PHYSIOLOGY

FACULTY OF PHARMACEUTICAL SCIENCES
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LECTURE 14-REPRODUCTIVE SYSTEM

THE REPRODUCTIVE SYSTEMS

- **The male and female reproductive organs work together** to produce offspring.
- In addition, the **female reproductive organs contribute to sustaining the growth of embryos and fetuses**.
- **Sexual reproduction** is the process by which **organisms produce offspring by making germ cells called gametes.**
- **After the male gamete (sperm cell) unites with the female gamete (secondary oocyte)—an event called fertilization- the resulting cell contains one set of chromosomes from each parent.**
- **Males and females have anatomically distinct reproductive organs that are adapted for producing gametes, facilitating fertilization, and, in females, sustaining the growth of the embryo and fetus.**

THE REPRODUCTIVE SYSTEMS

- **The male and female reproductive organs can be grouped by function.**
- The **gonads—testes** in males and **ovaries** in females— **produce gametes and secrete sex hormones.**
- **Various ducts then store and transport the gametes.**
- **Accessory sex glands produce substances that protect the gametes and facilitate their movement.**
- Finally, **supporting structures, such as the penis in males and the uterus in females**, assist the delivery of gametes, and **the uterus** is also **the site for the growth of the embryo and fetus during pregnancy.**

MALE REPRODUCTIVE SYSTEM

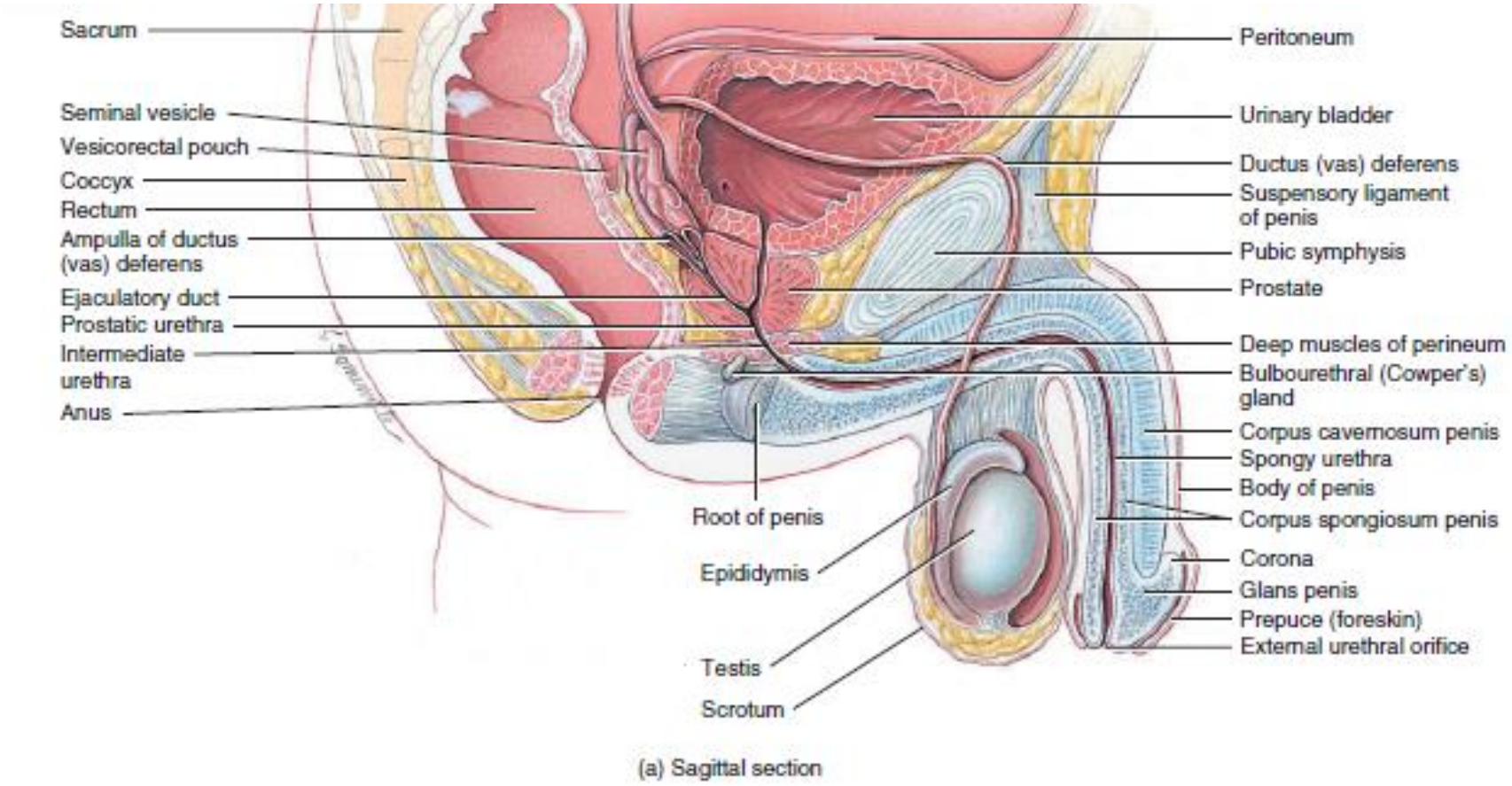
- **The organs of the male reproductive system include the testes, a system of ducts, accessory sex glands, and several supporting structures, including the scrotum and the penis.**

FUNCTIONS OF THE MALE REPRODUCTIVE SYSTEM

1. The testes produce sperm and the male sex hormone testosterone.
2. The ducts transport, store, and assist in maturation of sperm.
3. The accessory sex glands secrete most of the liquid portion of semen.
4. The penis contains the urethra, a passageway for ejaculation of semen and excretion of urine.

Figure 28.1 Male organs of reproduction and surrounding structures.

Reproductive organs are adapted for producing new individuals and passing on genetic material from one generation to the next.



(a) Sagittal section

MALE REPRODUCTIVE SYSTEM

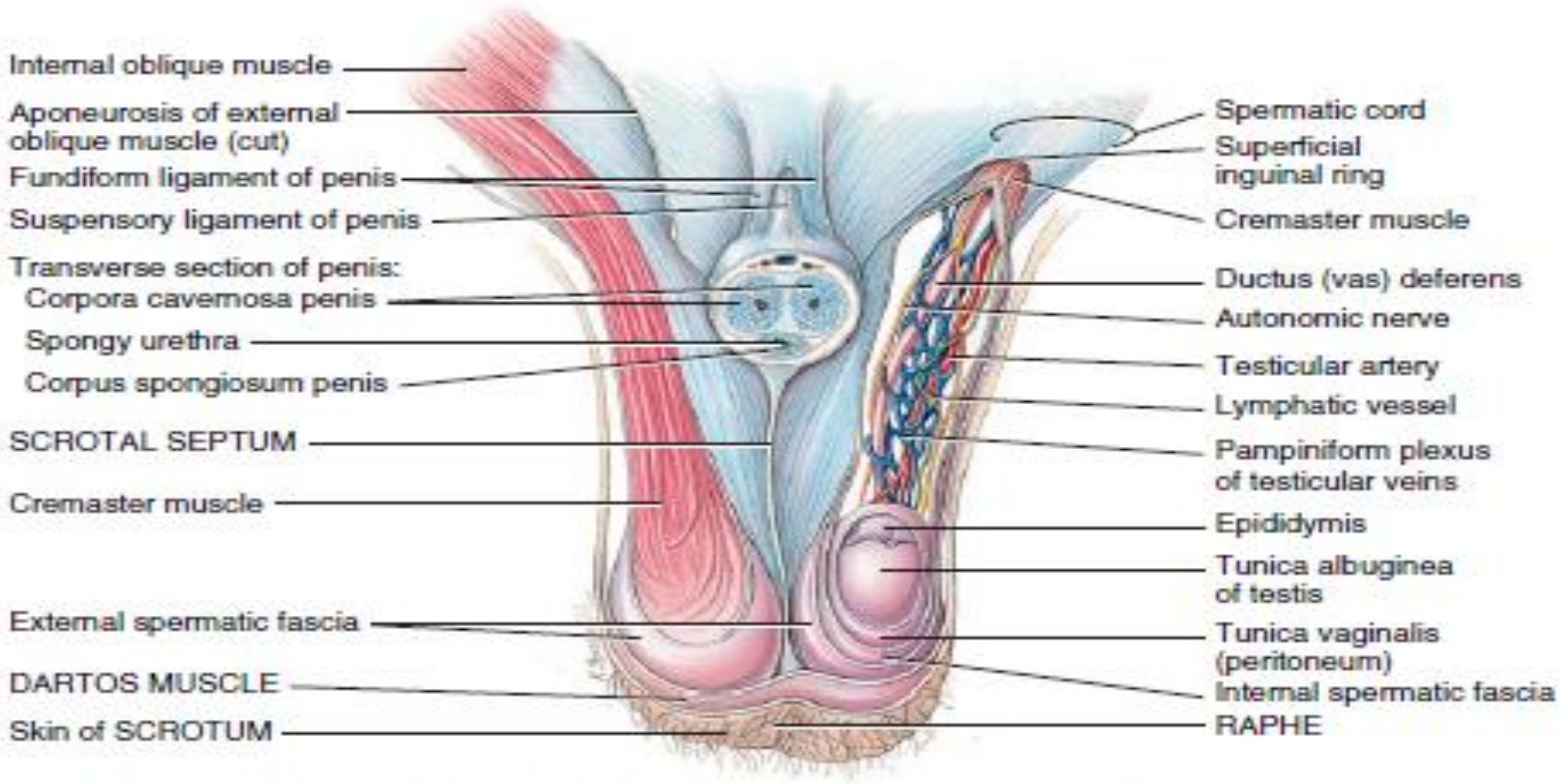
- ✓ **The location of the scrotum and the contraction of its muscle fibers regulate the temperature of the testes.**

- ✓ **Normal sperm production requires a temperature about 2–3 Celsius below core body temperature.**

MALE REPRODUCTIVE SYSTEM

Figure 28.2 The scrotum, the supporting structure for the testes.

The scrotum consists of loose skin and an underlying subcutaneous layer and supports the testes.



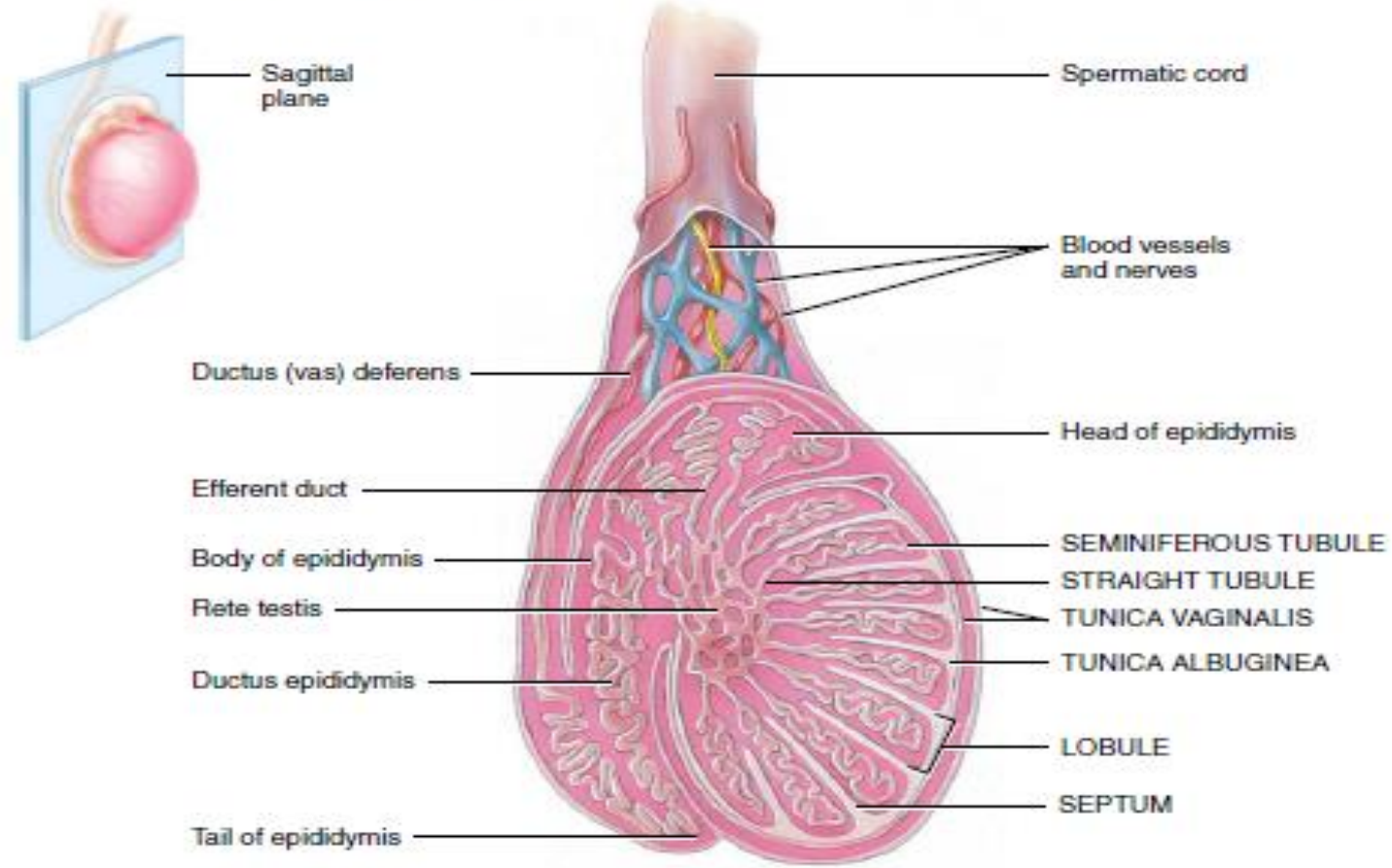
Anterior view of scrotum and testes and transverse section of penis

Which muscles help regulate the temperature of the testes?

MALE REPRODUCTIVE SYSTEM

Figure 28.3 Internal and external anatomy of a testis.

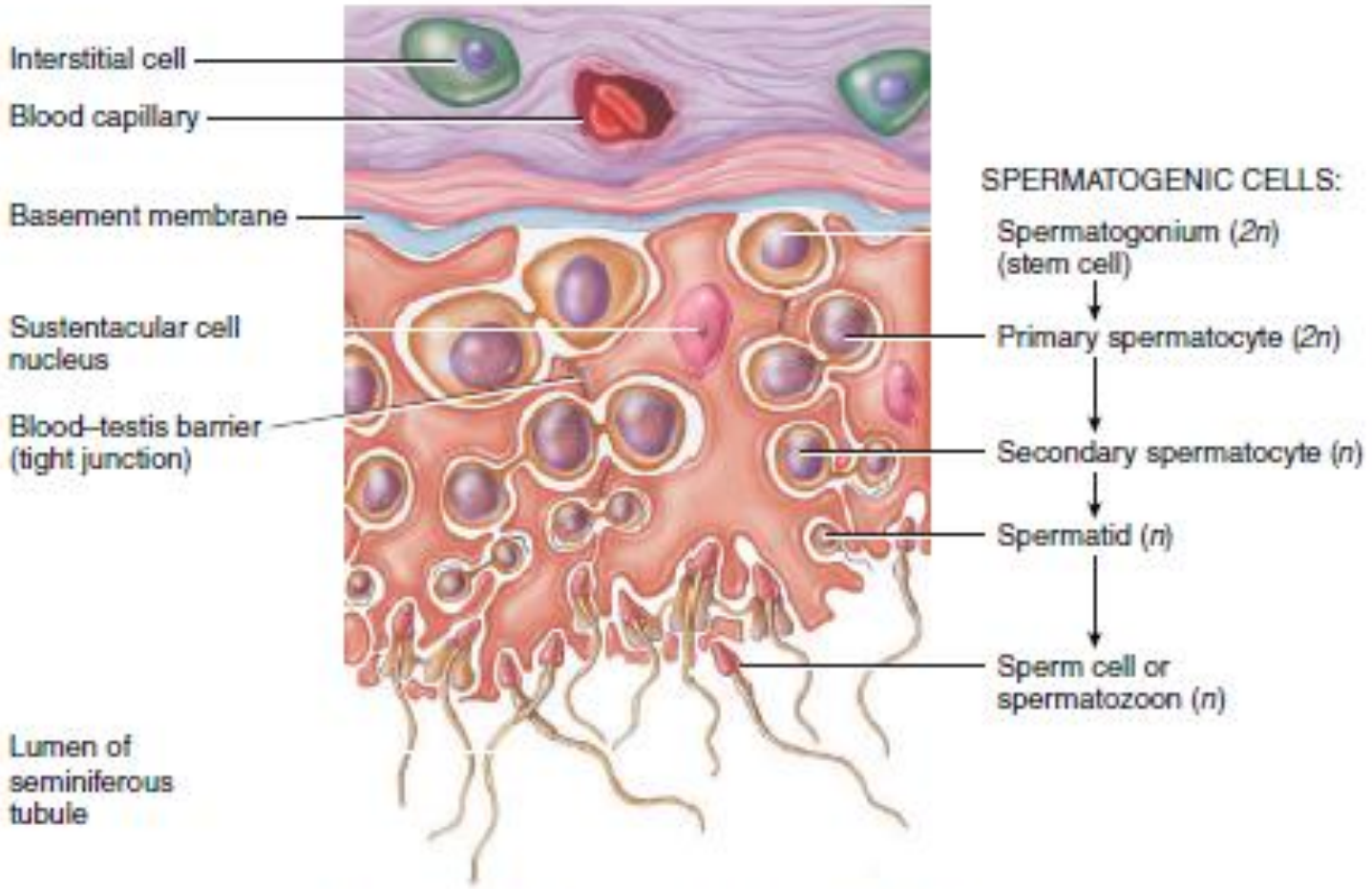
The testes are the male gonads, which produce haploid sperm.



(a) Sagittal section of testis showing seminiferous tubules

Figure 28.4 Microscopic anatomy of the seminiferous tubules and stages of sperm production (spermatogenesis). Arrows indicate the progression of spermatogenic cells from least mature to most mature. The (n) and ($2n$) refer to haploid and diploid numbers of chromosomes, respectively.

Spermatogenesis occurs in the seminiferous tubules of the testes.



Transverse section of part of seminiferous tubule

Which cells secrete testosterone?

- Spermatogonium:
  - **A cell produced at an early stage in the formation of spermatozoa, formed in the wall of a seminiferous tubule and giving rise by mitosis to spermatocytes.**

Figure 28.5 **Events in spermatogenesis.** Diploid cells ($2n$) have 46 chromosomes; haploid cells (n) have 23 chromosomes.

Spermiogenesis involves the maturation of spermatids into sperm.

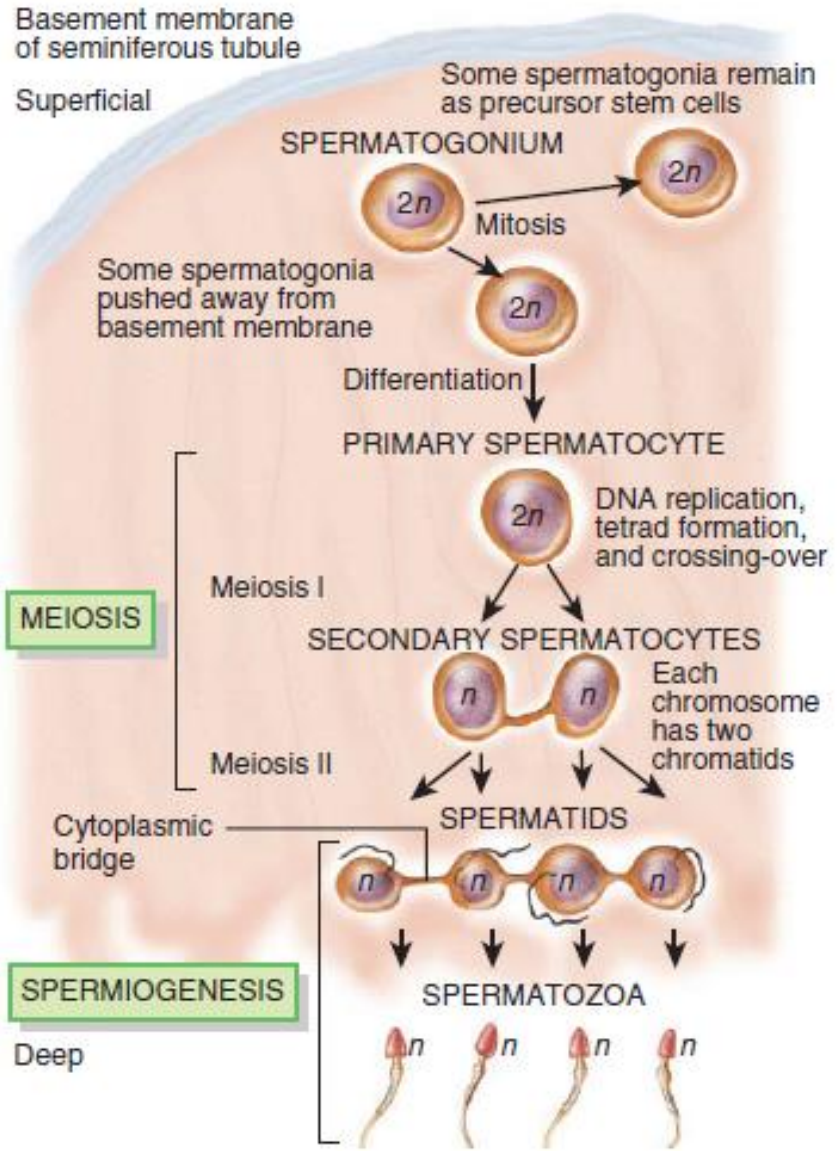
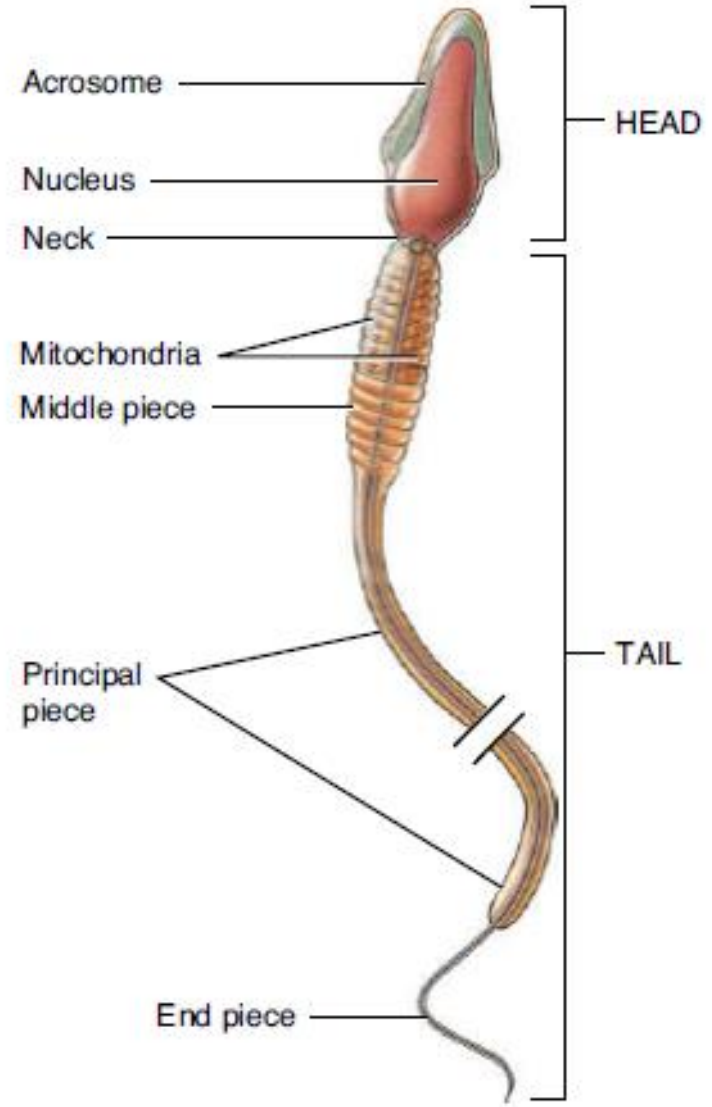


Figure 28.6 Parts of a sperm cell.

About 300 million sperm mature each day.



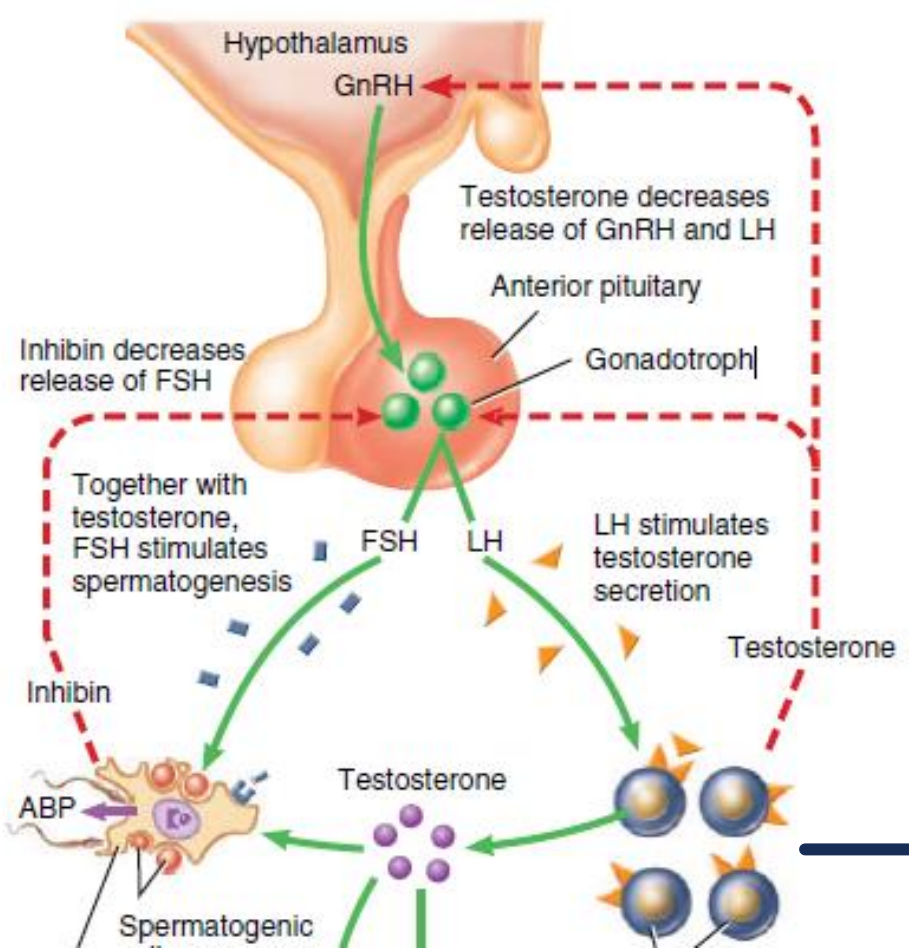
HORMONAL CONTROL OF TESTICULAR FUNCTION

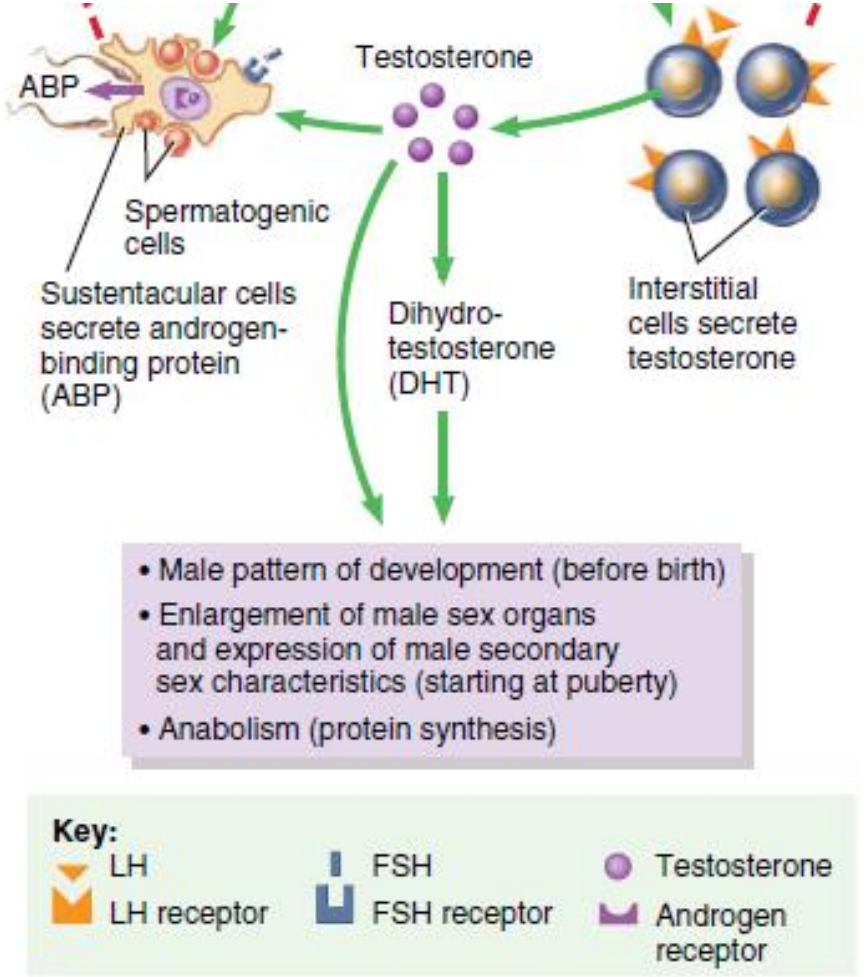
- Although the initiating factors are unknown, **at puberty** certain **hypothalamic neurosecretory cells increase their secretion of gonadotropin-releasing hormone (GnRH).**

- **This hormone in turn stimulates gonadotrophs in the anterior pituitary to increase their secretion of the two gonadotropins, luteinizing hormone (LH) and follicles-stimulating hormone (FSH).**

Figure 28.7 Hormonal control of spermatogenesis and actions of testosterone and dihydrotestosterone (DHT). In response to stimulation by FSH and testosterone, sustentacular cells secrete androgen-binding protein (ABP). Dashed red lines indicate negative feedback inhibition.

Release of FSH is stimulated by GnRH and inhibited by inhibin; release of LH is stimulated by GnRH and inhibited by testosterone.





HORMONAL CONTROL OF TESTICULAR FUNCTION

- **LH stimulates interstitial cells, which are located between seminiferous tubules, to secrete the hormone testosterone.**
- **This steroid hormone is synthesized from cholesterol in the testes and is the principal androgen.**
- **It is lipid-soluble and readily diffuses out of interstitial cells into the interstitial fluid and then into blood.**
- **Via negative feedback**, testosterone suppresses secretion of LH by anterior pituitary gonadotrophs and suppresses secretion of GnRH by hypothalamic neurosecretory cells.
- **In some target cells, such as those in the external genitals and prostate, the enzyme 5 alpha-reductase converts testosterone to another androgen called dihydrotestosterone (DHT).**

HORMONAL CONTROL OF TESTICULAR FUNCTION

- **FSH acts indirectly to stimulate spermatogenesis.**
- **FSH and testosterone act synergistically** on the sustentacular cells to **stimulate secretion of androgen-binding protein (ABP) into the lumen of the seminiferous tubules** and **into the interstitial fluid around the spermatogenic cells.**
- **ABP binds to testosterone, keeping its concentration high.**
- **Testosterone stimulates the final steps of spermatogenesis in the seminiferous tubules.**
- **Once the degree of spermatogenesis required for male reproductive functions has been achieved, sustentacular cells release inhibin, a protein hormone named for its role in inhibiting FSH secretion by the anterior pituitary.**
- **If spermatogenesis is proceeding too slowly, less inhibin is released, which permits more FSH secretion and an increased rate of spermatogenesis.**

HORMONAL CONTROL OF TESTICULAR FUNCTION

Testosterone and dihydrotestosterone both bind to the same androgen receptors, which are found within the nuclei of target cells.

The hormone–receptor complex regulates gene expression, turning some genes on and others off.

Because of these changes, the androgens produce several effects:

THE ANDROGENS PRODUCE SEVERAL EFFECTS:

1. **Prenatal development:**

- **Before birth, testosterone stimulates the male pattern of development of reproductive system ducts and the descent of the testes.**

- **Testosterone also is converted in the brain to estrogens (feminizing hormones), which may play a role in the development of certain regions of the brain in males.**

THE ANDROGENS PRODUCE SEVERAL EFFECTS:

2. **Development of male sexual characteristics:**

- **At puberty, testosterone and dihydrotestosterone bring about development and enlargement of the male sex organs.**

3. **Development of sexual function:**

- **Androgens contribute to male sexual behavior and spermatogenesis and to sex drive (libido) in both males and females.**

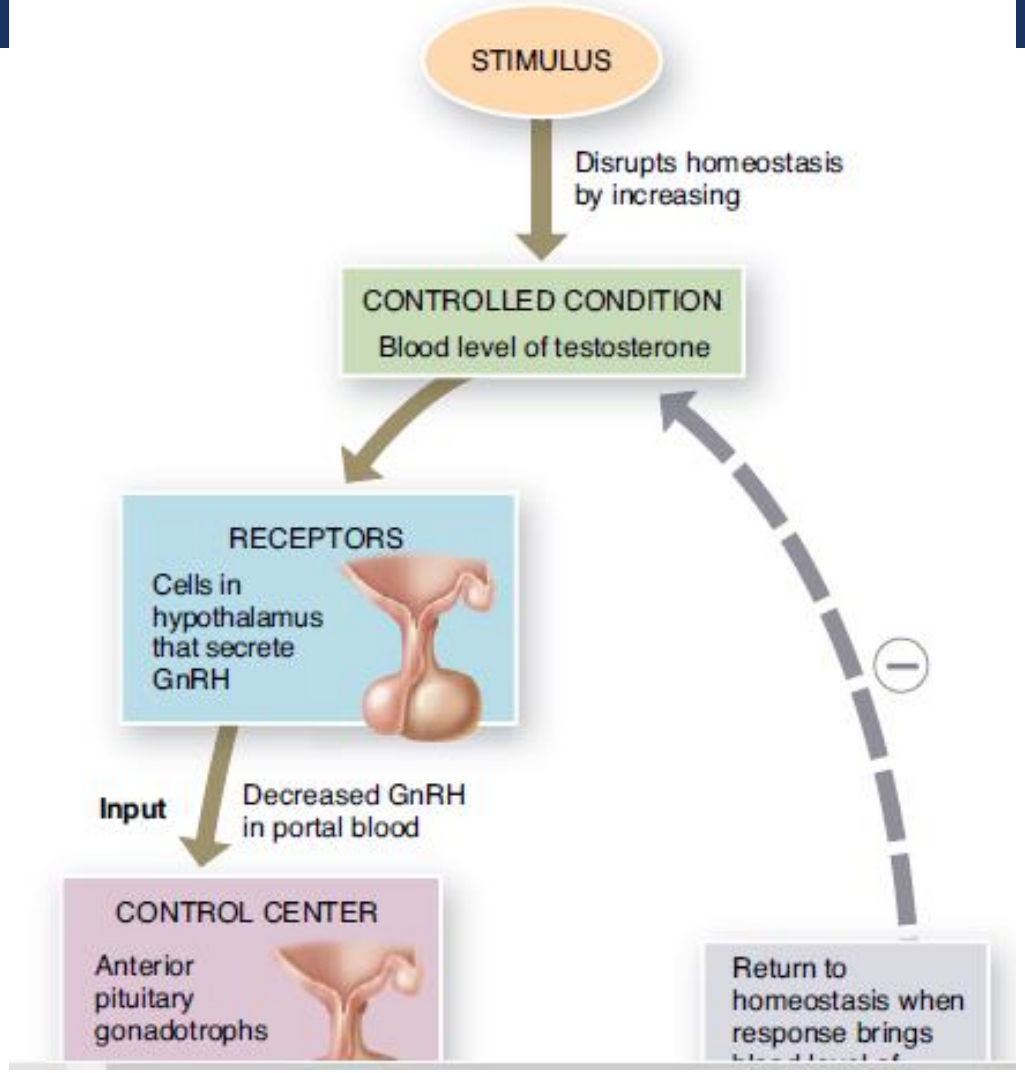
THE ANDROGENS PRODUCE SEVERAL EFFECTS:

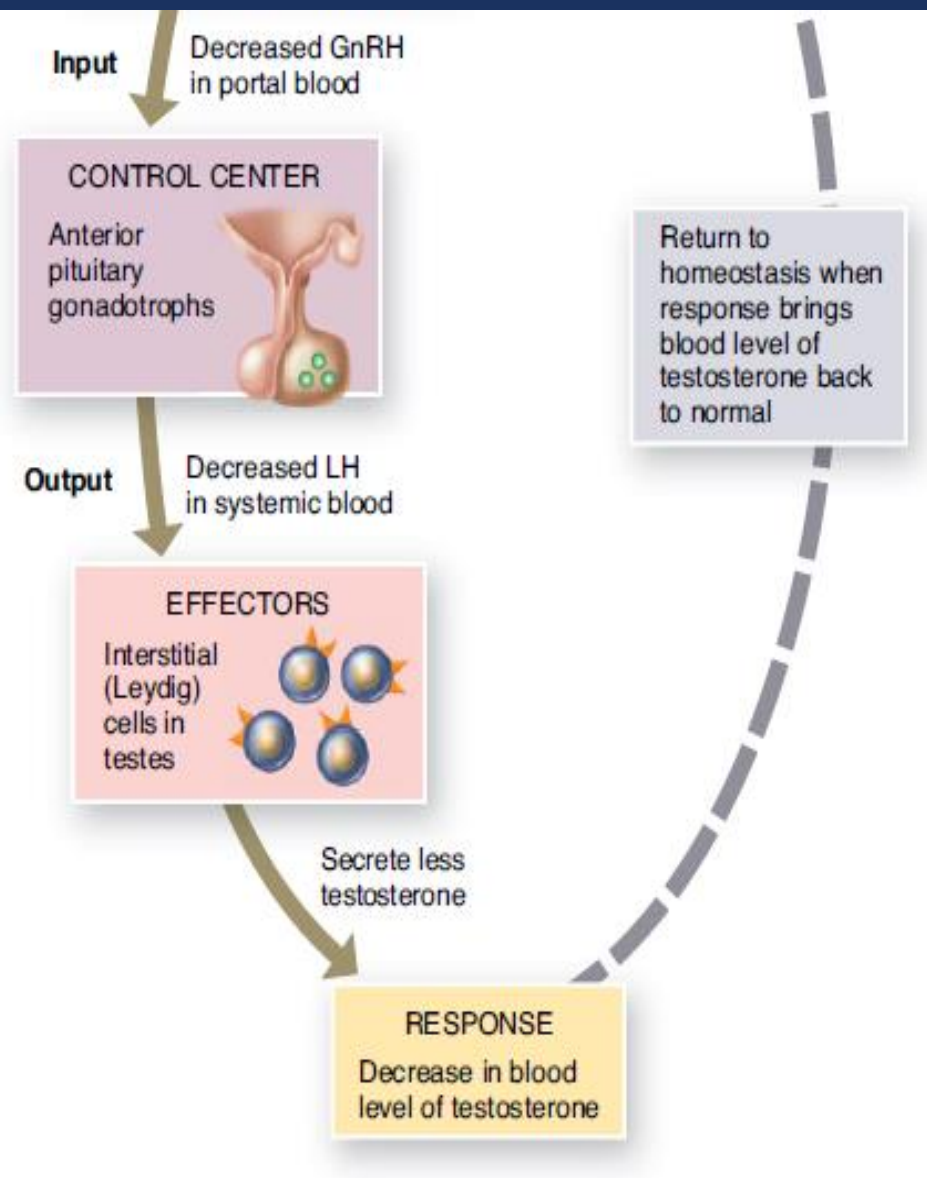
4. Stimulation of anabolism:

- **Androgens are anabolic hormones; that is, they stimulate protein synthesis. This effect is obvious in the heavier muscle and bone mass of most men as compared to women.**

Figure 28.8 Negative feedback control of blood level of testosterone.

Gonadotrophs of the anterior pituitary produce luteinizing hormone (LH).





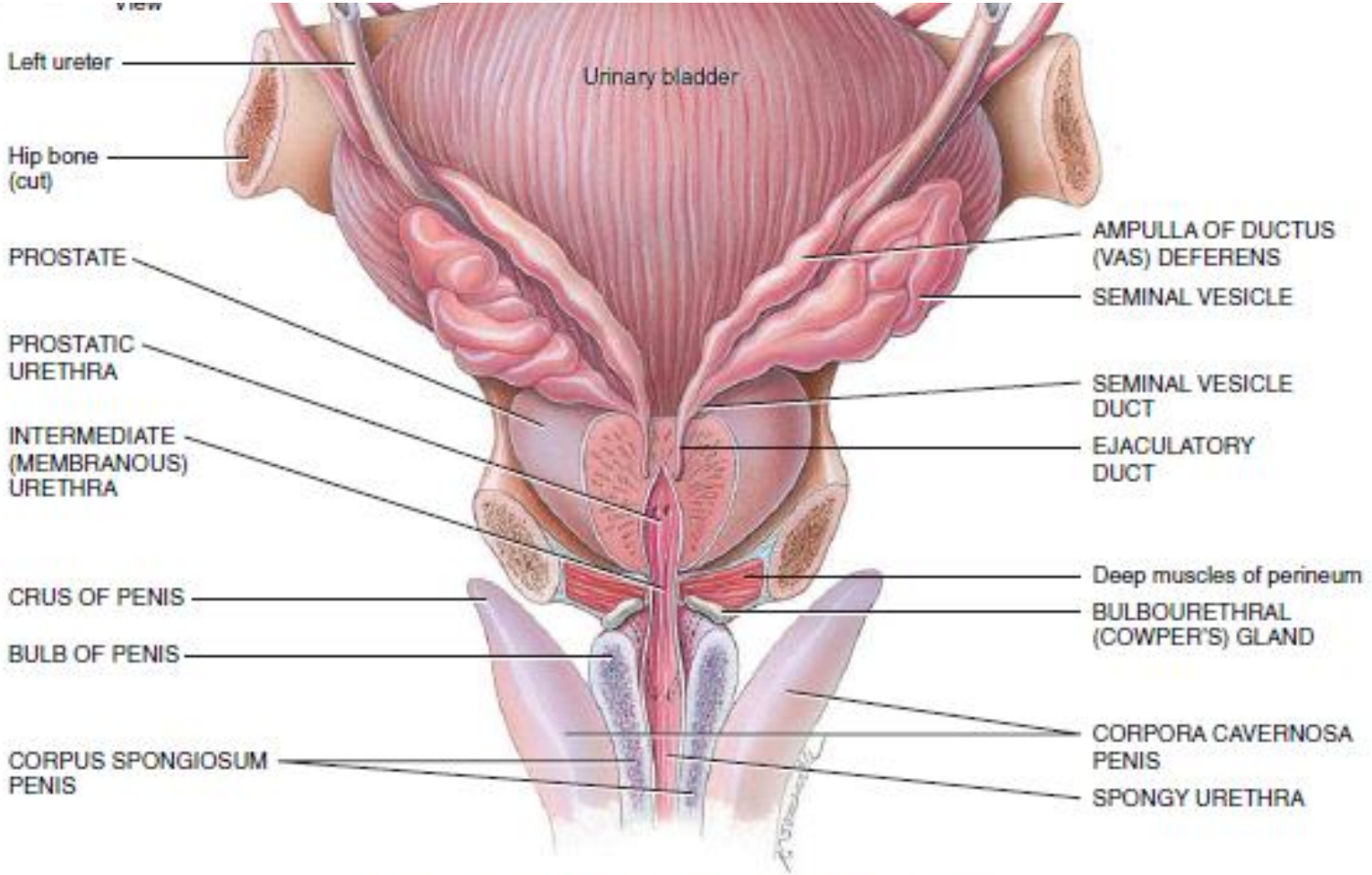
FUNCTIONS OF ACCESSORY SEX GLAND SECRETIONS

FUNCTIONS OF ACCESSORY SEX GLAND SECRETIONS

1. The seminal vesicles secrete an alkaline, viscous fluid that helps neutralize acid in the female reproductive tract, provides fructose for ATP production by sperm, contributes to sperm motility and viability, and helps semen coagulate after ejaculation.
2. The prostate secretes a milky, slightly acidic fluid that contains enzymes that break down clotting proteins from the seminal vesicles.
3. The bulbourethral glands secrete an alkaline fluid that neutralizes the acidic environment of the urethra and mucus that lubricates the lining of the urethra and the tip of the penis during sexual intercourse.

Figure 28.9 Locations of several accessory reproductive organs in males. The prostate, urethra, and penis have been sectioned to show internal details.

The male urethra has three subdivisions: the prostatic, membranous, and spongy (penile) urethra.



(a) Posterior view of male accessory organs of reproduction

FEMALE REPRODUCTIVE SYSTEM

- **The organs of the female reproductive system include the ovaries (female gonads); the uterine (fallopian) tubes, or oviducts; the uterus; the vagina; and external organs, which are collectively called the vulva, or pudendum.**

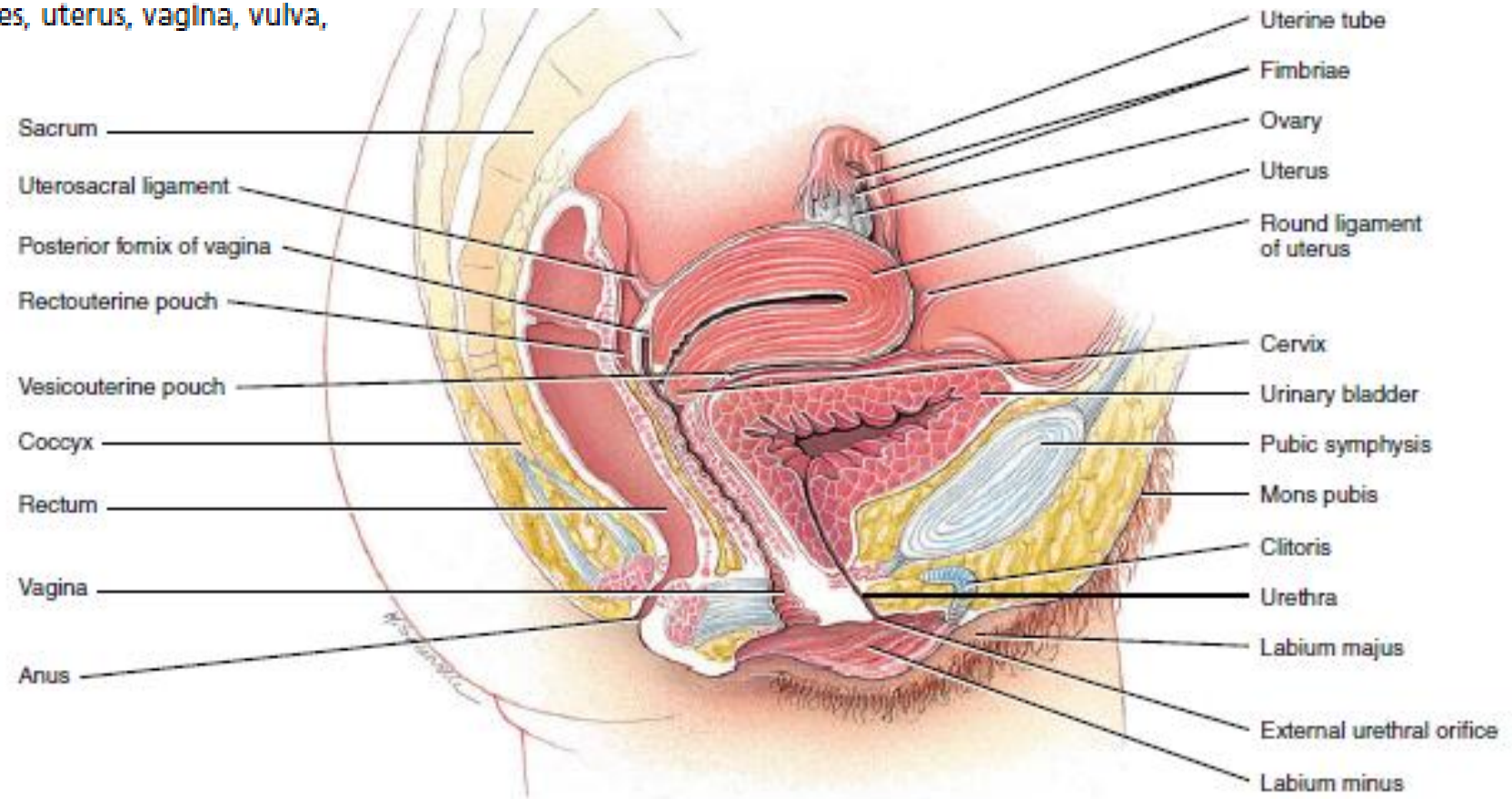
FEMALE REPRODUCTIVE SYSTEM

FUNCTIONS OF THE FEMALE REPRODUCTIVE SYSTEM

1. The ovaries produce secondary oocytes and hormones, including progesterone and estrogens (female sex hormones), inhibin, and relaxin.
2. The uterine tubes transport a secondary oocyte to the uterus and normally are the sites where fertilization occurs.
3. The uterus is the site of implantation of a fertilized ovum, development of the fetus during pregnancy, and labor.
4. The vagina receives the penis during sexual intercourse and is a passageway for childbirth.
5. The mammary glands synthesize, secrete, and eject milk for nourishment of the newborn.

Figure 28.11 Female organs of reproduction and surrounding structures.

The organs of reproduction in females include the ovaries, uterine (fallopian) tubes, uterus, vagina, vulva, and mammary glands.

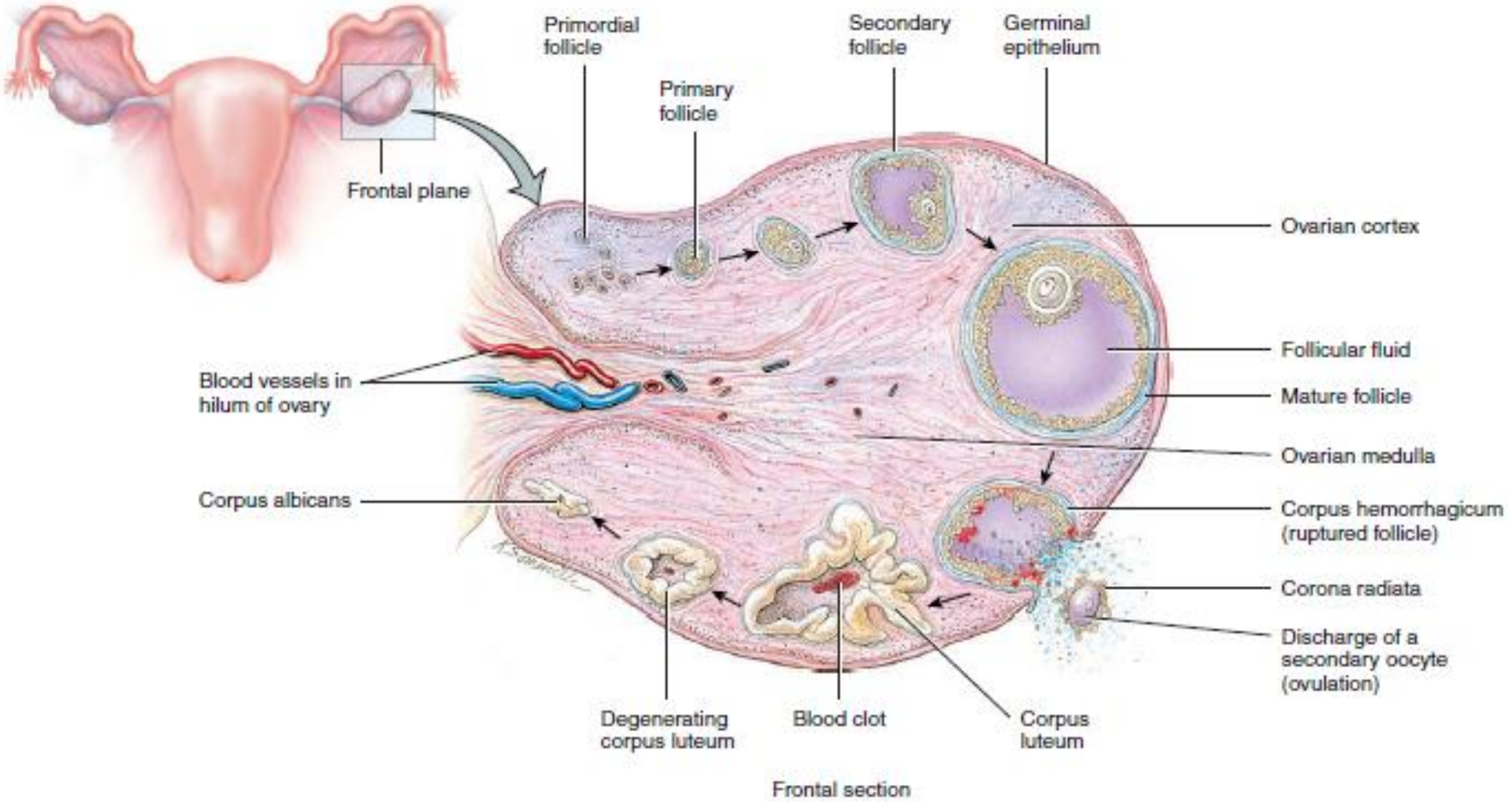


(a) Sagittal section

FIGURE 28.11 CONTINUES

Figure 28.13 **Histology of the ovary.** The arrows indicate the sequence of developmental stages that occur as part of the maturation of an ovum during the ovarian cycle.

The ovaries are the female gonads; they produce haploid oocytes.



THE FEMALE REPRODUCTIVE CYCLE

- **Ovarian follicles are in the cortex and consist of oocytes in various stages of development, plus the cells surrounding them. When the surrounding cells form a single layer, they are called follicular cells; later in development, when they form several layers, they are referred to as granulosa cells. The surrounding cells nourish the developing oocyte and begin to secrete estrogens as the follicle grows larger.**

- **A mature follicle is a large, fluid-filled follicle that is ready to rupture and expel its secondary oocyte, a process known as ovulation.**

- **A corpus luteum contains the remnants of a mature follicle after ovulation. The corpus luteum produces progesterone, estrogens, relaxin, and inhibin until it degenerates into fibrous scar tissue called the corpus albicans.**
- **A corpus luteum is a mass of cells that forms in an ovary and is responsible for the production of the hormone progesterone during early pregnancy.**

THE FEMALE REPRODUCTIVE CYCLE

- The formation of gametes in the ovaries is termed oogenesis.
- In contrast to spermatogenesis, which begins in males at puberty, oogenesis begins in females before they are even born.
- Oogenesis occurs in essentially the same manner as spermatogenesis; meiosis takes place and the resulting germ cells undergo maturation.
- During early fetal development, primordial (primitive) germ cells migrate from the yolk sac to the ovaries. There, germ cells differentiate within the ovaries into oogonia.
- Oogonia are diploid (2n) stem cells that divide mitotically to produce millions of germ cells. Even before birth, most of these germ cells degenerate in a process known as atresia. A few, however, develop into larger cells called primary oocytes that enter prophase of meiosis I during fetal development but do not complete that phase until after puberty.

THE FEMALE REPRODUCTIVE CYCLE

- During this arrested stage of development, each primary oocyte is surrounded by a single layer of flat follicular cells, and the entire structure is called a primordial follicle.
- At birth, approximately 200,000 to 2,000,000 primary oocytes remain in each ovary. Of these, about 40,000 are still present at puberty, and around 400 will mature and ovulate during a woman's reproductive lifetime. The remainder of the primary oocytes undergo atresia.
- Each month after puberty until menopause, gonadotropins (FSH and LH) secreted by the anterior pituitary further stimulate the development of several primordial follicles, although only one will typically reach the maturity needed for ovulation.
- A few primordial follicles start to grow, developing into primary follicles.
- Each primary follicle consists of a primary oocyte that is surrounded in a later stage of development by several layers of cuboidal and low-columnar cells called granulosa cells.

THE FEMALE REPRODUCTIVE CYCLE

- **The outermost granulosa cells rest on a basement membrane. As the primary follicle grows, it forms a clear glycoprotein layer called the zona pellucida between the primary oocyte and the granulosa cells.**

- **In addition, stromal cells surrounding the basement membrane begin to form an organized layer called the theca folliculi.**

THE FEMALE REPRODUCTIVE CYCLE

- **With continuing maturation:**

- **A primary follicle develops into a secondary follicle.**
- **In a secondary follicle, the theca differentiates into two layers.**
- **These layers are the theca interna, a highly vascularized internal layer of cuboidal secretory cells that secrete estrogens, and the theca externa, an outer layer of stromal cells and collagen fibers.**
- **In addition, the granulosa cells begin to secrete follicular fluid, which builds up in a cavity called the antrum in the center of the secondary follicle.**
- **The innermost layer of granulosa cells becomes firmly attached to the zona pellucida and is now called the corona radiata.**

THE FEMALE REPRODUCTIVE CYCLE

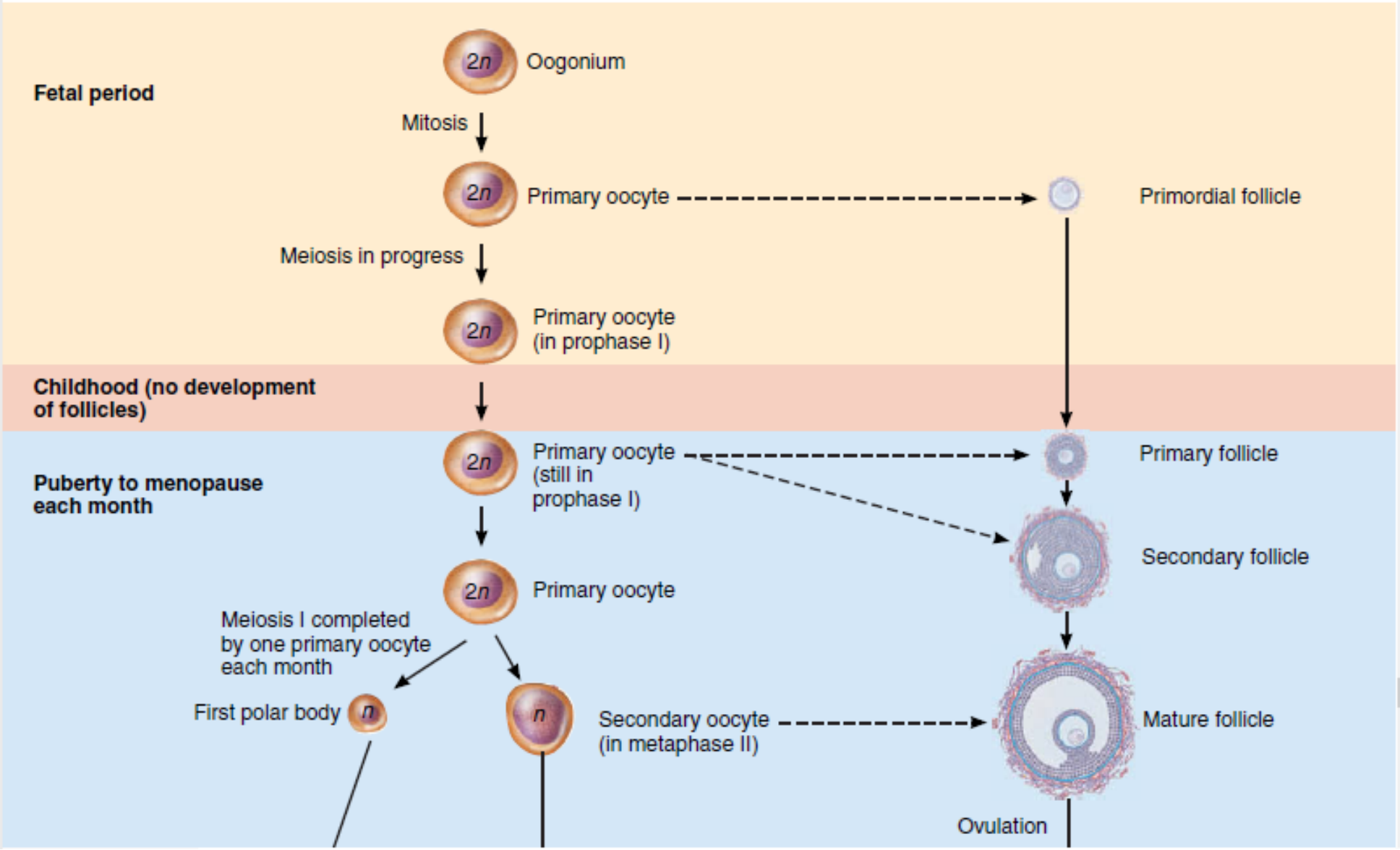
- **The secondary follicle eventually becomes larger, turning into a mature follicle.**
- **While in this follicle, and just before ovulation, the diploid primary oocyte completes meiosis I, producing two haploid (n) cells of unequal size—each with 23 chromosomes.**
- **The smaller cell produced by meiosis I, called the first polar body, is essentially a packet of discarded nuclear material. The larger cell, known as the secondary oocyte, receives most of the cytoplasm. Once a secondary oocyte is formed, it begins meiosis II but then stops in metaphase.**
- **The mature follicle soon ruptures and releases its secondary oocyte, a process known as ovulation.**

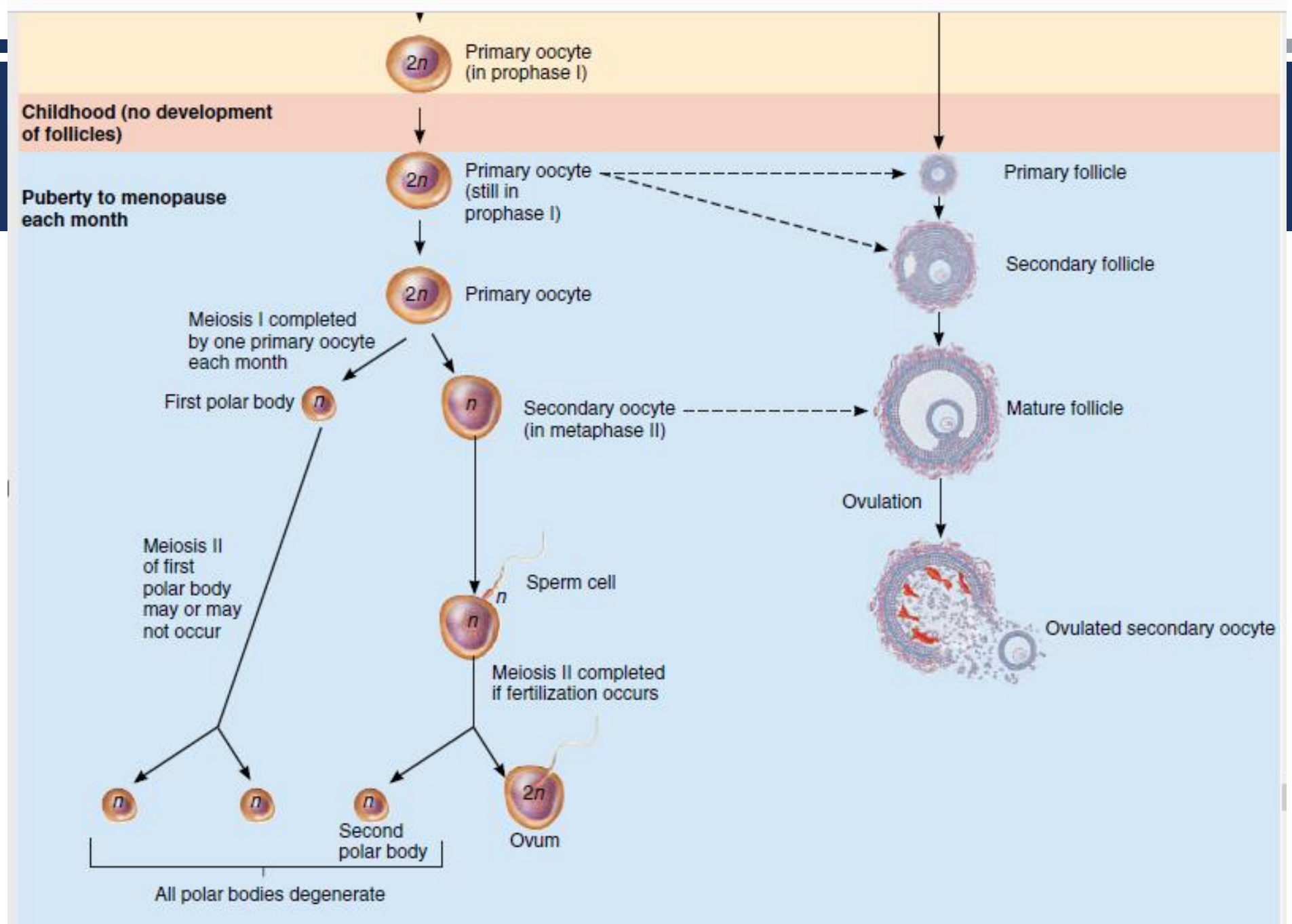
THE FEMALE REPRODUCTIVE CYCLE

- At ovulation, the secondary oocyte is expelled into the pelvic cavity together with the first polar body and corona radiata.
- The secondary oocyte splits into two haploid cells, again of unequal size.
- The larger cell is the ovum, or r mature egg.
- The smaller one is the second polar body.
- The nuclei of the sperm cell and the ovum then unite, forming a diploid zygote.
- If the first polar body undergoes another division to produce two polar bodies, then the primary oocyte ultimately gives rise to three haploid polar bodies, which all degenerate, and a single haploid ovum. Thus, one primary oocyte gives rise to a single gamete (an ovum). By contrast, recall that in malesone primary spermatocyte produces four gametes (sperm).

TABLE 28.1

Summary of Oogenesis and Follicular Development




2n
Primary oocyte
(in prophase I)
Childhood (no development of follicles)
Puberty to menopause each month
2n
Primary oocyte
(still in
prophase I)
Primary follicle
Secondary follicle
2n
Primary oocyte
Meiosis I completed by one primary oocyte each month
First polar body
n
n
Secondary oocyte
(in metaphase II)
Mature follicle
Ovulation
Meiosis II of first polar body may or may not occur
Sperm cell
n
n
Meiosis II completed if fertilization occurs
Ovulated secondary oocyte
n
n
n
2n
Second polar body
Ovum
All polar bodies degenerate

THE FEMALE REPRODUCTIVE CYCLE

- **During their reproductive years, nonpregnant females normally exhibit cyclical changes in the ovaries and uterus. Each cycle takes about a month and involves both oogenesis and preparation of the uterus to receive a fertilized ovum. Hormones secreted by the hypothalamus, anterior pituitary, and ovaries control the main events.**

- **The ovarian cycle is a series of events in the ovaries that occur during and after the maturation of an oocyte. The uterine (menstrual) cycle is a concurrent series of changes in the endometrium of the uterus to prepare it for the arrival of a fertilized ovum that will develop there until birth.**

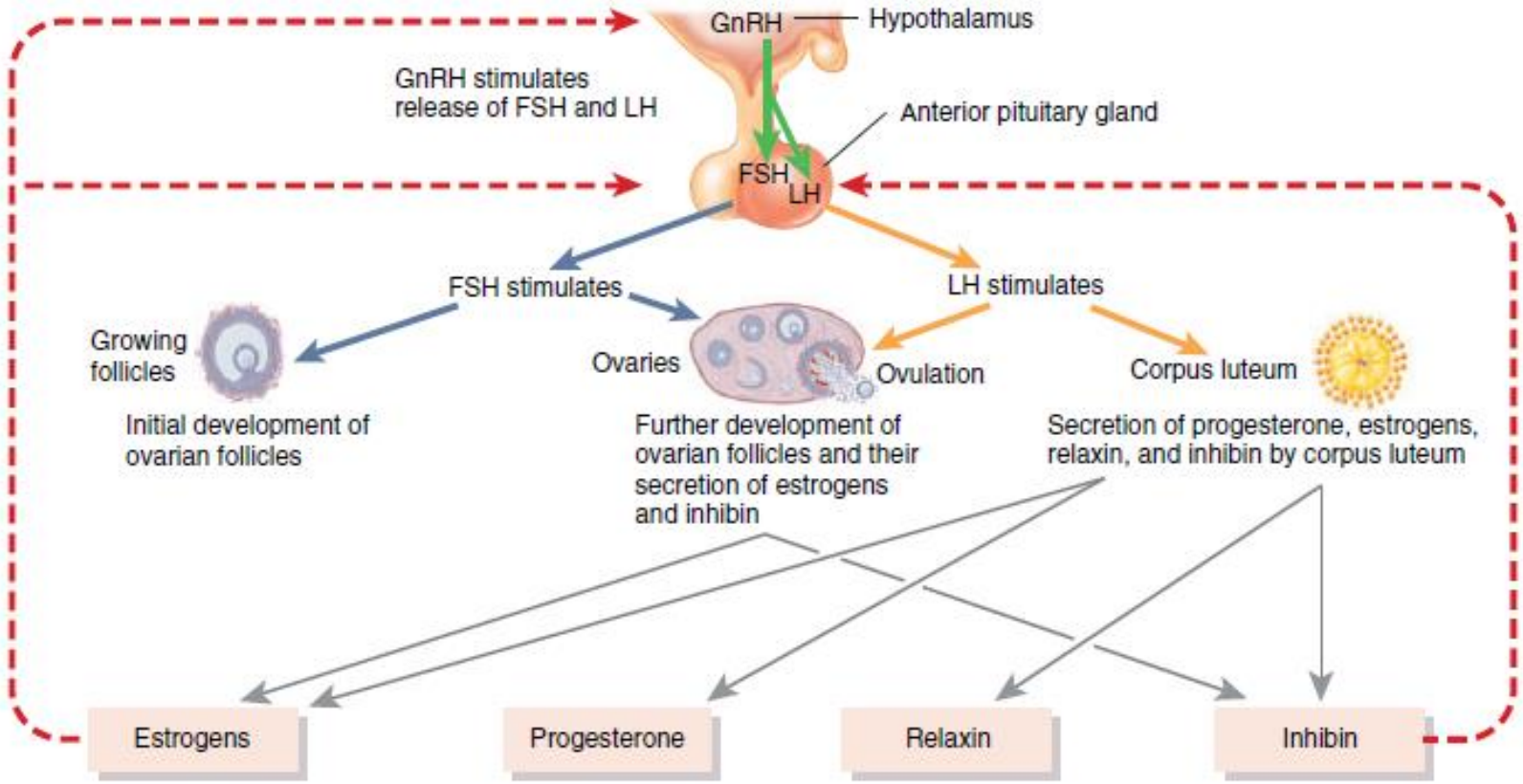
THE FEMALE REPRODUCTIVE CYCLE

- **The general term female reproductive cycle encompasses the ovarian and uterine cycles, the hormonal changes that regulate them, and the related cyclical changes in the breasts and cervix.**

HORMONAL REGULATION OF THE FEMALE REPRODUCTIVE CYCLE

Figure 28.23 **Secretion and physiological effects of estrogens, progesterone, relaxin, and inhibin in the female reproductive cycle.** Dashed red lines indicate negative feedback inhibition.

The uterine and ovarian cycles are controlled by gonadotropin-releasing hormone (GnRH) and ovarian hormones (estrogens and progesterone).



Estrogens

- Promote development and maintenance of female reproductive structures, feminine secondary sex characteristics, and breasts
- Increase protein anabolism
- Lower blood cholesterol
- Moderate levels inhibit release of GnRH, FSH, and LH

Progesterone

- Works with estrogens to prepare endometrium for implantation
- Prepares mammary glands to secrete milk
- Inhibits release of GnRH and LH

Relaxin

- Inhibits contractions of uterine smooth muscle
- During labor, increases flexibility of pubic symphysis and dilates uterine cervix

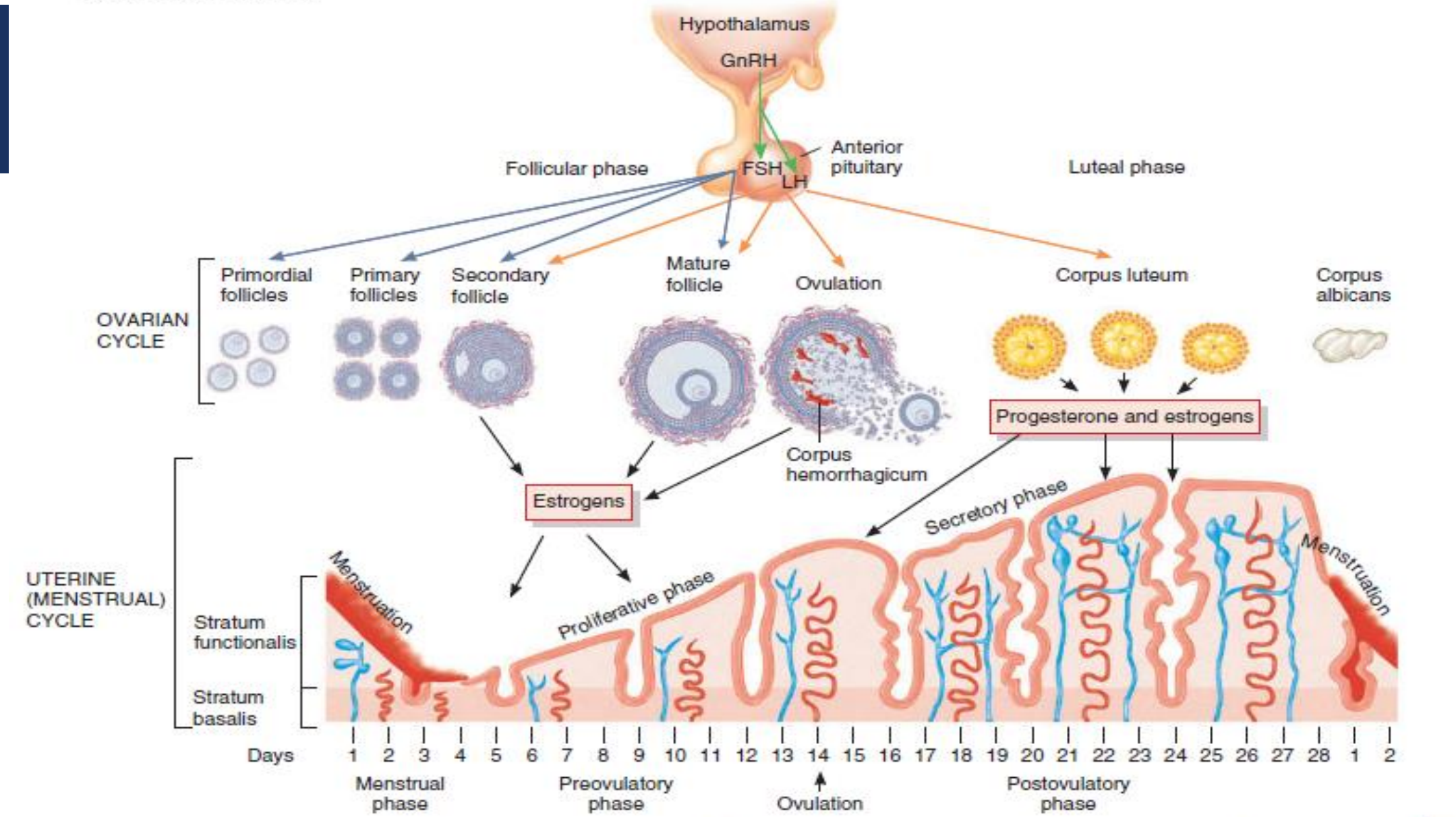
Inhibin

- Inhibits release of FSH and, to a lesser extent, LH

Figure 28.24 **The female reproductive cycle.** The length of the female reproductive cycle typically is 24 to 36 days; the preovulatory phase is more variable in length than the other phases. (a) Events in the ovarian and uterine cycles and the release of anterior pituitary hormones are correlated with the sequence of the cycle's four phases. In the cycle shown, fertilization and implantation have not occurred. (b) Relative concentrations of anterior pituitary hormones (FSH and LH) and ovarian hormones (estrogens and progesterone) during the phases of a normal female reproductive cycle.

Estrogens are the primary ovarian hormones before ovulation; after ovulation, both progesterone and estrogens are secreted by the corpus luteum.

Estrogens are the primary ovarian hormones before ovulation; after ovulation, both progesterone and estrogens are secreted by the corpus luteum.



(a) Hormonal regulation of changes in the ovary and uterus

FIGURE 28.24 CONTINUES

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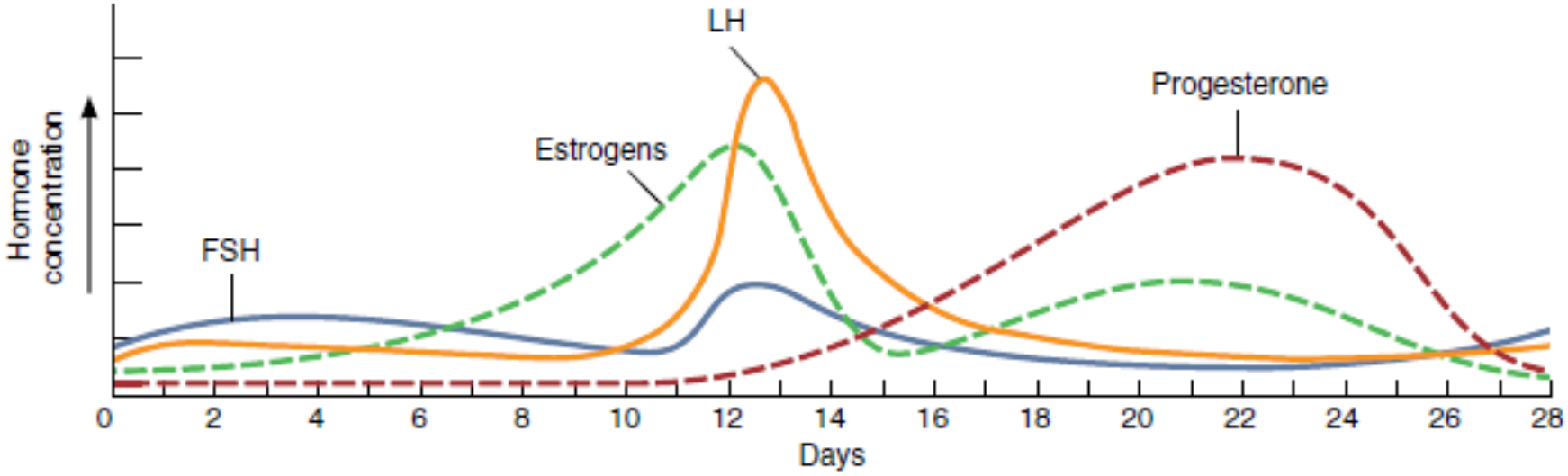


(b) Changes in concentration of anterior pituitary and ovarian hormones

Figure 28.25 **High levels of estrogens exert a positive feedback effect (green arrows) on the hypothalamus and anterior pituitary, thereby increasing secretion of GnRH and LH.**

At midcycle, a surge of LH triggers ovulation.

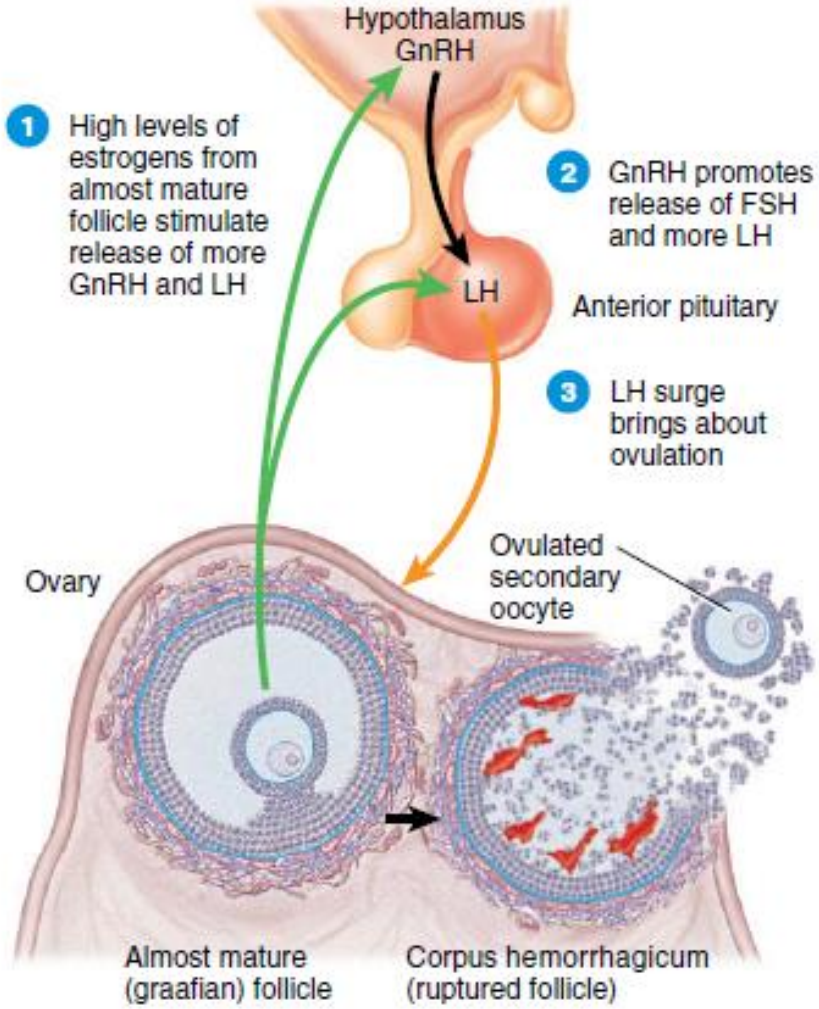
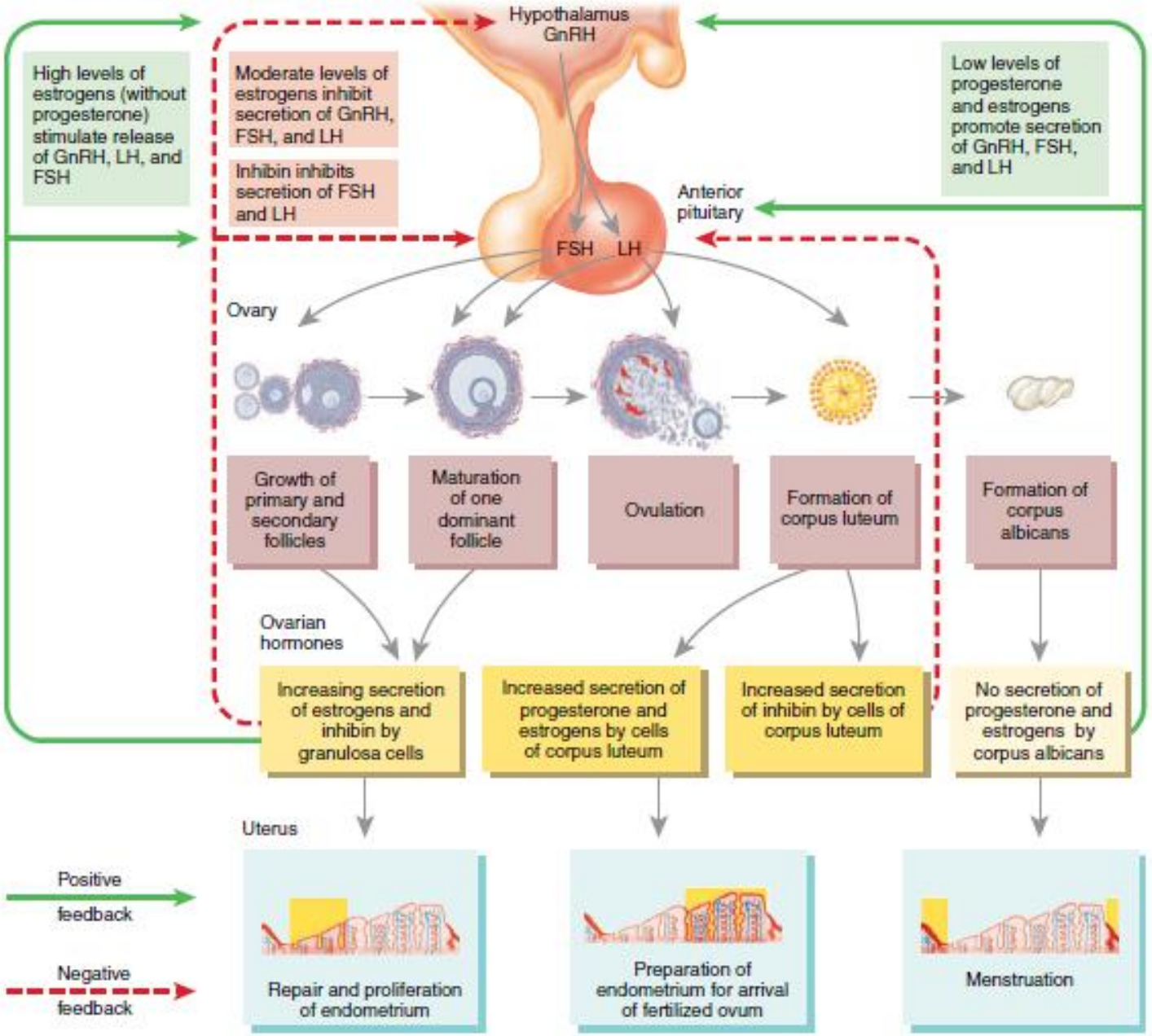


Figure 28.26 **Summary of hormonal interactions in the ovarian and uterine cycles.**

Hormones from the anterior pituitary regulate ovarian function, and hormones from the ovaries regulate the changes in the endometrial lining of the uterus.



FERTILIZATION, IMPLANTATION AND, PHYSIOLOGY OF PREGNANCY AND INFERTILITY

INTRODUCTION.

- Maternal adaptation to provide ideal atmosphere for fertilization, nutrition to growing fetus, safe child birth and to fulfil nutritional needs of newborn.

Fertilization and implantation.

- Transportation of ovum
- Transportation of sperm in female genital tract.
- Sperm capacitation
- Fusion of gamets.
- Activation of ovum.

Transportation of ovum

- **Fertilization** – fusion of male & female gametes.
- **Site** – Middle segment (Ampulla) of fallopian tube.

Transportation of ovum

- **Transport of ovum** – from peritoneal cavity after expulsion enters fallopian tube through fimbria of infundibulum
- **Helped by** – smooth muscles of tube & ciliated epithelium.

Ovum

- **Mature ovum** – consists of Oocyte (23 unpaired chromosomes) surrounded by Zona pellucida & Granulosa cells in multilayer called **Corona Radiata**.

Fate of ovum.

- Held at ampulla isthmic junction for **2-3 days**
- After ovulation ovum viable for 6-24 hrs.
- If fuses with sperm fertilization occurs if not dies and degenerate.

Transportation of sperm in female genital tract.

- Each ejaculate contains 200 million cells.
- Out of these only 50-100 manage to reach ovum
- **Only 1 penetrate.**

Motility of sperms.

- pH of fluid medium
- Cervical mucus secretions
- Fluid currents
- Temperature.
- Hormones.

pH of fluid medium

- **Neutraline & alkaline** – enhances activity.
- But vaginal fluid is **acidic** so immediately after ejaculation sperms become inactive
- Then alkaline semen neutralizes vaginal fluid – sperms becomes active again for next 24 to 40 hrs.

Cervical mucus secretions

- Acts like a mechanical barrier.
- Depend on hormonal levels
- Proliferative phase & near ovulation – more oestrogen – secretions more thin – **allow entry of sperms.**

Fluid currents

- Vaginal & uterine cavity currents are setup by ciliary movements.
- **Direction** – opposite towards externally.
- Opposes movements.

Temperature.

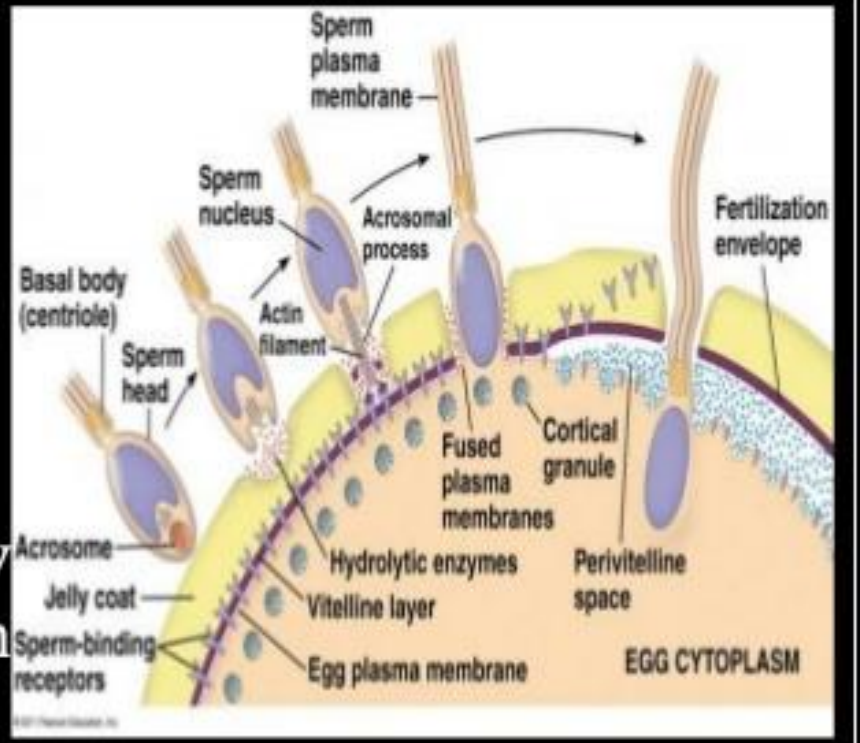
- With increase temperature activity increases but life span decreases.
- Can be stored at -100 ^{0} c for many years.

Hormones.

- **Oxytocin** – release during coitus causes propulsive movements of uterus which aspirate fluid from vagina into fallopian tube.
- **Oestrogen** – make cervical secretions thin and watery so favors transport of sperms.
- **Prostaglandins-** in semen increases female genital tract movements.
- **Progesterone-** in follicular fluid affects sperms motility.

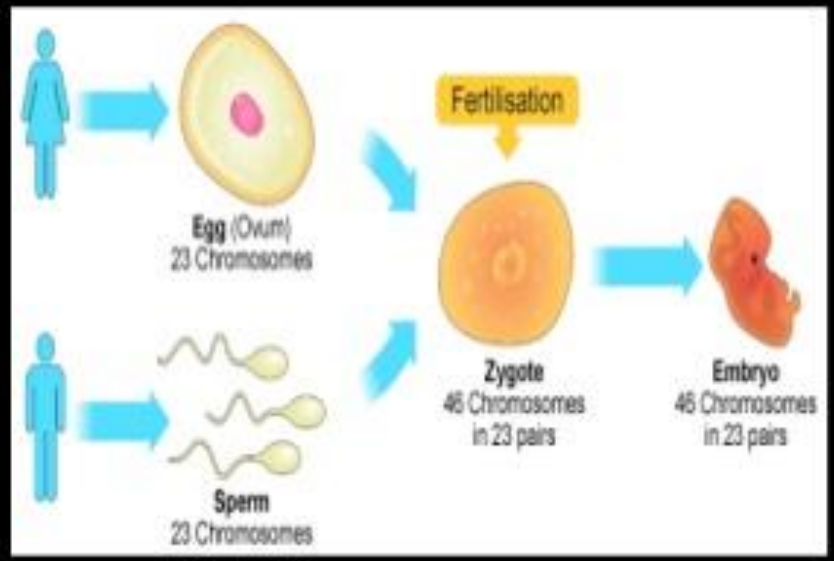
Sperm capacitation

- Process which makes sperms **capable** to fertilize ovum
- Takes 1-10 hrs
- Cholesterol content of **acrosomal** membrane decreases –leads to easy release of enzymes from head.



Fusion of Gametes.

- Chemoattraction –
- Penetration of sperm through ovum coverings.
- Fusion of sperm with oocyte.



Chemoattraction

- By substances produced by ovum.

Penetration of sperm through ovum coverings.

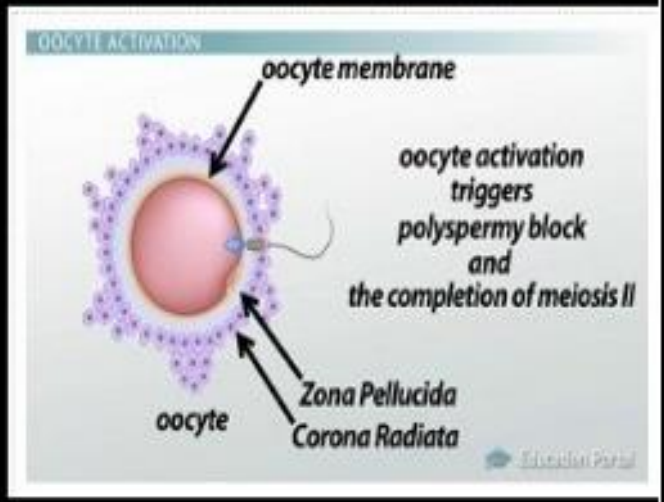
- Through 2 layers.
- **Corona radiata** –
  - Acrosome of sperm head releases Hyaluronidase enzyme & other proteolytic enzyme.
  - **Hyaluronidase enzyme** – polymerizes Hyaluronic acid
  - **Proteolytic enzyme** – digest proteins of structural tissue.

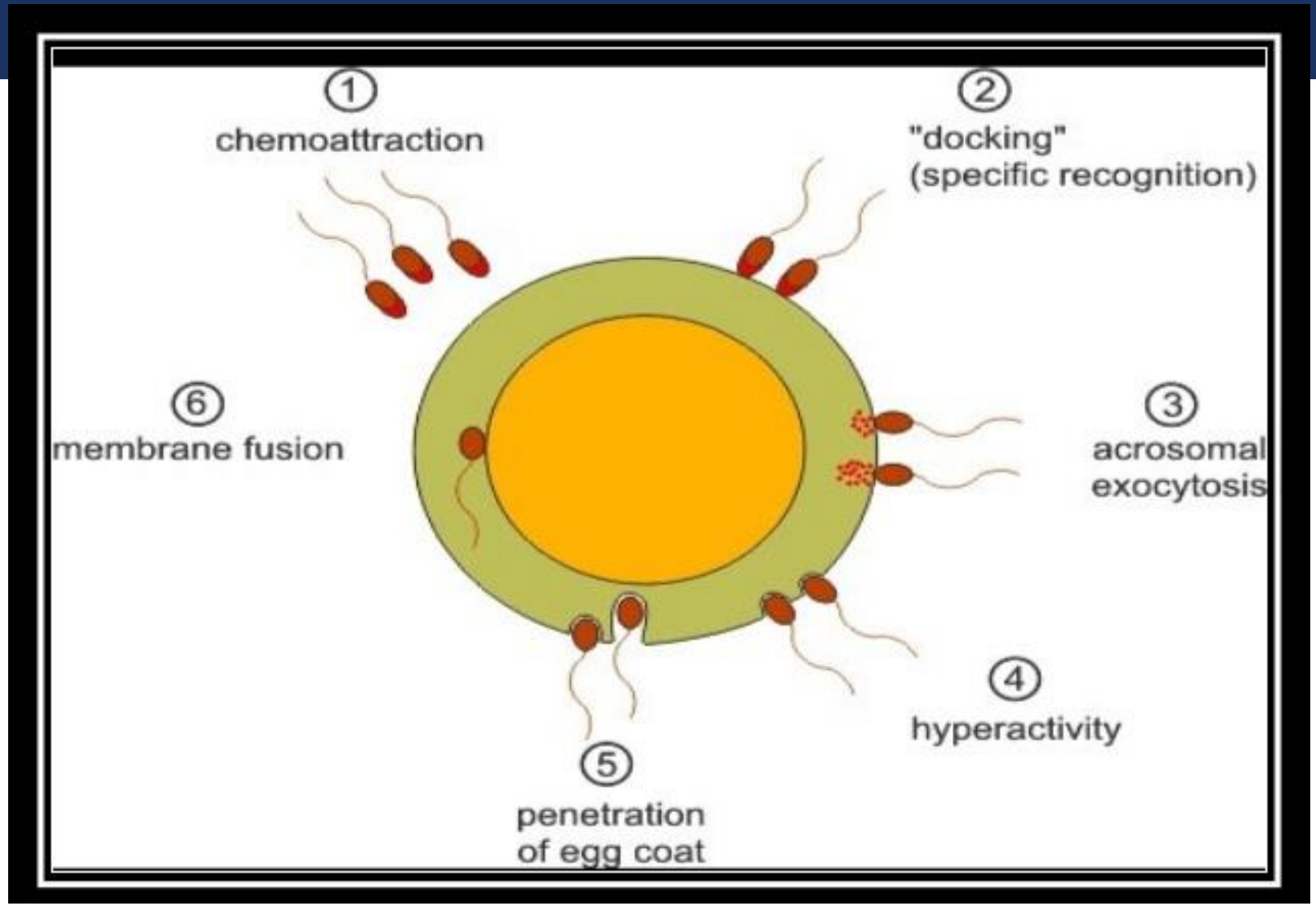
Fusion of sperm with oocyte.

- **Site of contact** - equatorial region of Acrosome.
- **Fertilin** on activated sperms contact with protein on vitelline membrane
- With 30 min membrane fuses-genetic material enters & embryo develops.

Activation of ovum.

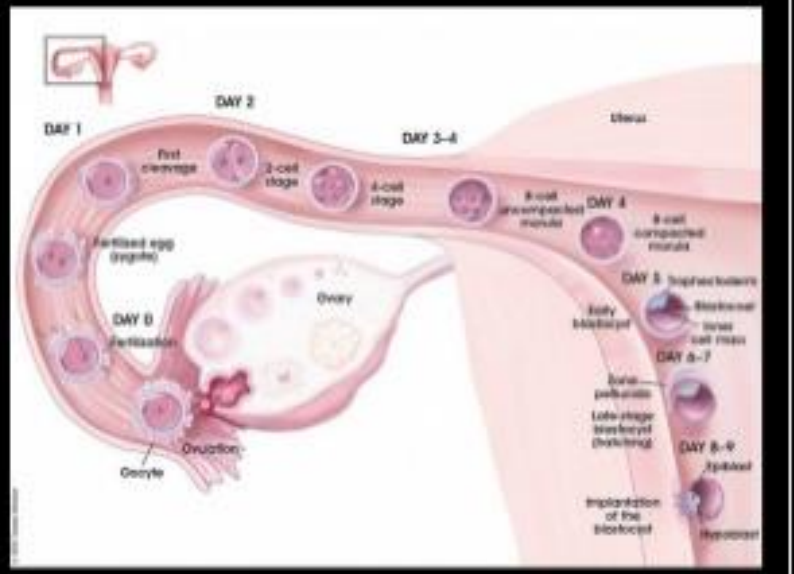
- Membrane potential of ovum decreases – **Zona pellucida** --structural changes
- Release of Ca
- Vitelline block to polyspermy
- Zona blockade to **polyspermy** - by glucosidase & protease.




1
chemoattraction
2
"docking"
(specific recognition)
6
membrane fusion
3
acrosomal
exocytosis
4
hyperactivity
5
penetration
of egg coat

IMPLANTATION.

- Formation of blastocyst
- Transportation of blastocyst in uterine cavity.
- Implantation of blastocyst in the endometrium.
- Decidual reaction.



PHYSIOLOGICAL CHANGES IN MOTHER DURING PREGNANCY

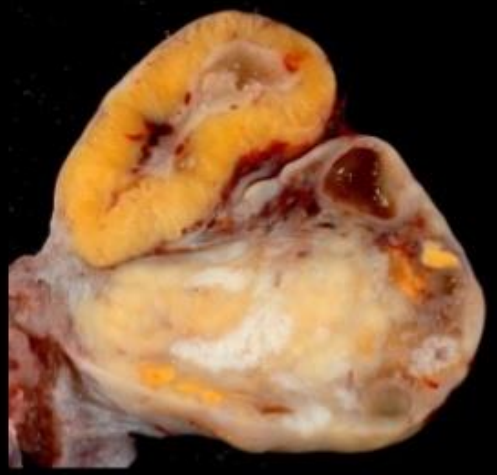
- Changes in genital organ
- Weight gain
- Haematological Changes
- CVS changes
- RS changes
- Urinary system changes
- GIT Changes
- Metabolic changes
- Endocrine changes
- Changes in skin.

Changes in Genital organ

- Uterus
- Ovaries
- Cervix
- Fallopiab tubes
- Mammary glands.

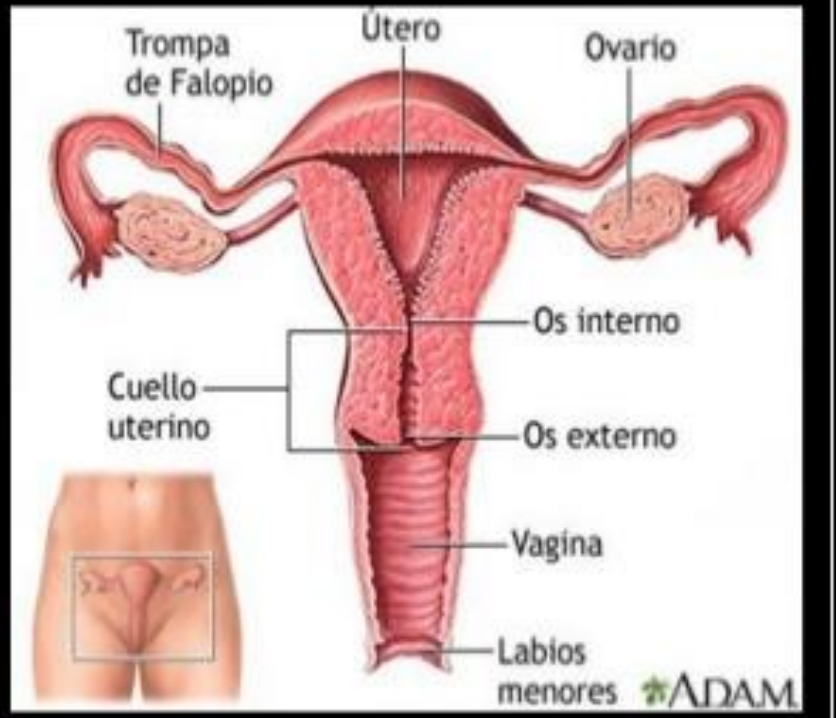
Ovaries

- First **12- 16 weeks** corpus leuteum enlarges
- Then as HCG levels decreases it degenerate
- Its function taken over by placenta.



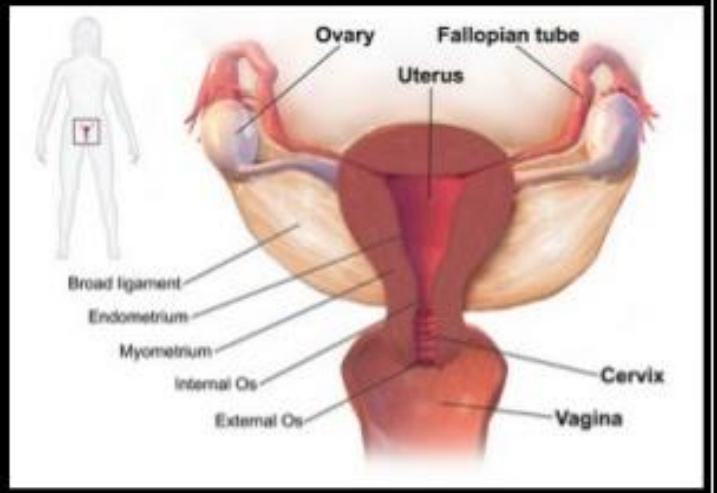
Cervix

- **Endocervix** – hypertrophied
- Cervical gland secretions increases form a plug which closes cervix
- Tough cervix becomes soft.



Fallopian tubes

- Due to enlargement of uterus – pushed upwards
- Blood supply increases
- Causes hyperplasia of epithelial cells.



Mammary glands.

- Hyperplasia of ductal & alveolar tissue
- **Areola** – Pigmented.
- Sebaceous glands becomes prominent in areola
- Nipples become larger & pigmented.

Weight gain

- Total weight gain – 10-12 kg.
- Fetus – 3kg
- Placenta & amniotic fluid – 1.5 kg
- Uterus & breast enlargement – 1.5 kg
- Blood volume & interstitai fluid 1.5 kg
- Fat deposition- 3-4 kg.

Haematological Changes

- Blood volume – ↑30%
- Blood indices - ↓
- Plasma proteins ↓
- Leucocytes ↑
- Platelets ↓
- Coagulation factors ↑
  (VII,VIII,IX & X)

CVS changes

- **Position of heart** – more laterally & upward & LAD
- **Heart rate** – Tachycardia (Hyperdynamic circulation)
- **Cardiac output**. - ⇧ due to blood volume
- **Blood pressure** – both decreases mainly due to vasodilation.
- **Venous pressure** – due to gravid uterus rises causes oedema of feet, varicose veins, piles & peripheral thrombosis.
- **Blood flow** - ⇧ to uterus, kidney & skin.

RS changes

- **Anatomical changes** – Diaphargm elevation
- **Hyperventilation** – progesterone increases sensitivity to CO2 -
- **Ventilatory** functions ↑ TV & IC and ↓ RV & FRC
- Gas exchange ↑ due to ↑ pulmonary blood flow
- Oxygen consumption ↑ by 15%.

Urinary system changes

- Renal blood flow
- Effective renal plasma flow
- GFR
- Renal tubular absorptive capacity
- Clearance rate
- Glycosuria
- Proteinuria
- Water balance
- Acid base balance Hyperventilation causes respiratory alkalosis

GIT Changes

- GIT secretion & motility ⬇
- Gall bladder function ⬆
- Liver function – fibrinogen ⬆ albumin ⬇
- **Morning sickness** – anorexia, nausia & vomiting.
- **GTT** – Diabetic type

Metabolic changes

- **BMR** – ↑
- **Protein** metabolism – nitrogen retention & positive nitrogen balance
- **Carbohydrate** -↑ BSL, glycosuria↓ hepatic glycogen.
- **fat** -↑ in cholesterol, TG, PL
- **Mineral** -↑ Ca & P retention, iron metabolism.

Endocrine changes

- **Pituitary** - ↑ prolactin, ACTH, TSH & ↓ GnRH
- **Thyroid** - ↑ thyroid binding globulin.
- **Parathyroid** ↑ active form of Vit D3
- **Adrenal cortex** - ↑ all
- **Pancreas** - ↑ Insulin.

PSYCHOLOGICAL CHANGES

- Craving for particular food
- Alterartion in behaviour, emotion & mood
- In some cases true Psychosis.

INFERTILITY : DEFINITIONS

- **Infertility: Failure to achieve a live birth over a 12-month period of unprotected intercourse.**
- **Primary infertility: Never having had a live birth.**
- **Secondary infertility: Failure to achieve a live birth after having had a live birth previously.**

INFERTILITY: CAUSES

- **Non-preventable: Anatomical, genetic, hormonal or immunological problems;**
  - **Do not vary much across countries/ within countries.**
  - **Account for a core of 5% of infertile couples.**

- **Preventable: Responsible for observed variations across/ within countries**

PREVENTABLE CAUSES

- **Infections:**
  - **Sexually transmitted diseases: Chlamydia, Gonorrhea, syphilis etc.**
  - **Infectious and parasitic diseases: Tuberculosis, schistosomiasis, Malaria, sickle cell disease.**

- **Health care practices and policies:**

  - Unhygienic obstetric practices.
  - Septic abortion and their complications.
  - Postpartum and postabortal complications.

PREVENTABLE CAUSES

- **Exposure to potentially toxic substances in:**

  - **Environment: Arsenic, aflatoxins, pesticides.**
  - **Diet: Caffeine, tobacco, alcohol.**

CULTURAL AND SOCIAL FACTORS

- **Female genital Mutilation.**
- **Early age at marriage or sexual intercourse.**
- **Multiple sexual partners.**

INFERTILITY : TREATMENT AND MANAGEMENT

- **Treatment :** A costly and less effective process.
- **Prevention:** More effective, less expensive.

TREATING INFERTILITY: PROGRAMMATIC STRATEGIES FOR DEVELOPING COUNTRIES

- **Advising about timing of intercourse and other behaviors - smoking and alcohol.**
- **Helping couples to cope with social and psychological burdens of infertility.**
- **Helping couples to consider non-medical options such as adoption.**

TREATING INFERTILITY: OTHER OPTIONS

- **Surgical techniques: Repairing tubalscarring, correcting other abnormalities of reproductive organs.**
- **Artificial insemination: Using husband's or donor's semen.**
- **In vitro fertilization techniques: Recovering mature ova, fertilizing them in lab, and then re-implantingin uterus**

THANK YOU

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