Chapter 26: Reproductive System

Reproductive System:

**Gonads**: Reproductive organs (testes / ovaries)

**Gametes**: Reproductive cells (sperm / egg)

Only system not essential to life of individual
Male Reproductive Anatomy:

- Testes (spermatozoa production)
- Duct system (spermatozoa transport)
- Glands (seminal fluids)

Semen = spermatozoa (20 – 100 million) + seminal fluids (2 – 5 ml)

Testes:
- Descent of the testes (~ 7 months in utero)

Cryptorchidism ("hidden testis")
- Undescended testis(es)
- ~ 3% full-term (~ 30% premies)
- Undescended = sterile
Testes:

**Spermatic Cord:**
- Includes ductus deferens, blood vessels, nerves, and lymphatic vessels
- Passes via inguinal canal (weak point – inguinal hernia...)

**Scrotum:**
- Divided internally into two chambers
- **Cremaster Muscles:** Regulate testes location (cold = muscle contraction)
  - Sperm development ~ 97.0°F
- Each testis divided into lobules (tunica albuginea)

**Semeniferous Tubules:**
- Slender, tightly coiled tubules (~ 0.5 miles / testis);
  - Sperm production

**Rete Testis:**
- Passageways collecting sperm from seminiferous tubules

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Testes - Histology:

**Seminiferous Tubule**

**Leydig Cells** (interstitial cells)
- Testosterone production

**Sertoli Cells** (sustentacular cells)
- Spermatogenesis
Spermatogenesis (sperm production):

- Spermatogonia (stem cell): Diploid
- Mitosis
- Primary Spermatocyte: Diploid
- Meiosis (crossing over)
- Spermatids: Haploid
- Spermiogenesis

- Lumen of seminiferous tubule

- ~ 14 yrs. of age
- 9 week process
- 400 million / day

Anatomy of a Sperm:

1) Head:
   - Nucleus - contains DNA
   - Acrosomal cap
     - Hydrolytic enzymes
     - Egg penetration

2) Midpiece:
   - Mitochondria - ATP

3) Tail:
   - Flagellum - movement

- Lack most intracellular structures
  - Nutrients from environment
Male Reproductive Tract:

1) Epididymis:
   - 7 m long; move immature sperm via currents (2 week journey)
     A) Monitors / Adjusts tubule fluid composition
     B) Recycles damaged / non-utilized sperm
     C) Facilitates functional maturation of sperm
        • Secrete chemicals that prevent capacitation (mobile sperm)
        • Sperm activated via seminal fluids & female reproductive tract

2) Ductus Deferens:
   - ~ 18 in. long; thick layer of smooth muscle
     • Propel sperm via peristaltic contractions
     • Stores sperm (several months)
     • Ejaculatory Duct: Portion through prostate gland

3) Urethra

Male Reproductive Accessory Glands:

Functions:
1) Activate spermatozoa
2) Provide nutrients (power mitochondria)
3) Propel sperm / fluids (peristalsis)
4) Provide buffers (neutralize urethra / vagina)

1) Seminal Vesicles (60% semen volume):
   - ↑ fructose = Activate sperm
   - Prostaglandins = smooth muscle contraction
   - Fibrinogen = temporary clot in vagina
   - Buffers = Neutralize acids

2) Prostate Gland (30% semen volume):
   - Seminalplasmin (antibiotic)

3) Bulbourethral Glands (5% semen volume):
   - Thick, alkaline solution (buffer / lubricant)
Penis:
1) Root
   - Attaches penis to body wall
2) Shaft (erectile tissue)
   - Corpora cavernosa / Corpus spongiosum
3) Glans
   - Prepuce (foreskin)

Sexual Response:
1) Erection = Enlargement / stiffening of the penis
   - Parasympathetic reflex:
     • Nitric oxide relaxes erectile tissue sphincters
     • Bulbourethral gland stimulated (pre-ejaculate)
2) Ejaculation = Propulsion of semen from duct system
   - Accessory glands contract (seminal fluids)
   - Bladder sphincters contract (close off bladder)
   - Penis musculature rhythmically contracts (semen = 200 in / sec)

Male Reproductive System - Hormones:
- Maintains accessory glands
- Stimulates metabolic processes
- Secondary sex characteristics
- Influences brain development

Gonadotropin-releasing Hormone (GnRH) → Luteinizing Hormone (LH) → Follicle-stimulating Hormone (FSH) → Testes
- Increases testosterone
- Inhibin (-)
- Sertoli Cells
- Leydig Cells

Ejaculate:
- 2 – 5 ml semen
- ~ 20 – 100 million sperm

Hypothalamus
(-)
Anterior Pituitary
(-)
Females:
- Ovaries (egg production)
- Duct / Development System

Chapter 26: Reproductive System

Ovary:
- Composed of cortex (egg formation) and medulla (blood/nerve supply)
  - Function: 1) Production of eggs (ova)
  - Function: 2) Secretion of sex hormones

Oogenesis (ovum production – long process):
- Primary Oocytes (~ 400,000)
- Atresia: Degeneration of primary oocytes
  - ~ 500 eggs released / life
Ovary:
- Oogenesis occurs within ovarian follicles:

**Primordial Follicle:** Primary Oocyte + Follicle cells

**Ovarian Cycle:** (~ 28 days)

1) **Primary Follicle**
   - Follicle cells enlarge / replicate
   - **Zona Pellucida:** Increased surface area around egg for absorption

2) **Secondary Follicle**
   - Fluid-filled cavity forms between follicle cells

3) **Tertiary Follicle** (Graafian Follicle)
   - Central chamber appears (antrum)
   - 15 mm diameter; bulge in ovarian wall appears

4) **Ovulation**
   - Primary oocyte matures to secondary oocyte (1st polar body formed)
   - Ovarian wall ruptures

5) **Corpus Luteum**
   - Follicle cells collapse; form endocrine structure
   - Pregnancy = CL remains
   - No Pregnancy = CL degenerates (12 days)

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Duct / Development System:
• Oocytes pass through **Fallopian tubes** to uterus

Infundibulum:
Expanded funnel

Fimbriae:
Finger-like projections (collect egg)

Ampulla:
Middle segment of tube

Isthmus:
Connection of tube to uterus wall

Trip takes 3 – 4 days
Fertilization must occur within ~ 24 hours of release

1) Mechanical protection
2) Nutritional support
3) Waste removal
4) Ejection

Uterus layers = Endometrium / myometrium

Duct / Development System:
• Uterine (Menstrual) Cycle:
  1) Menses: Endometrium sloughs off from uterine wall (~ 7 days)
  2) Proliferative Phase: Cells multiple across endometrium (~ 7 days)
  3) Secretory Phase: Endometrial glands enlarge / increase secretions
     • ~ 14 days; prepares uterus for embryo
Duct / Development System:
- Vagina: Elastic, muscular tube between uterus and external environment
  1) Passageway for elimination of menstrual fluids
  2) Receives penis during sexual intercourse
  3) Holds spermatozoa prior to uterus entrance
  4) Forms birth canal during fetus delivery

Stratified squamous epithelium
Devoid of glands (mucus = cervix)
- Very slight keratinization
- Support bacteria (= lactic acid)

Hormonal Regulation of Female Reproductive Cycle:

<table>
<thead>
<tr>
<th>Phases of the Ovarian Cycle</th>
<th>Follicular Phase</th>
<th>Luteal Phase</th>
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<tbody>
<tr>
<td>Gonadotropin hormone levels</td>
<td>$E_2$ triggers LH surge</td>
<td>Corpus Luteum = Follicle cells</td>
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<tr>
<td>Follicular stages during the ovarian cycle</td>
<td>LH surge triggers ovulation</td>
<td>- Release progesterone</td>
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<tr>
<td>Ovarian hormone levels</td>
<td>Follicle development</td>
<td>- Maintains uterine lining</td>
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Birth Control Pill

- Inhibits FSH release