

Male Reproductive Physiology

- 2-phase sexual response
 - Erection – penetration
 - Excitement > Parasympathetic ANS > Nitric Oxide vasodilates arterioles > erectile bodies fill with blood
 - Ejaculation – sperm delivery
 - Sympathetic ANS control: sperm ducts & accessory glands contract & empty into urethra; bladder sphincter constricts; smooth muscle contractions in penis
 - ~100-500 million sperm

Human Life Cycle

- Chromosome number in body cells (46) – the diploid or 2n number
 - 23 pairs of homologous chromosomes
 - 1 of each pair: paternal, 2nd of each pair: maternal
 - Homologues carry same genes but *not* necessarily same form of each gene
- Chromosome number in gametes (sperm/eggs) (23) – the haploid or n number
 - **Meiosis** (reductive division) – only in gonads

Events of Meiosis

- [Mitosis: prophase, metaphase, anaphase, telophase, cytokinesis; all preceded by S (DNA synthesis/chromosome replication)]
- Meiosis I (the reduction division):
 - Prophase I: synapsis (crossing over) between homologues
 - Metaphase I: homologous chromosomes line up double file at center of cell
- Meiosis II – looks the same as mitosis

Spermatogenesis

- Production of male gametes (sperm) – Meiosis
 - In seminiferous tubules of the testes
 - Stem cells – spermatogonia – undergo Mitosis only
 - Some become primary spermatocytes
 - Meiotic divisions:
 - Meiosis I: primary > secondary spermatocytes
 - Meiosis II: secondary spermatocytes > spermatids
 - Spermiogenesis – maturation

- Formation of functional sperm
- Formation of acrosome & flagellum, shedding of cytoplasm

Sperm (spermatozoa)

- Head (genetic region) – nucleus & acrosome
- Midpiece (metabolic region) – mitochondria
- Tail (locomotor region) – flagellum (microtubules)

Hormonal regulation of male reproduction

- Brain-testicular axis – hypothalamus, anterior pituitary, & testes
 - Hypothalamus secretes GnRH
 - Anterior pituitary secretes FSH/LH (gonadotropins)
 - FSH: ups testicular response to testosterone
 - LH: stimulates testosterone production
 - Feedback inhibition: testosterone & inhibin on GnRH
- Testosterone – spermatogenesis + anabolism + secondary sexual characteristics + behavior

Female Reproductive Anatomy

- Ovaries (female gonads) – produce:
 - Gametes (eggs) – oogenesis
 - Sex hormones – estrogen, progesterone
- Accessory structures:
 - Ducts – uterine (fallopian) tubes, uterus, vagina
 - External genitalia
 - Mammary glands

Ovaries

- Anchored to uterus, pelvic wall by ligaments
- Connective tissue containing ovarian follicles
 - Follicle: **oocyte** (immature egg), follicle cells
 - Primordial > primary > secondary > vesicular
 - Following ovulation/rupture: corpus luteum

Duct System

- Uterine/fallopian tubes (oviducts)
 - Site of fertilization (in ampulla)
 - Receive ovulated oocyte in fimbriae of infundibulum > ampulla (curve) > isthmus (connection to uterus)
 - Oocytes *captured* by uterine tube (cilia on fimbrae)
 - Smooth muscle (peristalsis) & cilia propel oocyte
- Uterus – hollow, thick-walled, muscular

- Fundus, body, cervix, cervical canal
- Ligaments anchor to anterior & posterior (sacrum) body wall

Duct System, cont'd.

■ Uterine wall

- Perimetrium – serous membrane (visceral peritoneum)
- Myometrium – thickest; smooth muscle
- Endometrium – inner lining
 - Functional layer – responds to hormones, shed in menstruation
 - Basal layer – gives rise to new functional layer monthly
- Rich blood supply – uterine arteries > spiral arteries (degenerate & regenerate)

Duct System, cont'd.

- Vagina – between cervix & body exterior
 - Receives semen (intercourse), passageway for birth and menstruation
 - Distensible walls (has rugae)
 - Acidic environment
 - Hymen over vaginal orifice until 1st intercourse
 - Vaginal fornix surrounds cervix

External genitalia

- External genitalia (vulva)
 - Mons pubis
 - Labia major/minora
 - Clitoris
 - Perineum (pelvic floor)

Mammary Glands

- Function in females to nourish newborn
- Highly modified sweat glands
- External: areola/nipple
- Internal: lobes – surrounded by connective tissue/fat
 - Lobes > lobules > alveoli (produce milk)
 - Lactiferous ducts empty to the nipple
 - Nonpregnant women: duct system undeveloped
- Breast cancer

Female Reproductive Physiology

- Oogenesis – Meiosis to produce female gametes (eggs)
 - Begins in the female fetus – diploid oogonia (egg stem cells) divide by

mitosis

- Mature into primary oocytes surrounded by primordial follicles
- Arrest at the beginning of Meiosis I – remain dormant until puberty
- Each month, few primary oocytes activated – one completes Meiosis I
 - 2 *unequal* cells
 - Secondary oocyte + polar body
 - Secondary oocyte arrests at beginning of Meiosis II

Differences between spermatogenesis & oogenesis

- **Spermatogenesis – male gamete (sperm) production**
 - Spermatogonia continue to divide through life
 - Four viable sperm formed from one primary spermatocyte
- **Oogenesis – female gamete (egg) production**
 - Oogonia finished dividing before birth
 - Final Meiotic division completed only upon sperm activation
 - One viable egg (ovum) + 3 polar bodies formed
 - Egg has all the cytoplasm, nutrients

Ovarian Cycle

- **Follicular phase: follicle growth – days 1-14**
 - Primordial > Primary follicle
 - Primary follicle > Secondary follicle
 - Formation of zona pellucida; formation of antrum
 - Secondary follicle > Vesicular follicle
 - Formation of corona radiata
- **Ovulation – rupture & expulsion of oocyte**
- **Luteal phase: corpus luteum active – days 14-28**
 - Ruptured follicle > corpus luteum: secretes progesterone, estrogen
 - Degenerates ~10 days later if no pregnancy

Hormonal regulation of ovarian cycle

- Hypothalamus releases GnRH rhythmically
- Stimulates anterior pituitary to release FSH & LH (gonadotropins)
- FSH/LH stimulate follicle growth, estrogen secretion
- Estrogen inhibits FSH/LH; continues own release
- Very high estrogen level causes surge of LH > causes primary oocyte to complete Meiosis I
- LH triggers ovulation, turns follicle > corpus luteum
- Estrogen/progesterone inhibit LH/FSH release
- Low LH causes corpus luteum degeneration; estrogen/progesterone drop

Uterine/Menstrual Cycle

- Cyclic changes to endometrium (responding to hormone levels)
- *Menstrual phase* (1-5) sheds functional layer
- *Proliferative phase* (6-14) rebuilding from basal layer (estrogen rising)
 - Ovulation occurs
- *Secretory phase* (15-28) elaboration of endometrium (progesterone high)
 - Breakdown IF progesterone drops

Effects of Estrogen & Progesterone

- Steroid hormones analogous to testosterone
- Estrogen: Promote oogenesis, follicle growth
- Promote anabolism of female reproductive structures – duct system, external genitalia
- Puberty growth spurt
- Secondary sex characteristics (breasts, body shape, hair growth)
- Progesterone: establishes/regulates uterine cycle; pregnancy effects