Reproductive Systems

- Male Reproductive System
Reproductive Systems

- Internal oblique muscle
- Aponeurosis of external oblique muscle (cut)
- Suspensory ligament of penis
- Penis (cut)
- Middle septum of scrotum
- Cremaster muscle
- External spermatic fascia
- Scrotum
  - Superficial fascia containing dartos muscle
  - Skin
- Superficial inguinal ring (end of inguinal canal)
- Spermatic cord
- Ductus (vas) deferens
- Autonomic nerve fibers
- Pampiniform plexus of testicular veins
- Testicular artery
- Epididymis
- Tunica vaginalis (from peritoneum)
- Tunica albuginea of testis
- Internal spermatic fascia
Reproductive Systems

- Testes

(a) Diagram of the testis showing:
- Spermatic cord
- Blood vessels and nerves
- Seminiferous tubule
- Head of epididymis
- Efferent ductule
- Ductus (vas) deferens
- Rete testis
- Tubulus rectus
- Body of epididymis
- Tail of epididymis

(b) Microscopic view of spermatogenic cells:
- Interstitial cells
- Immature sperm

(c) Photograph showing:
- Spermatic cord
- Epididymis
- Testis
Reproductive Systems

• Penis
Reproductive Systems

Seminal Vesicles – alkaline solution – fructose for energy, clotting proteins (causes semen to coagulate), prostaglandins (sperm motility; possible uterine smooth muscle contraction)

Prostate Gland – slightly acidic, citiric acid (Krebs cycle energy production), enzymes one being PSA (break down clotting factors), acid phosphatase (unknown function)

Bulbourethral (Cowper’s) Glands – mucous that neutralizes the urethra
Reproductive Systems

- Semen – milky white, sticky, mixture of sperm and secretions
  - Fructose – fuel
  - Prostaglandins – dissolves mucous guarding cervix, stimulates reverse peristalsis
  - Relaxin – enhances sperm motility
  - pH – 7.2 – 7.6
  - Seminalplasmin – kills certain bacteria
  - Clotting factors – forms an aggregate mass
  - Fibrinolysin – dissolves above mass
  - 2 – 5 ml’s containing 50 – 130 million sperm/ml
Reproductive Systems

- Physiology of Male Reproductive System
  - Male Sexual Response
    - Erection
      - Vasodilation the result of NO release from parasympathetic NS
      - Initiated by physical and psychological stimulation
    - Ejaculation
      - Sympathetic control – spinal reflex
        » Ducts release their secretions
        » Bladder sphincter constricts
        » Penile muscles contract
Reproductive Systems

- Spermatogenesis

Diagram showing the process of spermatogenesis with stages including:
- Haploid gametes ($n = 23$)
- Egg
- Sperm
- Fertilization
- Diploid zygote ($2n = 46$)
- Multicellular diploid adults ($2n = 46$)
- Mitosis and development
## Reproductive Systems

<table>
<thead>
<tr>
<th>Event</th>
<th>Mitosis</th>
<th>Meiosis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of divisions</td>
<td>One; consisting of prophase, metaphase, anaphase, and telophase</td>
<td>Two; each consisting of prophase, metaphase, anaphase, and telophase; DNA replication does not occur between the two nuclear divisions; an event unique to meiosis is that during meiosis I, the homologous chromosomes synapse (join along their length), forming tetrads (groups of four chromatids)</td>
</tr>
<tr>
<td>Number of daughter cells</td>
<td>Two; each diploid (2n) and identical to the mother cell</td>
<td>Four; each containing half as many chromosomes as the mother cell (hence haploid or n); nonidentical to mother cell</td>
</tr>
<tr>
<td>and genetic composition</td>
<td>Development of multicellular adult from zygote; to produce cells for growth and tissue repair; ensures constancy of genetic makeup of all body cells</td>
<td>To produce cells for reproduction (gametes); introduces genetic variability in the gametes and reduces chromosomal number by half so that when fertilization occurs, the normal diploid chromosomal number is restored (in humans, 2n = 46)</td>
</tr>
<tr>
<td>Importance in the body</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Reproductive Systems

Interphase events
As in mitosis, meiosis is preceded by events occurring during interphase that lead to DNA replication and other preparations needed for the cell division process. Just before meiosis begins, the replicated chromatids, held together by centromeres, are ready and waiting.
Reproductive Systems

**Prophase I**
As in prophase of mitosis, the chromosomes coil and condense, the nuclear membrane and nucleolus break down and disappear, and the spindle is formed. However, a unique event not seen in mitosis, called synopsis, occurs in prophase I of meiosis. Synopsis involves the coming together of homologous chromosomes to form tetrads, little packets of four chromatids. While in synopsis, the “arms” of adjacent homologous chromatids become wrapped around each other, forming several points of crossover or chiasmata. Generally speaking, the longer the chromatids, the more chiasmata are formed. (This process of crossover is shown in one tetrad of the prophase I view, and the result of that one event of crossing over is followed through meiosis II.) Prophase I is the longest period of meiosis, accounting for about 90% of the total period. By its end, the tetrads have attached to the spindle and are moving toward the spindle equator, and the sister chromatids have exchanged parts at points of crossover.

**Metaphase I**
During metaphase I, the tetrads align on the spindle equator in preparation for anaphase.

**Anaphase I**
Unlike the anaphase events of mitosis, the centromeres do not break during anaphase I of meiosis, and so the sister chromatids (dyads) remain firmly attached. However, the homologous chromosomes do separate from each other and the dyads are moved toward opposite poles of the cell.

**Telophase I**
The nuclear membranes re-form around the chromosomal masses, the spindle breaks down, and the chromatin reappears as telophase and cytokinesis are completed, forming two daughter cells. The daughter cells (now haploid) enter a second interphase-like period, called interkinesis, before meiosis II occurs. There is no second replication of DNA before meiosis II.
Meiosis II begins with the products of meiosis I (two haploid daughter cells) and undergoes a mitosis-like nuclear division process referred to as the equational division of meiosis. After progressing through prophase, metaphase, anaphase, and telophase, followed by cytokinesis, the product is four haploid daughter cells each genetically different from the original mother cell. During human spermatogenesis the daughter cells remain interconnected by cytoplasmic extensions.
Reproductive Systems
Reproductive Systems
Reproductive Systems
Reproductive Systems

• Anatomy of the Female Reproductive System
Reproductive Systems
Reproductive Systems

(a) Ovarian cortex

(b) Secondary follicle

- Primordial follicles
- Germinal epithelium
- Tunica albuginea
- Ovarian cortex

- Antrum filled with follicular fluid
- Corona radiata
- Secondary follicle granulosa cells

- Theca folliculi
- Zona pellucida
- Primary oocyte
- Primary follicle granulosa cells

LM about 200x

LM 60x
Reproductive Systems

- Uterine Tubes – transport oocyte or zygote to the uterus
  - Structures
    - End near ovary expanded to form the infundibulum
    - Opening is the ostium, surrounded by fimbriae
    - Infundibulum connects the ampulla that narrows to the isthmus
    - Consists of outer serosa, middle muscular layer, and inner mucosa with simple ciliated columnar epithelium
Reproductive Systems

- Uterus
  - Held in place by the broad, round, and uterosacral ligaments
Reproductive Systems

- Wall of uterus made up of
  - Perimetrion (serous membrane)
  - Myometrium (smooth muscle)
  - Endometrium (mucous membrane)
Reproductive Systems

Arcuate artery
Uterine artery
Cervix
Vagina
Perimetrium
Myometrium
Endometrium
Uterine cavity
Radial artery
Endometrial gland
Endometrium:
Stratum functionalis
Stratum basalis
Straight arteriole
Radial artery
Spiral arteriole
Details of portion of uterine wall

Anterior view with left side of uterus partially sectioned
Reproductive Systems

• Vagina
  
  – Connects the uterus (cervix) to the vestibule
  
  – Consists of smooth muscle and an inner lining of moist stratified squamous epithelium
  
  – Folded into rugae and longitudinal folds
  
  – Hymen covers the vestibular opening of the vagina
  
  – Serves as the female copulatory organ
Reproductive Systems

- Vulva – (External Genitalia)
Reproductive Systems

(a) Skin (cut)
(b) Pectoralis major muscle
(c) Suspensory ligament
(d) Adipose tissue
(e) Lobe
(f) Areola
(g) Nipple
(h) Opening of lactiferous duct
(i) Lactiferous sinus
(j) Lactiferous duct
(k) Lobule containing alveoli
(l) Superficial fascia
(m) Intercostal muscles
Reproductive Systems

- Physiology of the Female Reproductive System

- Oogenesis
Reproductive Systems

- Ovarian Cycle

- Follicular Phase (1-6)
- Ovulation (7)
- Luteal Phase (8)
Reproductive Systems

- Hormonal Regulation of the Ovarian Cycle

Key:
- = Stimulates
- = Inhibits
Reproductive Systems

(a) Fluctuation of gonadotropin levels

(b) Fluctuation of ovarian hormone levels
(c) **Ovarian cycle**

(d) **Uterine cycle**
Reproductive Systems

• Extrauterine Effects of Estrogens and Progesterone
  
  – Promotes oogenesis
  
  – Growth hormone for female reproductive tract
  
  – Growth spurt, epiphysis closes sooner than males
  
  – Secondary sex characteristics
Reproductive Systems

• Female Sexual Response – similar to males
  – Clitoris, vaginal mucosa, and breast fill with blood
  – Nipples erect
  – Vestibular glands become active
  – No ejaculation, but orgasm similar to males