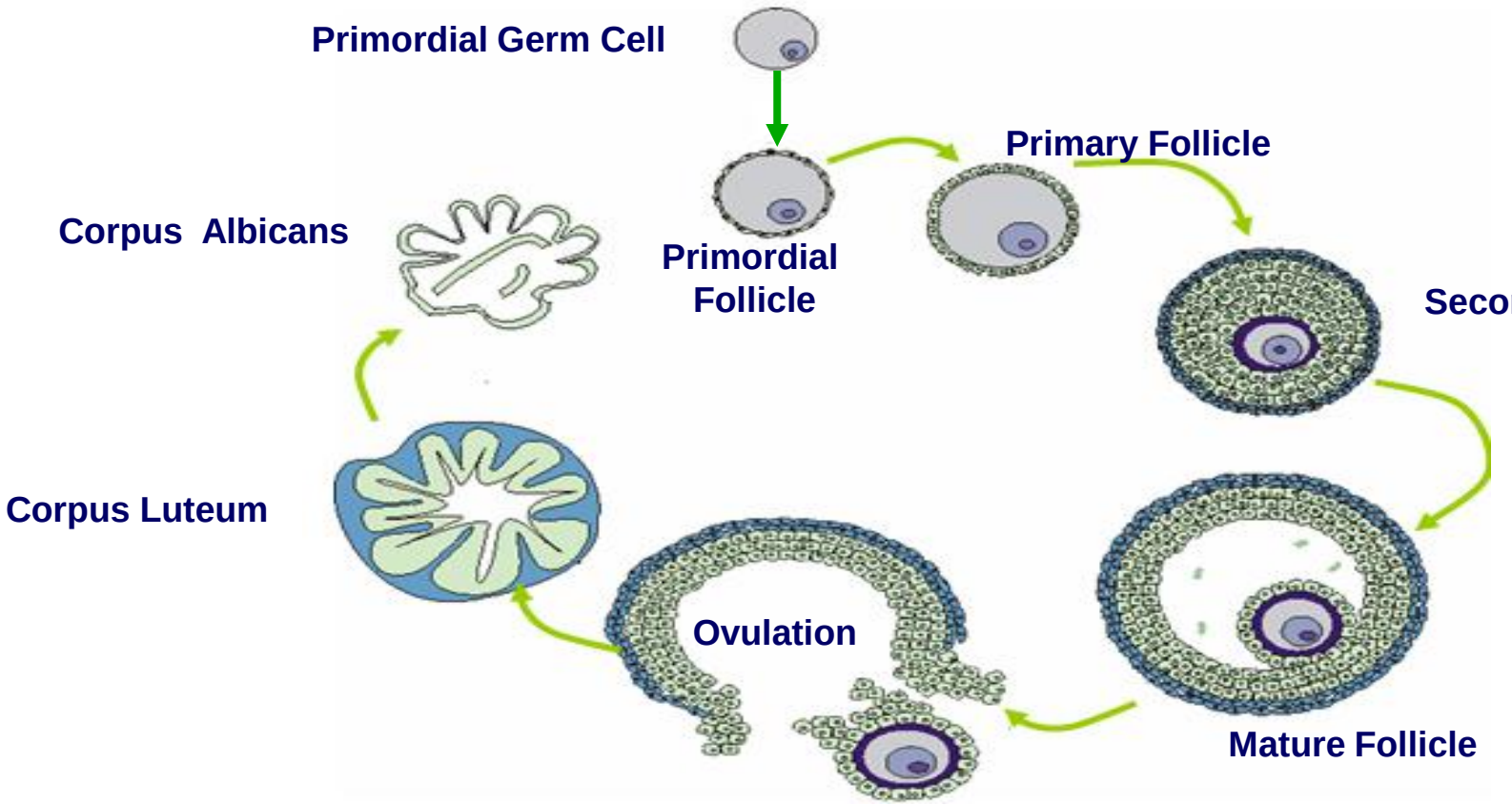
Ovary has both endocrine (produces hormones) and exocrine (release of the oocyte)function.

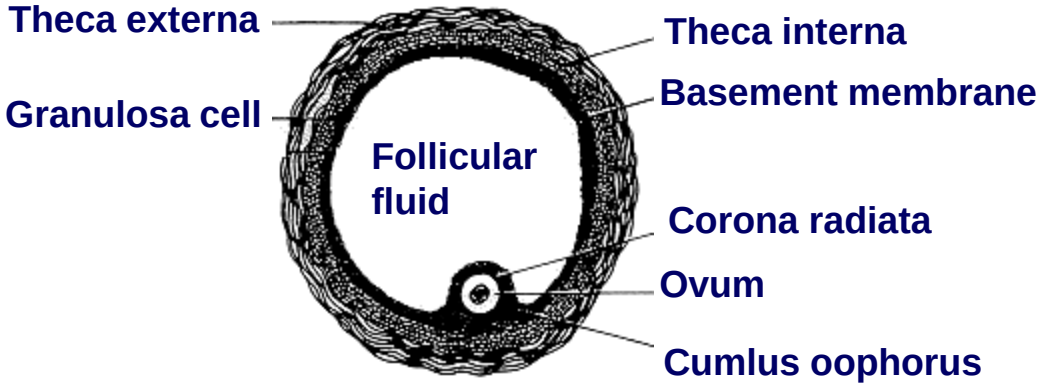
The female is borned with ovaries containing a limited pool of ova. Folliculogenesis defined as the formation of Graafian follicle from a pool of primordial (non-growing) follicle.

Types of Ovarian Follicles:

Primordial Follicles: constitutes a centrally located oocyte and a single layer of flattened granulosa cells associating with the oocyte. The cell cycle of oocytes at this stage is arrested at the prophase of the first meiotic division, and oocytes usually are never released from the arrest until they have passed through a growth phase




Primordial Germ Cell
Primordial Follicle
Primary Follicle
Secondary Follicle
Mature Follicle
Ovulation
Corpus Luteum
Corpus Albicans


Theca externa
Granulosa cell
Follicular fluid
Theca interna
Basement membrane
Corona radiata
Ovum
Cumlus oophorus

Types of Ovarian Follicles

1- Primordial Follicle single layer of squamous epithelial cells resting state

2- Primary follicle
single layer follicle cells
primary oocyte
follicle cells expand (cuboidal)

3- Secondary follicle
primary oocyte
zona pellucida present
multiple layers of granulosa cells
thecal layer forms
pre-antral

4- Antral follicle
Many layers of Granulosa cells
primary oocyte
oocyte reaches maximum size
granulosa cells expand
zona pellucida present
cavities appear, antrum forms

5- Graafian follicle
latest stage of tertiary follicle
primary oocyte
final stage
preovulatory

Oocyte numbers
- Fetal – 7,000,000
- Birth – 2,000,000
- Aged - 20,000
- Number ovulated
- >> human ~500 >> cow ~350

Follicle growth involves hormonally induced proliferation and differentiation of both **theca** and **granulosa** cells leading to increased ability of follicles to produced **estradiol** (E2) and respond to **gonadotropins** (LH & FSH)

Follicles that produce E2 will gain **LH receptors** necessary for ovulation and luteinization

Folliculogenesis)

It is divided into 5 events:

Recruitment (initial ,cyclic) FSH↑

Common growth phase (FSH)↓

Deviation - Selection - Dominance

Recruitment=emergence: It is the process where a cohort of follicles begins to mature in a sufficient pituitary gonadotropins to permit progress towards ovulation.

it is corresponding to entry into terminal growth of a group of follicles. pituitary gonadotropic stimulation permit progress towards ovulation.

Common growth phase : the dominant follicle grows at a continuing rate , and the remaining or subordinate follicles regress or grow at a reduced rate and then regress .

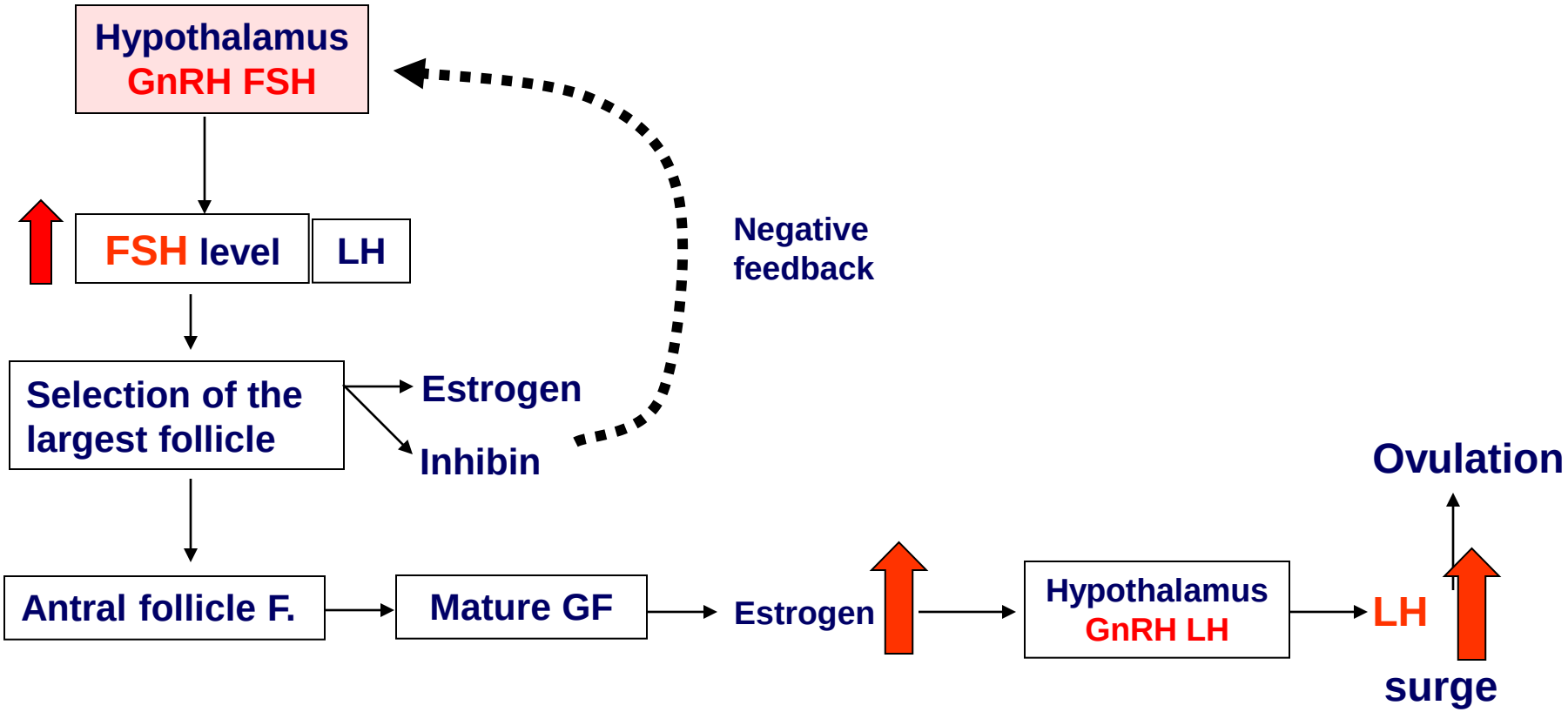
It occurs after emergence of(7-11 follicles enter).

Higher levels of estrogen and inhibins are secreted from the largest follicle which suppress the pituitary FSH released during the mid follicular phase.

The growing follicles also produce higher levels of autocrine and paracrine growth factors that stimulate vasculature of the follicle.

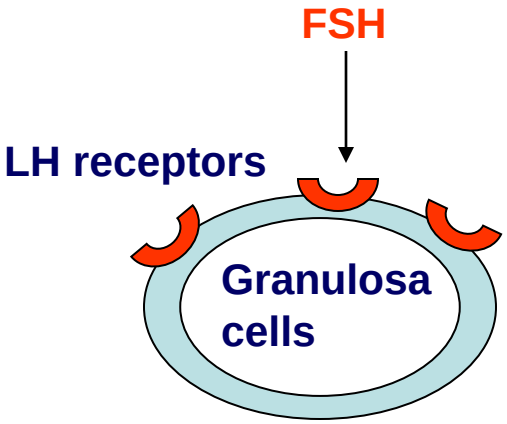
Endocrine control of reproduction

Hormonal regulation of folliculogenesis



High level of estrogen → LH surge → Lutenization of the ovulated follicle

LH surge → Ovulation

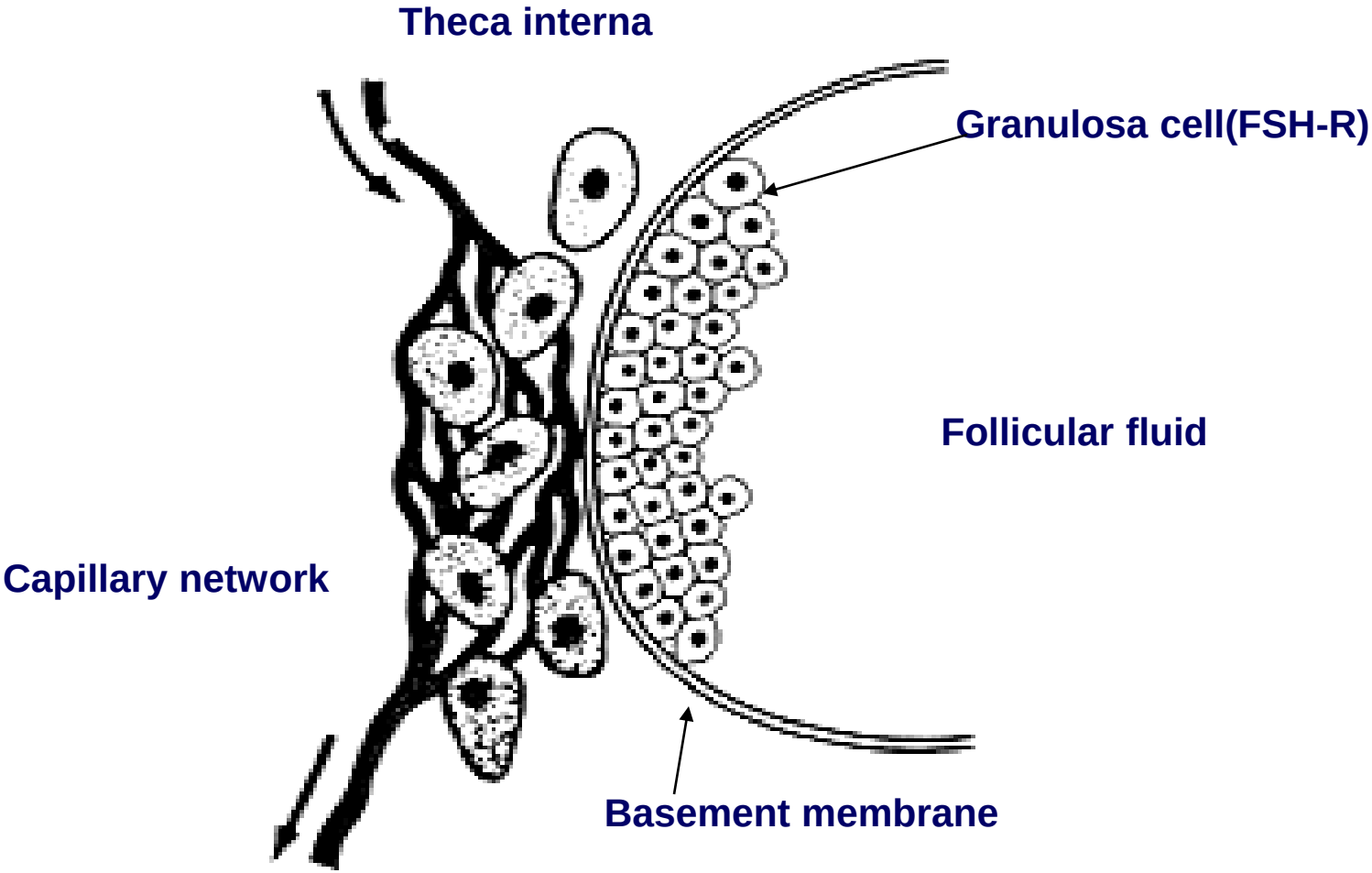


Estrogen secretion is from all selected follicle then from antral follicle

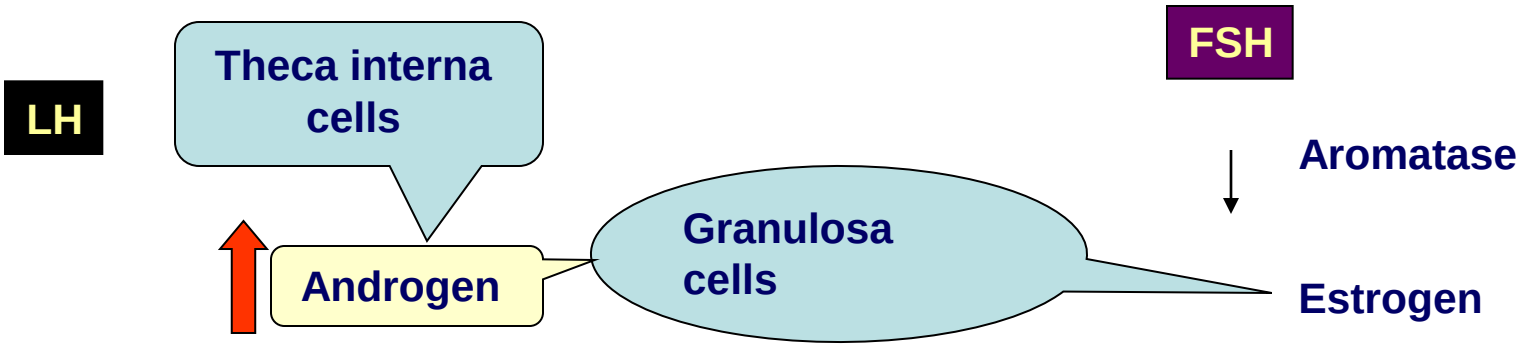
FSH → LH receptors

LH → Ovulation

LH → Lutenization of the ovulated follicle


Theca interna
Granulosa cell(FSH-R)
Follicular fluid
Capillary network
Basement membrane

Estrogen synthesis



Summary of follicular events during estrus cycle

- Two or three waves of follicular activity emerge at 0,9, 16 days after ovulation.

-The follicle of a wave undergo a common growth phase for 3 days after emergence .At the end of this phase ,deviation begins.

-Deviation has been proposed to be the eminent event in follicle selection.

-Each follicular wave is stimulated by a surge of FSH when the emerging follicles are 4-mm in cow& 6mm in mare. The FSH levels declining during the common growth phase.

-At the beginning of deviation ,only the more developed largest follicle is able to utilize the low FSH. The smaller follicles have not reached a similar developmental stage.

- A small transient elevation in LH begins before deviation and decreases after deviation .LH receptor increase in granulosa cells of the dominant follicle. The LH Stimulates the production of estrogen.

ovulation

Expulsion of the ovum from the follicle

preovulatorySurge of LH (follicle & oocyte)

LH stimulate PGF

FSH stimulate plasminogen activator

PGS stimulate collagenase

Oxytocin stimulate contraction of SMF. Of theca externa.

1-The ovulatory surge in LH is responsible for:

A-releasing MIF by which the primary oocyte of the GF resumes and completes its first meiotic division, resulting in the formation of two daughter cells, the secondary oocyte and the polar body. The newly formed secondary oocyte enters the second meiotic division and is arrested in metaphase.
B-Initiating acute changes in increasing local prostaglandins, lipoxins ,kinins, splatelet-activating factor cause dilatation of the capillaries in the theca interna of the follicle wall &hyperemic response)
2-Granulosa cells continue to synthesize proteoglcans and hyaluronic acid which attract water thus causing increase in the size of the GF and loosening of granulosa layer (cummlus expansion).
3-just before ovulation, the surface of the ovary looses its blood supply. (stigma) .The connective tissue at the stigma degenerate, loses its strength and rupture by the intra-follicular pressure.

Cumulus expansion :

The preovulatory surge of gonadotrophins induces marked changes in both the follicle and the oocyte – cumulus complex . Oocytes resume meiosis and progress to metaphase II before ovulation.

As oocytes mature in response to the preovulatory gonadotropin surge, cumulus cells secrete hyaluronic acid which becomes hydrated and the spaces between cumulus become enlarged and the cells become embedded in a sticky, mucified matrix (cumulus expansion and mucification)

Thus cumulus expansion is one of several important processes that must occur in preovulatory follicles to enable ovulation .

Types of ovulation

Induced or reflex ovulatory animals : this type is stimulated by the act of copulation .physical stimulation of the cervix triggers the release of gonadotropins from the pituitary. These gonadotropins signals the egg to resume meiosis and initiate ovulation after 30hours from LH surge (she-camel)&10½ in rabbits.

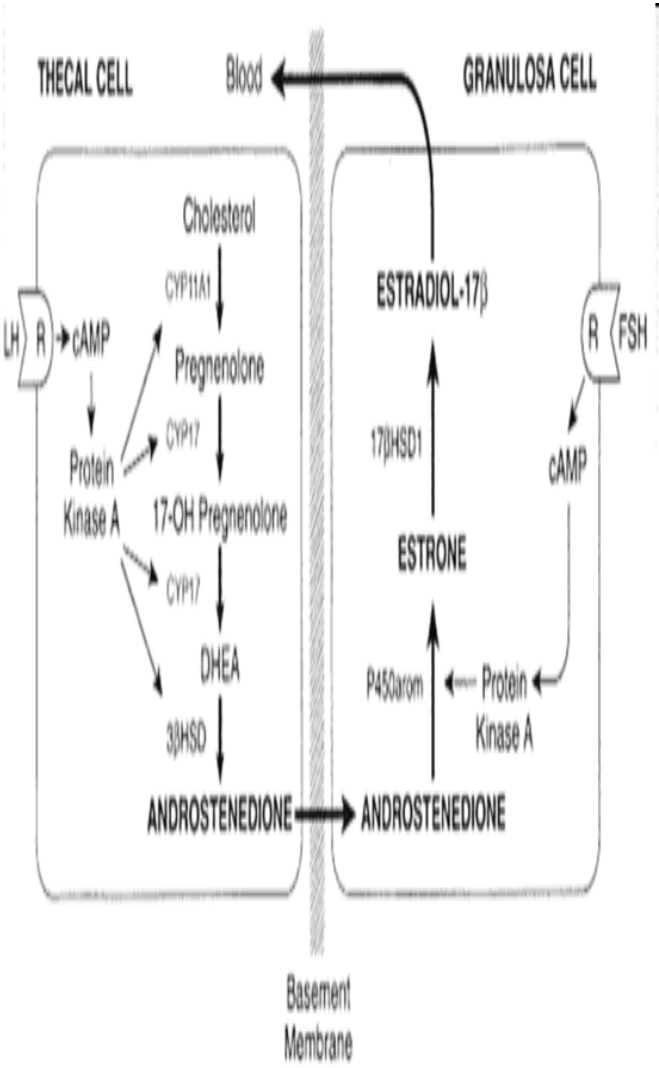
Spontaneous ovulatory animals : a periodic ovulation pattern independent on mating , in which female ovulates at specific time of the year

Lutenization

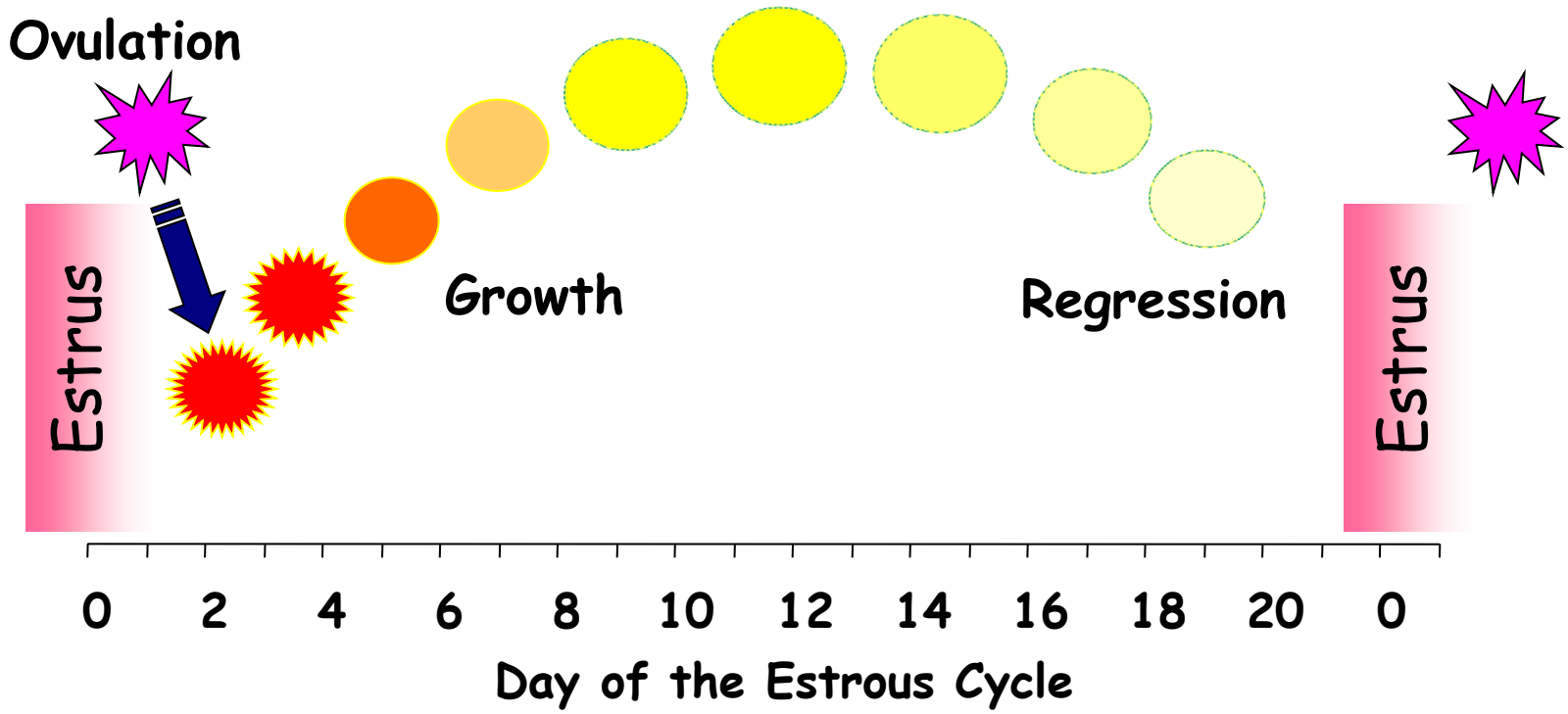
Formation of CL under the effect of LH after the rupture of the follicle & release of oocyte

- granulosa cells are transformed into lutein cells (80%) they produce progesterone and convert androgens produced by the theca-lutein cells into estrogen.

-theca – lutein cells (20%) produce progesterone ,some estrogen and androgens .

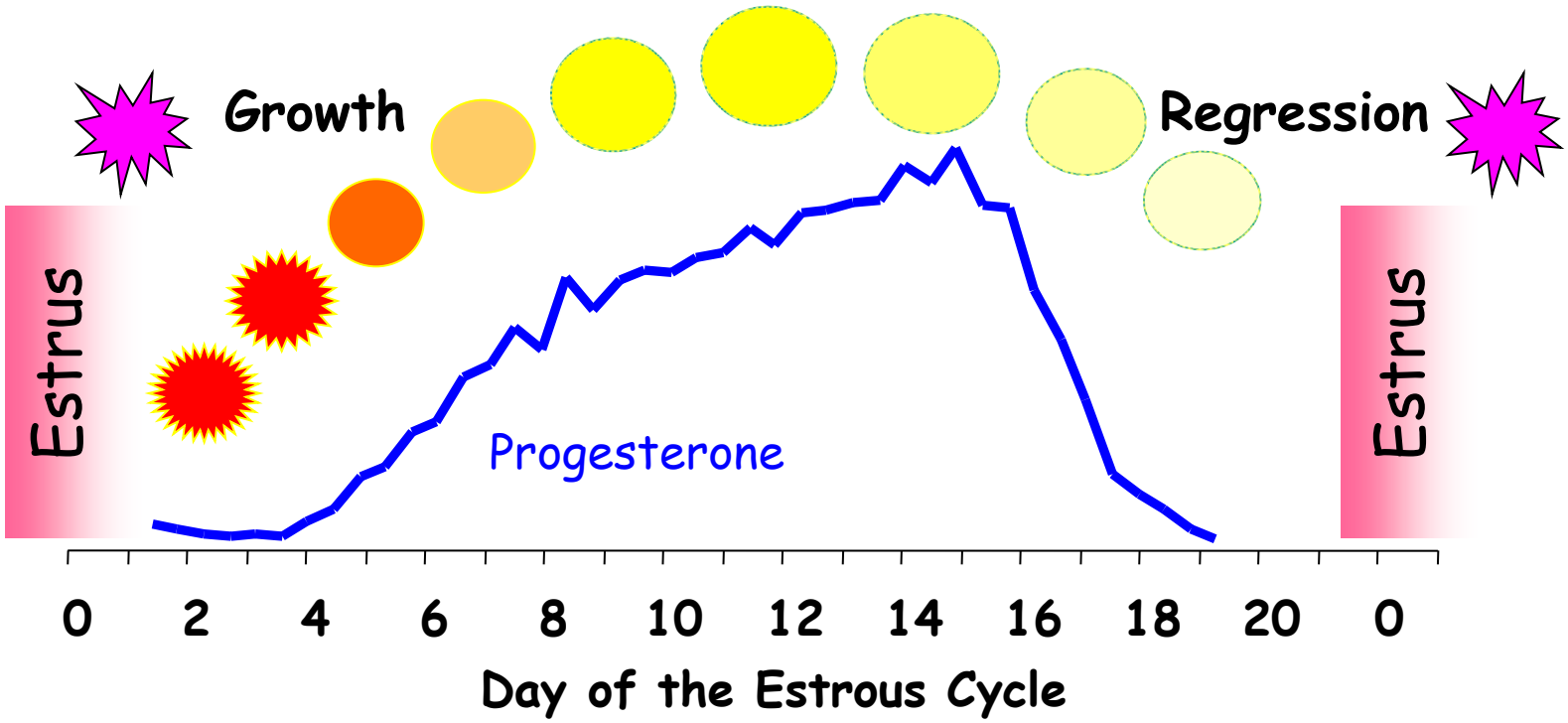


Corpus Luteum (CL)
Growth and Regression



- Corpus luteum develops from the ovulated follicle and takes approximately 10 days to reach mature size

Corpus Luteum (CL)
Progesterone



- Corpus luteum produces progesterone
- Progesterone is responsible for maintenance of pregnancy after conception occurs

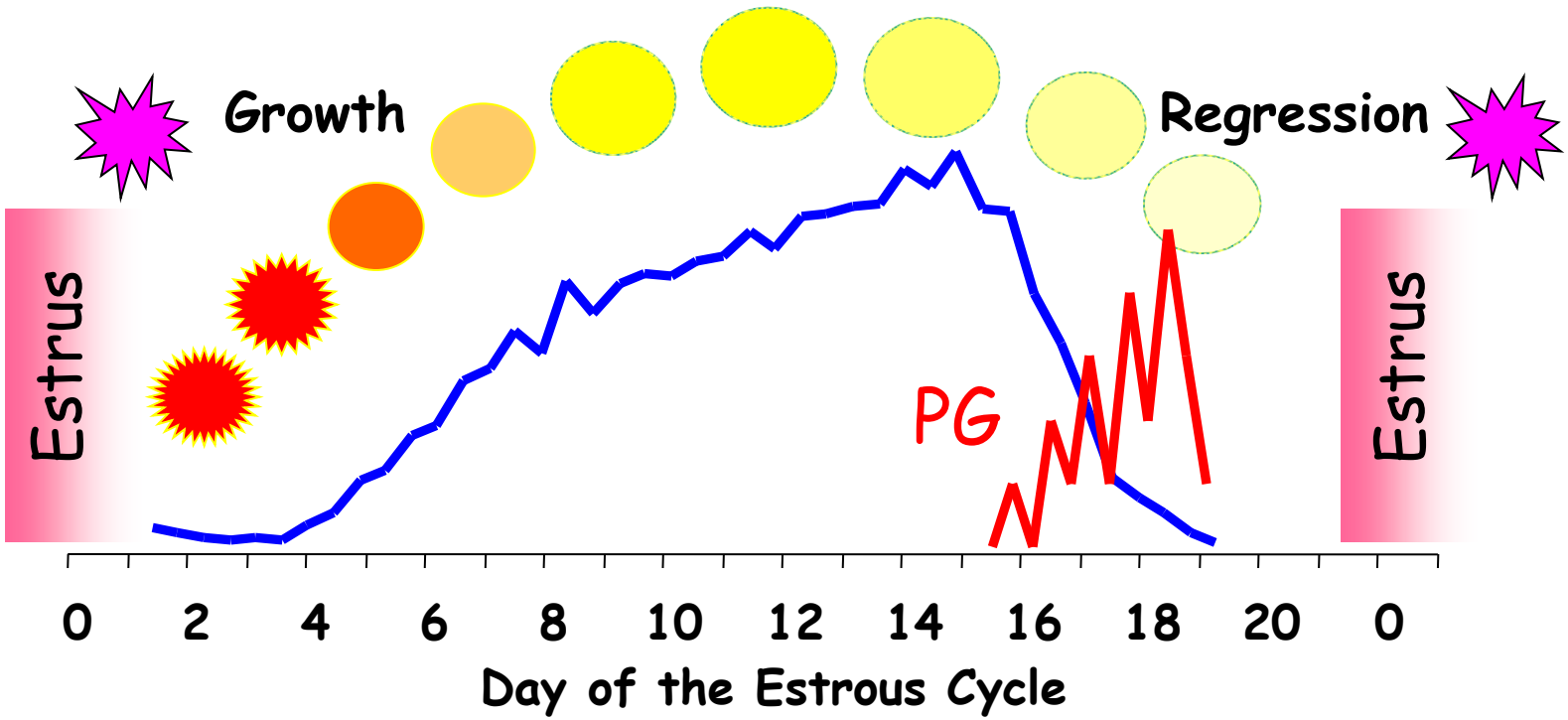
In rodents there is blood clot formed in the center which is surrounded by lutein cells forming corpus haemorrhagicum. This clot is absorbed and CL become fully developed CL to secret large amount of progesterone and small amount of estrogen

LH interact with receptors (theca interna) to stimulate the secretion of progesterone and initiate morphological and functional changes.

luteolysis

Regression of CL and becomes fibrotic and stop to function and a new cycle begins as a result of fertilization failure. The fibrous connective tissue that forms in place of CL is known as corpus albicans which persists for sometime before reabsorbed.

Corpus Luteum (CL) Regression
Prostaglandin $F_{2\alpha}$ (PG)

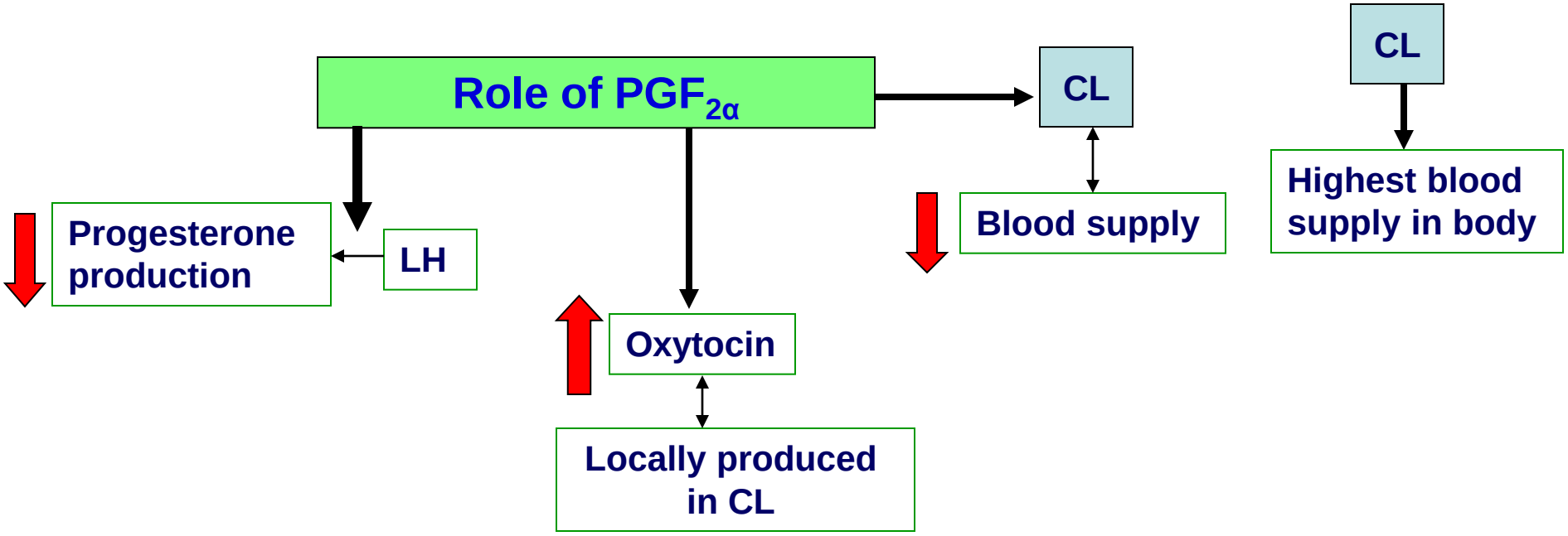


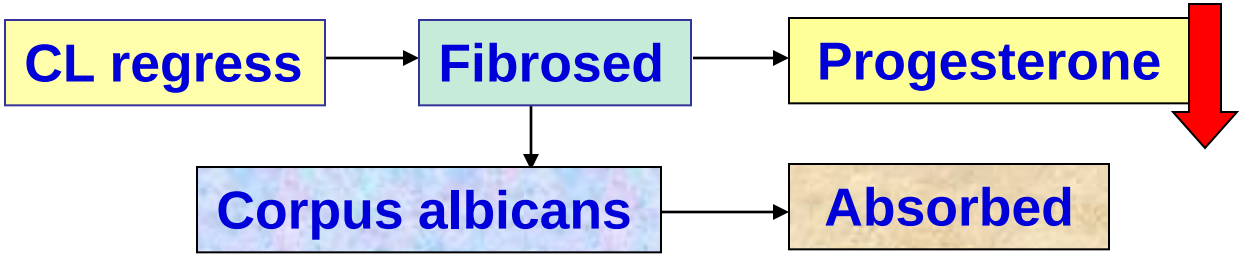
- Late in the estrous cycle, uterus produces PG which causes regression of corpus luteum
- PG is the same or similar hormone in "Lutalyse®", "Estrumate®", "ProstaMate®", and "In Synch®"

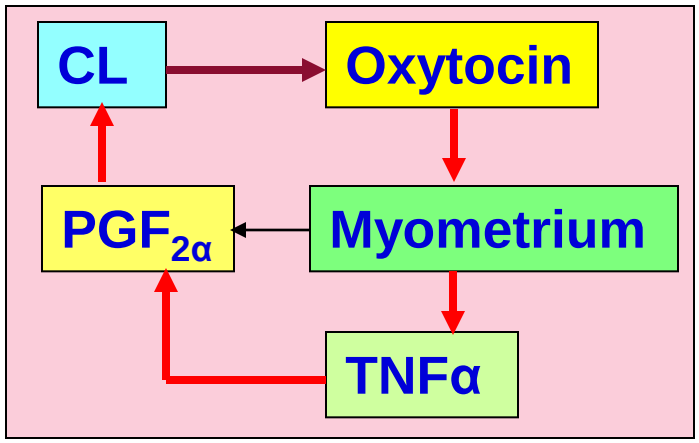
If fertilization and implantation do not occur, the rising level of progesterone and estrogen from CL inhibit GnRH leading to inhibition of LH. So CL degenerates and becomes corpus albicans.

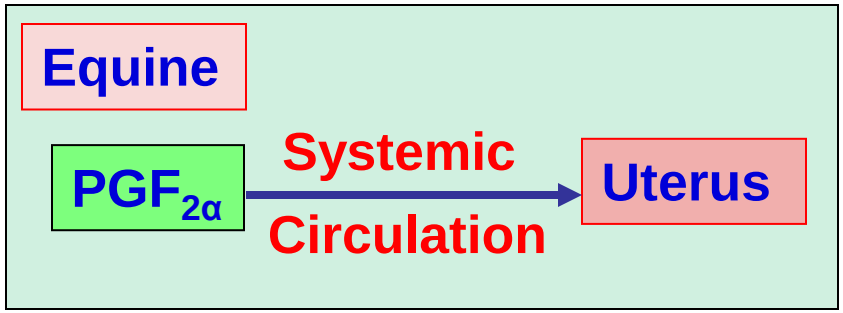
Oxytocin (formed by CL has dual effect):

1. It support secretion of progesterone (lutotrophic) through formation of 3BHSD enzyme(hydroxysteroid dehydrogenase) which help P4 production which in turn leads to formation of PGAenzyme (peptidylglycin-α-amidating mono- oxygenase) responsible for processing oxytocin
2. It increase PGF2α (from uterus) which lead to Luteolysis.

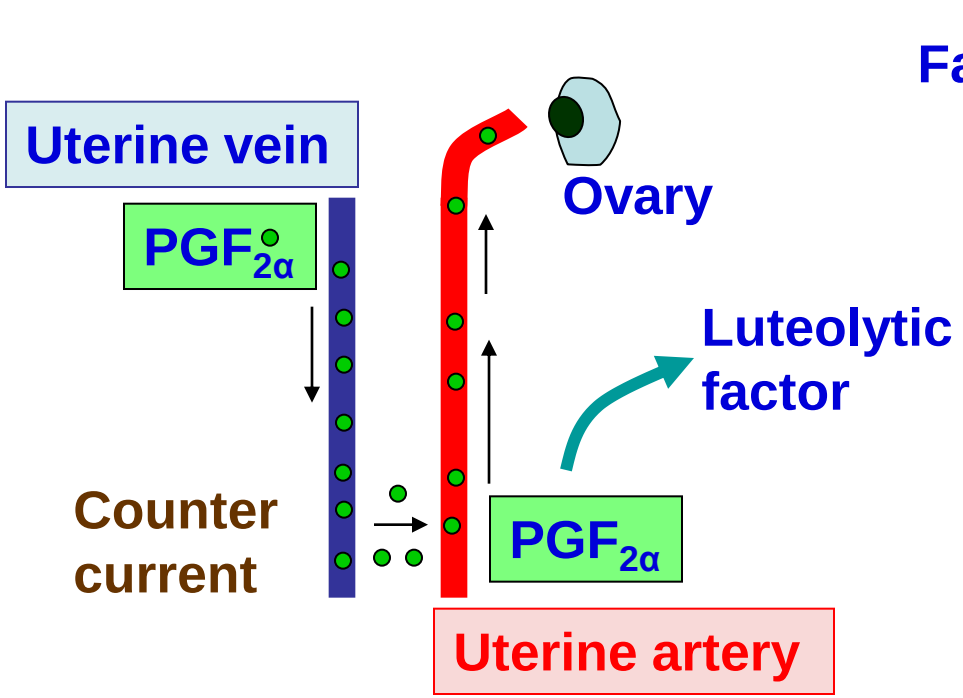

Role of PGF2α
CL
CL
Highest blood supply in body
Blood supply
Progesterone production
LH
Oxytocin
Locally produced in CL

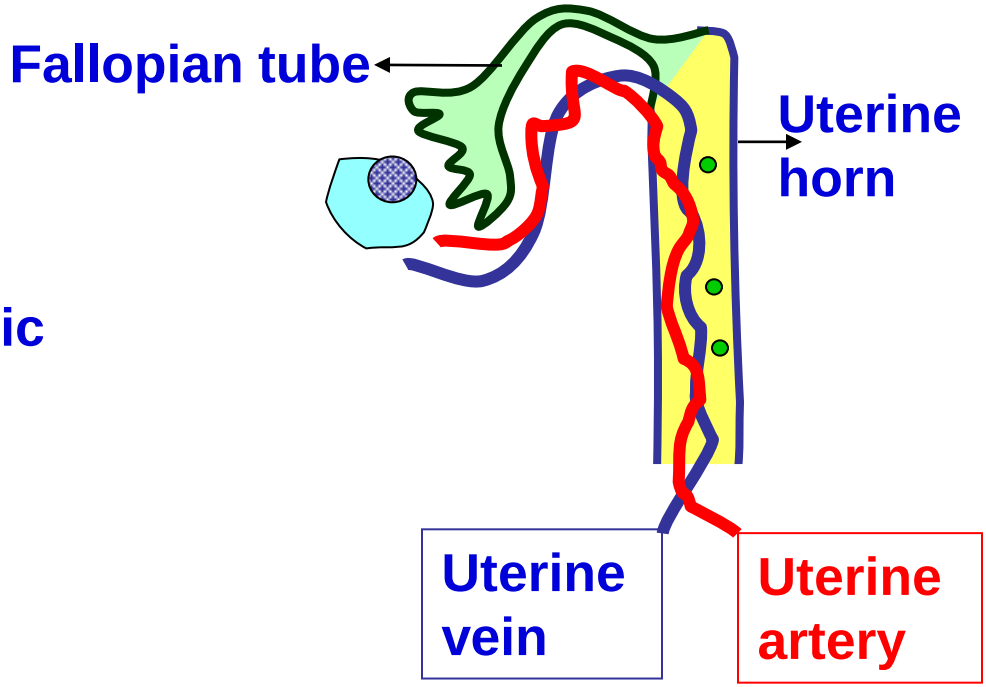

CL regress
Fibrosed
Progesterone
Corpus albicans
Absorbed


CL
Oxytocin
PGF2α
Myometrium
TNFα


Equine
PGF2α
Systemic
Circulation
Uterus

Local utero-ovarin pathway of PGF²α is the mechanism of CL regression in cow& ewe while in mare there is no direct unilateral effect of the PGF²α from the uterus to the ovaries, since the uterine artery is relatively straight and caudal to the ovarian vein. Thus, in mares the regression of CL is systemic pathway.





Mode of action of PGF2 on Luteolysis

-Constricting utero –ovarian vessels causing ischemia and starvation of luteal cells.

-Interfering directly with progesterone synthesis by interfering with ability of LH to activate adenylcyclase.

-Competing with LH for receptor site .

- Destroying LH receptor site.

Luteal phase:CL grow under the effect of LH leading to production of progesterone

The uterus become flabby as progesterone decreases its water contents

Increase secretory activity of endometrial glands

The glands appear tortuous ,coiled and become secretory.

Oestrous cycle

Rhythmic sexual behavior patterns develop in female animals after puberty.

Types of estrous cycle:

According to duration (short- long &very long

Short:4-5 days as in rat, ferret and mouse.

Long: 2-3 weeks as in cow ,buffalo, mare, ewe and sow.

Very long: from 3-6 month as in bitch.

According to pattern:

Spontaneous estrous: estrous comes at any time of the year (cow-buffalo and mare).

Seasonal polyestrous: estrous appears several times only during season (ewe & mare).

Seasonal monoestrous: one estrous cycle occur once during definite season of the year as in bitch.

Continuous: estrous is continuous and ovulation takes place after copulation as in case of rabbit, cat ,mink, camel and wolf (induced ovulators).

The mature graffian follicle does not end by ovulation but degenerate followed by development of a new follicle .Thus we get a continuous production of estrogen responsible for estrous.

Phases of estrus cycle:

Proestrous:-

Which is characterized by the following:

Ovarian follicle are growing rapidly under the effect of FSH

Begins at 17-21 days of estrous cycle in cattle.

Increase estrogen secretion by the follicle & decrease progesterone from CL

Increase mucosal layers of the uterus and vagina

Increase uterine vascularity and contractility (edematous & turgid).

Proestrous bleeding in bitch due to effect of estrogen.

Reproductive Cycle

Estrus cycle

Heat or estrus

Menstrual cycle

Menstruation

Prominent event

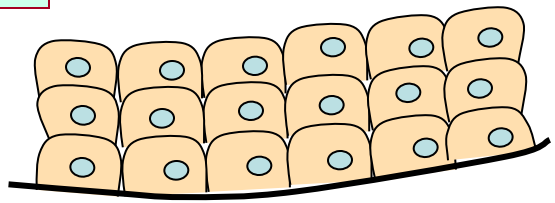
Primates

Phases of estrus cycle

Proestrus

FSH

LH



Mucosal layers

Uterus & vagina

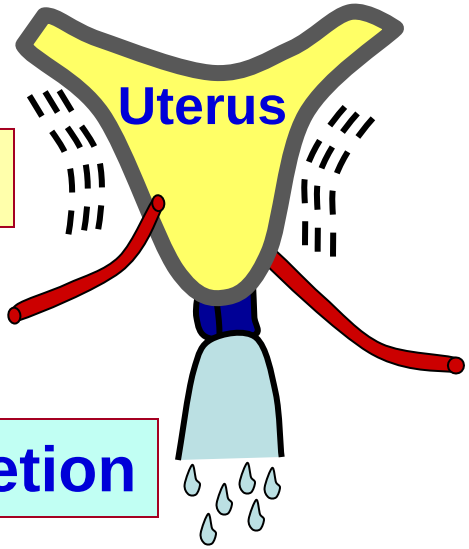
Estrogen

Rapid growth the of the ovarian follicle(s)

Contractility

Vascularity

Serous secretion



Begins day 17-21 of the previous cycle

Estrous:-

Begins at day 1 of the estrus cycle.

High level of estrogen (preovulatory surge of LH behavioral estrus).

All animals ovulates during this phase except cattle.

Cervix is edematous & turgid .Opened cervical canal and the secretion is thin, copious and watery , it can be pulled into threads (spinnbarkeit) aids in the movement of spermatozoa
The secretion is alkaline and contains NaCL increases at ovulation (arborization or palm leaf crystals).

Vagina &vulva (cornification &keratinization)

Metestrus-:

:Begins at days 2-4 of the estrus cycle.

Cow ovulates at the beginning of this phase.

Decrease estrogen and increase progesterone

High level of progesterone (inhibit FSH/ LH–

Inhibit uterine contractility –stimulate endometrial gland to produce uterine milk (progestational proliferation).progesterone results in thick &tough secretion and forms a cervical plug during pregnancy closes cervical canal to be impermeable for spermatozoa penetration.

Estrus **During it:** **All animals ovulate except cattle**

Estrogen → **Behavior estrus** **Male receptivity**

Estrogen → **LH surge** → **Ovulation**

Begins day 1 of the cycle

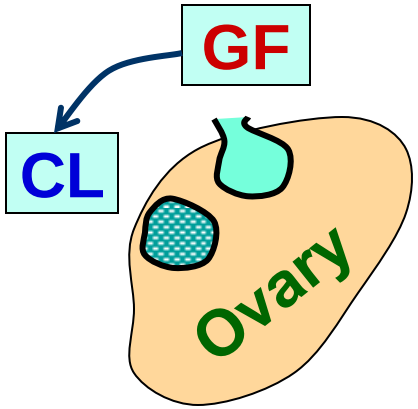
Metestrus **Beginning of luteal activity**

Progesterone ↓ **FSH/LH**

Estrogen ↓

Uterus ↓ **Contractility** ↓

Uterine milk ↑



Begins day 2-4 of the cycle

Diestrus;

Begins at days 5-16 of the estrus cycle.

Fully developed CL

CL remains functional for about 13 days in ewe and 15-17 days in sow, cow & mare.

If fertilization does not occur ,CL regress at this phase.

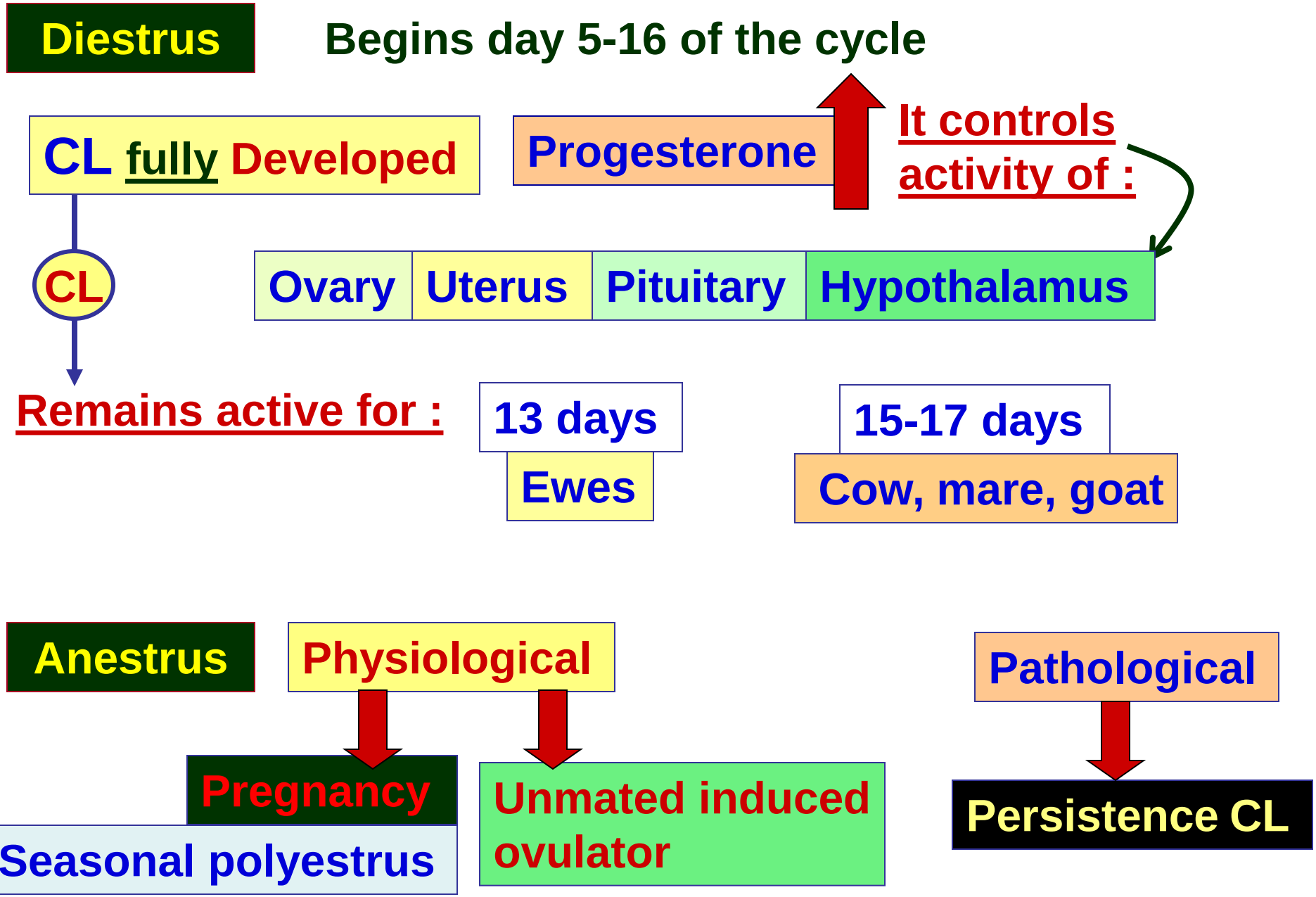
Anestrus:

It is a period between the diestrus and proestrus.

Quiescence of the reproductive tract.

Physiological (during pregnancy in spontaneous ovulators-in unmated induced ovulators –in seasonal monoestrus animals)

Pathological: persistence of CL without pregnancy


Diestrus
Begins day 5-16 of the cycle
CL fully Developed
Progesterone
It controls activity of :
CL
Ovary
Uterus
Pituitary
Hypothalamus
Remains active for :
13 days
Ewes
15-17 days
Cow, mare, goat
Anestrus
Physiological
Pathological
Pregnancy
Seasonal polyestrus
Unmated induced ovulator
Persistence CL
Not an estrus phase in polyesturs animals

Some reproductive peculiarities of farm animals

Cow

Length of the estrous cycle (range 18 to 24 days)

Estrus (standing heat)
12 to 18 hours (range 8 to 30 hours)

Ovulation :- Approximately 30 hours after the beginning of standing heat (or 12 to 18 hours after the end of standing heat)

Major structures on the ovary are follicle … a blister-like structure containing the egg (referred to as oocyte); produces hormone "estrogen"

High amount of estrogen causes "standing heat" and "ovulation" produces hormone"progesterone" that is responsible for maintenance of pregnancy.

Signs of estrus: bellowing-restlessness-clear mucus-homosexual

Ewe :polyestrus- or seasonal polyestrus

Estrus cycle 17 days- heat 30-40 hours spontaneous ovulation 8-10 hours before the end of estrous.

signs :usually silent using teaser

Goat: Seasonal polyestrus 20 days heat 30-40 h . Spontaneous ovulation 8-10 h. before the end of heat

signs : Swollen vulva.

.

Mare: Some are seasonal polyestrus, others are polyestrus 22 days.

Heat (4-11 days) average 6 days.

Spontaneous ovulation one - two days before the end of heat.

Signs: Swinging of rear quarters towards teaser.

Elevation of tail.

Frequent urination.

Winking of clitoris congested and hyperemic vulva.

Reproductive cycle in she- camel

Seasonal breeders-induced ovulators

No cyclic appearance of CL in non mated females .It is present only in pregnancy.

Follicular wave pattern in she camel(22-24 days):

Follicular recruitment 2-4 days

Growth phase: maximum diameter is 2cm taking 6-10 days

Mature phase:7.6 days.

Regression phase: in absence of mating , mature follicle regress -11.9 days

Bitch: seasonal monoestrus

proestrus: 7-9 days(male & female are interested to each other but coitus is not allowed. Sanguinous discharge due to estrogen

Estrus 4-13 with average of 9 days (the interest between male & female increased and coitus occurs 1-2 days after the onset of heat)-lordosis reflex.

luteal phase 70 days

Spontaneous ovulation continue for 12-72 h.

1-2 days after the onset of heat super fecundation

Queen: Continuous seasonal monoestrous

Cycle (15-21 days)

proestrus : Courtship activities and seeks out male but does not accept him.

Heat (4-9 days)

Rolling

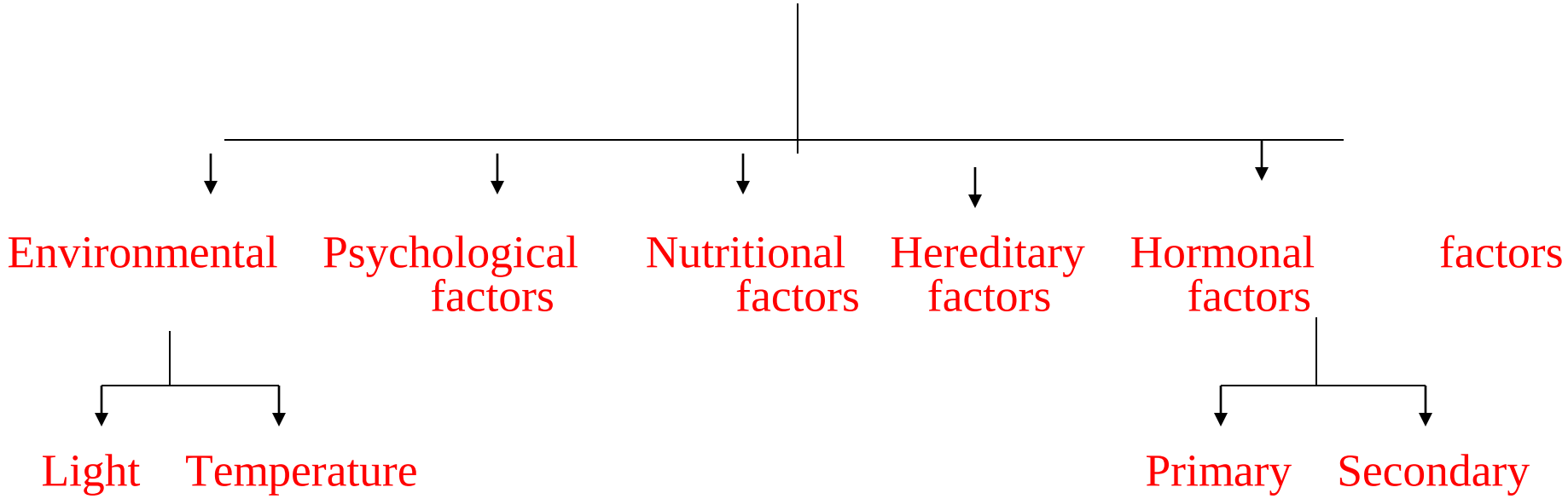
Rubbing against in animate objects,

Repetitive pawing

Tom (neck biting and mounting)

Ovulation: induced --24-30 h. after coitus superfetation.

Regulation of estrous cycle



A-Environmental factors

I-Light ;

Pineal gland is involved in the timing of seasonal cycle in reproduction (seasonal oestrous cycle) because it secretes photoperiodic hormone which is called melatonin which is in relation to daily light-dark cycles in all species , but it only influences the hypothalamic function in seasonal breeder .

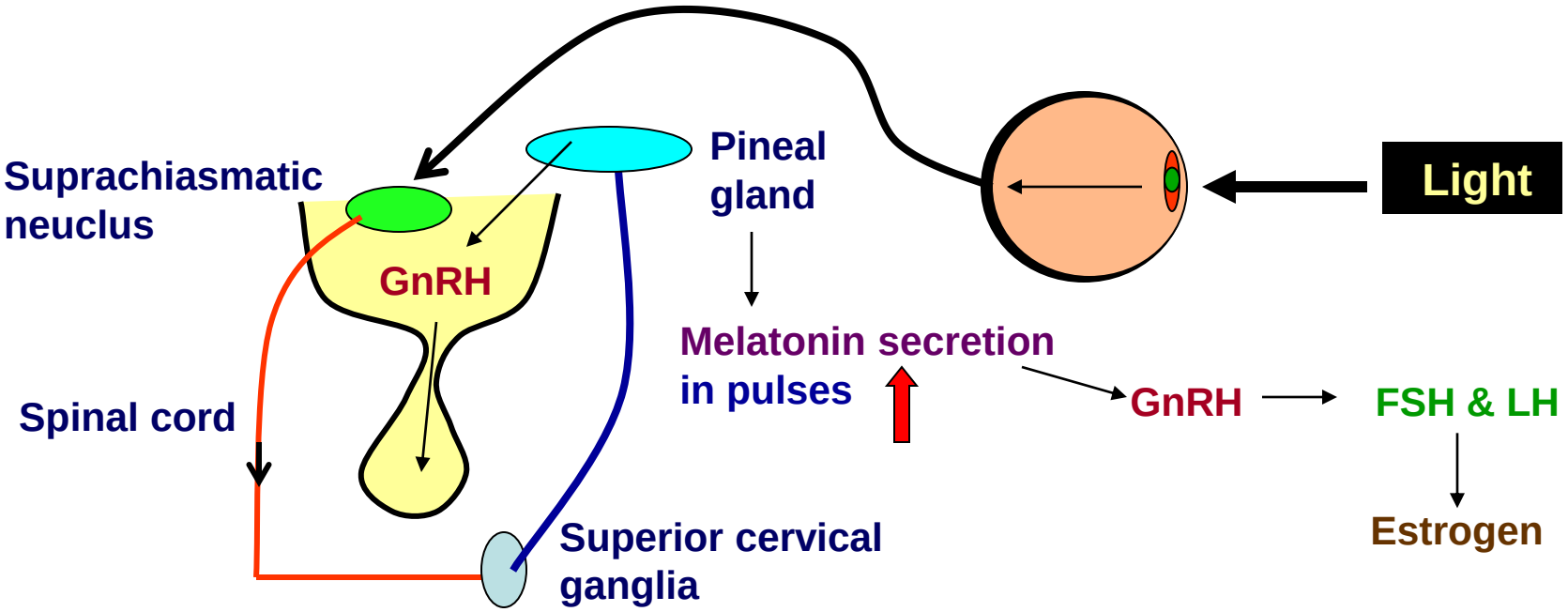
Change in the amount of light falling on the retina of eye produces an action potential that goes to the suprachiasmatic nucleus in hypothalamus.

Then, a descending efferent fiber goes from suprachiasmatic nucleus, reach the spinal cord and emerge to the superior cervical ganglia.

Adrenergic post-ganglionic fibers from the superior cervical ganglia supplying the pineal gland stimulate melatonin secretion. Melatonin stimulates the hypothalamus to release gondaotropin-releasing factors. The pattern of melatonin pulses during the day is the determining of the melatonin effect.

These releasing factors stimulate pituitary gland to secrete gonadotropin (FSH, LH) which cause the follicle cells to proliferate (folliculogenesis) and secrete estrogen. The estrogen has a dual action: enters certain neurons in mid brain and evokes the pattern mating behavior characteristic of the species (signs of estrus). Also, estrogen plays important role stimulating the LH surge from the pituitary gland, which is essential for the ovulation. However, ovulation occurs 24-45 h after LH surge except in mare in which ovulation occurs before the peak of LH surge.

Effect of melatonin on reproduction



II-Temperature ; warmth

stimulate the beginning of oestrous cycle.

B-Nutritional Factors ;

Adequate and balanced ration are necessary for regulation of oestrous cycle.

Flushing in sheep may produce super ovulation.

C-Psychological factors ;

In some species , presence of the male stimulates oestrous cycle and ovulation i.e. coitus is considered to exert an accelerating effect on ovulation (e.g., in goat and sow the pheromones secreted from both male and female stimulates oestrous cycle)

D-Endocrinological factors

I-Secondary factors ;

Growth hormone, cortisol, insulin hormone, and thyroxin are necessary for successful reproductive process.

II-Primary factors ;

A- Hypothalamic hormones (GnRH) ;

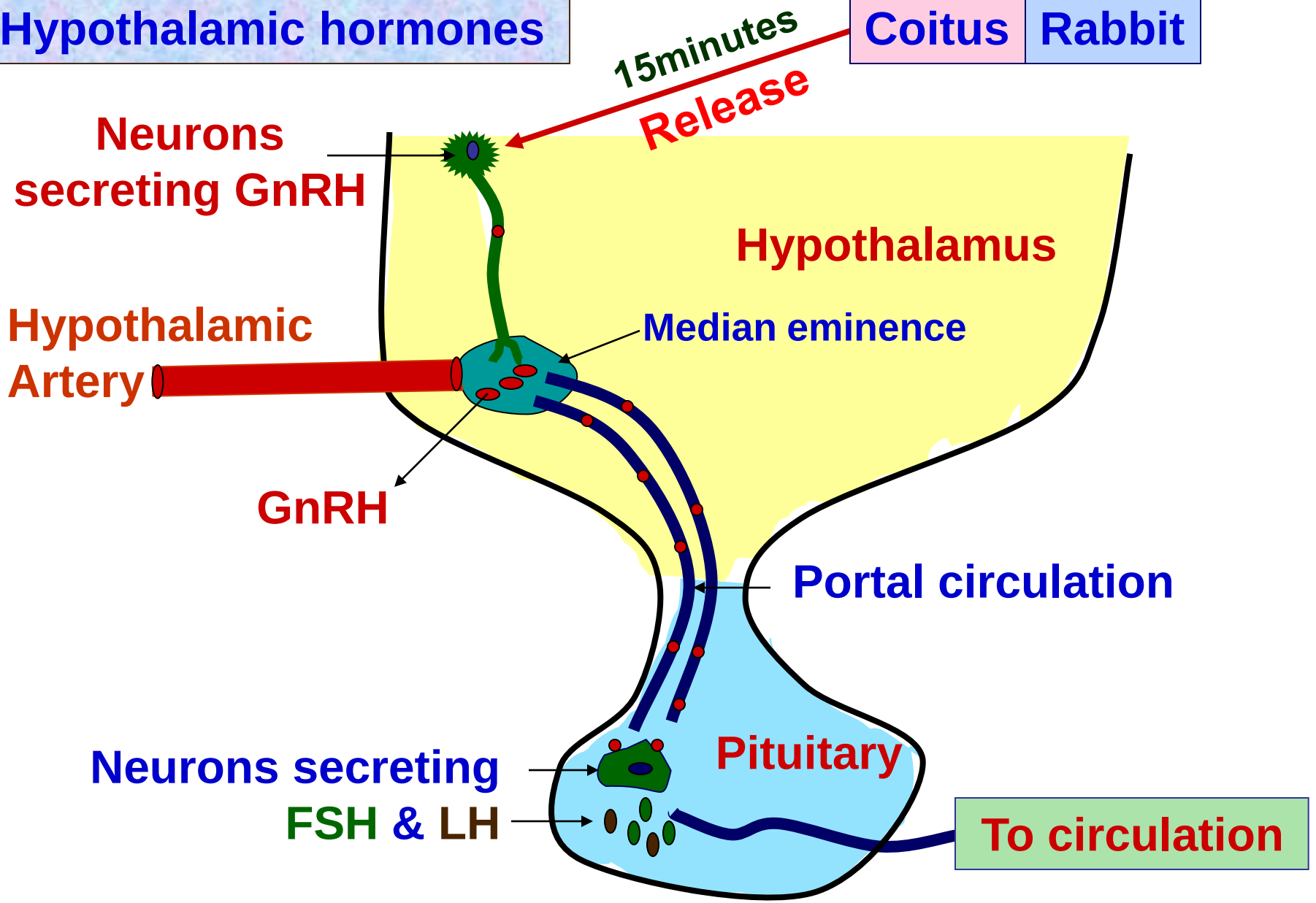
secreted from the hypothalamus and stored in the median eminence, then they are released in pulses and cause secretion of F.S.H. and L.H.

Hormonal control of ovarian cycle

Pheromones

Coitus | **Rabbit**

Hypothalamic hormones



B-Pituitary hormones ;

1 *-Anterior Pituitary hormones* ;

-F.S.H, L.H. and prolactin

FSH & LH act on the ovary and cause follicular ripening and estrogen secretion . The preovulatory surge of L.H. stimulates the granulosa cells to grow and secrete progesterone.

-*Post.Pit.Hormones* -Oxytocin

It is synthesized from hypothalamus and transported to post. Pit.(stored).

The hormone is released by increasing nervous activity in the supra-optic and para-ventricular nuclei which is stimulated by:

1-Nervous impulses in teat (suckling or milking).

2-Genitalia (during copulation & parturition).

Function of oxytocin:

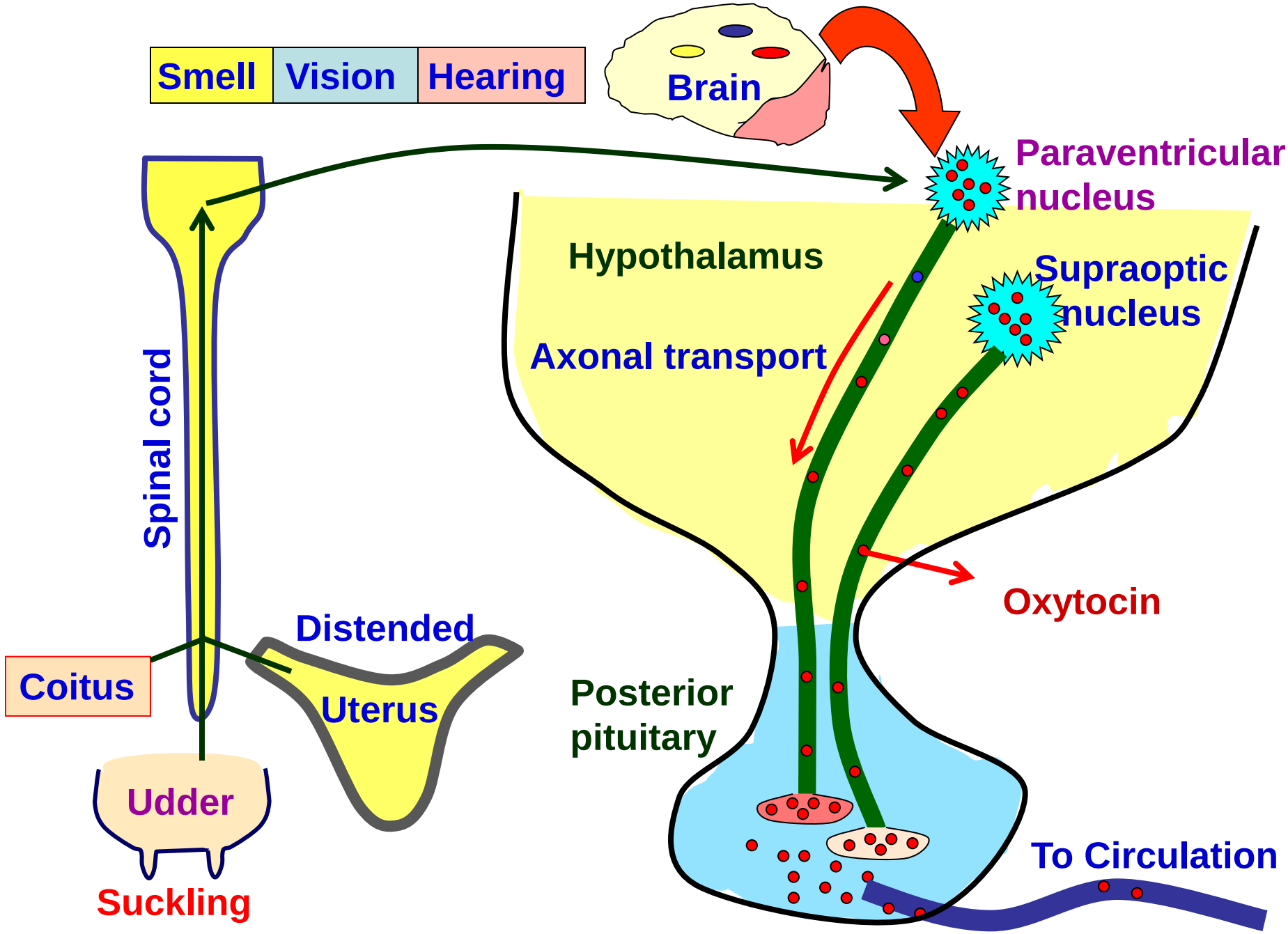
1-Contraction of G.Fduring estrous (ovulation)

2-Increase oviduct and uterine motility for ascendance of spermatozoa during coitus.

3-Causes luteolysis. 4-Parturition.

5-Let down of milk.

6-transport of ova down to the uterus.


Smell
Vision
Hearing
Brain
Paraventricular nucleus
Hypothalamus
Supraoptic nucleus
Axonal transport
Spinal cord
Oxytocin
Distended
Coitus
Uterus
Posterior pituitary
Udder
To Circulation
Suckling

C-Female sex hormones:

1- Ovarian hormones (estrogen-progesteron-bradykinin—relaxin—inhibin)

2- Uterine hormone (prostaglandins).

Role of Estrogen

Has DUAL effects;

High dose → Suppress FSH → -ve feedback

Very high dose → Release of LH → +ve feedback

Role of Progesterone

Suppress FSH & LH

Follicular phase

At the end of luteal phase of previous cycle

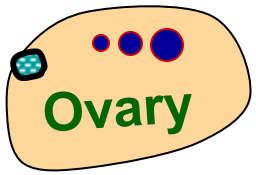
Progesterone ↓ | Estrogen | Inhibin

LH | FSH ↑

NO CL or GF

Luteolized CL ↑

GF not selected ↑



Anterior pituitary hormones

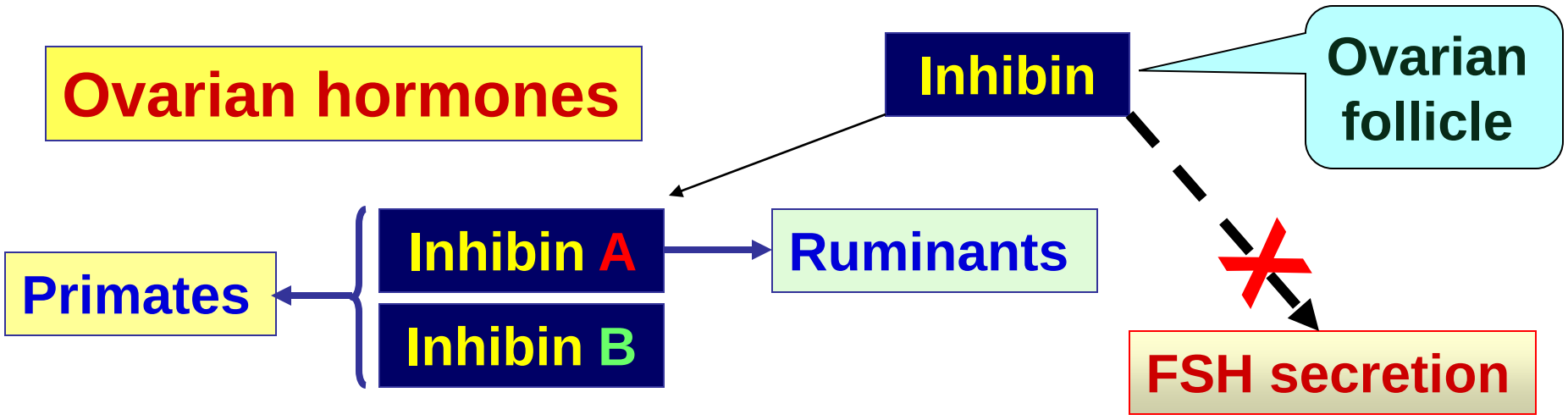
FSH

- LH receptors on antral follicle
- Follicular growth
- Synthesis of Inhibin B
- Synthesis of estrogen

LH

- Synthesis of progesterone
- Formation of CL
- Synthesis of Inhibin A
- Meiosis of oocyte
- Follicle selection
- Follicle dominance

Ovarian hormones



Estrogen

sex organs

Uterus

Uterine motility

Oxytocin receptors

Cervix

Cervical relaxation

watery secretion

Udder

Duct system

Vagina

Vaginal wall thickness and Vascularity

Signs of Estrus

Female fat distribution

Broad pelvis

Glycogen deposition

glycogenolysis

Lactic acid

Acidic vagina

Metabolic rate

Na & H_2O retention

Ca^{2+} deposition in bone

Prolactin release

Progesterone

Progestional block

Myometrial activity ↓

Quiescent uterus

↑ **Uterus**

- **Blood supply**
- **Spiral arteries** — **Primates**
- **Endometrial thickness**
- **Uterine glands** — **Secretory activity**

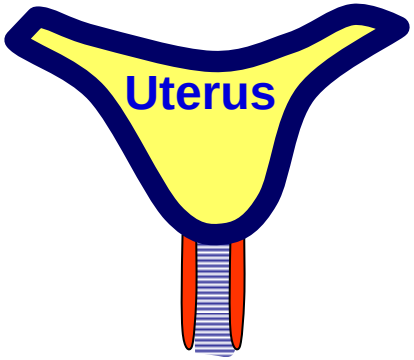
Glandular part of udder ↑

Cervical closure ↑

Thick cervical mucus ↑

↓ **Estrogen**

body temperature



Bradykinin hormone:

Isolated from follicular fluid and released at the time of ovulation

Activated by fallopian tube secretion results in relaxation of its muscles.

This mechanism creates a negative pressure in the oviduct to trap the released ovum.

Relaxin:

Relaxes pubic symphsis and other pelvic joints and softens and dilates the uterine cervix during pregnancy. Thus it facilitates delivery. It inhibit uterine contraction and play a role in the development of the mammary gland.

Inhibin:

Higher level of FSH in blood stimulate the granulosa cells to produce inhibin to lower FSH (feed back mechanism).

Prostaglandins

Contraction of:

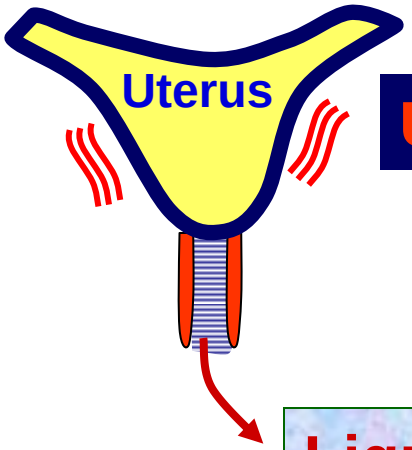
- Follicular wall

- Ovulation

luteolysis

Synchronization of estrus

All animals get in estrus together



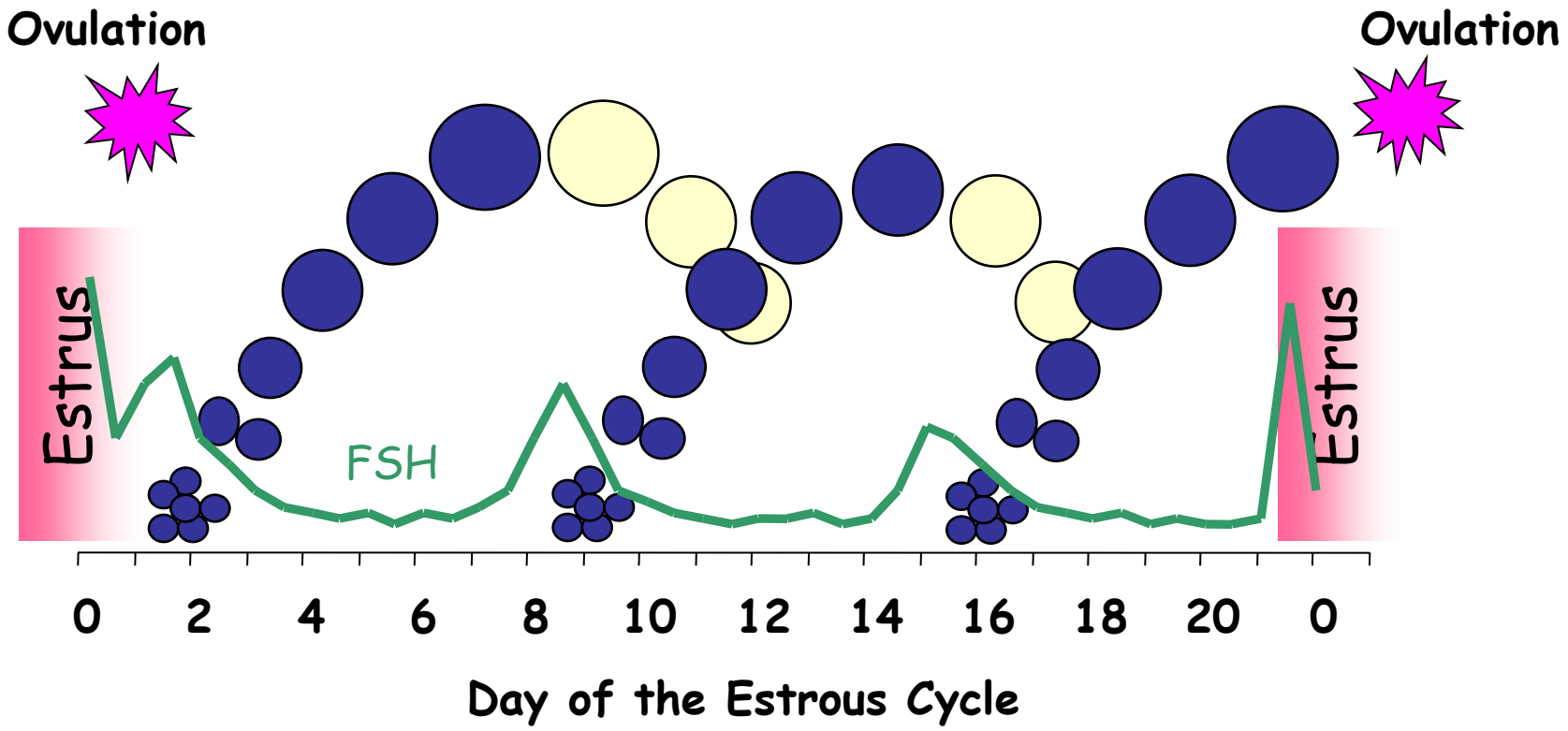
Uterine contraction

During parturition

Liquefy cervical mucus

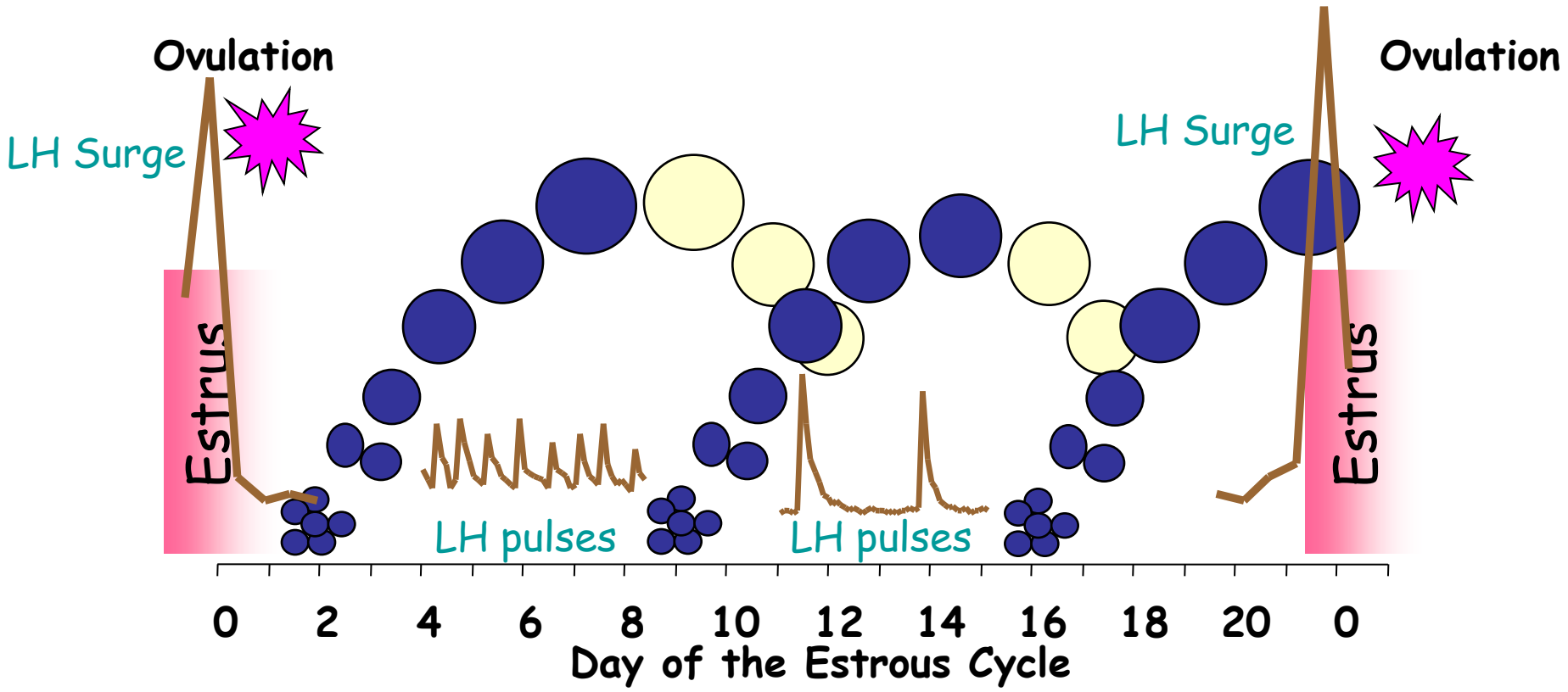
Sperm transport

Endocrinology During the Estrous Cycle
Follicle Stimulating Hormone (FSH)



- Example shown for cattle having 3 follicular waves during a 21-day estrous cycle

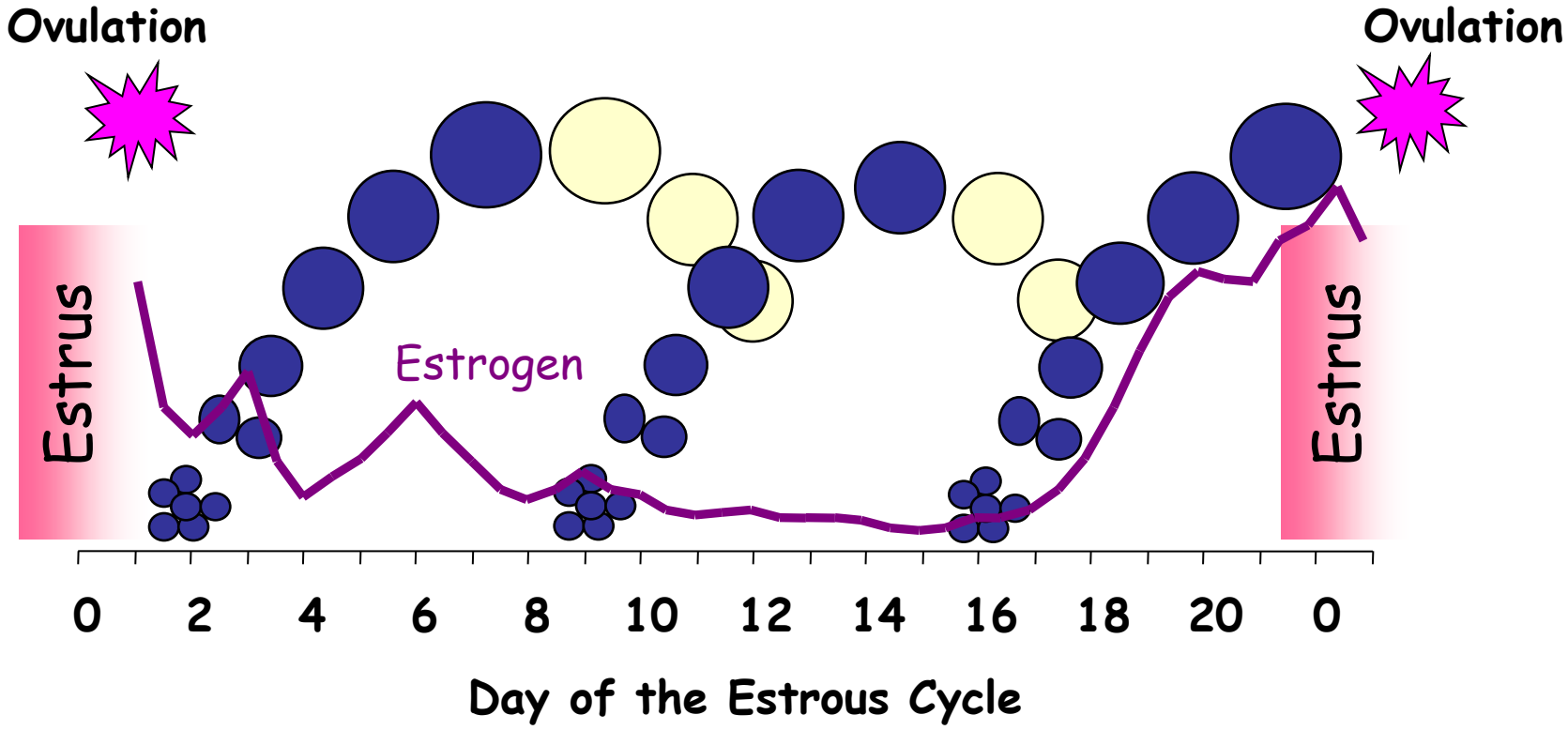
Endocrinology During the Estrous Cycle
Luteinizing Hormone (LH)



- Example shown for cattle having 3 follicular waves during a 21-day estrous cycle

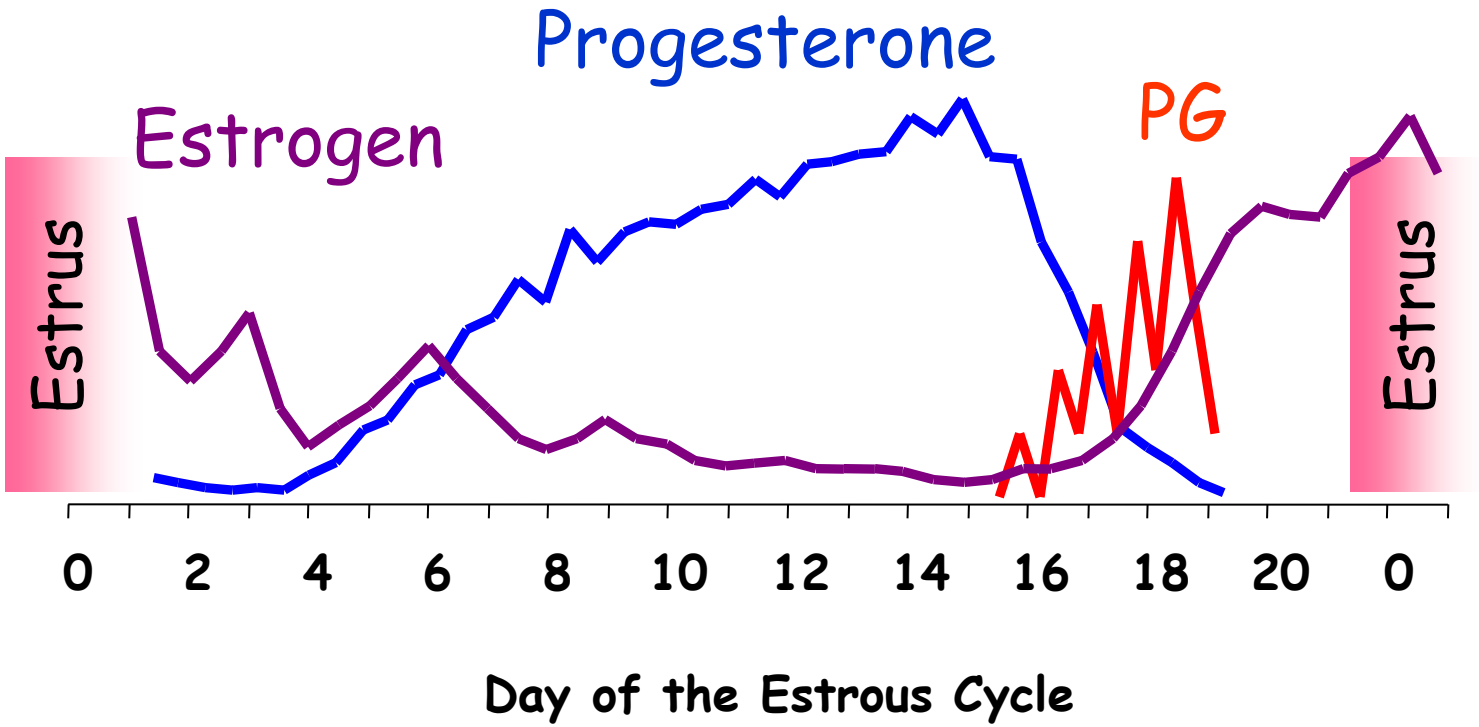
Endocrinology During the Estrous Cycle

Estrogen



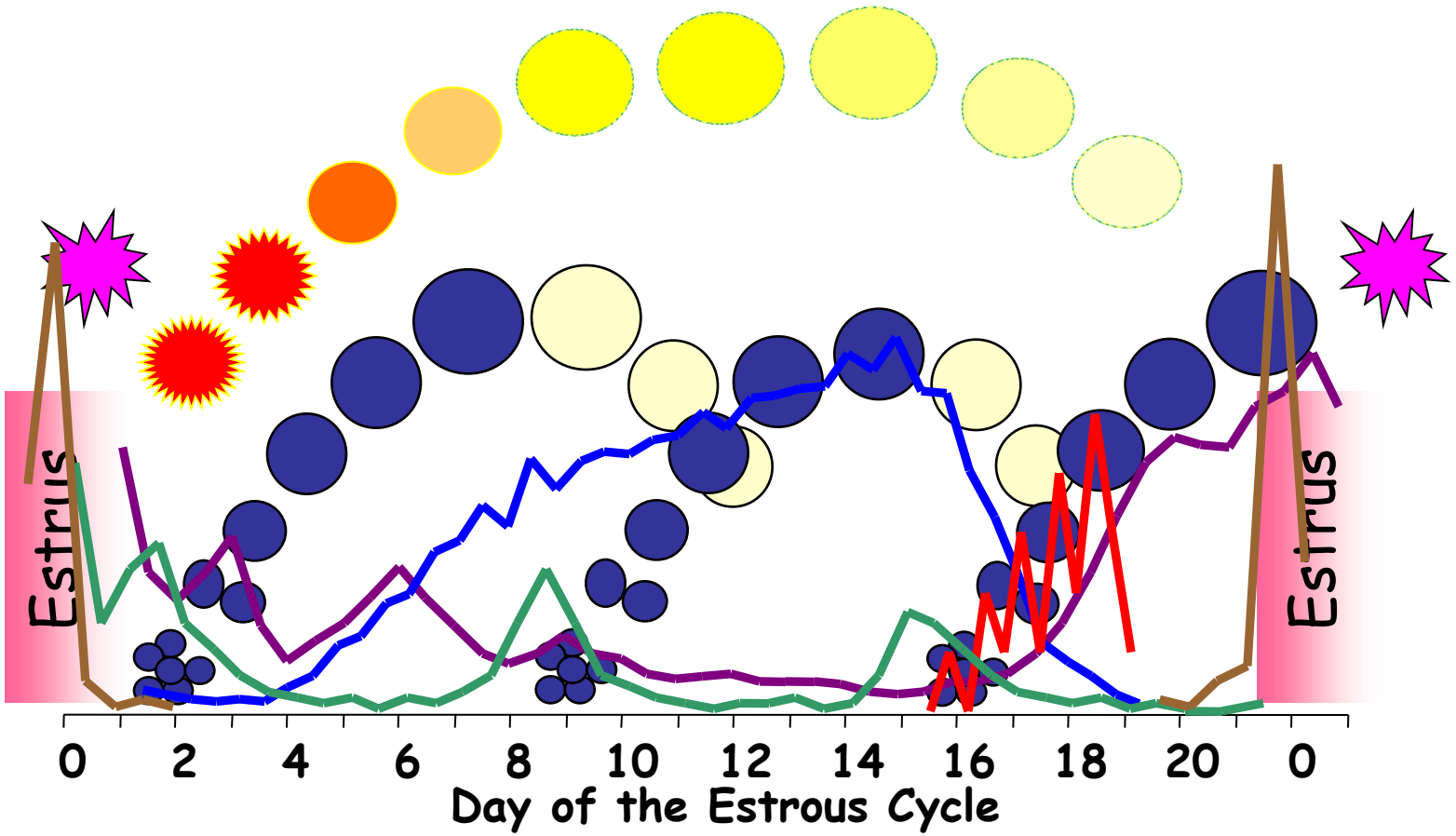
- Example shown for cattle having 3 follicular waves during a 21-day estrous cycle

Endocrinology of the Estrous Cycle

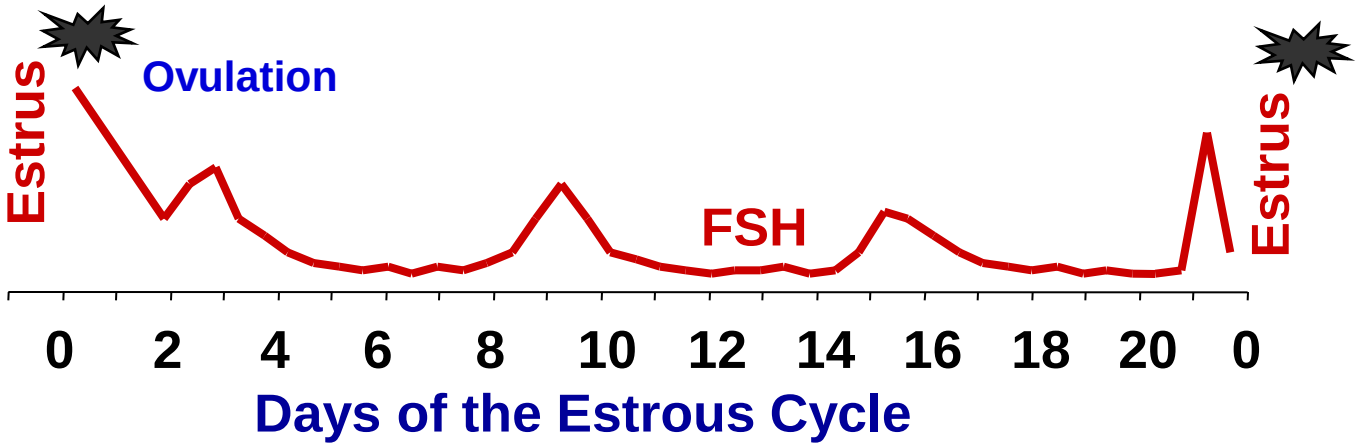


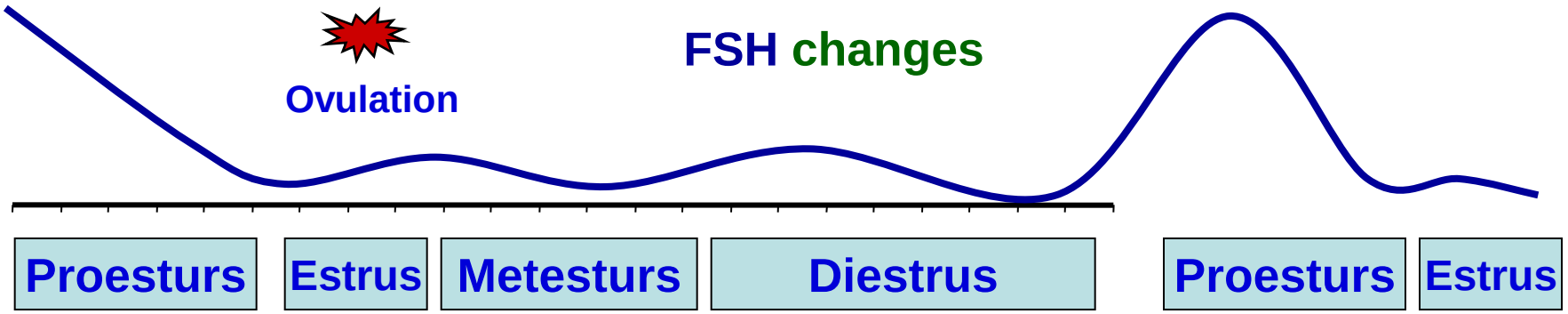
- Relationships among estrogen, progesterone, and PG during the 21-day estrous cycle

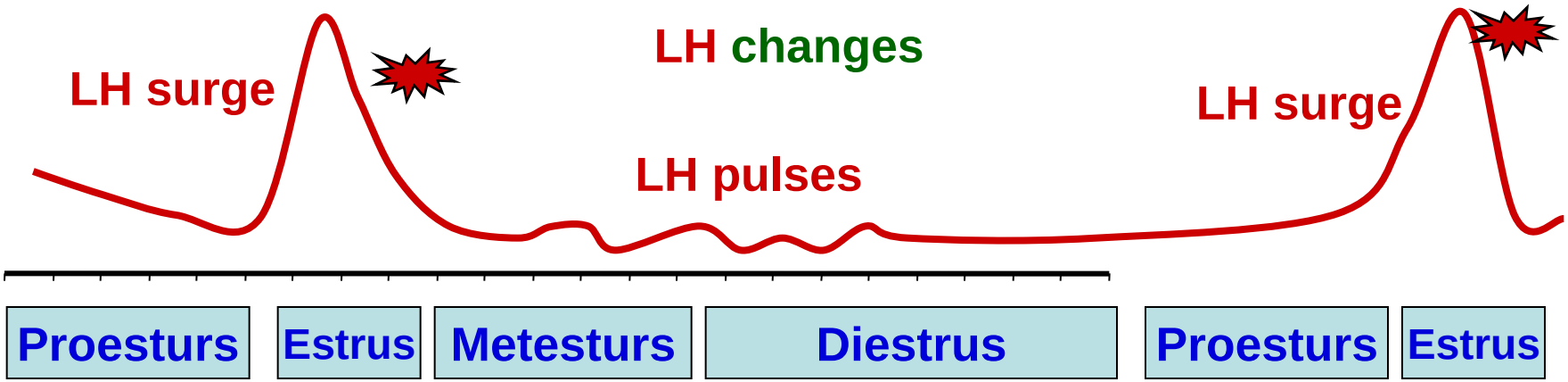
Physiology and Endocrinology of the Estrous Cycle

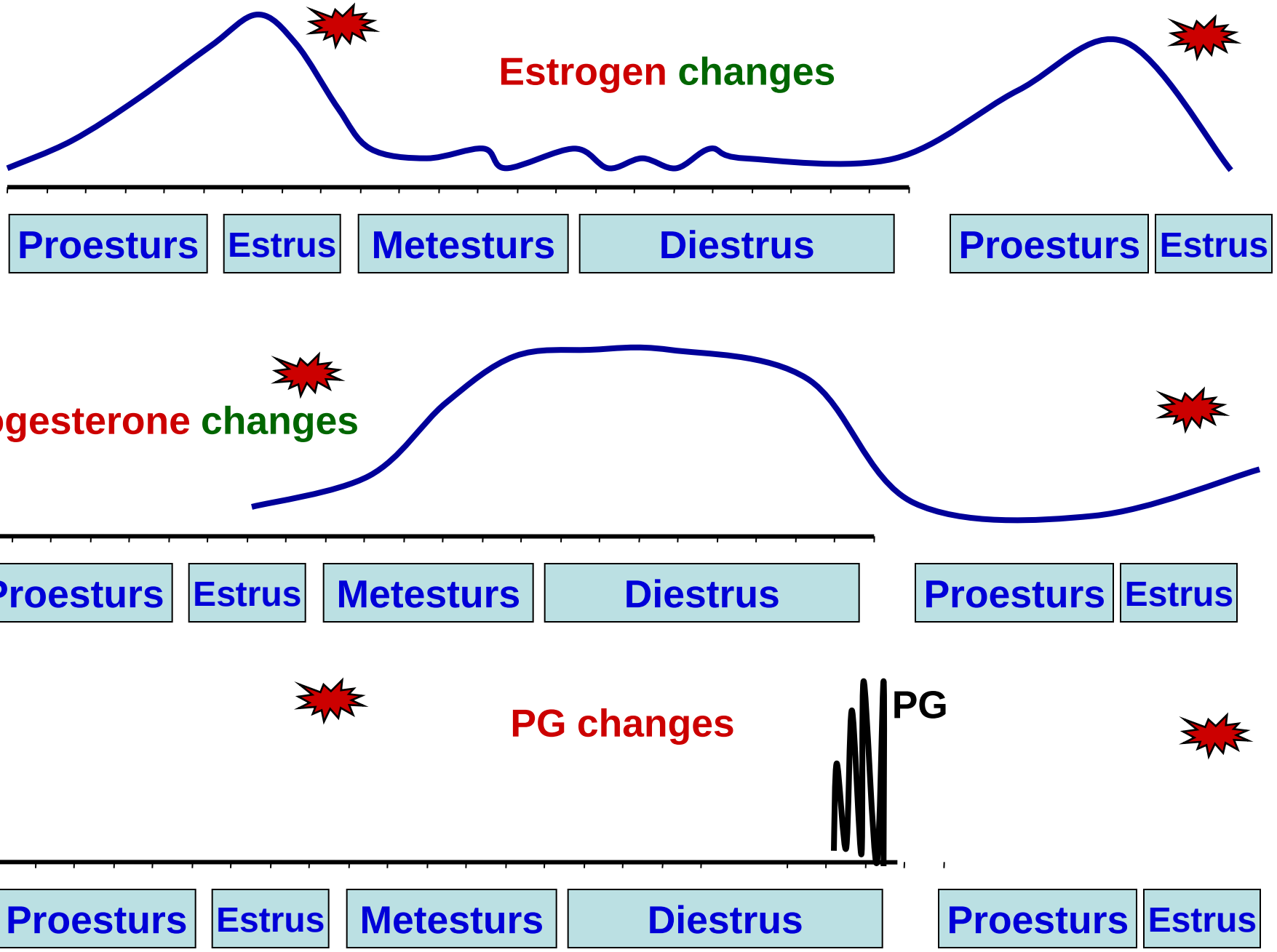


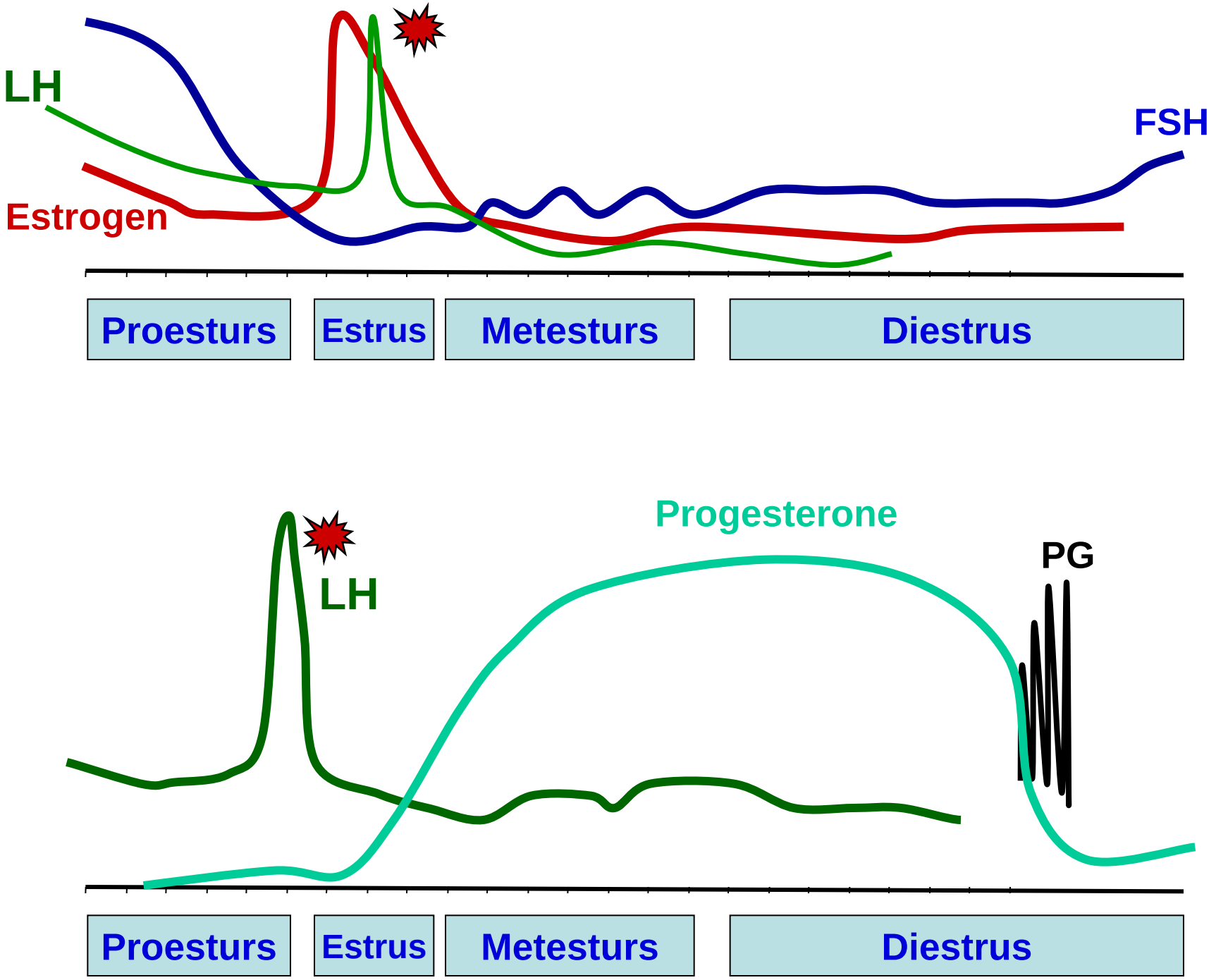
- Relationships among structural and hormonal changes during the 21-day estrous cycle (example shown for cattle having 3 follicular waves)


Estrus
Ovulation
FSH
Estrus
0 2 4 6 8 10 12 14 16 18 20 0
Days of the Estrous Cycle

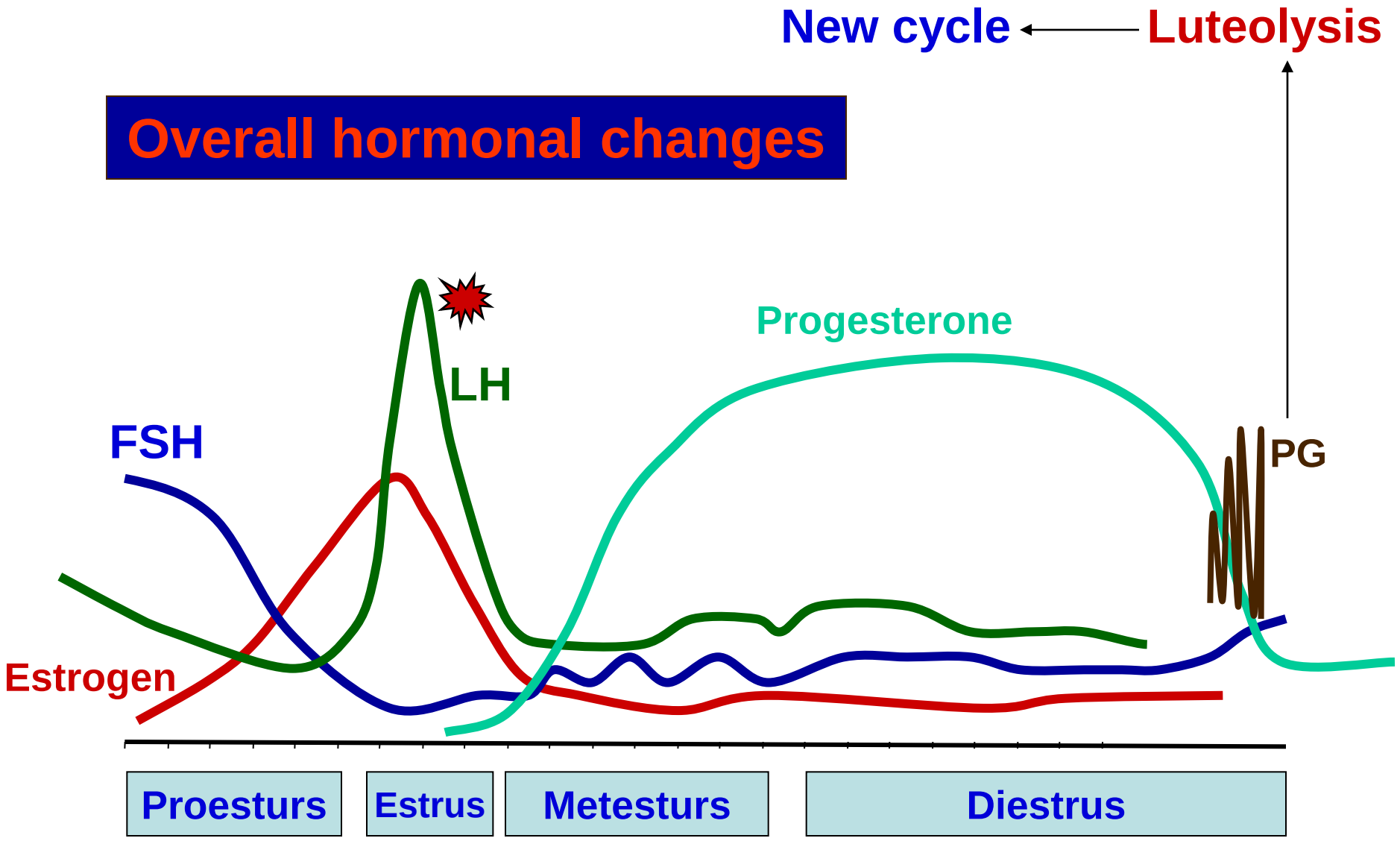

Ovulation
FSH changes
Proesturs
Estrus
Metesturs
Diestrus
Proesturs
Estrus


LH surge
LH changes
LH surge
LH pulses
Proesturs
Estrus
Metesturs
Diestrus
Proesturs
Estrus


Estrogen changes
Proesturs
Estrus
Metesturs
Diestrus
Proesturs
Estrus
Progesterone changes
Proesturs
Estrus
Metesturs
Diestrus
Proesturs
Estrus
PG changes
PG
Proesturs
Estrus
Metesturs
Diestrus
Proesturs
Estrus


LH
FSH
Estrogen
Proesturs
Estrus
Metesturs
Diestrus
Progesterone
PG
LH
Proesturs
Estrus
Metesturs
Diestrus

Overall hormonal changes



Phermones: are substances that are secreted by one sex and when detected by the other sex ,it induce activation of its sexual derive.

In some males a special glands are located in the head region near the horns called pole glands, it secretes volatile substances that can be smelled by the females and increase their sex drive.

Also the sloughed keratinized epithelium lining the vagina of female during heat period become decomposed by the action of normal flora inhabiting the vagina and the result is a wide variety of volatile fatty acids specific for that species.

These volatile fatty acid are a signal for the male to copulate that female.

In bitch a special substance called methylparahydroxybenzoat is produced specifically attract male to female.

Pheromones

Flehmen Or Lip curling

methyl-parahydroxy-benzoate

In dogs

Sent glands at anus

Sloughed epith. of vagina at estrus

↓

Decompose by bacteria

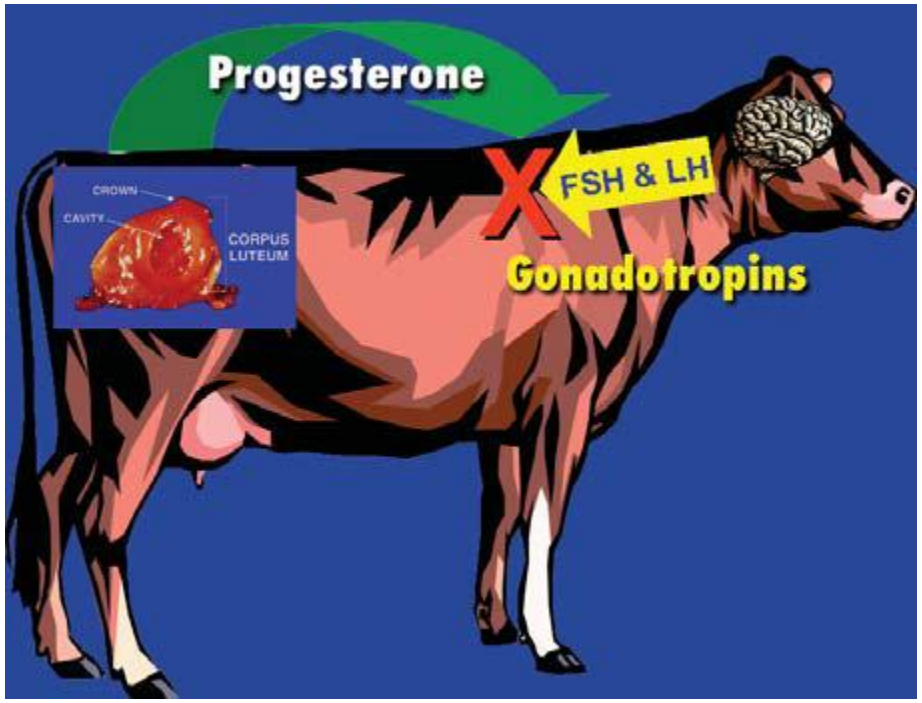
↓

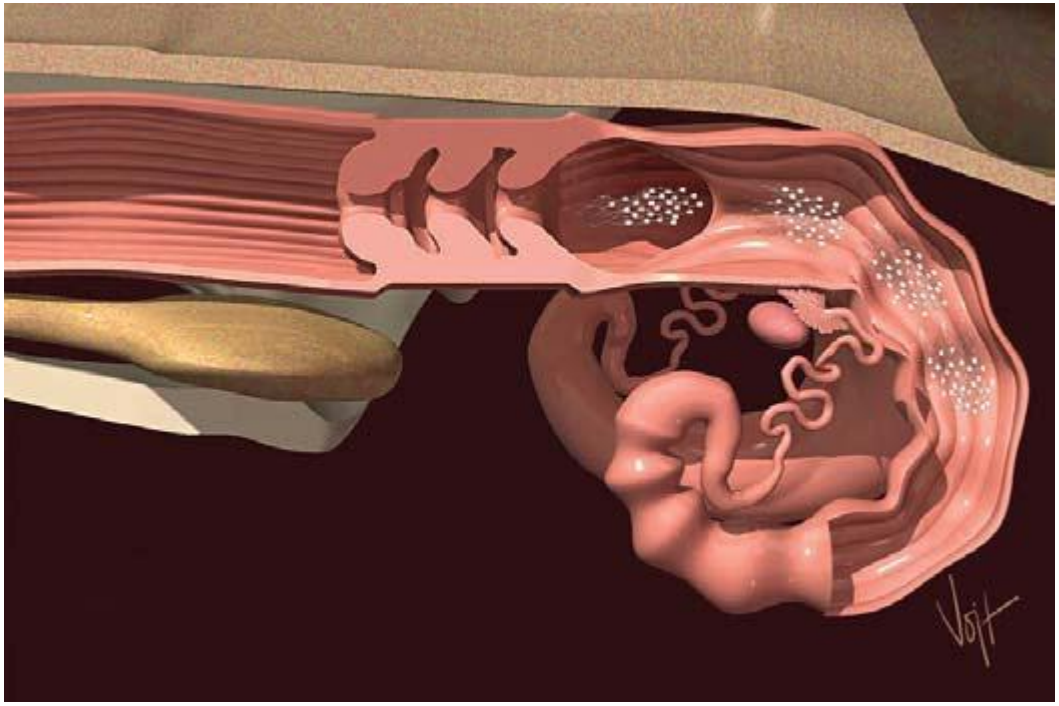
Volatile fatty acid

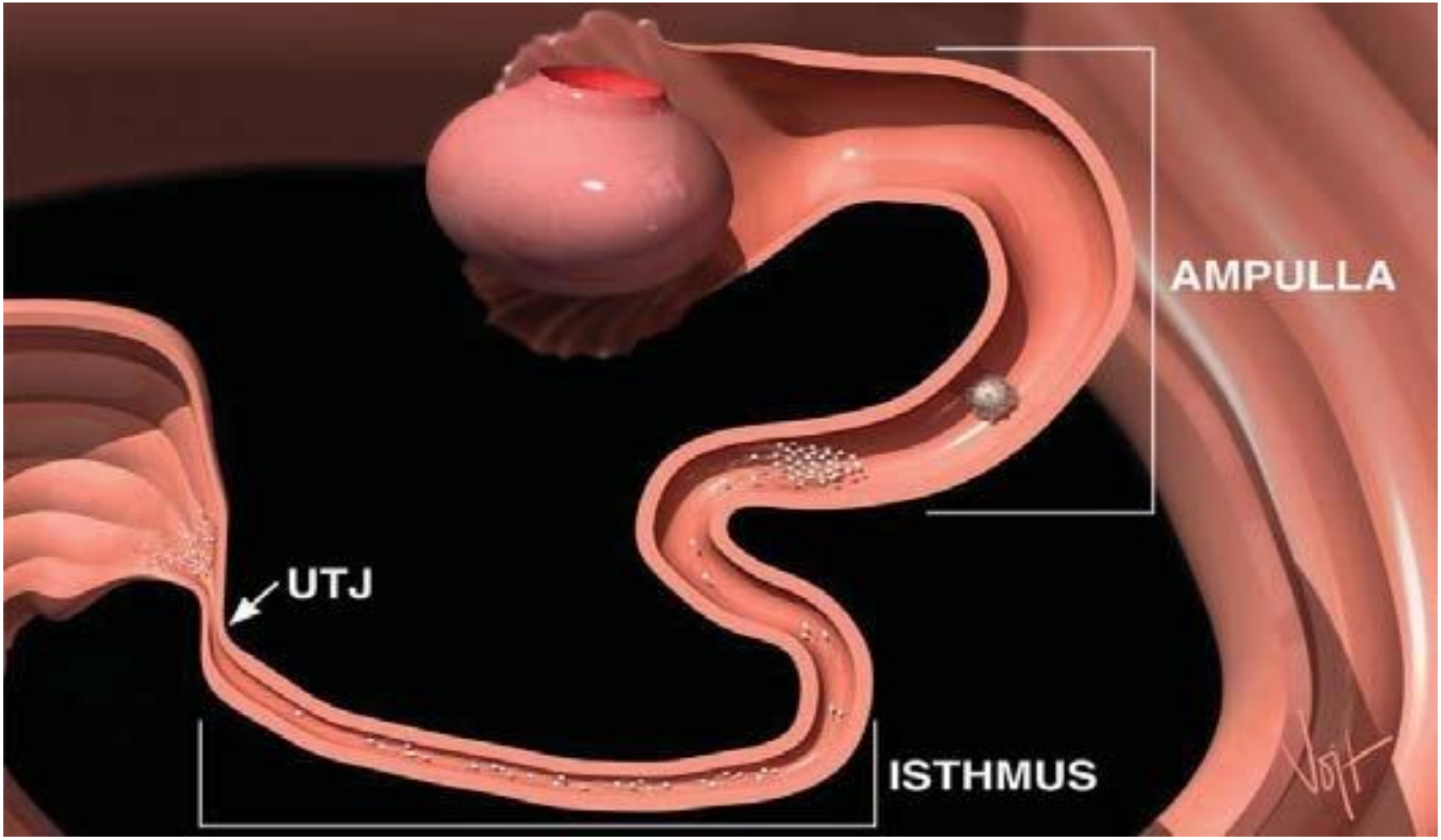
Pole glands

Near the horns

Attract other sex


Progesterone
FSH & LH
Gonadotropins
CROWN
CAVITY
CORPUS LUTEUM




AMPULLA
UTJ
ISTHMUS

Pregnancy (gestation period)

It is a condition of a female while youngs are developing within her uterus. The gestation period extends from fertilization of the ovum to the birth.
It includes:
1- fertilization.
2-cleavge..
3- implantation.
4- placentation.
5-continuous growth of the embryo

1- Fertilization

Union of two gametes (sperm and ova) forming zygote.
Only one sperm needed for one ova.

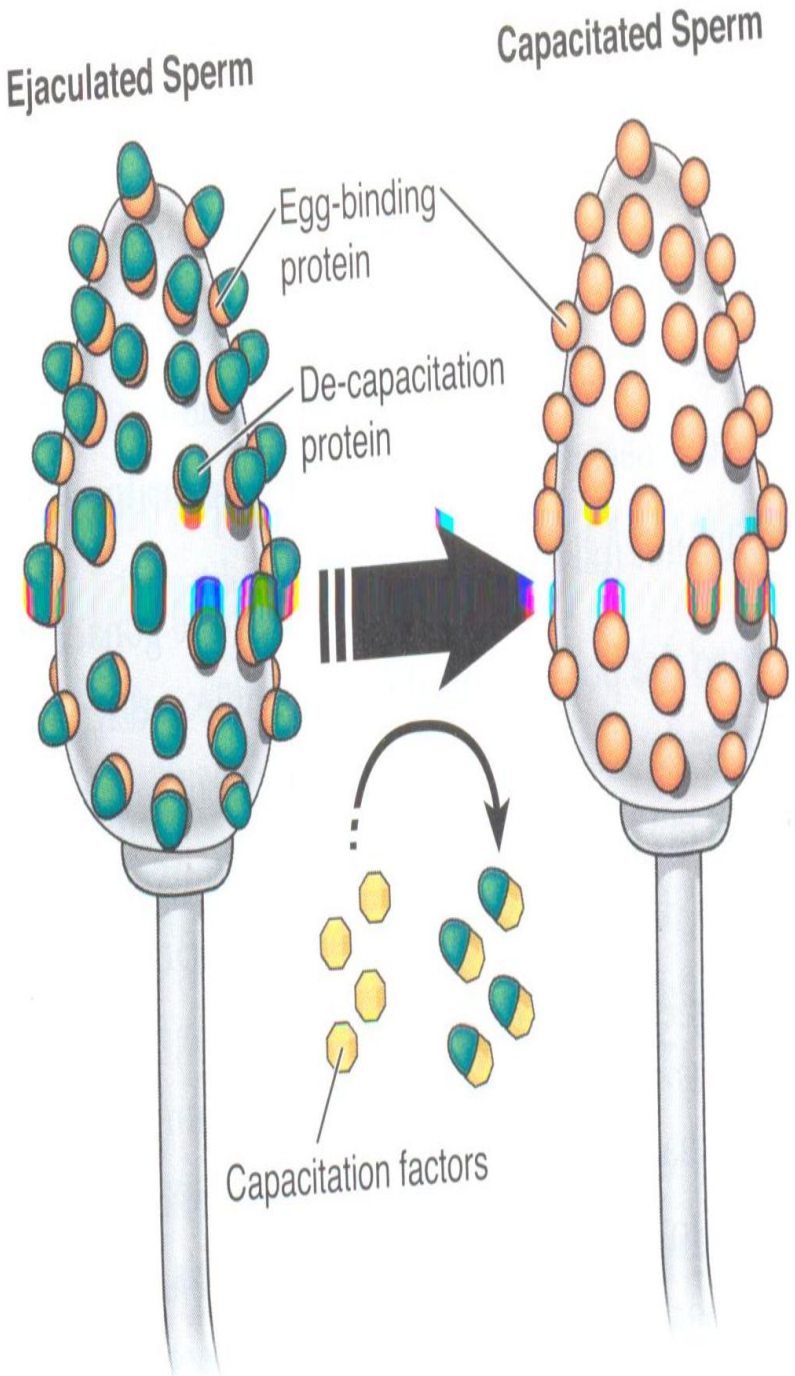
*journey of sperm: Millions of sperms **deposited during ejaculation** (in vagina) thousands (in isthmus) ,few hundreds arrive in ampulla
Only one sperm make fertilization

Conditions for successful fertilization:

1) Healthy ova and sperm.
2) Proper time of insemination (mating) with respect to life span to sperm and ova.
3) Capacitation of the sperm by the uterine and fallopian tube fluids(6-7 hrs.)
It is the process by which the sperm undergo certain changes in the female genitalia to acquire the capacity to fertilize the ova. It involve the following:
A-removal of macromolecules adsorbed on the sperm from the seminal plasma.
B-removal of the sperm coating antigens by amylase enzyme.
C-inactivation of decapacitation factor.

4-acrosomal reaction: it is the breakdown of the plasma membrane and outer acrosomal membrane and liberation of its contents of enzymes. it starts by the formation of vesicles between them, escape of the acrosome contents and finally loss of the membrane.

The capacitated sperm is prone to the decapacitation factor in the seminal gland or the epididymal fluid. this factor reversibly blocks the union of the sperm and the ovum. It prevents or inhibits the enzymes of the sperms which enable them to digest their passage through the corona radiata cell.

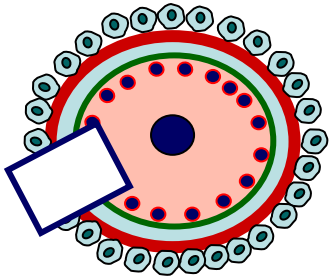


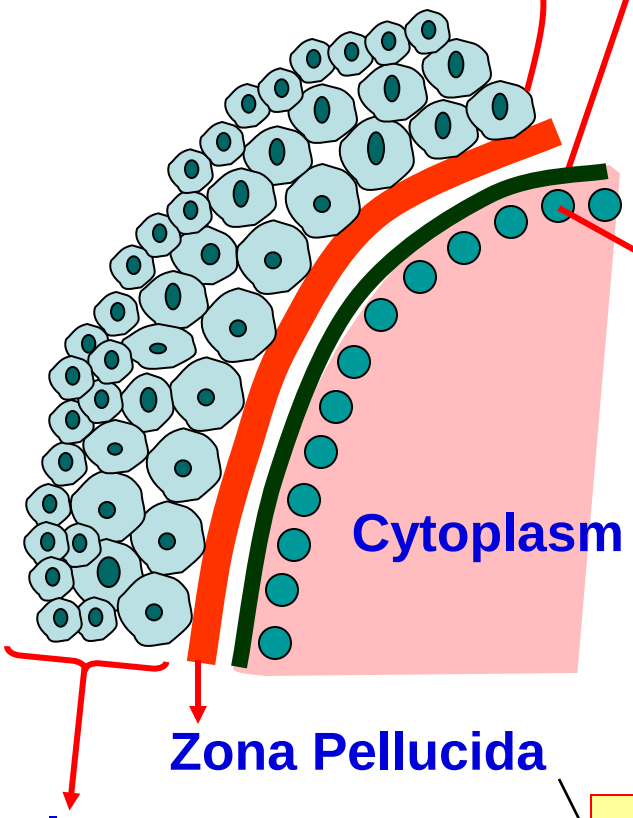
Many sperms are needed to release enough acrosomal enzymes (acrosin) to enable one of them to penetrate zona radiata and zona pellucida to fuse with oocyte membrane. Lytic enzymes (hyalorunidase to penetrate corona radiata and proteolytic for zona pellucida digesting it and permitting flagellar movement of sperm to propel it towards oocyte . Finally the sperm penetrates through the vitelline membrane and the union of gametes is accomplished.

. **Fusion between sperm and egg is mediated by protein molecules whose hydrophobic groups merge the sperm and egg plasma membranes. In mammals fertilin proteins in the sperm binds to integrin in the egg and allow membranes to fuse.**

Pregnancy

Ovulated oocyte





Corona radiata

Oocyte membrane

Cortical granules

Proteolytic enzymes
Mucopolysaccharides

polyspermy

Protection & support

Adhesive glycoprotein
Hyaline protein

Cytoplasm

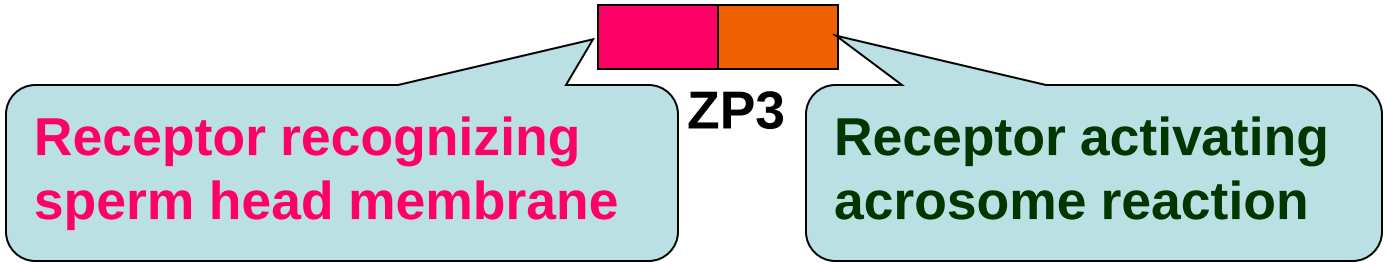
Zona Pellucida

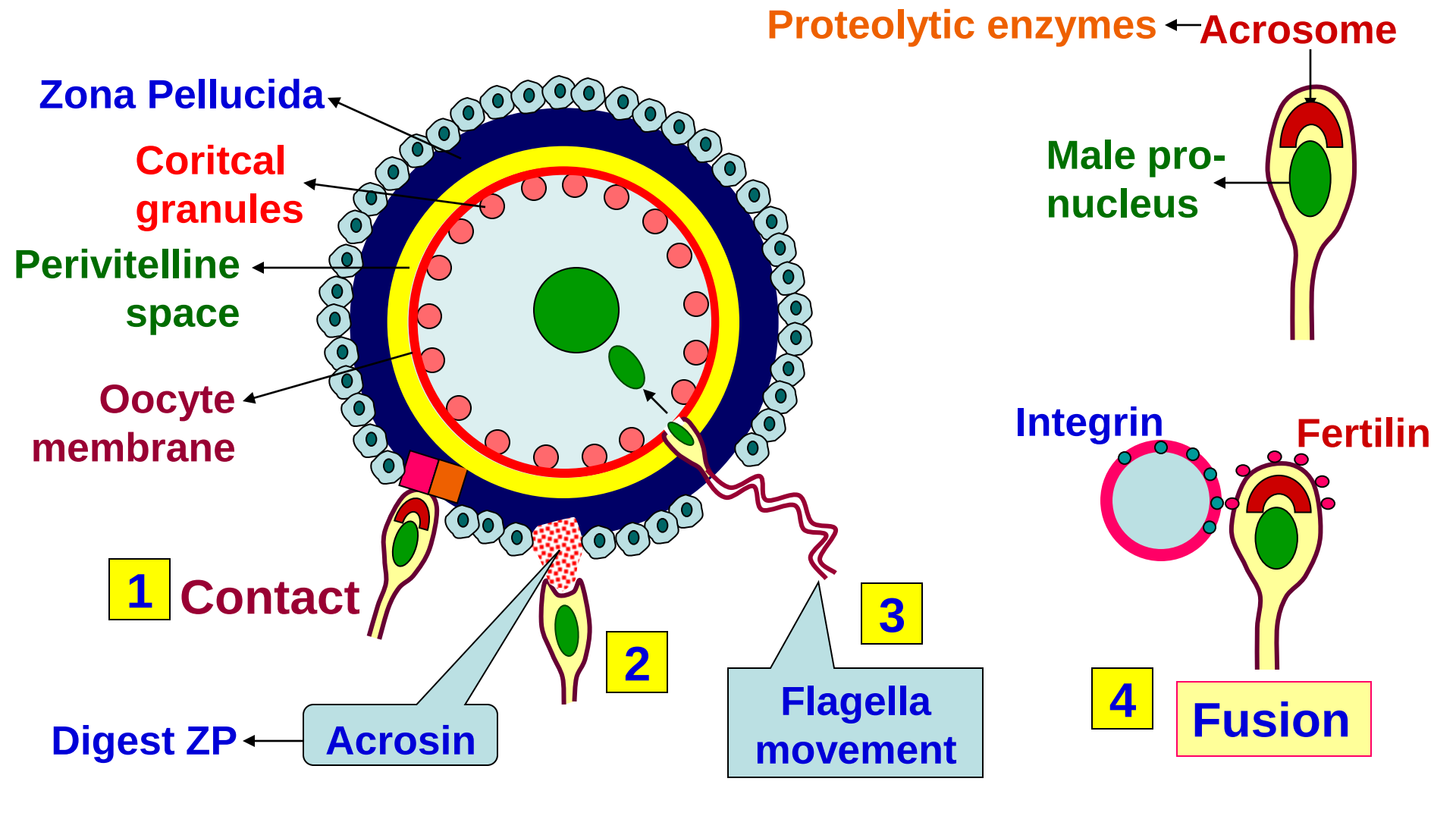
Is a glycoproteins named, ZP1 ZP2, ZP3

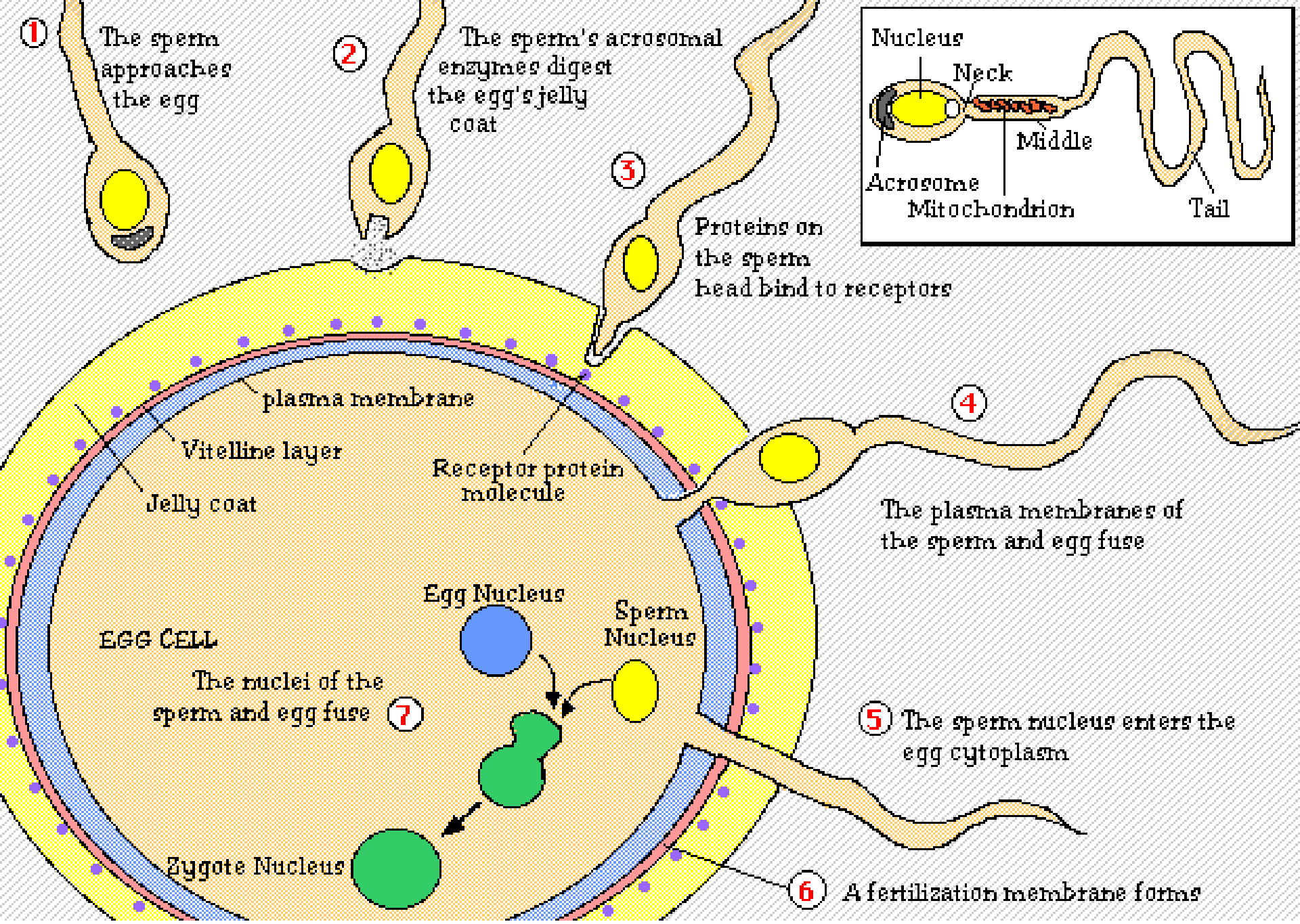
Cumulus

Ovarian follicular cells

Fertilization






1
The sperm approaches the egg
2
The sperm's acrosomal enzymes digest the egg's jelly coat
3
Proteins on the sperm head bind to receptors
Nucleus
Neck
Middle
Acrosome
Mitochondrion
Tail
plasma membrane
Vitelline layer
Jelly coat
Receptor protein molecule
4
The plasma membranes of the sperm and egg fuse
Egg Nucleus
Sperm Nucleus
EGG CELL
The nuclei of the sperm and egg fuse
7
5
The sperm nucleus enters the egg cytoplasm
Zygote Nucleus
6
A fertilization membrane forms

Events occurring after entrance of the sperm:

1-zona pellucida reaction:

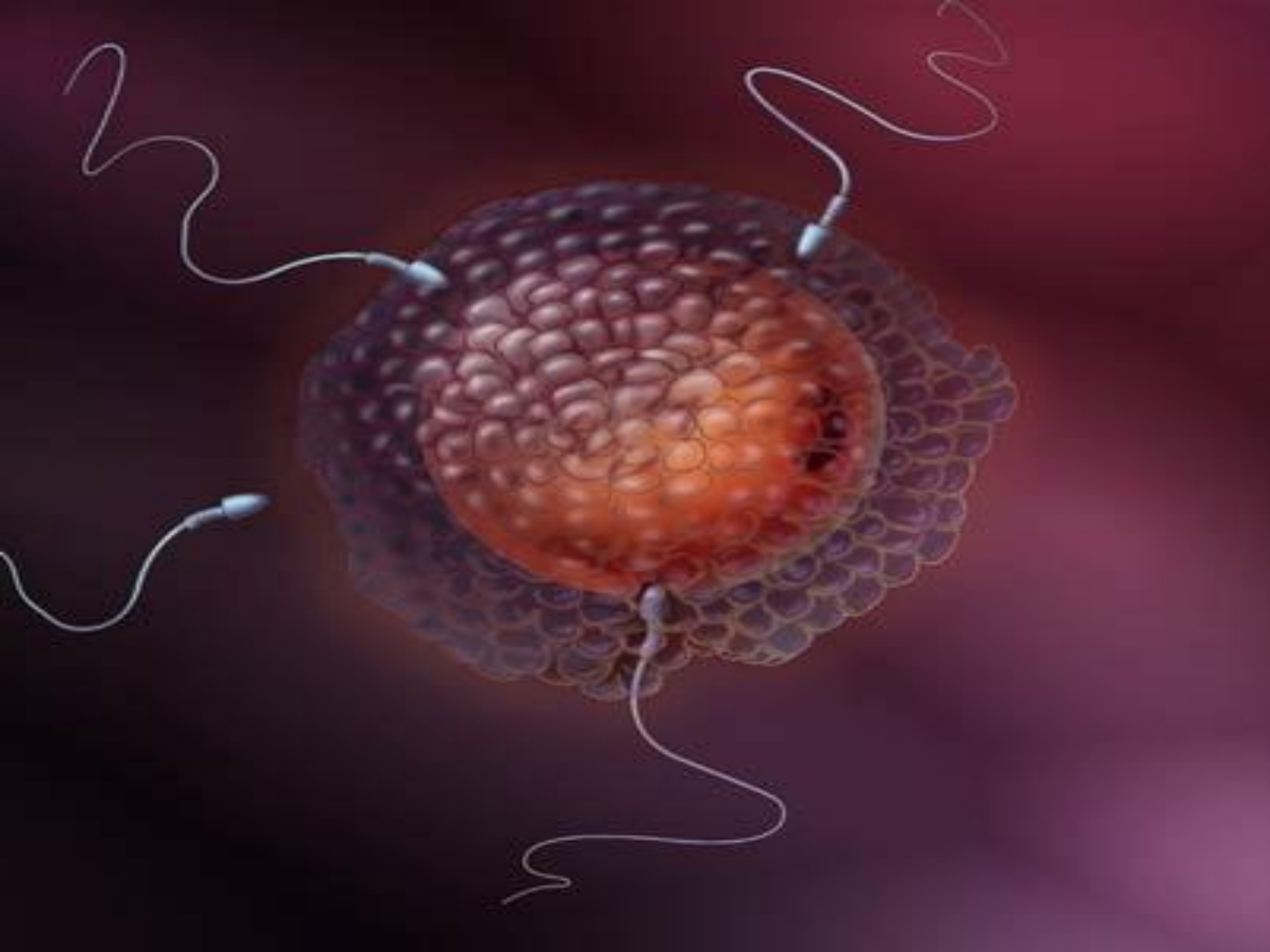
The contact between sperm and occyte responsible for releasing of cortical granules which is librated by exocytosis aided by ca++ resulting in slow block to polyspermy.

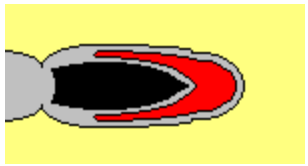
2-vetelline membrane reaction (fast block):

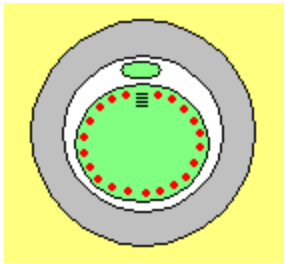
Is resulting from thickening and electrical depolarization of the membrane . The electrical charges on the surface of the ovum block the entry of the other sperms.

3-formation of pronuclei,meiosis ll and the zygot:

After entrance of the sperm into the ovum, the tail is shed and the nucleus in the developes into a structure called male pronucleus The entry of sperm nucleus triggers secondary oocyte to complete meiosis forming second polar body. The nucleus of the ovum develops into a female pronucleus, and then migrates to the periphery to fuse together with the male pronucleus to form a segmentation nucleus (zygote)





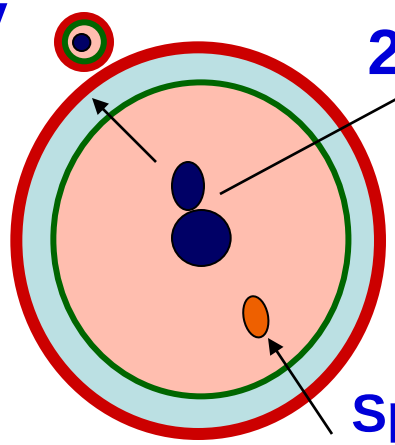


2

2nd meiotic division

2nd polar body

3



Nuclei have

Haploid number

Sperm nucleus entry

1

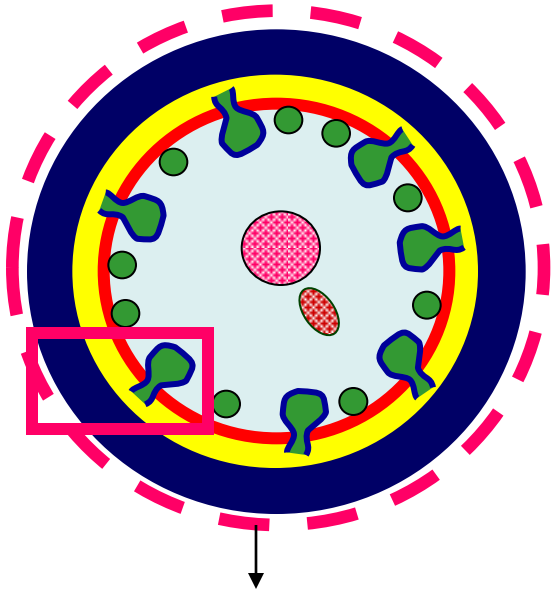
4

Zygote

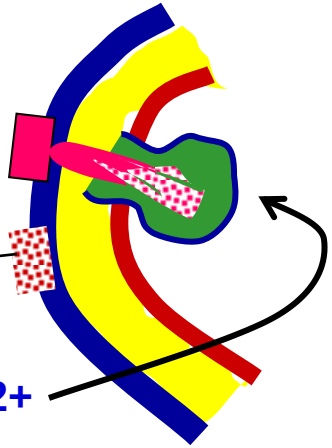
Diploid number

To prevent:

Polyspermy



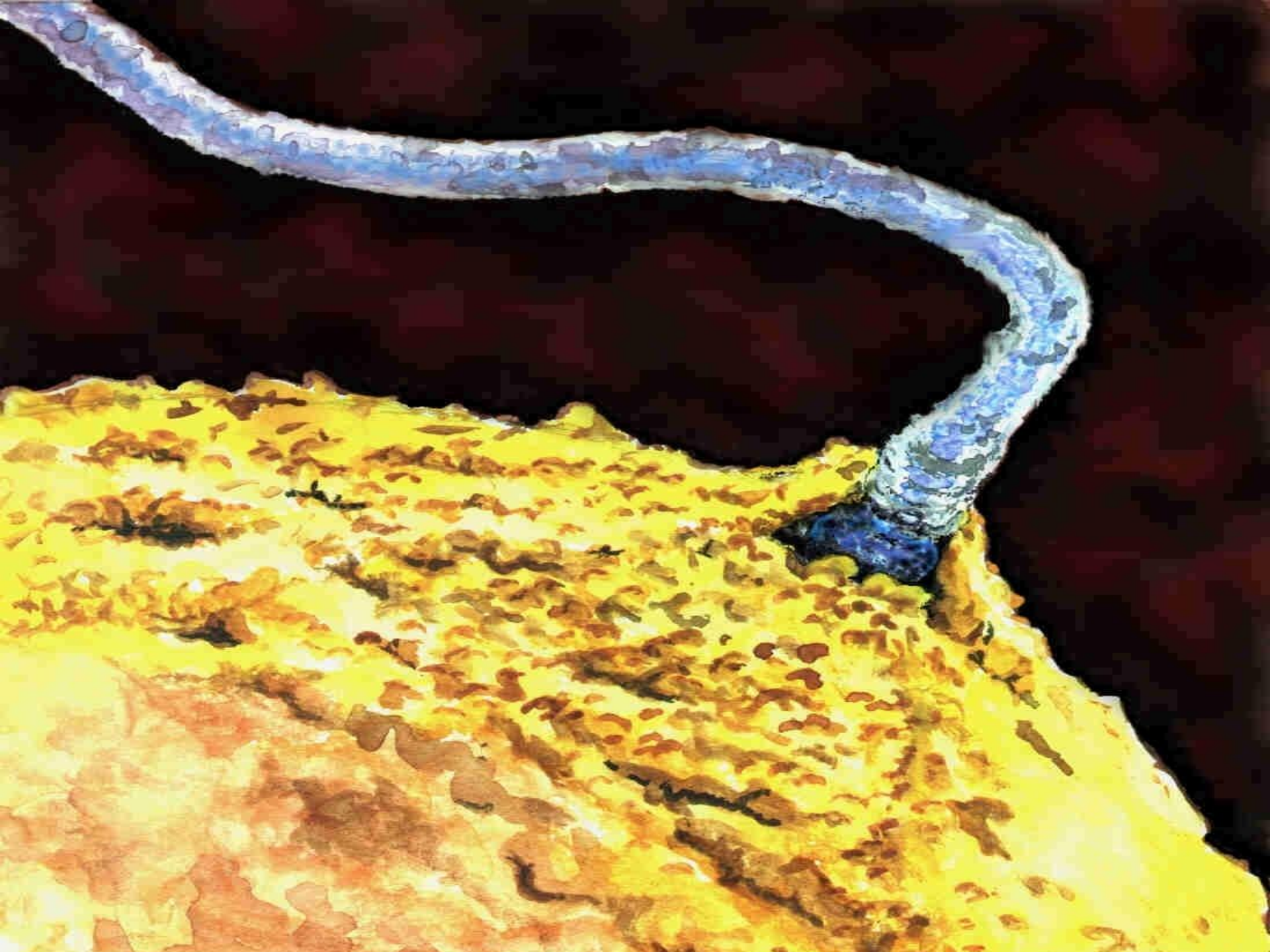
Membrane potential

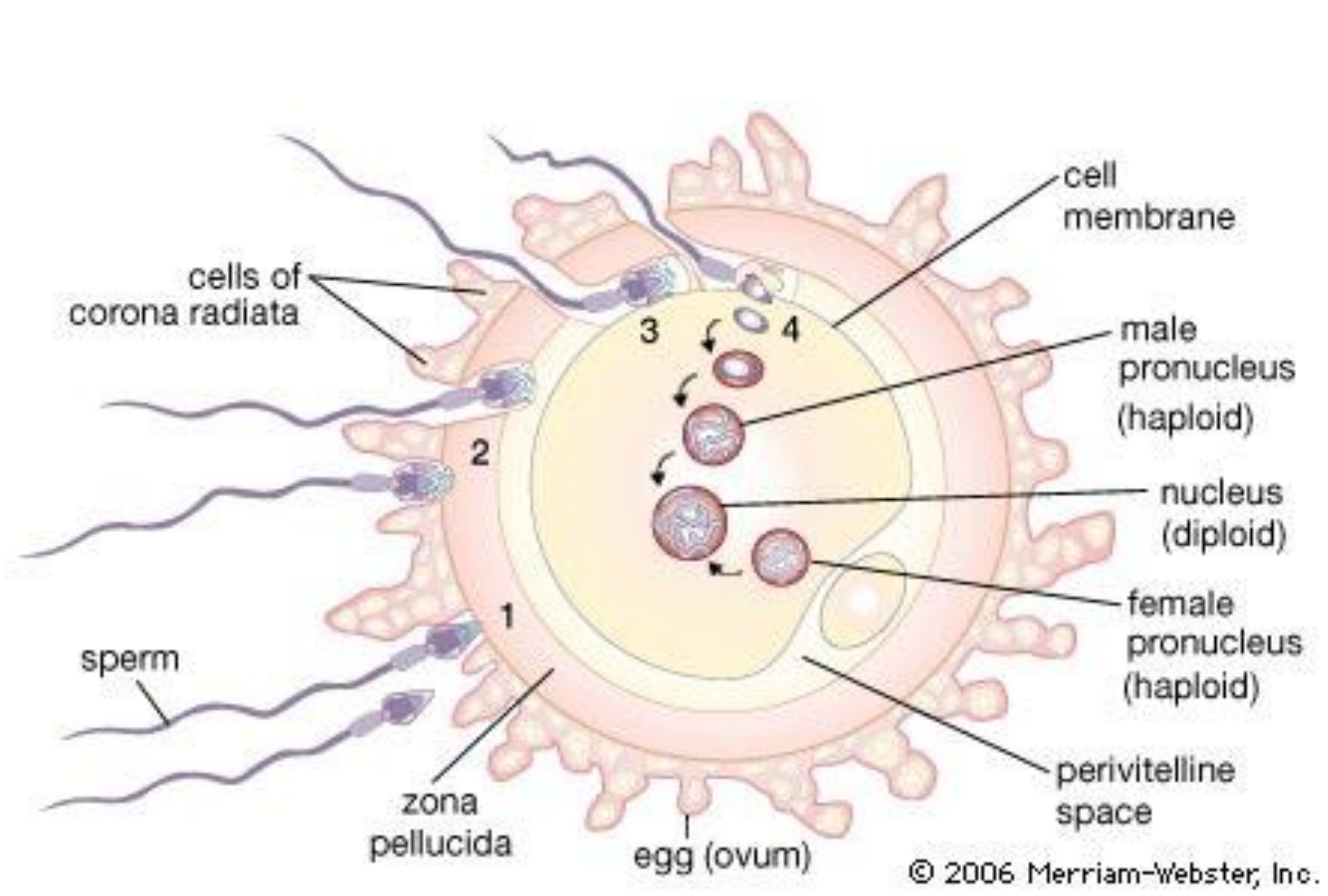


ZP3

Destruction of ZP3

Ca^{2+}

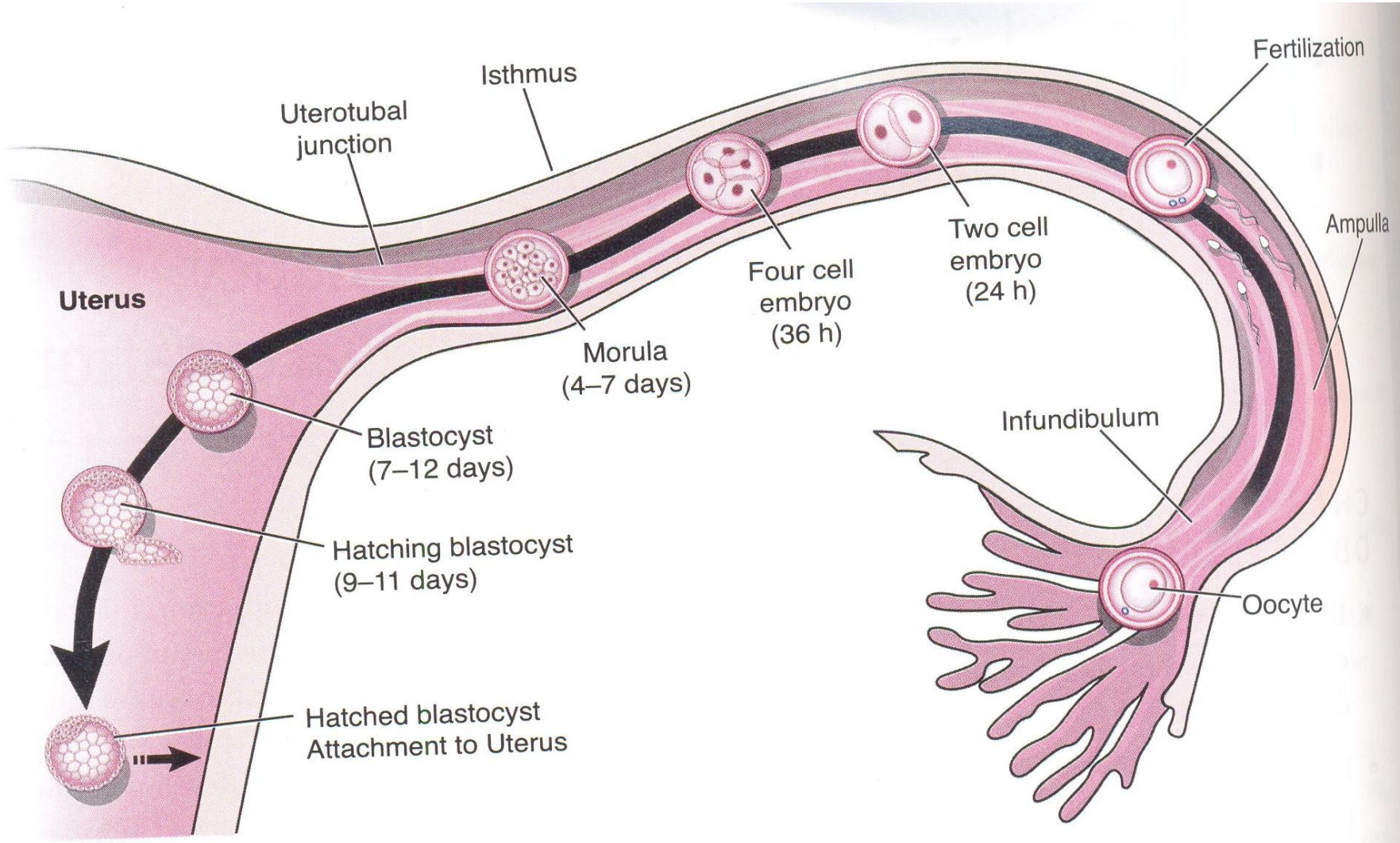




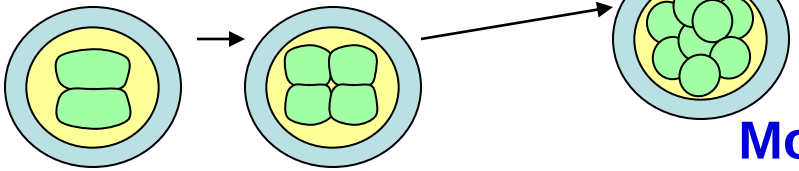
Cleavage:

1-formation of the morula

2-development of blastula



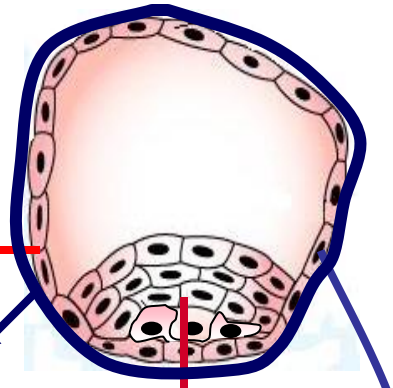
Embryonic Development



2 cell stage

4 cell stage

Morula
Ball of cells



Trophoblast

Surrounded by ZP

Embryoblast

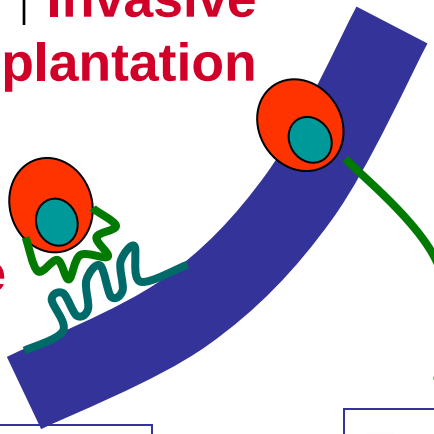
Implantation

Primates, dog, cat, rabbit, rat

Invasive implantation

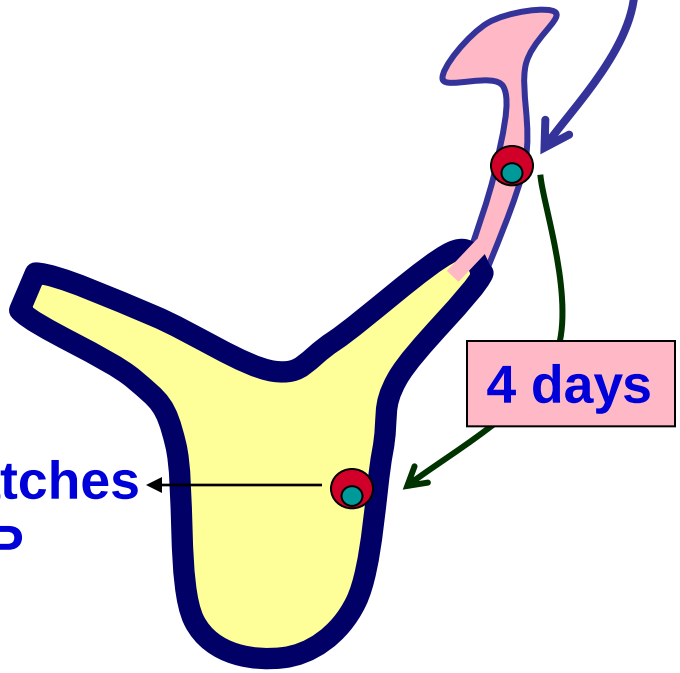
Cow, mare, sheep, sow

NON-invasive implantation



Fetus & maternal layers attaches together

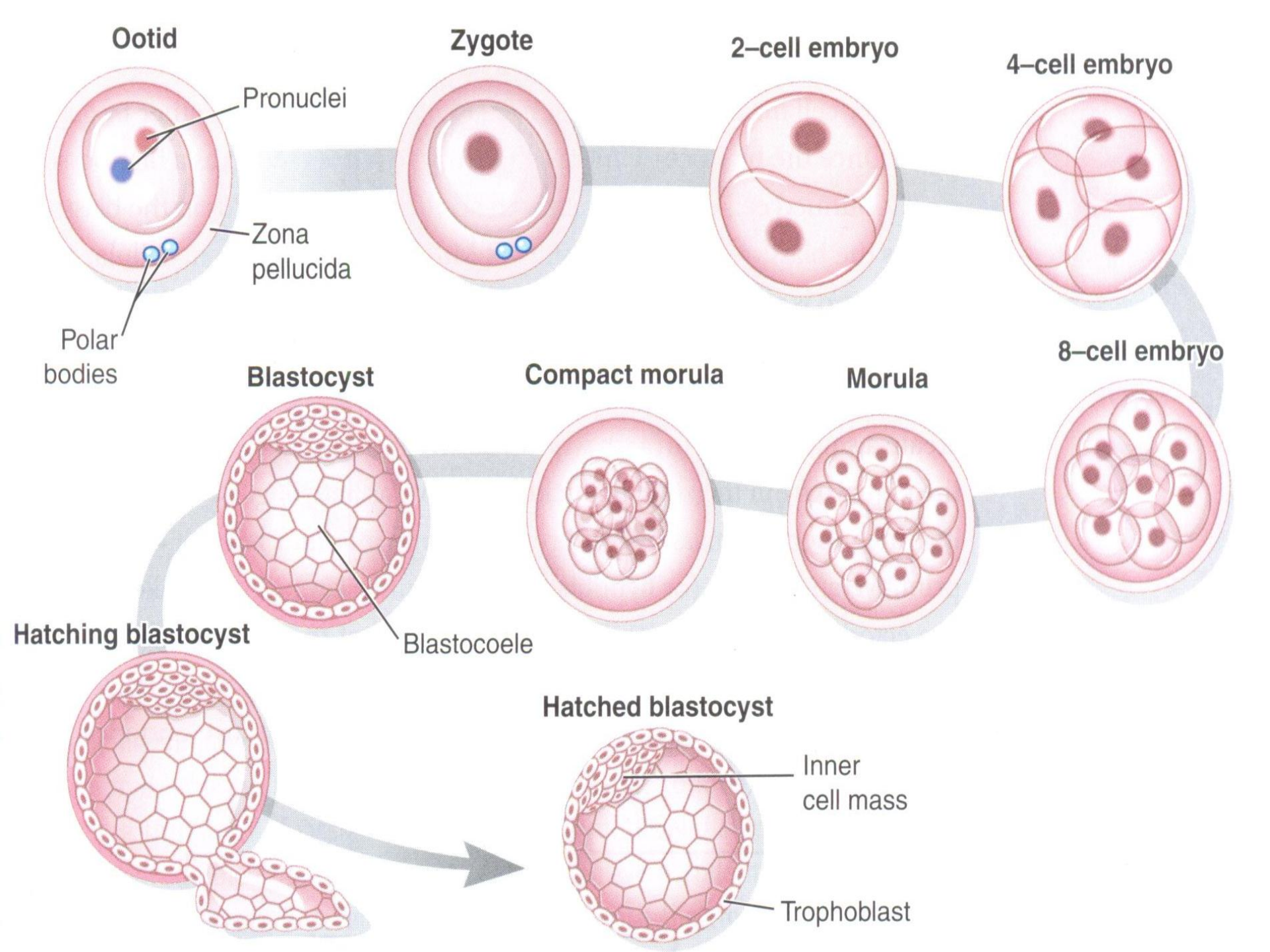
Fetus erode uterine wall

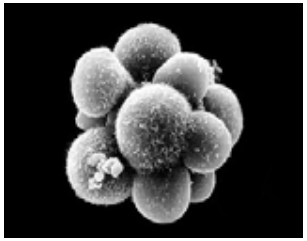


4 days

Ova hatches from ZP

Fetus implants in uterine wall

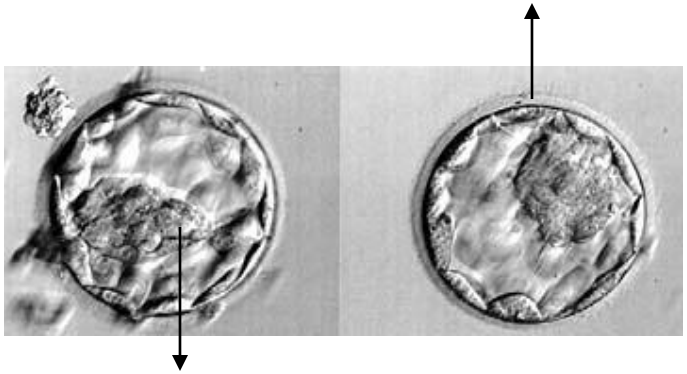

Ootid
Pronuclei
Zona pellucida
Polar bodies
Zygote
2–cell embryo
4–cell embryo
8–cell embryo
Morula
Compact morula
Blastocyst
Blastocoele
Hatching blastocyst
Hatched blastocyst
Inner cell mass
Trophoblast



The morula

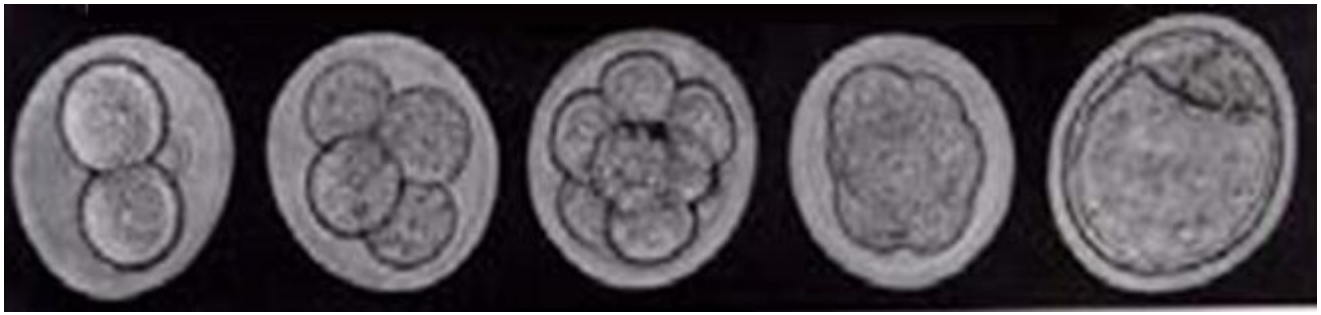
The blastocyst

Trophoblast - will form the placenta



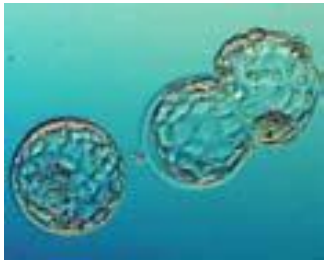
Inner cell mass - will form the embryo

Pre-implantation embryo developmental stages



Cleavage

Hatching of blastocyst



Monozygotic (identical) twinning may occur at this stage

Hormones & implantation

Estrogen

↓

↑ Endometrial glands

Progesterone

↓

Uterine milk ↑

Endometrial glands

↓ Myometrial motility

Embryonic nutrition

Fertilized ova → Cytoplasmic nutrients stored in ova → Morula stage

Blastocyst stage → Uterine milk → Implantation

Placentation

Fetal part

Chorion

Maternal part

Decidua basalis Uterus

Functions of the Placenta

Gas transport — Fetal Hb → ↑ O_2 affinity

Nutritive — By diffusion → All nutrients

Excretion → Of all waste products of Mb

Barrier — Incomplete barrier

Substances pass across:

Hormones, IGg, sedatives, some viruses

Substances don't pass across:

Large molecules like: Insulin, heparin, and antibodies in herbivore

Herbivore feti born without ANY maternal antibodies in their blood

Table 10-11. The main differences between hCG and eCG

hCG (human and primates)	eCG ,PMSG, (equines only)
Produced from the trophoblast layer of the embedded fertilized ova.	Produced from the cuplic structures in the endometrium.
Produced 10 days after fertilization; reaches maximum levels after 10 weeks; then decline and remain low	Produced 30 days after implantation; reaches maximum at mid-gestation
Can be detected in both urine and serum samples	Can be detected only in serum samples
It is LH in nature and weak FSH effect	It is FSH in nature
Actions: 1. It prevents luteolysis 2. Stimulates corpus luteum growth 3. Stimulates corpus luteum to secrete estrogen and progeste-rone till the 10th week of gestation for continual endometrial growth. 4. It acts on placenta itself from the 4th month to secrete estrogen and progesterone. 5. Suppresses maternal immune function i.e. reduces the possibility of fetus immunorejection	Actions: 1. It prevent luteolysis 2. Since it is FSH in nature, so it may stimulate follicular growth during pregnancy, which leads to increase in estrogen secretion and appearance of estrus during pregnancy. Secondary corpus luteum will be formed when these follicles ovulate and more progesterone is produced for further pregnancy maintenance.

Placental hormones

Chorionic gonadotropines

hCG in primates

Like LH

10 days – 10 weeks

Detected in urine and serum

Luteotropic ↑

Progesterone ↑

Luteolysis ✕

Affect placenta → Estrogen | Progesterone

Maternal immune activity ↓

Fetal rejection ✕

PMSG | eCG in equines

Like FSH

30 days – mid-gestation

Detected in serum only

Follicular growth ↑

Estrogen ↑

Signs of estrus ↑

Secondary CL

Progesterone ↑

Placental lactogen — **Chorionic somatommamotropin**

GH-like in primates — **Prolactin-like in ruminants**

Functions

Maturation of mammary gland

Energy production

Fetal & placental growth

Lipolysis

Nitrogen, K and Ca retention

Relaxin — **CL, uterus, placenta**

Relax pubic symphysis — **Dilates the cervix**

Progesterone — **Estrogen**

CRH, TRH, GHRH, ACTH, TSH, Activates Vit.D

Maternal Recognition of Pregnancy

A critical need arises early in the gestation for the mother to recognize that she is pregnant, why? t

Progesterone levels in maternal blood must remain at high level to keep endometrial maintenance in a state conducive to embryonic survival.

Maternal recognition of pregnancy does not involve any type of conscious recognition by the mother, Instead. The concepts must signal Its presence to the mother in order to prevent luteolysis of the corpus luteum.

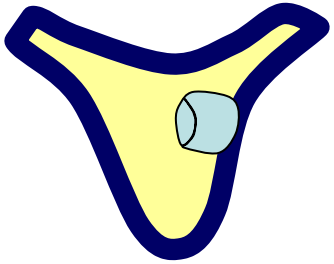
The need to prolong luteal life is accomplished by:

1-production of positive luteotropic factors

2-prevention of normal luteolytic factors

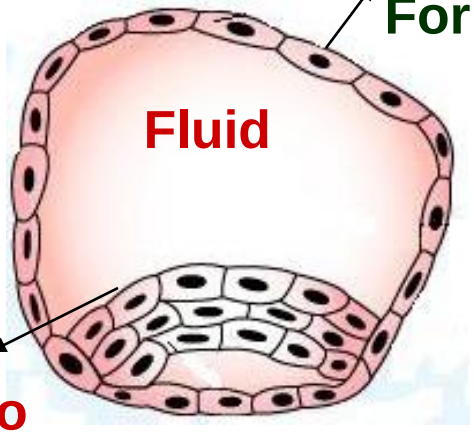
Maternal Recognition of Pregnancy

In primates



Inner cell mass
Form the embryo

Blastocyst



Outer cells
Form placenta

Trophoblast

6-7 days of fertilization

hCG

LH receptor

CL

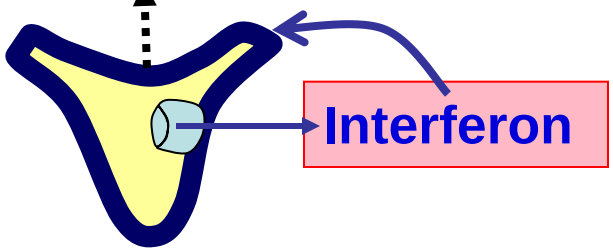
Progesterone

Prolong CL life

In animals

Cattle & sheep

$PGF_{2\alpha}$



Interferon

Extra CL(s)

Endometrial cups

eCG

Prolong CL life

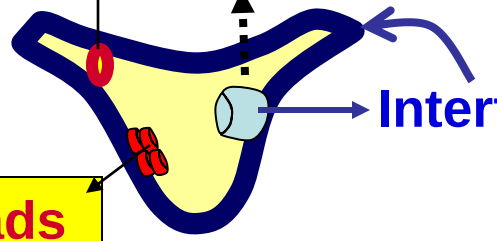
Estrogen

Fetal gonads

Mid-gestation

Equines

$PGF_{2\alpha}$



Interferon

In cats and bitch:

In cats,

the corpus luteum lasts for 35-45 days after ovulation, whether pregnant or not.Placenta extends luteal function for the rest of pregnancy (63 days).

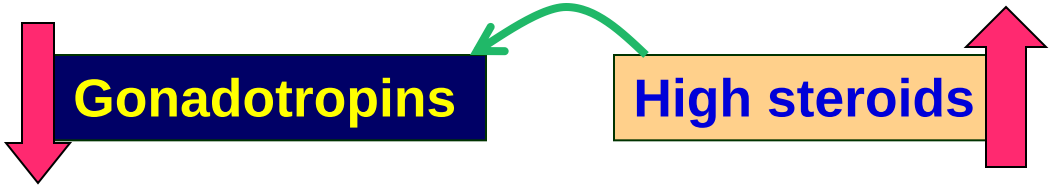
In bitch:

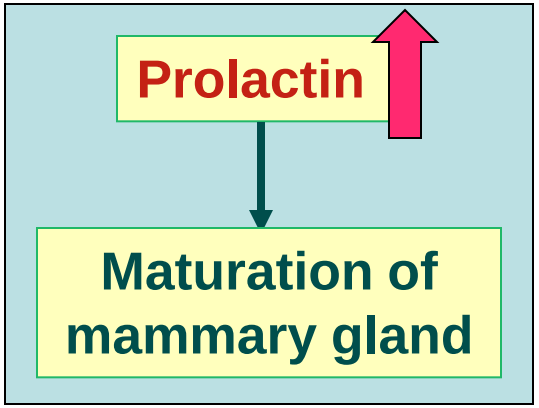
The presence of conceptus prolongs the luteal life.

Time the placenta take over (totally) the progesterone production from CL

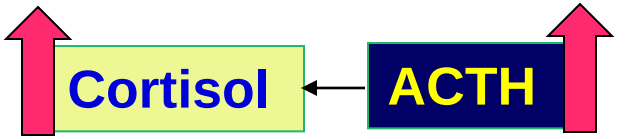
	Time of placental take-over	Gestation Length (days)
Primates	5-8 weeks	Differs
Cow	150 days	270 days
Ewe	50 days	150 days
Mare	70 days	340 days
Cat	45 days	63 days
Goat	Totally on CL	150 days
Sow	Totally on CL	115 days
Rabbit	Totally on CL	30 days

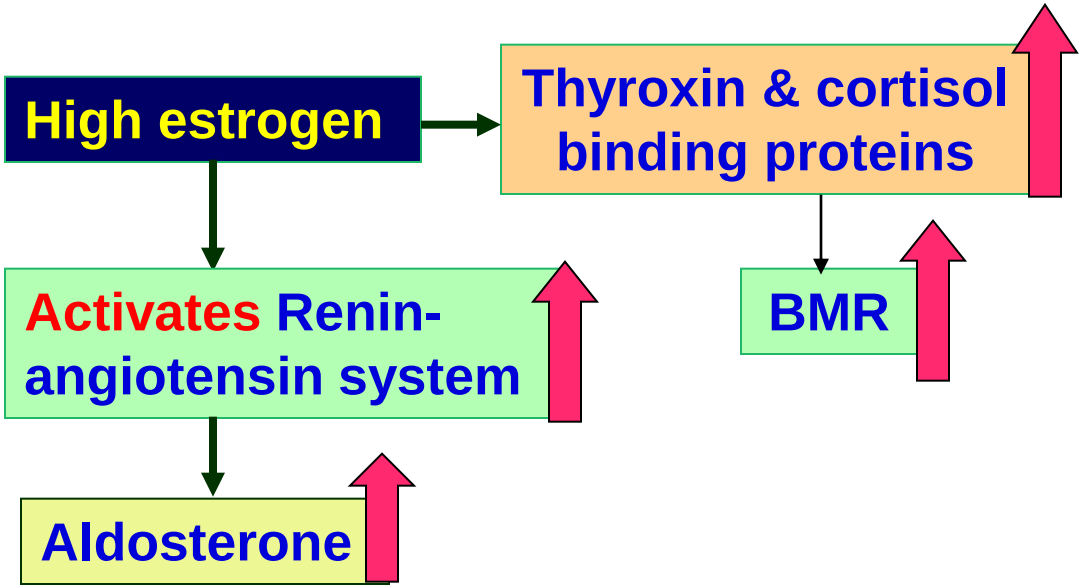
Hormonal control of pregnancy

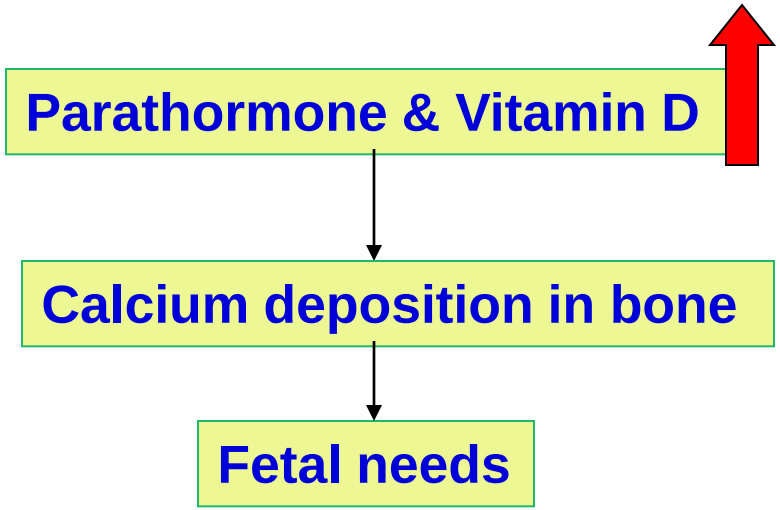




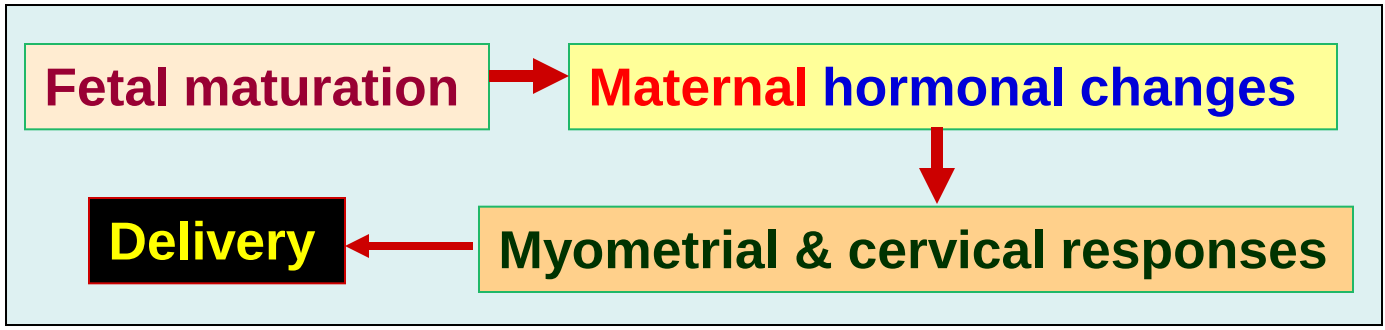
Progesterone blocks effect of estrogen on myometrial activity







Parturition



Goes into 3 stages

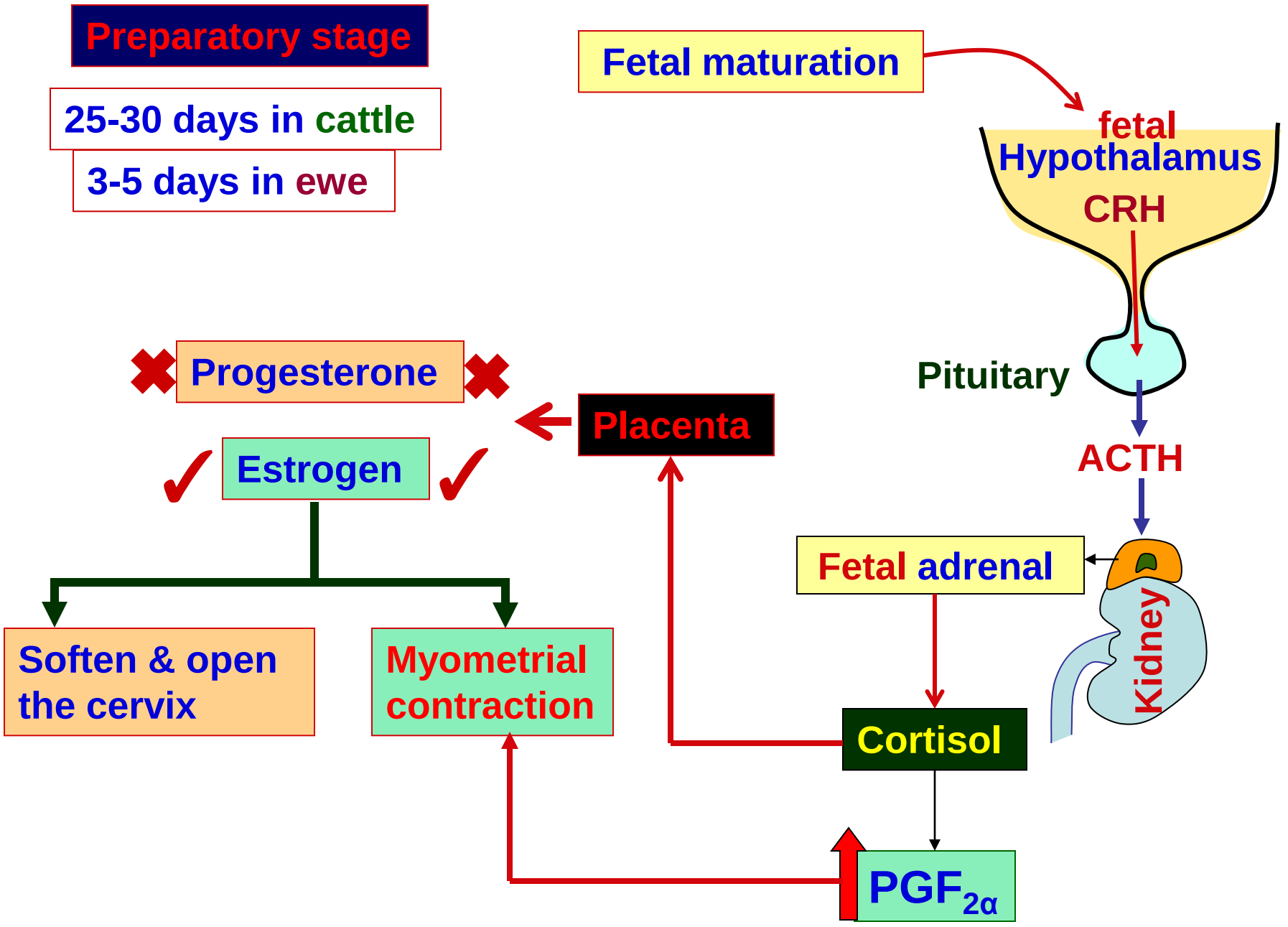
1 **Preparatory stage**

Maternal and fetal hormonal changes

2 **Expulsive stage**

Open the cervix & strong myometrial contractions → Expulsion of the fetus

3 **Expulsion of the fetal membranes**


Preparatory stage
25-30 days in cattle
3-5 days in ewe
Fetal maturation
fetal
Hypothalamus
CRH
Pituitary
ACTH
Fetal adrenal
Kidney
Progesterone
Placenta
Estrogen
Soften & open the cervix
Myometrial contraction
Cortisol
PGF2α

25-30 days in cattle | 3-5 days in ewe

During last trimester of pregnancy

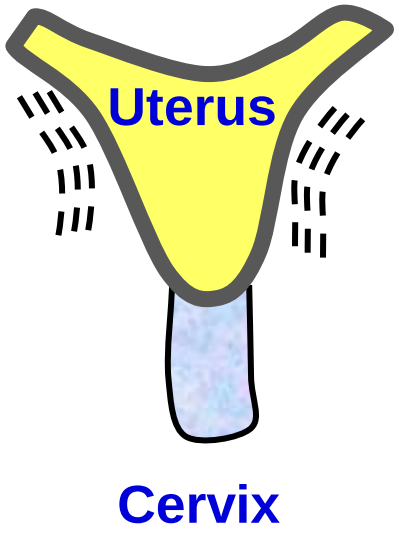
Estrogen

Fetal Hypothalamus-pituitary-adrenal axis

Matures:

Estrogen : progesterone ratio

Placenta form estrogen instead of progesterone



Fetal cortisol

Placenta

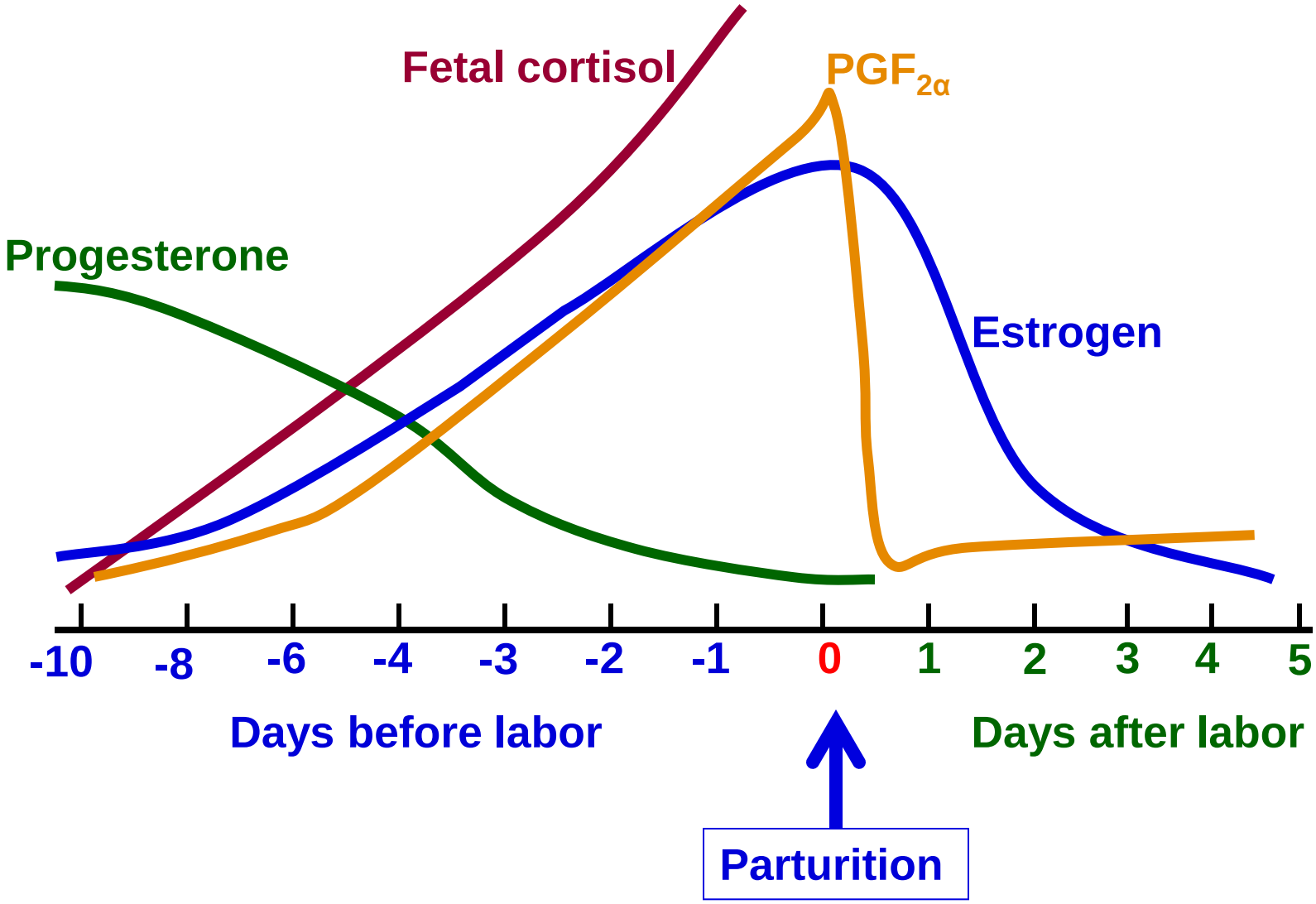
17- hydroxylase & 17-20 lyase ✓

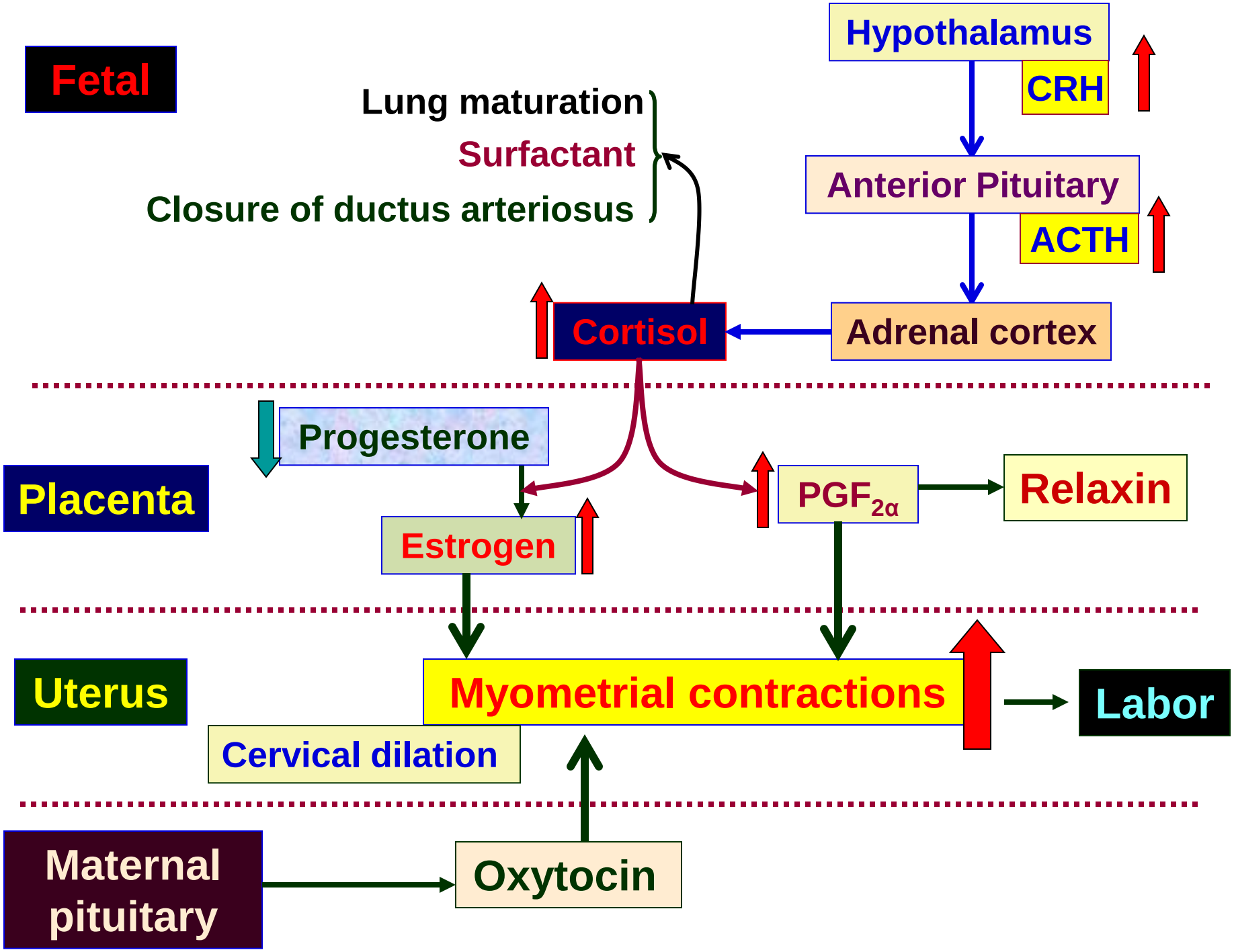
Progesterone

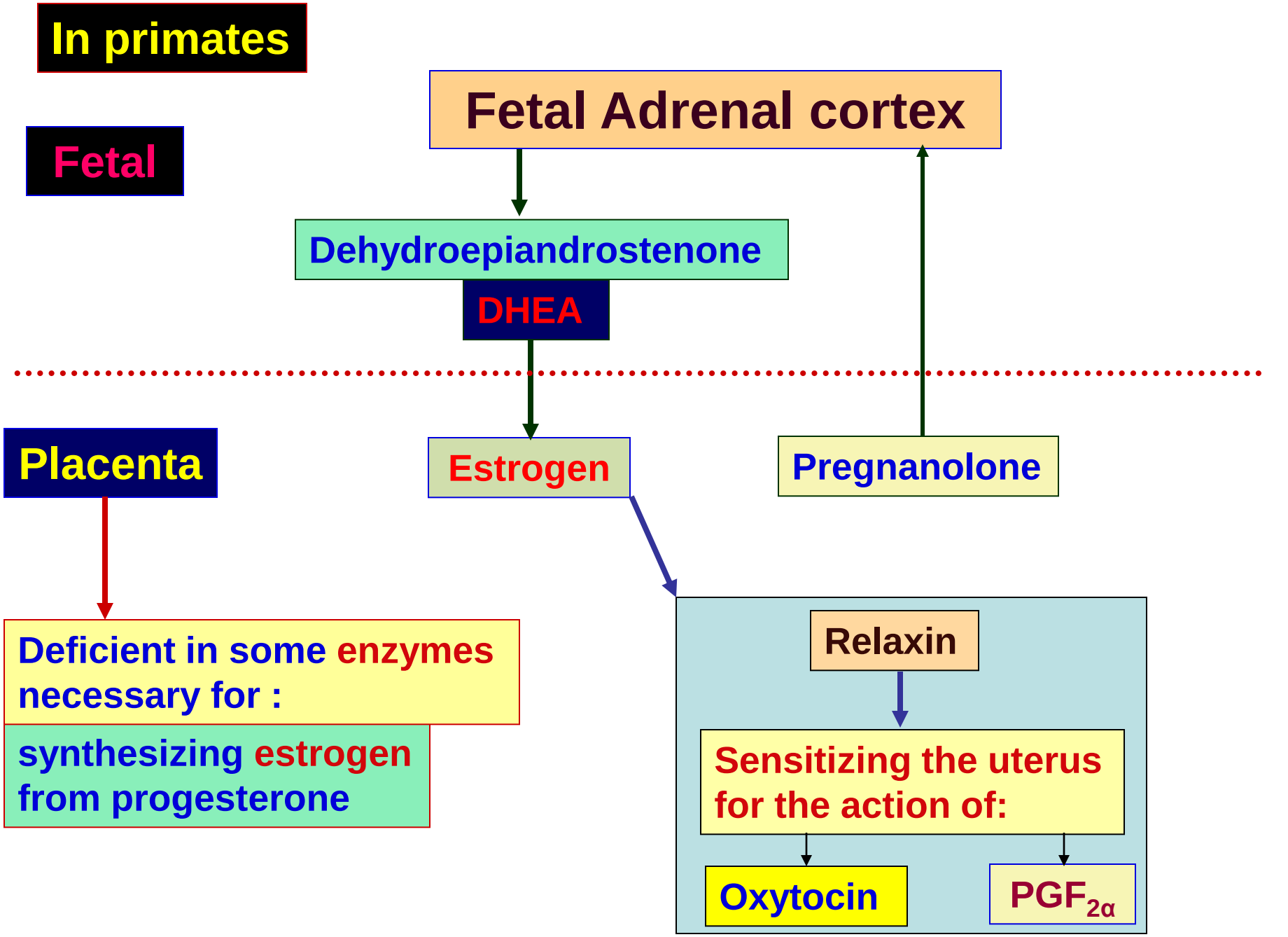
Estrogen

$PGF_{2\alpha}$

Hormonal changes leading to parturition




Fetal
Hypothalamus
CRH
Lung maturation
Surfactant
Closure of ductus arteriosus
Anterior Pituitary
ACTH
Cortisol
Adrenal cortex
Progesterone
Placenta
Estrogen
PGF2α
Relaxin
Uterus
Myometrial contractions
Labor
Cervical dilation
Maternal pituitary
Oxytocin


In primates
Fetal
Fetal Adrenal cortex
Dehydroepiandrostenone
DHEA
Placenta
Estrogen
Pregnanolone
Deficient in some enzymes necessary for :
synthesizing estrogen from progesterone
Relaxin
Sensitizing the uterus for the action of:
Oxytocin
PGF2α

Synthesis of sex steroids

Placenta

Cholesterol

Pregnanolone

Progesterone

Pregnanolone → ✖ → Dehydroepiandrosterone

Fetal adrenal

Pregnanolone

Dehydroepiandrosterone

Dehydroepiandrosterone ✓

Androstenedione ✓

Testosterone ✓

Estrogen

primates

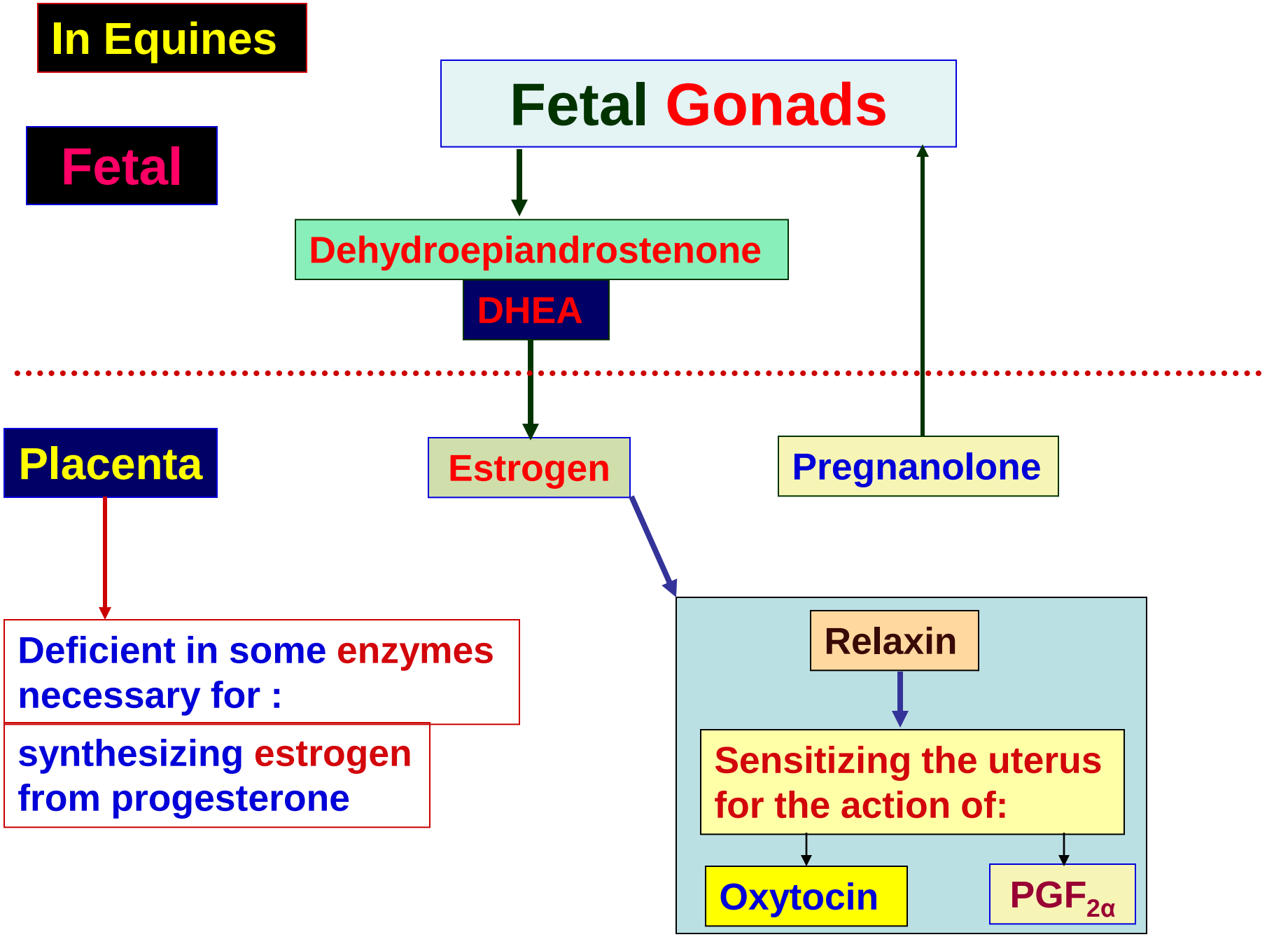
Placenta

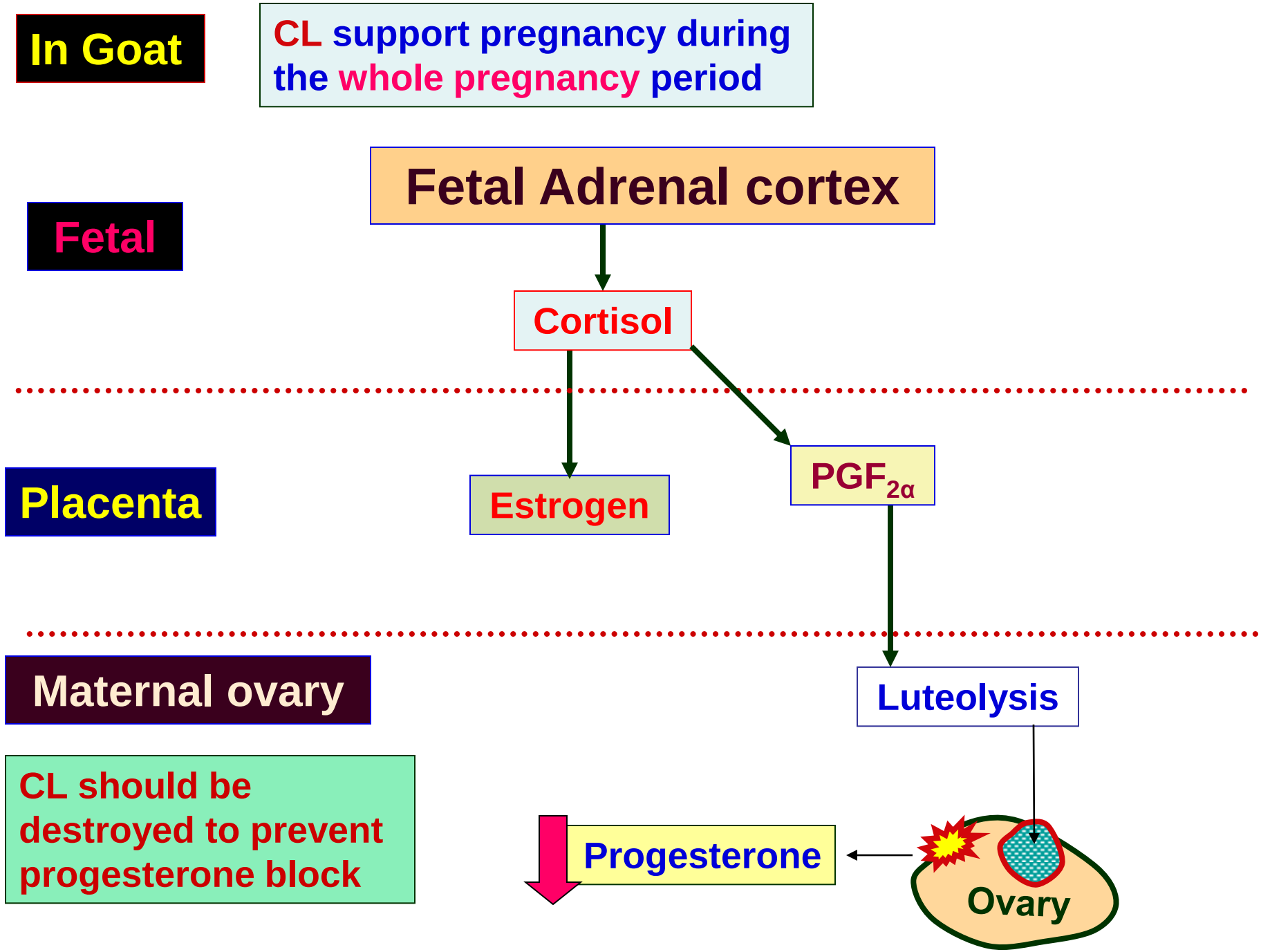
Dehydroepiandrosterone

Androstenedione

Testosterone

Estrogen


In Equines
Fetal
Fetal Gonads
Dehydroepiandrostenone
DHEA
Placenta
Estrogen
Pregnanolone
Deficient in some enzymes necessary for :
synthesizing estrogen from progesterone
Relaxin
Sensitizing the uterus for the action of:
Oxytocin
PGF2α


In Goat
CL support pregnancy during the whole pregnancy period
Fetal
Fetal Adrenal cortex
Cortisol
Placenta
Estrogen
PGF2α
Maternal ovary
Luteolysis
CL should be destroyed to prevent progesterone block
Progesterone
Ovary

Mechanical changes **:the uterus is converted from quiescence to a contractile organ. The cervix relaxes and opens to allow the fetus to be delivered.**

Thus, the mechanical changes include; increased the velocity and amplitude of myometrial contractions and cervical ripening or softening.

Both PGF2α and oxytocin are the target hormones regulate these changes.

Role of PGF2α:

Liberates Ca from its storehouse to bind with actin –myosin proteins to initiate uterine contraction.

Triggers a powerful uterine and abdominal contraction

Decreasing and loosening the collagen bundle in the cervix resulting in dilatation of cervical canal.

Stimulate relaxin hormone release

Luteolysis.

Role of oxytocin:

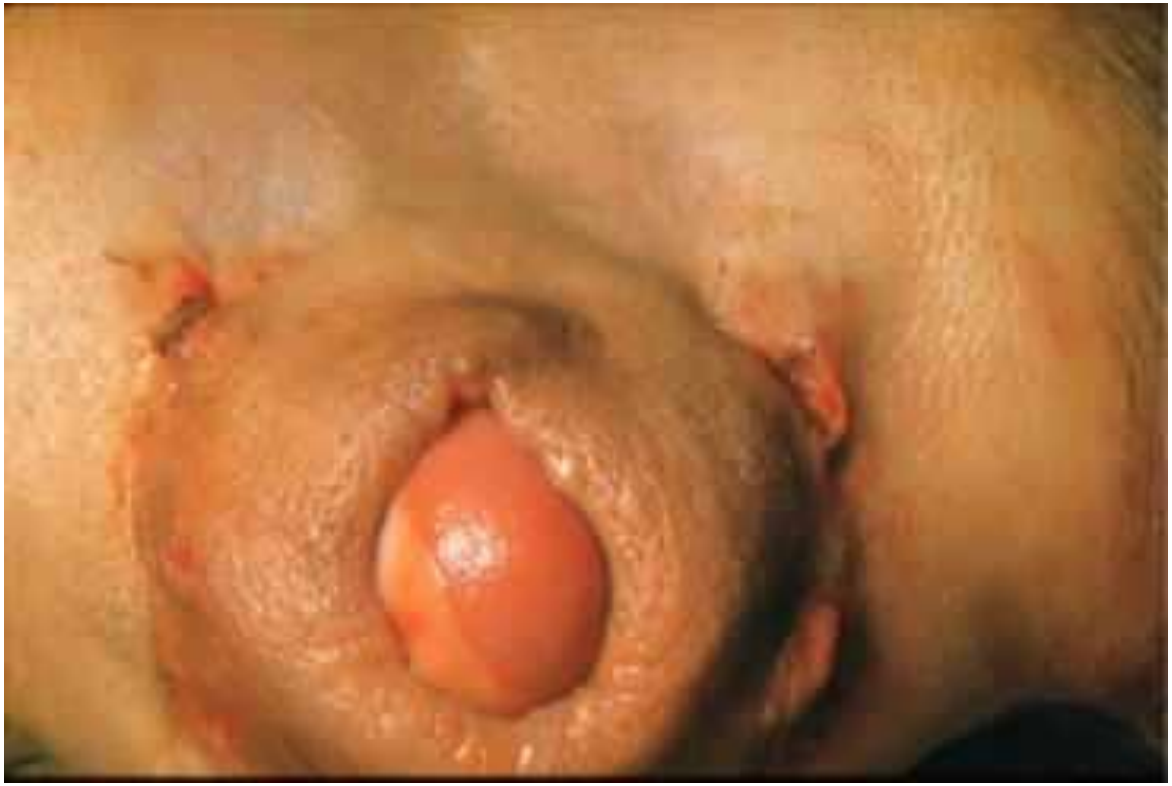
Small amount of oxytocin begins to be released during the first stage (dilation of the cervix), and maximum levels occur at the time when fetus head emerges from the vulva during the second stage (fergusson reflex)

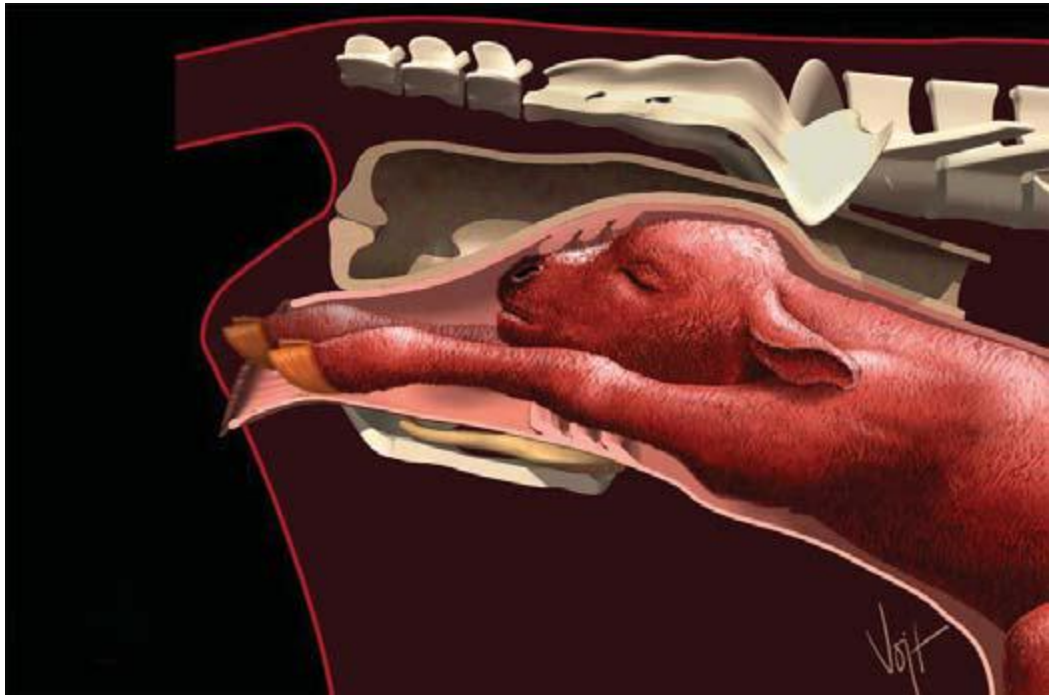
Stages of parturition

First stage: it involves presentation of the fetus at the internal os of the cervix. Once the cervix opens and the fetus passes into the pelvic canal, myometrial contractions become less important for delivery; abdominal muscle, becomes the main force involved in the delivery process.

Second stage (expulsion stage)

Third stage (placental expulsion stage)



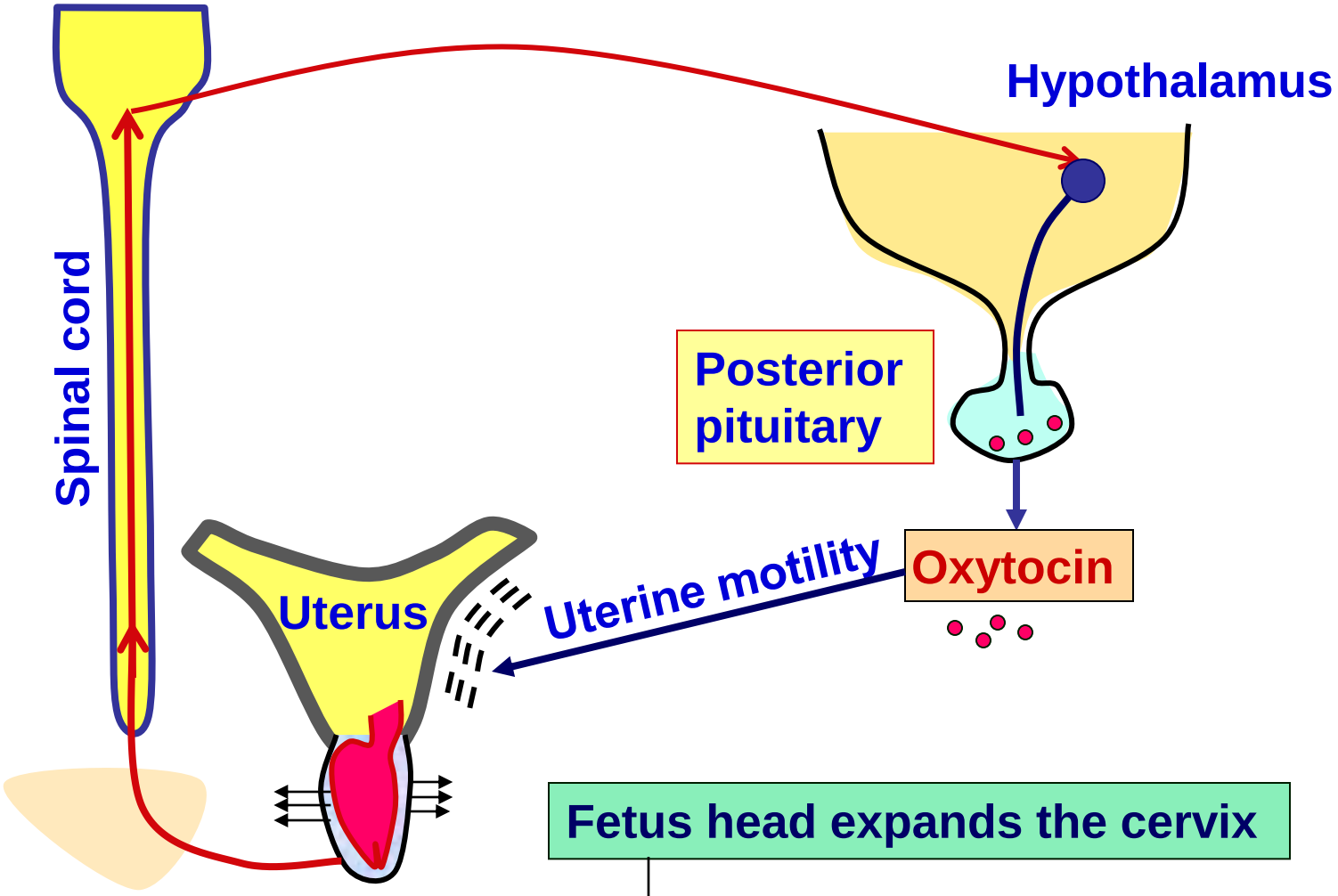



FiasCoFarm.com

Expulsive stage

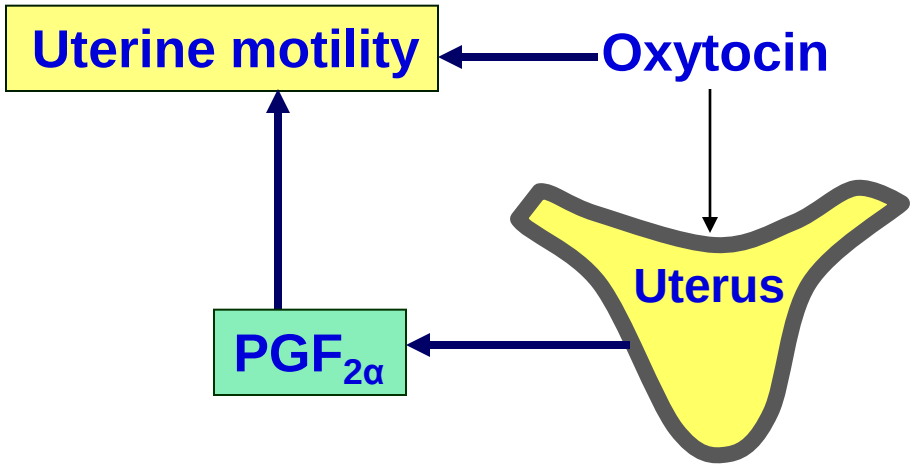
Neurohumoral release of oxytocin

Fergusion reflex



Interaction between oxytocin and PG

Feedback loop between oxytocin and PG → **Labor**



Oxytocin **Facilitate release of:** **$PGF_{2\alpha}$**

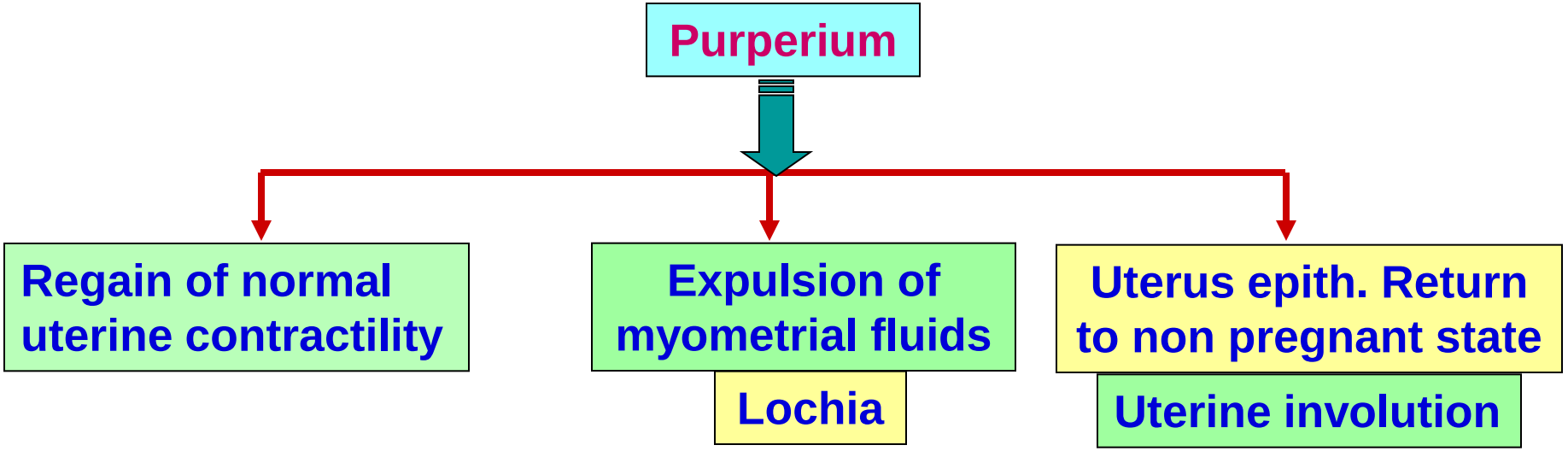
Expulsion of fetal membrane

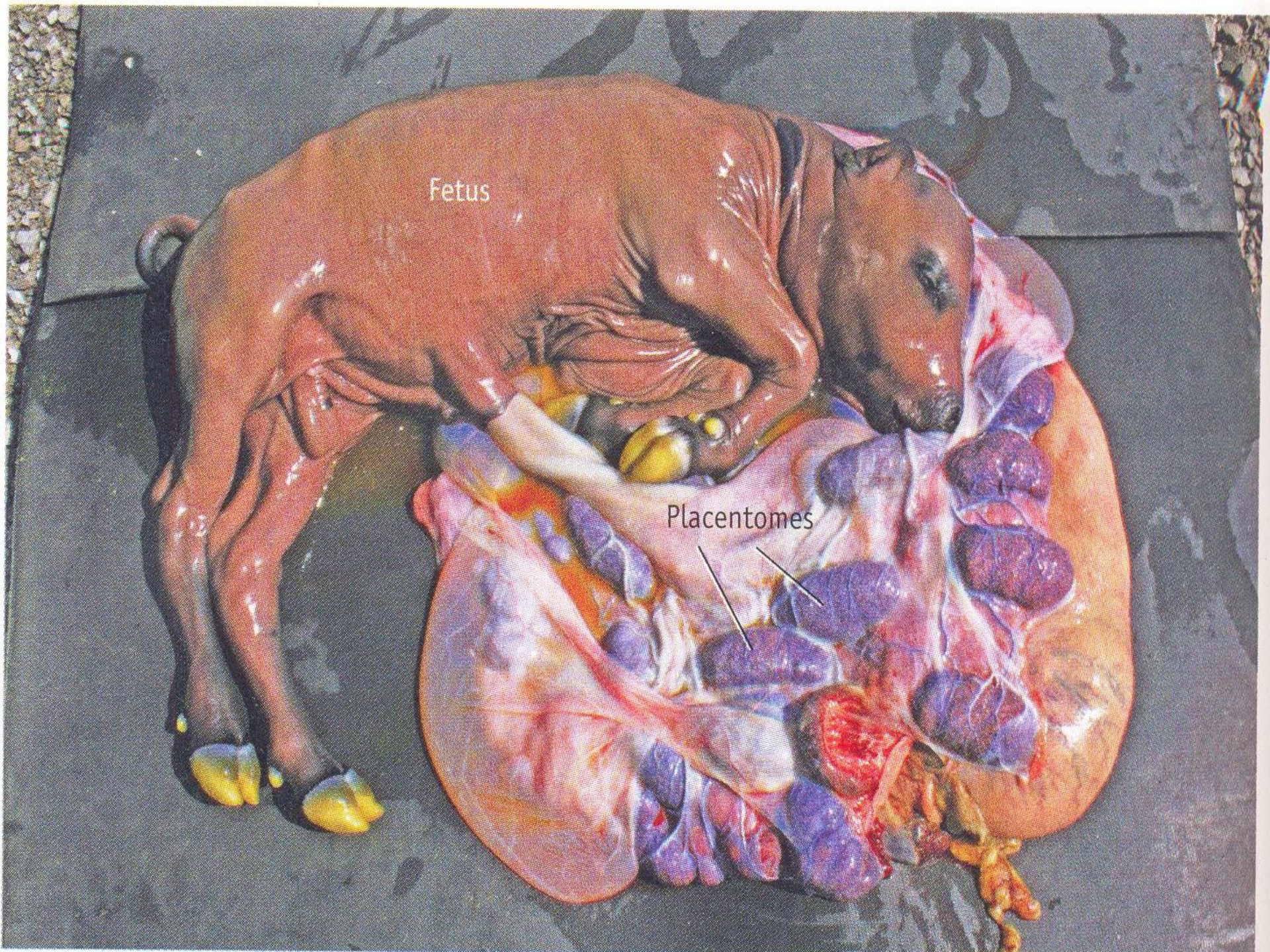
In liter- bearing animals — **Immediately after birth**

Bitch, cat, rat

In single bearing animals — **Few hours after delivery**

Cow, mare, ass, ewe




Fetus
Placentomes

(a)

(b)

(c)

(d)

Physiology of the fetus and newborn:

Closure of foramen ovale which found between the two auricles to facilitate the oxygenated blood transport from the right side to the left side of the heart without passing through the inactive lung

Closure of the ductus arteriosus that facilitates passage of blood from the pulmonary artery to the aorta

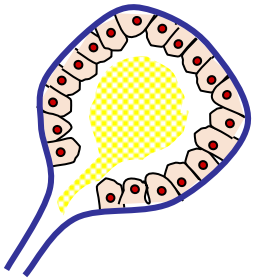
Closure of the ductus venosus that act as hepatic shunt transferring the blood from umiblical vein to the posterior vena cava.

The liver and the kidney are functionally immature

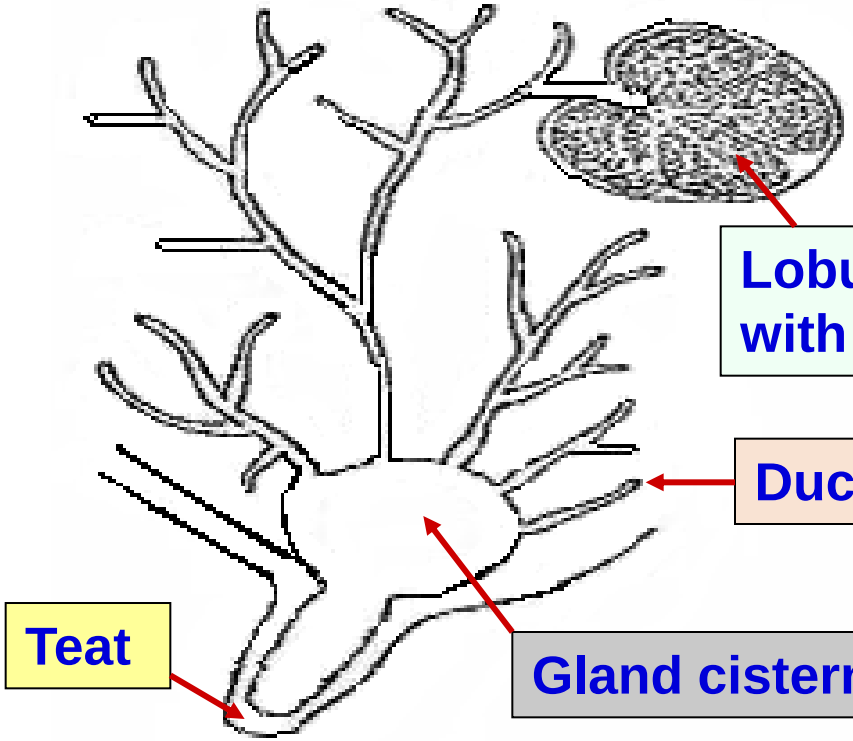
There is a slight jaundiced tint in the skin and eyes of the newborn due to destruction of the excess RBCs and the functional immaturity of the liver.

The intestine contains a dark brown or black tarry material (meconium)

Lactation



Functional unit of the mammary gland



Mammogenesis

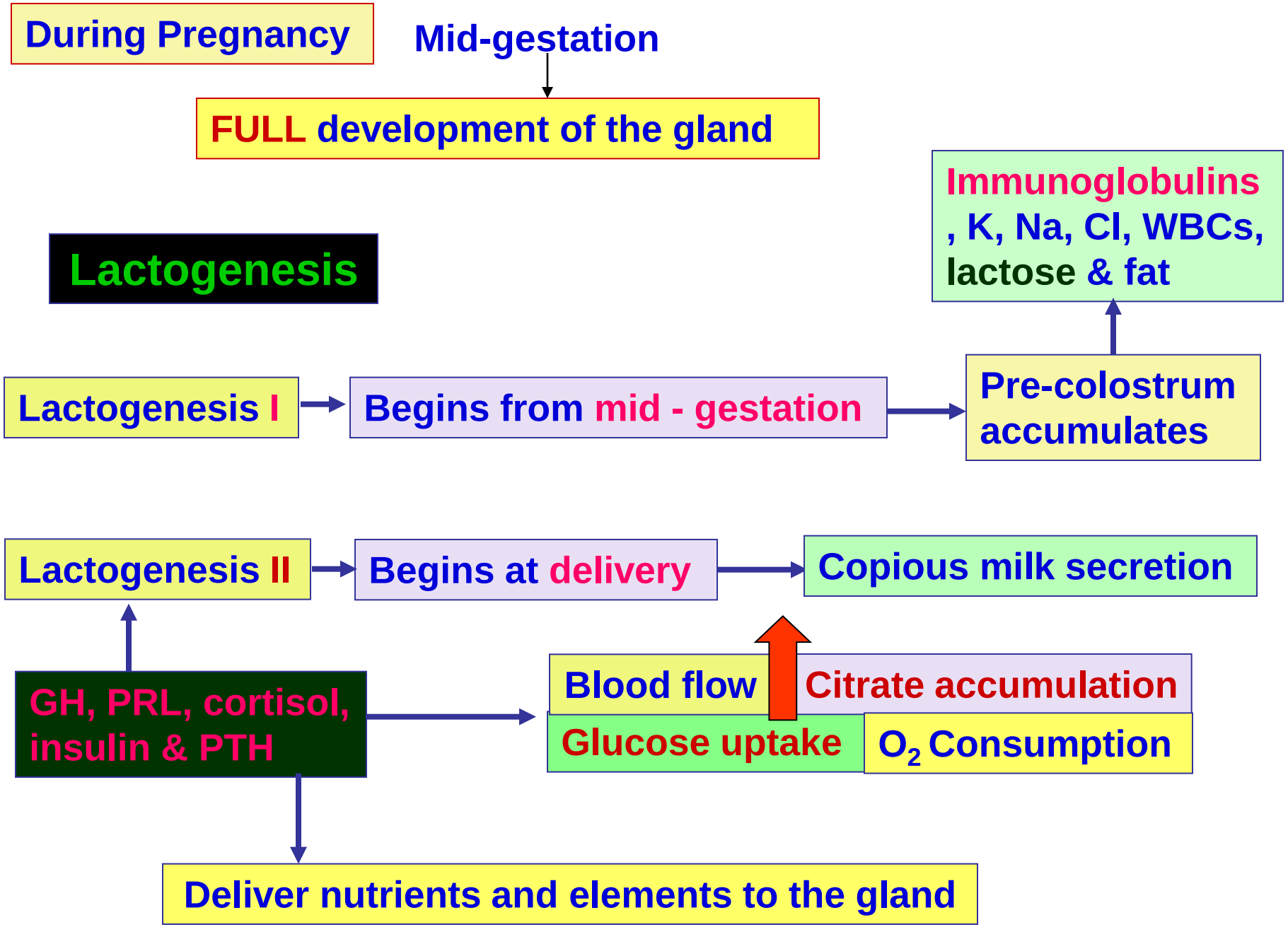
Development of mammary gland

During puberty → Estrogen → Begins growth of tubulo-alveolar system

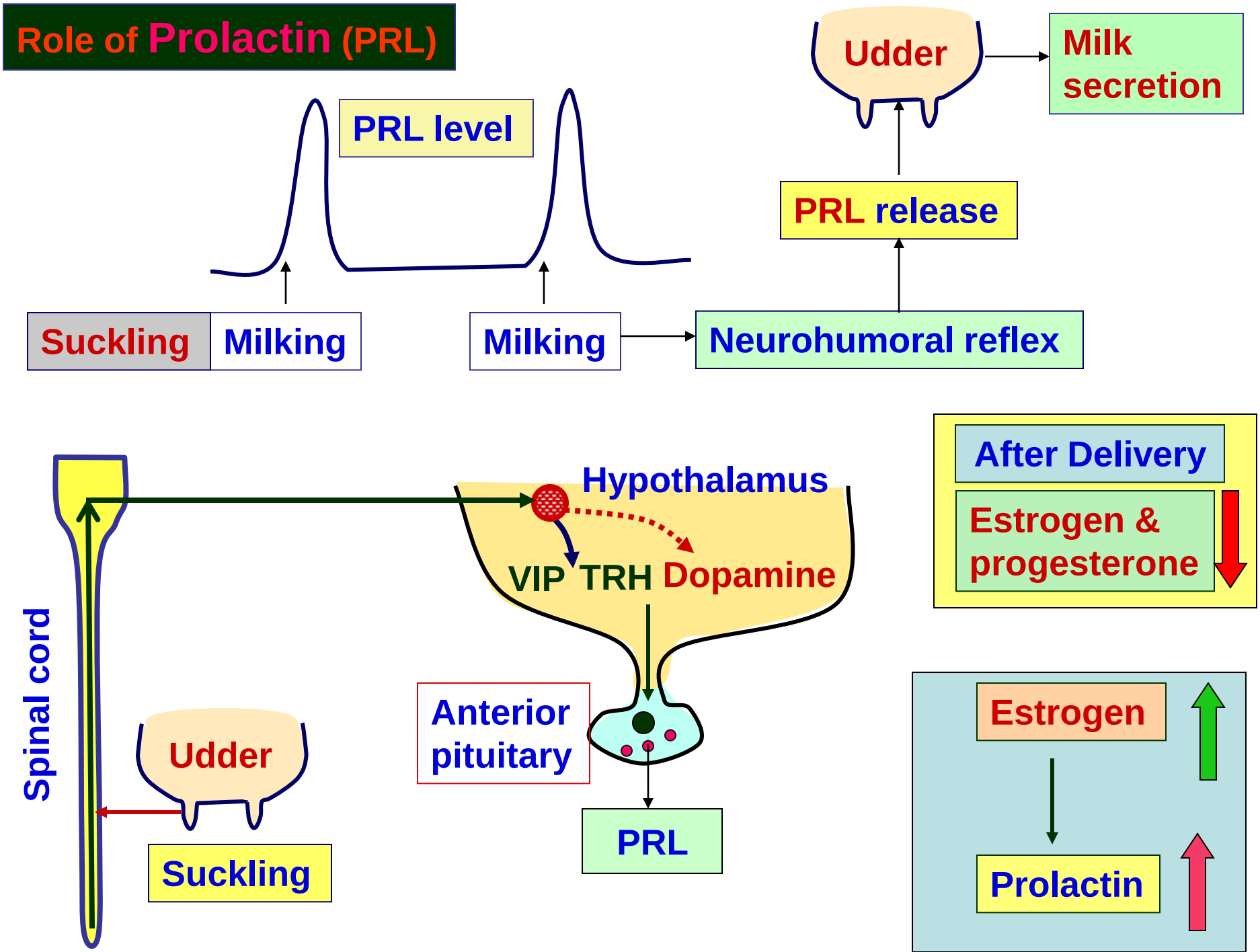
During Reproductive cycles

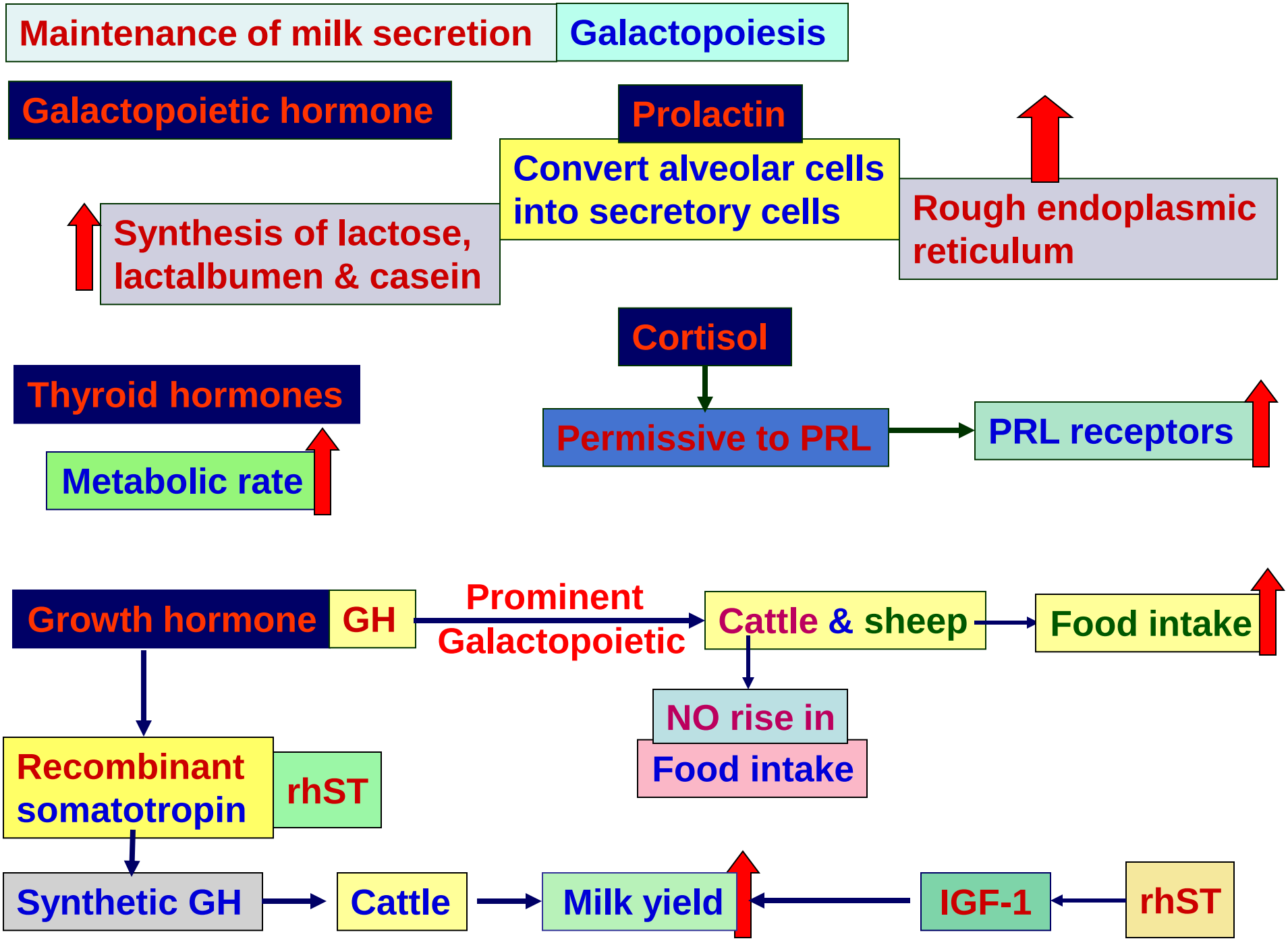
- Estrogen, GH & cortisol → Duct system
- Progesterone & Prolactin → Alveolar sysem

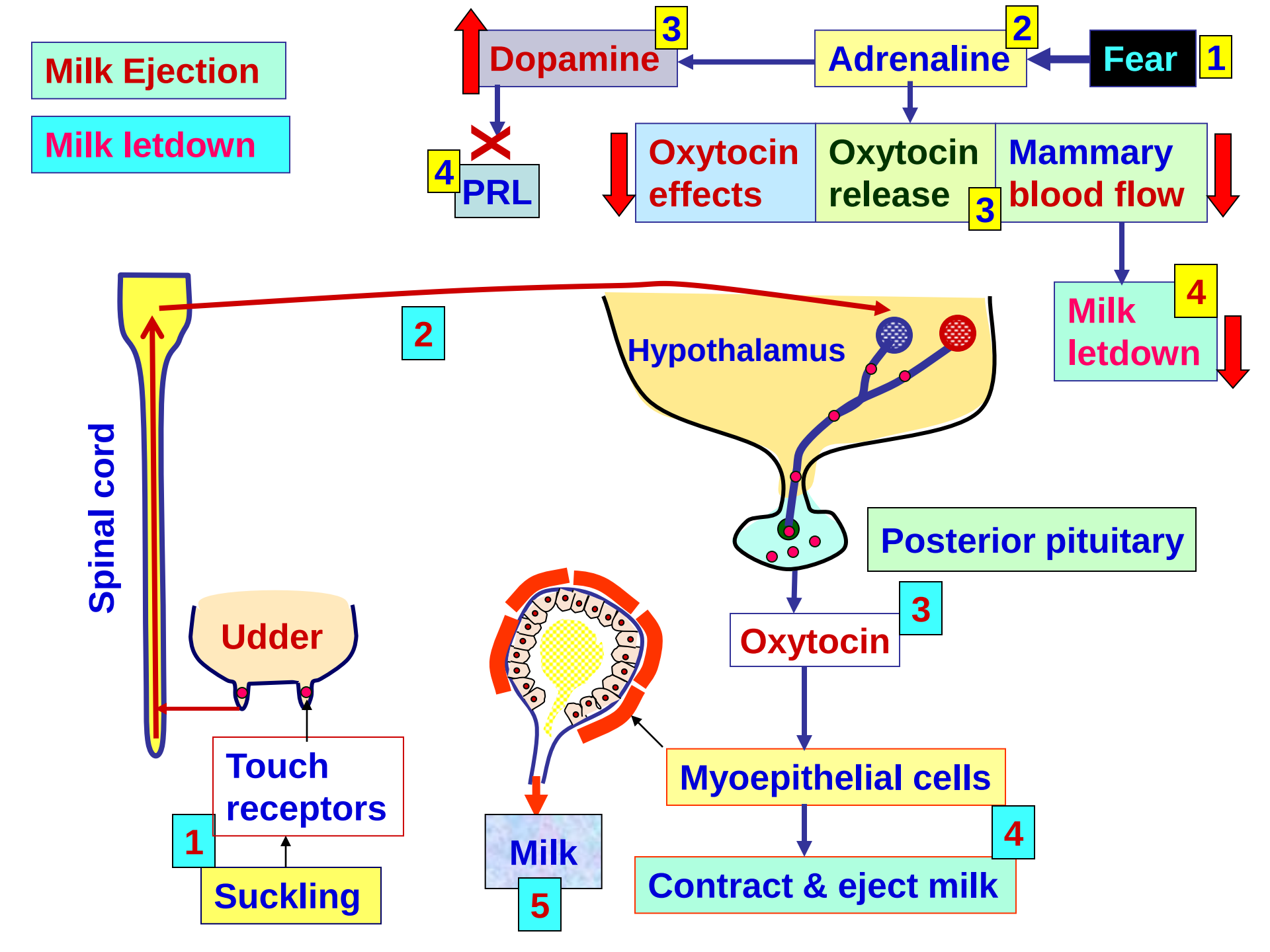
Differentiation of:


During Pregnancy
Mid-gestation
FULL development of the gland
Lactogenesis
Immunoglobulins , K, Na, Cl, WBCs, lactose & fat
Lactogenesis I
Begins from mid - gestation
Pre-colostrum accumulates
Lactogenesis II
Begins at delivery
Copious milk secretion
GH, PRL, cortisol, insulin & PTH
Blood flow
Citrate accumulation
Glucose uptake
O2 Consumption
Deliver nutrients and elements to the gland

Role of Prolactin (PRL)

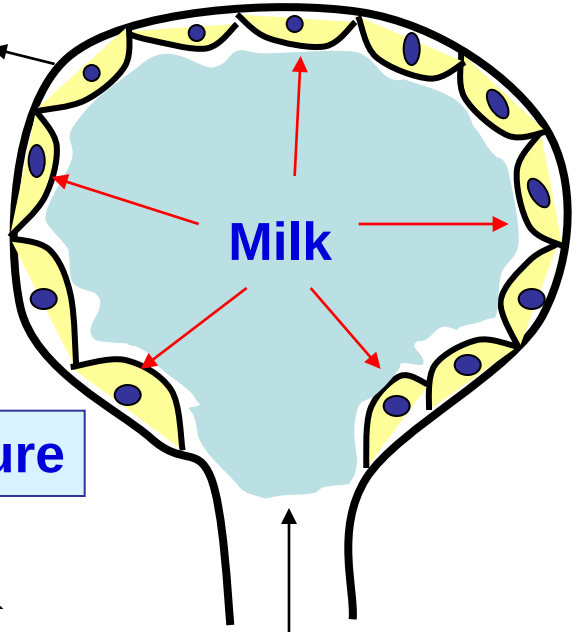



Maintenance of milk secretion
Galactopoiesis
Galactopoietic hormone
Prolactin
Convert alveolar cells into secretory cells
Rough endoplasmic reticulum
Synthesis of lactose, lactalbumen & casein
Cortisol
Thyroid hormones
Permissive to PRL
PRL receptors
Metabolic rate
Growth hormone
GH
Prominent Galactopoietic
Cattle & sheep
Food intake
NO rise in Food intake
Recombinant somatotropin
rhST
Synthetic GH
Cattle
Milk yield
IGF-1
rhST


Milk Ejection
Milk letdown
Dopamine
3
Adrenaline
2
Fear
1
4
PRL
Oxytocin effects
Oxytocin release
3
Mammary blood flow
Milk letdown
4
2
Hypothalamus
Spinal cord
Posterior pituitary
Udder
Oxytocin
3
Touch receptors
1
Suckling
Milk
5
Myoepithelial cells
4
Contract & eject milk

Effect of un-milking

Atrophied epithelium



Accumulated milk

press over the lining epithelium

Atrophy

Intra- mammary pressure

Sympathetic nerves

Blood flow

Nutrients & hormones

Un-milking

Prolactin release

Colostrum

First milk formed characterized by presence of:

Immunoglobulins

Antimicrobial factors:

Lactoperoxidase | Lysozyme | Lactoferrin

Colostrum is essential for herbivores:

→ NO immunoglobulin pass through placenta

In primates, bitch, cat & rat

↓

immunoglobulin pass through placenta

Colostrum

Should be consumed directly after birth

↓

Intestinal epith. Is leaky for 24 hours after birth

Pregnant cows shouldn't be transported before delivery

↓

To form Ab against local microbes present

Residual milk

After complete evacuation of the udder

Some milk still trapped in the gland

Can be obtained by:

Oxytocin injection inside the gland