**Objectives:**
1. Review male & female reproductive anatomy
2. Gametogenesis & steroidogenesis
3. Reproductive problems

**Review of Male Reproductive Anatomy**

- Urinary bladder
- Symphysis pubis
- Vas deferens
- Urethra
- Penis
- Glans penis
- Prepuce (foreskin)
- Rectum
- Prostate
- Bulbourethral gland
- Epididymis
- Seminal vesicle
- Ejaculatory duct deferens
- Testis
- Scrotum
Male Reproductive anatomy and physiology.

Testes = paired gonads containing seminiferous tubules

Seminiferous tubules = tubules within testes where sperm and testosterone are produced

3. Male Reproductive anatomy and physiology.

Testes = paired gonads that produce sperm and testosterone

Seminiferous tubules = coiled tubes within testes where sperm produced.

3 cell types in seminiferous tubules:

1. Sertoli cells – assist in sperm production by responding to pituitary FSH.

2. Leydig cells – produce testosterone in response to pituitary LH.

3. Spermatogonia = primordial cells that undergo meiosis to produce mature sperm cells (spermatogonia).
**Epididymis** = structures on top of testes where sperm mature before entering vas deferens.

**Scrotum** = skin sacs holding testes outside of abdominal cavity.

**Cremaster muscle** = Muscle that can lift or lower the testes within scrotum to regulate temperature.

**Spermatic cord** = Connective tissue that wraps around cremaster, testes, & testicular nerve and blood vessels

**Inguinal ring** = Opening in inguinal ligament through which testes descend (around 7 months gestation).

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**3 Sperm Transport Tubes:**

1. **Vas deferens** = first and longest sperm transport tube. Meets with epididymis.

2. **Ejaculatory duct** = sperm transport tube, which goes through prostate.

3. **Urethra** = common passageway for either urine or semen.

**What is a vasectomy?**
**3 Male Secretory Glands:**

1. **Seminal vesicles** = large, paired glands that meet with vas deferens and contribute secretions to seminal fluid.
   - **alkaline mucus** (counteract vaginal acidity)
   - **prostaglandin** (cause uterine contractions)
   - **fructose** (energy source)

2. **Prostate** = gland under bladder which secretes mucus.

3. **Bulbourethral gland** = Gland that secretes lubricating Fluid, to lubricate head of penis, during sexual arousal.

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**The Prostate Gland**

> **Benign prostate hyperplasia (BPH)**

- Prostate grows with age.
- non-cancerous growth of prostate.
- Can block urine or semen transport.

**Prostate cancer**

- Malignant
- Detect with **PSA** = prostate-specific antigen. High levels in blood indicate possible prostate cancer.
- Increased risk with **mutation in BRCA gene (see later in powerpoint)**
Corpus spongiosum = lower chamber surrounding urethra

Corpus cavernosa = upper left and right chamber.
- have arterial blood supply to fill with blood.
- arteries vasodilate based on nitric oxide (NO) release.

Erectile chambers of penis.

Prostate cancer is commonly tested using a blood test for prostate-specific antigen (PSA). A more common disorder, affecting most men over 60 to different degrees, is benign prostatic hyperplasia (BPH). This is responsible for most cases of bladder outlet obstruction, causing difficulty in urination. BPH treatment may involve a surgical procedure called transurethral resection (TUR), or the use of drugs. These drugs include $\alpha_1$-adrenergic receptor blockers (chapter 6), which decrease the muscle tone of the prostate and bladder neck, making urination easier, and 5α-reductase inhibitors. The latter drugs block the conversion of testosterone into dihydrotestosterone (DHT), which reduces androgen stimulation and thus the size of the prostate.²
How an erection works:
See Clinical App

1. Arousal Causes nitric oxide (NO) release in arteries of corpus cavernosa.

2. NO causes production of a chemical messenger called cGMP).

3. cGMP causes arteries to relax & they open wide (vasodilate) allowing blood into spongy chambers.

4. Fluid pressure of blood causes erection.

5. When stimulation done, or after ejaculation, cGMP is broken down by enzyme (phosphodiesterase). Erection ends.

Clinical applications

Nitric oxide, released in the penis in response to parasympathetic nerve activation, enters the smooth muscle cells in the arterioles and stimulates the production of a second messenger, cyclic guanosine monophosphate (cGMP). The cGMP causes the smooth muscle cells to relax and the vessels to dilate, so that more blood can flow to the corpora cavernosa and produce erection. A particular cGMP phosphodiesterase enzyme then breaks down cGMP, ending the erection. Erectile dysfunction is now often treated with drugs such as sildenafil (Viagra), which block the cGMP phosphodiesterase enzyme. These drugs increase the cellular concentration of cGMP and thereby promote erection.
How ED Drugs work (Viagra, Cialis, Levitra):

**Phosphodiesterase inhibitor** = a chemical that inhibits phosphodiesterase.

So ..., what would giving a phosphodiesterase inhibitor do to cGMP levels in the corpus cavernosa?

___________________________

What would that do to arteries in the penis? ______________

What would that do w/respect to an erection? ____________

Viagra, Cialis, & Levitra are phosphodiesterase inhibitors.

4. Gametogenesis and Steroidogenesis in Males and Females

**Gametogenesis** = production of gametes (eggs & sperm).

> **Spermatogenesis** = production of sperm within testes.

> **Oogenesis** = production of eggs within ovaries.

**Steroidogenesis** = production of sex steroids (estrogen, progesterone, testosterone).
Spermatogenesis:

Spermatogonia (2n) = cells that undergo meiosis to make sperm.

Primary spermatocyte (2n)

Secondary spermatocytes (1n)

Spermatids (1n) = immature sperm cells.

Spermatozoa = mature sperm cells.

The Ovaries have follicles that contain a developing egg (oocyte). Once a month one follicle & egg mature. A secondary oocyte is ovulated. The remaining follicle becomes the corpus luteum & produces progesterone.
Oogenesis:

Oogonium (2n) → Primary oocyte (2n) → Meiosis 1 → Secondary oocyte (1n) within “Graafian follicle”

- 2° oocyte is “ovulated” once/month
- graafian follicle becomes corpus luteum
- “CL” produces progesterone ~14 days

Progesterone = hormone released from CL that maintains uterus in pregnancy-friendly state. Prevents egg development and ovulation.

Eggs in stasis as primary oocyte (2n) in ovaries from time a fetus to just before puberty.

Fig 15.16

Not fertilized → Fertilized

Secondary oocyte (1n) ovulated → Corpus luteum (CL) produces progesterone ~14 days
Steroidogenesis (Male & Female) =

**review – Hypothalamus endocrine function:**

> communicates between nervous and endocrine systems
> Secretes “releasing hormone” to stimulate gonads = GnRH
> This stimulates anterior pituitary to secrete LH & FSH
> FSH stimulates sperm or egg maturation
> LH stimulates testosterone production in testes, and estrogen production, ovulation, and corpus luteum formation in ovaries.

**Steroidogenesis**

Hypothalamic neurons secrete “releasing hormone” GnRH

Anterior pituitary responds to GnRH by secreting LH & FSH:

**Testes**
LH – make testosterone
FSH – stim. sperm develop.

**Ovaries**
LH – make estrogen & ovulate egg
FSH – stim. egg development.

**QUEST: How does hormonal birth control work??**
**Clinical Applications**

About 60 million women worldwide currently use oral contraceptives (birth control pills). These contain a synthetic estrogen combined with synthetic progesterone, which are taken each day for 3 weeks after the last day of the menstrual period. Placebo pills are taken for the fourth week, to cause a fall in the blood levels of estrogen and progesterone so that menstruation can occur. The birth control pills immediately produce high blood levels of estrogen and progesterone, mimicking the luteal phase and causing negative feedback inhibition of FSH and LH. Thus, no follicles grow and ovulate (so fertilization is prevented), and no corpus luteum can be formed. The newer contraceptive pills have other benefits: they may reduce the risk of endometrial and ovarian cancer, as well as osteoporosis. However, they may also increase the risk of breast cancer, and possibly cervical cancer. Each woman should consult with a physician to weigh the potential benefits and risks in light of her own medical situation and family history.

**Review**

Male reproductive anatomy & physiology
- male sexual structures
- physiology of an erection
- reproductive problems (ED, BPH)

Gametogenesis
- spermatogenesis
- oogenesis

Steroidogenesis
- Hypothalamic-pituitary-gonadal axis
- negative feedback inhibition of steroidogenesis