REPRODUCTIVE SYSTEM

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REPRODUCTIVE SYSTEM

- The reproductive system performs 2 functions:
  - Produces, nutures & transports ova & sperm
  - Secretes hormones
- The primary reproductive organs are the gonads
  - Females are the ovaries
  - Males are the testes
- Gonads perform 2 functions:
  - Secrete hormones
  - Produce gametes; the ova & the sperm
- All other organs, ducts or glands are secondary reproductive structures that nourish & transport the sperm & nourish & provide safety to fertilzed eggs

Male Reproductive System

- The male reproductive system plays 3 roles:
  1. It produces, nourishes & transports sperm
  2. It deposits the sperm within the female reproductive tract
  3. It secretes hormones

Testes

- Testes:
  - Male gonads
  - 2 functions:
    - The production of sperm
    - Secretion of male hormones
  - Two oval testes are located outside the abdomen within the scrotum
  - Begin development within the abdomen but 2 months before birth they descend; failure is called cryptorchidism which can lead to sterility if untreated due to tempature
  - Each testis is divided into 250 smaller units called lobules which contain seminferous tubules & interstitial cells that are tightly coiled & form sperm
  - The interstitial cells are what produces the male hormones called androgens
  - Testosterone is the most important male hormone

Cells of Sperm Formation

- Millions of sperm are produced daily by the epithelium of the seminiferous tubules
- The seminiferous tubules contain 2 types of cells: spermatogenic & supporting cells
- The spermatogenic are sperm producing
- The supporting cell supports, nourishes & regulates the spermatogenic cells
- The supporting cells have several names which include: sertoli cells or nurse cells

Spermatogenesis

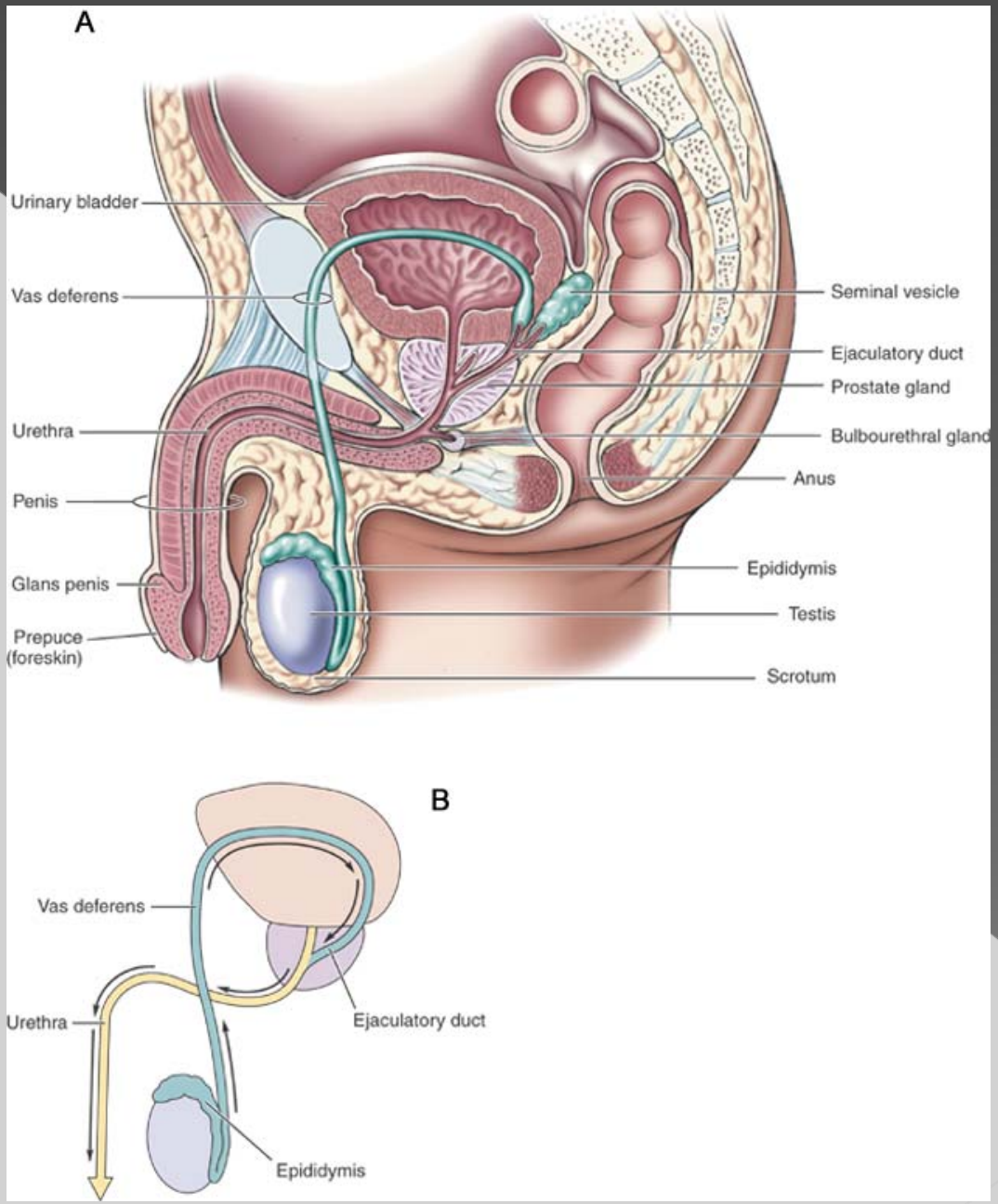
- Spermatogensis
  - The formation of sperm
  - The undifferentiated spermatogenic cells are called spermatogonia
  - Each spermatogonia contains 46 chromosomes
  - Under the influence of testosterone, the spermatogonia enlarge to become primary spermatocytes
  - Primary spermatocytes divided by a special cell division call meiosis which reduces the number of chromosomes by half; 23
  - When the egg & sperm meet & fertilization occurs the fertilized egg has 46 chromosomes which is the normal number for the human body cells

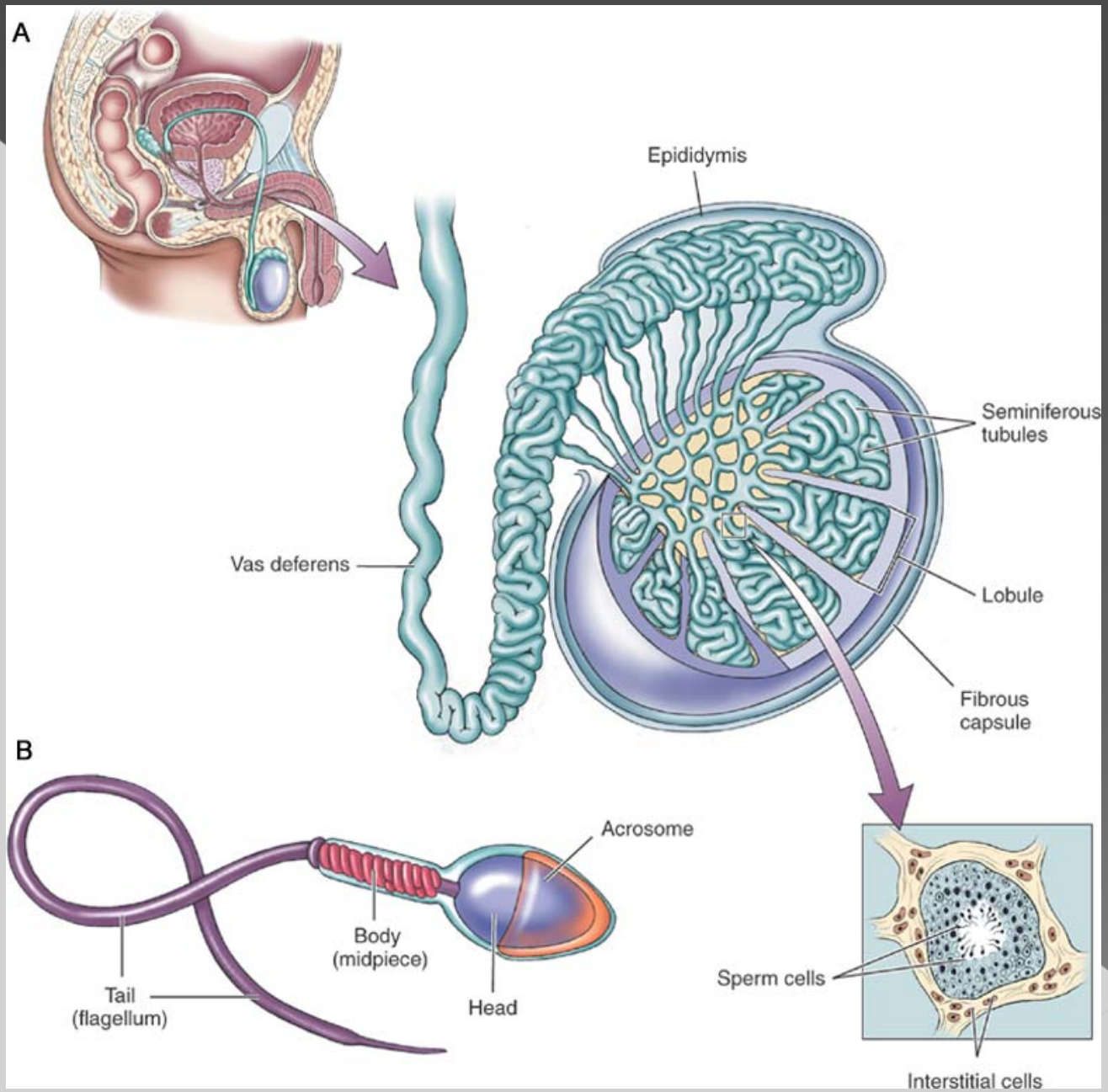
Sperm

- Sperm:
  - Looks like a tadpole
  - Three parts:
    - Head: primary nucleus
      - Acrosome is front part of head that contains enzymes that help the sperm penetrate the egg
    - Body: spiral-shaped that contains many mitochondria to supply energy for big swim
    - Tail: is a flagellum; produces whip-like motion
- Most sperm live only hours after deposit in the female reproductive tract but some survive up to 3 days

Genital Ducts

- As sperm form they gather in the seminiferous tubules & move into a series of genital ducts to mature
- The ducts include:
  - 2 epididymides
  - 2 vas deferens
  - 2 ejaculatory ducts
  - 1 urethra


A
Urinary bladder
Vas deferens
Urethra
Penis
Glans penis
Prepuce (foreskin)
Seminal vesicle
Ejaculatory duct
Prostate gland
Bulbourethral gland
Anus
Epididymis
Testis
Scrotum
B
Vas deferens
Urethra
Ejaculatory duct
Epididymis


A
Epididymis
Seminiferous tubules
Vas deferens
Lobule
Fibrous capsule
B
Acrosome
Body (midpiece)
Tail (flagellum)
Head
Sperm cells
Interstitial cells

Epididymis

- Epididymis:
  - First part of the duct system
  - 20 feet long
  - Tightly coiled & rests along the top & posterior side of testis
  - Sperm matures, becoming more fertile & motile
  - The walls of the epididymis contract & push sperm into the next structure, the vas deferens

Vas Deferens & Ejaculatory Ducts

- Vas deferens is continuous with the epididymis
- It ascends as part of the spermatic cord through the inguinal canal in the groin region into the abdominopelvic cavity on right & left side
- The spermatic cord includes: blood vessels, lymphatic vessels, nerves, muscles & connective tissue
- The vas deferens course through the pelvic cavity, curves over the bladder & joins the duct of the seminal vesicle to form the ejaclatory duct on right & left side
- They pass through the prostate gland & join as one urethra

Urethra

- Urethra
  - Extends from the base of the urinary bladder to the tip of the penis
  - Serves to organ systems:
    - Reproductive & Urinary
  - Carries urine from the bladder
  - Carries semen from the ejaculatory ducts
  - Cannot pass both at same time

Accessory Glands

- Various secretions are added to sperm as they travel through the genital ducts
- The secretion are from 3 glands:
  - Seminal vesicles: located at the base of the bladder & secretes a thick yellowish material rich in substances such as fructose, Vit C & prostaglandins
  - These substances nourish & activate the sperm as they pass through the ducts

Prostate Gland

- Single donut-shaped gland that encircles the prostatic urethra just below the bladder
- The prostate gland secretes a milky alkaline substance
- Plays a role in increasing sperm motility & counteracts the acidic environment of the vagina which helps protect the sperm as it enters the woman's body
- During ejaculation, the smooth muscle of the prostate gland contracts & forces the secretions into the urethra

Bulbourethral Gland

- Bulbourethral Gland
  - AKA cowper gland
  - Tiny glands that secrete thick mucus into the penile urethra
  - Serves as a lubricant during sexual intercouse

Semen

- Semen
  - Mixture of sperm & secretions from the accessory glands
  - 69% of volume is from the seminal vesicles
  - The remaining volume is from the prostate gland
  - Milky-white & alkaline which helps to neutralize the acidic pH in the vagina
  - Sperm are sluggish in an acidic pH so the alkaline pH protects them from the effects of the acidic environment
  - The amount of semen per ejaculation is about 2-6ml but contains 50-100 million sperm
  - Secretions of the accessory glands perform several funcions:
    - Nourish sperm
    - Aid in transport of the sperm
    - Lubricate the reproductive tract

External Genitals

- The external genitals include:
  - Scrotum containing the testes
  - Penis
- The testes are located in the scrotum in order to keep the testes temperature below body temperature
- The penis has two function:
  - It carries urine to the outside of the body
  - It acts as a sex organ of copulation & deposits sperm into the female reproductive tract

Penis

- The body of the penis contains 3 columns of erectile tissue
- Glans penis is the enlarged tip
- Foreskin is loose skin that extends down forming a cuff of skin around the glans
- Smegma is the cheesy substance that forms from the accumulation of dead cells & discharge oily substance from the glans; requires daily cleansing
- Two issues related to foreskin are:
  - Phimosis: inability to retract foreskin
  - Circumcision: surgical removal of the foreskin

Male Sex Response

- Erectile tissue is spongy
- When a man is sexually stimulated:
  - the parasympathetic nerves fire
  - causing a dilation of the penile arteries
  - Blood fills the erectile tissue which enlarges the & makes the penis rigid
  - The process is called an erection
  - Inability is to achieve erection is called impotence
- Orgasm refers to the physiologic & psychological sensation that occurs during sexual stimulation

Male Sex Response

- With males, orgasm is accompanied by emission of sperm from the testes & genital ducts into the urethra
- Ejaculation is the expulsion of sperm from the urethra to the outside which begins with the urethra filling with semen
- The motor nerves impulse travels from the spinal cord stimulating the skeletal muscles at the base of the erectile columns in the penis to contract rhythmically
- The rhythmic contraction provides force necessary to expel sperm

Male Sex Hormones

- Male sex hormones are called androgens
- Most of the testosterone is secreted by the interstitial cells of the testes
- Small amount is secreted by the adrenal cortex
- Secretion of testoterone begins during fetal development & continues at very low level througout childhood
- During puberty, 10-13, testosterone secretion increases rapidily
- After puberty, testosterone is secreted continuously throughout a males life

Male Sex Hormones

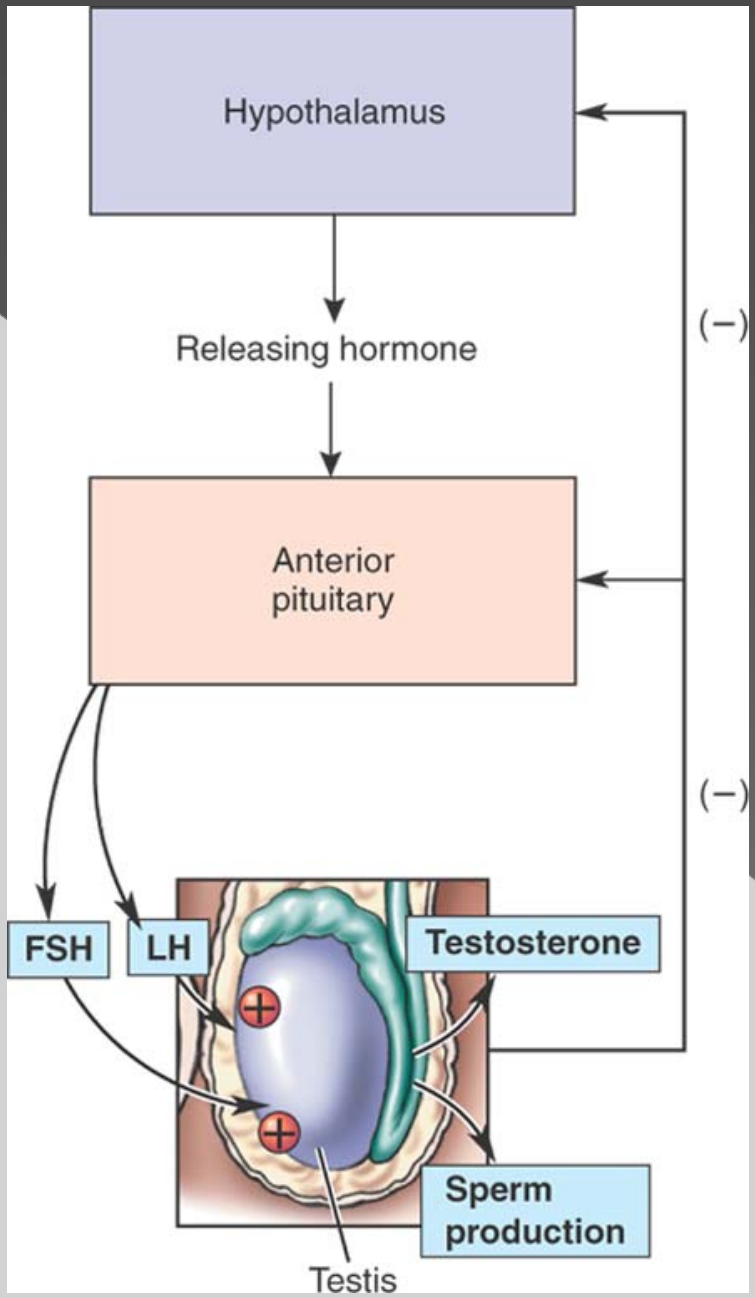
- Testosterone is necessary for production of sperm & the development of male sex characteristics
- Primary sex characteristics include enlargement of testes & penis
- Secondary sex characteristics include:
  - Increased growth of hair
  - Deepening of voice
  - Thickening of the skin & increase in oil & sweat gland activity
  - Increase in musculoskeletal growth, broad shoulders & narrow waist

Hormonal Control

- Male reproductive system is controlled primarily by the hormones secreted by the hypothalamus, anterior pituitary gland & testes
- The hypothalamus secretes a releasing hormone which stimulates the anterior pituitary to secrete the gonadotropins
- Follicle-stimulating hormone(FSH) promotes spermatogensis by stimulating spematogenic cells to respond to testosterone
- Lutenizing hormone (LH) promotes the development of the interstitial cells of the testes & secretion of testosterone

Hormonal Control

- After puberty, negative feed back regulates testosterone production
- When the blood level of testosterone increases the hypothalamus & anterior pituitary gland decreases hormonal secretion, thereby decreasing the production of testosterone
- When the blood levels decrease, the anterior pituitary gland increases secretion of LH which stimulates the interstitial cells to secrete testosterone again


Hypothalamus
Releasing hormone
Anterior pituitary
(−)
(−)
FSH
LH
Testosterone
Sperm production
Testis

Female Reproductive System

- The female reproductive system produces eggs, secretes hormones & nutures & protects a developing baby

Ovaries

- Ovaries:
  - Female gonads
  - Two almond shaped structures located on either side of the uterus in the pelvic cavity
  - Anchored by ligaments called the ovarian & broad ligament
  - Close relationship to fallopian tubes
  - Within the ovary is sac-like structure called ovarian follicles

Ovarian Follicle

- Women are born with 2 million follicles; by puberty is decreases to 400,000
- Only 400 follicles will mature & produce an egg
- Egg production begins at puberty & ends with menopause
- Each ovarian follicle consists of an immature egg called oocyte & follicular cells that surround the oocyte
- Several follicles mature every month starting at maturity but only one fully matures
- As the egg matures it begins to go through meiotic cell division which reduces the number of chromosomes in half to 23
- As the follicle enlarges, the fluid filled center is formed & the follicular cells begin to secrete estrogen
- A mature ovarian follicle is called graafian follicle
- The graafian follicle looks like a blister on the surface of the ovary that is ready to burst

Ovulation

- Once a month the ovarian follicle bursts
- The ovary ejects a mature egg called on ovum
- This ejection phase is called ovulation
- The egg travels from the surface of the ovary into the peritoneal cavity, where it is swept into the fallopian tubes by a swishing motion of the fimbriae(finger-like projections at the end of the fallopian tube)
- The egg gradually travels through the fallopian tubes to the uterus
- If fertilized, it implants in the uterine lining & grows into a baby
- If not fertilized, the egg dies & is eliminated in menstrual blood

Ovulation

- Once ovulation has occurred, the follicular cells that remain in the ovary develop into a glandular structure called the corpus lutem
- The corpus lutem secretes 2 hormones:
  - Large amounts of progesterone
  - Small amounts of estrogen
- If fertilization does not occur, the corpus lutem deteriorates in about 10 days & becomes corpus albicans
- If fertilization does occur the corpus lutem will continue to secrete hormones until the placenta takes over the role

Ovarian Hormones

- The ovaries begin to secrete sex hormones estrogen & progestrone beginning at puberty
- The follicular cells of maturing follicles secrete estrogen & the corpus lutem secretes large amounts of progesterone & smaller amounts of estrogen

Estrogen

- Estrogen
  - Term used for a group of similar hormones
  - Most important is estradiol
  - Exerts 2 important effects:
    - Promotes the maturation of the egg
    - Helps develop female secondary sex characteritics
  - Characteristics include:
    - Enlargement of organs of reproductive system
    - Breast development
    - Deposition of fat, esp. thighs, buttocks & breast
    - Widening of pelvis
    - Onset of menstrual cycle
    - Closure of epiphyseal disc in long bones

Progesterone

- Secreted by the corpus lutem
- 3 important effects:
  1. It works with estrogen to establish menstral cycle
  2. Helps maintain pregnancy
  3. Prepares breast for milk production
- The corpus lutem will secrete enough progesterone to maintain pregnancy in the early months

Genital Tract

- Genital tract includes:
  - Fallopian tubes
  - Uterus
  - Vagina
- Fallopian tubes:
  - Also called oviducts or uterine tubes
  - 4 inches in length situated on either side of the uterus to the extending to the ovaries
  - Funnel-shaped end nearest the ovary is called the infundibulum & contains finger-like projections called fimbriae
  - The fallopian tube does not attach directly to the ovary but the fimbriae hang over the ovary & the swishing motion sweeps the egg from the surface of the ovary into the fallopian tube

Fallopian Tubes

- At ovulation, the fimbriae sweep the egg from the surface of the ovary into the fallopian tube
- Once the egg is the fallopian tube, it moves slowly toward the uterus by perastaltic muscle contraction within the walls of the fallopian tubes
- 2 functions of fallopian tubes:
  - Transport of egg from ovary to uterus
  - Usually site of fertilization of egg by sperm
- If fertilization does occur, the fertilized egg moves through tube into uterus where it implants
- The journey takes about 4-5 days
- Ectopic pregnancy occurs when the fertilized egg implants in the lining of the tube instead of traveling to uterus for implantation; serious health issue

Uterus

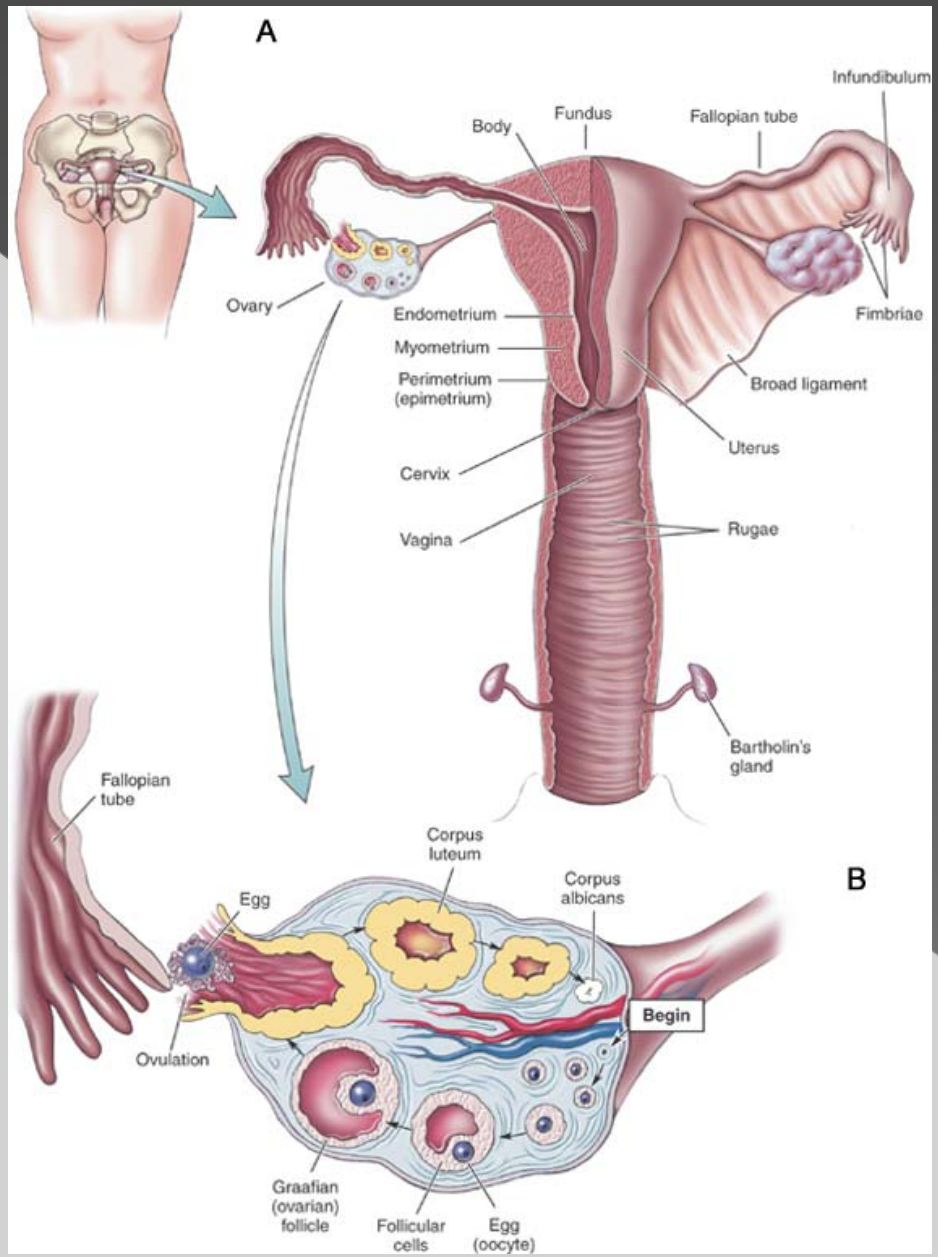
- Uterus:
  - AKA womb
  - Shaped like an upside down pear
  - Located between the urinary bladder & rectum
  - Broad ligament holds the uterus in place
  - Provides the growing baby a safe & nuturing place
  - The uterus increase considerably in size
  - 3 parts:
    - Fundus: upper dome-shaped region above the entrance of the fallopian tubes
    - Body: central region
    - Cervix: lower region that opens into the vagina & area Pap smear is performed to detect cancer

Uterus

- Uterus has 3 layers:
  - Outer serosal layer called epimetrium
  - Middle muscle layer called myometrium
  - Inner layer is endometrium containing 2 layers:
    - Basilar layer is thin & vascular lying close to the myometrium
    - Functional layer responds to ovarian hormones and thickens in preparation for the fertilized egg or sloughs off during menstruation

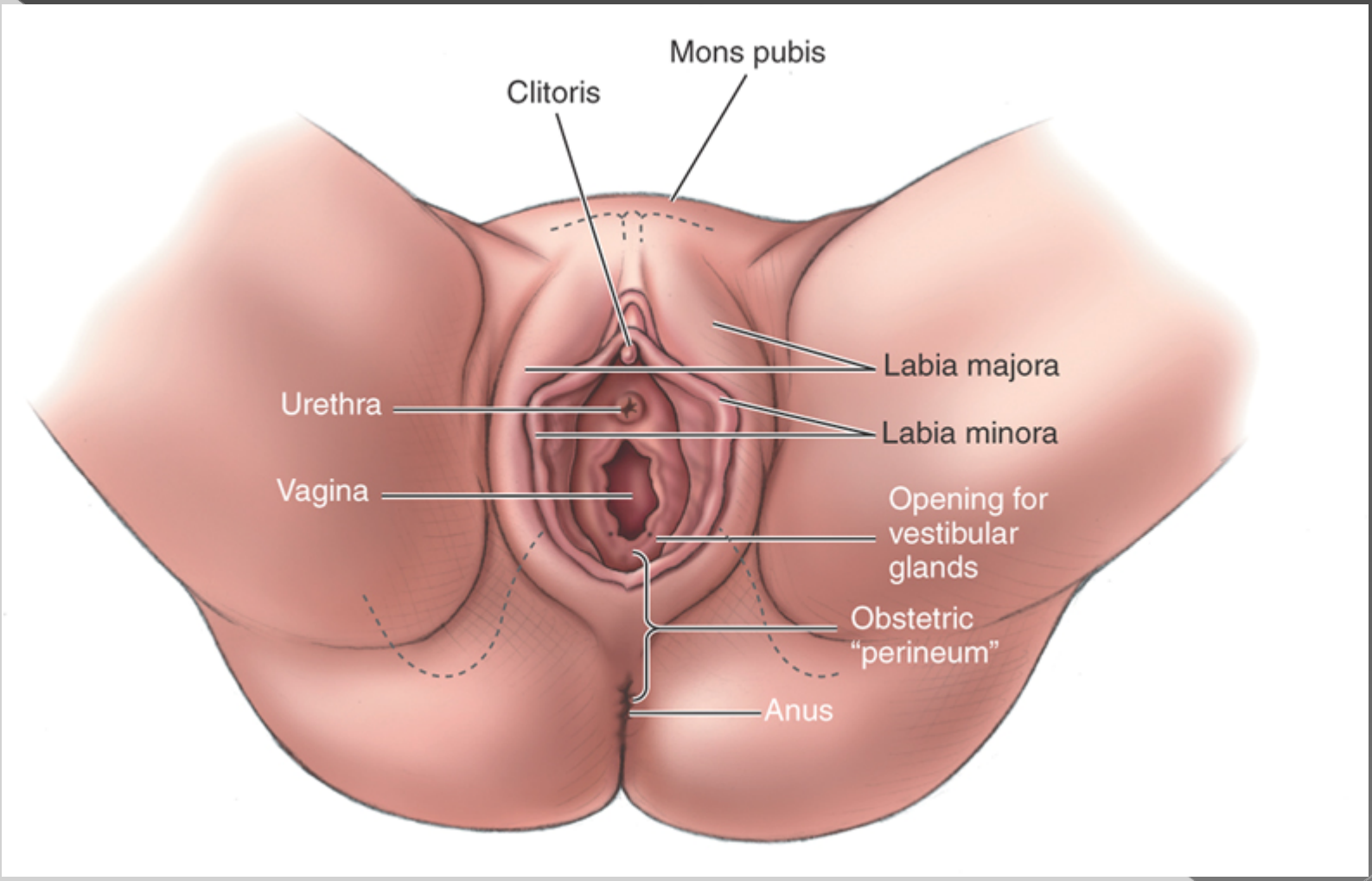
Vagina

- Vagina
  - 4 inch tube that extends from the cervix to the vaginal opening in the perineum
  - The vaginal opening is covered by a thin membrane called the hymen which is usually ruptured during first sexual intercourse, trauma, strenuous exercise
  - Upper portion of the vagina receives the cervix which dips into the vagina creating pockets called fornices
  - The deepest fornix is located behind the cervix
  - The mucosal lining of the vagina lies in folds capable of expanding
  - The expanding provides the birth canal for delivery of a baby & receives the penis during copulation
  - The acidic environment of the vagina discourages the growth of bacteria.


A
Infundibulum
Body
Fundus
Fallopian tube
Ovary
Endometrium
Myometrium
Perimetrium
(epimetrium)
Fimbriae
Broad ligament
Uterus
Cervix
Vagina
Rugae
Bartholin's
gland
Fallopian
tube
Corpus
luteum
Corpus
albicans
B
Egg
Begin
Ovulation
Graafian
(ovarian)
follicle
Follicular
cells
Egg
(oocyte)

External Genitalia

- Vulva includes:
  - Labia majora: external folds of hair-covered skin
  - Labia minora: smaller internal folds of skin
  - Vestible is a cleft that separates the labia & contains the urethral & vaginal opening
  - Vestibular glands or Bartholin's glands lie on either side of the vaginal opening & secrete mucus substance that helps lubricate the vestibule
  - Mons pubis is the hair-covered area that the labia majora merge form over the symphysis pubis
  - Clitoris: contains erectile tissue & sensory receptors that allow the female to experience sexual sensation
  - Perineum is the pelvic floor; area between vaginal opening & anus


Mons pubis
Clitoris
Labia majora
Urethra
Labia minora
Vagina
Opening for vestibular glands
Obstetric "perineum"
Anus

Female Sexual Response

- In response to sexual stimulation, the parasympathetic nerves induce arterial dilation of erectile tissue causing swelling in the vaginal mucosa, breasts & clitoris
- The vestibular glands also secretes
- When an orgasm occurs the muscles in the perineum, uterine wall & uterine tubes contract which is thought to aid sperm through the genital tract

Reproductive Cycle

- Two components of the reproductive cycle:
  - Ovarian cycle
  - Uterine cycle
- These cycles begin at puberty & last about 40 years ending at menopause

Ovarian cycle

- Ovarian cycle:
  - Consists of the changes that occur within the ovary over the 28-day monthly period
  - Two phases:
    - Follicular phase
    - Luteal phase

Follicular Phase

- Follicular phase: begins with the hypothalamic secretion of releasing hormone stimulating the anterior pituitary to release gonadotropins
- The FSH & small amounts of LH stimulate the growth of the ovarian follicle
- The maturing ovarian follicle secretes large amounts of estrogen increasing plasma levels of estrogen
- Estrogen affects both the ovary: helping it to mature & uterus: builds up the uterine lining
- The follicular phase ends with ovulation with the expulsion of the egg from the ovary
- There is a sharp rise of LH on day 14 causing ovulation
- Estrogen dominates the follicular phase

Luteal Phase

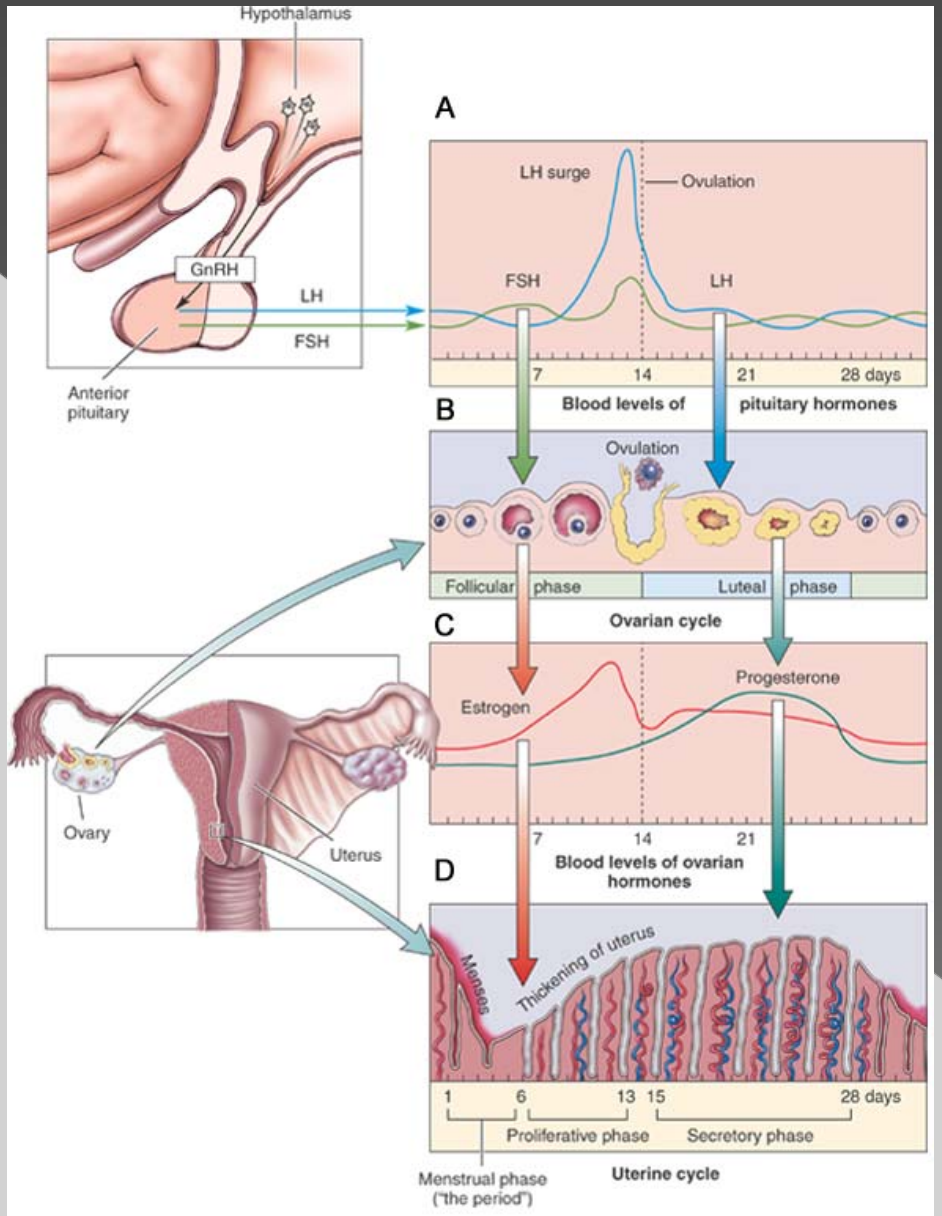
- Luteal phase immediately follows ovulation
- The corpus luteum develops during the luteal phase
- Follicular cells of the ruptured follicle on the surface of the ovary form the corpus lutem
- LH then stimulates the corpus to secrete progesterone & small amounts of estrogen
- The progesterone & estrogen exert negative feedback effect on the anterior pituitary gland which inhibits the secretion of FSH & LH
- Progesterone dominates the luteal phase
- When the corpus luteum dies, the secretion of progesterone & estrogen declines which stimulates the release of LH & FSH & the cycle repeats

Uterine Cycle

- The uterine cycle:
  - AKA menstrual cycle
  - Consists of the changes that occur in the endometrium over 28-day period
  - Estrogen & progesterone secreted by the ovaries causes endometrial changes
  - Thus the ovarian cycle controls the uterine cycle
  - Three phases:
    - Menstrual phase
    - Proliferative phase
    - Secretory phase

Uterine Cycle

- Menstrual phase:
  - The functional layer of the endometrial lining & blood leave the uterus through the vagina as menstrual flow
- Proliferative phase:
  - Begins with at the end of the menstrual phase
  - Repair & growth of the inner endometrial lining occurs as a result of estrogen secretion by the ovaries
  - The endometrial lining become thicker & acquires more blood vessels
  - Called proliferative because cells proliferate
- Secretory phase:
  - Due to the secretion of progesterone by the corpus luteum causing the endometrial lining to become thick & lush in anticipation of the fertilized ovum arrivial


Hypothalamus
GnRH
LH
FSH
Anterior pituitary
A
LH surge
Ovulation
FSH
LH
7
14
21
28 days
Blood levels of pituitary hormones
B
Ovulation
Follicular phase
Luteal phase
Ovarian cycle
C
Estrogen
Progesterone
7
14
21
Blood levels of ovarian hormones
D
Menses
Thickening of uterus
1
6
13
15
28 days
Proliferative phase
Secretory phase
Menstrual phase ("the period")
Uterine cycle
Ovary
Uterus

Implantation

- If fertilization of the egg occurs, the uterine lining must be preserved
- Cells at the site accomplish this by secreting a hormone called human chorionic gonadotropin (hCG)
- Blood carries hCG from the uterus to the ovary where it stimulates the corpus luteum
- hCG prevents the corpus luteum from deteriorating which ensure the continued secretion of estrogen & progesterone
- hCG prolongs the life of the corpus luteum for 11-12 weeks until the placenta takes over secretion of estrogen & progesterone

- Menarche: is the first menstrual period that occurs during puberty
- Menses: are mentrual periods that occur regularly after menarche until menopause
- Menopause: occurs when menses becomes more & more irregular until it ceases completely
  - Decrease in estrogen & progesterone secretion
  - Uterine cycle ceases so menstruation stops
  - Symptoms may occur such as:
    - Hot flashes—sweating—depression—irriability

Birth Control

- Birth control can be mechanical or chemical
  - Hormonal contraceptives include:
    - birth control pill contains estrogen & progesterone which raises plasma level of estrogen & progesterone causing negative feedback therefore inhibiting FSH secretion & preventing ovulation
    - Implantation are placed under the skin & contain progesterone that is slowly released causing an elevation in plasma levels of progesterone preventing ovulation

Birth Control

- Surgical methods:
  - Vasectomy: both of the vas deferens are cut or tied so sperm can not leave the epidiymis
  - Tubal ligation: fallopian tubes are tied or cut preventing the egg from transporation from the ovary
  - Intrauterine device: solid object is placed in the uterine cavity stimulating the uterus to prevent implantation of the fertilized egg

Birth Control

- Behavioral methods include:
  - Abstinence or avoidance: most effective prevention of pregnancy
  - Rhythm method: called natural family planning requires avoiding sexual intercourse at the time of ovulation; high rate of pregnancy
  - Coitus interruptus: refers to the withdrawl of the penis from the vagina before ejaculation; high rate of pregnancy

Birth Control

- RU-486:
  - Called morning after pill
  - Causes loss of implanted embryo by blocking progesterone receptors in the endometrium
  - Loss of progesterone cause the endometrium to slough, carrying the embryo with it; does not prevent conception just implantation