

The Reproductive System

PowerPoint® Lecture Slide Presentation by Jerry L. Cook, Sam Houston University



ESSENTIALS OF HUMAN ANATOMY & PHYSIOLOGY

EIGHTH EDITION

ELAINE N. MARIEB

The Reproductive System

- Gonads – primary sex organs
 - Testes in males
 - Ovaries in females
- Gonads produce gametes (sex cells) through meiosis and secrete hormones
 - Sperm – male gametes (XY) - testosterone
 - Ova (eggs) – female gametes (XX) - estrogen

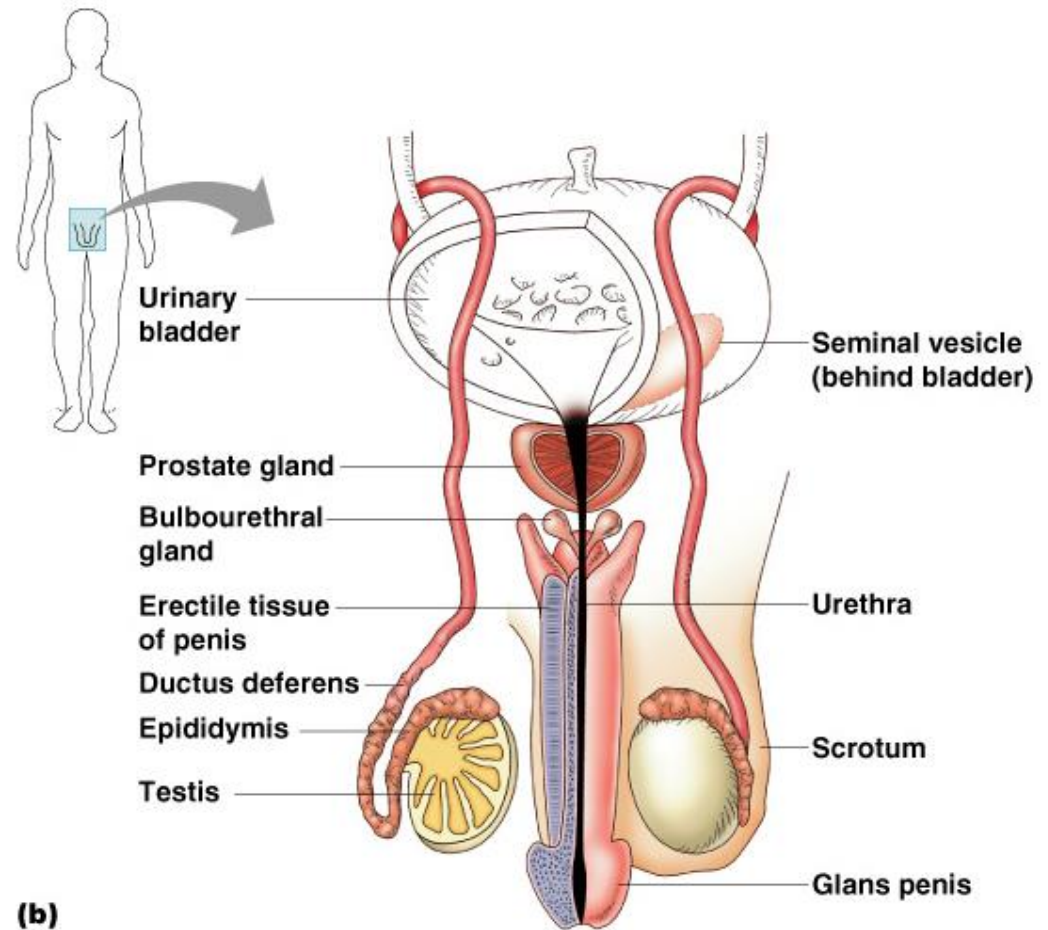
Male Reproductive System

■ Testes

- 4 x 2 x 2.5cm
- 3°C lower T
- Location based on T

■ Duct system

- Epididymis
- Ductus deferens (vas deferens)
- Urethra



**PRESS
TO PLAY**

MALE REPRODUCTIVE SYSTEM OVERVIEW ANIMATION

Figure 16.2b

Male Reproductive System

- Accessory organs
 - Seminal vesicle
 - Prostate gland
 - Bulbourethral gland/Cowper's gland
- External genitalia
 - Penis
 - Scrotum

Male Reproductive System

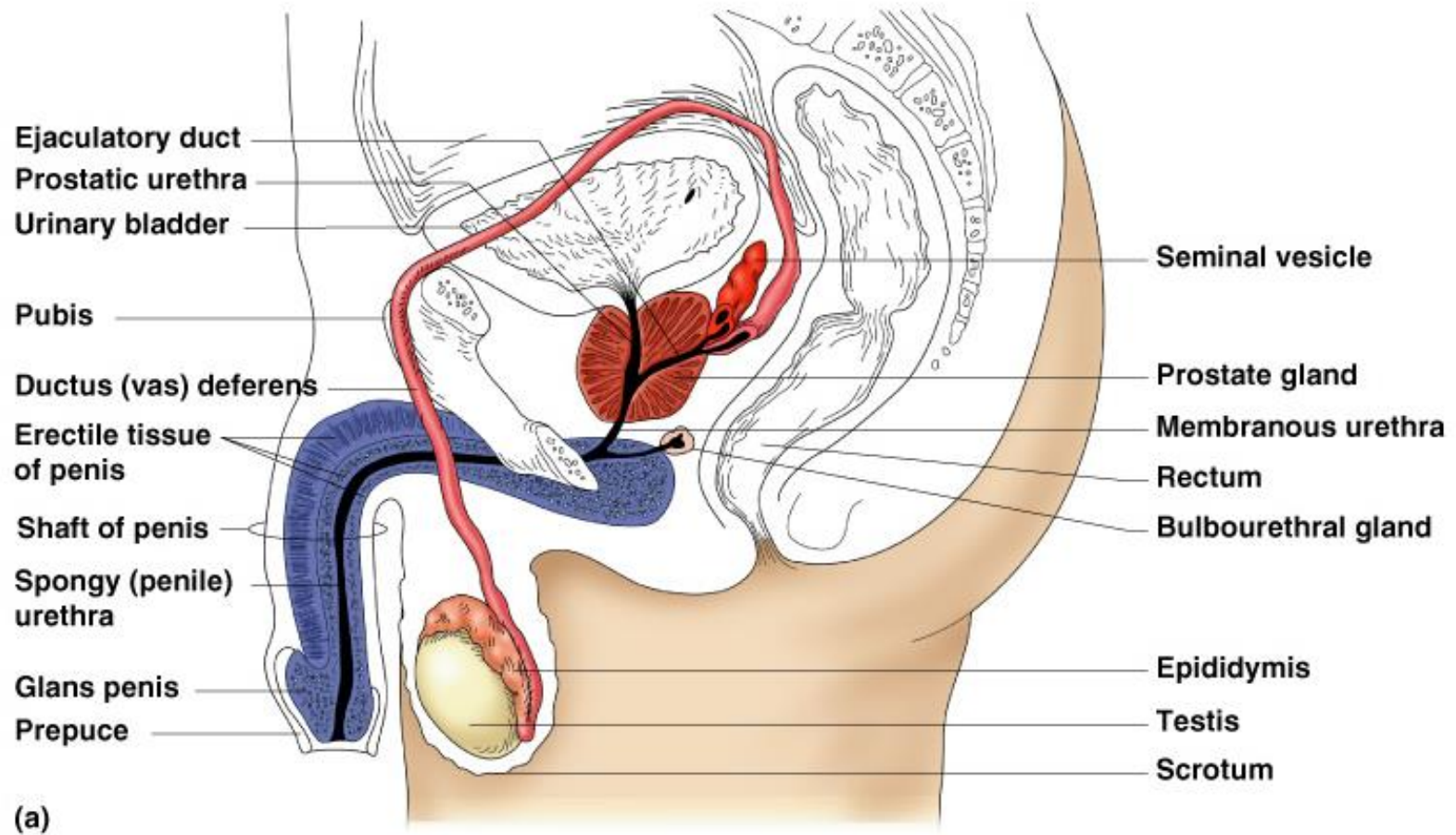


Figure 16.2a

Testes

- Coverings of the testes
 - Tunica albuginea – capsule that surrounds each testis

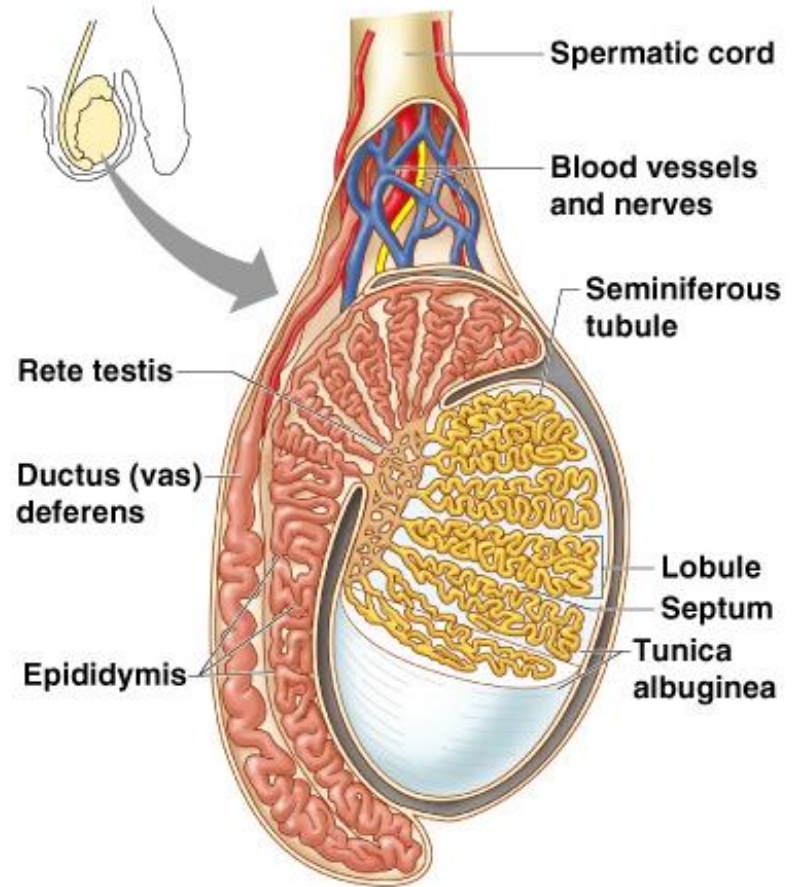


Figure 16.1

Testes

- Coverings of the testes (continued)
 - Septa – extensions of the capsule that extend into the testis and divide it into lobules

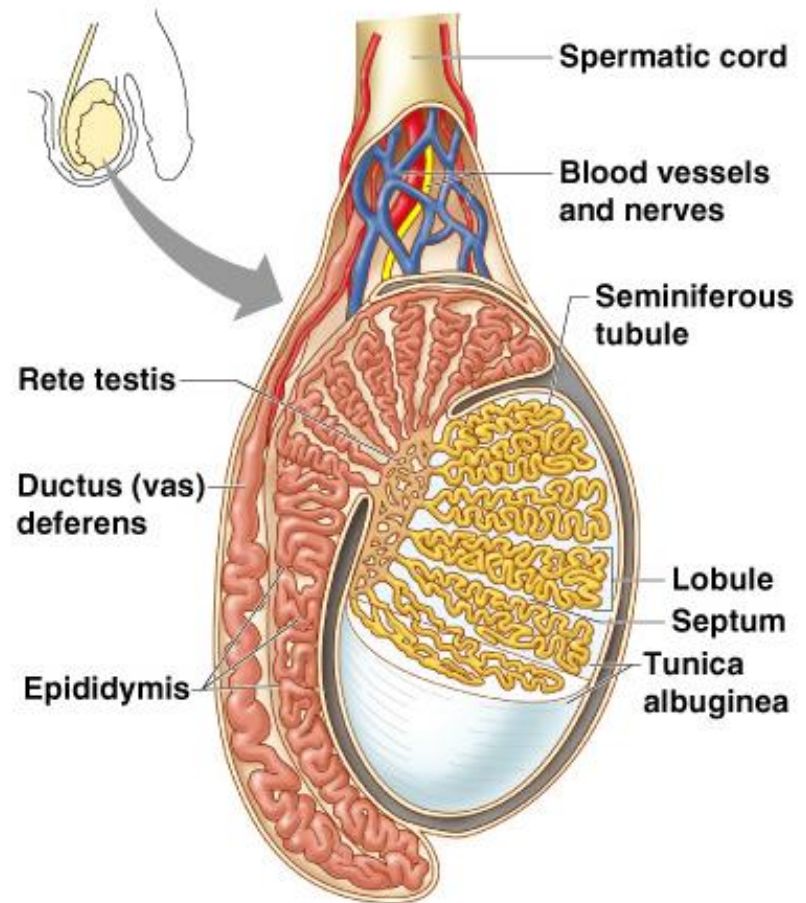


Figure 16.1

Testes

- Each lobule contains one to four seminiferous tubules (total of 72 days)
 - Tightly coiled structures
 - Function as sperm-forming factories (FSH stimulates production)
 - Empty sperm into the rete testis
 - Sperm travels through the rete testis to the epididymis
- Interstitial cells produce androgens such as testosterone

Epididymis

- Comma-shaped, tightly coiled tube, approx. 6 m long
- Found on the superior part of the testis and along the posterior lateral side
- Functions to mature and store sperm cells (at least 20 days)
- Expels sperm with the contraction of muscles in the epididymis walls to the vas deferens

Ductus Deferens (Vas Deferens)

- Carries sperm from the epididymis to the ejaculatory duct (approx. 45 cm)
- Passes through the inguinal canal and over the bladder
- Moves sperm by peristalsis
- Spermatic cord – ductus deferens, blood vessels, and nerves in a connective tissue sheath

Ductus Deferens (Vas Deferens)

- Ends in the ejaculatory duct which unites with the urethra
- Vasectomy – cutting of the ductus deferens at the level of the testes to prevent transportation of sperm

Urethra

- Extends from the base of the urinary bladder to the tip of the penis
- Carries both urine and sperm
- Sperm enters from the ejaculatory duct

Urethra

- Regions of the urethra
 - Prostatic urethra –surrounded by prostate
 - Membranous urethra – from prostatic urethra to penis
 - Spongy (penile) urethra – runs the length of the penis

Seminal Vesicles

- Located at the base of the bladder
- Size and shape of finger
- Produces a thick, yellowish, alkaline secretion (60% of semen)
 - Fructose (sugar)
 - Vitamin C
 - Prostaglandins
 - Other substances that nourish and activate sperm

Prostate Gland

- Encircles the upper part of the urethra
- Size of a chestnut
- Secretes a milky fluid (approx. 1/3 of semen)
 - Alkaline
 - Helps to activate sperm – enzymes (odor)
 - Enters the urethra through several small ducts

Bulbourethral Glands

- Pea-sized gland inferior to the prostate
- Produces a thick, clear mucus
 - Cleanses the urethra of acidic urine
 - Serves as a lubricant during sexual intercourse
 - Secreted into the penile urethra

Semen

- Mixture of sperm and accessory gland secretions
- 2-6 mL; contains 50-100 million sperm/mL
- Advantages of accessory gland secretions
 - Fructose provides energy for sperm cells
 - Alkalinity of semen helps neutralize the acidic environment of vagina
 - Semen inhibits bacterial multiplication
 - Elements of semen enhance sperm motility

External Genitalia

- Scrotum
 - Divided sac of skin outside the abdomen
 - Maintains testes at 3°C lower than normal body temperature to protect sperm viability

External Genitalia

- Penis – copulatory organ
 - Delivers sperm into the female reproductive tract
 - Regions of the penis
 - Shaft
 - Glans penis (enlarged tip)
 - Prepuce (foreskin)
 - Folded cuff of skin around proximal end
 - Often removed by circumcision

External Genitalia

- Internally there are three areas of spongy erectile tissue around the urethra
- Erection – engorgement with blood
 - Prohibits venous return
- Ejaculation – orgasm with muscular contractions releasing semen

Spermatogenesis

- Production of sperm cells
- Begins at puberty and continues throughout life
- Occurs in the seminiferous tubules

Processes of Spermatogenesis

- Spermatogonia (stem cells) undergo rapid mitosis to produce more stem cells before puberty
- Follicle stimulating hormone (FSH) modifies spermatogonia division
 - One cell produced is a stem cell
 - The other cell produced becomes a primary spermatocyte

Processes of Spermatogenesis

- Primary spermatocytes undergo meiosis
- Haploid spermatids are produced

Processes of Spermatogenesis

- Spermiogenesis
 - Late spermatids are produced with distinct regions
 - Head – contains DNA covered by the acrosome
 - Midpiece
 - Tail
 - Sperm cells result after maturing of spermatids
- Spermatogenesis takes 64 to 72 days

Processes of Spermatogenesis

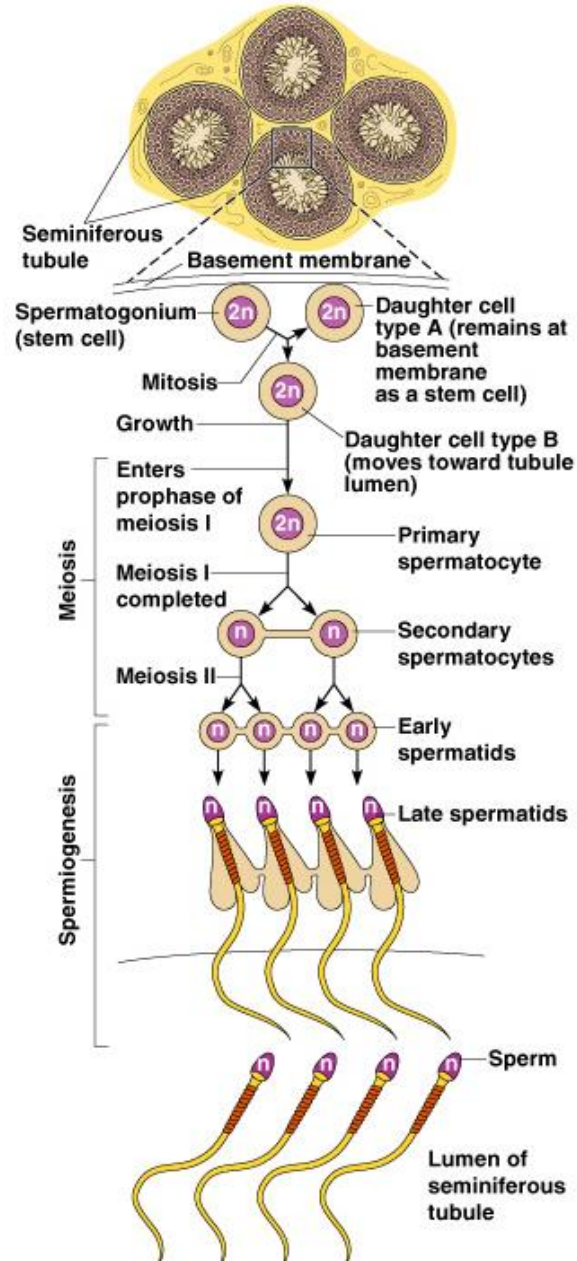


Figure 16.3

Anatomy of a Mature Sperm Cell

- The only human flagellated cell
- DNA is found in the head

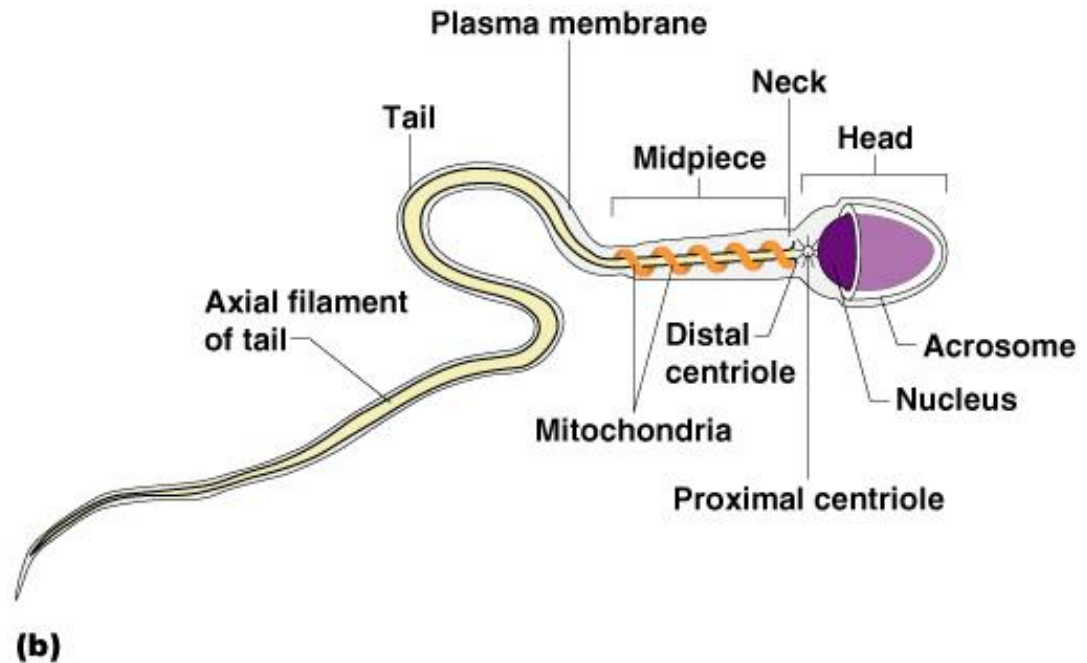


Figure 16.5b

Testosterone Production

- The most important hormone of the testes
- Produced in interstitial cells

Testosterone Production

- Functions of testosterone
 - Stimulates reproductive organ development
 - Underlies sex drive
 - Causes secondary sex characteristics
 - Deepening of voice
 - Increased hair growth
 - Enlargement of skeletal muscles
 - Thickening of bones

Regulation of Male Androgens (Sex Hormones)

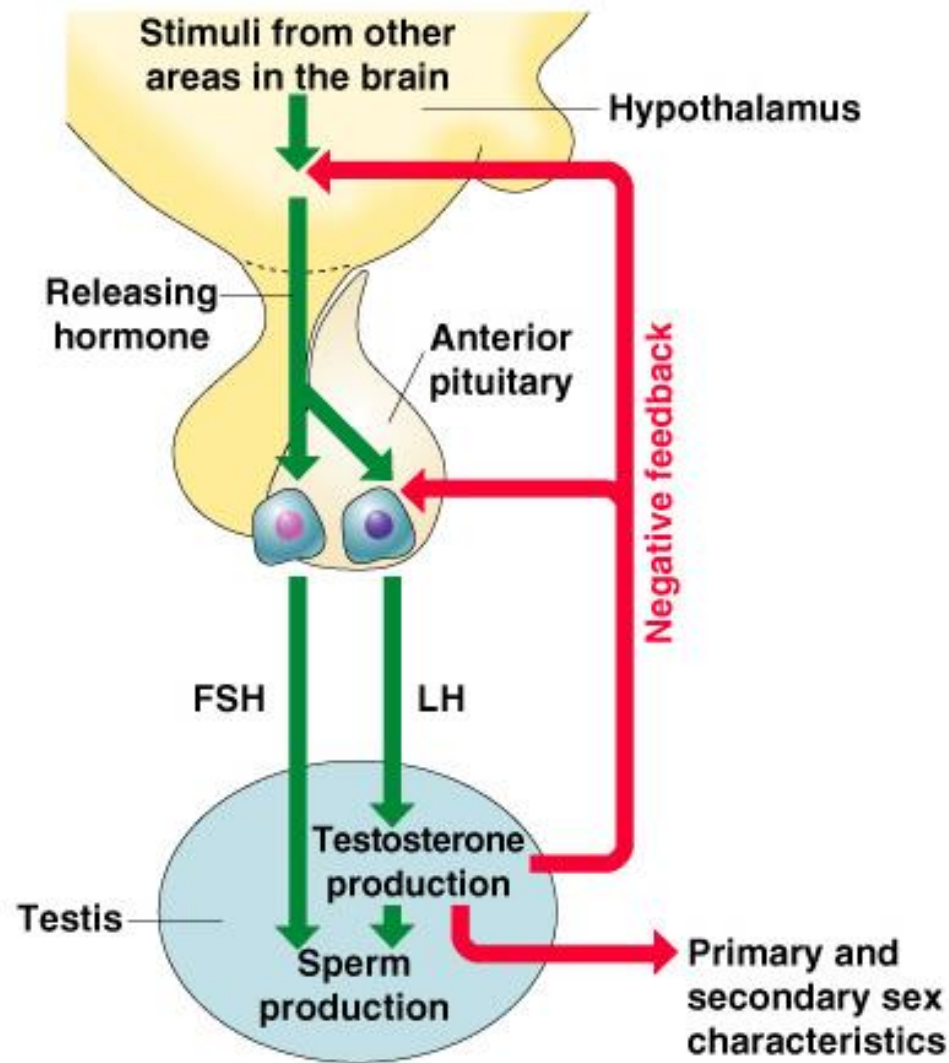


Figure 16.6

The Reproductive System

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Female Reproductive System

- Ovaries
- Duct System
 - Uterine tubes (fallopian tubes)
 - Uterus
 - Vagina
- External genitalia



FEMALE REPRODUCTIVE SYSTEM OVERVIEW ANIMATION

Female Reproductive System

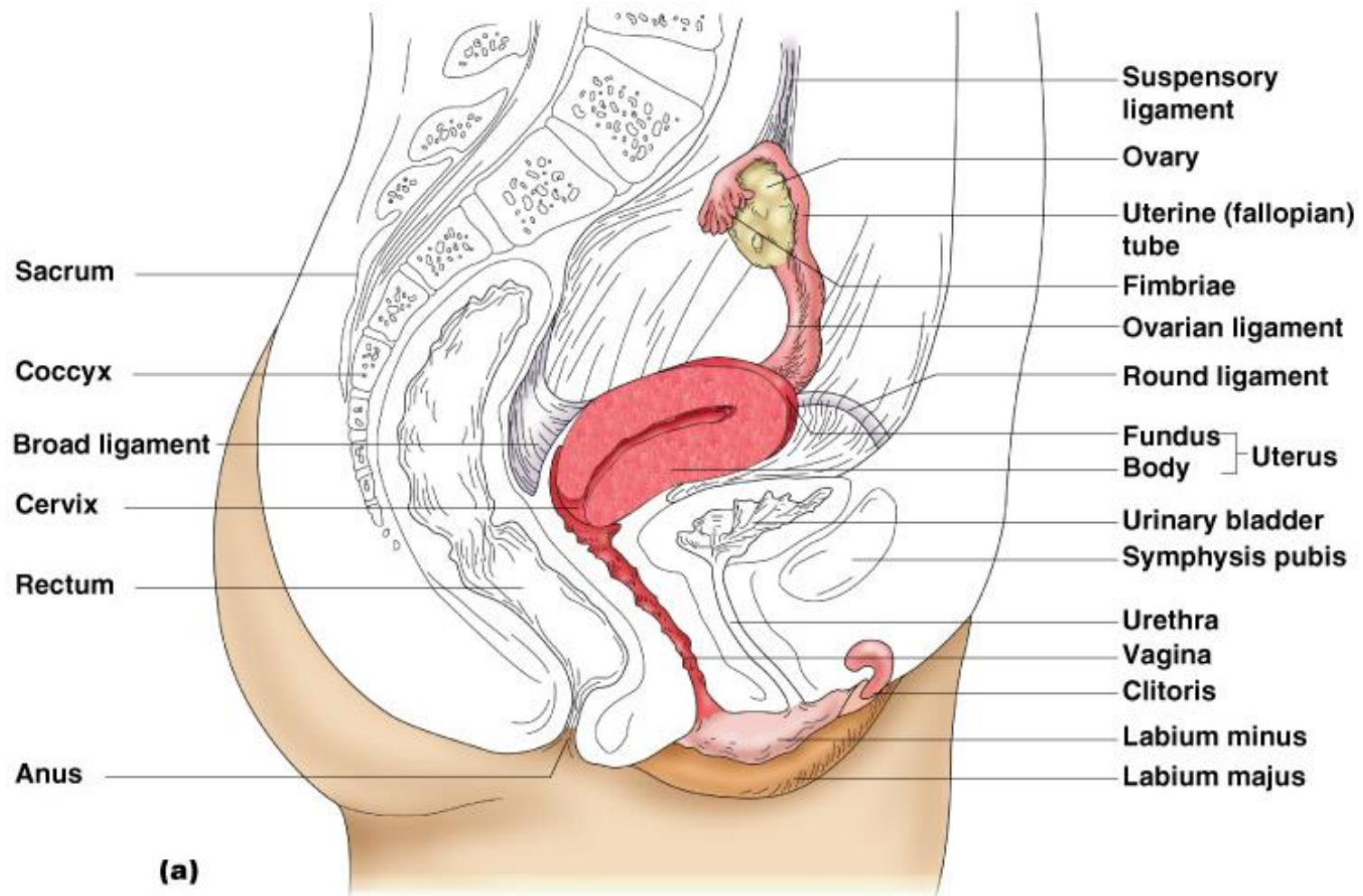


Figure 16.8a

Ovaries

- Composed of ovarian follicles (sac-like structures)
- 3 x 1.5-3 cm
- Structure of an ovarian follicle
 - Oocyte
 - Follicular cells
- Produce estrogen & progesterone

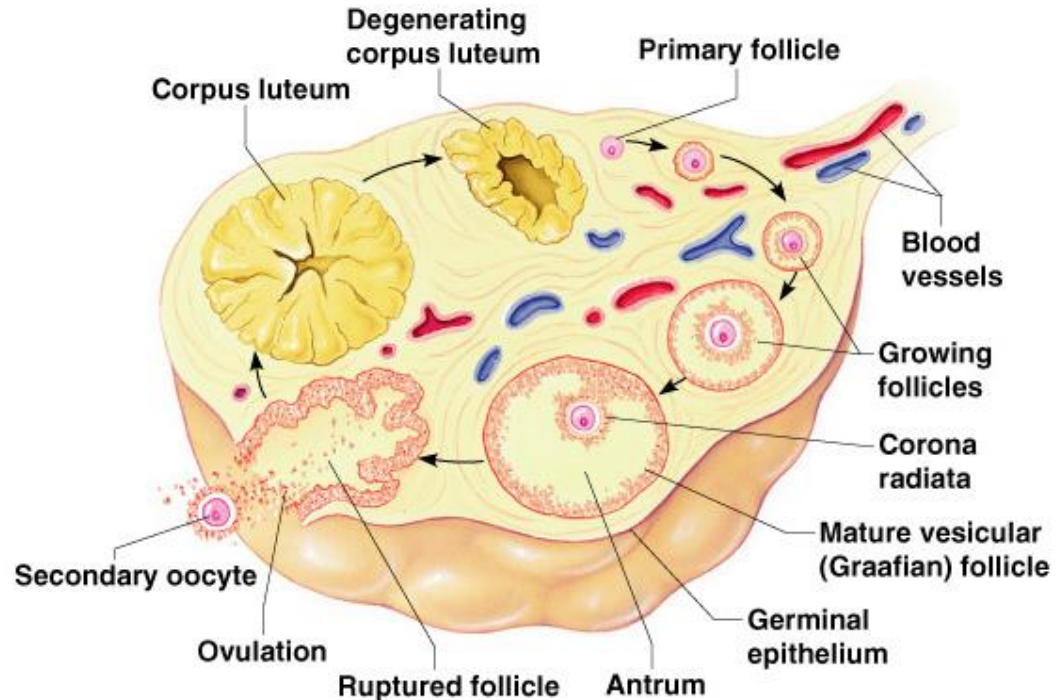


Figure 16.7

Ovarian Follicle Stages

- Primary follicle – contains an immature oocyte
- Graafian (vesicular) follicle – growing follicle with a maturing oocyte (secretes estrogen)
- Ovulation – when the egg is mature the follicle ruptures
 - Occurs about every 28 days – 14 days before menstruation
- The ruptured follicle is transformed into a corpus luteum (secretes progesterone)
 - Maintains uterine lining

Support for Ovaries

- Suspensory ligaments – secure ovary to lateral walls of the pelvis
- Ovarian ligaments – attach to uterus
- Broad ligament – a fold of the peritoneum, encloses suspensory ligament

Support for Ovaries

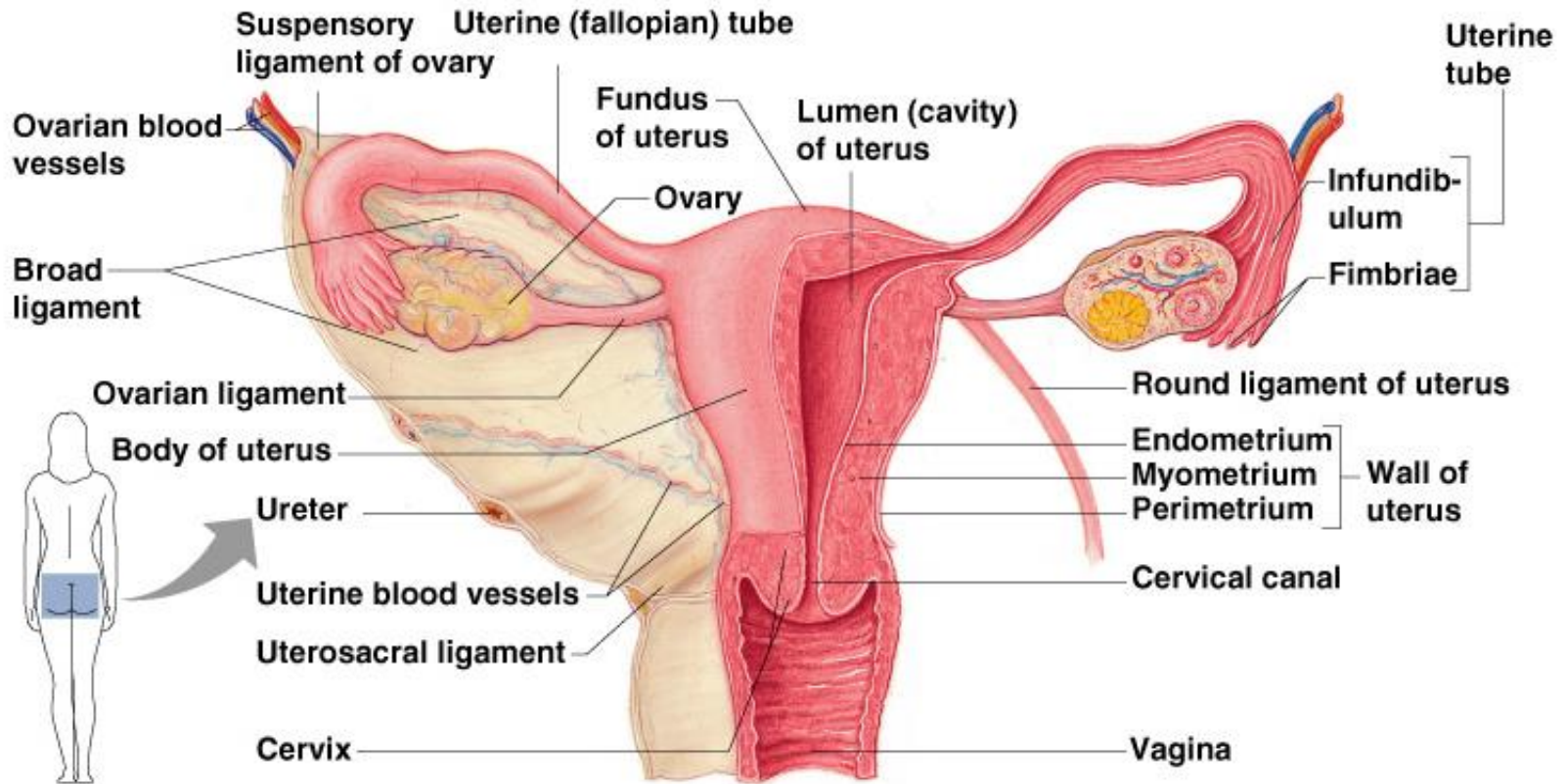


Figure 16.8b

Fallopian Tubes (Oviducts)

- 10 cm long, smooth muscle, ciliated, mucus lined
- Receive the ovulated oocyte
- Provide a site for fertilization
- Attaches to the uterus
- Does not physically attach to the ovary
- Supported by the broad ligament

Uterine Tube Function

- Fimbriae – finger-like projections at the distal end that receive the oocyte
- Cilia inside the uterine tube slowly move the oocyte towards the uterus (takes 3–4 days)
- Fertilization occurs in the infundibulum

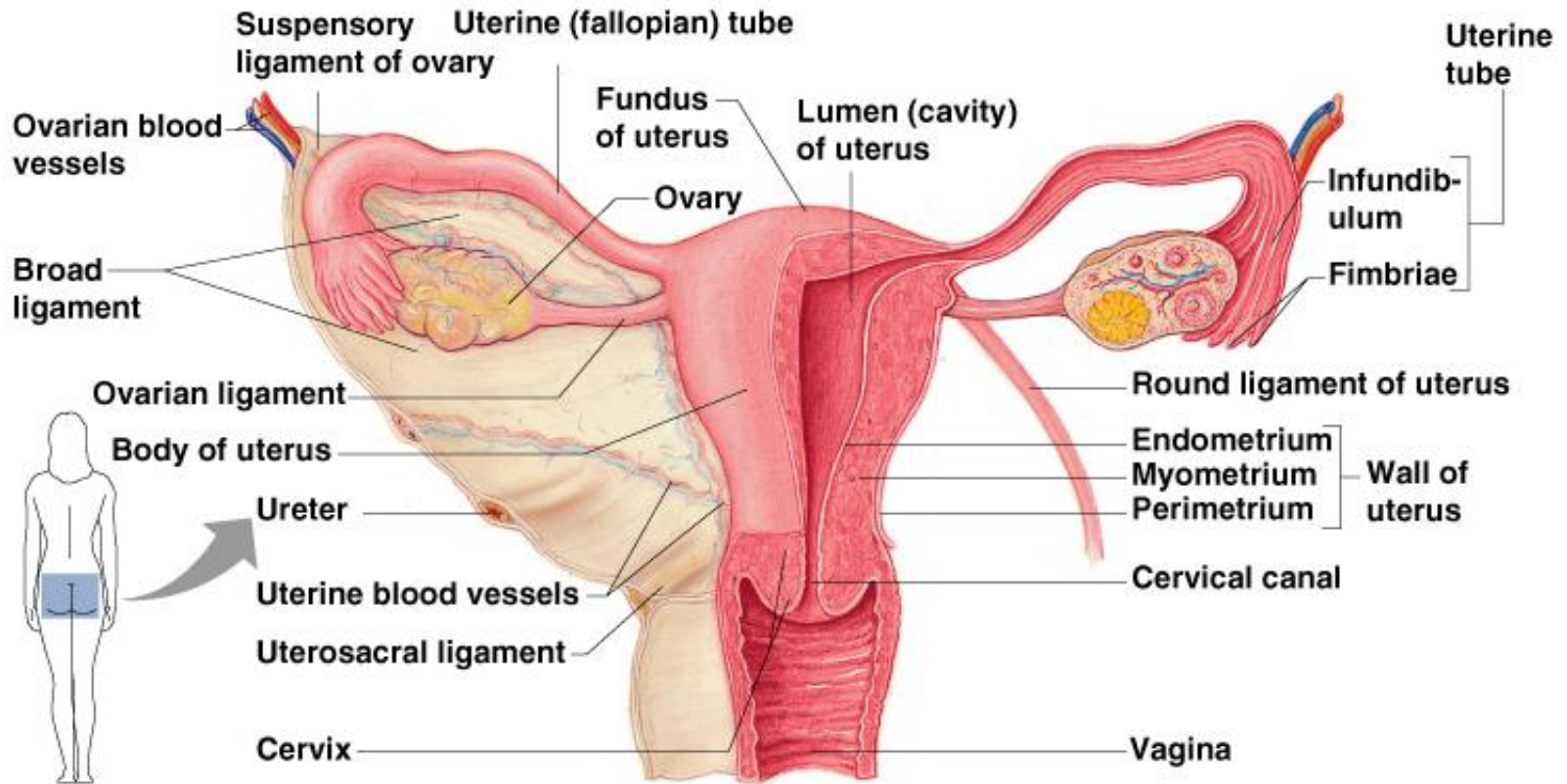
Uterus

- Located between the urinary bladder and rectum
- Hollow, thick-walled, pear-shaped, muscular organ
 - Non-gravid = 7.5 x 5 x 2.75 cm
- Functions of the uterus
 - Receives a fertilized egg
 - Retains the fertilized egg
 - Nourishes the fertilized egg

Support for the Uterus

- Broad ligament – attached to the pelvis
- Round ligament – anchored anteriorly
- Uterosacral ligaments – anchored posteriorly

Support for the Uterus



(b)

Figure 16.8b

Regions of the Uterus

- Body – main portion
- Fundus – area where uterine tube enters
- Cervix – narrow outlet that protrudes into the vagina

Walls of the Uterus

- Endometrium
 - Inner mucous layer
 - Allows for implantation of a fertilized egg
 - Sloughs off if no pregnancy occurs (menses)
- Myometrium – thick middle layer of smooth muscle
- Perimetrium – outer serous layer (visceral peritoneum)

Vagina

- Extends from cervix to exterior of body (vulva)
- Behind bladder and in front of rectum
- Serves as the birth canal
- Receives the penis during sexual intercourse
- Hymen – partially closes the vagina until it is ruptured

External Genitalia (Vulva)

- Mons pubis
 - Fatty area overlying the pubic symphysis
 - Covered with pubic hair after puberty

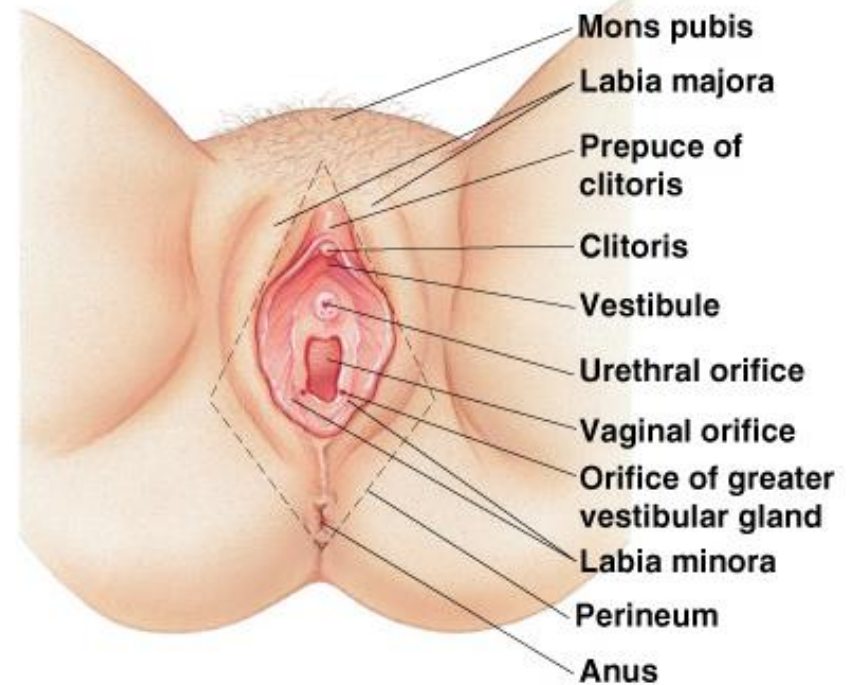


Figure 16.9

External Genitalia (Vulva)

- Labia – skin folds
 - Labia majora
 - Labia minora

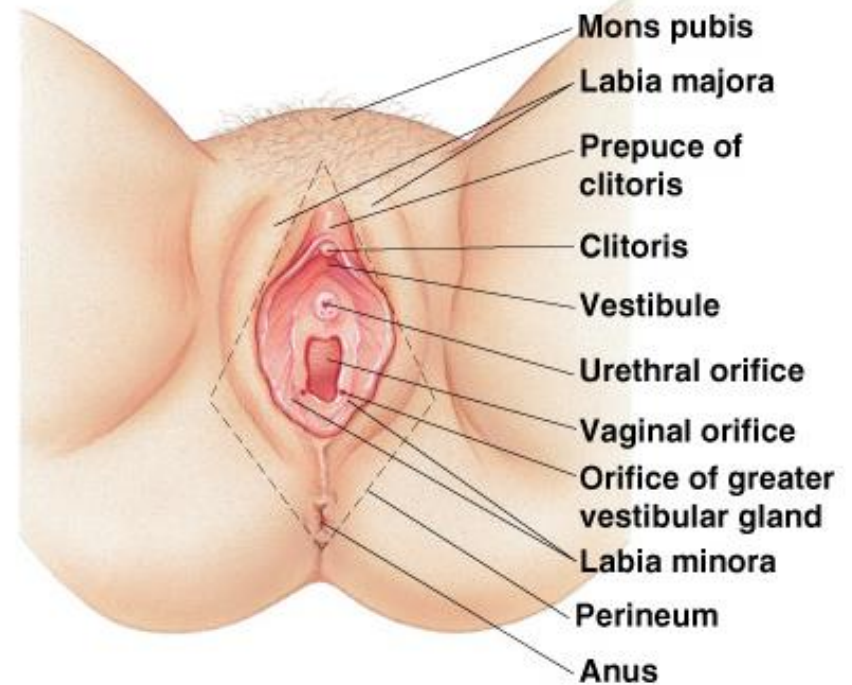


Figure 16.9

External Genitalia

- Vestibule
 - Enclosed by labia majora
 - Contains opening of the urethra and the greater vestibular glands (produce mucus)
- Clitoris
 - Contains erectile tissue
 - Corresponds to the male penis
- Bartholin's gland – secretes mucous at opening of vagina
- Perineum – area between vagina and rectum
 - Episiotomy – incision to facilitate birth

Oogenesis

- The total supply of eggs are present at birth
- Ability to release eggs begins at puberty
- Reproductive ability ends at menopause
- Oocytes are matured in developing ovarian follicles

Oogenesis

- Oogonia – female stem cells found in a developing fetus
- Oogonia undergo mitosis to produce primary oocytes
- Primary oocytes are surrounded by cells that form primary follicles in the ovary
- Oogonia no longer exist by the time of birth

Oogenesis

- Primary oocytes are inactive until puberty
- Follicle stimulating hormone (FSH) causes some primary follicles to mature
 - Meiosis starts inside maturing follicle
 - Produces a secondary oocyte and the first polar body
 - Meiosis is completed after ovulation only if sperm penetrates
 - Two additional polar bodies are produced

Oogenesis

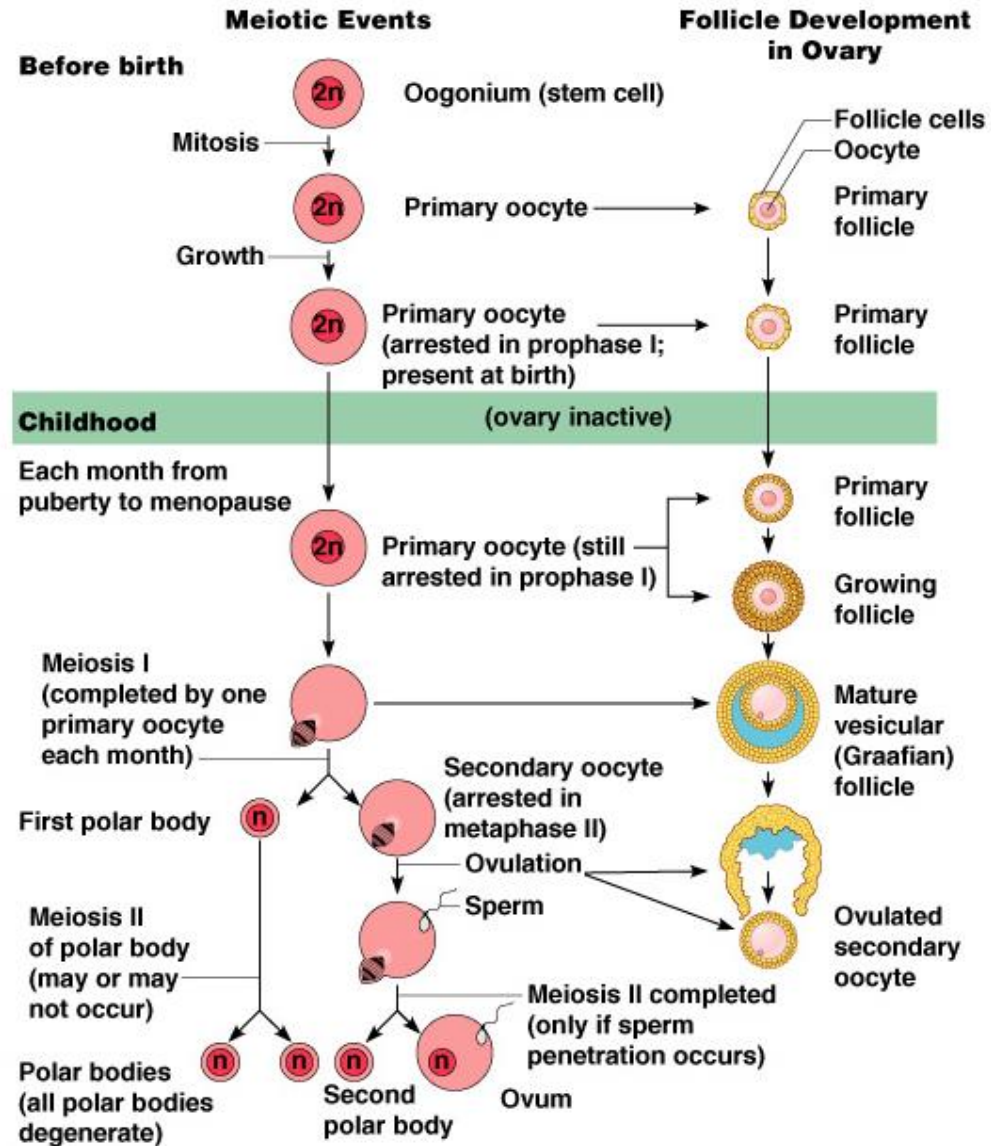


Figure 16.10

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Menstrual (Uterine) Cycle

- Cyclic changes of the endometrium
- Regulated by cyclic production of estrogens and progesterone
- Stages of the menstrual cycle
 - Menses – functional layer of the endometrium is sloughed
 - Proliferative stage – regeneration of functional layer
 - Secretory stage – endometrium increases in size and readies for implantation

Hormonal Control of the Ovarian and Uterine Cycles

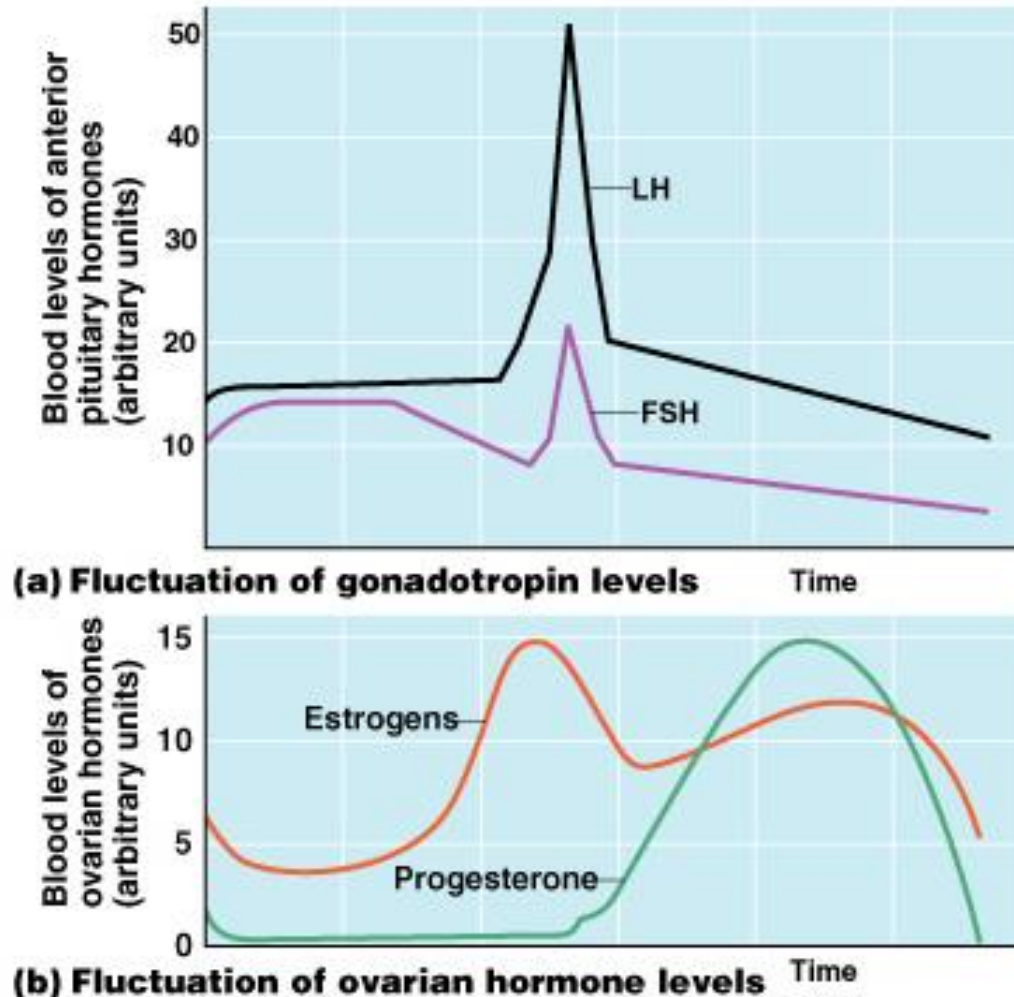


Figure 16.12a, b

Hormonal Control of the Ovarian and Uterine Cycles

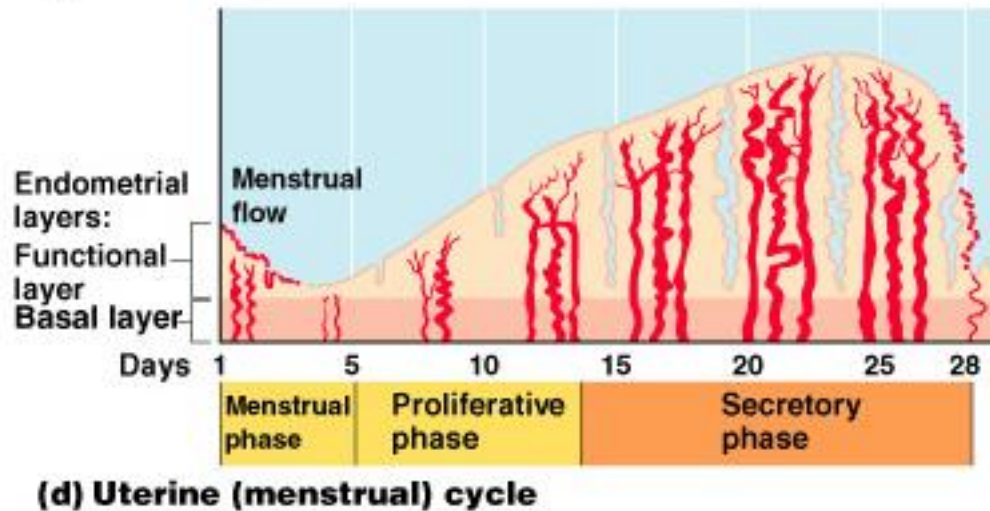
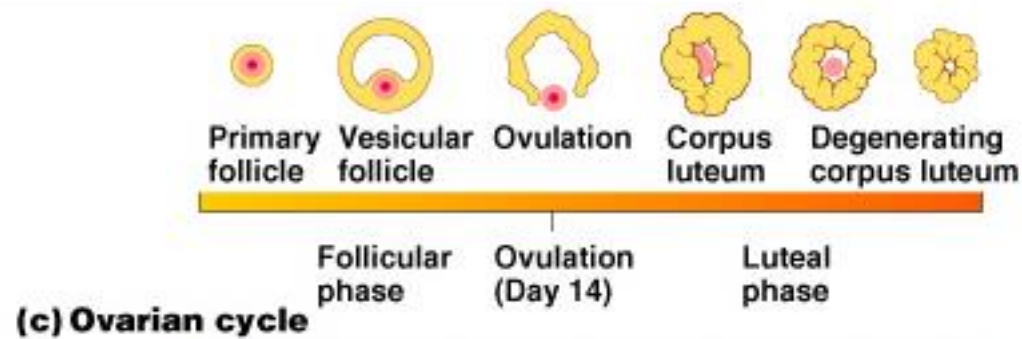


Figure 16.12c, d

Hormone Production by the Ovaries

- Estrogens
 - Produced by follicle cells
 - Cause secondary sex characteristics
 - Enlargement of accessory organs
 - Development of breasts
 - Appearance of pubic hair
 - Increase in fat beneath the skin
 - Widening and lightening of the pelvis
 - Onset of menses

Hormone Production by the Ovaries

- Progesterone
 - Produced by the corpus luteum
 - Production continues until LH diminishes in the blood
 - Helps maintain pregnancy

Mammary Glands

- Present in both sexes, but only function in females
 - Modified sweat glands
- Function is to produce milk
- Stimulated by sex hormones (mostly estrogens) to increase in size

Anatomy of Mammary Glands

- Areola – central pigmented area
- Nipple – protruding central area of areola
- Lobes – internal structures that radiate around nipple
- Alveolar glands – clusters of milk producing glands within lobules
- Lactiferous ducts – connect alveolar glands to nipple

Stages of Pregnancy and Development

- Fertilization
- Embryonic development
- Fetal development
- Childbirth

Fertilization

- The oocyte is viable for 12 to 24 hours after ovulation
- Sperm are viable for 12 to 48 hours after ejaculation
- Sperm cells must make their way to the uterine tube for fertilization to be possible

Mechanisms of Fertilization

- Membrane receptors on an oocyte pulls in the head of the first sperm cell to make contact
- The membrane of the oocyte does not permit a second sperm head to enter
- The oocyte then undergoes its second meiotic division
- Fertilization occurs when the genetic material of a sperm combines with that of an oocyte to form a zygote

The Zygote

- First cell of a new individual
- The result of the fusion of DNA from sperm and egg
- The zygote begins rapid mitotic cell divisions
- The zygote stage is in the uterine tube, moving toward the uterus

The Embryo

- Developmental stage from the start of cleavage until the ninth week
- The embryo first undergoes division without growth
- The embryo enters the uterus at the 16-cell state
- The embryo floats free in the uterus temporarily
- Uterine secretions are used for nourishment

The Blastocyst

- Ball-like circle of cells
- Begins at about the 100 cell stage
- Secretes human chorionic gonadotropin (hCG) to produce the corpus luteum to continue producing hormones
- Functional areas of the blastocyst
 - Trophoblast – large fluid-filled sphere
 - Inner cell mass

The Blastocyst

- Primary germ layers are eventually formed
 - Ectoderm – outside layer
 - Mesoderm – middle layer
 - Endoderm – inside layer
- The late blastocyst implants in the wall of the uterus (by day 14)

Derivatives of Germ Layers

- Ectoderm
 - Nervous system
 - Epidermis of the skin
- Endoderm
 - Mucosae
 - Glands
- Mesoderm
 - Everything else

Development from Ovulation to Implantation

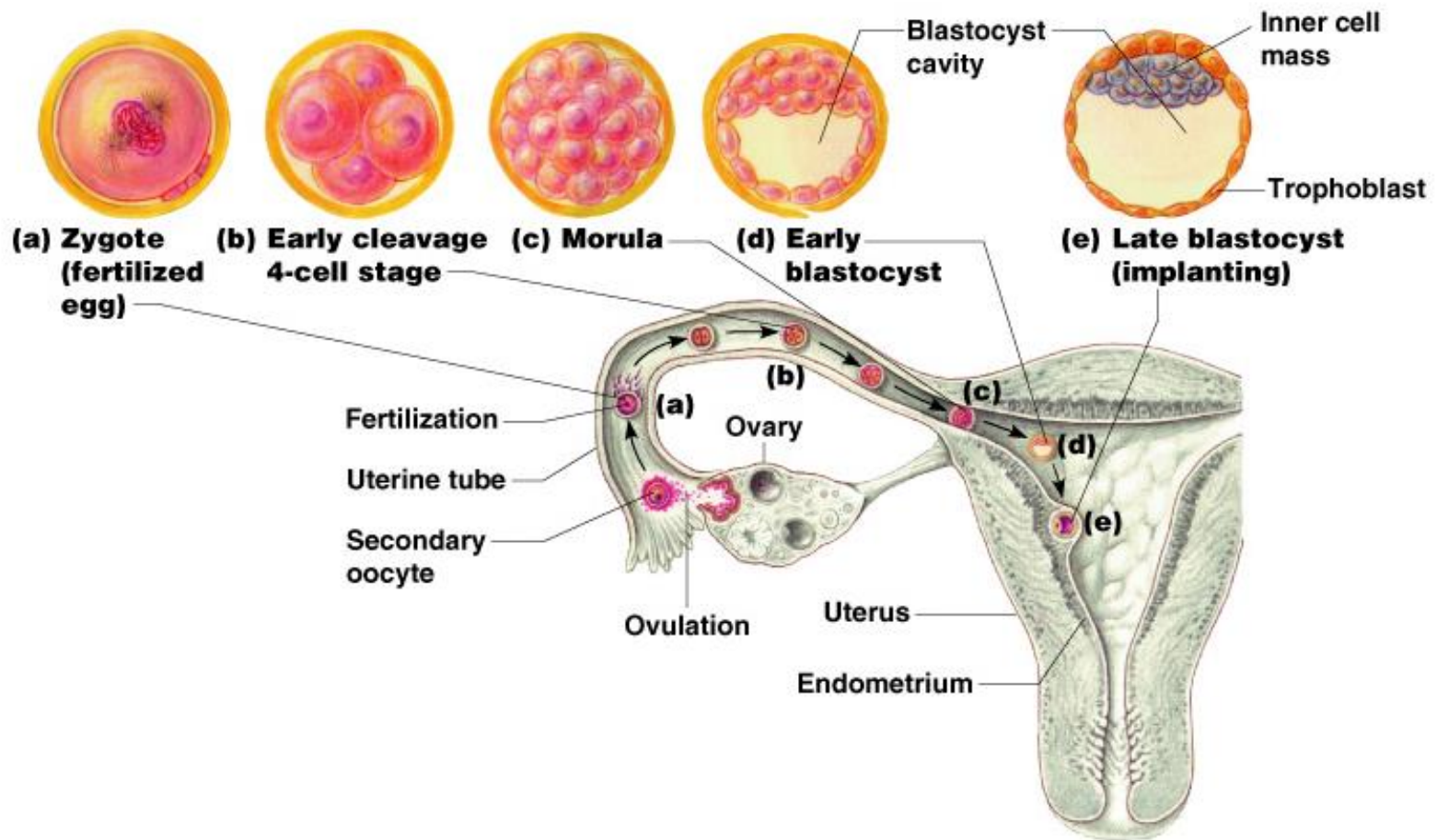


Figure 16.15

Development After Implantation

- Chorionic villi (projections of the blastocyst) develop
 - Cooperate with cells of the uterus to form the placenta
- The embryo is surrounded by the amnion (a fluid filled sac)
- An umbilical cord forms to attach the embryo to the placenta

Development After Implantation

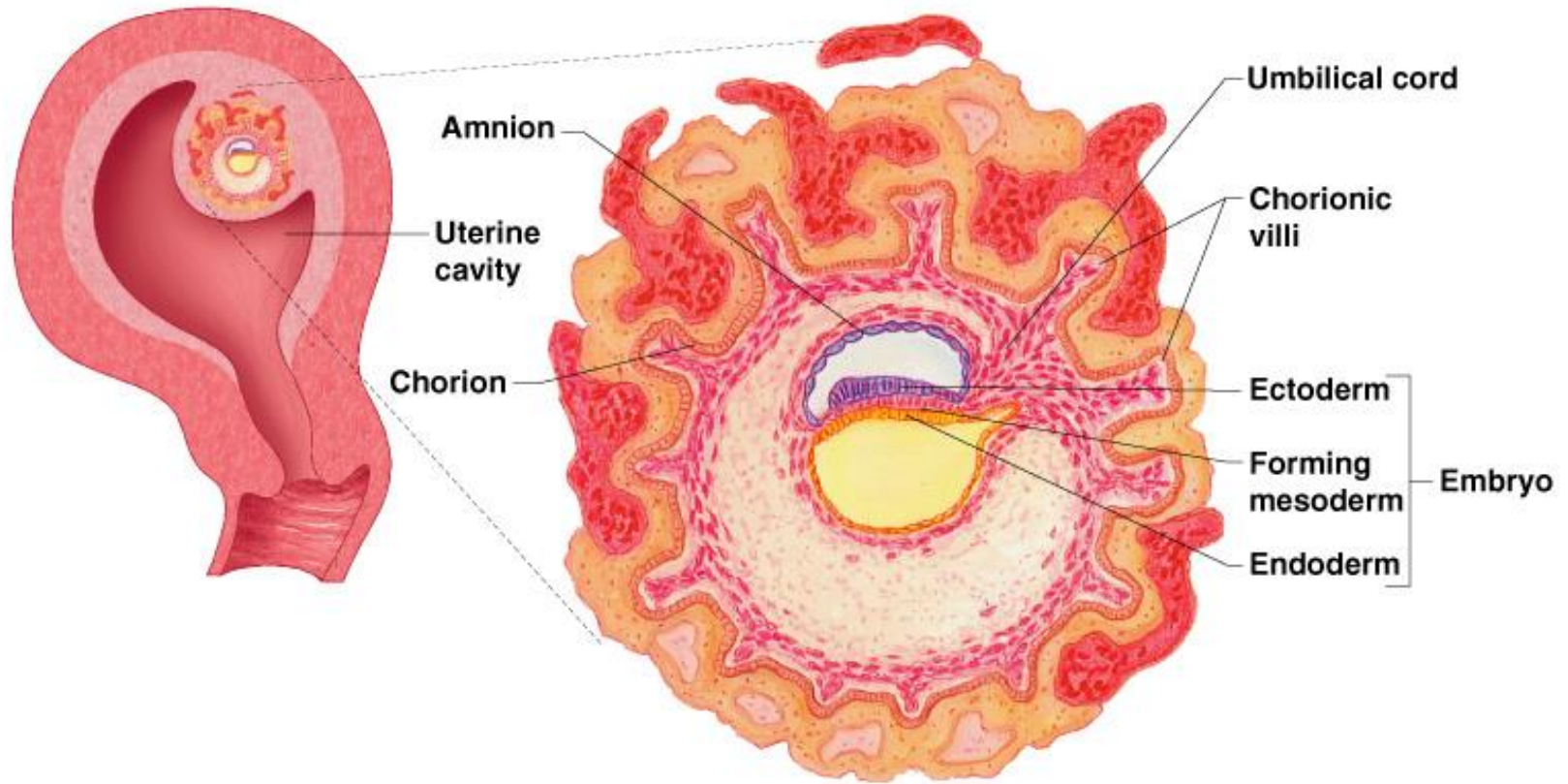


Figure 16.16

Functions of the Placenta

- Forms a barrier between mother and embryo (blood is not exchanged)
- Delivers nutrients and oxygen
- Removes waste from embryonic blood
- Becomes an endocrine organ (produces hormones) and takes over for the corpus luteum
 - Estrogen
 - Progesterone
 - Other hormones that maintain pregnancy

The Fetus (Beginning of the Ninth Week)

- All organ systems are formed by the end of the eighth week including sex organs
- Activities of the fetus are growth and organ specialization
- A stage of tremendous growth and change in appearance

The Effects of Pregnancy on the Mother

- Pregnancy – period from conception until birth
- Anatomical changes
 - Enlargements of the uterus
 - Accentuated lumbar curvature
 - Relaxation of the pelvic ligaments and pubic symphysis due to production of relaxin

Effects of Pregnancy on the Mother

- Physiological changes
 - Gastrointestinal system
 - Morning sickness is common due to elevated progesterone
 - Heartburn is common because of organ crowding by the fetus
 - Constipation is caused by declining motility of the digestive tract

Effects of Pregnancy on the Mother

- Physiological changes
 - Urinary System
 - Kidneys have additional burden and produce more urine
 - The uterus compresses the bladder

Effects of Pregnancy on the Mother

- Physiological changes
 - Respiratory System
 - Nasal mucosa becomes congested and swollen
 - Vital capacity and respiratory rate increase

Effects of Pregnancy on the Mother

- Physiological changes
 - Cardiovascular system
 - Body water rises
 - Blood volume increases by 25 to 40 percent
 - Blood pressure and pulse increase
 - Varicose veins are common

Childbirth (Partition)

- Labor – the series of events that expel the infant from the uterus
- Initiation of labor
 - Estrogen levels rise
 - Uterine contractions begin
 - The placenta releases prostaglandins
 - Oxytocin is released by the pituitary
 - Combination of these hormones produces contractions

Initiation of Labor

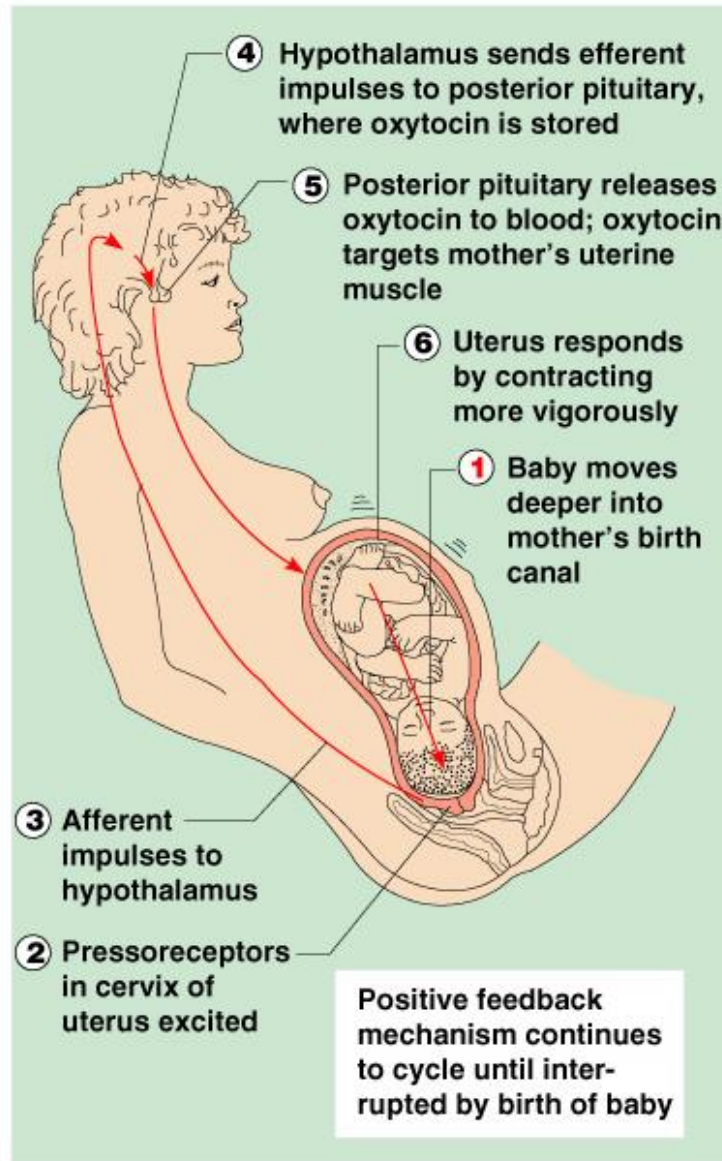


Figure 16.18

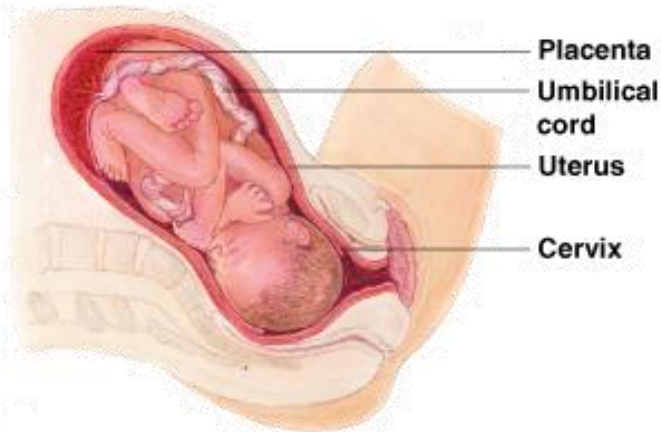
Stages of Labor

- Dilation (approx. 6-12 hours)
 - Cervix becomes dilated to 10 cm
 - Uterine contractions begin and increase
 - The amnion ruptures

Stages of Labor

- Expulsion (approx. 20 min – 2 hours)
 - Infant passes through the cervix and vagina
 - Normal delivery is head first
 - Crowning – see head
 - Breech – feet or butt first
 - Cesarean Section
- Placental stage (15 – 20 minutes after birth)
 - Delivery of the placenta

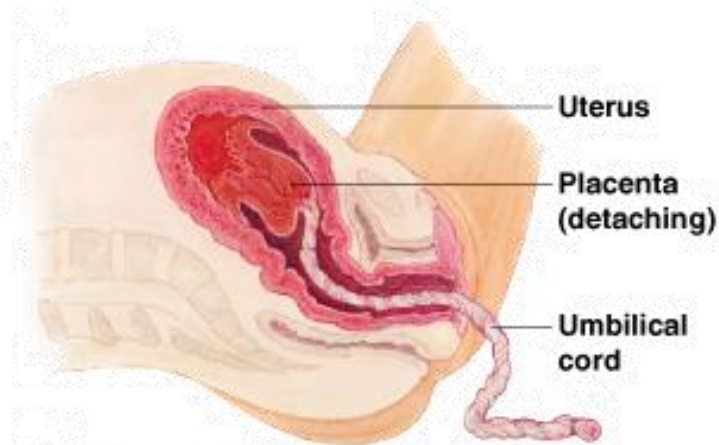
Stages of Labor



① Dilation of the cervix



② Expulsion: delivery of the infant



③ Delivery of the placenta

Figure 16.19

Developmental Aspects of the Reproductive System

- Gender is determined at fertilization
 - Males have XY sex chromosomes
 - Females have XX sex chromosomes
- Gonads do not begin to form until the eighth week

Developmental Aspects of the Reproductive System

- Testes form in the abdominal cavity and descend to the scrotum one month before birth
 - Cryptorchidism
- The determining factor for gonad differentiation is testosterone

Developmental Aspects of the Reproductive System

- Reproductive system organs do not function until puberty
- Puberty usually begins between ages 10 and 15
- The first menses usually occurs about two years after the start of puberty
- Most women reach peak reproductive ability in their late 20s

Developmental Aspects of the Reproductive System

- Menopause occurs when ovulation and menses cease entirely – between 45 & 55
 - Ovaries stop functioning as endocrine organs
 - “hot flashes”
- There is a no equivalent of menopause in males, but there is a steady decline in testosterone

Male/Female Differentiation

All will become female unless androgens are present

- Testis = Ovaries
- Glans penis = Clitoris
- Penile shaft = Labia minora
- Scrotum = Labia majora
- Epididymis = Fallopian tubes
- Vas deferens = Uterus
- Ejaculatory duct = Vagina

Contraception

100% Abstinence

Sterilization (tubal ligation/vasectomy)

95-99% Birth control pills

Subcutaneous implant

Depo-Provera

93-99% Interuterine Device (IUD)

90-99% Diaphragm & Cream/Cap

96-98% RU486 or DES “morning after pill”

85-97% Condom – male or female

65-85% Rhythm Method

70-80% Coitus interruptus

70-75% Spermicides

0% Douching

Artificial Fertilization

- Artificial insemination – sperm placed in vagina with sperm
- In-vitro fertilization – female given ovulation stimulating drugs, ova removed, cultured with sperm & fertilized, zygote is implanted into female

Disorders of Female Reproductive System

- Amenorrhea – no menstrual cycle
- Premenstrual Syndrome (PMS)
- Dysmenorrhea – painful menstruation
- Endometriosis – endometrium outside uterus
- Fibroid tumors – benign
 - Hysterectomy
- Breast tumors

Disorders of Female Reproductive System

- Breast cancer
 - Lumpectomy
 - Mastectomy
 - Mammogram
- Endometrial cancer
- Ovarian cancer
- Cervical cancer
 - Pap smear

Disorders of Male Reproductive System

- Epididymitis
- Orchitis – inflammation of testis
- Prostatitis
- Benign prostatic hypertrophy (BPH)
- Prostate cancer
 - Prostatectomy

Infections/STD's

- Pelvic Inflammatory Disease (PID)
- Salpingitis – inflammation of oviduct
- Toxic Shock Syndrome (TSS) – staph infection
- Vaginal yeast infection
- Chlamydia – most common STD, bacterial infection
- Genital warts – caused by HPV
 - Cryosurgery

Infections/STD's

- Genital herpes – viral infection
- Gonorrhea “The Clap” – bacterial infection
 - Males – painful urination & pus
 - Females – sterility or blockage
- Syphilis – bacterial infection
 - Sores
 - Patches on hands/feet, skin rashes, flu, lesions
 - Liver damage, brain/heart damage
- Pubic lice “crabs” – parasites
- AIDS/HIV – viral infection