Overview

- **Main job** – ensure continuation of the human species
- **Gonads** – in all sexually reproducing organisms
  - Aid in sexual reproduction
  - Start to develop at 4.5 weeks, function at 11.5
  - Derived from mesoderm that forms the kidneys
  - Specialized germ cells (SGCs)
    - Unique to gonad; mobile
  - At 7 weeks, can undergo meiosis
    - Gonad becomes an ovary (female gonad) or testis (pl. testes – male gonad)
• Sexual dimorphism – developmental differences between male and female
  • Secondary sex characteristics - anatomical features that distinguish males from females
    • Evident after 14 weeks of development
    • Further development takes place at puberty
      • Stage where reproduction becomes possible
Female Reproductive System

- Divided into reproductive tract and mammary glands
  - Most is internal
    - Some can be external genitalia—sex organs on outside of body
- Produce and transport the egg
- Sexual reproduction and care of developing fetus also takes place in reproductive tract
- Tract composed of: ovaries, fallopian tubes, uterus, and vagina
Reproductive Tract - Ovaries

- Paired, oval-shaped organs responsible for egg formation and sex-hormone production
  - Located on lateral sides of the uterus, below opening to fallopian tubes
  - Attached to uterus by the ovarian ligament (CT)
- Composed of outer cortex and inner medulla layer
  - Outer cortex – cellular CT where eggs are located
    - Egg also referred to as ovum
    - Eggs not produced here, just stores eggs in ovarian follicles
      - Where eggs mature
  - Medulla – loose CT, contains many blood vessels and nerves
Ovarian follicles consist of an immature egg; or oocyte

- Oocyte – cell that has not yet undergone meiosis
  - Ovary contains nearly 7 million oocytes by 6 months of development
    - Approx. 40,000-60,000 are present by puberty
    - About 400 mature within a lifetime

- One develops at a time
  - As it matures, it fills with fluids that nourish and protect the oocyte
    - Migrates towards the surface of ovary, facing opening of fallopian tube
    - When mature = graafian follicle
    - Now, it is an ovum
      - Ovum ruptures out of graafian follicle during ovulation
Ovum Development

Structure of an Ovary

- Secondary follicle
- Oocyte
- Primary follicles
- Primordial follicles
- Ovarian ligament
- Degenerating corpus luteum (corpus albicans)
- Corpus luteum
- Corona radiata
- Ovulated ovum
- Developing corpus luteum
Ovaries, cont.

- Ovulation – release of ovum from the ovary
  - Egg enters fallopian tube
    - Not all reach follicle tube; some fall into abdominal cavity
      - Decay after 2 days
Ovaries, cont.

- Ovarian Responsible for producing estrogen and secreting it into the blood stream
  - Aromatase – converts androgens into estrogen
  - Androgen – maintains body structure and provides male sex char.
    - Secreted by ovaries – (female = small amounts) – needed to maintain bone and muscle structure
- Corpus luteum – makes progesterone
  - Forms in a follicle that has released an egg during ovulation
    - Progesterone – used as a indicator to detect ovulation
    - Desmolase – help convert cholesterol into progesterone
    - Disintegrates if egg is not fertilized
Ovaries, cont.

- Some can have dysfunctional aromatase and desmolase
  - Creates intersex condition – not sure of sex
    - Usually only have male or female gonad – not both
      - Usually doesn’t produce gametes because of abnormal hormone levels
15.2 Fallopian Tubes

- Aka oviducts, 3 inch long tubes that extend from each side of the uterus
  - One fallopian tube leads to each ovary
    - Do not make contact

- Carry eggs and sperm to site of fertilization
  - End near ovary has finger-like projections called fimbriae
    - Have many ciliated cells who wave-like movements sweep ovulated egg into fallopian tube
      - Lined with mucous membranes that secrete substances to maintain egg and sperm
        - Also provide nutrients to early embryo

- Myosalpinx – contracts to move egg through fallopian tube

- Broad ligaments – hold fallopian tubes in place by attaching them to uterus
Fallopian Tubes

The journey of a sperm to the Fallopian tube is somehow guided to fertilize the egg. The sperm attaches to the egg, sheds its cap, or acrosome, and releases enzymes that dissolve the outer covering of the egg. In about three hours, the entire sperm enters the egg. Simultaneously, changes occur in the egg as soon as the sperm has entered it, rearranging the zona pellucida so that no other sperm can gain entrance. The egg is now said to be fertilized, having the potential to develop into a new baby.
Uterus

- Aka womb – hollow muscular organ where the embryo and fetus develop

- Has three layers
  - Middle layer – myometrium – very thick and contractions aid in childbirth
  - Inner layer is thick mucosa – endometrium – rich in blood vessels
    - Varieties in thickness with the menstrual period
      - Menstrual cycle is periodic thickening and shedding of the endometrium
      - Prepares lining of uterus for development of embryo
  - Outer layer – perimetrium – CT that attaches laterally to the broad ligament
• Uterus divided into 3 regions
  • Upper region – uterine fundus – where embryo normally develops
  • Lower uterine segment – body –
  • Cervix – slightly protrudes into vagina
    • Composed of bands of muscles that contract during sexual activity and dilate during childbirth
Gestation Facts

- Normally takes 253-303 days from time of fertilization for human fetus to develop
Vagina

- Muscular passage that connects uterus to external genitalia
- Middle muscular layer is rich in blood vessels
  - Involved in female sexual response – may assist in passage of sperm into uterus
- Lined with high flexible stratified, squamous, non-keratinized epithelium
- Urethra – near opening of vagina
  - Skene’s glands – produces mucus at the base of the female urethra
    - Important during sexual activity
- Perineum – extends from vagina to anus – diamond shaped
Vagina – External Genitalia

- Vulva – external
- Mons – pad of fat tissue that covers the pubic bone
  - Rich in nerves associated with sexual sensitivity
  - Protects pubic bone from forces of sexual activity
- Labia majora – outer lips of vulva
  - Pads of fat tissue that wrap around the vulva from the mons to the perineum
    - Covered with pubic hair after puberty
    - Have many sweat and sebaceous glands
- Labia minora – inner lips of vulva
  - Cover and protect the vaginal opening
Vagina – External Genitalia

- **Clitoris** – in upper region of labia minor
  - Small piece of highly innervated erectile tissue involved in sexual response
  - Clitoral hood protects clitoris from abrasion
- **Hymen** – thin membrane – partially covers vaginal opening at birth
  - Has a variety of sizes and shapes depending on embryological development
  - Erodes with age or can be broke during sexual activity
Mammary Glands

- Breasts – specialized organs that secrete milk following pregnancy
- Composed of glandular tissue located in subcutaneous tissue of the upper chest
  - Develops after puberty and contributes to secondary sex characteristics
- Composed of many lobes
  - Composed of loose CT and glands
  - Contain many lymphatic vessels and lymph nodes
- Rich blood supply
Mammary Glands, cont.

- Lactiferous ducts – carry milk to nipples
- Nipple – small raised area in center of each mammary gland
  - Has openings for passage of milk
  - Areola – pigmented skin around areola
  - Heavily innervated for sexual stimulation and milk release
- Lactation – formation of milk
  - Stimulated by hormonal changes due to end of pregnancy
Milk is complete mixture of nutrients required for growth of baby
Provides antibodies against general infections
Differs significantly from cow’s milk
- Higher carbohydrate and lower protein than other animal milk
  - Cow milk is lower in amino acids needed for CNS development
  - Formula designed to provide all nutritional components of human milk
    - Lacks antibodies needed to assist the baby’s agility to fight off sickness
Mammary Glands

Mammary gland sagittal section

- pectoral fascia
- pectoralis major muscle
- intercostal muscles
- suspensory ligaments
- lactiferous sinus
- lactiferous duct
- gland lobules
- fat
- ribs
- lung
15.3 Male Reproductive System

• Male reproductive system facilitates sexual reproduction and eliminates wastes from the kidneys

• Internal components
  • Seminal vessels
    • Network of tubes and glands that assist with the transport of sperm

• External components
  • Penis (phallus) – external part of the urinary and reproductive systems of the male
  • Testes – male gonad
  • Scrotum – pouch of skin that encloses the testes
Testes

- Start out near kidneys
  - Descend through openings at the base of pelvis and into scrotum sometime just before birth
  - Divided into two halves by thin membrane
    - Each half holds one testis
- Undescended testicles, or cryptorchidism – condition in which one or both testes do not pass into scrotum
  - 4% of males born in North America
  - Usually descend by month 9
  - Surgical intervention is necessary if they do not descend on their own
Testes, cont.

- Seminiferous tubules – tubes in testes where sperm is produced
- Each testis is believed to produce trillions of sperm in a lifetime
- Leydig’s cells – produce testosterone in the testis
  - Interspersed between seminiferous tubules
- Epididymis – tube where sperm are collected and stored after leaving the testis
  - Abnormal sperm, and sperm that do not leave the epididymis, are broken down and absorbed
Fluids secreted by epididymis nourish the sperm and permit them to mature until moving into vas deferens, of ductus deferens

Vas deferens – transports sperm from testis to urethra

- Sperm remains here until sexual stimulation causes them to be expelled
- Curved tube that runs up along the bladder and past the glands called the seminal vesicles
  - Paired glands that produce semen
    - Composed of sperm and seminal secretions
Seminal Vessels, cont.

- Semen passes into ejaculatory ducts – opens to urethra
- Prostate gland – gland in male that surrounds base of urethra
  - Secretes mucous like fluid into semen
    - Secretion provides lubrication during sexual activity
    - Inflammation can impede passage of semen and urine, sometimes making it painful to urinate
- Cowper’s glands – pair of glands that lie beneath the prostate gland
  - Urethra passes by
  - Produce alkaline fluid that neutralizes acidic environment of urethra
    - Sperm are disable or killed by acidic conditions
Prostate

This shows the prostate and nearby organs.

This shows the inside of the prostate, urethra, rectum, and bladder.
Penis

- Corpus cavernosum – large cylinder of erectile tissue in the penis
  - Runs along the dorsal surface of penis
  - Engorges with blood and makes the penis erect during sexual excitement
- Dorsal vein – runs along the dorsal length of penis
- Erection – enlargement and hardening of the penis during sexual excitement
  - Occurs when blood fills the three cylinders of erectile tissue
    - Corpus spongiosum and (2) corpus cavernosum
Structures of Penis

- Skin
- Deep dorsal vein
- Tunica albuginea
- Corpus cavernosum:
  - Trabeculae
  - Cavemosal spaces
  - Cavemosal artery
- Septum
- Corpus spongiosum
- Urethra
Structure of a Sperm

- Acrosomal cap
- Nucleus
- Mitochondria
- Middle piece
- Axial filament
- Tail
Menstrual cycle is series of events that prepare body for pregnancy

- 2 parts:
  - Ovarian cycle
    - Leads to ovulation
    - Prepares egg and passes it out of ovary
  - Uterine cycle
    - Preovulation (follicular)
    - Postovulation (luteal)

- 2 phases
  - Preovulation (follicular)
  - Postovulation (luteal)
Ovarian Cycle

- Days (1-5) Menses (shedding of endometrium)
  - Dead cells from uterine lining slough off, tearing blood vessels
  - Causes vaginal bleeding
- Days (6-13) Proliferative Phase
  - Epithelial cells reproduce to build up uterine lining
- Days (14-15) Ovulation
  - Ovum released from ovary and moves into fallopian tubes for possible fertilization
- Days (16-28) Secretory Phase
  - Uterine lining prepares for pregnancy
    - Grows thick, increases blood supply
  - If fertilization does not occur, hormones decrease, lining cells are sloughed off
Menses

- 28 days is average length of menstrual cycle
  - Can range from 23-35 days
- Timing affected by nutrition, stress, and other health factors
- Women in many cultures used to be considered unclean or unholy during menses
Copulation

- Aka sexual intercourse – act of mating
- Fertilization is union of egg and sperm
- In males, erection is required to place sperm deep in vaginal canal
  - Erectile dysfunction – inability to produce or maintain an erection
    - Various treatments and medications
- Semen is pushed into urethra and out of the urethral meatus in process called ejaculation
  - ~400 million sperm in an average intercourse
- Orgasm – intense sensation, occurs at height of sexual excitement
  - Detumescence – loss of erection following ejaculation
  - In females, contractions of vaginal tract necessary to push sperm into uterus
Embryology and Pregnancy

- Point of conception
  - Fertilization
  - Other particular point of development
- Sperm can survive up to 48 hours in reproductive tract
  - Only a few hundred survive the trip
- Sperm uses enzyme’s in a structure called acrosome to create small opening in egg’s covering
  - Once fertilized, egg finishes meiosis, following by rapid periods of mitosis and development called embryogenesis
    - Two eggs + two sperm – fraternal twins 😊
Embryogenesis

- Begins when fertilized egg, now termed zygote, undergoes mitosis
  - Occurs rapidly from trip down fallopian tube to uterus
    - Divides every 7 hours
- Blastula, or blastocyst – hollow sphere of cells formed by mitosis of zygote
  - ~ 7 days after fertilization
- Implantation – imbedding of blastula into endometrium
  - Initiates formation of placenta – needed to nourish the remaining stages of embryogenesis
Pregnancy

- Begins after successful formation of placenta
  - hCG – human chorionic gonadotropin – protein produced by placenta
    - Maintains pregnancy by triggering release of estrogen and progesterone
    - Useful indicator of pregnancy
    - Present in blood and urine ~10 days after fertilization

- Blastula becomes gastrula
  - Ectoderm, mesoderm, and endoderm layers form
  - Identical twins happen in gastrula stage
    - Occur when one gastrula divides into 2 gastrulas
    - Share one placenta and start out with identical genetic material
  - Conjoined twins – occur when gastrula fails to split completely
    - Leaves babies joined in a variety of ways
Pregnancy, cont.

- Development of gastrula produces the fetus
- Aminiotic sac, or bag of waters, surrounds the fetus
  - Baby is cushioned in amniotic fluid
- Mother’s nutritional level determines degree of organ system development
  - Alcohol, drugs, infectious diseases, and variety of pollutants can alter the fate of fetal development
  - Birth defects – caused by genetic disorders
Pregnancy, cont.

- Internal components of both genders present @ 10 weeks
- Sexual dimorphism begins @ 13 weeks
- Fetus almost fully formed by end of 8\textsuperscript{th} month
  - Lungs and parts of digestive system remain incomplete
- Labor – process of childbirth
  - First stage – dilation of cervix
    - Powerful contractions of myometrium
    - Amniotic sac ruptures
    - Contractions push baby past cervix through vagina
- Placenta – shortly after birth, loosens attachment and is expelled
- Colostrum – fluid produced by mammary glands just after birth
  - High in calories and nutrients, even more so than regular breast milk
    - Regular milk produced a few days after labor
15.5 Pathology (congenital)

- Prevent normal development of reproductive system
- Hypospadias – abnormal development of the penis and male urethra
  - Sometimes develops as an open slit
  - Makes urination and sexual reproduction very difficult
Sexually transmitted diseases (STDs) – most common
- Predominantly spread through copulation
  - Can be spread through oral sex

Reports of STDs are sent to the Centers for Disease Control and Prevention (CDC) and the National Institutes of Health (NIH)
- The World Health Organization (WHO) monitors STDs worldwide

Pelvic inflammatory disease (PID) – develops from untreated bacterial STDs
- Causes inflammation of fallopian tubes and can spread to ovaries and peritoneum
  - Common cause of female infertility
Degenerative Disorders

- Prostate cancer – cancer of prostate
  - Slow-growing, malignant growth in prostate gland
  - Cause is unknown
  - Risk increases with age.. 75% are over 65

- Testicular cancer – cancer of testes
  - More common in younger males
  - 1% of all cancer in males
  - Can be fatal if spreads to other organs
Degenerative Disorders

- Breast cancer – cancer of mammary glands
  - Usually has genetic cause
  - Can be initiated by birth control or estrogen supplements
  - Can be localized to one lobe or in many
  - If left untreated, fatal
- Cervical cancer
  - Most caused by HPV
  - Can spread and cause death if untreated
- Genital warts – warts on penis or female reproductive tract caused by HPV
- Fibroids – tumors of myometrium
  - Noncancerous
  - Can be as large as grapefruit and cause cramping
  - Can cause infertility
Ectopic pregnancy – when implantation takes place outside the upper uterine cavity
  - Placenta will form, but does not provide environment needed for fetal development

Placenta previa – location of placenta is in lower portion of uterus, covering cervix
  - Does not affect growth and development
  - Can block the passage of the baby out of the uterus

Cesarean section – delivery of a fetus by surgical incision through abdominal wall
Ectopic Pregnancy

A. The embryo implants in the right fallopian tube before it reaches the uterus.

B. The embryo grows causing the fallopian tube to bulge.

C. As the embryo grows larger, the fallopian tube ruptures and hemorrhages.
Cesarean Section
Aging

- Vesicoureteral reflux – backup of urine to the kidneys
  - Due to prostate gland enlarging and develops scar-like tissue
- Andropause – age-related changes to male reproductive system
  - Occur gradually after 50
  - Slow decline in fertility
  - Decline in testosterone
- Menopause – cessation of the menstrual periods
  - Caused by a decrease in sensitivity to follicle-stimulating hormones
- Prolapse – condition in which organ becomes displaced
  - Can occur with or after menopause
  - Tissues atrophy and sag, can cause bladder, uterus, or vagina to drop out of position
Uterine Prolapse