Session Plan

- Functions of female reproductive system
  - Ovaries
    - Oogenesis and follicular development
  - Uterine tubes
  - Uterus
  - Vagina
  - Vulva
  - Mammary glands
Female Reproductive System
Female Reproductive System

- Organs of female reproductive system:
  - Gonads: Ovaries
  - Ducts: uterine (Fallopian) tubes,
  - Supporting structures: uterus, vagina, vulva,
  - Mammary glands
Female Reproductive System

- Functions of female reproductive system:
  - Ovaries: Produce secondary oocytes and hormones, including progesterone and estrogens, inhibin, and relaxin.
  - Uterine tubes: Transport a secondary oocyte to the uterus and normally are the sites where fertilization occurs.
  - Uterus: The site of implantation of a fertilized ovum, development of the foetus during pregnancy, and labour.
  - Vagina: Receives the penis during sexual intercourse and is a passageway for childbirth.
  - Mammary glands: Synthesize, secrete, and eject milk for nourishment of the newborn.
Female Reproductive System

- Uterine (fallopian) tube
- Fimbriae
- Ovary
- Uterus
- Round ligament of uterus
- Cervix
- Urinary bladder
- Pubic symphysis
- Mons pubis
- Clitoris
- Urethra
- Labium majus
- External urethral orifice
- Labium minus

(a) Sagittal section
Ovaries
Ovaries

- **The ovaries**: paired unshelled almonds sized and shaped glands
- **Location**: one on either side of the uterus.
  - descend to the brim of the superior portion of the pelvic cavity during the third month of development.
- **Hilum**: The point of entrance and exit for blood vessels and nerves along which the mesovarium is attached.
Ovaries

- **Ligaments:** maintain the ovaries position in pelvic cavity.
  - **Broad ligament:** attaches to the ovaries by a double-layered fold of peritoneum called the mesovarium.
  - **Ovarian ligament:** anchors the ovaries to the uterus
  - **Suspensory ligament:** attaches ovaries to the pelvic wall
Ovaries: Ligaments

- Rectus abdominis muscle
- Urinary bladder
- Uterus
- Round ligament
- **Ovarian ligament**
- Mesovarium
- Cecum
- **Broad ligament**
- Vermiform appendix
- Cardinal ligament
- Uterosacral ligament
- Common iliac artery

**Suspending ligaments**
- Uterine (fallopian) tube
- Ovary
- Rectouterine pouch (pouch of Douglas)

**Surgical ligaments**
- Suspensory ligament
- Ureter
- Ileum
- Sigmoid colon

**Superior view of transverse section**
Ovaries: Histology

Each ovary consists of the following parts:

- Germinal epithelium
- Tunica albuginea
- Ovarian cortex
- Ovarian medulla
- Ovarian follicles
- A mature (Graafian) follicle
- A corpus luteum
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The Ovary: Histology

- **Germinal epithelium**: A simple epithelial covering over the ovary
- **Tunica albuginea**: A capsule of dense connective tissue
- **Cortex**: A region just deep to tunica, containing follicles
- **Medulla**: A deeper region composed of connective tissue, blood vessels and lymphatics
- **Ovarian follicles**: Consist of oocytes in various stages of development in the cortex
- **A mature follicle**: a large, fluid filled follicle that rupture and expel its secondary oocyte, during ovulation.
- **A corpus luteum**: contains the remnants of a mature follicle after ovulation
Oogenesis and Follicular Development

- **Oogenesis**: The formation of gametes in the ovaries.
  - **Events in oogenesis**: Mitosis, reduction division (Meiosis I), equatorial division (Meiosis II), and maturation

- **Follicular development**: occurs along with oogenesis
  - **Developmental stages**: Primordial, primary, secondary, and mature (Graafian) follicles, and corpus luteum and corpus albicans.
Oogenesis and Follicular Development

TABLE 28.1
Summary of Oogenesis and Follicular Development

<table>
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<th>AGE</th>
<th>OOGENSES</th>
<th>FOLLICULAR DEVELOPMENT</th>
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<tr>
<td>Fetal period</td>
<td>Oogonion</td>
<td>Primordial follicle</td>
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<tr>
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<td>Mitosis</td>
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<td>Meiosis in progress</td>
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<td>Primary oocyte</td>
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<td>Childhood (no development of follicles)</td>
<td>Primary oocyte (stil in prophase I)</td>
<td>Primary follicle</td>
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<td>Meiosis I completed by one primary oocyte each month</td>
<td>Secondary follicle</td>
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<td>First polar body</td>
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<tr>
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<td>Meiosis II of first polar body may or may not occur</td>
<td>Secondary oocyte (in metaphase II)</td>
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<td>Second polar body</td>
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<td>Ovulation</td>
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<td>Ovulated secondary oocyte</td>
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</tbody>
</table>
Events in oogenesis

- **Mitosis:** Germ cells from yolk sac migrate to ovary and become oogonia
  - In the female fetus, oogonia divide to produce millions by mitosis but most degenerate (atresia)

- **Meiosis I:** Some develop into primary oocytes and stop in prophase stage of meiosis I
  - 200,000 to 2 million are present at birth
  - 40,000 remain at puberty, but only 400 mature during a woman’s life

- **Meiosis I resumes and Meiosis II:** After puberty, each month, hormones cause Meiosis I to resume in several follicles so that Meiosis II is reached by ovulation
  - Penetration by the sperm causes the final stages of meiosis to occur
Follicular Stages: Primordial follicle

Primordial follicle: primary oocyte is surrounded by a single layer of flat follicular cells
Late primary follicle: consists of a primary oocyte surrounded by several granulosa cells.
Follicular Stages: Secondary follicle

Secondary follicle with theca interna, theca externa and antrum
Follicular Stages: Graafian Follicle

Graafian Follicle with Zona Pellucida, Corona radiata and Antrum
Follicular Stages: Graafian Follicle

Histology of a Graafian follicle:

- **Zona Pellucida**
  - clear area between oocyte and granulosa cells

- **Corona radiata**
  - granulosa cells attached to Zona Pellucida - still attached to oocyte at ovulation

- **Antrum**
  - formed by granulosa cells secreting fluid

- By this time, the oocyte has reached the metaphase of Meiosis II stage and stopped developing - the first polar body has been discarded
Follicular Stages: Corpus Luteum and Albicans

- Corpus luteum: An ovulation wound that fills in with hormone-secreting cells
- Corpus albicans: A white fibrous tissue scar left after corpus luteum degenerates (when it is not needed)
Uterine Tubes and Uterus
Uterine or Fallopian Tubes

- **Uterine Tubes:** Narrow, 10cm tube extends from ovary to uterus
- **Three parts:**
  - Infundibulum – fimbriae
  - Ampulla
  - Isthmus
- **Functions:**
  - Transport ova from ovaries to uterus
  - The normal sites of fertilization
Histology of Uterine Tube

Histology: 3 Layers

- **Mucosa**: ciliated columnar epithelium with secretory cells provide nutrients
- **Muscularis**: circular and longitudinal smooth muscle
  - peristalsis helps move ovum down to the uterus
- **Serosa**: outer serous membrane
Uterus

- **Shape:** of an inverted pear
- **Size:** 7.5cm long, 5cm wide and 2.5cm thick
- **Functions:**
  - Transport of spermatozoa,
  - Menstruation,
  - Implantation of a fertilized ovum,
  - Development of a fetus during pregnancy, and labor
Anatomy of the Uterus

- Anatomical Subdivisions:
  - Fundus
  - Body
    - uterine cavity
  - Isthmus
  - Cervix
    - Cervical canal
    - Internal os
    - External os
Uterus: Position

- **Position:** anteflexion—projects anteriorly and superiorly over the urinary bladder

- **Ligaments:** hold uterus in normal position
  - Broad ligament, uterosacral ligaments, cardinal (lateral cervical) ligaments, round ligaments

- **Retroflexion:** Posterior tilting of the uterus,
  - A harmless variation of the normal position of the uterus.
  - May occur after childbirth.
Histology of the Uterus

- **Endometrium**
  - Simple columnar epithelium
  - Stroma of connective tissue and endometrial glands
    - **stratum functionalis**: shed during menstruation
    - **stratum basalis**: replaces stratum functionalis each month

- **Myometrium**
  - 3 layers of smooth muscle

- **Perimetrium**
  - Visceral peritoneum

(b) Details of endometrium

Courtesy Michael Ross, University of Florida
Blood Supply of Uterus

- **Arterial supply**: Uterine arteries and their numerous branches
  - Arcuate and radial arteries: Supply the myometrium
  - Straight and spiral branches: penetrate to the endometrium
    - Spiral arteries: supply the stratum functionalis
    - Their constriction due to hormonal changes starts menstrual cycle
- **Venous drainage**: Uterine veins
Blood Supply of Uterus

Anterior view with left side of uterus partially sectioned
Cervical Mucus

- **Cervical mucus**: Produced by secretory cells of the mucosa of the cervix
- **Contains**: A mixture of water, glycoprotein, serum-type proteins, lipids, enzymes, and inorganic salts
- **Significance**:
  - When thin, is more receptive to sperm; When thick, forms a cervical plug that physically impedes sperm penetration
  - Supplements the energy needs of the sperm
  - Serve as a sperm reservoir, protect sperm from the hostile environment of the vagina, and protect sperm from phagocytes
  - Play a role in *capacitation*
Vagina and Vulva
Vagina

The vagina:

- **Size:** 10cm long fibromuscular organ ending at the cervix
- **Location:** lies between urinary bladder and rectum
- **The vaginal orifice:** Vaginal opening to exterior
- **Hymen:** a thin fold of vascularized mucous membrane, often partially cover the vaginal orifice.
Vagina

Functions:

- a passageway for spermatozoa and the menstrual flow,
- the receptacle of the penis during sexual intercourse,
- the lower portion of the birth canal
Vagina - Histology

- **Mucosa:**
  - **Rugae:** Folds of epithelial layer
  - **Mucosa dendritic cells:** Are Antigen Presenting Cells (APC) perform an immune function
  - **Glycogen:** which decompose into organic acids which set up a hostile acid environment for bacteria and sperm.

- **Muscularis:** smooth muscle layer
  - can stretch considerably to accommodate the penis during sexual intercourse and a child during birth.

- **Adventitia:** is loose connective tissue
  - that binds vagina to other organs
Vulva

The vulva/pudendum: the external genitalia of the female

- **Components:**
  - Mons pubis
  - Labia majora
  - Labia minora
  - Clitoris, vestibule
  - Vaginal and urethral orifices
  - Hymen
  - Bulb of the vestibule
  - Paraurethral (Skene’s), Greater vestibular (Bartholin’s) and Lesser vestibular glands
Vulva

- **Mons pubis**: fatty pad over the pubic symphysis

- **Labia majora and minora**: folds of skin encircling vestibule with the urethral and vaginal openings

- **Clitoris**: small mass of erectile tissue

- **Bulb of vestibule**: masses of erectile tissue just deep to the labia on either side of the vaginal orifice

- **Paraurethral (Skene’s), Greater vestibular (Bartholin’s) and Lesser vestibular glands**: produce a small quantity of mucus during sexual arousal and intercourse that adds to cervical mucus and provides lubrication.
**Perineum**

- **Perineum**: The diamond-shaped area between the thighs and buttocks of both males and females that contains the external genitals and anus.
  - urogenital triangle contains external genitals
  - anal triangle contains anus
Mammary Glands
Mammary Glands

- Mammary Glands: modified sudoriferous (sweat) glands
- Consist of:
  - Lobes → lobules → alveoli (milk-secreting glands)
  - Adipose tissue
  - Secondary tubules → mammary ducts → lactiferous sinuses → Lactiferous ducts
- Functions: synthesis of milk, secretion and ejection of milk.
Mammary Glands

(a) Sagittal section

(b) Anterior view, partially sectioned
Mammary Glands

- **Breast**: A hemispheric projection of variable size anterior to the pectoralis major and serratus anterior muscles that consist of a mammary gland.

- **Nipple**: The pigmented projection, consist of a series of closely spaced openings of ducts called lactiferous ducts.

- **Areola**: The pigmented area around nipple that contains modified sebaceous glands.
Fibrocystic Disease of the Breasts

- **Fibrocystic disease**: The most common cause of a breast lump
  - one or more cysts (fluid-filled sacs)
  - thickening of alveoli (clusters of milk-secreting cells) develop

- **Cause**
  - hormonal imbalance
    - excess of estrogen or deficiency of progesterone in the postovulatory phase
  - result is lumpy, swollen and tender breast a week before menstruation begins
# Homologous structures: Male and Female

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<td>Scrotum</td>
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<tr>
<td>Labia minora</td>
<td>Spongy (penile) urethra</td>
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<tr>
<td>Vestibule</td>
<td>Membranous urethra</td>
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<tr>
<td>Bulb of vestibule</td>
<td>Corpus spongiosum penis and bulb of penis</td>
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<td>Clitoris</td>
<td>Glans penis and corpora cavernosa</td>
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<td>Paraurethral glands</td>
<td>Prostate</td>
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<tr>
<td>Greater vestibular glands</td>
<td>Bulbourethral (Cowper’s) glands</td>
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Readings and Resources

- Harris, P, Nagy, S & Vardaxis, N 2010, Mosby’s Dictionary of Medicine, Nursing and Health Professions, 2nd edn, Mosby Elsevier.
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