

## REPRODUCTIVE SYSTEM

Purpose is to produce gametes (egg & sperm), to ensure fertilization, & in ♀ to provide a site for embryo *Meiosis* (cell division process that produces gametes).

### *Formation of Gametes.*

#### MEIOSIS

- 1 cell with diploid number of chromosomes (46 for humans) divides twice to form 4 cells, each with haploid number of chromosomes = 23.
- *Haploid*= half the usual diploid number.
- Although meiosis is essentially the same in ♂ & ♀, there are important differences.

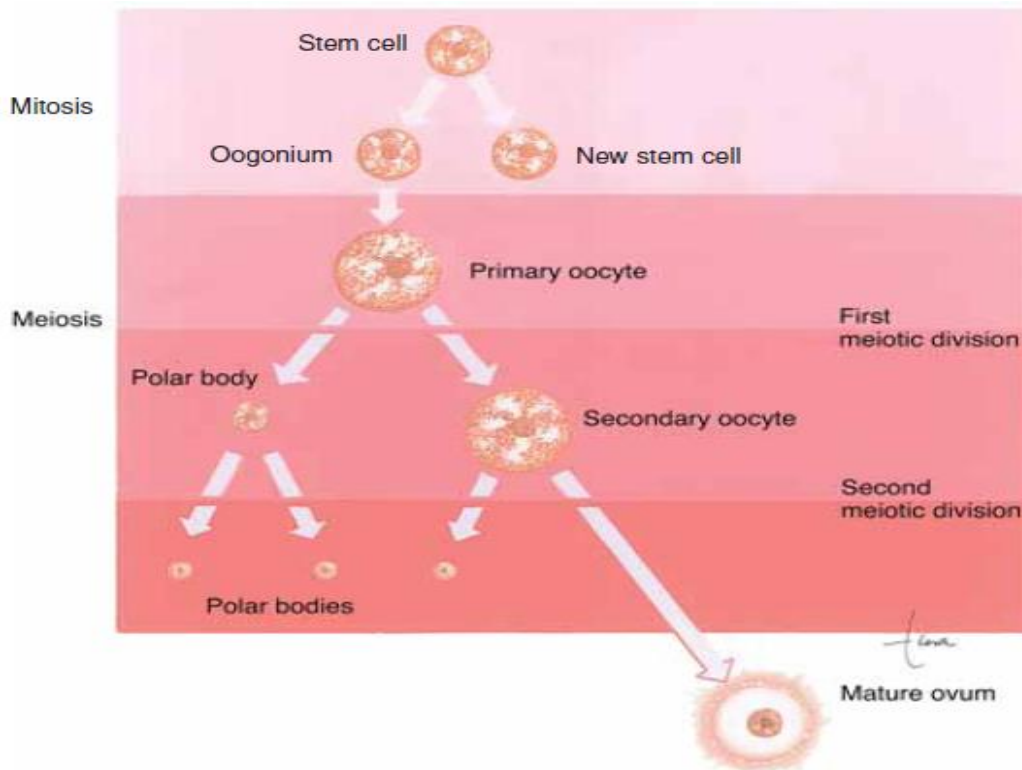
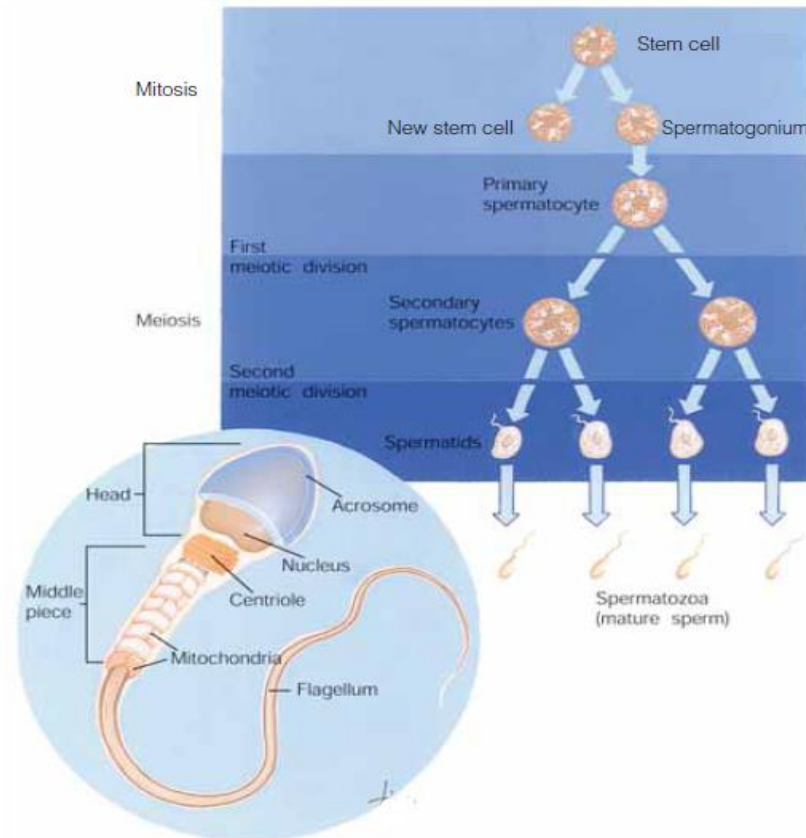
#### SPERMATOGENESIS

- It is process of meiosis that takes place in testes, site of sperm production.
- It is continuous process from puberty (10-14 years of age) throughout life, & millions of sperm are formed each day in testes.
- Each 1ry spermatocyte produces 4 functional sperm.
- Gamete formation is regulated by Hs.
  - ❖ FSH initiates sperm production.
  - ❖ Testosterone promotes maturation of sperm.
  - ❖ Inhibin ↓ secretion of FSH.

#### OOGENESIS

- It is process of meiosis for egg cell formation; that begins in ovaries.
- Production of ova begins at puberty (10-14 years of age)& continues until menopause , when ovaries atrophy & no longer respond to pituitary Hs. During this 30-40 year span, egg production is cyclical.
- FSH:
  - Initiates growth of ovarian follicles, which contains an oogonium (a stem cell for egg cell production).
  - Stimulate follicle cells to secrete estrogen that promotes ovum maturation.
- Each 1ry oocyte that undergoes meiosis, only 1 functional egg cell is produced. The other 3 cells produced are called *polar bodies*, have no function, & deteriorate.
- Several follicles usually begin to develop during each cycle. However, rupturing (ovulation) of 1<sup>st</sup> follicle to mature stops growth of the others.

Spermatogenesis. The processes of mitosis and meiosis are shown. For each primary spermatocyte that undergoes meiosis, four functional sperm cells are formed. The structure of a mature sperm cell is also shown.



**Figure 20-2.** Oogenesis. The processes of mitosis and meiosis are shown. For each primary oocyte that undergoes meiosis, only one functional ovum is formed.

## Disorders due to abnormal meiosis

### Trisomy

- It is presence of 3 (rather than the normal two) of a particular chromosome in cells.
- This occurs because of non-disjunction (nonseparation) of a chromosome pair during 2<sup>nd</sup> meiotic division, usually in an egg cell. (a total of 47 chromosomes).
  - Most trisomies are lethal (quickly die in pregnancy), & if embryo survives & born → developmental defects are always present.
  - Severity; seen in Trisomy 13 & 18 (occurs once for every 5000 live births).
  - Both are characterized by severe mental & physical retardation, heart defects, deafness, & bone abnormalities. Affected infants usually die within their 1<sup>st</sup> year.

### Down syndrome (Trisomy 21)

- It is the most common trisomy, with a frequency of about 1 per 750 live births.
- Children are mentally retarded, with a great range of mental ability.
- Physical characteristics; a skin fold above each eye, short stature, poor muscle tone, & heart defects.
- Women over age of 35 are at great risk of having a child with Down syndrome. Reason may be that as egg cells age process of meiosis is more likely to proceed incorrectly.

## MALE REPRODUCTIVE SYSTEM

- ♂ Reproductive system consists of testes & a series of ducts & glands.
  - Testes produce sperm.
  - Reproductive ducts are epididymis, ductus deferens, ejaculatory duct & urethra.
  - Reproductive glands; seminal vesicles, prostate gland, & bulbourethral glands.
    - They produce secretions that become part of semen.
    - Semen is fluid that is ejaculated from urethra.

### 1. TESTES (paired)

- They (paired) are located in scrotum.
- Temperature within scrotum is 96 F, slightly lower than body temperature, which is necessary for production of viable sperm.
- Divided into lobes, each lobe contains *seminiferous tubules*.
  - **Spermatogonia**; stem cell that generate sperm & lies within seminiferous tubules.
  - **Sustentacular (Sertoli) cells** lies within spermatogonia.
  - **interstitial cells** lie between seminiferous tubules.
- Sperm from seminiferous tubule enter a network (*rete testis*) → epididymis.
- A sperm cell consists of;
  - ❖ Head, which contains 23 chromosomes.
  - ❖ Middle piece, which contains mitochondria.
  - ❖ Flagellum for motility (capability of sperm cell to move).
  - ❖ Acrosome on tip of head, contains enzymes to digest membrane of an egg cell

➤ **Cryptorchidism** is condition in which testes fail to descend, & result in sterility unless testes are surgically placed in scrotum (it descend into scrotum just before birth).

## 2. EPIDIDYMIS (paired)

A long coiled tube (6m) on posterior surface of each testis. In which sperms complete their maturation.

## 3. VAS DEFERENS (ductus deferens) (paired)

It extends from epididymis into abdominal cavity to join ejaculatory duct. Smooth muscle in wall contracts in waves of peristalsis.

## 4. EJACULATORY DUCTS (paired)

It receive sperm from vas deferens & secretions from seminal vesicle, empty into urethra.

## 5. SEMINAL VESICLES (paired)

Duct of each opens into ejaculatory duct. Secretion contains fructose to nourish sperm & is alkaline to enhance sperm motility.

## 6. PROSTATE GLAND

➤ A muscular gland below urinary bladder. It surrounds 1<sup>st</sup> inch of urethra.

- Glandular tissue secretes an alkaline fluid that helps maintain sperm motility.
- Smooth muscle contracts during ejaculation to contribute to expulsion of semen.

➤ **Prostatic hypertrophy (BPH)** is enlargement of prostate gland.

- BPH is a common in ♂ over age of 60 years. It compress urethra within it & may make urination difficult. A possible consequence is impaired ejaculation.
- Cancer of prostate is the 2<sup>nd</sup> most common cancer among ♂ (> 50 years old).

## 7. BULBOURETHRAL GLANDS (Cowper's glands) (paired)

➤ Below prostate gland; empty into urethra ;

➤ Secretion is alkaline to line urethra prior to ejaculation which neutralizes acidic urine.

## 8. URETHRA—PENIS

➤ Urethra is duct through which semen travels to exterior. Penis contains 3 masses of erectile tissue that have blood sinuses.

➤ Sexual stimulation & parasymp. impulse cause dilation of penile arteries & erection.

➤ Dilation of penile arteries → erection; are brought by localized release of nitric oxide (NO) & by parasymp. impulse.

➤ Ejaculation involves peristalsis of all male ducts & contraction of prostate gland & pelvic floor.

## 9. SEMEN

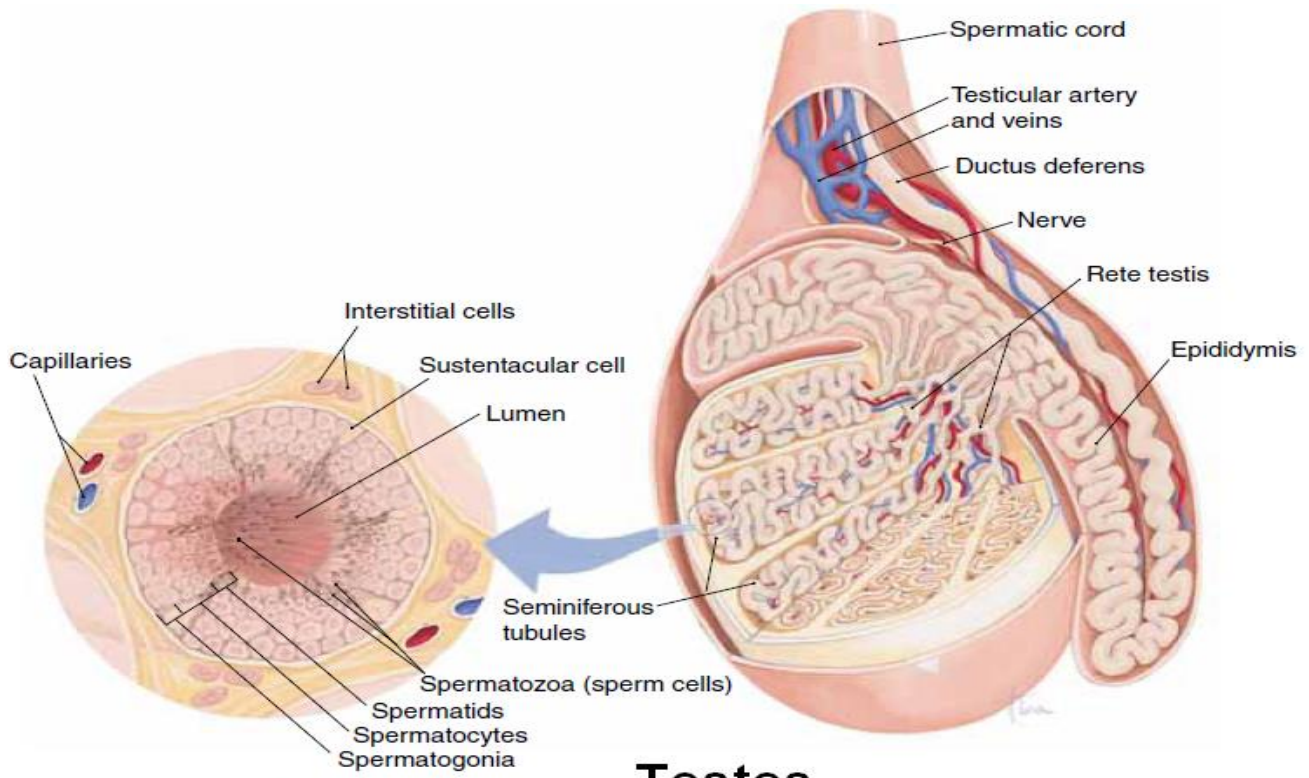
❖ It is sperms + secretions of seminal vesicles, prostate gland & bulbourethral glands.

❖ Its average pH is 7.4.

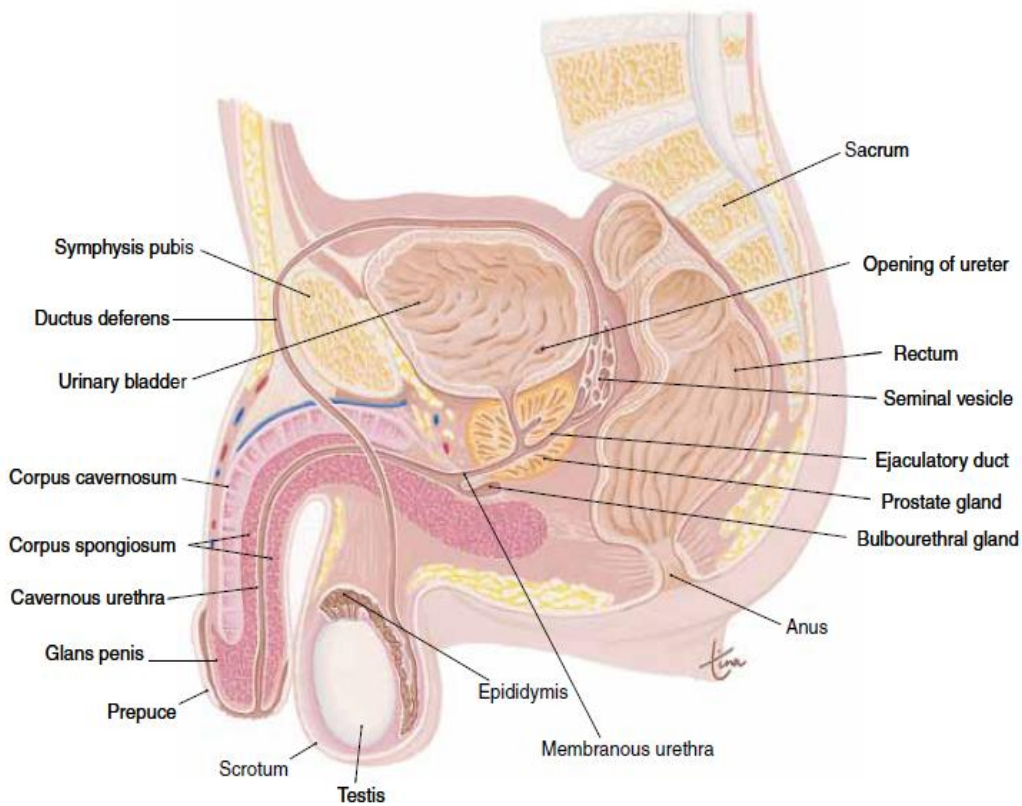
❖ During ejaculation, 2 - 4 mL of semen is expelled. (each ml have 100 million sperm).

**Secretion of ♂ reproductive glands are alkaline;** this is important because;

- ❖ It helps neutralize acidic vaginal pH (created by normal flora, which are natural bacterial population of vagina) & permits sperm motility.



## Testes



Male reproductive system shown in a midsagittal section through the pelvic cavity.

## FEMALE REPRODUCTIVE SYSTEM

It consists of paired ovaries & fallopian tubes, single uterus & vagina & external genital structures

### 1. OVARIES

- Within an ovary are several hundred thousand **1ry follicles**, which are present at birth.
- During childbearing years, 300- 400 of these follicles will produce mature ova.
- Each 1ry ovarian follicle contains an oocyte, surrounded by follicle cells.
- Maturation of a follicle(**graafian follicle**), requiring FSH & estrogen.
- Under influence of LH;
  - Ovulation occur(rupture of **graafian follicle** with release of ovum),
  - the ruptured follicle becomes **corpus luteum** & begins to secrete progesterone as well as estrogen.
- Hs produced in smaller amounts by corpus luteum are inhibin & relaxin.
- At ovulation, other developing follicles begin to deteriorate; (called **atretic follicles**).

### 2. FALLOPIAN TUBE

- Smooth muscle layer of tube contracts in peristaltic waves that help propel ovum.
- Fertilization takes place in it & ovum becomes a zygote & is swept into uterus; this takes about 4- 5 days.
- If not fertilized, an ovum dies within 24 - 48 hrs & disintegrates.

### 3. UTERUS

- Lining of uterus is **endometrium**, which consists of 2 layers.
  - Basilar layer, is vascular but very thin & is a permanent layer.
  - Functional layer is regenerated & lost during each menstrual cycle.
- Under influence of estrogen & progesterone from ovaries, growth of blood vessels thickens functional layer in preparation for a possible embryo.

If fertilization does not occur, functional layer sloughs off in menstruation.

### 4. VAGINA

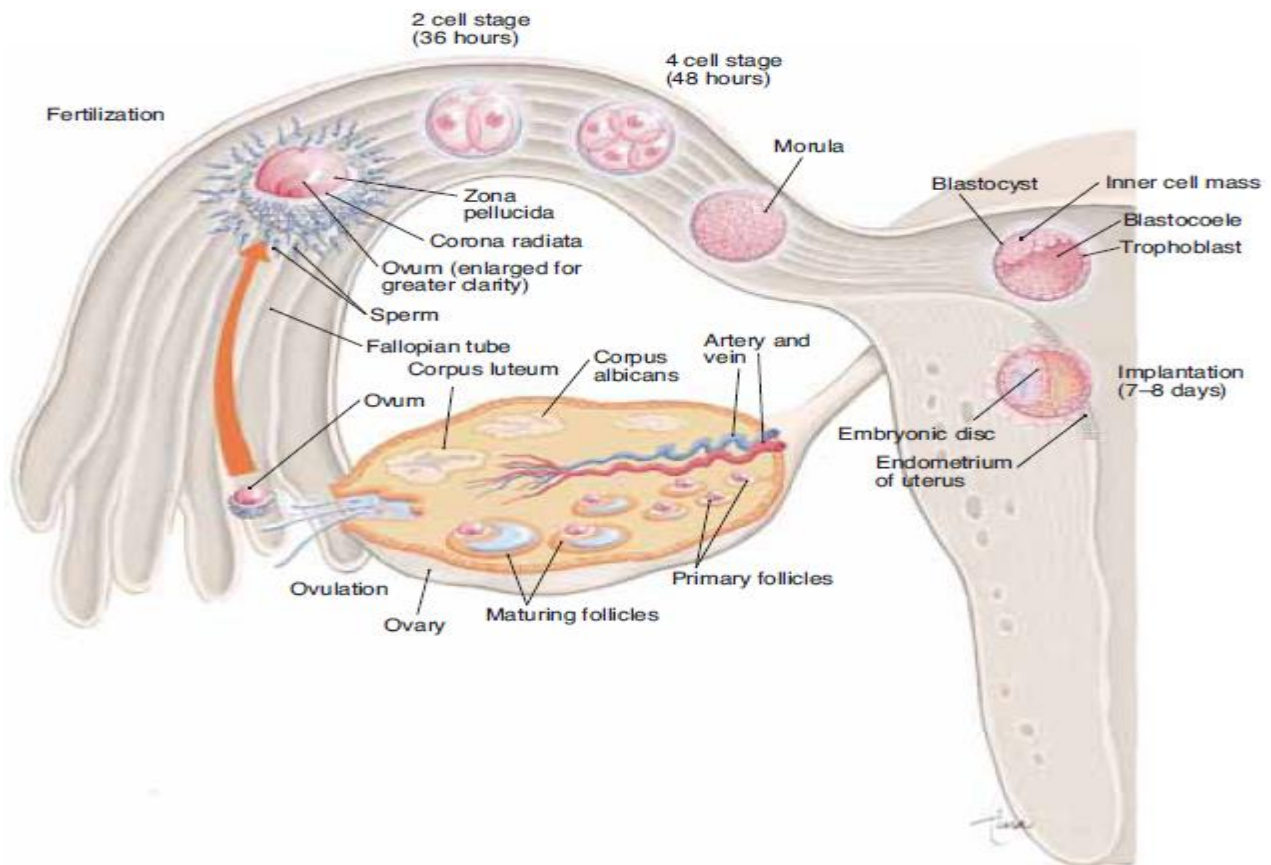
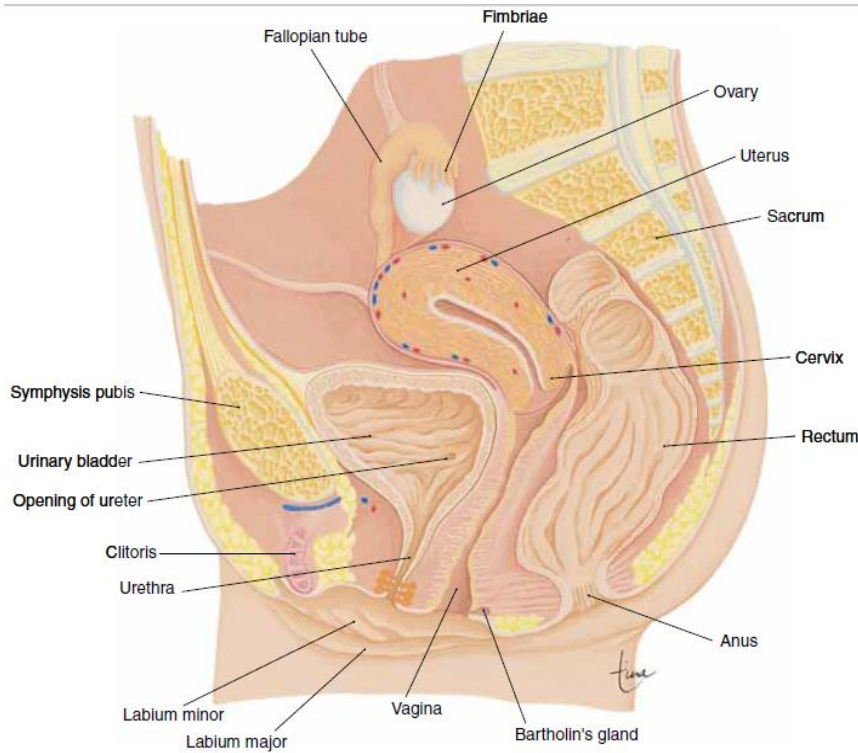
It is a muscular tube that extends from cervix to vaginal orifice. Its function is;

- 1- Receive sperm from penis during sexual intercourse.
  - 2- Provide exit for menstrual blood flow.
  - 3- Become a birth canal at end of pregnancy.
- Its normal flora(bacteria) create acidic pH that helps to inhibit growth of pathogens.

### 5. BARTHOLIN GLANDS;

They open into vaginal orifice & secrete mucus.

***In vitro* fertilization (IVF)** is fertilization outside the body, usually in a glass dish.



Ovulation, fertilization, and early embryonic development.

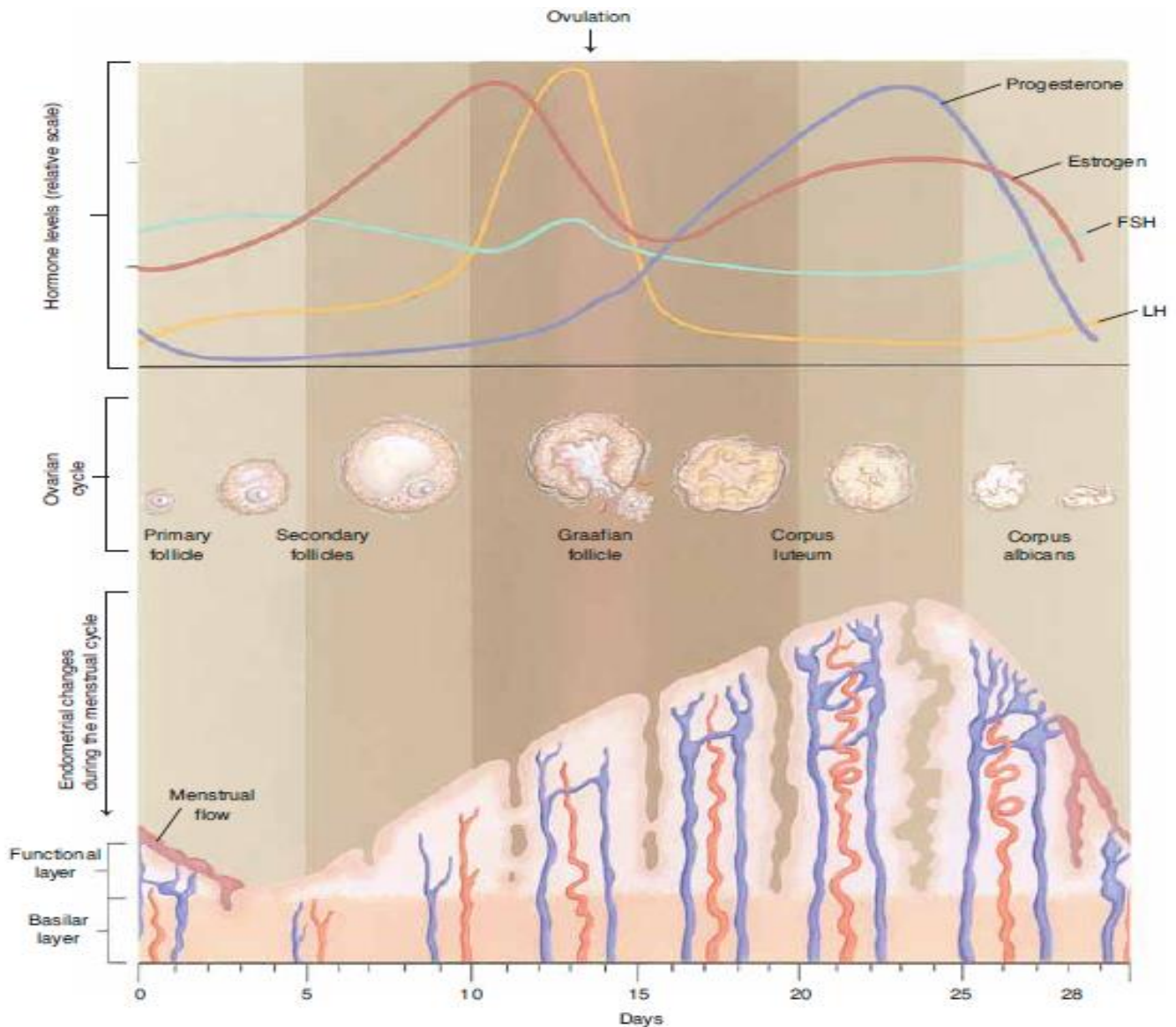
## Menstrual Cycle

- Average is 28 days; includes effects of FSH, LH, estrogen, & progesterone, & changes in ovaries & endometrium; its phases are;
  - 1- Menstrual phase (mense) ,last 3-6 days.
    - ❖ loss of functional layer of endometrium.
  - 2- Follicular phase;
    - ❖ ↑FSH →Growth of ovarian follicles → secretion of estrogen.
    - ❖ ↑LH , but more slowly.
    - ❖ FSH & estrogen promote growth & maturation of ovum.
    - ❖ Estrogen stimulates growth of blood vessels in endometrium to regenerate functional layer.
    - ❖ This phase ends with ovulation, when a sharp ↑ in LH causes rupture of a mature ovarian follicle.
  - 3- Luteal phase;
    - ❖ Under influence of LH, the ruptured follicle becomes corpus luteum & begins to secrete progesterone as well as estrogen.
    - ❖ Progesterone stimulates further growth of blood vessels in functional layer of endometrium promotes storage of nutrients such as glycogen.
    - ❖ As progesterone secretion ↑, LH secretion ↓, & if ovum is not fertilized, secretion of progesterone also begins to ↓.
    - ❖ Without progesterone, endometrium cannot be maintained & begins to slough off in menstruation. FSH secretion begins to ↑ (as estrogen & progesterone ↓), & cycle begins again.
    - ❖ Also secreted by corpus luteum during a cycle are inhibin & relaxin.
    - ❖ **Inhibin** inhibits secretion of FSH.
    - ❖ **Relaxin** inhibit contractions of myometrium (as does progesterone), which would help make implantation of the early embryo successful.

## AGING & REPRODUCTIVE SYSTEMS

- *For women;*
  - ❖ There is a definite end to reproductive capability; (menopause); that occurs between ages of 45 & 55years.
  - ❖ Estrogen secretion ↓; ovulation & menstrual cycles become irregular & finally cease.
  - ❖ Drying of vaginal mucosa ↑es susceptibility to vaginal infections.
- *For most men,*
  - ❖ Testosterone secretion continues throughout life, as does sperm production, though both diminish with advancing age.
  - ❖ The most common reproductive problem for older men is prostatic hypertrophy.





**Figure 20-9.** The menstrual cycle. The levels of the important hormones are shown rel-

### Cell Division

1. Mitosis—one cell with diploid number of chromosomes divides once to form two cells, each with diploid number of chromosomes (46 for humans).
  - Stages of mitosis: prophase, metaphase, anaphase, & telophase.
  - Mitosis is essential for growth & for repair & replacement of damaged cells.
  - Most adult nerve & muscle cells seem unable to divide; permanent loss of function.
2. Meiosis—one cell with diploid number of chromosomes divides twice to form four cells, each with haploid number of chromosomes (23 for humans).
  - Oogenesis in ovaries forms egg cells.
  - Spermatogenesis in testes forms sperm cells.
  - Fertilization of an egg by a sperm restores the diploid number in the fertilized egg.