

The Reproductive System, Pregnancy & Human Development

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Function of the Reproductive System

- ↳ to produce offspring

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Function of the Reproductive System

- ↳ males
 - to manufacture male gametes
 - to deliver gametes to the female reproductive tract
 - where fertilization can occur
- ↳ females
 - to produce female gametes

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Function of Reproductive System

- ↳ appropriate timing
 - fusion of sperm and egg
 - formation of a fertilized egg
- ↳ both reproductive systems
 - are equal partners in events leading up to fertilization
 - male
 - female

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Primary Sex Organs

- ↳ also known as gonads
 - females
 - ovaries
 - males
 - testes

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Male Reproductive System (fig 28.1)

6

Female Reproductive System (fig 28.11)

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Functions of the Gonads

- ↳ produce sex cells or gametes
 - females
 - ova or egg
 - males
 - sperm
- ↳ secrete sex hormones
 - females
 - estrogen and progesterone
 - males
 - androgens

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Accessory Reproductive Organs

- ↳ ducts
- ↳ glands
- ↳ external genitalia

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Anatomy of the Male Reproductive System

- sperm-producing testes (gonads)
 - lie within the scrotum

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Sperm Travel

- from the testes
 - sperm are delivered to the body exterior
 - through a system of ducts (in order)
 - the epididymus,
 - the ductus deferens
 - the urethra
 - which opens outside at the tip of the penis

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Male External Genitalia

- scrotum
 - sac of skin
 - hangs outside of the abdominopelvic cavity
 - contains the testes
- penis
 - the male, copulatory organ
 - designed to deliver sperm into the female reproductive tract

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Male External Genitalia

- penis and scrotum
 - hang in the perineum
 - region between the thighs and buttocks

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Perineum

- diamond-shaped region
- location
 - between
 - the pubic symphysis anteriorly
 - the coccyx posteriorly
 - the ischial tuberosities laterally

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Penis

- internally
 - contains
 - the spongy urethra
 - three long cylindrical bodies of erectile tissue

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Penis

- erectile tissue
 - a spongy network of connective tissue
 - smooth muscle with vascular spaces
 - veins with very thin walls
 - balloon out when filled with blood
 - during sexual excitement
 - causes an erection
 - enables the penis to serve as a penetrating organ

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Erectile Tissue

- Corpus cavernosa
 - paired dorsal erectile bodies
- Corpus spongiosum
 - mid-ventral erectile body

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Corpus cavernosa

- paired dorsal erectile bodies
- make up most of the penis
- proximal ends form the crura of the penis (singular - crus)
 - anchors to the pubic arch

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Fertilization

- ⚡ fusion of the sperm and egg nuclei

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Vasectomy

- ⚡ male form of birth control to prevent fertilization
- ⚡ simple, minor, highly effective operation
- ⚡ sperm continue to be produced
 - can no longer reach the body exterior

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Vasectomy

- ⚡ a small incision into the scrotum
- ⚡ cut through and ligate (tie off) the ductus deferens

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Testicular Cancer

- ⚡ most common cancer in young men
- ⚡ relatively rare
 - affects 1 of every 20,000 males
- ⚡ most common sign
 - painless solid mass in the testis

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Testicular Cancer

- ⚡ most important risk factor
 - nondescent of the testis (*cryptorchidism*)
- ⚡ trt
 - surgical removal of the cancerous testis (*orchietomy*) followed by radiation therapy and chemotherapy

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Accessory Glands

- ⚡ paired seminal vesicles
- ⚡ paired bulbourethral glands
 - also known as Cowper's glands
- ⚡ single prostate gland
- ⚡ function
 - produce the bulk of semen
 - sperm plus accessory gland secretions

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Seminal Vesicles

- ⚡ large glands
- ⚡ located on the posterior wall of the bladder
- ⚡ secretion accts for ~ 60% of semen volume

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Seminal Vesicles

- ⚡ the duct of each vesicle joins the ductus deferens
 - on the same side
 - forms the ejaculatory duct
 - sperm and seminal fluid mix and enter the urethra
 - during ejaculation

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The Prostate Gland

- ⚡ single doughnut-shaped gland
- ⚡ secretion accts for up to one-third of semen volume
 - plays a role in activating sperm
 - it enters the urethra via several ducts during ejaculation

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Prostate Gland Hypertrophy

- ⚡ affects nearly every elderly male
- ⚡ distorts the urethra
- ⚡ blockage of the gland
- ⚡ enhances the risk of bladder infections
 - cystitis
 - kidney damage

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The Bulbourethral Gland

- ⚡ AKA Cowper's gland
- ⚡ pea-sized gland
- ⚡ located inferior to the prostate gland
- ⚡ produces a thick, clear mucus
 - prior to ejaculation
 - drains into the spongy urethra
 - lubricates the glans penis
 - result of parasympathetic stimulation

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Semen

- ⚡ milky white
- ⚡ sticky alkaline mixture
 - sperm and accessory gland secretions
- ⚡ provides a transport medium and nutrients
- ⚡ contains chemicals
 - protect and activate the sperm
 - facilitate movement

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Ejaculation

- ⚡ contains 2-5 ml of semen
 - 50-130 million sperm/ml in normal adult males
 - only a small percentage of sperm reaches and penetrates the outer layers of the ovum

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Male Sexual Response

- ⚡ The chief phases are:
 1. erection of the penis
 - allows it to penetrate the female vagina
 2. ejaculation
 - expels semen into the vagina

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Erection

- ⚡ enlargement and stiffness of the penis
- ⚡ results from engorgement of the erectile bodies with blood
- ⚡ initiated by a variety of sexual stimuli

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Sexual Stimuli

- ⚡ touching the genital skin
- ⚡ mechanical stimulation of the pressure receptors in the penis
- ⚡ erotic sights
- ⚡ sound
- ⚡ smells

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Sexual Excitement

- a parasympathetic reflex is triggered
 - promotes release of nitric oxide (NO) locally
- NO relaxes vascular smooth muscle
 - causing the erectile tissue arterioles to dilate and fill with blood
 - expansion of the corpora cavernosa
 - » compresses the drainage veins
 - » retards blood outflow and maintains engorgement
 - expansion of corpus spongiosum
 - » keeps the urethra open during ejaculation

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Erectile Inhibition

- ⚡ caused by emotions and thoughts
 - result in vasoconstriction

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Ejaculation

- ⚡ propulsion of semen
 - from the male duct system
- ⚡ under sympathetic control
- ⚡ initiation of a spinal reflex

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Spinal Reflex

- ⚡ when impulses provoking erection reach a certain critical level
 - a massive discharge of nerve impulses serving the genital organs
 - three ejaculatory events

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Ejaculation Events

- ⚡ 1. Contraction of the ducts
 - reproductive ducts and accessory glands
 - empty their contents into the urethra
- ⚡ 2. Constriction of the bladder sphincter muscle
 - prevents expulsion of urine
 - prevents reflux of semen into the bladder
- ⚡ 3. Contraction of the bulbospongiosus muscles of the penis
 - propel semen at a speed of up to 200 inches/sec from the urethra
 - (skelatal muscle enclosing the base of the penis)

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Ejaculation

- ⚡ entire ejaculatory event
 - known as climax or orgasm
 - quickly followed by
 - muscular relaxation
 - psychological relaxation
 - vasoconstriction
 - allows the penis to become flaccid once again

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Latent Period

- ⚡ occurs after ejaculation
- ⚡ ranges in time from minutes to hours
- ⚡ a man is unable to achieve another orgasm
- ⚡ increases with age

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Erectile Dysfunction (ED)

- ⚡ AKA impotence
- ⚡ inability to attain an erection when desired
- ⚡ causes of temporary ED
 - healthy males
 - block the effects of NO release
 - psychological factors
 - alcohol
 - certain drugs

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Erectile Dysfunction (ED)

- ⚡ causes of chronic impotence
 - hormonal problems
 - DM
 - single most important cause
 - leads to arterial blockages
 - reduces blood flow to the penis
 - causes nerve damage
 - makes erection difficult or impossible

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Erectile Dysfunction (ED)

- ⚡ causes of chronic impotence
 - vascular problems
 - arteriosclerosis
 - injury to the penile blood vessels
 - incompetent varicose veins in the penis
 - create a venous leak
 - nervous system problems
 - damage to the penile nerves
 - surgery or radiation therapy
 - tumors
 - physical trauma

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Erectile Dysfunction (ED)

- ⚡ drugs that result in impotence
 - antihypertensives
 - antihistamines
 - antidepressants
 - some appetite suppressants
 - cold remedies

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Erectile Dysfunction Remedies

- ⚡ most have been unpleasant and invasive
 - use of a vacuum pump
 - suck blood into the penis
 - painful injections
 - dilate the penile blood vessels
 - insertion of a soft pellet into the urethra
 - surgery
 - vascular disease

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Viagra

- ⚡ most common ED remedy
- ⚡ a blue triangular pill
- ⚡ 70% success rate
- ⚡ advantages
 - works within the hour to produce a sustained erection
 - increases the concentration of NO in the penis
 - taken orally
 - has no significant side effects in healthy males

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Viagra

- ⚡ disadvantages
 - transient blue-green vision
 - stuffy nose
 - headaches
 - temporary facial flushing
 - mild stomach upset
 - major problems
 - occur among men with serious preexisting health conditions
 - heart disease, hypertension, diabetes mellitus

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Spermatogenesis

- ⚡ occurs in the testes
 - seminiferous tubules
- ⚡ sequence of events
 - produces male gametes
 - sperm or spermatozoa

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Spermatogenesis

- ⚡ begins during puberty
 - around the age of 14
- ⚡ continues in life
- ⚡ a healthy adult male produces ~400 mil sperm daily

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Meiosis

- ⚡ involves gamete formation in both sexes
- ⚡ a unique kind of nuclear division
- ⚡ occurs only within the gonads

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Meiosis

- ⚡ consists of two consecutive nuclear divisions
- ⚡ produces four daughter cells
 - each with half as many chromosomes as typical body cells
 - haploid or n chromosomal number (23)

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Meiosis

- ⚡ fusion of egg and sperm
 - formation of a fertilized egg
 - reestablishes the diploid chromosomal number of human cells
 - (46)

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Sperm Regions

- ⚡ three major regions
 - head
 - midpiece
 - tail

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Head

- ↳ genetic region
- ↳ consists almost entirely of a flattened nucleus
 - contains compacted DNA
- ↳ helmetlike acrosome
 - adheres to the top
 - produced by the golgi apparatus
 - contains hydrolytic enzymes
 - enable the sperm to penetrate and enter the egg

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Midpiece

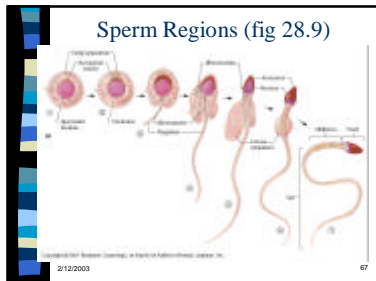
- ↳ metabolic region
- ↳ contains mitochondria spiraled tightly around the contractile filaments of the tail

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Tail

- ↳ locomotor region
- ↳ typical flagellum produced by a centriole
- ↳ mitochondria
 - metabolic energy for motion
 - propel the sperm into the female reproductive tract

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Testosterone

- ↳ stimulates maturation of the male reproductive organs
- ↳ triggers the development of male secondary sex characteristics

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Testosterone

- ↳ stimulates spermatogenesis
- ↳ responsible for sex drive (libido)
 - in both males and females
- ↳ has multiple anabolic effects

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Testosterone

- ↳ targets all accessory reproductive organs
 - cause them to grow
 - assume adult size and function
- ↳ in adult males
 - normal plasma levels maintain these organs

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Testosterone

- ↳ hormonal deficiency or hormonal absence
 - all accessory organs atrophy
 - semen volume declines
 - erection and ejaculation are impaired
 - sterility and impotence
 - easily remedied with testosterone replacement therapy

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Secondary Sex Characteristics

- ↳ features induced in the nonreproductive organs
- ↳ appearance of hair
 - pubic
 - axillary
 - facial
- ↳ enhanced hair growth
 - chest
 - other body areas

2/12/2003* some men 72

Secondary Sex Characteristics

- ⚡ deepening of the voice
 - as the larynx enlarges
- ⚡ skin thickens and becomes oilier
 - predisposes young men to acne

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Somatic Effects of Testosterone

- ⚡ bones
 - grow
 - increase in density
- ⚡ skeletal muscles
 - increase
 - size
 - mass

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Hormonal Regulation of Male Reproduction

- ⚡ brain-testicular axis
 - describes hormonal regulation
 - spermatogenesis
 - testicular androgen production
 - describes the interactions
 - between
 - hypothalamus
 - anterior pituitary gland
 - testes

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Hormonal Regulation of Male Reproduction

- ⚡ 1) hypothalamus releases GnRH
- ⚡ 2) GnRH reaches the ant pit via the hypophyseal-portal system
- ⚡ 3) GnRH binds to pituitary cells and prompts them to secrete FSH and LH
- ⚡ 4) FSH indirectly stimulates spermatogenesis and testosterone
 - by stimulating the sustentacular cells

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Hormonal Regulation of Male Reproduction

- ⚡ 5) LH binds to interstitial cells
 - stimulates them to secrete testosterone
- ⚡ 6) testosterone is the final trigger
 - spermatogenesis
 - libido
 - male secondary sex characteristics

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Hormonal Regulation of Male Reproduction

- ⚡ 7) testosterone inhibits
 - further hypothalamic release of GnRH
 - acts directly on the ant pit
 - inhibit LH and FSH
 - when sufficient levels of testosterone have been released

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Hormonal Regulation of Male Reproduction (fig 28.10)

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Anatomy of Female Reproductive System (fig 28.11)

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Female Reproductive System

- ⚡ female gonads
 - ovaries
 - primary reproductive organs
 - produce the gametes and female sex hormones
 - estrogen
 - progesterone
- ⚡ accessory ducts
 - transport and serve the needs of the reproductive cells and developing fetus
 - uterine tubes
 - uterus
 - vagina

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Ovaries

- paired organs
 - flank the uterus laterally
- held in place by ligaments
- saclike structures embedded within the connective tissue
 - ovarian follicles
 - each is an immature egg
 - an oocyte

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Ovaries

- each month in adult women
 - one of the ripening follicles
 - ejects its oocyte from the ovary
 - ovulation

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Ovaries (fig 28.14)

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Corona Radiata

- a layer of granulosa cells
 - remain around the ovum
 - after ovulation
 - provides a rough surface
 - helps the ovum move through the fallopian tube
 - provides the needed friction
 - with the fallopian tube wall
 - peristalsis of the tube moves the ovum toward the uterus

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Structure of the Ovary (fig 28.12)

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Movement of the Oocyte

- mechanism
 - moves the oocyte into the uterine tube and then to the uterus

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Movement of the Oocyte

- 1) the oocyte is cast into the peritoneal cavity
- 2) the infundibulum bends to drape over the ovary
 - the fimbriae stiffen and sweep the ovarian surface
- 3) the beating cilia on the fimbriae create currents in the peritoneal fluid
 - act to carry the oocyte into the uterine tube
- 4) the oocyte travels to the uterus
 - via (combination)
 - muscular peristalsis
 - beating of cilia

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Ectopic Pregnancy

- homeostatic imbalance
- uterine tubes are not continuous with the ovaries
 - this places women at risk
- fertilized ovum begins to develop in the peritoneal cavity
 - or any site other than the uterus
- common site is the uterine tubes
 - AKA tubal pregnancy

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Tubal Pregnancy

- this type usually naturally aborts with substantial bleeding
- full-term can result if a placenta can be established and growth accommodated

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Cervical Cancer

- ages 30 - 50
- cancer cells
 - arise from epithelium of cervical tip
- early dx
 - cervical smear (Papanicolaou)
 - "indicate"
 - vaginal cancer
 - endometrial cancer (*uterus*)
- risk factors
 - frequent cervical inflammations
 - STDs
 - multiple pregnancies

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Uterine Wall

- three layers
 - perimetrium (*visceral*)
 - outer, serous
 - myometrium
 - middle
 - contracts rhythmically during childbirth
 - endometrium
 - mucosal lining
 - simple columnar
 - embryo implantation and residential layer

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Vagina

- AKA birth canal
- thin-walled tube
- female organ of copulation
- mucosa has no glands
 - lubricated by cervical mucous glands
- epithelial cells
 - release large amts of glycogen
 - anaerobically metabolized to lactic acid by bacteria

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Vagina

- pH - acidic (adults)
 - vagina healthy
 - hostile to sperm
 - free of infection
- pH - alkaline (adolescents)
 - STDs

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External Genitalia

- external to vagina
- AKA vulva or pudendum
 - mons pubis
 - labia
 - clitoris
 - structures associated with vestibule

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External Genitalia (Vulva)

- mons pubis
 - fatty rounded area
- labia majora
 - two hairy fatty skin folds
- labia minora
 - two hair-free skin folds

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External Genitalia (Vulva)

- clitoris
 - protruding skin fold
 - homologous to penis
 - primarily erectile tissue
 - swollen with blood, erect
 - stimulation

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External Genitalia (Vulva)

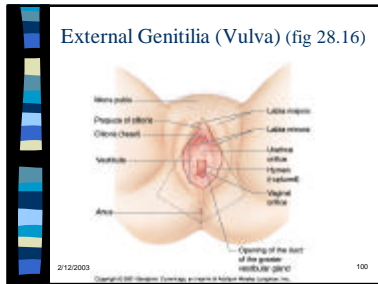
- perineum
 - diamond-shaped region
 - pubic arch
 - coccyx
 - ischial tuberosities
- vestibule
 - external opening of urethra

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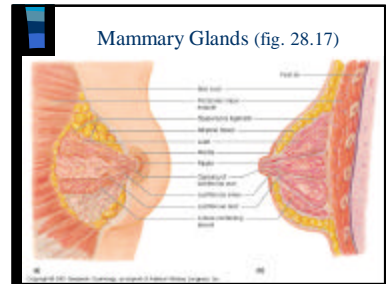
External Genitalia (Vulva)

- vestibular glands
 - homologous to bulbourethral glands
 - release mucus
 - lubrication
 - flank vaginal opening
- vestibular bulbs
 - homologous to corpus spongiosum
 - within labia minora
 - engorged with blood

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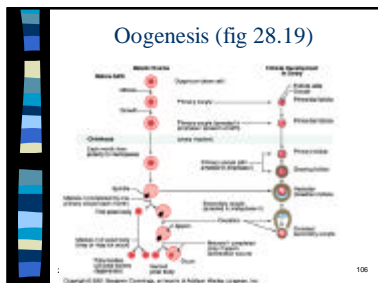
- ### Mammary Glands
- both sexes
 - function in females
 - size (nonlactating women)
 - adipose tissue
 - breast cancer
 - most common form of malignant cancer
 - 200,000 w women/year
 - risk factors
 - early/late onset menses
 - no pregnancies or first later in life
 - previous or family history
 - treatment
 - radiation, chemo, surgery
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- ### Oogenesis
- egg production
 - begins in fetus
 - takes years to complete
 - 10-14
 - total egg supply
 - determined by birth
 - egg release
 - puberty to menopause
 - meiosis
 - specialized nuclear division
 - ovaries
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- ### Oogenesis
- infant's ovaries
 - contain ~ 2 mil primary oocytes
 - arrested in prophase I
 - puberty
 - meiosis resumes
 - each month
 - 1 primary oocyte completes meiosis I
 - produces a large secondary oocyte and 1 polar body
 - meiosis II
 - secondary oocyte arrested in metaphase II if not penetrated by sperm
 - deteriorate
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- ### Oogenesis
- each month
 - meiosis II completed
 - only if sperm penetration
 - produce a functional ovum and a second polar body
 - end products
 - unequal cytoplasmic division
 - one large ovum (functional gamete)
 - most of primary oocyte's cytoplasm
 - ensures fertilized egg has ample nutrients
 - for its 7 day journey to uterus
 - three tiny polar bodies
 - nonfunctional
 - devoid cytoplasm - die
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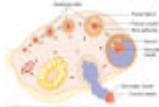


- ### Ovarian Cycle
- monthly series of events
 - egg maturation
 - phases
 - follicular phase
 - follicle growth
 - maturation of primordial follicle
 - days 1-14
 - luteal phase
 - corpus luteum activity
 - days 15-28
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- ### Ovarian Cycle
- repeats every 28 days
 - cycle length vary (21 days - 40 days)
 - follicular phase - varies
 - luteal phase - constant
 - 14 days
 - between ovulation and cycle end
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Ovarian Cycle (fig 28.20)

SEQUENCE OF EVENTS IN THE DEVELOPMENT AND FATE OF THE OVARIAN FOLLICLES

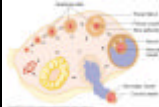


- 1) primordial follicle with primary oocyte (nuc. cells)
- 2) primary follicle with primary oocyte (cuboidal cells)
- 3,4) primary follicle grows and secretes estrogen
- 5) formation of the antrum (fluid filled cavity) and secondary follicle

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Ovarian Cycle (fig 28.20)

SEQUENCE OF EVENTS IN THE DEVELOPMENT AND FATE OF THE OVARIAN FOLLICLES

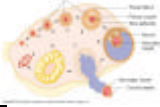


- 6) formation of the Graafian follicle and completion of Meiosis I - (day 14 - secondary oocyte and 1st polar body)
- 7) follicle ruptures and release of the secondary oocyte into the peritoneal cavity (ovulation)
 - occurs w/ thin ballooning ovary wall ruptures

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Ovarian Cycle (fig 28.20)

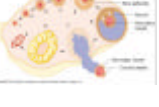
OVULATION (STEP 7)
LUTEAL PHASE (STEPS 8 & 9)



- 8) conversion of ruptured follicle into corpus luteum
 - produces progesterone, estrogen until cycle end
 - persists w/ fertilization and pregnancy until placenta forms in 3 mo
- 9) formation of corpus albicans (if no fertilization)
 - degeneration of the corpus luteum (scar) in 10 days

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Zona pellucida (fig 28.20)



- thick, transparent membrane
- around the oocyte
- secreted by the granulosa cells
- during ovarian cycle (step 4)
 - as the primary follicle grows

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Dominant Follicle

- several follicles at different maturation stages
- one follicle becomes the *dominant* follicle
 - at the peak stage of maturation
 - ovulation LH stimulus
- others degenerate

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Multiple Births

- increases with age
- 1-2 % of all ovulations
- fraternal twins (nonidentical)
 - different oocytes fertilized by different sperm
 - genetically dissimilar
 - may or may not be the same sex

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Multiple Births

- identical twins
- fertilization of a single oocyte by a single sperm
 - followed by the separation of the fertilized egg's daughter cells
 - in early development
- derived from the same genetic material
- always the same sex

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Hormonal Regulation of Ovarian Cycle (fig 28.21)

28-day menstrual cycle




- 1) GnRH stimulates the ant pit to release FSH and LH
 - stimulate follicle maturation and estrogen production

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Hormonal Regulation of Ovarian Cycle (fig 28.21)

28-day menstrual cycle



- 2) increase in estrogen levels causes positive feedback results & sudden release of LH
 - stimulates the primary oocyte to continue meiosis and trigger ovulation
 - LH causes conversion of ruptured follicle to CL and stimulates its secretory activity

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Hormonal Regulation of Ovarian Cycle (fig 28.21)

- 3) rising levels of progesterone and estrogen inhibit the hypothalamic-pituitary axis, CL deteriorates, ovarian hormones drop to low est levels, cycle begins again (day 26-28)

28-day menstrual cycle

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Menstrual (Uterine) Cycle

- series of cyclic changes
 - monthly
 - uterine endometrium
 - response to changing blood ovarian hormone levels
 - coordinated with ovarian cycle

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Menstrual (Uterine) Cycle

- three phases
 - menstrual (1-5)*
 - shed endometrium
 - proliferative (6-14)*
 - rebuild endometrium
 - secretory (15-28)**
 - enrich blood supply
 - provide nutrients to receive embryo
- *occurs before ovulation
- **occurs after ovulation

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Menstrual (Uterine) Cycle

- menstrual phase
 - endometrial functional layer sloughs off (menses)
- proliferative phase
 - rising estrogen levels
 - stimulate endometrium regeneration
 - ovulation (day 14)
 - response to sudden LH release

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Menstrual (Uterine) Cycle

- secretory phase
 - endometrium prepares for embryo implantation
 - rising progesterone levels
 - from CL and conversion to secretory mucous

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Menstrual (Uterine) Cycle

*rising levels of ovarian hormones trigger events in the uterine cycle
 *falling hormone levels during last days of ovarian cycle cause arteries to stop blood supply to functional layer and uterine cycle begins again with menstruation

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Amenorrhea

- cessation of menses
 - caused by extremely strenuous activity
 - delay menarche (girls)
 - disrupt normal menstrual cycle (adult women)
- lack of body fat
 - affects adrenal androgen conversion to estrogens
- severe physical regimens
 - block hypothalamic control
- low estrogen levels and no menses
 - bone loss

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Premenstrual Syndrome (PMS)

- physical and emotional distress
- late in postovulatory phase (ovarian cycle)
- overlaps with menstruation

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Premenstrual Syndrome (PMS)

- signs and symptoms
 - edema
 - breast swelling, tenderness
 - abdominal distension
 - backache, headache
 - joint pain
 - constipation
 - skin eruptions
 - fatigue, lethargy
 - irritability
 - depression, anxiety

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Estrogen & Secondary Sex Characteristics

- ⚡ breast growth
- ⚡ increased subcutaneous fat (*hips and breasts*)
- ⚡ pelvic widening and lightening
- ⚡ axillary and pubic hair growth
- ⚡ metabolic effects (*anabolic*)
 - low total blood cholesterol levels
 - calcium uptake
 - skeletal density

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Progesterone

- ⚡ stimulates breast growth
- ⚡ prepares the breast for lactation
 - acts with estrogen
 - cause mammary glands to achieve mature milk-producing state

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Female Sexual Response

- ⚡ two phases
- ⚡ 1) sexual excitement
 - promoted by touch, psychological stimuli
 - analogous to erection phase (*males*)
 - more widespread than male
- ⚡ 2) orgasm
 - increased
 - muscular tension
 - pulse rate
 - blood pressure
 - uterine contraction

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Sexual Excitement

- ⚡ blood engorgement
 - clitoris
 - vaginal mucosa
 - breasts
- ⚡ erect nipples
- ⚡ vestibular glands
 - increased activity
 - lubricates the vestibule
 - facilitates penile entry

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Female Orgasm

- ⚡ pleasure then relaxation
- ⚡ no refractory period
 - multiple orgasms
- ⚡ not required for conception
 - *males must experience orgasm and ejaculation for fertilization*

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STDs

- ⚡ sexually transmitted diseases
- ⚡ venereal diseases (VDs)
- ⚡ infectious diseases
- ⚡ spread through sexual contact
- ⚡ most important cause of reproductive disorders

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STDs

- ⚡ United States
 - highest rate among developed countries
 - affects ~12 million persons/year (US)
 - ~3 mil adolescents
- ⚡ prevention
 - abstinence
 - condoms

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Puberty

- ⚡ period in life
 - ages 10-15
- ⚡ reproductive organs mature and become functional
 - earliest time reproduction is possible

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Puberty

- ⚡ response to rising gonadal hormones
 - males (testosterone)
 - females (estrogen)
- ⚡ events occur sequentially (*all*)
- ⚡ age (*varies*)

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Male Puberty Onset

- ⚡ enlargement of testes and scrotum
 - ages 8-14
- ⚡ pubic, axillary and facial hair
- ⚡ growth of penis
- ⚡ unexpected, embarrassing erections
- ⚡ frequent nocturnal emissions

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Female Puberty Onset

- ⚡ budding breasts
 - ages 8-13
- ⚡ menarche
- ⚡ hormonal control maturation
 - ovulation and fertility

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Menopause

- ⚡ occurs when a whole year has passed ~ without menstruation
- ⚡ 1) decreasing ability of aging ovaries to respond to FSH and LH
- ⚡ 2) ovaries produce decreasing amounts estrogen
- ⚡ 3) low estrogen levels stop menses

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Symptoms of Menopause

- ⚡ hot flashes
- ⚡ copious sweating
- ⚡ emotional instability
- ⚡ atrophy
 - vagina (becomes dry)
 - external genitalia
 - breasts
 - uterus
- ⚡ bone mass loss
- ⚡ risk for cardiovascular ds

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Contraception

- ⚡ birth control
- ⚡ prevention of fertilization
- ⚡ types
 - BCPs
 - most used
 - tubal ligation
 - female sterilization
 - rhythm method
 - diaphragm
 - spermicide

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BCPs

- ⚡ supplied in 28 day packets
- ⚡ pills 20-21
 - estrogens and progestins (minute amounts)
- ⚡ last 7 pills
 - hormone free (placebo)

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BCPs

- ⚡ trick the hypothalamic-pituitary axis
 - lulls it to sleep
 - constant ovarian hormone levels
 - appear pregnant
 - ovarian follicles do not develop
 - ovulation ceases
 - endometrium proliferates slightly
 - endometrium sloughs off when pill use stops
 - menstrual flow decreased

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Tubal Ligation

- ⚡ cutting the uterine tubes
- ⚡ permanent
 - incision into abdominal cavity
 - part of each fallopian tube is squeezed into a small loop
 - suture tied at base of the loop
 - loop is cut
 - suture digested by body fluids
 - two severed tube ends separate
 - ova prevented from passing into uterus
 - sperm cannot reach the ova

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Rhythm Method

- ⚡ fertility awareness methods
 - recognition of ovulation (fertility) period
 - intercourse avoidance
- ⚡ techniques require record keeping
 - several cycles
- ⚡ high success rate 80-90%

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Rhythm Method

- ⚡ record daily basal body temp
 - drops slightly before ovulation
 - rises slightly after ovulation
- ⚡ record changes in vaginal mucus consistency
 - fertile period
 - mucus sticky, then clear and stringy

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Barrier Methods

- ⚡ reduce the spontaneity
- ⚡ types
 - diaphragm
 - fits over the cervix
 - used w/ spermicide can stop the passage of sperm into the uterus
 - cervical cap
 - condom
 - spermicidal foam
 - sperm killing chemical
 - gels
 - sponges

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Pregnancy & Development



Terms

- ⚡ pregnancy
 - events from fertilization (conception) until birth of the infant
- ⚡ conceptus
 - pregnant woman's developing offspring
- ⚡ gestation
 - time of development
 - ~280 days
 - last menstrual cycle to birth

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Stages of Development

- ⚡ preembryonic period
- ⚡ embryonic period
- ⚡ fetal period
- ⚡ birth

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Preembryonic Period

- ⚡ two weeks post fertilization
- ⚡ conceptus
 - preembryo

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Embryonic Period

- ⚡ week three to week eight
 - post fertilization
- ⚡ conceptus
 - embryo

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Fetal Period

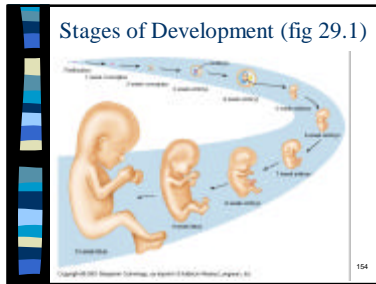
- ⚡ week nine to birth
- ⚡ conceptus
 - fetus

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Birth

- ⚡ infant

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Accomplishing Fertilization

- ☞ coitus
- ☞ sperm transport
- ☞ sperm capacitation
- ☞ acrosomal rxn
- ☞ sperm penetration
- ☞ fast block to polyspermy
- ☞ cortical rxn
 - slow block to polyspermy
- ☞ completion of meiosis II
- ☞ fertilization

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Accomplishing Fertilization

- ☞ sperm must reach ovulated secondary oocyte
- ☞ oocyte
 - viable for 12-24 hrs
 - after cast out of ovary
 - chance drops to almost zero next day

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Accomplishing Fertilization

- ☞ sperm
 - retain fertilizing ability for 24-72 hrs post ejaculation
 - some viable for five days in female reproductive tract

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Coitus

- ☞ act of sexual union
 - copulation
- ☞ must occur
 - no more than three days before ovulation
 - no later than 24 hours after
 - 24 hrs post ovulation
 - oocyte ~1/3 way down uterine tube

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Sperm Transport

- ☞ millions sperm expelled
 - w/ force into vaginal canal
 - millions
 - leak from vagina almost immediately
 - destroyed by vagina's acidity
 - fail to make it through the cervix
 - » unless cervical mucus has been made fluid by estrogens

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Sperm Transport

- ☞ sperm entering the uterus
 - subjected to forceful uterine contractions
 - dispersed throughout the cavity
 - thousands more destroyed by phagocytic leukocytes
 - only a few thousand reach the uterine tubes

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Sperm Capacitation

- ☞ sperm deposited in vagina
 - incapable of penetrating an oocyte
 - must first be capacitated
 - membranes must become fragile
 - » allows hydrolytic enzymes w/in acrosome to be released

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Sperm Capacitation

- ☞ exact mechanism is unknown
 - cholesterol is depleted
 - as sperm swim through cervical mucus, uterus, uterine tubes
 - keeps acrosomal membrane tough and stable
- ☞ process occurs gradually over next 6-8 hrs
 - sperm "wait around" even if they reach oocyte

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Acrosomal Reaction

- ovulated oocyte
 - encapsulated by zona pellucida & corona radiata
- sperm bind to zona pellucida
 - undergoes acrosomal rxn
 - release of acrosomal enzymes
 - hyaluronidase, acrosin, proteases
 - acrosomal rupture of hundreds of sperm
 - breakdown granulosa cells
 - digest holes in zona pellucida
 - expose oocyte membrane

Sperm Penetration

- fusion of sperm with oocyte's membrane receptors
 - removal sperm's nucleus by oocyte's cytoplasm
- two part binding apparatus (*sperm*)
 - beta protein finds and binds to oocyte membrane receptor
 - alpha protein inserts into the membrane

Sperm Penetration

- egg and sperm membranes open and fuse together
 - combined within a single membrane

Fast Block to Polyspermy

- electrical event
- prevents other sperm from fusing with oocyte membrane
- fusion of PM
- opening of Na channels
- release of Ca by oocyte's ER
 - activates oocyte to prepare for cell division
 - causes the cortical rxn

Cortical Reaction & Slow Block to Polyspermy

- Cortical granules
 - located deep in PM
 - spill enzymatic contents into ECS
 - beneath zona pellucida
 - destroy sperm receptors
 - bind water and swell
 - detaches all sperm still in contact with oocyte receptors
 - accomplishes the **permanent slow block to polyspermy**

Cortical Reaction & Slow Block to Polyspermy

- rare cases
 - polyspermy
 - embryos contain too much genetic material
 - die

Accomplishing Fertilization Events (fig 29.2)

The diagram illustrates the process of fertilization. It shows a sperm cell with its head, midpiece, and tail approaching an egg cell. The sperm's head penetrates the egg's outer layers (zona pellucida and corona radiata). The acrosomal reaction is shown as enzymes are released from the sperm's head to break down the egg's outer layers. The sperm's nucleus then fuses with the egg's nucleus, and the two sets of chromosomes combine to form a diploid zygote. Labels include: Sperm, Egg, Acrosomal reaction, Sperm penetration, Fusion of nuclei, and Zygote.

Completion of Meiosis II

- sperm loses its tail and midpiece
 - migrates to center of oocyte
- secondary oocyte completes meiosis II
 - forms ovum nucleus and ejects the second polar body
- ovum and sperm nuclei swell
 - become female & male pronuclei
 - approach each other

Completion of Meiosis II

- pronuclei membranes rupture & release chromosomes
- fertilization occurs
 - maternal & paternal chromosomes combine
 - produce diploid zygote

Completion of Meiosis II & Fertilization (fig 29.3)

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Preembryonic Development

- ⚡ rapid series of mitotic divisions
 - occur without growth
 - enhances uptake of nutrients and oxygen
 - disposal of wastes
- ⚡ begins w/ zygote
- ⚡ ends w/ a blastocyst

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Preembryonic Development

- ⚡ blastocyst
 - consists of trophoblast and an inner cell mass
- ⚡ trophoblast
 - adheres to, digests, and implants in the endometrium

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Preembryonic Development (fig 29.4)

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Implantation

- ⚡ takes ~ one week
- ⚡ blastocyst reaches the uterus
- ⚡ blastocyst floats in cavity
 - 2-3 days
- ⚡ window of implantation is opened
 - estrogens & progesterones

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Implantation

- ⚡ blastocyst implants high in uterus
 - if endometrium is ready
- ⚡ blastocyst detaches & floats to a lower level
 - if endometrium is not prepared
 - continues
 - until it finds a site with proper chemical signals

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Implantation

- ⚡ trophoblast cells adhere to endometrium
 - begin to secrete digestive enzymes & GFs
- ⚡ endometrium thickens
 - uterine blood vessels become permeable and leaky
 - inflammatory cells invade the area
- ⚡ endometrium becomes eroded

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Implantation

- ⚡ blastocyst burrows
 - completely covered
 - endometrial cells
- ⚡ completed
 - blastocyst entirely surrounded by endometrial tissue
 - ~14 days post ovulation
 - exact time endometrium normally sloughs off in menses

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Implantation of Blastocyst (fig 29.5)

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Human Chorionic Gonadotropin (hCG)

- ⚡ LH-like hormone
- ⚡ secreted by trophoblast cells
- ⚡ bypasses pituitary-ovarian controls
- ⚡ prompts CL to continue secreting hormones
 - progesterone and estrogen
- ⚡ maintains the viability of CL
 - function maintained by chorion
 - develops from trophoblast

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Human Chorionic Gonadotropin (hCG)

- ⚡ detectable in mother's blood
 - third week of gestation
 - one week post fertilization
- ⚡ levels rise until end of month 2
- ⚡ decline sharply by month 4
 - low levels
 - persist through gestation
- ⚡ pregnancy tests
 - detect hCG in blood or urine

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Blood Hormonal Levels (29.6)

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Physiological Changes - GI System

- ⚡ nausea
 - morning sickness
 - first few months of pregnancy
 - until system adjusts to elevated levels of progesterone and estrogen

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Physiological Changes - GI System

- ⚡ reflux of stomach acid into esophagus
 - causes heartburn
- ⚡ esophagus
 - displaced
- ⚡ stomach is crowded
 - growing uterus
- ⚡ constipation
 - decline in GI tract motility

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Embryo Nutrition

- ⚡ endometrial cells (initially)
 - digested by implanted embryo
- ⚡ placenta (month 2)
 - provides nutrients and oxygen
 - carries away metabolic wastes

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Placentation

- ⚡ formation of a placenta
- ⚡ temporary organ
 - originates
 - embryonic (trophoblastic) tissue
 - maternal (endometrial decidua) tissue
 - becomes the chorion
 - develops fingerlike chorionic villi
 - contact w/ mother's blood

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Placentation

- ⚡ respiratory, nutritive, excretory, endocrine organ
 - by end of third month of pregnancy
- ⚡ produces hormones of pregnancy

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Placentation

- ⚡ chorionic villi
 - vascularized w/ new blood vessels
 - erosion
 - large, blood filled lacunae (intervillous spaces) in endometrium (decidua basalis)
 - villi lie w/in these spaces
 - immersed in maternal blood
- ⚡ placenta
 - chorionic villi and decidua basalis

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Placentation

- oxygen and nutrients
 - diffuse from maternal to embryonic blood
- embryonic metabolic wastes
 - pass in opposite direction

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Placentation

- embryonic barriers
 - chorionic villi membrane
 - endothelium of embryonic capillaries
 - prevent free passage of substances between the two blood supplies
 - normally do not intermix

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Placentation (fig 29.7 f, g)

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Amnion

- thin, protective embryonic membrane
 - surrounds the embryo
- becomes filled w/ amniotic fluid
- also called “bags of water”
- protects the embryo from physical trauma

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Amnion

- provides a constant temperature
- allows fetal movement
- prevents growing parts from adhering and fusing together

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Fetal Testing

- performed when known risk of genetic disorder
- invasive procedures
 - risk to mother and fetus
- routinely ordered for pregnant women over 35
- chorionic villi sampling (CVS)
- amniocentesis
 - most common type

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Amniocentesis

- insertion of wide-bore needle into amniotic sac
 - through mother’s abdominal wall
- removal of small sample (~10 ml) of fluid
- done after 14 weeks of pregnancy
 - lesser chance of injuring fetus

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Amniocentesis

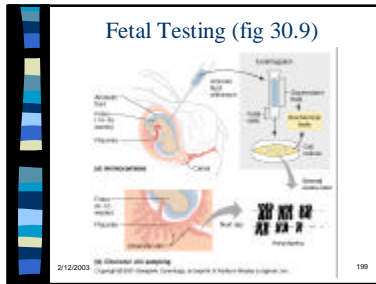
- sample
 - test sloughed off fetal cells
 - isolate and culture cells
 - presence of chemicals that serve as DNA markers for specific ds
 - chromosomal abnormalities

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Chorionic Villi Sampling (CVS)

- bits of chorionic villi suctioned off from placenta
- small tube is inserted through the vagina and cervical canal
- done as early as 8 weeks
 - 10 weeks is recommended
- faster results
 - karyotype immediately on dividing chorionic cells

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- ### Terms
- umbilical cord
 - structure bearing arteries and veins
 - connects the placenta and the fetus
 - parturition
 - culmination of pregnancy
 - giving birth to the baby
 - occurs within 15 days of the calculated due date
 - 280 days from the LMP
- 200

- ### Terms
- lactation
 - production of milk
 - hormone-prepared mammary glands
 - initially due to rising hormonal levels towards the end of pregnancy
 - estrogen
 - progesterone
 - lactogen
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- ### Terms
- lactation
 - hormones stimulate hypothalamus
 - release PRH
 - anterior pituitary gland responds
 - secretes PRL
 - initial 2-3 day delay
 - true milk production begins
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- ### Terms
- afterbirth
 - placenta & its attached fetal membranes
 - easily removed by a gentle tug on umbilical cord
 - removal is essential to prevent continued uterine bleeding
 - postpartum bleeding
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