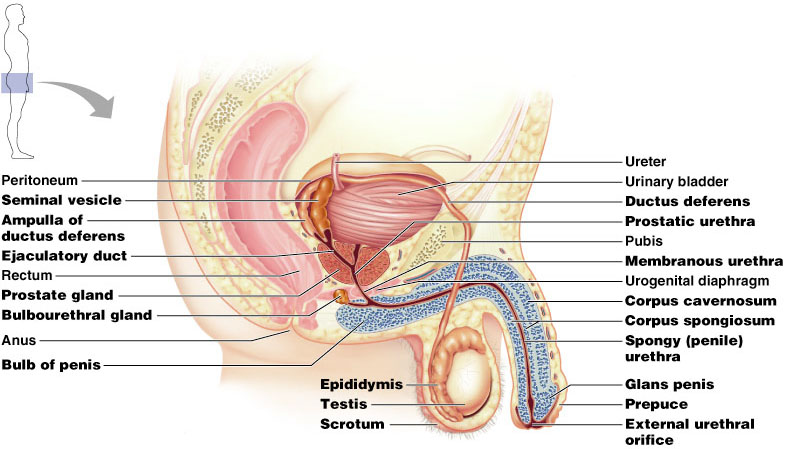
**Male Reproductive System**

**Dr. Gary Mumaugh**

**Reproductive System Basics**

* Primary sex organs (gonads) – testes in males, ovaries in females
* Gonads produce sex cells called gametes (gametes means spouses) and secrete sex hormones
* Accessory reproductive organs – ducts, glands, and external genitalia
* Sex hormones – androgens (males), and estrogens and progesterone (females)
  + Sex hormones play roles in:
    - The development and function of the reproductive organs
    - Sexual behavior and drives
    - The growth and development of many other organs and tissues
* Functioning of the reproductive system ensures the survival of the genetic characteristics of a species
* Male reproductive system consists of organs whose functions are to produce, transfer, and introduce mature sperm into the female reproductive tract, where fertilization can occur



**Male Reproductive System**

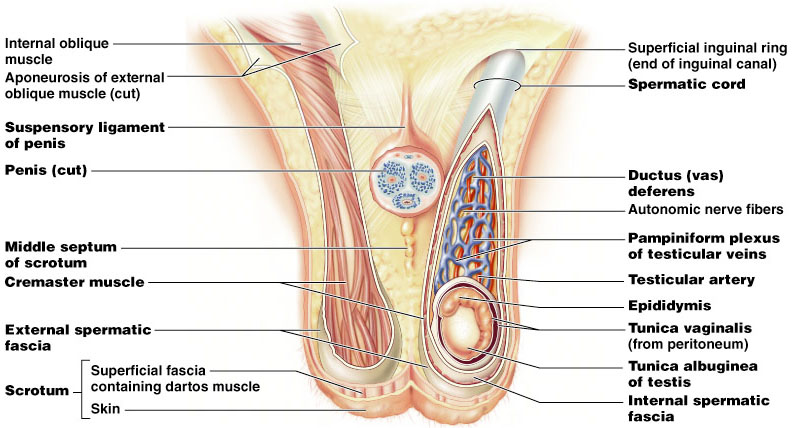
* The male gonads (testes) produce sperm and lie within the scrotum
* Sperm are delivered to the exterior through a system of ducts: epididymis, vas deferens, ejaculatory duct, and the urethra
* Accessory sex glands:
  + Empty their secretions into the ducts during ejaculation
  + Include the seminal vesicles, prostate gland, and bulbourethral glands

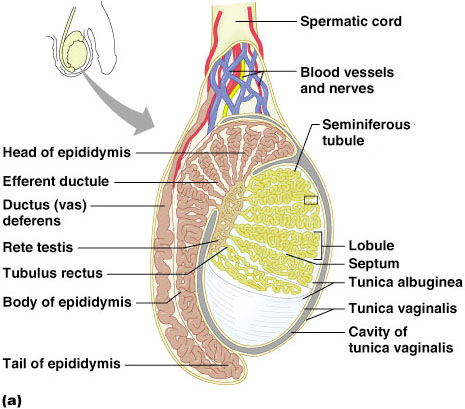
**Male Reproductive Organs**

* Essential organs
  + For production of gametes
  + Gonads of male – testes
* Accessory organs
  + Support the reproductive process
  + Genital ducts convey sperm outside the body
    - pair of epididymides
    - paired vasa deferentia,
    - pair of ejaculatory ducts, and the
    - urethra
  + Accessory glands
    - produce secretions that nourish, transport, and mature sperm
    - pair of seminal vesicles, the prostate, and pair of bulbourethral glands
  + Supporting structures
    - Scrotum
    - Penis
    - Pair of spermatic cords
* Male – Perineum
  + Roughly diamond-shaped area between thighs
  + Extends from pubic symphysis to coccyx
  + Lateral boundary is the ischial tuberosity bilateral Divided into the urogenital triangle and the anal triangle

**The Scrotum**

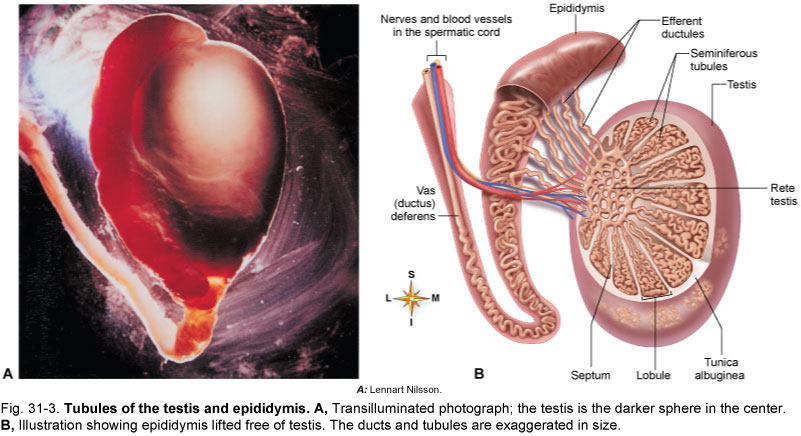
* Sac of skin (scrotum = “pouch”) and superficial fascia that hangs outside the abdominopelvic cavity at the root of the penis
* Divided into two compartments - contains paired testicles separated by a midline septum
* Contains testis, epididymis, and lower part of a spermatic cord
* Dartos and cremaster muscles elevate the scrotal pouch
* Its external positioning keeps the testes 3°C lower than core body temperature (needed for sperm production)

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**The Testes**

* Located in scrotum, one testis in each of two scrotal compartments
* Each testis is surrounded by two tunics or layers
* Septa (walls) divide the testis into 250-300 lobules, each containing 1-4 seminiferous tubules
  + Produce and carry the sperm
* The microscopic structure of the seminiferous tubules contains interstitial cells called Leydig cells
  + The interstitial cells produce androgens
* The seminiferous tubules are encased in fibrous capsule called the tunica albuginea
* Seminiferous tubules in testis open into a plexus called rete testis
* From the rete testis, the sperm:
  + Leave the testis via efferent ductules
  + Enter the epididymis

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**Functions of Testes**

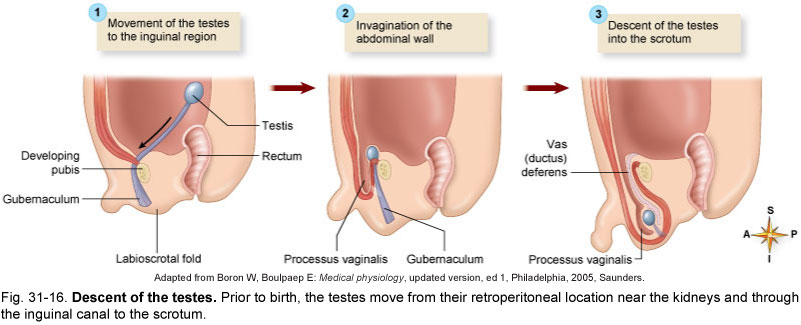
* Spermatogenesis - formation of mature male gametes (spermatozoa) by seminiferous tubules
  + stimulated by FSH from the anterior pituitary
* Secretion of hormones by interstitial cells
  + Testosterone
    - Type of androgen: maleness hormone
    - Secondary male sexual characteristics
    - Regulated by LH from anterior pituitary

**Functions of Testes - comtinued**

* + Inhibin
    - Inhibits release of FSH by anterior pituitary
    - Allows the testis some control over spermatogenesis
  + Estrogen
    - Small amounts secreted by interstitial cells, liver, and other organs
    - Role in males uncertain but may influence spermatogenesis and other functions

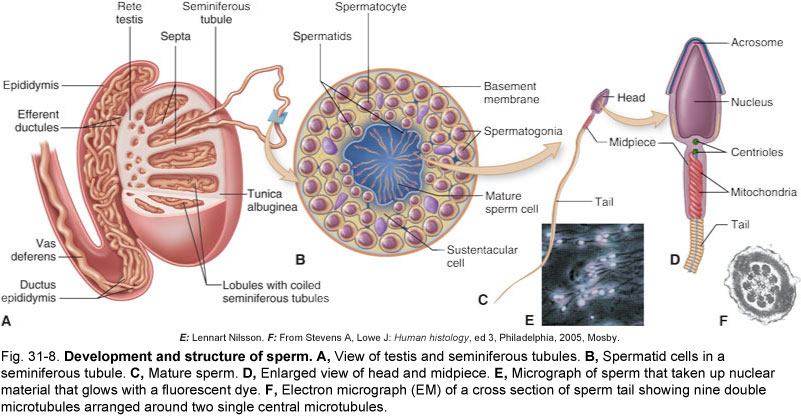
**Testicular cancer**

* Very rare cancer (<1% of all cancers), but most common cancer of young men
* Most common risk factor – cryptorchidism (undesended testicle)
* 7000 cases per year with 300 death per year
* 90% success rate with orchidectomy

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**Spermatogenesis**

* The sequence of events that produces sperm in the seminiferous tubules of the testes – takes 64 to 72 days
* Each cell has two sets of chromosomes (one maternal, one paternal)
* Humans have 23 pairs of chromosomes
* Spermatogenesis begins at puberty and continues throughout life
* Healthy adult male produces 400 million sperm per day
* Sperm have three major regions
  + Head – contains DNA and has a helmetlike acrosome containing hydrolytic enzymes that allow the sperm to penetrate and enter the egg
  + Midpiece – contains mitochondria spiraled around the tail filaments
  + Tail – a typical flagellum produced by a centriole

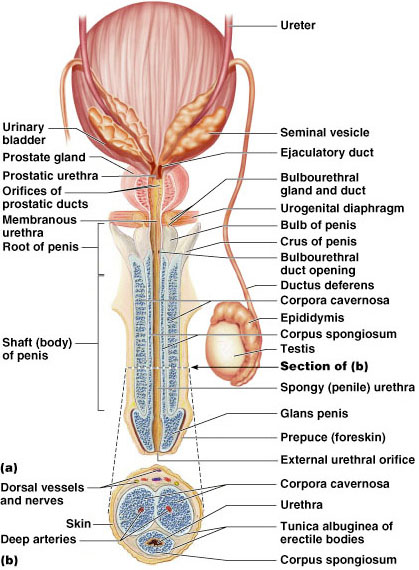
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**Male Secondary Sex Characteristics**

* Male hormones make their appearance at puberty and induce changes in nonreproductive organs, including
  + Appearance of pubic, axillary, and facial hair
  + Enhanced growth of the chest and deepening of the voice
  + Skin thickens and becomes oily
  + Bones grow and increase in density
  + Skeletal muscles increase in size and mass
* Testosterone is the basis of libido in both males and females

**The Penis**

* Composed of three cylindrical masses of erectile tissue, one of which contains urethra
* Functions
  + Contains the urethra, the terminal duct for both urinary and reproductive tracts
  + Penetrating copulatory organ during sexual intercourse
* Consists of an attached root and a free body that ends in the glans penis or head
* Prepuce, or foreskin – cuff of skin covering the distal end of the penis
* Internal penis – the urethra and three cylindrical bodies of erectile tissue
* Erectile tissue – spongy network of connective tissue and smooth muscle riddled with vascular spaces
* Corpus spongiosum – surrounds the urethra and expands to form the glans and bulb of the penis

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**Epididymis**

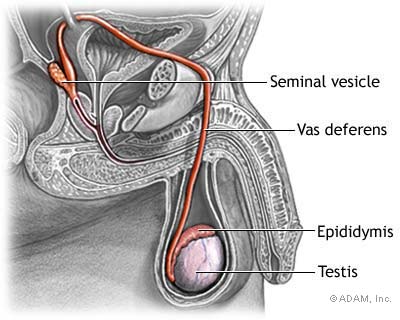
* Structure and location
  + Single tightly coiled tube enclosed in fibrous casing
  + Lies along top and side of each testis
  + Anatomical divisions include head, body, and tail
* Functions
  + Duct for seminal fluid
  + Also secretes part of seminal fluid
  + Sperm become capable of motility while they are passing through the epididymis
* Its head joins the efferent ductules and caps the superior aspect of the testis
* Nonmotile sperm enter, pass through its tubes and become motile (it takes about 20 days)
* If the epididymus ducts were uncoiled, it would be about 20 feet long
* Upon ejaculation the epididymis contracts, expelling sperm into the vas deferens

**Vas Deferens** (ductus deferens)

* Runs from the epididymis through the inguinal canal into the pelvic cavity then joins the duct of the seminal vesicle to form the ejaculatory duct
* Is approximately 18 inches long
* Propels sperm from the epididymis to the urethra
* Vasectomy – cutting and ligating the ductus deferens, which is a nearly 100% effective form of birth control
* Vasovasotomy – vasectomy reversal

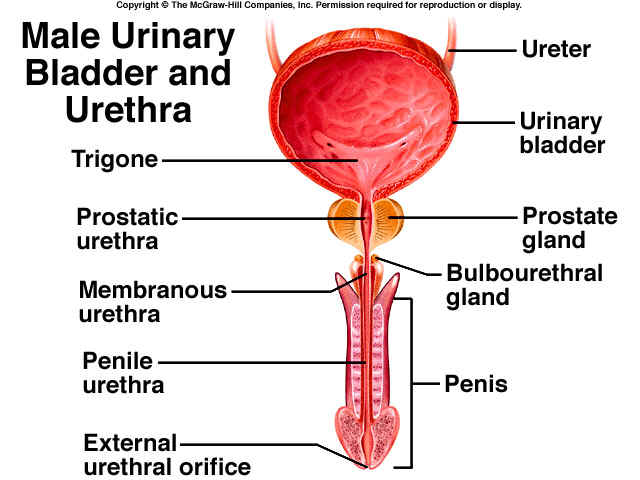
**Vas Deferens** (ductus deferens) - continued

* Structure and location
  + Tube, extension of epididymis
  + Extends through inguinal canal, into abdominal cavity, over top and down posterior surface of bladder
  + Enlarged terminal portion called ampulla; joins duct of seminal vesicle
* Function
  + Excretory duct for seminal fluid
  + Connects epididymis with ejaculatory duct

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**Urethra**

* Conveys both urine and semen
* Consists of three regions
  + Prostatic – portion surrounded by the prostate
  + Membranous – lies in the urogenital diaphragm
  + Spongy, or penile – runs through the penis and opens to the outside at the external urethral orifice



**Accessory Glands**

* Seminal Vesicles
  + Secrete 60% of the volume of semen
  + Join the vas deferens to form the ejaculatory duct
  + Sperm and seminal fluid mix in the ejaculatory duct and enter the prostatic urethra during ejaculation
* Prostate Gland
  + Encircles part of the urethra inferior to the bladder
  + Doughnut shaped
  + Plays a role in the activation of sperm
  + Function: adds slightly acidic, watery, milky-looking secretion to seminal fluid (30% of semen volume)
* Bulbourethral Glands (Cowper’s Glands)
  + Structure and location
    - Small, pea-shaped structures with approximately 2.5-cm long (1 inch) ducts leading into urethra
    - Lie below prostate gland
  + Function
    - Secrete alkaline fluid that is part of semen (5% of semen volume)
    - Produce thick, clear mucus prior to ejaculation that neutralizes traces of acidic urine in the urethra

**Semen**

* Provides a transport medium and nutrients, protects and activates sperm, and facilitates their movement
* Prostaglandins in semen:
  + Decrease the viscosity of mucus guarding the cervix
  + Stimulate reverse peristalsis in the uterus
  + Facilitate the movement of sperm through the female reproductive tract
  + The relative alkalinity of semen neutralizes the acid environment found in the male urethra and female vagina
* Only 2-5 ml of semen are ejaculated, but it contains 50-130 million sperm/ml

**Erection**

* Engorgement of spongy erectile bodies with blood during stimulation
* Under the control of parasympathetic control which releases nitrous oxide (NO2), which relaxes vascular smooth muscle causing the arterioles to dilate
  + Cavernous bodies fills with 50 cc blood
  + The erection blocks the venous flow from the penis after the cavernous bodies engorge

**Ejaculation**

* The propulsion of semen from the male duct system
* At ejaculation, sympathetic nerves serving the genital organs cause:
  + Reproductive ducts and accessory organs to contract and empty their contents
  + The bladder sphincter muscle to constrict, preventing the expulsion of urine
  + Bulbospongiosus muscles to undergo a rapid series of contractions
  + Propulsion of semen from the urethra

**Composition and Course of Seminal Fluid**

* Consists of secretions from testes, epididymides, seminal vesicles, prostate, and bulbourethral glands
* Each milliliter contains millions of sperm
* Passes from testes through epididymis, vas deferens, ejaculatory duct, and urethra

**Male Fertility**

* Relates to many factors: number, size, shape, and motility of sperm
* Infertility may be caused by antibodies some men make against their own sperm
* Male fertility begins at puberty and extends into old age

**Cycle of Life: Male Reproductive**

* Reproductive functions begin at time of puberty
* Development of organs begins before birth; immature testes descend into scrotum before or shortly after birth
* Puberty: high levels of hormones stimulate final stages of development
* System operates to permit reproduction until advanced old age
* Late adulthood: gradual decline in hormone production may decrease sexual appetite and fertility

