Chapter 17
Lecture Outline

See separate PowerPoint slides for all figures and tables pre-inserted into PowerPoint without notes.
Reproductive System
Points to ponder

• What are mitosis and meiosis?
• How many chromosomes do body cells and sex cells each have?
• Understand the anatomy of both the male and female.
• Know the functions of each structure in the male and female.
• What are the three parts of a sperm?
• How do hormones play a role in the male?
• Explain the ovarian and uterine cycles.
• Be able to discuss the levels of hormones during the ovarian and uterine cycles.
• Where do fertilization and implantation occur?
Points to ponder

- Be able to discuss common birth control methods.
- What is infertility? What can cause this?
- What are the options if a person is infertile?
- Should we treat people who are infertile? Why or why not?
- Understand genital warts, genital herpes, HIV, hepatitis, chlamydia, gonorrhea, syphilis, bacterial vaginosis, trichomoniasis, and candidiasis.
- Which STDs can be treated with antibiotics?
- Which birth control methods can help prevent STDs?
DNA in body and sex cells

• Body cells
  – Each body cell has 46 chromosomes (23 pairs) within the nucleus.
  – Cells that have pairs of chromosomes are called diploid (2n).
DNA in body and sex cells

• Sex cells
  – **Gametes** (egg and sperm) have only 23 chromosomes (1 of each pair) in their nuclei.
  – Cells that have only one of each pair of chromosomes are called haploid (n).
  – During fertilization, a sperm and an egg combine to form a **zygote**, and the chromosome number is restored to the diploid number of 46.
Mitosis and meiosis

• Mitosis is
  – a type of duplication division in which a cell makes an exact copy of itself.
  – a process used for growth and repair of tissues.
  – used by body cells (cells other than sex cells).
Mitosis and meiosis

• **Meiosis** is
  – a type of *reduction division* in which a cell halves the number of chromosomes.
  – a process used to form eggs and sperm.
  – used by gametes (sex cells).
The human life cycle

Figure 17.1 The human life cycle.
Male anatomy

1. Scrotum (1)
2. Testes (2)
3. Epididymides (2)
4. Vasa deferentia (2)
5. Urethra (1)
6. Three glands
7. Penis (1)
17.2 Male Reproductive System

Figure 17.2 The male reproductive system.
Male anatomy: Scrotum and testes

- **Scrotum**
  - Sacs that hold the testes
  - Help regulate the temperature of the testes

- **Testes**
  - Paired organs that produce sperm and male sex hormones (made by *interstitial cells*)
  - Composed of *seminiferous tubules* where sperm are being produced

- **Epididymis**
  - Sperm mature and are stored here
Male anatomy: Scrotum and testes

Figure 17.4a-b Spermatogenesis produces sperm cells.
Sperm production

- Sperm are produced within the seminiferous tubules of the testes.

- **Sertoli cells** help nourish sperm and regulate the process of sperm production (spermatogenesis).

- **Sperm** (spermatozoa) are stored and mature in the epididymis.
Sperm anatomy

• Three parts
  – The head is covered by a cap called the **acrosome** which stores enzymes needed to penetrate the egg.
  – The middle piece contains mitochondria to make ATP.
  – The tail provides movement for the sperm.

Figure 17.4d  Spermatogenesis produces sperm cells.
Male anatomy: Vas deferens and urethra

- **Vas deferens**
  - Transports sperm to the urethra

- **Urethra**
  - Transports sperm out of the body

17.2 Male Reproductive System
Male anatomy: 3 glands that contribute to semen

- **Seminal vesicles** – produce a sugary fluid that provides energy for the sperm

- **Prostate gland** – produces an alkaline fluid to help buffer the acidic pH of the vagina

- **Bulbourethral glands** – produce mucus that acts as a lubricant
Male anatomy: Penis

• Penis
  – This organ is used for sexual intercourse and urination.

• Glans penis
  – It is the tip of the penis, usually covered by foreskin, that is intensely sensitive.
  – Circumcision is the removal of all or part of the foreskin.
  – Erectile dysfunction (impotency) occurs when the erectile tissue does not expand enough to compress the veins.
17.2 Male Reproductive System

Male anatomy: Penis

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Figure 17.3a The structure of the penis.
Hormonal regulation in males

- **Gonadotropin-releasing hormone (GnRH)** – secreted by the thalamus to control release of other hormones

- **Follicle-stimulating hormone (FSH)** – promotes the production of sperm

- **Luteinizing hormone (LH)** – controls the production of testosterone

- **Testosterone** – important for normal development and functioning of the male reproductive organs
Figure 17.5 The hormones that control the production of sperm and testosterone by the testes.

Hormonal regulation in males

17.2 Male Reproductive System

Figure 17.5 The hormones that control the production of sperm and testosterone by the testes.

Hormonal regulation in males
Female anatomy

- Genital tract
  - Ovaries
  - Oviducts
  - Uterus
  - Cervix
  - Vagina

- External genitals (vulva)
  - Labia major
  - Labia minor
  - Mons pubis
  - Clitoris
Female anatomy: Genital tract

- **Ovaries** – produce eggs and sex hormones
- **Oviducts** – move eggs and normal site of fertilization
- **Uterus** – normal site of implantation and fetal development
- **Cervix** – opening to the uterus that can dilate during childbirth
- **Vagina** – birth canal and the copulatory organ of the female
Female anatomy: Genital tract

Figure 17.6 The female reproductive system.
Female anatomy: External anatomy

- Labia major – Two large folds of fatty skin
- Labia minor – Two small folds just inside the labia major that contain the openings to the urethra and vagina
- Mons pubis – fatty skin covered in coarse hair
- Clitoris – erectile organ and site of intense sexual feeling
The ovarian cycle: The ovary

- An ovary contains many **follicles**, each containing an immature egg (oocyte).

- At puberty a female has 300,000-400,000 follicles.

- During the lifetime of a female, only 400 follicles mature.
The ovarian cycle: The ovary

- One follicle matures each month from puberty until menopause (end of ovarian and uterine cycles).

- Ovulation is the monthly release of an oocyte from the ovary when a follicle ruptures.
1. A primary follicle contains an oocyte and begins producing the sex hormone estrogen.

2. The secondary follicle contains a secondary oocyte and produces the sex hormones estrogen and some progesterone.

3. Vesicular (Graafian) follicle develops.

4. Ovulation: The secondary oocyte is released.

5. Corpus luteum produces the sex hormones progesterone and some estrogen.

6. Corpus luteum degenerates.

Figure 17.8 The ovarian cycle.
Anatomy of the ovary

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primary oocyte (46 chromosomes) → meiosis I → secondary oocyte (23 chromosomes) → sperm → second polar body → meiosis II → zygote

Sperm enters, fertilization occurs, and meiosis II proceeds to completion.

Figure 17.9 Oogenesis produces egg cells.
The ovarian cycle

• This is the formation and release of an immature egg.

• It is controlled by GnRH from the hypothalamus.
The ovarian cycle

• Two phases
  - **Follicular phase**
    - FSH promotes the development of a follicle that secretes estrogen.
    - An estrogen spike leads to a surge in LH and ovulation around day 14 in the 28-day cycle.
  - **Luteal phase**
    - LH promotes the development of the corpus luteum that functions to secrete progesterone.
    - When pregnancy does not occur, menstruation begins.
17.4 The Ovarian Cycle

Hormonal control of the ovaries

**Figure 17.10** The hormones that control the production of estrogen and progesterone by the ovaries.
The uterine cycle

- A 28-day cyclic event in the uterus
  - Days 1-5: low levels of estrogen and progesterone cause the inner uterine lining (endometrium) to disintegrate, and menstruation occurs
  - Days 6-13 (proliferative phase): increase in estrogen causes the endometrium to thicken
  - Day 14: ovulation usually occurs
  - Days 15-28 (secretory phase): increase in progesterone causes endometrium to double or triple in thickness in preparation for the developing embryo; if the egg is not fertilized then the corpus luteum regresses and the endometrium breaks down
Hormones in the ovarian and uterine phases

Figure 17.11 The effects of estrogen and progesterone on the endometrium during the uterine cycle.
Fertilization and pregnancy

- **Fertilization** – union of a sperm and egg nucleus to form a zygote
  - Normally occurs in an oviduct

- **Pregnancy** – begins with implantation
  - Usually six days after fertilization
Some common birth control methods

- Abstinence – not engaging in sexual intercourse

- Hormonal control
  - Birth control pills block FSH and LH release to stop follicular development and ovulation.
  - Contraceptive injections of hormones (progesterone and/or estrogen) stop ovulation.
  - Contraceptive implants use synthetic progesterone to prevent ovulation.

Note: Abstinence and the use of condoms are the only methods that protect against STDs.
Some common birth control methods

• Barrier methods
  • An IUD is a small plastic piece inserted into the uterus to prevent implantation.
  • Condoms (male and female) block fertilization.
  • The diaphragm is a soft latex cup that covers the cervix so sperm cannot enter the uterus.

• Sterilization
  • Vasectomy consists of cutting and sealing the vasa deferentia.
  • Tubal ligation consists of cutting and sealing the oviducts.
17.5 Control of Reproduction

Some common birth control methods

Figure 17.14
Placement of birth control devices.

- a. Intrauterine device placement
- b. Female condom placement
- c. Male condom placement

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Sterilization

Figure 17.15 Vasectomies and tubal ligations.
What about pills that can be taken after intercourse?

- Preven, a morning-after pill, upsets the normal uterine cycle so an embryo has a hard time implanting (85% effective).

- RU-486 (mifepristone) causes loss of an implanted embryo (95% effective).
What is infertility and what causes it?

• This is the inability to achieve pregnancy after one year of regular, unprotected intercourse.

• Causes
  - Overweight females
  - Low sperm count
  - Blocked oviducts
  - Endometriosis
What are your options if you are infertile?

• Adoption – legal custody of a nonbiological child

• Assisted reproductive technologies
  – Artificial insemination by a donor (AID): sperm are placed inside the vagina by a trained physician
  – In vitro fertilization (IVF): conception occurs in laboratory glassware, then embryos are transferred to a woman’s uterus
What are your options if you are infertile?

- **Gamete intrafallopian transfer (GIFT):** similar to IVF, except the eggs and sperm are placed in the oviducts immediately after they have been brought together.

- **Surrogate mothers:** women are legally paid to have babies.

- **Intracytoplasmic sperm injection (ICSI):** a single sperm is injected into an egg, typically when a man has infertility problems.
Should infertility be treated?

- What are some drawbacks of the procedures?
  - Surgery and collection of eggs have risks such as organ damage and bleeding.
  - Fertility drugs can have side effects, some life-threatening.
  - IVF usually creates many embryos; some are frozen or donated while others are destroyed.
  - There is a significant increase in multifetal births which can result in a difficult pregnancy as well as complications to the fetus.
Should infertility be treated?

• What happens to frozen embryos?

• Who should be treated?
Sexually transmitted diseases (STDs)

- **Viral diseases** cannot be treated with antibiotics, but there are some antivirals.
  - HIV
  - Genital warts
  - Genital herpes
  - Hepatitis

- **Bacterial diseases** can be treated with antibiotics.
  - Chlamydia
  - Gonorrhea
  - Syphilis
STDs: HIV/AIDS

• HIV causes AIDS, the last stage of an HIV infection, in which the helper T cell count is low and the immune system is compromised leading to a suite of opportunistic infections.

• There is no cure, but there is a treatment called highly active antiretroviral therapy (HAART) that can limit HIV replication.
STDs: Genital warts

• Caused by human papillomaviruses (HPVs)
• Transmitted through skin to skin contact
• Can be transmitted without symptoms
• Most people do not have symptoms, but for the few that do, most of them see warts, and flat lesions, most often on the penis or opening to the vagina
• Associated with cervical cancer (up to 90% of cases)
• Most often found through regular pap smear screenings in women
• Can be transmitted to a baby during birth
• HPV vaccine was developed to help prevent cervical cancer
STDs: Herpes

- Caused by herpes simplex virus (HSV)
- Two types
  - Type 1 is usually found above the waist
  - Type 2 is usually found below the waist (genital herpes)
- Transmitted through skin to skin contact and secretions
- Can be transmitted when there are no symptoms
STDs: Herpes

- Usually have painful ulcers periodically in the same place(s) each time
- Outbreaks occur when the virus is reactivated by stress, sunlight, fever, lack of sleep, etc.
- No cure, but there are drugs that can keep outbreaks to a minimum or stop them entirely
- Can be transmitted to a baby during birth
STDs: What do herpes ulcers look like?

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Figure 17.18 Herpes simplex virus 2 and genital herpes.

a: © Bart’s Medical Library/Phototake; b: © Biophoto Associates/Science Source
STDs: Hepatitis

• An infection of the liver by one of 6 viruses (Hepatitis A,B,C,D,E,G)

• Hepatitis B: most common sexually transmitted hepatitis

• Transmitted through sexual contact and by contaminated blood

• Hepatitis B can lead to liver failure

• Vaccine available for both Hepatitis A and B
STDs: Chlamydia

- Very common bacterial infection in men and women

- Some men and most women do not have symptoms (18-21 days after exposure) but if they do:
  - Male symptoms: burning during urination and a mucoid discharge
  - Female symptoms: vaginal discharge and symptoms of a UTI
STDs: Chlamydia

- If the infection reaches the uterus, oviducts, and ovaries, it can lead to pelvic inflammatory disease (PID) and sterility.

- Can be transmitted to a baby during birth (causes inflammation of the eyes and/or pneumonia).
STDs: Gonorrhea

• Also a common bacterial infection in men and women
• Male symptoms (3-5 days after contact): pain during urination and a thick, greenish yellow penile discharge
• Female symptoms: uncommon to have vaginal discharge
• Can also lead to PID and sterility in men and women
• Resistance to antibiotics is common in this bacterium
• Can be contracted by a baby during birth, leading to an eye infection and even blindness
STDs: Syphilis

• A bacterial infection with three stages
  – Stage 1 (1-8 weeks after infection): hard chancre at the site of infection
  – Stage 2 (3-4 months after infection): nonitchy rash, even found on the soles of feet and the palms of the hands; may also see hair loss and gray patches on mucous membranes
  – Stage 3 (5-20 years after infection and continues until death): affects the cardiovascular and/or nervous systems: gummas (large ulcers) can develop on the skin and internal organs
STDs: Syphilis

- These stages are separated by latent periods that make the stages hard to link together and the disease hard to diagnose.

- Syphilis can cross the placenta and affect the fetus.
17.6 Sexually Transmitted Diseases

*Treponema pallidum*, the syphilis bacterium

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**Figure 17.20** Syphilis.
Other common infections of the reproductive tract

• **Bacterial vaginosis (BV):**
  – Accounts for 50% of vaginitis in American women
  – Caused by a disruption of the normal flora in the vagina leading to an overgrowth of certain bacteria

• **Trichomoniasis**
  – Caused by a protozoan (*Trichomonas vaginalis*)
  – Can cause a frothy discharge, with a foul smell and itching
  – Common cause of vaginitis
Other common infections of the reproductive tract

- **Candidiasis**
  - Overgrowth of normal yeast (*Candida albicans*) in the vagina
  - Characterized by tissue that is red, inflamed and itchy; sometimes accompanied by a white, curdy discharge
  - Birth control hormones and use of antibiotics make women more prone to this overgrowth
Preventing transmission of STDs

• Abstain from sexual intercourse.

• Develop long-term monogamous relationships.

• Be aware if your partner is an intravenous drug user because STD prevalence is higher in this group.

• Avoid anal-rectal intercourse.
17.6 Sexually Transmitted Diseases

Preventing transmission of STDs

• Use caution with uncircumcised males as they are more likely to be infected.

• Practice safer sex.
  – Always use a latex condom during intercourse.
  – Avoid oral sex.
  – Limit or do not use alcohol and drugs that can impair your judgment or change your behavior.