Reproductive Female Physiology -I

Unit XIV

Chapter 82

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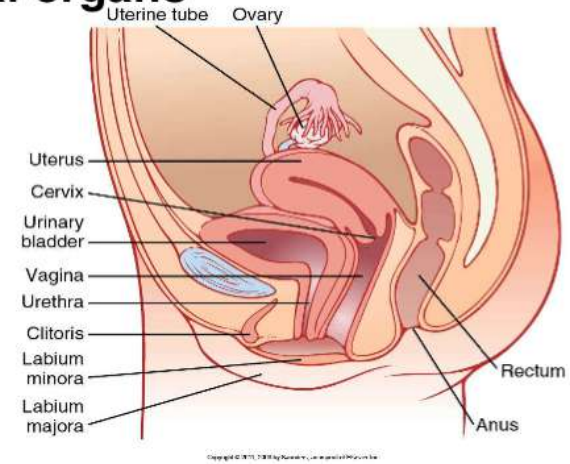
Physiological anatomy of the female sexual organs

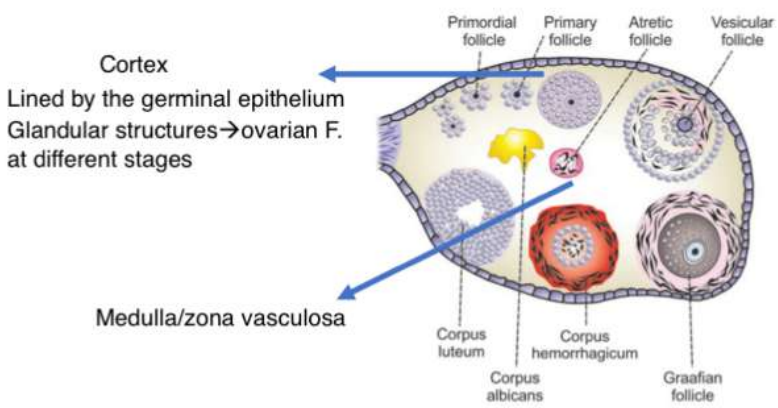
- **Primary sex organs**

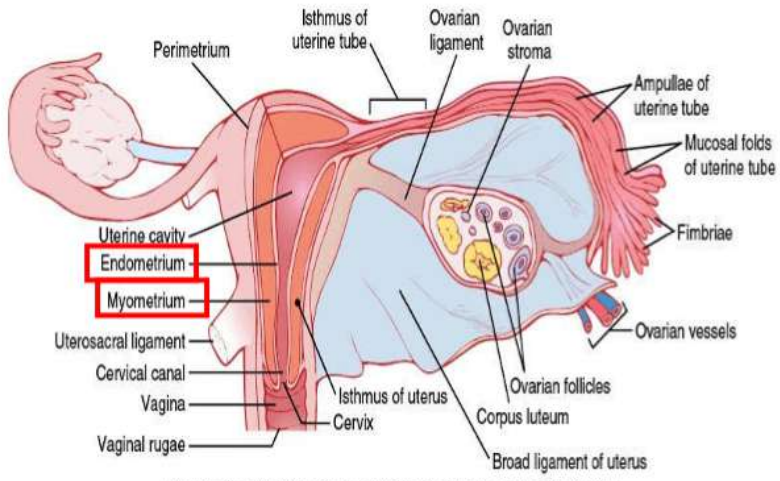
➢ Ovaries

✓ **Gametogenic**→ site of follicular development and production of 2nd oocytes

✓ **Endocrine**→ hormones (E&P)



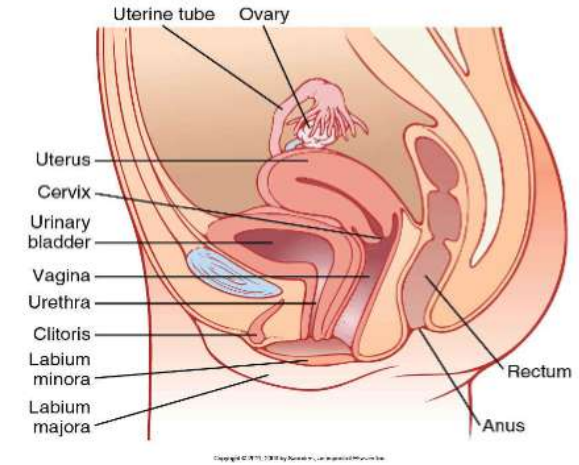


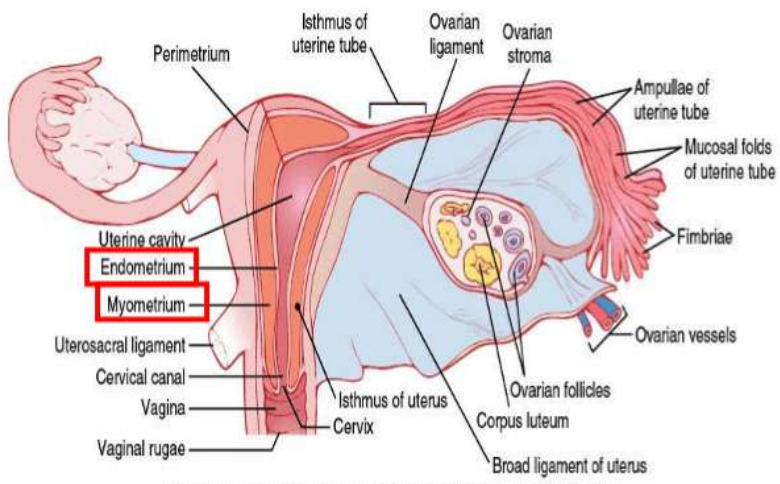


Physiological anatomy of the female sexual organs

- **<u>Accessory sex organs</u>**

- Uterine/Fallopian tubes→ transport fertilized ova
- Uterus → fetal development
- Cervix →mucus secretion
- Vagina → birth canal
- External genitalia





(Redrawn from Guyton AC: Physiology of the Human Body, 6th ed. Philadelphia: Saunders College Publishing, 1984.)

Sexual life in females

FIRST PERIOD

- Birth-puberty
- primary and accessory sex organs do **not** function

SECOND PERIOD

- Puberty -menopause
- First menstrual cycle = menarche
- women menstruate and reproduce.

THIRD PERIOD

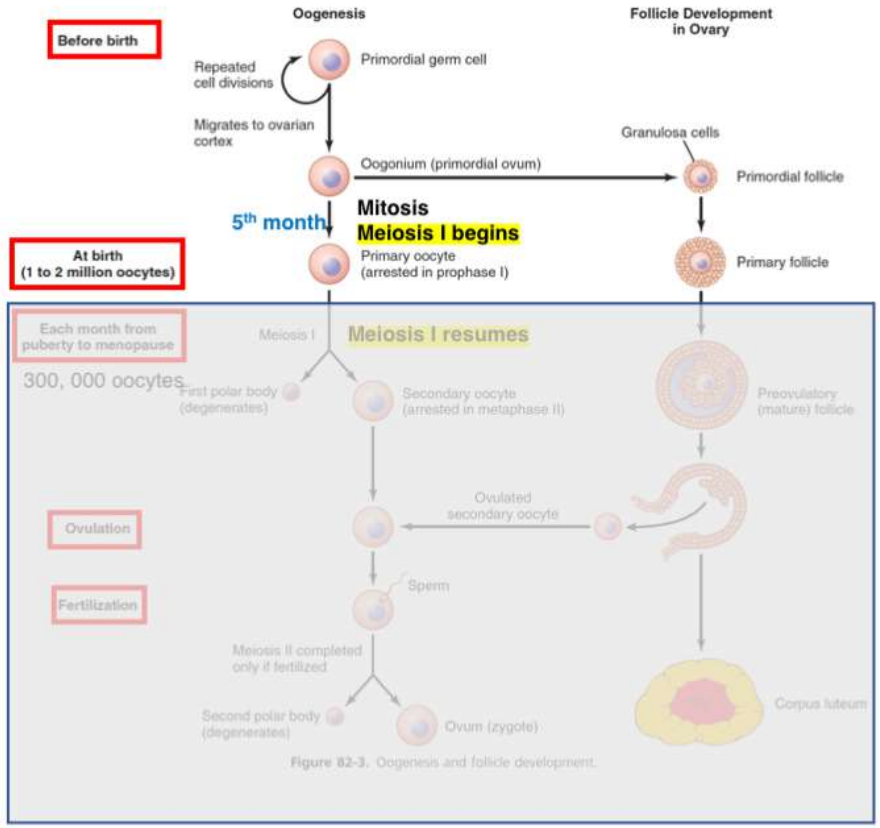
- Menopause
- Permanent stoppage of menstrual cycle (45 -50y).

Oogenesis and follicular development in the ovaries

Oogenesis= Developing egg /oocyte → mature egg/ovum

Intrauterine life

- primordial germ cells → primordial ova/oogonia
- Oogonia divide to produce **millions** by mitosis but most degenerate (atresia) during fetal growth
- Some develop into **primary oocytes** & stop in *prophase stage of meiosis I*
- 2 million present at birth



Fundamental reproductive unit = single ovarian follicle =one germ cell (oocyte)+ surrounded by endocrine cells

Oogenesis and follicular development in the ovaries

Puberty

- 300, 000 remain at puberty but only 400- 500 mature during a woman's life
- **Each month**, hormones cause **meiosis I** to resume in several follicles so that meiosis II is reached by ovulation
- Penetration by the sperm causes **the final stages of meiosis** to occur

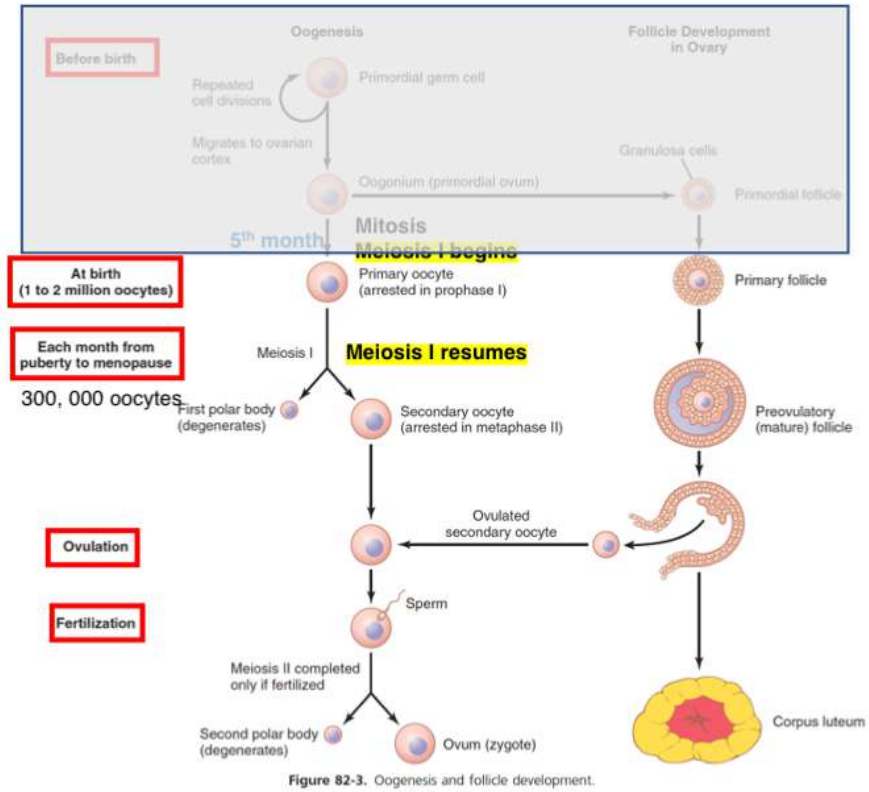


Figure 82-3. Oogenesis and follicle development.

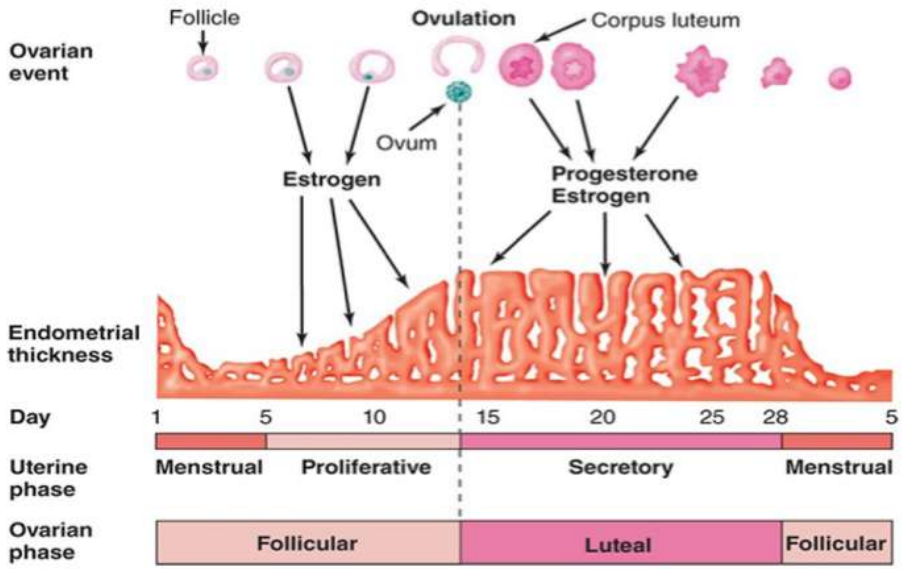
Monthly ovarian cycle

- **female monthly sexual cycle /menstrual cycle= monthly rhythmical** changes in:
  - ✓rates of secretion of the female hormones
  - ✓ovaries and other sexual organs.

Avg 28 d (20-45 d)
Abnormal cycle length → decreased fertility

- **Outcomes of female sexual cycles:**
  1-single ovum/month→ fetus?
  2-prepared uterus for implantation

Female monthly sexual cycle



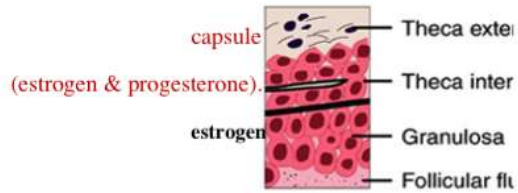
Ovarian cycle

- Follicular phase -- avg 15 d (range, 9-23 days)
- Ovulatory phase -- 1-3 d -- culminates with ovulation
- Luteal phase – 14 d -- less variable than follicular

Endometrial cycle

- Menstruation phase
- Proliferative phase
- Secretory phase

Follicular Phase



- Upon **FSH** stimulation, (6-12) primordial follicles becomes a primary follicle (one layer of granulosa cells)
- Primary follicle then becomes a secondary follicle (additional layers of granulosa cells)
- The theca and granulosa cells cooperate to produce **estrogens**
- The antrum is formed→ vesicular folicle

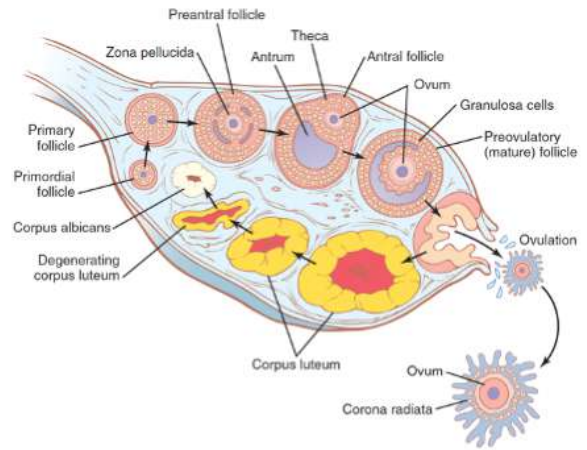


Figure 82-5. Stages of follicular growth in the ovary, also showing formation of the corpus luteum.

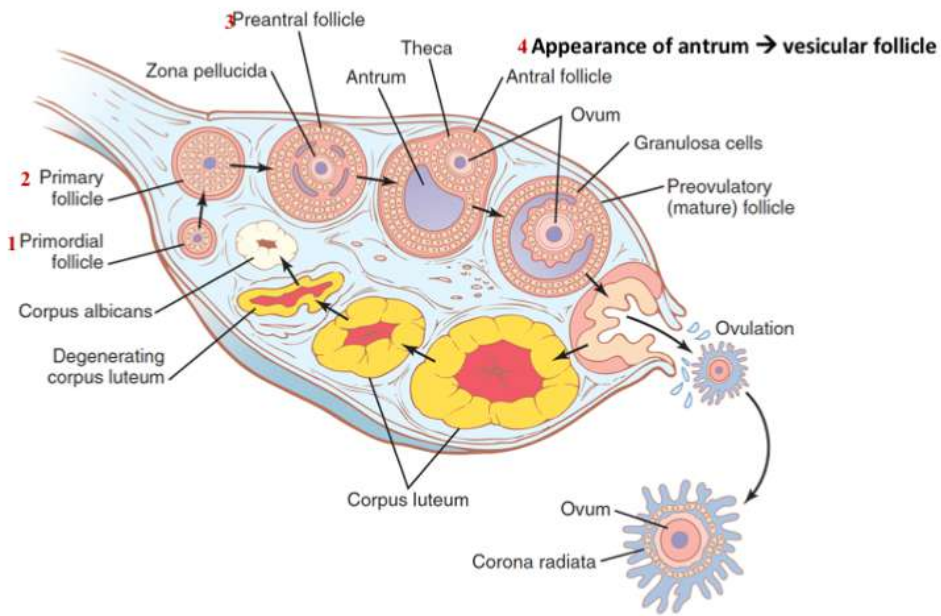
OVARIAN FOLLICLE GROWTH

<u>accelerated growth to form vesicular F. is caused by:</u>

1. ***<u>Estrogen</u>*** → **++** FSH Receptors on **<u>granulosa</u>** cells →positive feedback effect (makes the granulosa cells even more sensitive to FSH (intrinsic +ve FB)

2. FSH & estrogens → **++LH receptors** on **<u>granulosa</u>** cells → LH mediated **follicular secretion.**

3. estrogens +↑LH → ++proliferation of **thecal** & ++ their **secretion**.



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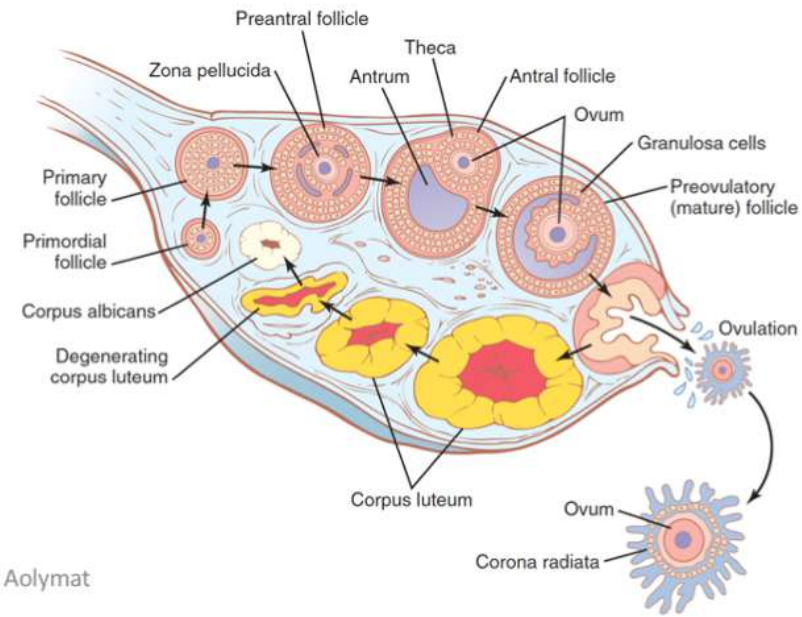
OVARIAN FOLLICLE GROWTH

Before ovulation only **One** Follicle Fully Matures (**outgrow** all the others) Each Month, and the Remainder Undergo Atresia→1 fetus/preg

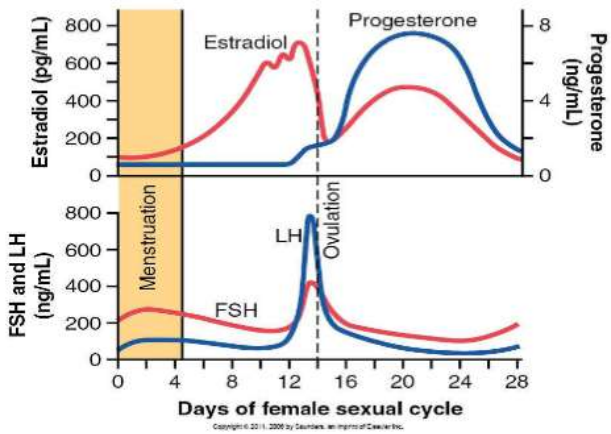
cause → large amounts of **estrogen** from the most rapidly growing follicle → --inhibit FSH → blocking further growth of the less well-developed follicles.

The single follicle reaches a diameter of 1-1.5 centimeters at the time of ovulation and is called the **mature follicle**

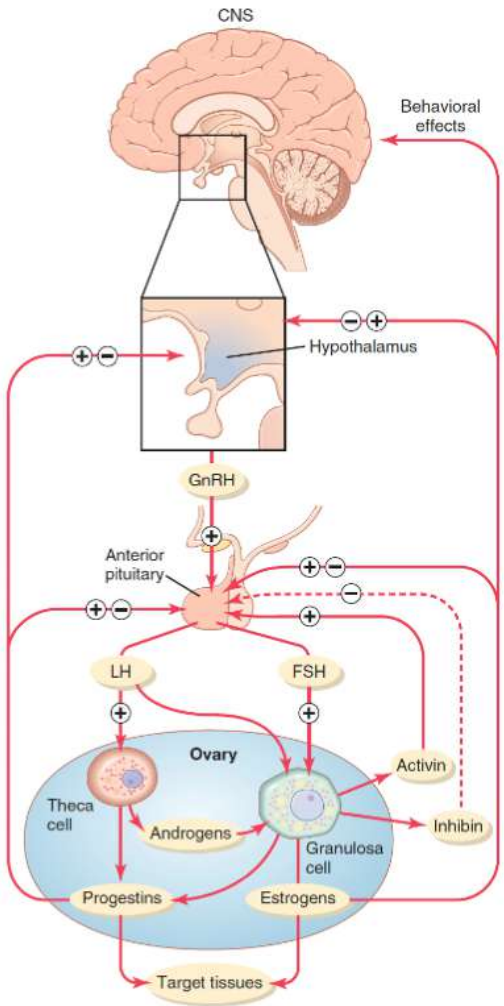


Hormonal regulation of follicular growth

- GnRH rises in response to a decline in inhibin and sex steroids
- GnRH stimulates rise in pituitary FSH & LH secretion
- FSH stimulates new follicle growth, E2 & LH receptors
- LH induces thecal cell growth, vascularization & androgen synthesis



Overview of Hormonal Regulation



Ovulation

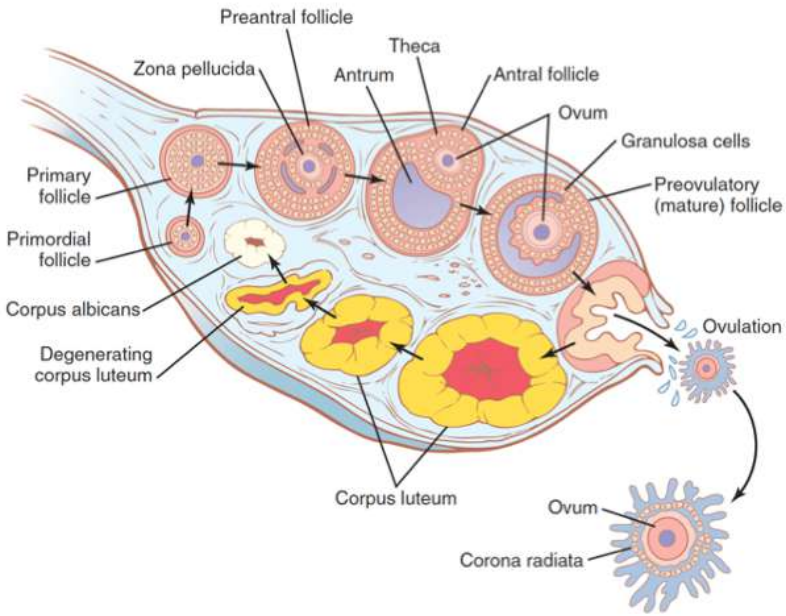
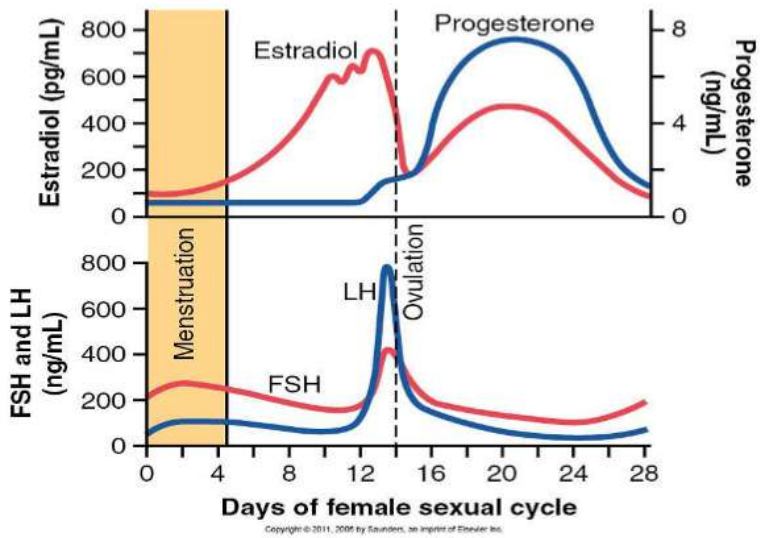


Figure 82-5. Stages of follicular growth in the ovary, also showing formation of the corpus luteum.

In 28-day cycle →ovulation 14 days after onset of menstruation
small area in the center of the follicular capsule (**stigma**)→ ruptures →ovum surrounded by a granulosa cells→called the corona radiata

Hormonal regulation of Ovulation

- **A Surge of LH Is Necessary for Ovulation**.
- **2 days** before ovulation → rate of secretion of LH **increases markedly**, 6-10-fold, peaking **16 h before** ovulation.
- **FSH** also increases 2-3 fold at the same time
- FSH & LH act synergistically to cause rapid swelling of the follicle before ovulation.
- LH converts **granulosa and theca** cells to mainly **progesterone** secreting cells.
- Rate of secretion of estrogen begins to fall about **1 day before ovulation**



Signs of Ovulation

- Increase in basal body temperature
- Changes in cervical mucus
- Cervix softens
- Mittelschmerz---pain

Postovulatory Phase

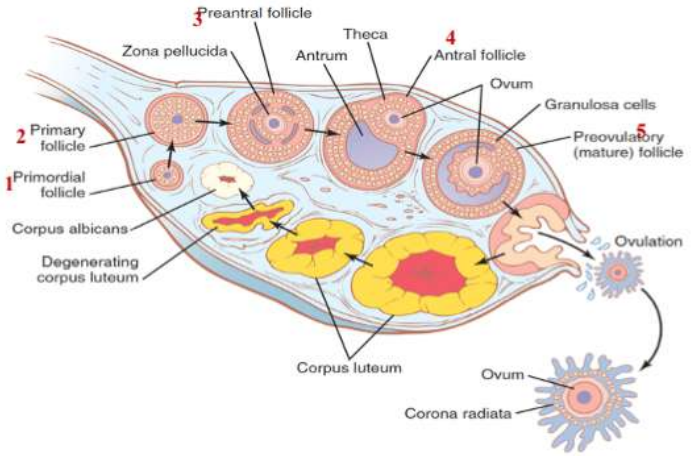
- Lasts 14 days
- In the ovary→ (luteal phase)
  - LH→luteinization→granulosa & theca interna cells change rapidly into **lutein** cells→filled with lipid→c. luteum→ P&E→ low FSH & LH
  - Lutein cells→inhibin→ inhibts FSH

↓

Involution of CL

  - No fertilization→corpus albicans is formed
  - As P&E levels drop, secretion of GnRH, FSH & LH rise

  - **Fertilization** → embryo secretes human chorionic gonadotropin (hCG) which maintains health of corpus luteum & its hormone secretions



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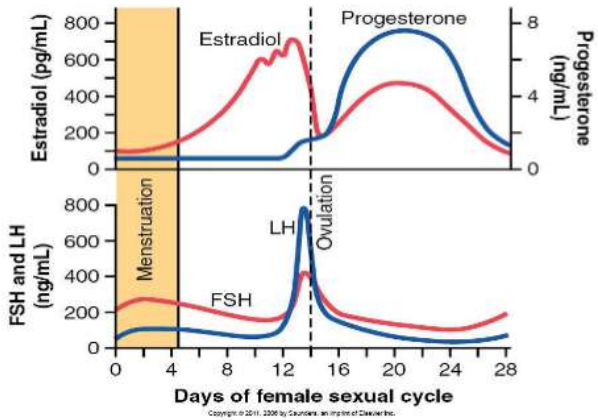
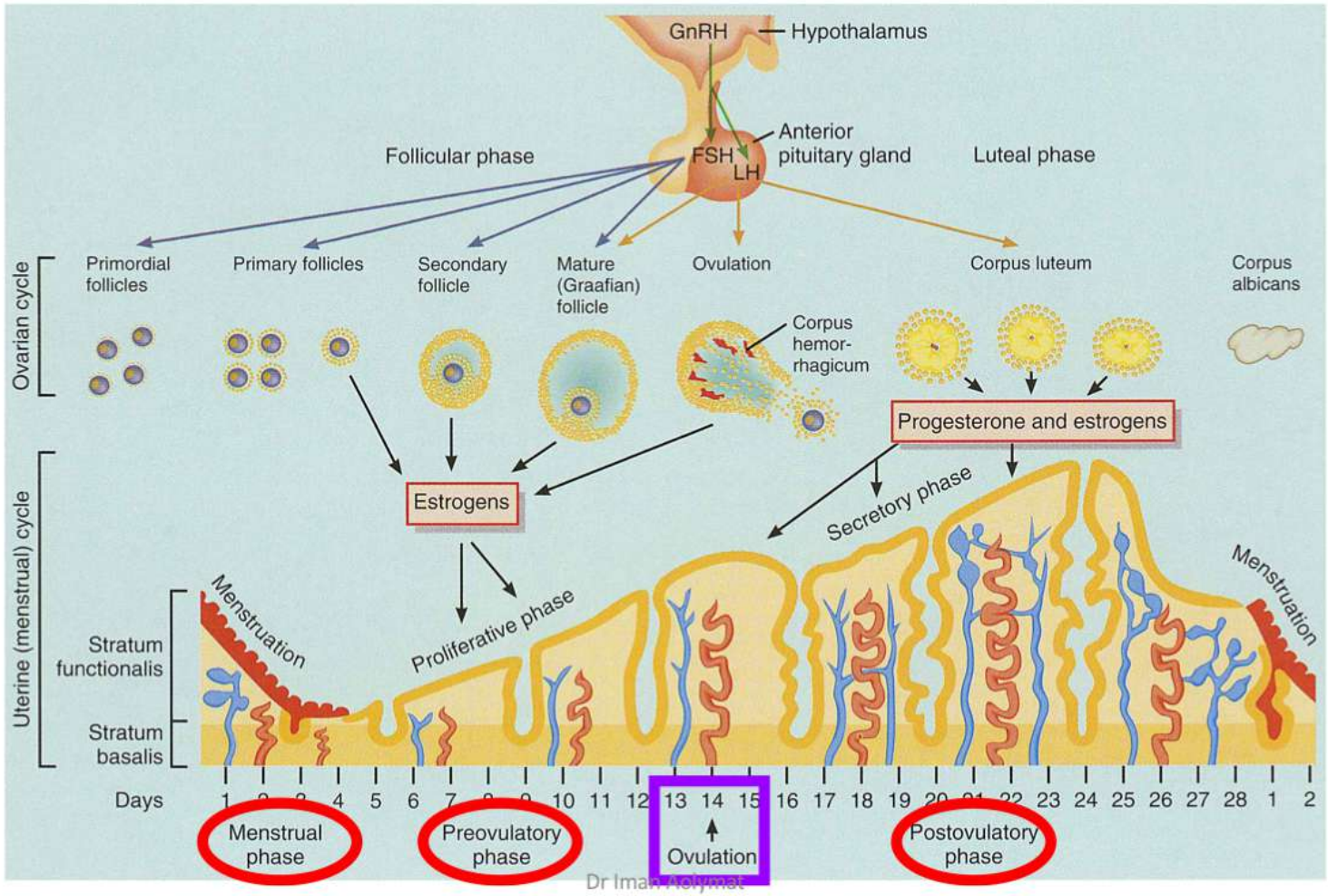


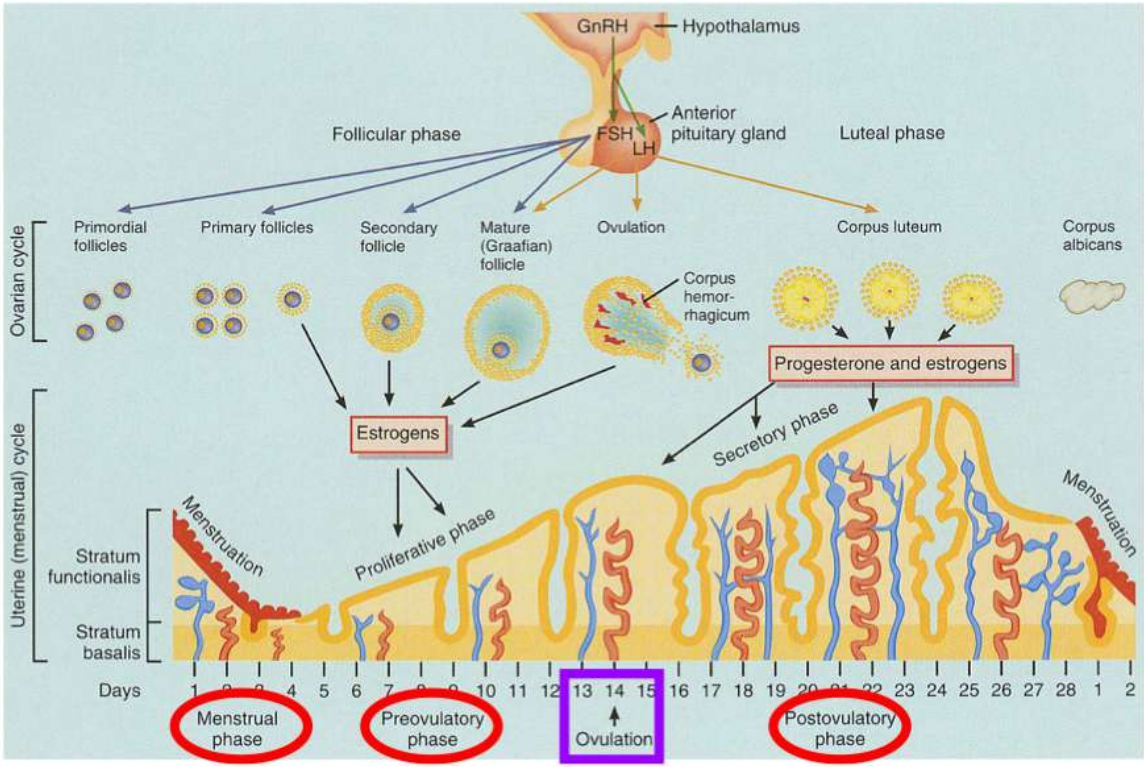


Menstrual Phase

- Menstruation lasts for 5 days
- First day is considered beginning of 28 day cycle
- In ovary
  - Early follicular growth
- In uterus
  - **LOW progesterone** (mainly) & estrogen→ **spiral arteries** constriction→ ischemia & necrosis → glandular tissue dies→ sloughing of stratum functionalis
  - 40 ml of blood, 35 ml serous fluid
  - Menstrual fluid is **nonclotting→ fibrinolysin** presence
  - Excessive bleeding→ not enough fibrinolysin →clotting
  - Within 4 to 7 days after menstruation starts, the loss of blood ceases because, by this time, the endometrium has become **re-epithelialized.**

Proliferative phase

++ estrogen →endometrial re-epithelialization
increase numbers of stromal cells & progressive growth of the endometrial glands and new blood vessels



Postovulatory Phase

- secretory phase/progestational phase
  - Hormones (progesterone mainly) from corpus luteum promote marked **swelling** and **secretory** development of **endometrium→** implantation of fertilized ovum

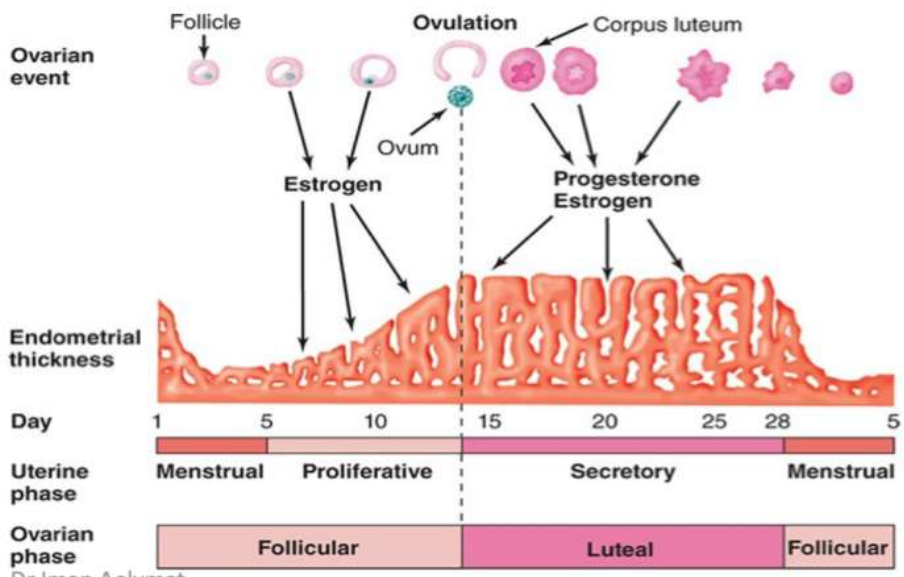
Glands→
increase in tortuosity
Full of secretions

Stromal cells →
Cytoplasm increases
lipid and glycogen deposition

Uterine milk= provide nutrition for the early dividing ovum

Increase blood supply to the endometrium →blood vessels becoming highly tortuous.

*If **no** fertilization occurs, menstrual phase will begin*



Anovulatory Cycles—Sexual Cycles at Puberty

Preovulatory **surge of LH is not sufficient** →anovulatory cycle

Consequences

Failure of development of corpus luteum

No secretion of **progesterone** during the latter portion of the cycle

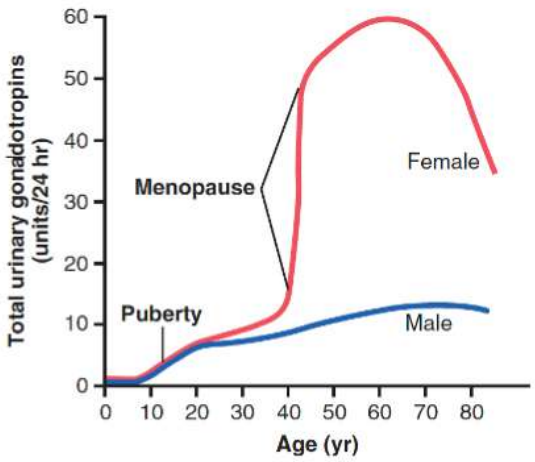
cycle is shortened

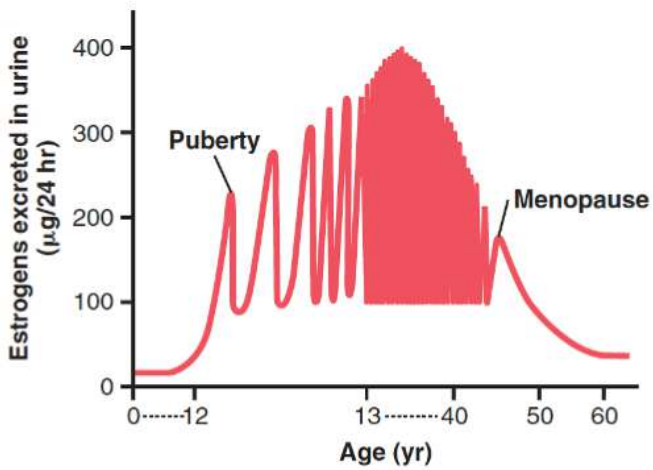
The first few cycles after the onset of puberty are usually anovulatory, as are the cycles occurring several months to years before menopause

PUBERTY AND MENARCHE

Hypothalamus does **not** secrete significant quantities of **GnRH** during childhood.

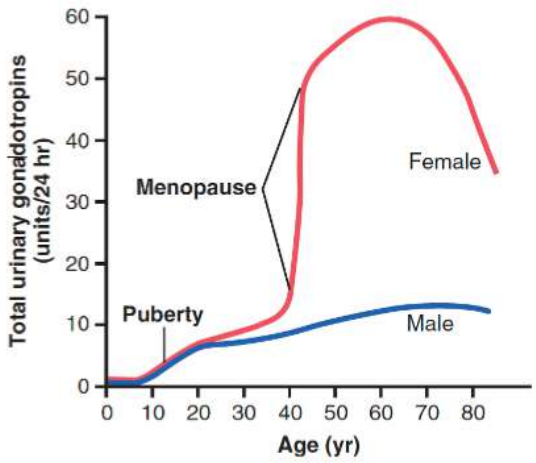
The period of **puberty** is caused by a *gradual* increase in **GnRH** by the pituitary
Beginning in about the **eighth** year of life, and usually culminating in the onset of puberty and menstruation between ages **11 and 16** years in girls
(average, 13 years).

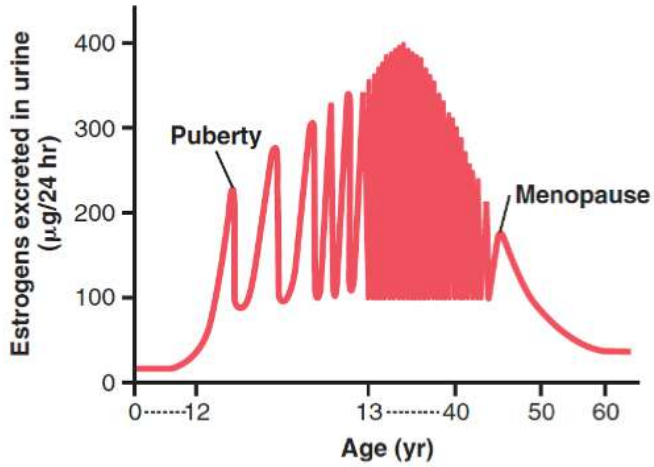




Menopause

At age 40 to 50 years, the sexual cycle usually becomes **irregular** and **anovulatory**
After a few months to a few years, the cycle ceases & **female sex hormones diminish** to almost none is called **menopause**





FSH and LH (mainly FSH) are produced after menopause **in large** and continuous quantities

WHY? Estrogens can no longer inhibit FSH and LH

Menopause

The loss of estrogens :
(1)"Hot flushes" characterized by extreme flushing of the skin
(2)Dyspnea
(3) Irritability
(4) Fatigue
(5) Anxiety
(6) Decreased strength and calcification of bones throughout the body

Administration of Estrogen (HRT) after menopause→ ▼symptoms of menopause

Functions of the ovarian hormones

Two types of ovarian sex hormones:

1-Estrogens

- Responsible for the development of most **secondary sexual characteristics** of the female

Source of estrogen

- Non-pregnant- *ovary* (mainly) & adrenal cortex.
- Pregnant- placenta.

Functions of the ovarian hormones

Two types of ovarian sex hormones:

2-progestins

- The most important →**progesterone**
- In non-pregnant progesterone is secreted mainly from corpus luteum.
- In pregnancy, large amount by placenta especially after 4th month of pregnancy
- to *prepare the uterus for pregnancy and the breasts for lactation.*

Functions of estrogen

- External female sex organs:

1. ***Increase in size of ovaries***, fallopian tubes, uterus and vagina, external genitalia at puberty
2. Deposition of fat in mons pubis
3. **Vaginal epithelia** change from **cuboidal** to **stratified** type→ more resistant to trauma & infection
4. **Endometrium:** proliferation of stroma and endometrial glands (**nutrition** of fertilized ovum)

Functions of estrogen

- External female sex organs:

5. **Fallopian Tubes:**
   - proliferation of **glandular tissues**
   - **increase number & activity of ciliated** epithelial cells

   cilia always beat toward the uterus→ helps propel the fertilized ovum in that direction.

6. Breasts:

   fat deposition

   development of stromal cells

   growth of ducts (progesterone (mainly),

Prolactin important in milk production. **estrogen** influence growth of alveoli & lobules

Functions of estrogen

- Skin: **increase vascularization** of skin and development of **soft** skin

- Hair: little effect -pubic & axillary hair → **adrenal androgens**

- Bones: estrogen **inhibits osteoclastic** activity→ so **height increases** after puberty, but epiphyses and shafts of bones **unite early and growth stops**

Menopause → osteoporosis

Functions of estrogen

- Estrogens slightly increase **protein deposition**

- **Sodium and water retention** by the kidney. *Slight effect* but during **pregnancy** the tremendous formation of estrogens by the placenta may contribute to **body fluid retention**

- Estrogens **increase body metabolism** and **fat deposition** (subcutaneous tissues, breasts, buttocks and thighs)→ More subcutaneous fat in women than men

Functions of Progesterone

1. Promotes **secretory changes** in the uterus during the latter half of the monthly female sexual cycle suitable for implantation of an embryo.

2. **Decreases contraction of uterine tubes and myometrium** (decreases expulsion of implanted ovum).

Functions of Progesterone

3. Stimulates breast growth.

4. Increase **mucosal secretions** of the fallopian tubes to provide nutrition to the fertilized dividing ovum which traverses the tubes towards the uterus body.

5. Changes the cervix mucus into **thick and sticky** (cervical plug).

Female sexual response

- **Stimulation of the Female Sexual Act.**
- Psychic stimulation, local sexual stimulation & thoughts.
- Sexual desire is based on psychological and physiological drive
- sexual desire does **increase** in proportion to the level of sex hormones
- Desire also changes during the monthly sexual cycle, reaching a **peak** near the time of **ovulation**, probably because of the high **levels of estrogen** secretion during the **preovulatory period.**

Female sexual act

- Sexual stimulation in women is initiated by stimulation of the vulva, vagina, and other perineal regions can create sexual sensations.
- The glans of the clitoris is very sensitive the sexual stimulation

sensory signals

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pudendal nerve and sacral plexus

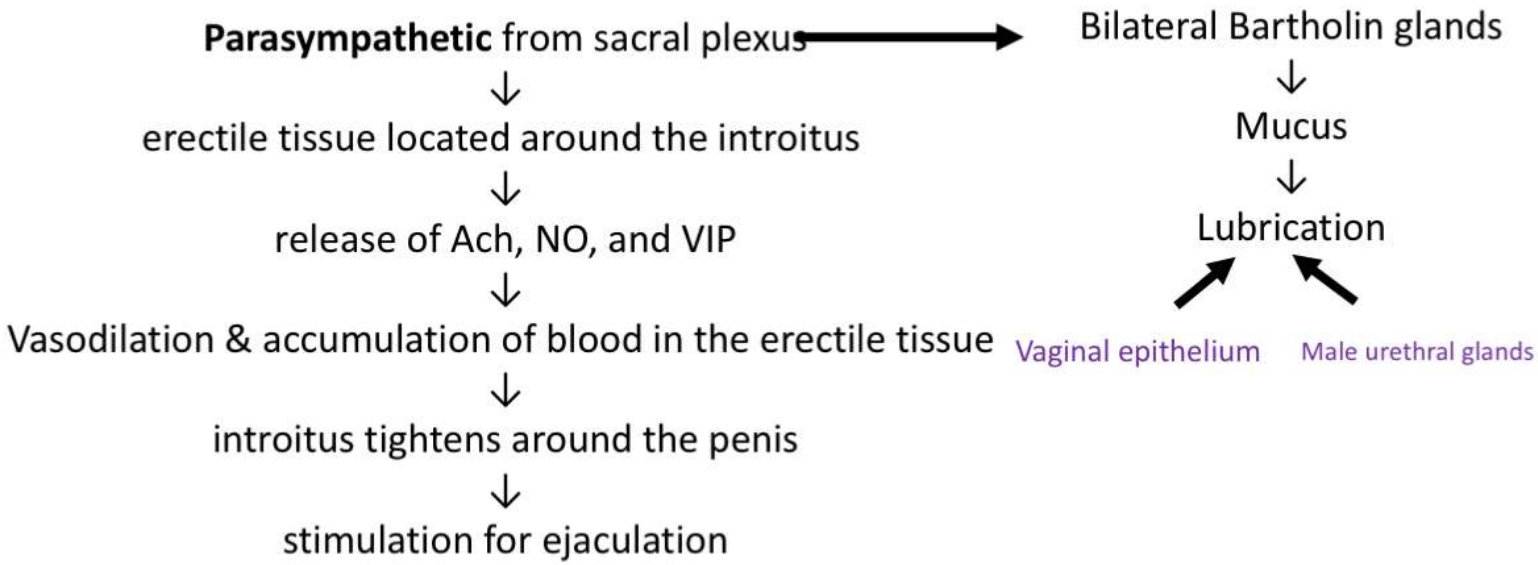
↓

sacral segments of the spinal cord

↓

Cerebrum

Female Erection and Lubrication.



Female Orgasm

Female Orgasm (female climax) : happens when **maximal sexual sensation** is reached
Variable- rhythmic contractions of the pelvic musculature

female orgasm is analogous to **emission and ejaculation** in the male, and it may help promote fertilization of the ovum.

Process is similar in males and females:

1) Excitement phase: caused by psychological or physical stimulation; engorgement and erection of clitoris, vaginal congestion -- parasympathetic nerves → increased HR, BP, respiratory rate

2) Plateau phase: intensification of these responses, increased HR, BP, respiratory rate, muscle tension

3) Orgasmic phase:culmination of sexual excitement, intense physical pleasure

4) Resolution phase:returns genitalia and body systems to pre-arousal state

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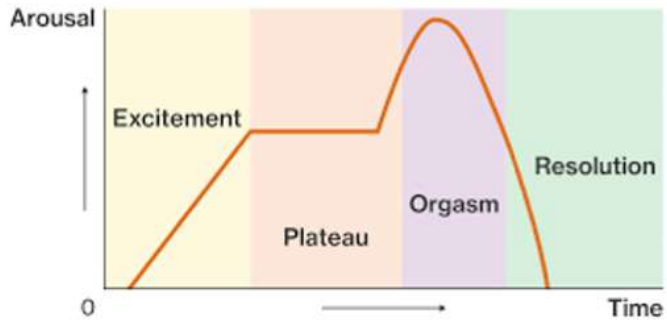


Male and female sexual response

Differences:

Women don't require refractory time before beginning excitation again

No ejaculation in the female

Maturation and fertilization of the ovum

Secondary oocyte+ granulosa cell (corona radiata)

↓

Ovulation

↓

Peritoneal cavity

↓

Secondary oocyte at mpullae of FT ← **Sperm**

↓

fertilization

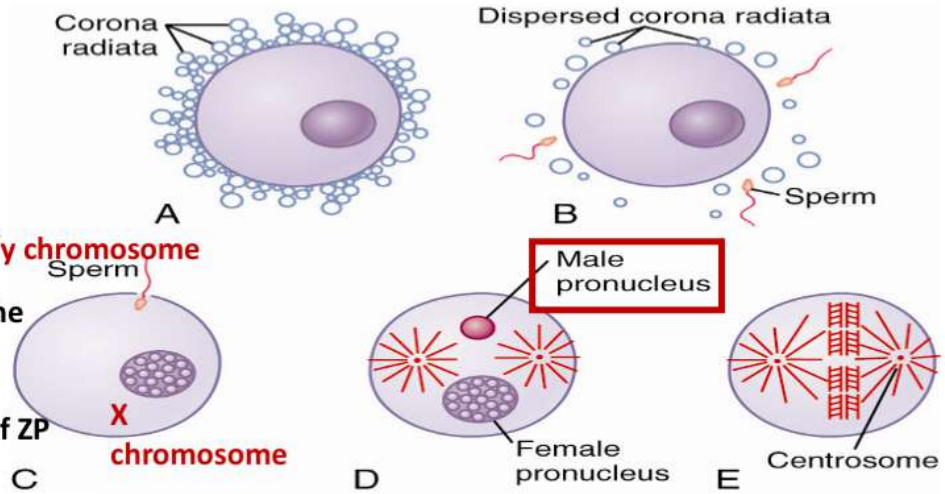
<u>transport of sperm is aided by:</u>

1- contractions of the uterus and FT →**PG** in seminal fluid

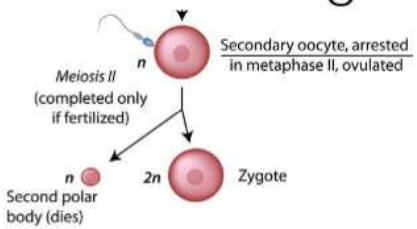
2- **oxytocin** during female orgasm

Fertilization

Bind to & penetrate zona pellucida
release acrosomal enzymes, hyaluronidase and proteolytic enzymes



<u>Fusion of 1 sperm prevents polyspermy</u>
↓ in the membrane potential of the ovum
↑ IP3 in ovum → Ca release--> release of enzymes--> hardening of ZP



Once a sperm has entered the →the oocyte divides to form mature ovum + second polar body

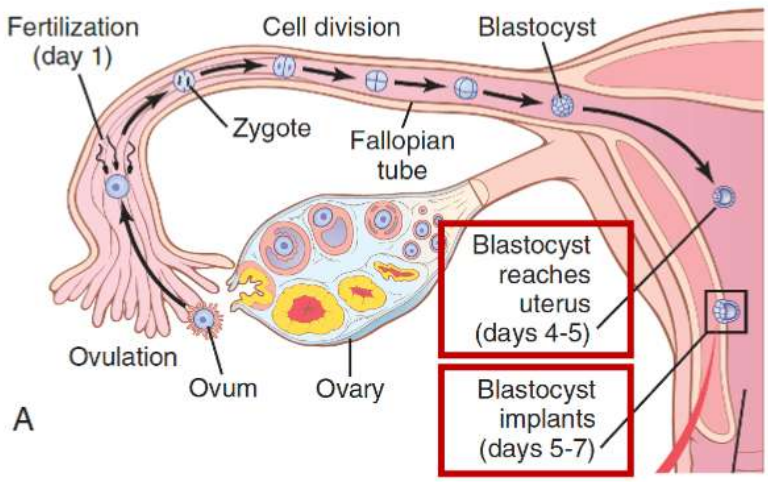
23 unpaired chromosomes of male pronucleus+ 23 unpaired chromosomes of female pronucleus <u>align themselves</u>→
re-form a complete complement of 46 chromosomes (23 pairs) in the fertilized ovum or zygote

Transport of fertilized ovum

- 3 - 5 days after fertilization→ ovum is transported to U cavity

Aided by:

- Epithelial secretions
- Cilia action
- Weak contractions of fallopian tube

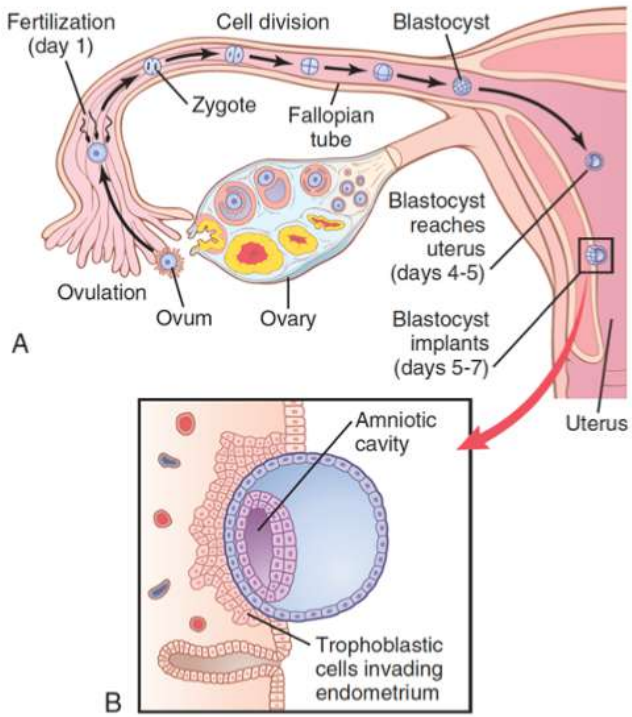


- Several division of the developing embryo take place before implantation (blastomere→ morula→blastocyst)

Implantation of fertilized ovum

Mediated by **trophoblast** on surface of the blastocyst → Proteolytic enzymes

Invasion results in fluid secretion → nutrient
trophoblast & blastocyst (foetus) + endometrium (mother) → **placenta**



Nutrition during pregnancy

nutrition

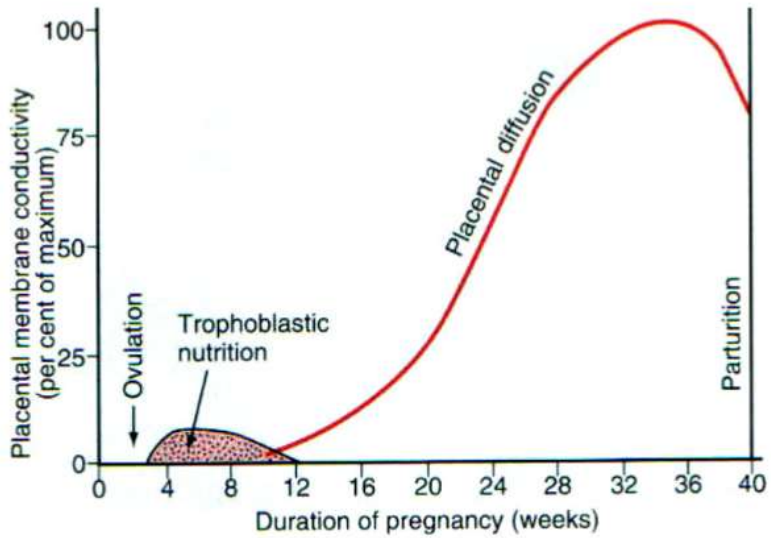
- FT→FT secretions
- Uterine cavity

Before imp.

- uterine endometrial secretions "uterine milk"

After imp.

- decidual cells/decidua : glycogen, proteins, lipids & minerals



Progesterone effect

Functions of the placenta

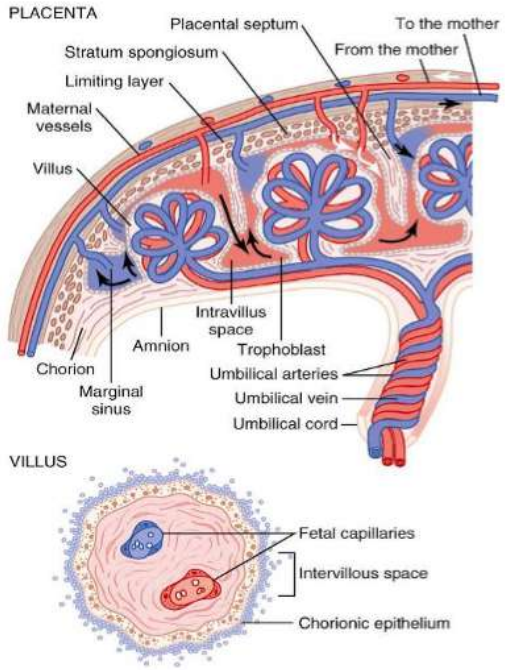
major function:

1- Providing **food & oxygen** from the mother's blood into the fetus's blood

2- Diffusion of **excretory products** from the fetus back into the mother

Early months of pregnancy→ ↓*placental permeability*→ **thick** placental membrane& ↓ **surface area**

Later months of pregnancy→ ↑placental permeability→ thin placental membrane& ↑ surface area



Circulation of the placenta

2 umbilical arteries+ one umbilical vein **connected capillaries** called chorionic villi

Exchange between chorionic villi & maternal sinuses of uterine artery

Diffusion of gases through placenta

- **Diffusion of oxygen**
- Oxygen is transported by **simple diffusion**
- Maternal PO_2 → 50 mmHg
- Fetal PO_2→ 30 mmHg
- **Mean pressure gradient 20** mmHg

Low PO_2 in the foetus capillary

Low oxygen transport!!!
Not the case 😊
Why?

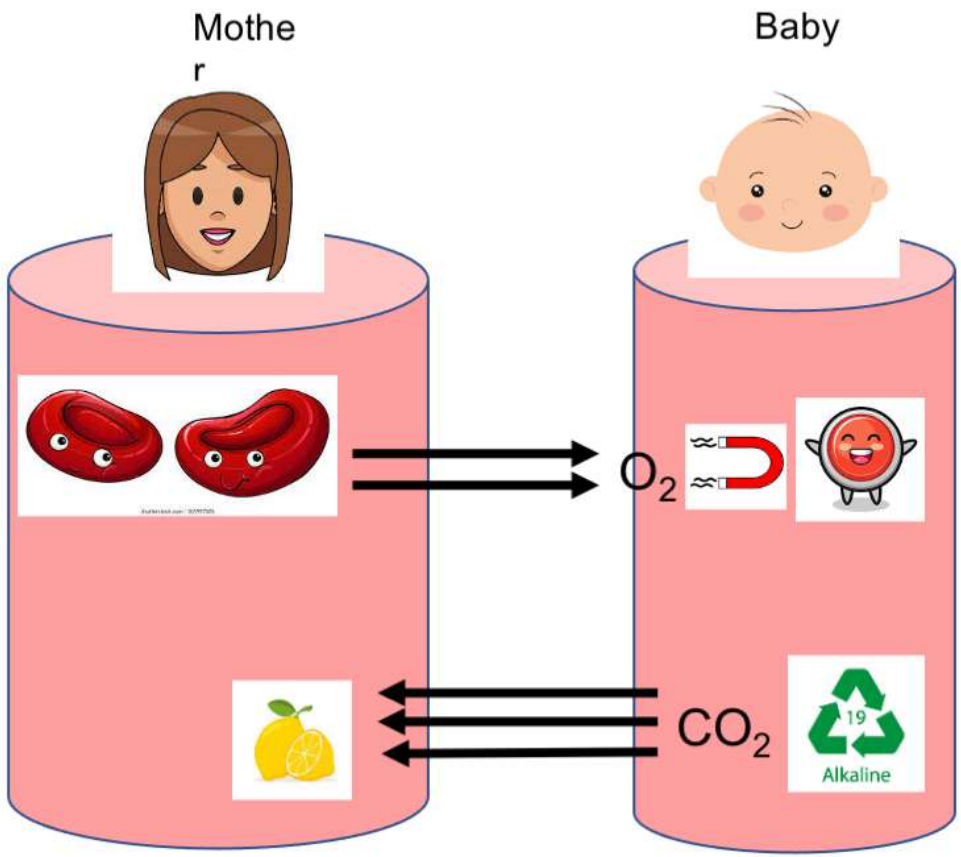
Reasons for enhanced oxygen transport

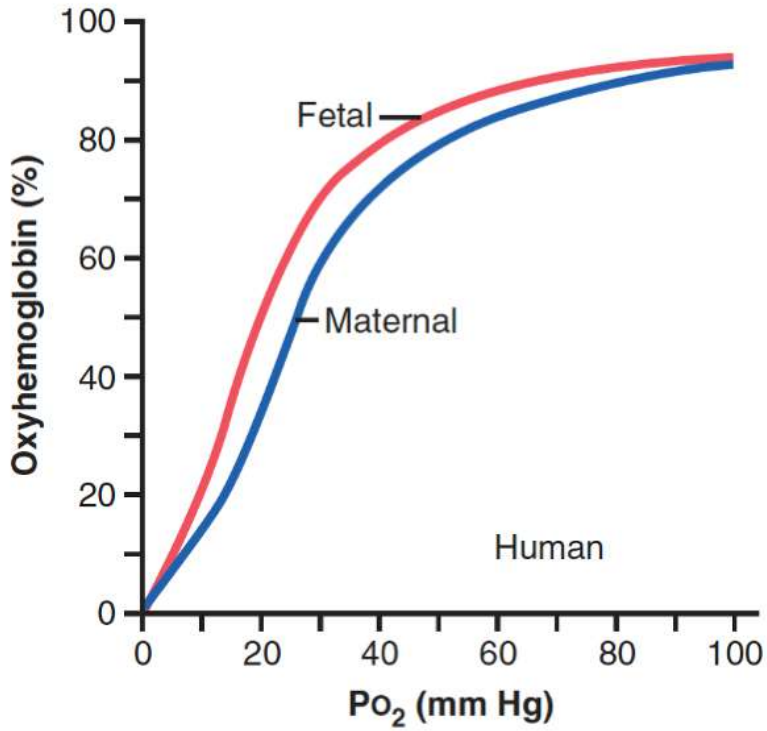
1- Fetal haemoglobin has a **higher affinity** for O2 (20- 50% more oxygen than maternal haemoglobin

2- 50% greater concentration of **haemoglobin** in the foetal blood > maternal blood

3- **Bohr effect**: haemoglobin carry more O_2 at low PCO_2

- CO2 **diffuses out** from foetal blood → maternal blood → loss of CO2 makes foetal blood **alkaline** one maternal blood **is acidic** →this **increases the capacity of foetal blood to combine with oxygen & decrees the maternal capacity to combine with oxygen** → more oxygen is delivered to the foetus


Mothe
r
Baby
O_2
CO_2
19
Alkaline



Oxyhemoglobin dissociation curves for maternal & fetal blood, showing that fetal blood can carry a **greater quantity of oxygen** than can maternal blood for a given blood Po2.

Diffusion of gases through placenta

- **Diffusion of CO2**

PCO_2 fetal blood is 2-3 mmHg >maternal blood→ simple diffusion of CO2

High solubility of CO2 20 times > as rapidly as oxygen→enhance CO2 diffusion

Diffusion of nutrients

Glucose
- Placenta stores glycogen
- by **facilitated diffusion** (carrier molecules)
- 20 to 30% **lower glucose** in the fetal blood than maternal blood

Fatty acids
- High solubility
- Diffuse slowly

Proteins
- active transport

Minerals
- potassium, sodium and chloride → diffuse easily

Excretion of waste products

- CO_2 → diffusion
- Excretory products (urea, uric acid and creatinine)→ diffusion
- [Urea] is just slightly greater in fetal blood →easily diffuse
- [Creatinine] higher in fetal blood → does **not** diffuse easily

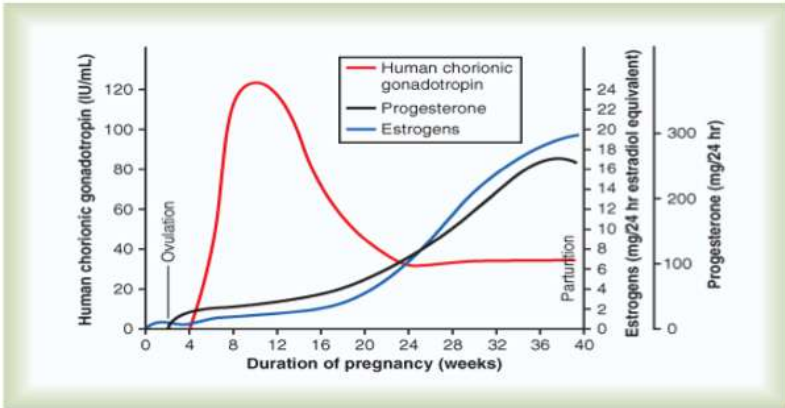
Protective function of the placenta

- Mainly after 3 months
- **Impermeable** to toxins and bacteria
- Premeable to antitoxins some immunoglobulins, viruses and drugs- malformation

Hormonal functions of the placenta

- Human chorionic gonadotropin (hCG)
- Estrogen
- Progesterone
- Human chorionic somatomammotropin

Hormonal functions of the placenta



human chorionic gonadotropin (hCG)

- Glycoprotein
- Similar structure and function as **luteinizing hormone**
- secreted by **syncytial trophoblast** cells
- detected in the **blood** 8-9 days after ovulation
- maximum secretion 10 -12 weeks of pregnancy
- decreases back to a lower level by 16-20 weeks for the remainder of the pregnancy

Hormonal functions of the placenta

human chorionic gonadotropin

Functions of human chorionic gonadotropin

• Persistence of the **corpus luteum** → secrete large quantities of *progesterone and estrogen* →

1-**prevent menstruation** to prevent sloughing of the implanted fetus

2- **Growing of the endometrium & storage of nutrients**→ development of the decidual cells

corpus luteum is very essential for pregnancy

after 12 week →placenta takes the role

involute slowly after the 13th to the 17th week of gestation

Hormonal functions of the placenta

human chorionic gonadotropin

Functions of human chorionic gonadotropin

- Stimulate the male fetal testes to produce **testosterone**

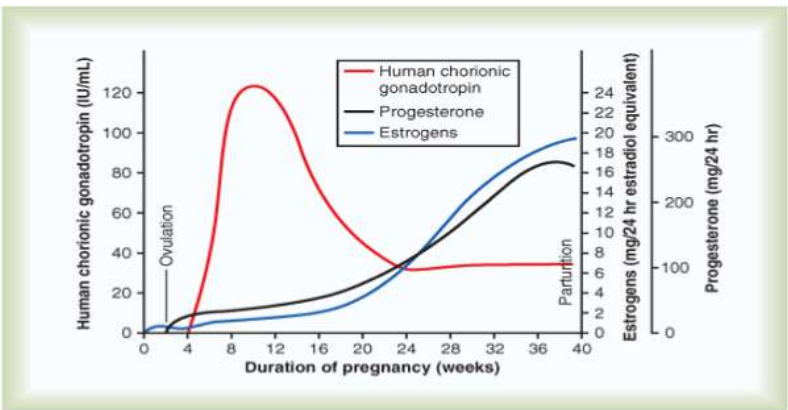
Development of male fetal sexual organs

Descend of the testicles to the scrotum

Hormonal functions of the placenta

Estrogen

- Secreted by the **syncytial trophoblast**
- Towards the end of pregnancy estrogen production increases up to 30 times



Functions of estrogens

- Enlargement of uterus (myometrium)
- Enlargement of breast and growth of **duct** system of the breast
- Enlargement of female external genital organs
- **Relax pelvic ligaments and symphysis pupis** of pelvic bone →allowing better accommodation for expanding fetus and easy passage through birth canal

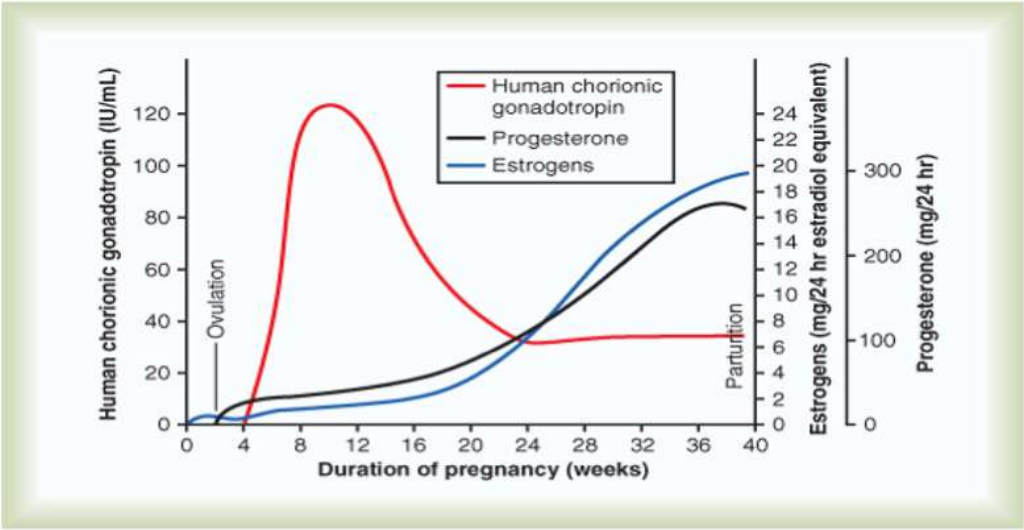
Functions of estrogens

- Increase cholesterol uptake by placenta to augment the synthesis of progesterone
- Increase formation of **oxytocin receptors**
- Both estrogen and progesterone **inhibits** the action of **prolactin** on mammary gland , thus no milk synthesis during pregnancy
- fetal development during pregnancy→by affecting the rate of cell reproduction in the early embryo

Hormonal functions of the placenta

Progesterone

- Towards the end of pregnancy, progesterone production increases tremendously



Hormonal functions of the placenta

Progesterone

Functions of progesterone

1- development of decidual cells → nutrition of early embryo

2- decreases contractility of the uterus by **inhibiting synthesis of PG and by decreasing uterus sensitivity to oxytocin** → prevent abortion

Hormonal functions of the placenta

Progesterone

Functions of progesterone

3- development of the conceptus before implantation→ increase the secretions of mother FT and uterus → nutrient

4- Development of **alveolar pouches** of mammary glands and increase their capacity to secrete milk

5- Stimulates **respiratory centers** tin mother to increase ventilation

Human chorionic somatomammotropin (HCS)

- Secretion is directly proportional to the weight of placenta
- Can be detected 5 weeks after gestation

Functions

- Has a similar action to **growth hormone** and increases protein synthesis
- development of breasts & causes lactation (similar function to prolactin) → also called human placental lactogen (HPL)

Human chorionic somatomammotropin (HCS)

- **antagonize insulin** action on carbohydrates increasing maternal blood glucose levels → more glucose available to the fetus

- Stimulates maternal **lipolysis**→ Source of energy for mother

Other hormonal factors in pregnancy

1- increased pituitary secretion

- anterior pituitary enlarge by 50%
- increased corticotropin, thyrotropin & prolactin
- Decrease LH and FSH (inhibited by E & P)

2- increase corticosteroid secretions

- moderate increase in **glucocorticoids** →mobilize *amino acids* from mother's tissue → used for synthesis of tissues in the fetus

- 2 fold increase in **aldosterone**→ with estrogen → fluid retention by excessive sodium absorption → pregnancy induced hypertension

3- increased insulin

Other hormonal factors in pregnancy

4- increased thyroid gland secretion

- 50% increase in thyroid gland size
- increase thyroxine → stimulated by **hCG & human chorionic thyrotropin** (secreted by placenta)

5- increased parathyroid gland secretion

- parathyroid gland increase in size
- increase **calcium absorption** from the mother's bone→ used by fetus for bone ossification

6-secretion of relaxin by the ovaries and placenta

- stimulated by hCG
- with estrogen →relaxation of pelvic ligaments
- softening of the cervix at the time of delivery
- vasodilator → increase blood flow increase venous return and cardiac output

Response of the mother's body to pregnancy

- Mainly due to higher levels of hormones of pregnancy

ENLARGMENT OF SEXUAL ORGANS

APPEARANCE

- Edema
- Acne
- Pigmentation
- Masculine or acromegalic features

Weight gain

Response of the mother's body to pregnancy

Nutrition during pregnancy

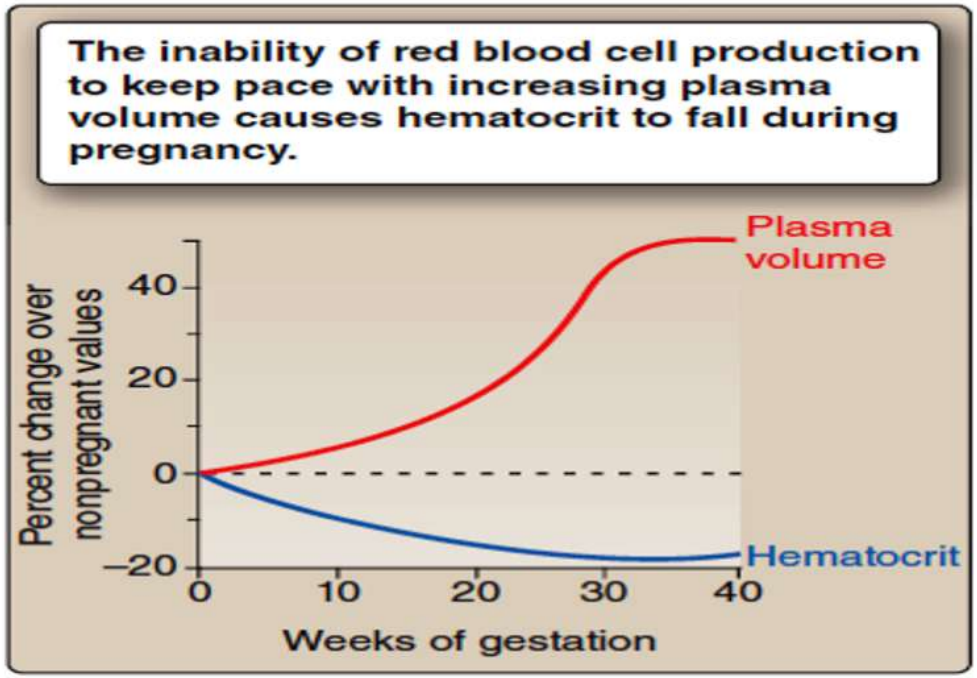
- Increased desire for food
- Increased nutritional and dietary needs (iron, calcium, phosphates, vit D, vit K)
- Iron deficiency→ **hypochromic** anaemia
- vitamin K→ **prothrombin** → to prevent hemorrhage (brain hemorrhage)

- Mother→ **less absorption of** protein, calcium, phosphate, and iron→ supply to the fetus

Response of the mother's body to pregnancy

Variables	Change
Cardiac output	Increased
Heart rate	Increased
Stroke volume	Increased
Systemic vascular resistance	Decreased
Pulmonary vascular resistance	Decreased
BP	Decreased
Blood volume	Increased
RBC volume	Increased, but less than blood volume
Hematocrit	Dilutional decrease
Serum protein levels	Decreased

Changes in maternal plasm volume and Hematocrit during pregnancy



Respiration

- **Increased** alveolar ventilation → due to progesterone
- Increased tidal volume (40%) → causes **decrease** in maternal plasma CO2 → slight alkalosis

Maternal kidney function

- Increased urine formation
- Increased tubular reabsorption → sodium, chloride and water by 50%
- Increased renal blood flow and GFR by 50% → renal vasodilation
- Causes of renal vasodilation

  1-NO

  2- Relaxin

Morning sickness

- 70% of pregnancies
- Onset 4-8 wks gestation
- improvement before 14-16 wks

- Mechanisms:
- Relaxation of smooth muscle of stomach
- ? Inc hCG

- Higher frequency of female fetus

Pre-eclampsia

- Idiopathic **multisystem** disorder specific to human pregnancy-BP normalizes following delivery
- **<u>Characterized by:</u>**

1- Maternal hypertension

2- Proteinuria

3-Generalized edema

- Disease of the placenta
  - *Failure of trophoblast invasion* of spiral arteries→ Supply of both nutrients and oxygen to the placenta is disturbed
- Decreased RBF & GFR
- Leading cause of maternal and perinatal mortality

Eclampsia

fatal severe preeclampsia with :

- Seizure
- Coma
- Decreased kidney output
- Liver malfunction
- Extreme hypertension

Parturition/ labor /delivery

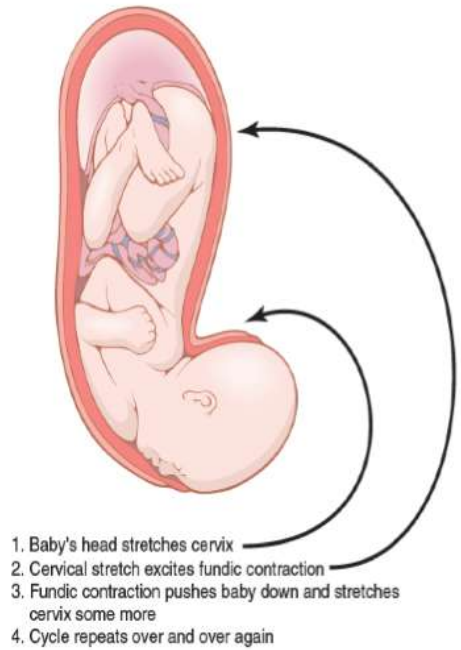
- Strong rhythmical uterine contraction

- **Stages of labor**

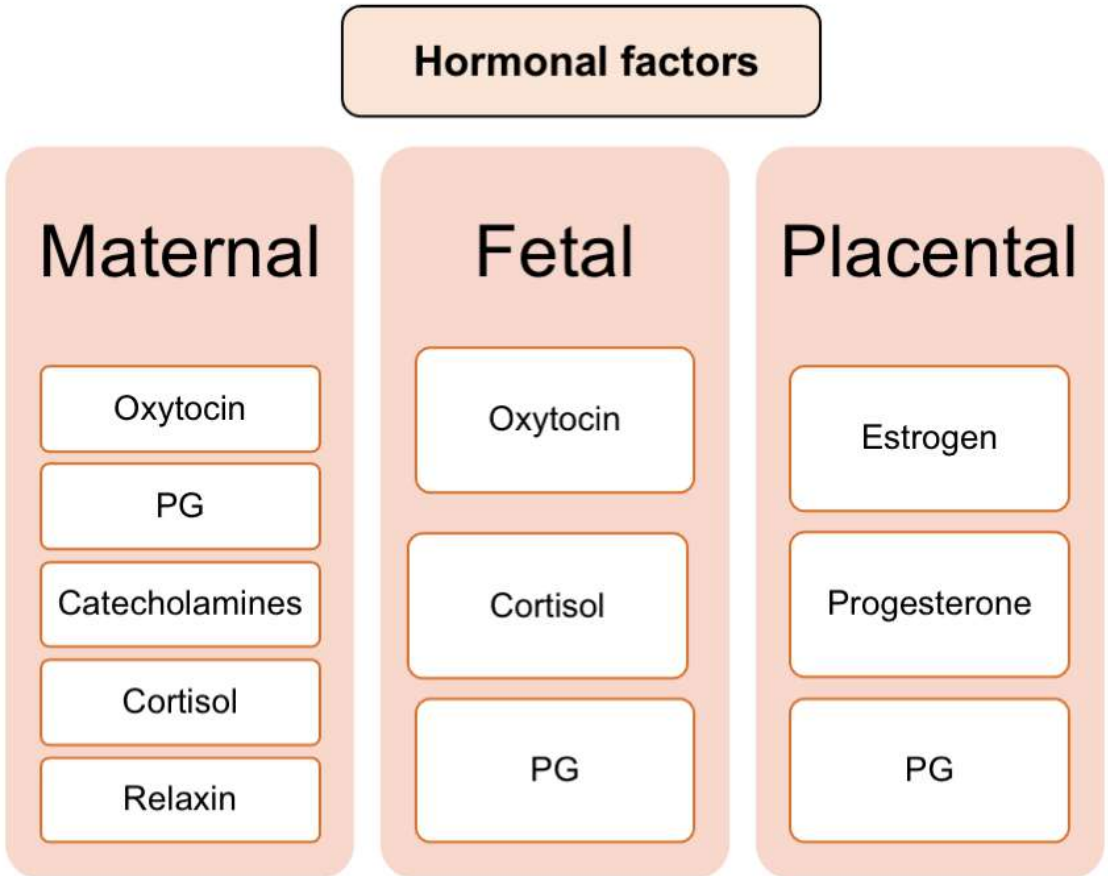
stage1: labor →contractions → dilatation of the cervix and opening of vaginal canal
uterine→ (stimulates more contractions positive feedback)
cervical→ head stretching→ more uterine contractions

stage 2: baby delivery

stage 3: placental detachment



Parturition/ labor /delivery



Hormonal factors

1- E & P

↑ ↑ E

Sudden ↓↓ P at end of pregnancy

P inhibits prostaglandin E2

↑ E/P ratio→

+ contraction

+ synthesis and **sensitivity** of oxytocin receptors

+ PG

2- Oxytocin

+ uterine contraction

+ PG from decidua

3- Relaxin

Secreted by placenta & mammary glands

Softening cervix

Relaxation of symphysis pubis ligaments

Dilatation of the cervix

+ oxytocin receptors

- inhibitory action of progesterone

Hormonal factors

4- PGE2
from the decidua→ + Calcium concentration

5-Catecholamines
adrenaline and noradrenaline
+ uterine contraction

6- cortisol
+ uterine contraction
stress tolerance

Mechanical factors

stretch of uterine muscles
stretch of the cervix

lactation

Estrogen effect on the breast:

1- growth of ductal system
2- + stroma
3- fat deposition

Progesterone effect on the breast

growth of lobule-alveolar system

E & P → inhibit prolactin

Stages of breast development

1- puberty

A-growth of mammary glands
B-fat deposition

2- during pregnancy

A- high estrogen
B- complete development of glandular tissue

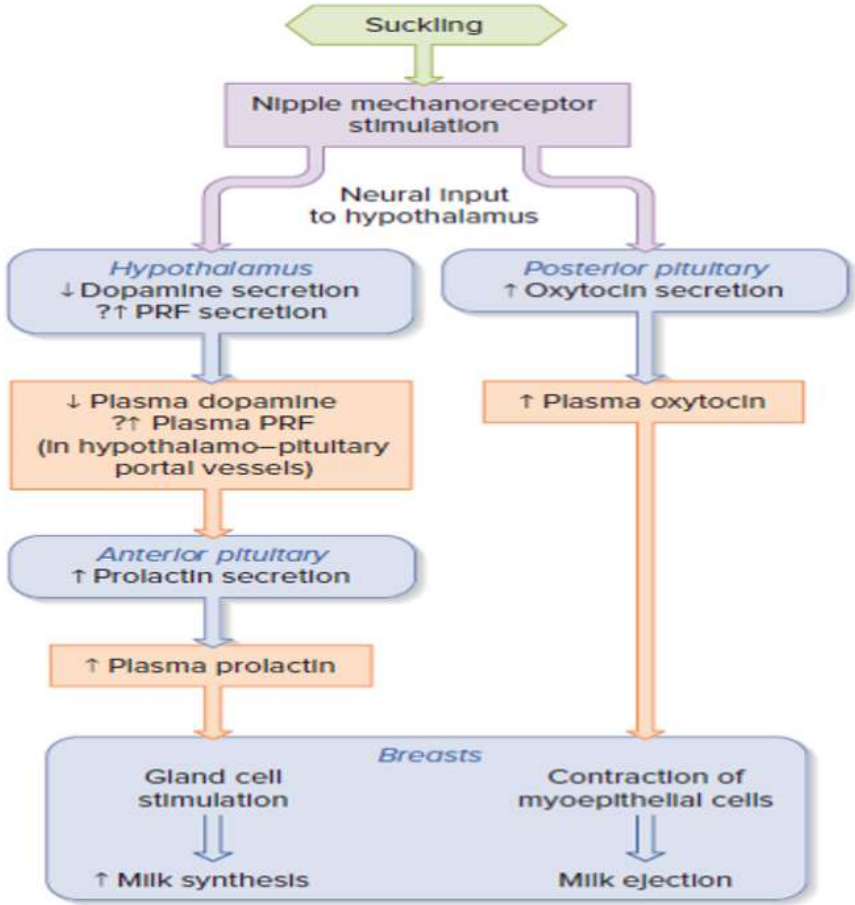
Lactation

- **Prolactin**
  - ❖secreted by anterior pituitary gland
  - ❖ + from the 5th week of pregnancy
  - ❖increases 10-20 times by delivery
  - ❖decreases after 7 to 9 months

- Human chorionic somatomammotropin→ lactogenic effect
- First few days (1-7)→ colostrum (very small amount)→ Protein and lactose almost no fat
- Up to 1.5 L of milk/day- higher in twins- **high energy consumption**
- Milk formation requires increase in growth hormone, cortisol, parathyroid hormone and insulin→ to increase amino acids, fatty acids, glucose and calcium

Lactation

- suckling→ hypothalamus→ prolactin surge
- Milk **ejection** from alveoli to ducts is caused by **oxytocin**
- Prolactin secretion is **inhibited** by the hypothalamus → prolactin inhibitory Factor
- Dopamine inhibits prolactin secretion
- Prolactin **inhibits LH and FSH**→ inhibits menstruation for several months
- Enlargement of parathyroid gland to supply needed calcium and phosphate + bone decalcification



lactation

Table 83-1 Composition of Milk

Constituent	Human Milk (%)	Cow's Milk (%)
Water	88.5	87.0
Fat	3.3	3.5
Lactose	6.8	4.8
Casein	0.9	2.7
Lactalbumin and other proteins	0.4	0.7
Ash	0.2	0.7

50% higher

2-3 higher

Calcium & other minerals

milk provides nutrients, antibodies & WBCs

The end