

**HUMAN ANATOMY AND  
PHYSIOLOGY-II  
UNIT-V**

**FEMALE REPRODUCTIVE SYSTEM**

# FEMALE REPRODUCTIVE SYSTEM

The female reproductive organs, or genitalia, are divided into external and internal organs.

## **External genitalia (vulva)**

The external genitalia are known collectively as the vulva, and consist of the labia majora and labia minora, the clitoris, the vaginal orifice, the vestibule, the hymen and the vestibular glands (Bartholin's glands).

## **Labia majora**

- These are the two large folds which form the boundary of the vulva.
- They are composed of skin, fibrous tissue and fat and contain large numbers of sebaceous glands.
- Anteriorly the folds join in front of the symphysis pubis, and posteriorly they merge with the skin of the perineum. At puberty hair grows on the mons pubis and on the lateral surfaces of the labia majora

## **Labia minora**

- These are two smaller folds of skin between the labia majora, containing numerous sebaceous glands.
- The cleft between the labia minora is the vestibule. The vagina, urethra and ducts of the greater vestibular glands open into the vestibule.

## **Clitoris**

- The clitoris corresponds to the penis in the male and contains sensory nerve endings and erectile tissue but it has no reproductive significance.

## **Hymen**

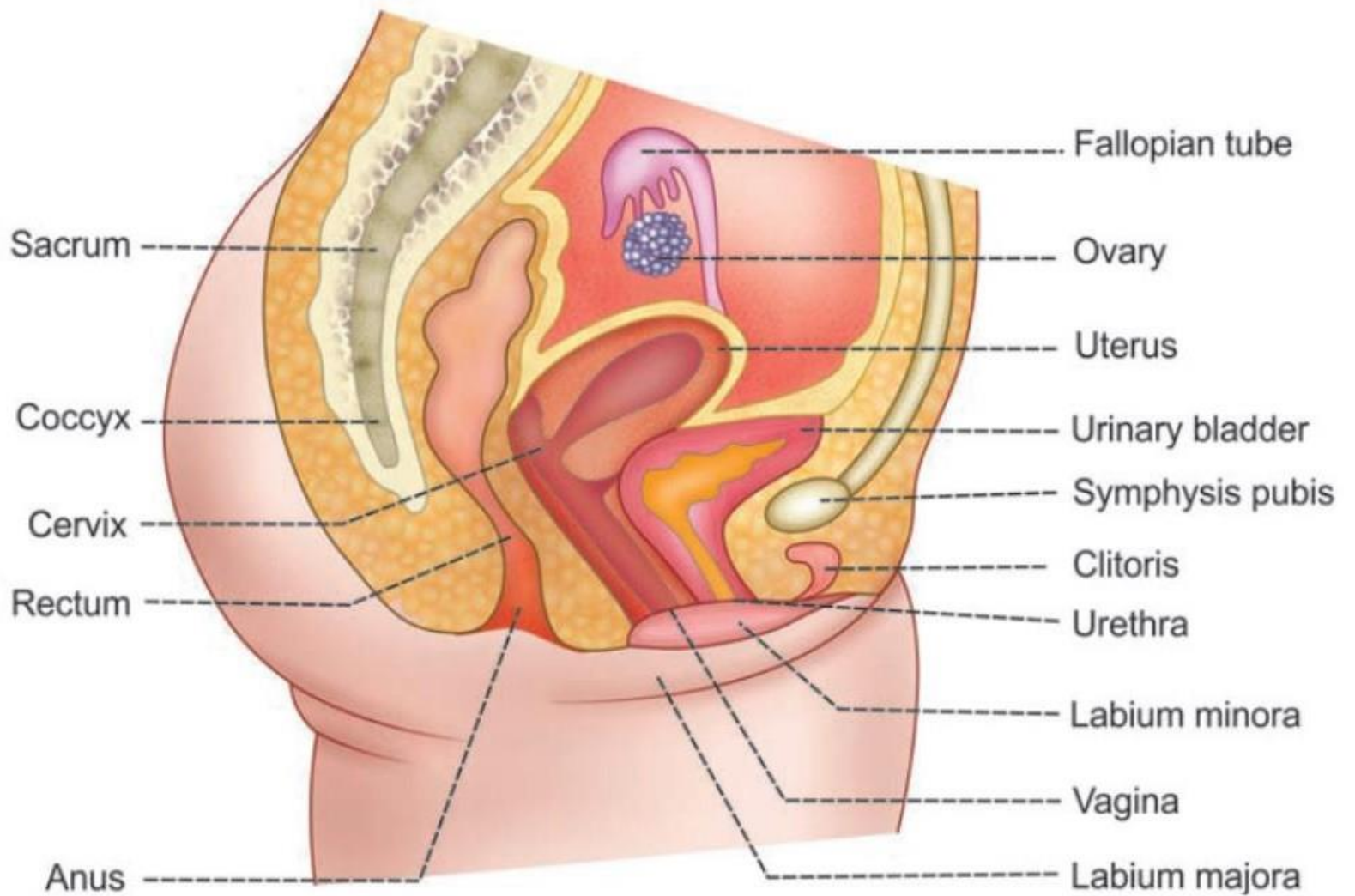
- The hymen is a thin layer of mucous membrane which partially occludes the opening of the vagina. It is normally incomplete to allow for passage of menstrual flow.

## **Vestibular glands**

- The vestibular glands (Bartholin's glands) are situated one on each side near the vaginal opening. They are about the size of a small pea and have ducts, opening into the vestibule immediately lateral to the attachment of the hymen. They secrete mucus that keeps the vulva moist.

## **Perineum**

- The perineum is the area extending from the base of the labia minora to the anal canal. It is roughly triangular and consists of connective tissue, muscle and fat. It gives attachment to the muscles of the pelvic floor



**FIGURE 78.1:** Female reproductive organs and other organs of pelvis

## **Internal genitalia**

The internal organs of the female reproductive system lie in the pelvic cavity and consist of the vagina, uterus, two uterine tubes and two ovaries.

### **Vagina**

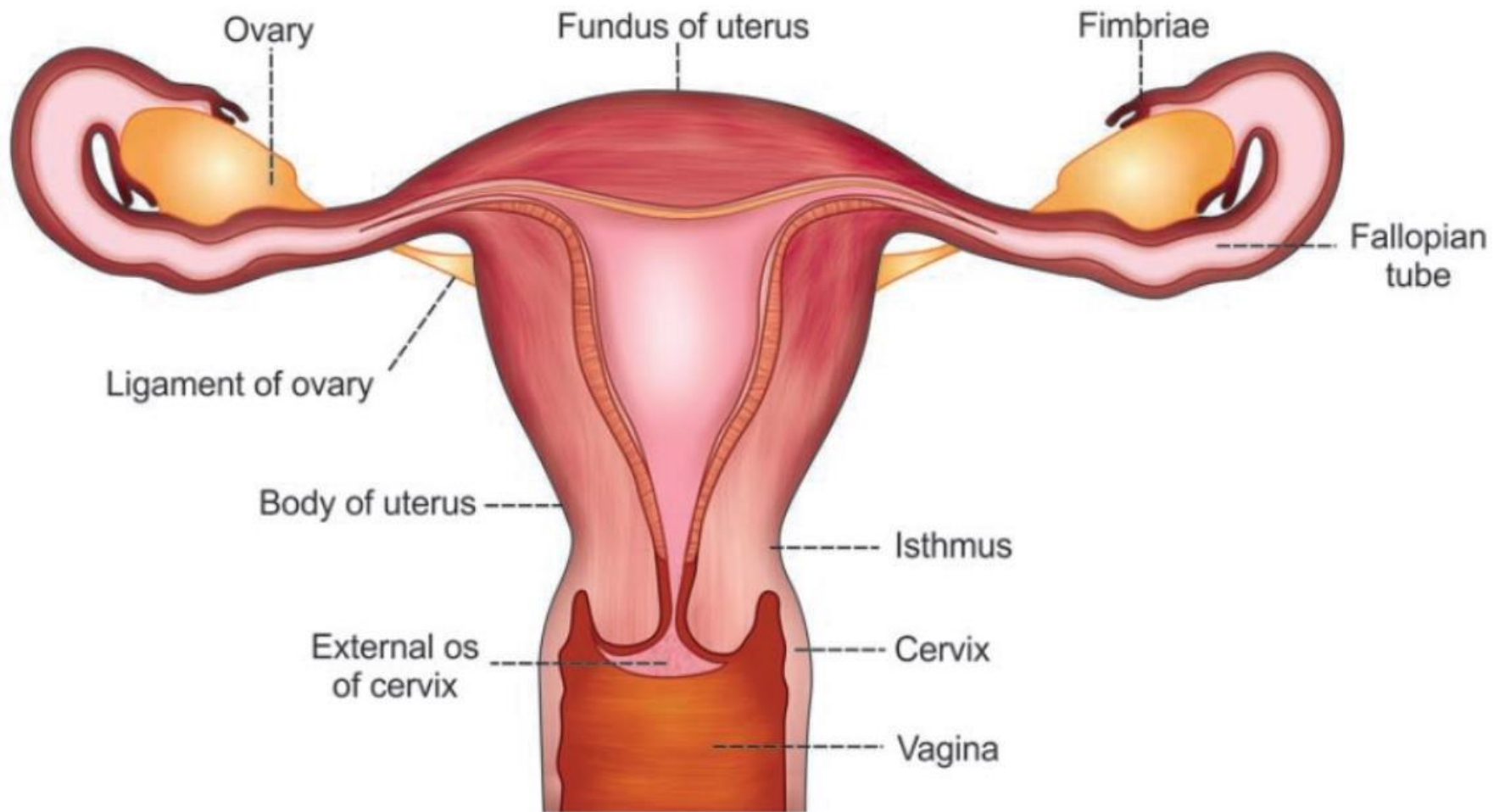
- The vagina is a fibromuscular tube lined with stratified squamous epithelium, connecting the external and internal organs of reproduction.
- It runs obliquely upwards and backwards at an angle of about 45° between the bladder in front and rectum and anus behind. In the adult the anterior wall is about 7.5 cm (3 inches) long and the posterior wall about 9 cm long.
- The difference is due to the angle of insertion of the cervix through the anterior wall.

## Structure of the vagina

- The vagina has three layers: an **outer covering** of areolar tissue, a **middle layer** of smooth muscle and an **inner lining** of stratified squamous epithelium that forms ridges or rugae.
- It has no secretory glands but the surface is kept moist by cervical secretions.
- Between puberty and the menopause, *Lactobacillus acidophilus* bacteria are normally present, which secrete lactic acid, maintaining the pH between 4.9 and 3.5.
- The acidity inhibits the growth of most other microbes that may enter the vagina from the perineum.

## Functions of the vagina

- The vagina acts as the receptacle for the penis during coitus, and provides an elastic passageway through which the baby passes during childbirth.



**FIGURE 78.2:** Female reproductive system

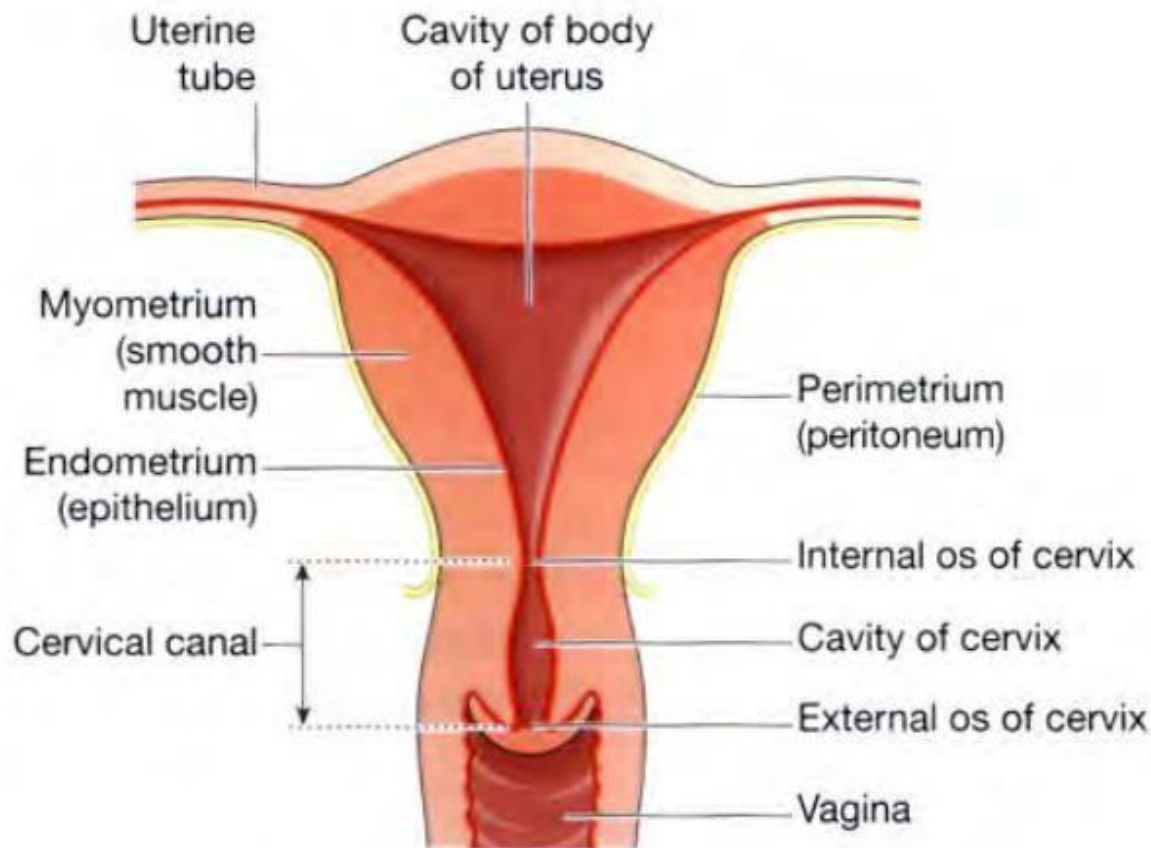


## **Uterus**

- The uterus is a hollow muscular pear-shaped organ, flattened anteroposteriorly. It lies in the pelvic cavity between the urinary bladder and the rectum.
- In most women, it leans forward (anteversiori), and is bent forward (anteflexiori) almost at right angles to the vagina, so that its anterior wall rests partly against the bladder below, and forming the vesicouterine pouch between the two organs.
- When the body is in the upright position the uterus lies in an almost horizontal position.
- It is about 7.5 cm long, 5 cm wide and its walls are about 2.5 cm thick. It weighs from 30 to 40 grams.
- The parts of the uterus are the fundus, body and cervix.

## Structure of the uterus

The walls of the uterus are composed of three layers of tissue: perimetrium, myometrium and endometrium.



**Figure 19.5** A section of the uterus.

## **Uterine tubes (Fallopian tubes)**

- The uterine tubes are about 10 cm long and extend from the sides of the uterus between the body and the fundus. They lie in the upper free border of the broad ligament and their trumpet-shaped lateral ends penetrate the posterior wall, opening into the peritoneal cavity close to the ovaries. The end of each tube has fingerlike projections called fimbriae. The longest of these is the ovarian fimbria which is in close association with the ovary.
- **Structure of the uterine tubes**
- The uterine tubes have an outer covering of peritoneum (broad ligament), a middle layer of smooth muscle and are lined with ciliated epithelium.

## **Function of the uterine tubes**

- The uterine tubes convey the ovum from the ovary to the uterus by peristalsis and ciliary movement.
- The mucus secreted by the lining membrane provides ideal conditions for movement of ova and spermatozoa.
- Fertilisation of the ovum usually takes place in the uterine tube, and the zygote is propelled into the uterus for implantation.

## **Ovaries**

- The ovaries are the female gonads, or glands, and they lie in a shallow fossa on the lateral walls of the pelvis.
  - They are 2.5 to 3.5 cm long, 2 cm wide and 1 cm thick. Each is attached to the upper part of the uterus by the ovarian ligament and to the back of the broad ligament by a broad band of tissue, the mesovarium.
  - Blood vessels and nerves pass to the ovary through the mesovarium
- Structure of the ovaries The ovaries have two layers of tissue.

### **The medulla.**

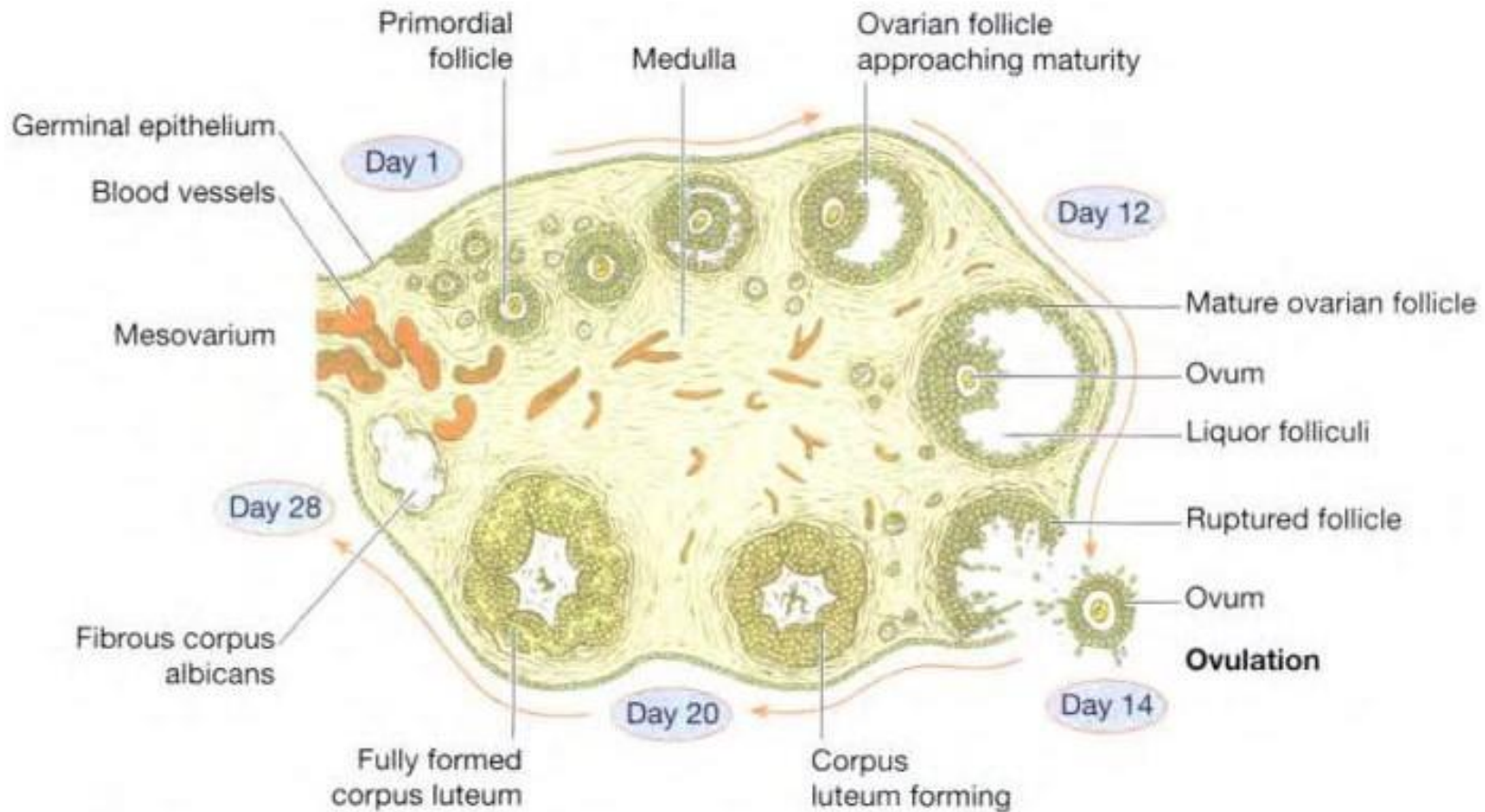
- This lies in the centre and consists of fibrous tissue, blood vessels and nerves.

### **The cortex.**

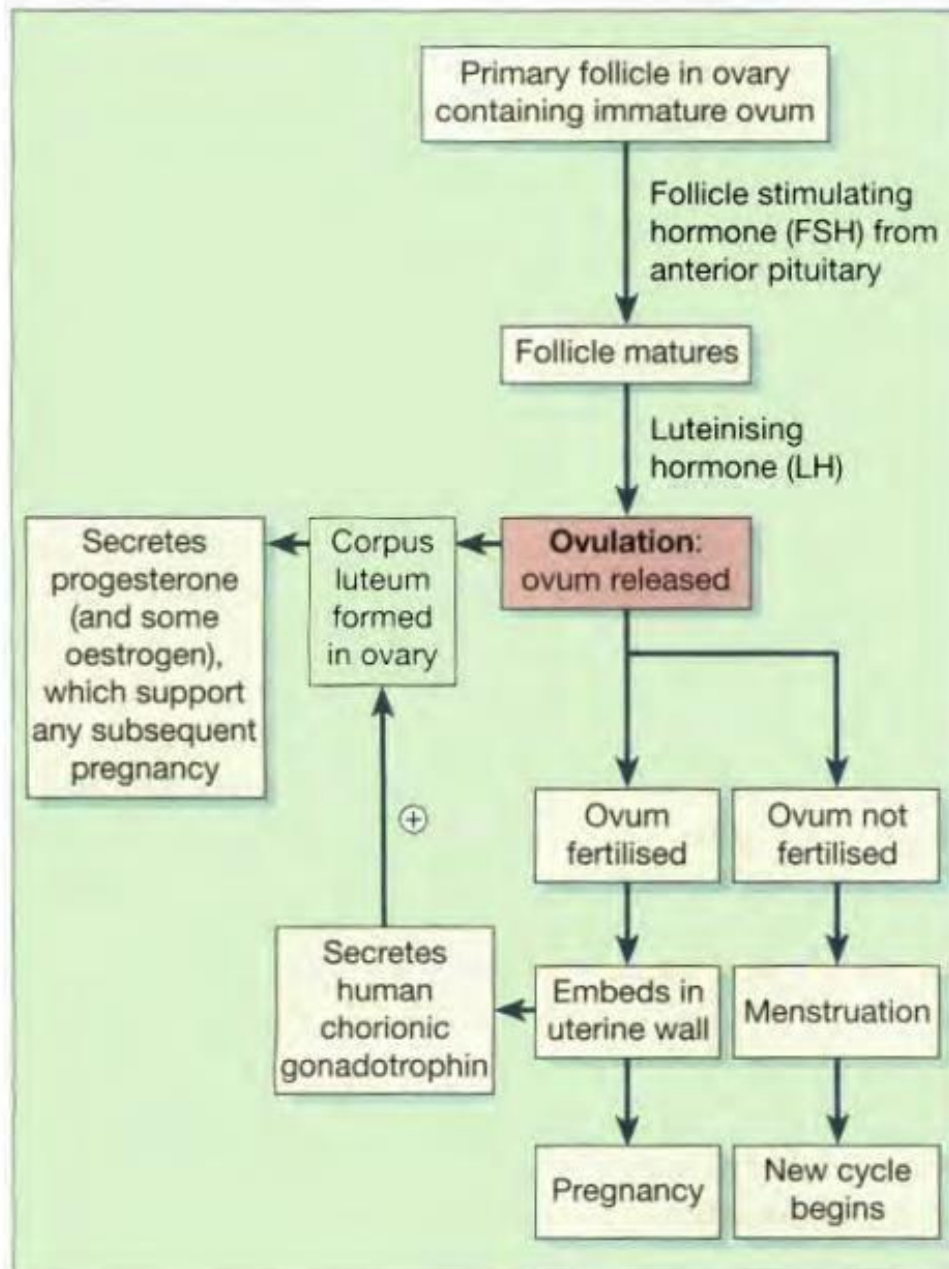
- This surrounds the medulla. It has a framework of connective tissue, or stroma, covered by germinal epithelium. It contains ovarian follicles in various stages of maturity, each of which contains an ovum.
- Before puberty the ovaries are inactive but the stroma already contains immature (primordial) follicles, which the female has from birth. During the childbearing years, about every 28 days, one ovarian follicle (Graafian follicle) matures, ruptures and releases its ovum into the peritoneal cavity. This is called ovulation and it occurs during most menstrual cycles.

## Functions of the ovaries

- Maturation of the follicle is stimulated by **follicle stimulating hormone (FSH)** from the anterior pituitary, and **oestrogen** secreted by the follicle lining cells.
- Ovulation is triggered by a flow of **luteinising hormone (LH)** from the anterior pituitary, which occurs a few hours before ovulation.
- After ovulation, the follicle lining cells develop into the **corpus luteum** (yellow body), under the influence of LH from the anterior pituitary.
- The **corpus luteum** produces the hormone **progesterone** and some **oestrogen**. If the ovum is fertilised it embeds itself in the wall of the uterus where it grows and develops and produces the hormone **human chorionic gonadotrophin (hCG)**, which stimulates the corpus luteum to continue secreting **progesterone and oestrogen** for the first 3 months of the pregnancy, after which time this function is continued by the placenta.
- If the ovum is not fertilised the corpus luteum degenerates and a new cycle begins with menstruation. At the site of the degenerate corpus luteum an inactive mass of fibrous tissue forms, called the **corpus albicans**.
- Sometimes more than one follicle matures at a time, releasing two or more ova in the same cycle. When this happens and the ova are fertilised the result is a multiple pregnancy.



**Figure 19.7** A section of an ovary showing the stages of development of one ovarian follicle.



**Figure 19.9** Summary of the stages of development of the ovum and the associated hormones.



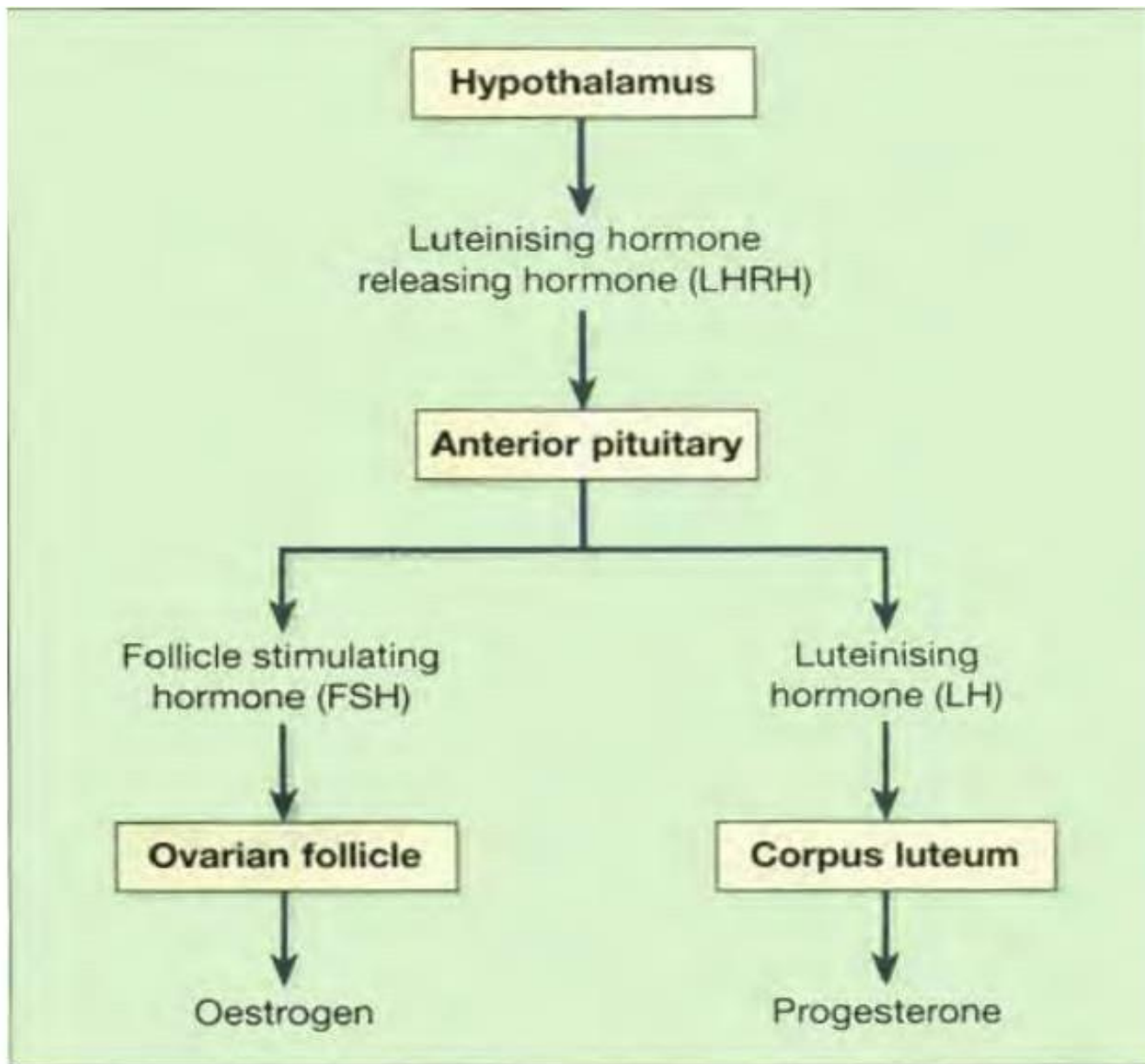
## Puberty in the female

- Puberty is the age at which the internal reproductive organs reach maturity. This is called the **menarche**, and marks the beginning of the childbearing period.
- The ovaries are stimulated by the **gonadotrophins** from the **anterior pituitary, follicle stimulating hormone** and **luteinising hormone**.
- The age of puberty varies between 10 and 14 years and a number of physical and psychological changes take place at this time:
  - ✓ the uterus, the uterine tubes and the ovaries reach maturity
  - ✓ the menstrual cycle and ovulation begin (menarche)
  - ✓ the breasts develop and enlarge
  - ✓ pubic and axillary hair begins to grow
  - ✓ there is an increase in the rate of growth in height and widening of the pelvis
  - ✓ there is an increase in the amount of fat deposited in the subcutaneous tissue, especially at the hips and breasts.

## Menstrual (sexual) cycle

- This is a series of events, occurring regularly in females every 26 to 30 days throughout the childbearing period of about 36 years.
- The cycle consists of a series of changes that take place concurrently in the ovaries and uterine walls, stimulated by changes in the blood concentrations of hormones.
- Hormones secreted in the cycle are regulated by negative feedback mechanisms.
- The hypothalamus secretes **luteinising hormone releasing hormone (LHRH)** which stimulates the anterior pituitary to secrete.
  - **follicle stimulating hormone (FSH)**, which promotes the maturation of ovarian follicles and the secretion of **oestrogen**, leading to ovulation
  - **luteinising hormone (LH)**, which triggers ovulation, stimulates the development of the **corpus luteum** and the secretion of **progesterone**.

- The hypothalamus responds to changes in the blood levels of **oestrogen** and **progesterone**.
- It is switched off by high levels and stimulated when they are low.
- The average length of the menstrual cycle is about **28 days**.
- By convention the days of the cycle are numbered from the beginning of the menstrual phase of the menstrual cycle which usually lasts about **4 days**.
- This is followed by the proliferative phase (about 10 days), then by the secretory phase (about 14 days).



**Figure 19.8** Female reproductive hormones and target tissues.

## Menstrual phase

- When the ovum is not fertilised, the **corpus luteum** starts to degenerate. (In the event of pregnancy, the corpus luteum is supported by **human chorionic gonadotrophin (hCG)** secreted by the developing embryo.
- **Progesterone and oestrogen** levels therefore fall, and the functional layer of the **endometrium**, which is dependent on high levels of these ovarian hormones, is shed in **menstruation**.
- The menstrual flow consists of the secretions from endometrial glands, endometrial cells, blood from the broken down capillaries and the **unfertilised ovum**.
- High circulating levels of ovarian **progesterone** and **oestrogen** inhibit the anterior pituitary, blocking the release of FSH and LH, and should pregnancy occur then rising **oestrogen** and **progesterone** levels therefore prevent the maturation and release of another ovum.
- After degeneration of the **corpus luteum**, however, falling levels of **oestrogen** and **progesterone** lead to resumed anterior pituitary activity, rising FSH levels and the initiation of the next cycle.

## **Proliferative phase**

- At this stage an ovarian follicle, stimulated by FSH, is growing towards maturity and is producing **oestrogen**.
- **Oestrogen** stimulates the proliferation of the functional layer of the endometrium in preparation for the reception of a fertilised ovum.
- The endometrium becomes thicker by rapid cell multiplication accompanied by an increase in the numbers of **mucus-secreting glands** and blood capillaries.
- This phase ends when ovulation occurs and **oestrogen** production declines.

## **Secretory phase**

- Immediately after ovulation, the lining cells of the ovarian follicle are stimulated by LH to develop the **corpus luteum**, which produces progesterone and some **oestrogen**.
- Under the influence of **progesterone** the endometrium becomes **oedematous** and the secretory glands produce increased amounts of watery mucus.
- This is believed to assist the passage of the **spermatozoa** through the uterus to the uterine tubes where the ovum is usually fertilised.
- There is a similar increase in the secretion of watery mucus by the glands of the uterine tubes and by cervical glands which lubricate the vagina.

- The ovum may survive in a fertilisable form for a very short time after ovulation, probably as little as 8 hours. The spermatozoa, deposited in the vagina during coitus, may be capable of fertilising the ovum for only about 24 hours although they may survive for several days.
- This means that the period in each cycle during which fertilisation can occur is relatively short. The time of ovulation can be determined by observing certain changes in the woman's body around this period.
- Changes in cervical mucus, from thick and dry in consistency to thin, elastic and watery, are detected and, in addition, body temperature rises by a small but measurable amount immediately following ovulation.
- Some women experience some degree of abdominal discomfort in the middle of the cycle, thought to correspond to rupture of the follicle and release of its contents into the abdominal cavity.
- If the ovum is not fertilised menstruation occurs and a new cycle begins.
- If the ovum is fertilised there is no breakdown of the endometrium and no menstrual flow.
- The fertilised ovum (zygote) travels through the uterine tube to the uterus where it becomes embedded in the wall and produces human chorionic gonadotrophin (hCG), which is similar to anterior pituitary luteinising hormone.
- This hormone keeps the corpus luteum intact, enabling it to continue secreting progesterone and oestrogen for the first 3 to 4 months of the pregnancy, inhibiting the maturation of further ovarian follicles.
- During that time the placenta develops and produces oestrogen, progesterone and gonadotrophins. ‘

## Menopause (climacteric)

- The menopause usually occurs between the ages of 45 and 55 years, marking the end of the childbearing period.
- It may occur suddenly or over a period of years, sometimes as long as 10 years, and is caused by changes in sex hormone levels.
- The ovaries gradually become less responsive to FSH and LH, and ovulation and the menstrual cycle become irregular, eventually ceasing.
- Several other phenomena may occur at the same time including:
  - short-term unpredictable vasodilatation with flushing, sweating and palpitations, causing discomfort and disturbance of the normal sleep pattern
  - shrinkage of the breasts
  - axillary and pubic hair become sparse
  - atrophy of the sex organs
  - episodes of uncharacteristic behaviour sometimes occur, e.g. irritability, mood changes
  - gradual thinning of the skin
  - loss of bone mass that predisposes to osteoporosis
  - slow increase in blood cholesterol levels that predisposes postmenopausal women to cardiovascular disorders.

Similar changes occur after bilateral irradiation or surgical removal of the ovaries.



## **Breasts or mammary glands**

- The breasts or mammary glands are accessory glands of the female reproductive system.
- They exist also in the male but in only a undeveloped form.
- In the female the breasts are small and immature until puberty.
- Thereafter they grow and develop to their mature size under the influence of **oestrogen and progesterone**.
- During pregnancy these hormones stimulate further growth.
- After the baby is born the hormone **prolactin** from the anterior pituitary stimulates the production of milk, and **oxytocin** from the posterior pituitary stimulates the release of milk in response to the stimulation of the nipple by the sucking baby, by a positive feedback mechanism.

## **Function of the breast**

- The mammary glands are only active during late pregnancy and after the birth of a baby when they produce milk (lactation).
- Lactation is stimulated by the hormone prolactin.

## **SEX HORMONE**

### **HORMONES SECRETED BY TESTES**

Testes secrete male sex hormones, which are collectively called the androgens.

Androgens secreted by testes are:

1. Testosterone
2. Dihydrotestosterone
3. Androstenedione.

Among these three androgens, testosterone is secreted in large quantities. However, dihydrotestosterone is more active.

### **OVARIAN HORMONES**

Ovary secretes the female sex hormones estrogen and progesterone. Ovary also secretes few more hormones, namely inhibin, relaxin and small quantities of androgens.