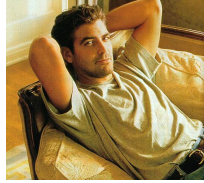


Chapter 27 The Male Reproductive System

- Sexual reproduction
- Sex determination & development
- Male reproductive anatomy
- Puberty
- Spermatogenesis, spermatozoa & sperm
- Male sexual response



The Essence of Sex

- Reproduction is one property of a living thing
 - great variety of methods
- Sexual reproduction means each offspring has 2 parents and receives genetic material from both
 - provides genetic diversity & is considered the foundation for the survival and evolution of species



The Two Sexes

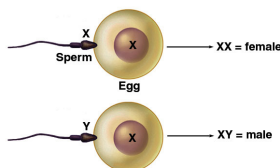
- Male and female gametes (sex cells) combine their genes to form a fertilized egg (zygote)



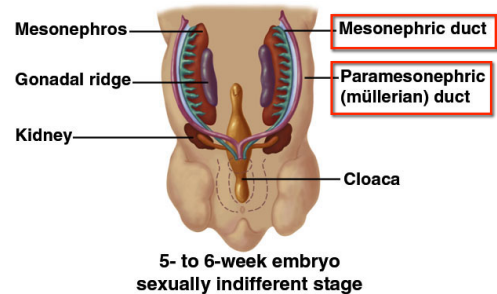
Overview of the Reproductive System

- Primary sex organs
- Secondary sex organs (essential for reproduction)
- Secondary sex characteristics

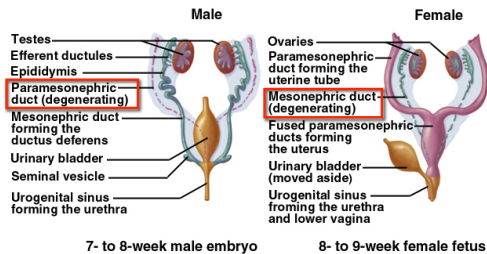
Role of the Sex Chromosomes



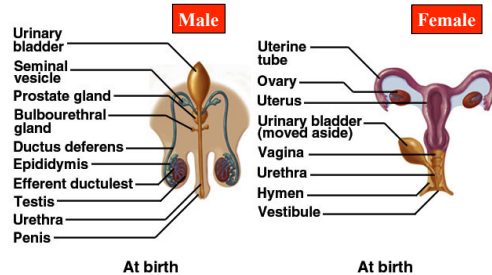
Embryonic Development



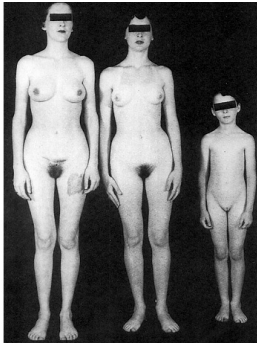
Embryonic Development



Embryonic Development

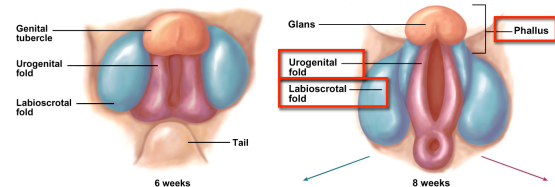


Androgen-Insensitivity Syndrome



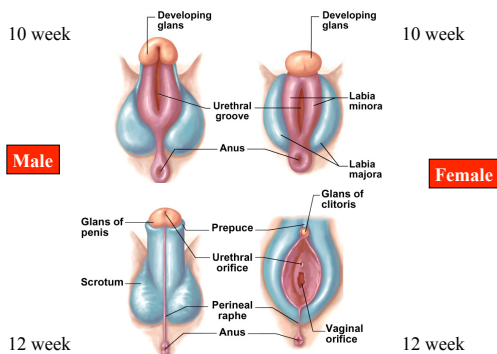
- Genetically male (XY)
- Testosterone is secreted
- Target cells lack receptors for the hormone
- No masculinizing effects occur

Development of External Genitalia



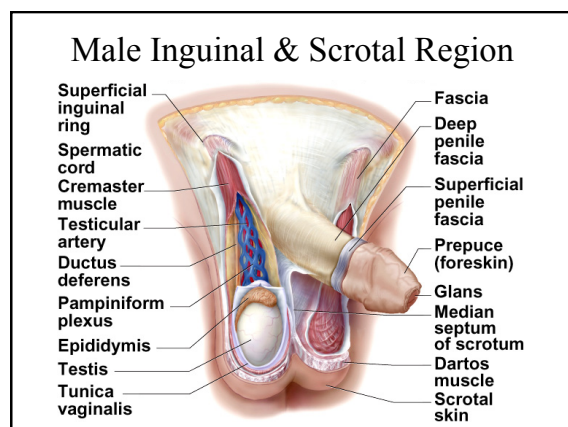
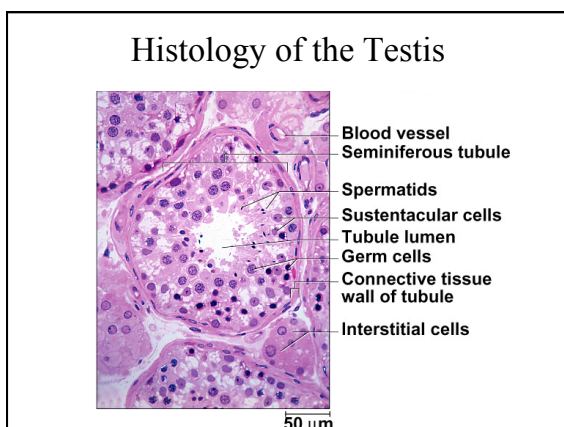
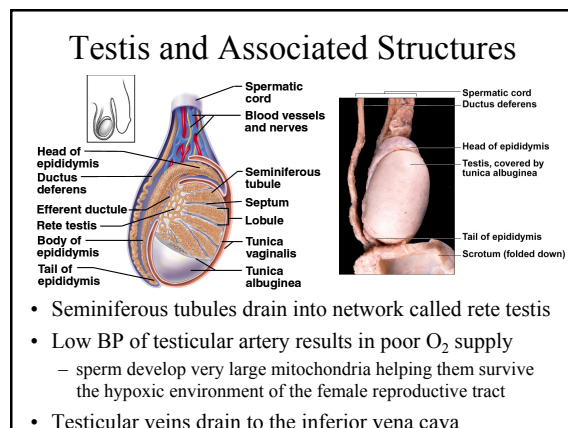
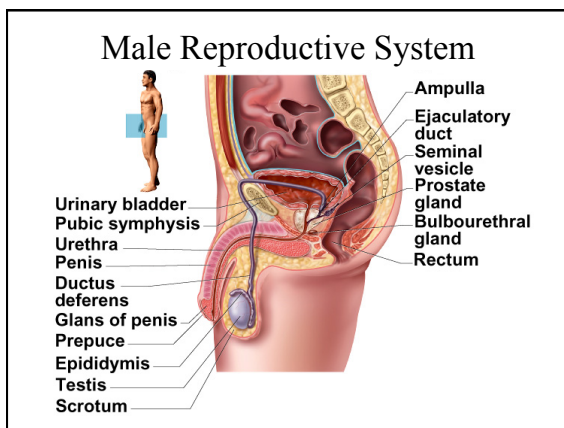
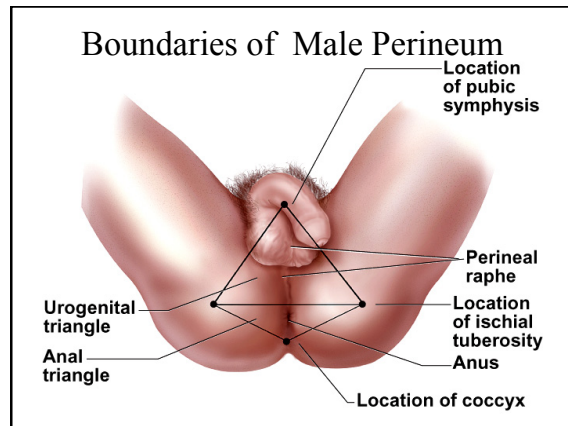
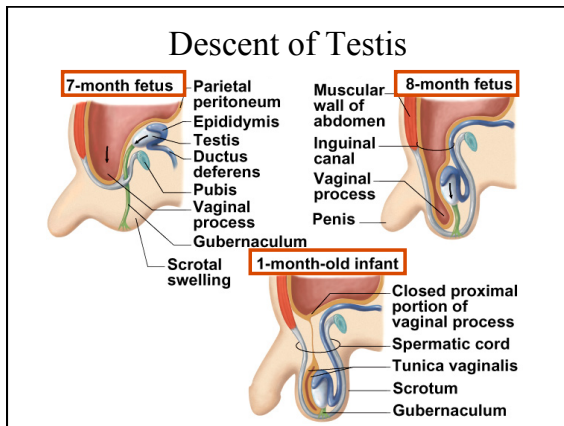
- All 8 week old fetuses have same 3 structures
 - by end of week 9, begin to show sexual differentiation
 - distinctly male or female by end of week 12

Development of External Genitalia

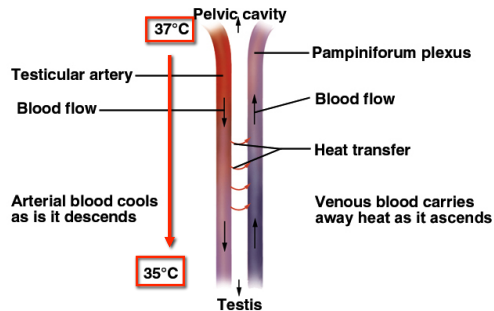


Descent of the Testes

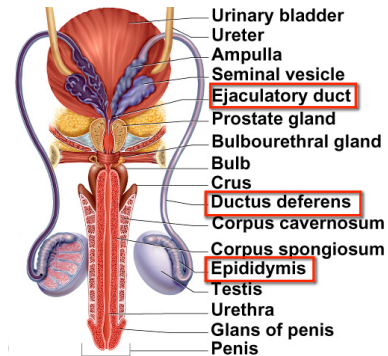
- Begin development near the kidney
- Descent begins in weeks 6-10 & is finished by 28
- Location outside the pelvic cavity is essential for low temperatures needed for sperm production



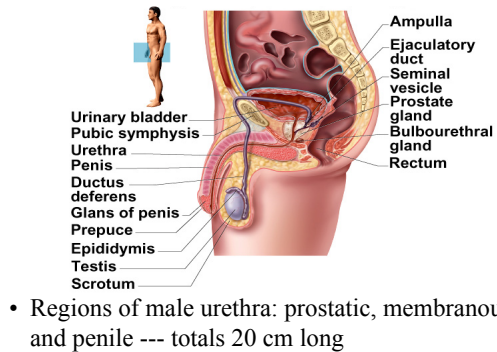
Heat Exchange of Pampiniform Plexus



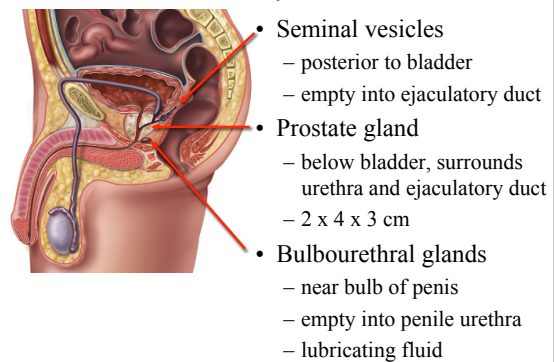
Male Duct System



Male Urethra

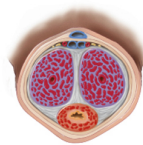


Accessory Glands

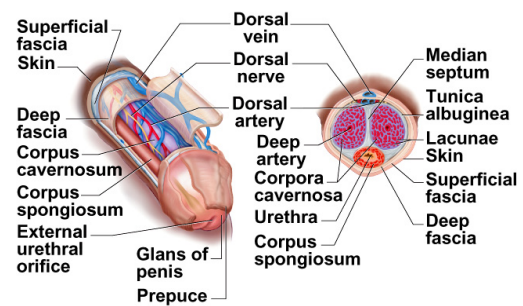


Penis

- Internal root and visible shaft and glans
 - external portion is 4 in. long when flaccid
 - skin over shaft is loosely attached allowing expansion
 - extends over glans as prepuce or foreskin
- Consists of 3 cylindrical bodies of erectile tissue
 - single corpus spongiosum along ventral side of penis
 - encloses penile urethra
 - ends as a dilated bulb ensheathed by bulbospongiosus muscle
 - paired corpora cavernosa
 - diverge like arms of a Y
 - each crus attaches to pubic arch & is covered with ischiocavernosus muscle



Anatomy of the Penis



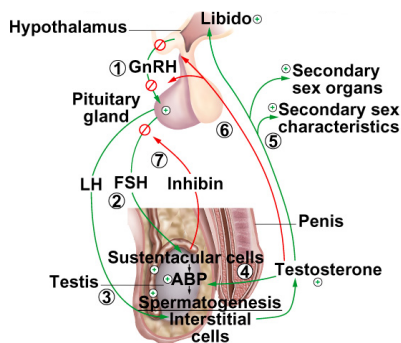
Puberty and Climacteric

- Reproductive system remains dormant for years after birth
 - surge of pituitary gonadotropins begins development
 - 10-12 in most boys; 8-10 in most girls
- Puberty = period from onset of gonadotropin secretion until first menstrual period or first ejaculation of viable sperm
- Adolescence = ends when person attains full adult height

Brain-Testicular Axis

- Mature hypothalamus produces GnRH
- Stimulation of gonadotrope cells in anterior pituitary causes secretion of FSH & LH
 - LH stimulates interstitial cells to produce testosterone
 - FSH stimulates sustentacular cells to secrete androgen-binding protein that interacts with testosterone to stimulate spermatogenesis
- Other effects of testosterone
 - enlargement secondary sexual organs
 - penis, testes, scrotum, ducts, glands and muscle mass enlarge
 - hair, scent and sebaceous glands develop
 - stimulates erythropoiesis and libido
- During adulthood, testosterone sustains libido, spermatogenesis and reproductive tract

Hormones & Brain-Testicular Axis



Aging and Sexual Function

- Decline in testosterone secretion
 - peak secretion at 7 mg/day at age 20
 - declines to 1/5 of that by age 80
- Rise in FSH and LH secretion after age 50 produces male climacteric (menopause)
 - mood changes, hot flashes & “illusions of suffocation”
- Impotence (erectile dysfunction)
 - 20% of those in 60s and 50% of those in 80s
 - Over 90% of impotent men remain able to ejaculate

Mitosis and Meiosis

- Mitosis produces 2 genetically identical daughter cells (occurs in tissue repair & embryonic growth)
- Meiosis produces gametes haploid cells required for sexual reproduction
 - 2 cell divisions (after only one replication of DNA)
 - meiosis I separates homologous chromosome pairs → 2 haploid cells
 - meiosis II separates duplicated sister chromatids → 4 haploid cells
 - meiosis keeps chromosome number constant from generation to generation after fertilization
 - occurs in seminiferous tubules of males

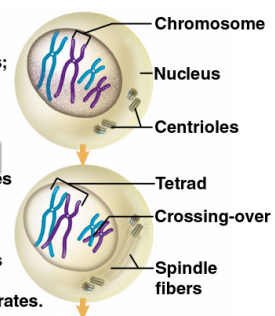
Meiosis I

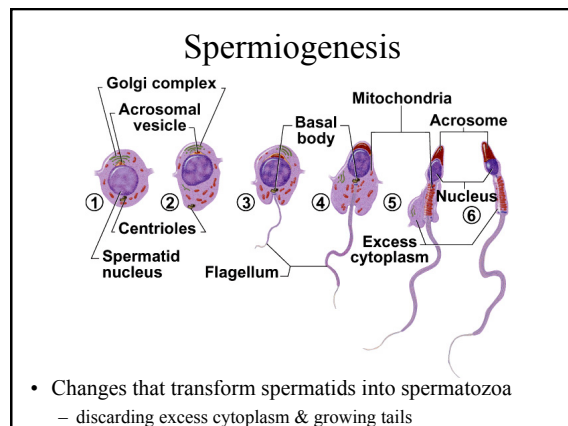
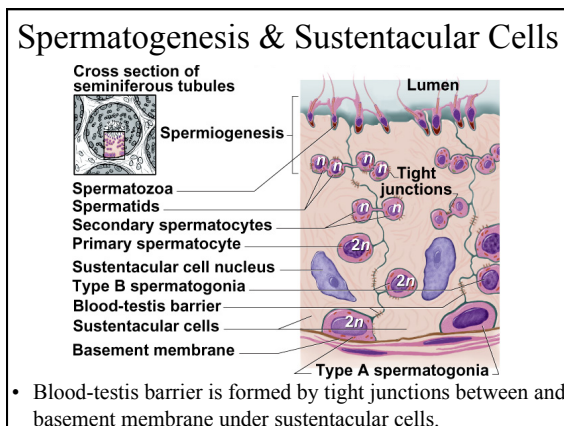
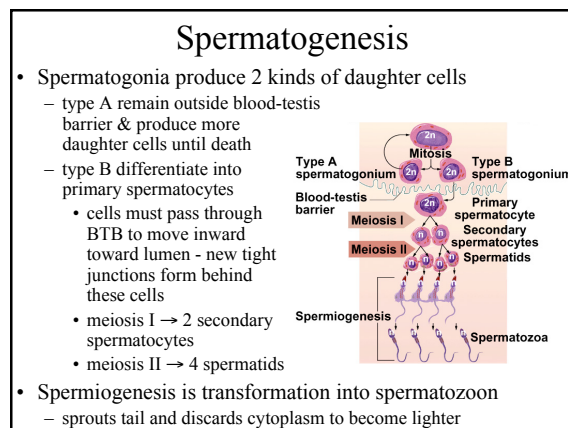
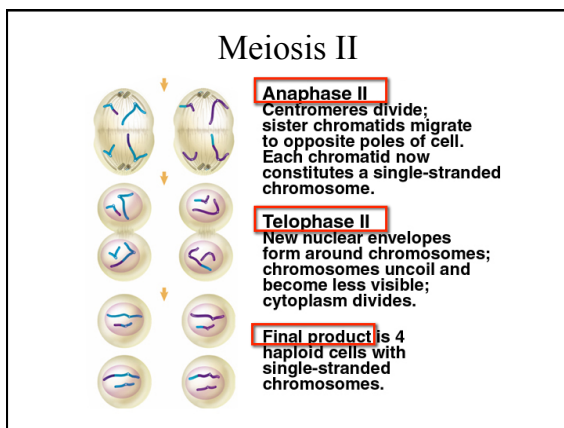
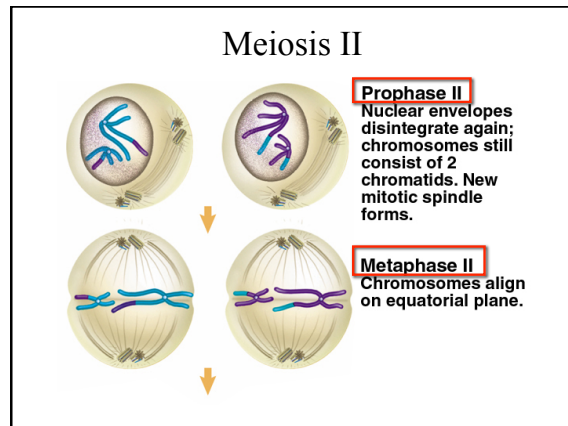
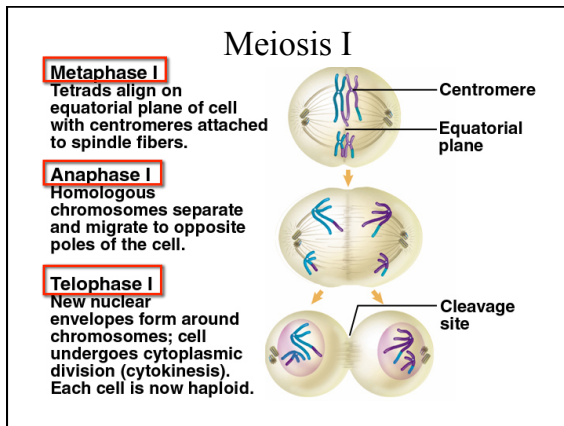
Early prophase I

Chromatin condenses to form visible chromosomes; each chromosome has 2 chromatids joined by a centromere.

Mid - to late prophase I

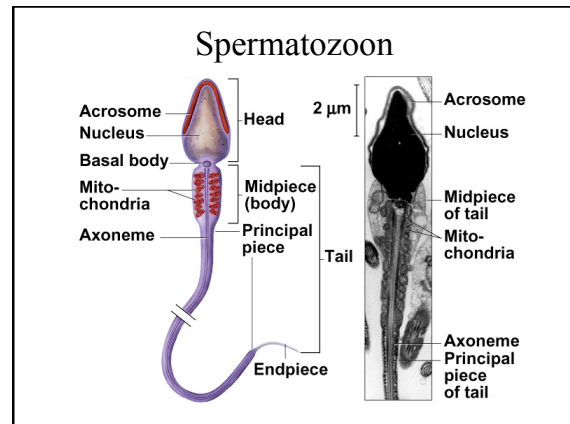
Homologous chromosomes form pairs called tetrads. Chromatids often break and exchange segments (crossing-over). Centrioles produce spindle fibers. Nuclear envelope disintegrates.





The Spermatozoon

- Head is pear-shaped front end
 - 4 to 5 microns long structure containing the nucleus, acrosome and basal body of the tail flagella
 - nucleus contains haploid set of chromosomes
 - acrosome contains enzymes that penetrate the egg
 - basal body
- Tail is divided into 3 regions
 - midpiece contains mitochondria around axoneme of the flagella (produce ATP for flagellar movement)
 - principal piece is axoneme surrounded by fibers
 - endpiece is very narrow tip of flagella



Semen or Seminal Fluid

- 2-5 mL of fluid expelled during orgasm
 - 60% seminal vesicle fluid, 30% prostatic & 10% sperm
 - normal sperm count is 50-120 million/mL (< 25 million/mL is associated with infertility)
- Other components of semen
 - fructose provide energy for sperm motility
 - fibrinogen causes clotting
 - enzymes convert fibrinogen to fibrin
 - fibrinolysin liquefies semen within 30 minutes
 - prostaglandins stimulate female peristaltic contractions
 - spermine is a base stabilizing sperm pH at 7.2 to 7.6

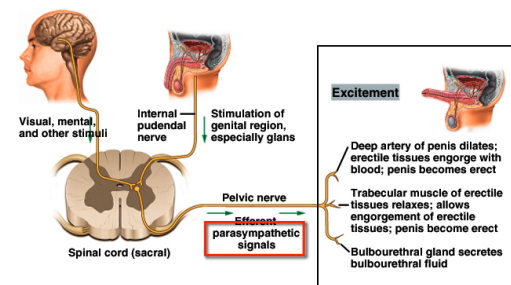
Male Sexual Response -- Anatomy

- Arteries of the penis
 - dorsal & deep arteries (brs. of the internal pudendal)
 - deep artery supplies lacunae of corpora cavernosa
 - dilation fills the lacunae causing an erection
 - normal penile blood supply comes from dorsal a.
- Nerves of the penis
 - abundance of tactile, pressure & temperature receptors
 - dorsal nerve of the penis and internal pudendal nerves lead to integrating center in sacral spinal cord
 - both autonomic and somatic motor fibers carry impulses from integrating center to penis & other pelvic organs

Excitement and Plateau

- Excitement is characterized by vasocongestion of genitals, myotonia, and increases in heart rate, BP, & pulmonary ventilation
- Initiated by many different erotic stimuli
- Erection of penis is due to parasympathetic triggering of nitric oxide (NO) secretion
 - dilation of deep arteries & filling of lacunae with blood
 - corpora spongiosum not nearly as hardened
 - enlarged elevated penis is ready for intromission
- Erection is maintained during plateau phase

Parasympathetic Signals & Sexual Response

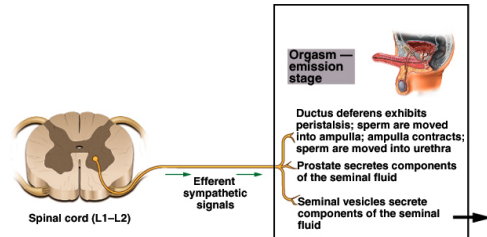


- Parasympathetic signals produce an erection with direct stimulation of the penis and other perineal organs

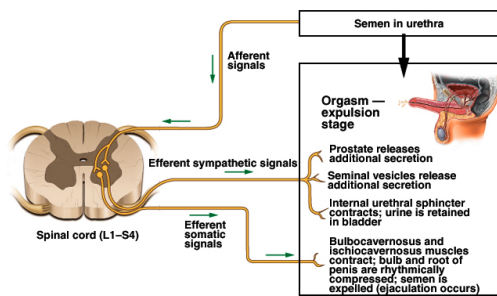
Orgasm and Ejaculation

- Climax (orgasm) is 15 second reaction that includes the discharge of semen (ejaculation)
- Ejaculation
 - emission = sympathetic nervous system propels sperm through ducts as glandular secretions are added
 - expulsion = semen in urethra activates muscular contractions that lead to expulsion
- Ejaculation and orgasm are not the same
 - can occur separately

Orgasm - Emission

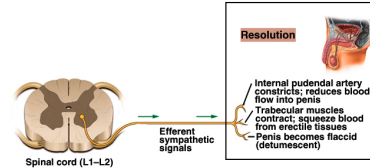


Orgasm - Ejaculation



Resolution

- Sympathetic signals constrict the internal pudendal artery & reduce blood flow to penis
 - penis becomes soft & flaccid (detumescence)
- Cardiovascular & respiratory responses return to normal
- Refractory period (10 minutes to few hours)
 - impossible to attain another erection and orgasm



How Viagra Prolongs Erection

