Reproductive Systems

OUTLINE:
- Gonads
- Male and Female Reproductive Roles
- Form and Function of the Male Reproductive System
- Form and Function of the Female Reproductive System
- Disorders of the Female Reproductive System
- Stages of the Human Sexual Response
- Birth Control

Gonads
- Two important functions:
  1. They produce the gametes, meaning the eggs and sperm—the cells that will fuse and develop into a new individual
  2. They produce the sex hormones
- Testes
  - Produce sperm and testosterone
- Ovaries
  - Produce eggs and estrogen and progesterone

Male and Female Reproductive Roles
- Males and females make an equal genetic contribution by contributing one copy of each chromosome to their offspring
- Reproductive strategies
  - Male
    - Produce millions of sperm and deliver them to the female reproductive system
  - Female
    - Produce one egg each month and nourish and protect developing offspring

Male and Female Reproductive Roles
- Each gamete contains one-half the number of chromosomes (23; haploid)
- When an egg and sperm fuse at fertilization, they form a zygote with a full set of chromosomes (46; diploid)

Form and Function of the Male Reproductive System
- Testes
- Duct system (epididymis, vas deferens, urethra)
- Accessory glands
  - Prostate gland
  - Seminal vesicles
  - Bulbourethral glands
- Penis

Testes
- Held outside the abdominal cavity in the scrotum: allows for temperature regulation
- Sperm develop in the seminiferous tubules
- Interstitial cells produce androgens, including testosterone

**Testes**
- Testicular cancer
  - Most common form of cancer among men 15–35 years of age
  - Does not usually cause pain, so monthly self-examinations are important
  - High cure rate when caught in early stages

**Duct System**
- Epididymis
  - Receives sperm from seminiferous tubules
  - Site of sperm maturation and storage
- Vas deferens
  - Conducts sperm from epididymis to urethra
- Urethra
  - Conducts urine from urinary bladder
  - Conducts sperm from vas deferens

**Accessory Glands**
- Semen
  - Fluid containing sperm and secretions of the accessory glands
  - Released through the urethra at sexual climax
- Accessory glands
  - Prostate gland
    - Surrounds upper portion of urethra
    - Produces alkaline secretions that activate sperm and reduce acidity of male and female reproductive tracts

**Accessory Glands**
- Two conditions of the prostate gland
  - Age-related enlargement: begins at middle age and may restrict flow of urine
  - Cancer: can be detected through rectal exam or blood test that measures prostate-specific antigen (PSA)
- Seminal vesicles
  - Paired glands
  - Secretions nourish sperm (fructose), thicken semen (amino acids), and assist movement of sperm in the female reproductive tract (prostaglandins)

**Accessory Glands**
- Bulbourethral glands
  - Paired glands
  - Release clear, slippery liquid before ejaculation that may rinse acidic urine from the urethra

**Accessory Glands**
- Penis
  - Delivers sperm to the female reproductive tract
  - Glans penis
    - Tip of the penis with many sensory nerve endings
    - Covered by the foreskin, which is sometimes surgically removed (circumcision)
• Contains three columns of spongy erectile tissue that fill with blood during an erection

**Penis**

- Erectile dysfunction (ED; impotence)
  - Inability to achieve or maintain an erection
  - Causes range from psychological issues to damaged nerves or blood vessels
  - Medications (Viagra, Levitra, and Cialis) prolong effects of nitric oxide, which promotes widening of arteries in the penis

**Sperm Development**

- Sperm development—spermatogenesis
  - Occurs within seminiferous tubules
  - Reduces number of chromosomes to one member of each pair
  - Changes shape of sperm so they can deliver chromosomes

**Sperm Development**

- Spermatogonia (undifferentiated diploid cells)
- Primary spermatocyte (diploid cell that undergoes two divisions of meiosis)
  - Secondary spermatocytes (after meiosis I)
  - Spermatids (after meiosis II; haploid)

**Sperm Development**

- Spermatozoa (exhibit structural changes necessary for reaching egg and fertilizing it)
- The mature sperm cell has three regions
  1. Head
  2. Midpiece
  3. Tail

**Hormones**

- Testosterone, secreted by the interstitial cells of the testes, is important for sperm production and development of male characteristics
  - Production is regulated by a negative feedback loop:
    - Hypothalamus releases gonadotropin-releasing hormone (GnRH)
    - GnRH stimulates anterior pituitary to secrete luteinizing hormone (LH)
    - LH stimulates production of testosterone by interstitial cells of testes
    - Rising testosterone levels then inhibit release of GnRH from hypothalamus, which decreases LH, which decreases testosterone secretion

**Hormones**

- Sperm production is also controlled by a negative feedback loop
  - Follicle-stimulating hormone (FSH) produced by the anterior pituitary makes the cells that will become sperm more sensitive to testosterone
    - This stimulates sperm production
  - High sperm numbers then prompt the seminiferous tubules to produce inhibin, which inhibits production of GnRH and FSH
Hormones

Form and Function of the Female Reproductive System
- Structures of the female reproductive system
  - Ovaries
  - Oviducts
  - Uterus
  - Vagina
  - External genitalia
  - Breasts

Ovaries and Oviducts
- Ovaries
  - Produce eggs through oogenesis
  - Produce estrogen and progesterone
- Oviducts
  - Also known as fallopian or uterine tubes
  - Transport immature egg from the ovaries to the uterus
  - Most commonly the site of fertilization

Uterus
- **Uterus**: hollow, muscular organ that receives and nourishes developing embryo
  - Wall has two layers
    - Smooth muscle
    - Endometrium
      - Site of implantation of the embryo (if outside uterus, then ectopic pregnancy)
      - If no embryo, then shed as menstrual flow

Uterus
- **Cervix**: narrow neck of the uterus that extends into the vagina
- **Vagina**: receives the penis during intercourse and serves as the birth canal during delivery

External Genitalia
- **External genitalia (vulva)**
  - Female reproductive structures that lie outside the vagina
  - Include
    - Labia majora
    - Labia minora
    - Clitoris
      - Contains erectile tissue and many nerve endings

Breasts
- **Mammary glands**
  - Present in both sexes, but only in females produce milk to nourish newborn
  - Contain milk-secreting glands and ducts, which drain through the nipple
  - Connective tissue supports breasts, which are mostly fatty tissue
Breasts

Ovarian Cycle
- Events leading to the release of an egg
- About one month in length

Ovarian Cycle
- Timing of egg development across a female’s lifetime
  - Before birth, all of a woman’s primary oocytes (immature eggs) have formed
    - Primary oocyte plus surrounding flattened cells—primary follicle
  - Eggs remain in immature state until puberty
  - At puberty, one primary follicle each month resumes development

Ovarian Cycle
- Steps of the ovarian cycle
  - Follicle maturation
    - Primary follicle matures into secondary (Graafian) follicle
    - Primary oocyte completes its first meiotic division, forming a secondary oocyte and first polar body
  - Ovulation
    - Secondary oocyte released from ovary
    - If fertilization occurs, then the second round of meiosis occurs, forming an ovum (mature egg) and second polar body

Ovarian Cycle
- Steps of the ovarian cycle (cont’d)
  - Formation of the corpus luteum
    - Luteinizing hormone (LH) transforms cells of the Graafian follicle into the corpus luteum
      - Endocrine structure that secretes estrogen and progesterone
      - Degenerates unless pregnancy occurs

Coordination of the Ovarian and Uterine Cycles
- At monthly intervals
  - An egg matures and is released from the ovary (ovarian cycle)
  - The uterus is readied to receive and nurture the embryo (uterine or menstrual cycle)
    - If fertilization does not occur, then uterine provisions are discarded as menstrual flow
    - If fertilization occurs, human chorionic gonadotropin (HCG) produced by the embryo maintains the corpus luteum
      - Hormones of the corpus luteum maintain the endometrium (keep it from shedding)

Coordination of the Ovarian and Uterine Cycles
- Hormones that control female fertility
  - Anterior pituitary gland
    - Follicle-stimulating hormone (FSH)
- Stimulates follicle development
  - Luteinizing hormone (LH)
  - Triggers ovulation

**Coordination of the Ovarian and Uterine Cycles**
- Hormones that control female fertility (cont’d)
  - Ovary
    - Estrogen
      - Development of endometrium and female reproductive structures
    - Progesterone
      - Maintains the endometrium

**Coordination of the Ovarian and Uterine Cycles**

**Menopause**
- Cessation of ovulation and menstruation
- Usually occurs between 45 and 55 years of age

**Menopause**
- Physiological effects caused by drop in estrogen associated with menopause
  - Loss of fat layer leads to wrinkles
  - Disruption of thermostat causes hot flashes
  - Vaginal dryness
  - Growth of facial hair
  - Increased risk of heart and blood vessels diseases
  - Osteoporosis

**Disorders of the Female Reproductive System**

**Premenstrual syndrome (PMS)**
- Symptoms appear 7–10 days before period
  - Include depression, irritability, fatigue, headaches
- Possibly caused by progesterone deficiency
- Treatments
  - Medications that raise serotonin
  - Changes in diet
  - Aerobic exercise

**Disorders of the Female Reproductive System**

**Menstrual cramps**
- Caused by high levels of prostaglandins produced by endometrial cells
- Prostaglandins cause smooth muscle cells of uterus to contract
- Muscle spasms may cause pain by reducing blood supply to uterine muscles

**Disorders of the Female Reproductive System**

**Endometriosis**
- Condition in which tissue from the uterine lining is found outside the uterine cavity
  - Often on oviducts, ovaries, outside surface of uterus, or bladder
- Endometrial tissue grows and breaks down in response to hormones, which may cause severe pain

**Disorders of the Female Reproductive System**
• Breast cancer
  • May begin in cells lining milk ducts or in milk glands
  • Detection
    • Monthly breast self-exam
    • Mammograms
  • Risk factors (increased exposure to estrogen)
    • Young age at first menstruation
    • Menopause after age 55
    • Childlessness and late age at first pregnancy
    • Obesity
  • Breast-feeding may reduce risk

Stages of the Human Sexual Response
• In both men and women, sexual arousal and sexual intercourse involve two physiological changes
  • Vasocongestion: certain tissues fill with blood
  • Myotonia: certain muscles show sustained or rhythmic contractions
• Four stages of the sexual response cycle
  1. Excitement
  2. Plateau
  3. Orgasm
  4. Resolution

Birth Control
• Prevents pregnancy
• In some cases can reduce the risk of spreading sexually transmitted diseases (STDs)
• Abstinence: refraining from sexual contact
  • Reliably avoids both pregnancy and spread of STDs

Birth Control
• Sterilization: cutting and sealing gamete transport tubes to permanently prevent fertilization
  • Offers no protection against STDs
  • Vasectomy in males: vas deferens cut to prevent sperm from leaving the body (reversible soon after)
  • Tubal ligation in females: oviducts cut to prevent egg and sperm from meeting (irreversible)

Hormonal Contraception
• Currently available only to females
• Does not protect against STDs, and may even increase risk of transmission
• Two basic approaches
  • Combination estrogen and progesterone
  • Progesterone only

Combination Estrogen and Progesterone Contraception
• Uses synthetic forms of estrogen and progesterone to suppress release of FSH and LH
• Prevents maturation of egg and its release from the ovary
Examples: “the pill,” skin patch, vaginal ring

**Progesterone-Only Contraception**
- Uses synthetic progesterone
- May prevent ovulation, thicken cervical mucus (making it difficult for sperm to reach egg), and keep endometrium unprepared for implantation
- Examples: injection every 3 months, “minipill,” rod-shaped implants

**Intrauterine Devices**
- Small device inserted into the uterus by a physician
- Prevent the union of sperm and egg and/or implantation
- Do not protect against STDs

**Barrier Methods**
- Prevent fertilization
- Examples
  - Diaphragm
  - Cervical cap
  - Contraceptive sponge
  - Male and female condoms
- Vary in degree of protection offered against STDs
  - No protection (cervical cap) to good protection (latex condom)

**Spermicidal Preparations**
- Kill sperm and therefore prevent fertilization
  - Effective for only about one hour once activated
- Forms include foam, cream, jelly, or tablet
- Also kill organisms responsible for STDs but may damage cells of vagina and increase susceptibility

**Fertility Awareness**
- The avoidance of intercourse when fertilization is likely to occur
- Also called “natural family planning” or “rhythm method”
- Challenging to determine the four days in each cycle when fertilization might occur
  - Methods include calendar, body temperature, cervical mucus

**Emergency Contraception**
- Morning-after pills
  - Hormones taken within the first few days after unprotected intercourse
  - Two types
    - Preven combines estrogen and progesterone
    - Plan B contains only progesterone

**You Should Now Be Able To:**
- Define and describe gonads
- Understand male and female reproductive roles
- Know the form and function of both male and female reproductive systems
- Understand the possible disorders of the female reproductive system
- Understand the stages of the human sexual response
- Know the choices available regarding birth control