

### male reproductive system anatomy

#### gonads (testes)

produce sperm & secrete hormones

system of ducts (ductus epididymis, ductus deferens, ejaculatory duct, urethra)

transport & stores sperm, assists in their maturation, conveys them to the exterior

accessory sex glands (Seminal vesicles, prostate gland, bulbourethral glands)

adds secretions to semen

#### supporting structures

scrotum supports testes, penis delivers sperm into female reproductive tract

#### scrotum

a cutaneous outpouching of the abdomen that supports the testes, normal sperm production & survival requires a temperature 2-3 degrees below core body temperature

#### testes/testicles

paired oval glands that descend from the abdomen to the scrotum during the 7th month of fetal development, covered by a fibrous tissue called tunica albuginea, invaginations form 200-300 compartments called lobules, each lobule is filled with 2 or 3 seminiferous tubules (spermatogenesis)

### perineum

- Diamond-shaped area medial to thighs and buttocks of males and females  
 - Contains external genitalia and anus  
 - During childbirth the emerging fetus may cause excessive stretching and tearing of the perineum. A physician may make a surgical incision (episiotomy) in this region to prevent excessive, jagged tears

### accessory sex glands

seminal vesicles (60% of vol)      viscous alkaline fluid that helps neutralise acid environment

contains fructose for ATP production by sperm

& prostaglandins contribute to sperm motility & viability

prostate glands (25% of vol)      single donut shaped gland that secretes milky, slightly acid fluid

it contains 1) citric acid (ATP production via Krebs)

2) several proteolytic enzymes

3) PSA - prostate specific antigen

### accessory sex glands (cont)

4) seminalplasmin (antibiotic)

paired bulbourethral glands (cowper's)      secrete alkaline fluid that protects passing sperm by neutralising acids from urine in urethra

mucus lubricates end of penis & lining of urethra

### vagina

Fibromuscular canal extending from exterior of body to uterine cervix

Mucosa continuous with uterine mucosa

Decomposition of glycogen makes acidic environment hostile to microbes and sperm

Alkaline components of semen raise pH

functions as a passageway for spermatozoa & the menstrual flow, the receptacle of the penis during sexual intercourse, and the lower portion of the birth canal  
 4 inch long fibromuscular organ ending at cervix

- mucosal layer

- muscularis layer is smooth muscle allows considerable stretch

- adventitia is loose connective tissue that binds it to other organs



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### fallopian tubes

provide route for sperm to reach an ovum

site of fertilisation

transport secondary oocytes & fertilised ova from ovaries to uterus

Infundibulum ends in finger-like fimbriae;  
Produce currents to sweep secondary oocyte into tube

Ampulla – widest longest portion

Isthmus – joins uterus

Three layers:

- 1) Mucosa – ciliary conveyor belt, peg cells provide nutrition to ovum
- 2) Muscularis – peristaltic contractions
- 3) Serosa – outer layer

### oogenesis & follicular development

- results in formation of a single haploid secondary oocyte
- during early foetal development, primordial primitive germ cells migrate from yolk sac to ovaries
- differentiate into oogonia - diploid 2n stem cells
- before birth, most germ cells degenerate - atresia
- a few develop into primary oocytes that enter meiosis I during foetal development
- Each covered by single layer of flat follicular cells – primordial follicle
- About 200,000 to 2,000,000 at birth in each ovary, 40,000 remain at puberty, and around 400 will mature and ovulate during a lifetime

### Testes cells

- |                                |  |
|--------------------------------|--|
| leydig cells                   | found in spaces between adjacent seminiferous tubules  |
| (interstitial endocrino-cytes) | secrete the male hormone testosterone  |
| sertoli cells                  | embedded among spermatogenic cells in tubules , form blood testes barrier, nourish spermatocytes, mediate effects of testosterone & FSH on spermatogenesis, phagocytose excess spermatids, secrete inhibin hormone which helps regulate sperm production by inhibiting production of FSH |

### mammary glands

- modified sudoriferous (sweat) glands that produce milk (lactation)
- 15-20 lobes divided into lobules composed of alveoli (milk-secreting glands)
- Milk secreting glands open by lactiferous ducts at the nipple
- Areola – pigmented area around nipple

### external female genitalia

- |                       |   |
|-----------------------|---|
| Mons pubis            | fatty pad cushions pubic symphysis  |
| Labia majora          | homologous to scrotum   |
| Labia minora          | homologous to spongy (penile) urethra   |
| Clitoris              | small mass of erectile tissue and numerous nerves/blood vessels homologous to glans penis |
| Vestibule             | region between labia minora   |
| Bulb of the vestibule | 2 elongated masses of erectile tissue on either side of vaginal orifice                   |

### secretions & functions

- Secretory cells of the mucosa of the cervix produce a cervical mucus (a mixture of water, glycoprotein, serum-type proteins, lipids, enzymes, and inorganic salts)
- when thin, is more receptive to sperm
- when thick, forms a cervical plug that physically impedes sperm penetration
- mucus supplements the energy needs of the sperm
- The cervix and the mucus also play a role in capacitation - renders them competent to fertilise an oocyte



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### oogenesis

- Once secondary oocyte is formed it begins meiosis II but stops at metaphase
- At ovulation, secondary oocyte expelled with first polar body
- If fertilisation does not occur, cells degenerate
- If a sperm penetrates secondary oocyte, meiosis II resumes
- Secondary oocyte splits into 2 cells of unequal size -second polar body (discarded), ovum or mature egg
- Nuclei of sperm cell and ovum unite to form diploid zygote- fertilisation

### follicular development

- Each month from puberty to menopause, FSH and LH stimulate the development of several primordial follicles (one reaches ovulation)
- Just before ovulation, diploid primary oocyte completes meiosis I
- Produces 2 unequal sized haploid (n) cells – secondary oocyte and first polar body (discarded)

### female reproductive system

gonads (ovaries)	produce secondary oocytes & hormones
uterine fallopian tubes or oviducts	transport fertilised ova
uterus	where foetal development occurs

### female reproductive system (cont)

vagina	
external organs	vulva or pudendum
mammary glands	produce milk

### penis

- passageway for ejaculation of semen
  - body composed of 3 erectile tissue masses filled with blood sinuses surrounded by smooth muscle & elastic connective tissue
- erection: parasympathetic fibers release/cause local production of nitric oxide, dilates arterial smooth muscle, large amounts of blood enter blood sinuses, compresses veins draining the penis

### sperm morphology

- adapted for reaching & penetrating a secondary oocyte
- head contains DNA (23 Chromosomes) & acrosome
- acrosome has enzymes that help sperm penetrate secondary cycle (hyaluronidase & proteinase)

midpiece contains mitochondria to form ATP

produced at rate of 300 million/day

life expectancy = 48hrs in female reproductive tract

### ovaries

- paired glands homologous to testes
- produce: **gametes** (secondary oocytes that develop into mature ova after fertilisation, & **hormones** including progesterone, estrogens, inhibin & relaxin)
- ligaments hold ovaries in place:

### ovaries (cont)

1. broad ligament - a fold of parietal peritoneum
2. ovarian ligament - anchors ovaries to uterus
3. suspensory ligament - attaches ovaries to pelvic wall

### histology:

- germinal epithelium covers surface of ovary
- tunica albuginea located underneath epithelium
- ovarian cortex = ovarian follicles & stromal cells
- ovarian medulla contains blood vessels, lymphatic vessels & nerves
- ovarian follicles in cortex consist of oocytes in various stages of development
- mature graafian follicle is a large, fluid-filled follicle ready to expel secondary oocyte during ovulation
- corpus luteum - remnants of mature follicle after ovulation

### uterus (womb)

#### Functions

- the transport of spermatozoa, menstruation, implantation of fertilised ovum, development of foetus during pregnancy and labour

Anatomically – can be subdivided into:

- Fundus
- Body
- Isthmus
- Cervix (opens into vagina)

#### blood supply:

- Uterine arteries branch as arcuate arteries and radial arteries that supply the myometrium
- Straight & spiral branches penetrate to the endometrium
- spiral arteries supply the stratum functionalis



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### uterus (womb) (cont)

- their constriction due to hormonal changes starts menstrual cycle

histology: 3 layers

(1) Perimetrium – outer layer

(2) Myometrium

- 3 layers of smooth muscle

- contractions in response to oxytocin from posterior pituitary

(3) Endometrium – inner layer

- highly vascularized

Stratum functionalis

- lines cavity, sloughs off during menstruation

Stratum basalis

- permanent, gives rise to new stratum functionalis after each menstruation

### male reproductive ducts

ducts of testis series of coiled efferent ducts that empty into epididymis

epididymis site of sperm maturation & storage

ductus (vas) deferens conveys sperm during sexual arousal through peristaltic contractions

spermatic cord ductus deferens ascends out of scrotum with arteries/veins, autonomic nerves, lymphatic vessels & cremaster muscle

ejaculatory ducts formed by union of ducts from seminal vesicle & ductus deferens, terminating in the prostatic urethra

### male reproductive ducts (cont)

urethra shared terminal duct of reproductive & urinary systems, subdivided into: prostatic urethra, membranous urethra, spongy penile urethra

### spermatogenesis

produces haploid sperm (n) = one set of 23 chromosomes from diploid spermatogonia (2n)

takes approx. 74 days

meiosis I - process = reduction division, homologous pairs line up to form a tetrad (4 chromatids from each homologous pair) & the two cells formed by this nuclear division are called **secondary spermatocytes** (haploid)

each of 23 chromosomes is still made up of 2 chromatids attached at centromere

goes through meiosis II = equatorial division, 2 chromatids separate (no DNA replication)

results in 4 spermatids - each haploid & unique, 50% X chromosome & 50% Y.

spermiogenesis = development of spermatids into sperm, acrosome & flagella (tail) form, mitochondria multiply

spermiation = release from connections to sertoli cells

### female reproductive cycle

Encompasses ovarian and uterine cycle, hormonal changes that regulate them, and related changes in breast and cervix

controlled by monthly hormone cycle of anterior pituitary, hypothalamus and ovary

ovarian cycle: changes in ovaries that occur during and after maturation of oocyte

Uterine (menstrual) cycle: concurrent series of changes in uterine endometrium preparing it for arrival of fertilized ovum. if implantation does not occur the stratum functionalis is shed during menstruation



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