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

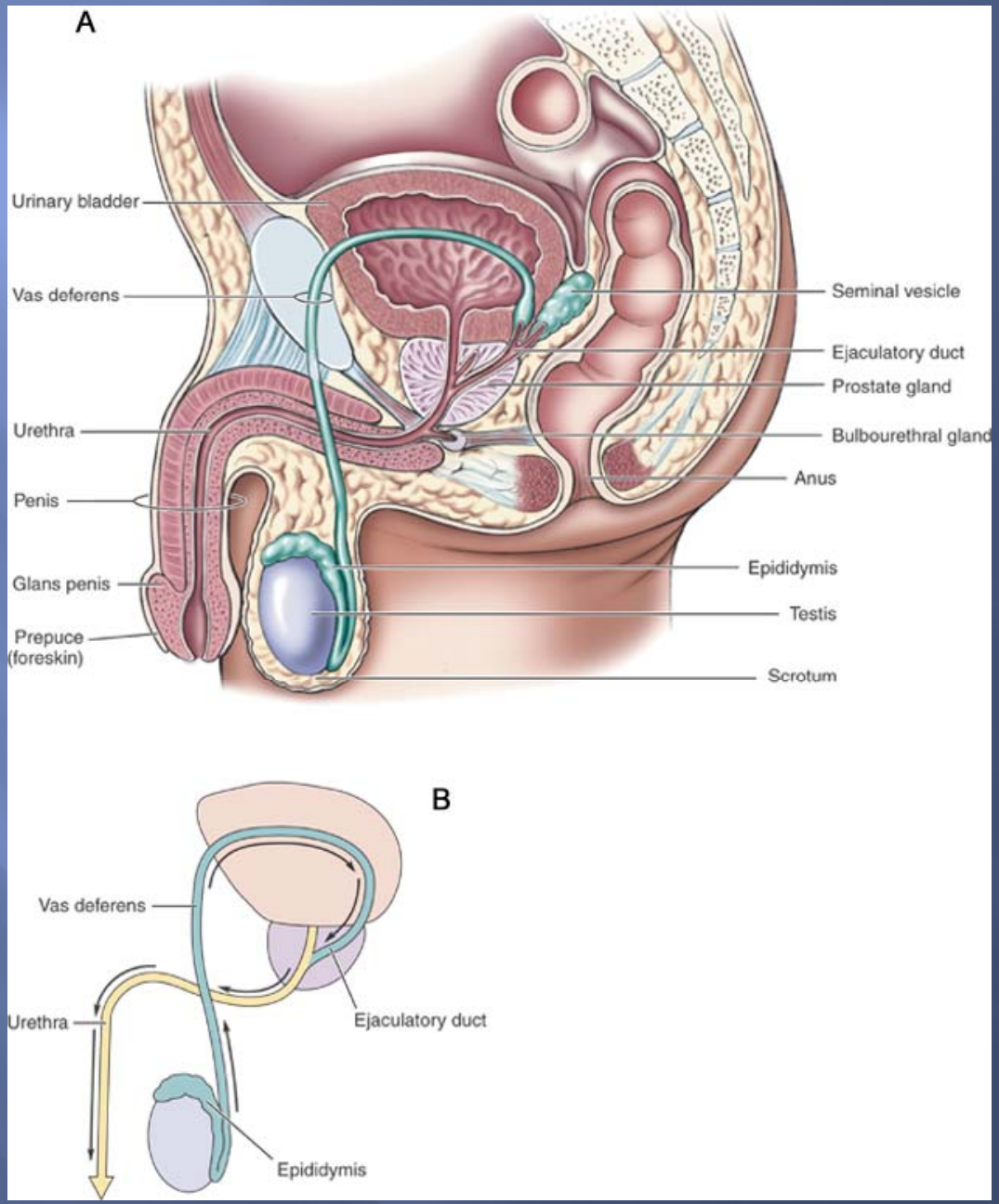
- Spermatogensis
  - The formation of sperm
  - The undifferentiated spermatogenic cells are called spermatogonia
  - Each spermatogonia contains 46 chromosomes
  - Under the influence of testosterone, the spermatogonia enlarge to become primary spermatocytes
  - Primary spermatocytes divided by a special 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

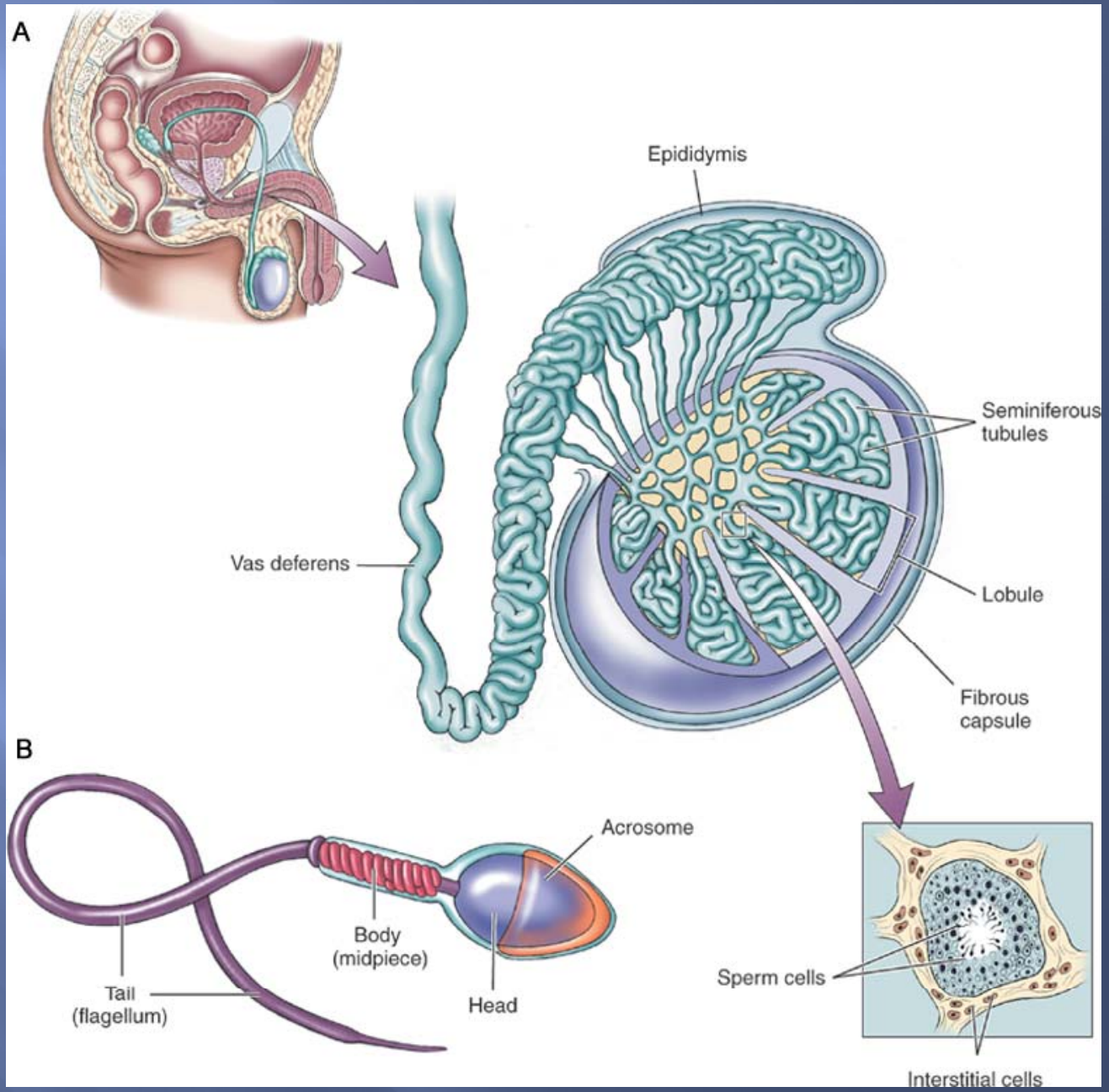
Sperm

- 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 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

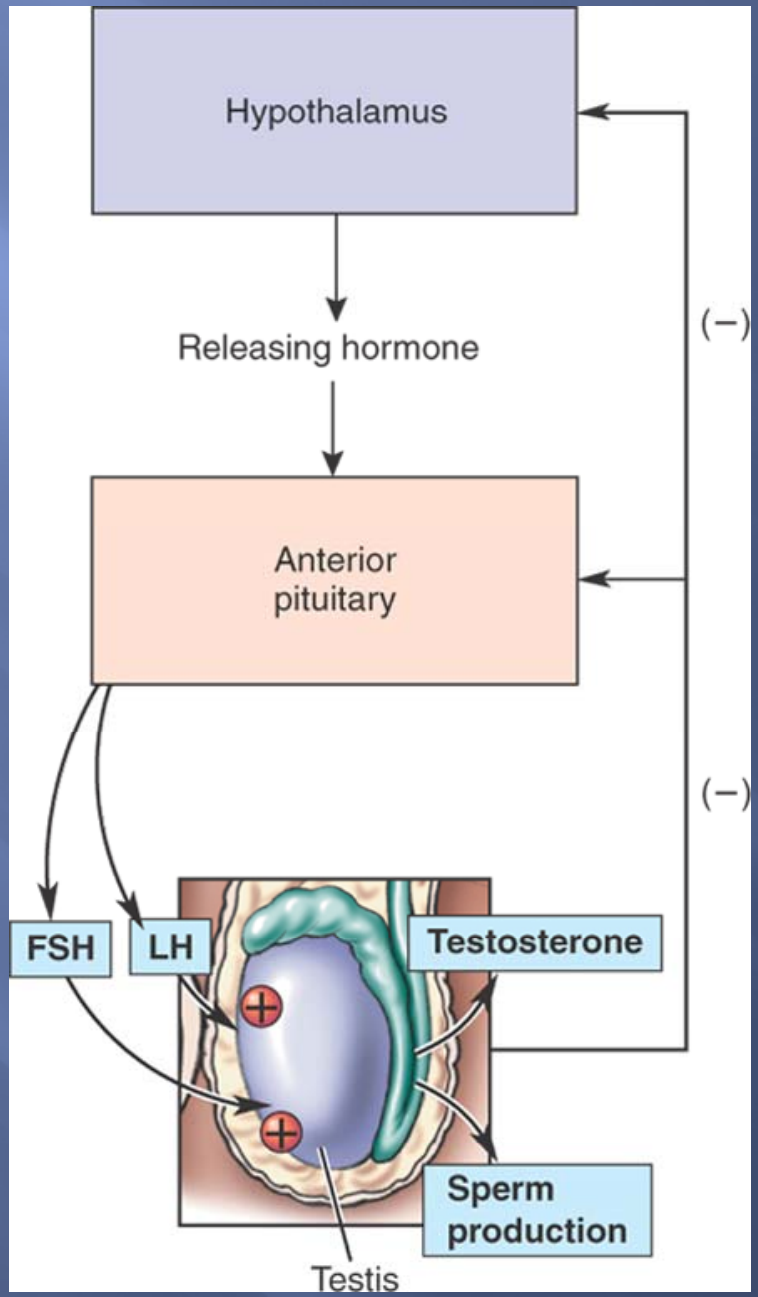
- Testosterone is necessary for production of sperm & the development of male sex characteristics
- Primary sex characteristics include enlargement of testes & penis
- Secondary sex characteristics include:
  - Increased growth of hair
  - Deepening of voice
  - Thickening of the skin & increase in oil & 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

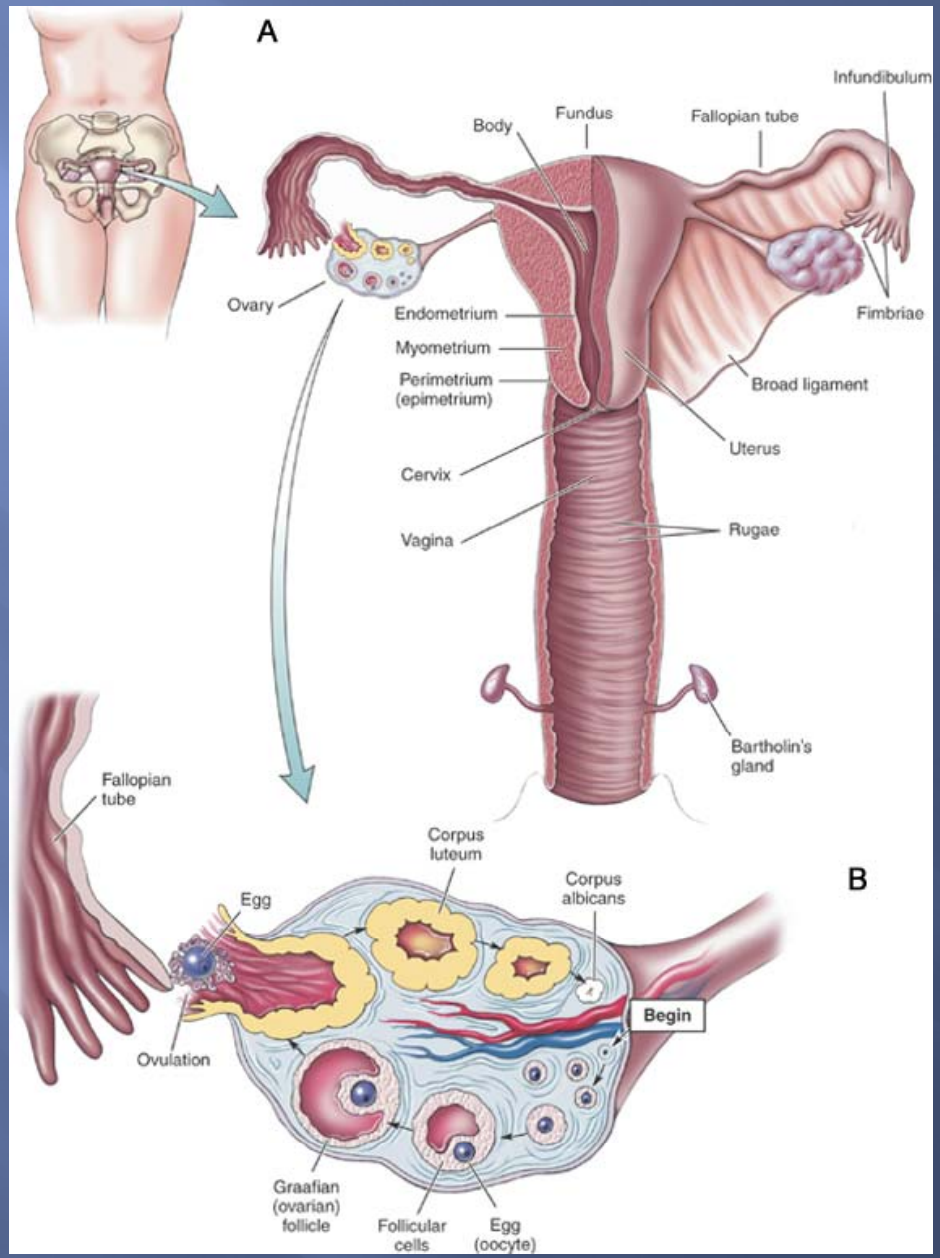
- Uterus:
  - AKA womb
  - Shaped like an upside down pear
  - Located between the urinary bladder & rectum
  - Broad ligament holds the uterus in place
  - Provides the growing baby a safe & nuturing place
  - The uterus increase considerably in size
  - 3 parts:
    - Fundus: upper dome-shaped region 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

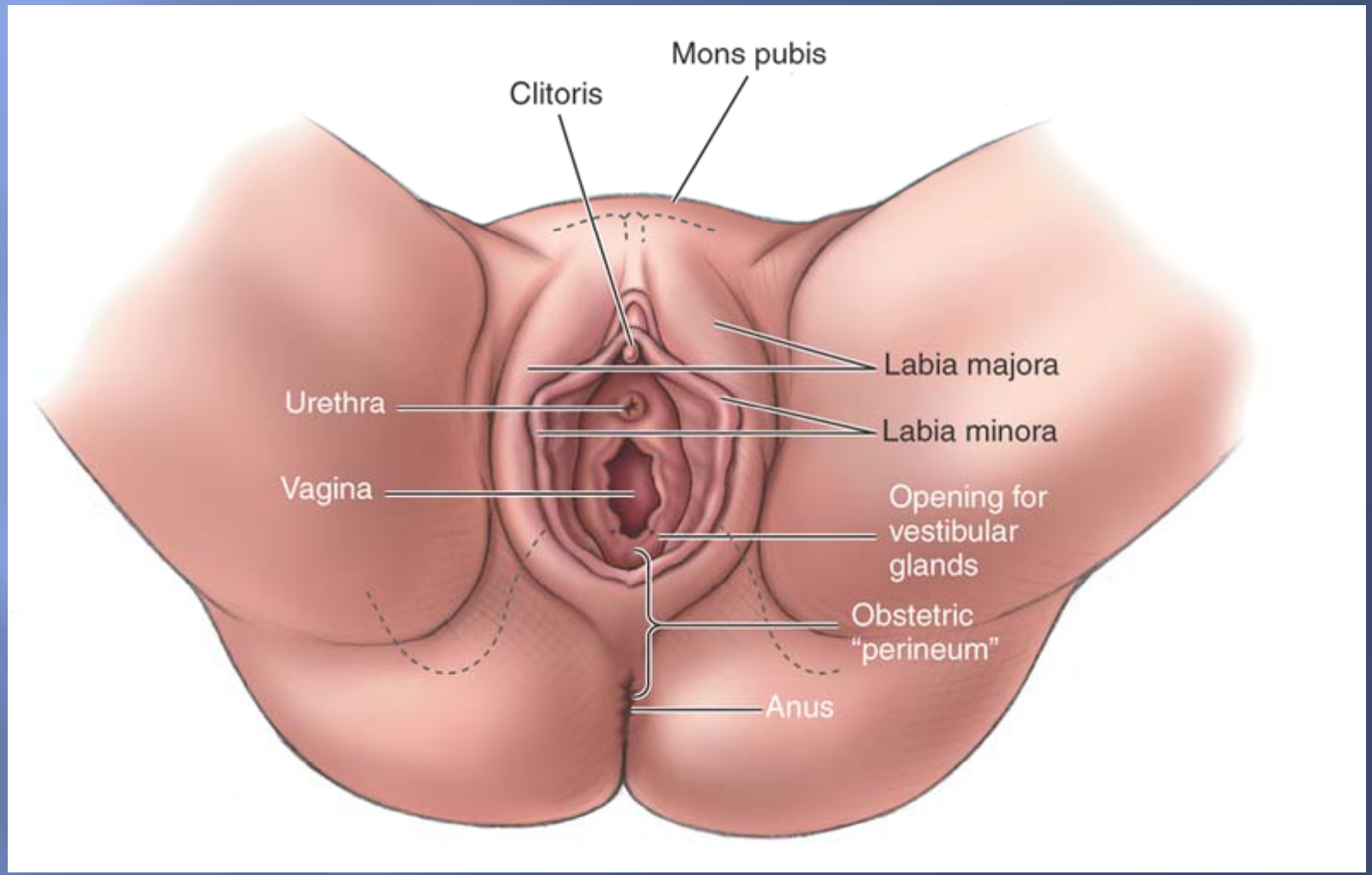
Vagina

- 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
Fundus
Body
Fallopian tube
Ovary
Endometrium
Myometrium
Perimetrium
(epimetrium)
Fimbriae
Broad ligament
Uterus
Cervix
Vagina
Rugae
Bartholin's
gland
Fallopian
tube
Corpus
luteum
Corpus
albicans
Egg
B
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

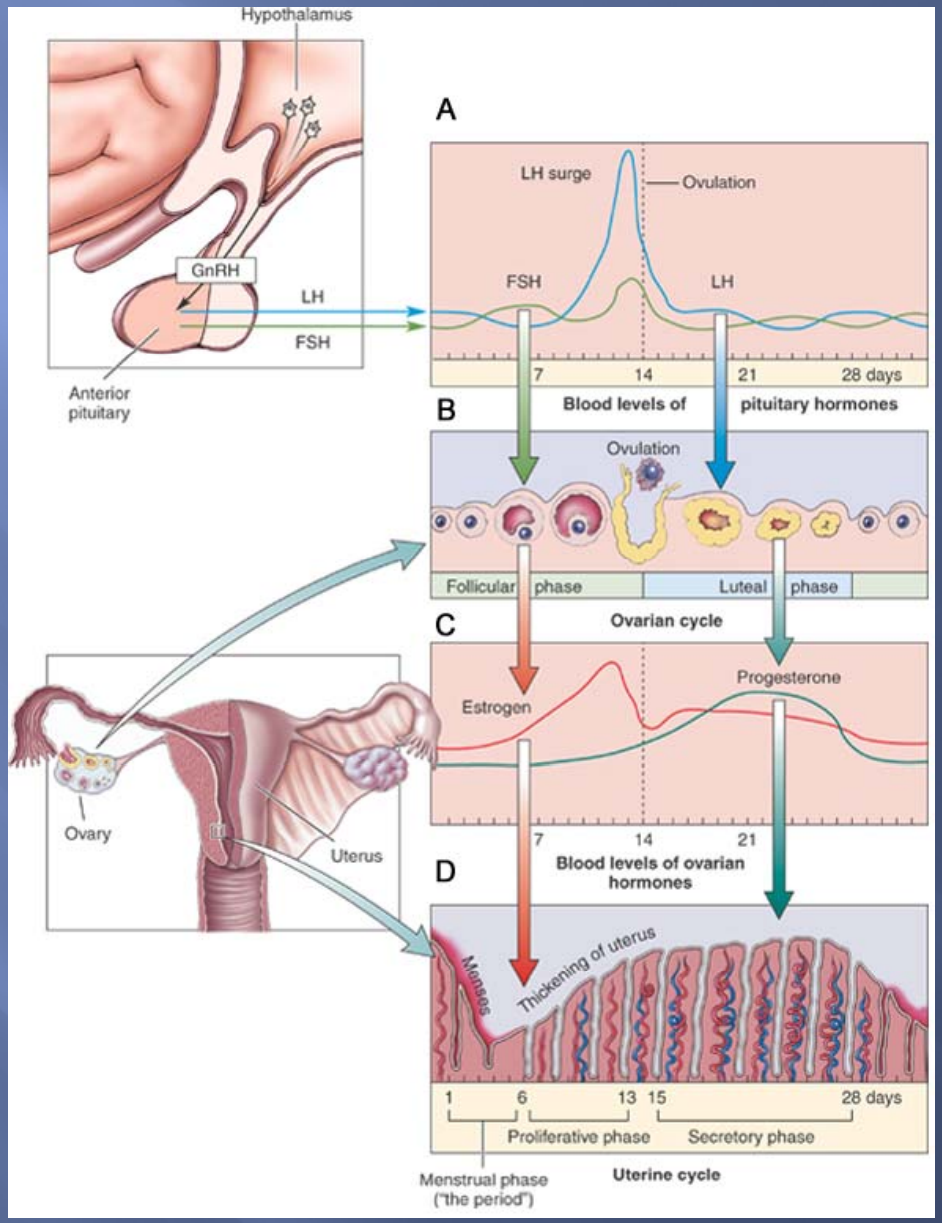
- Luteal phase immediately follows ovulation
- The corpus luteum develops during the luteal phase
- Follicular cells of the ruptured follicle on the surface of the ovary form the corpus lutem
- LH then stimulates the corpus to secrete progesterone & small amounts of estrogen
- The progesterone & estrogen 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
Progesterone
Estrogen
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