Activities

- Fetal Pig
- Urinalysis
- Models

They said I could live without you...But...

Life is more amazing with the two of us.
Urogenital system

- Urinary - removes wastes, maintains water balance
- Genital - reproduction
- Why consider them together?
  - Similar developmental origins and sharing of common structures.
Parts of the Urinary System

- Kidneys – Produce Urine
- Ureters – transport urine to urinary bladder
- Urinary Bladder – stores urine
- Urethra – transports urine outside body
- Ureter
- Direction of urine flow
- Muscle wall of bladder
- Ureter opening into bladder
Kidneys and Homeostasis

• Regulate:
  – Blood pressure
  – Salt balance
  – pH

• Eliminates waste
  • E.g., urea, the primary nitrogenous waste of humans
Parts of the Kidney

- nephrons
- renal pelvis
- renal cortex
- renal medulla
- ureter
- renal artery and vein
- renal pyramid in renal medulla
- collecting duct

a. Gross anatomy

b. Two nephrons
Nephron

Parts:
- Glomerular capsule (a)
- Glomerulus (j)
- Proximal convoluted tubule (b)
- Loop of the nephron (c)
- Distal convoluted tubule (f)
- Collecting duct (g)

Each nephron has its own blood supply

Other parts shown:
- renal artery (h)
- afferent arteriole (i)
- efferent arteriole (k)
- peritubular capillary network (l)
- renal vein (m)
Urine Production

Three Steps:
1) Glomerular Filtration
2) Tubular Reabsorption
3) Tubular Secretion
Urine Production

1) Glomerular Filtration

- Produces **glomerular filtrate**
  - Should contain:
    - Water
    - Salts
    - Nutrients
    - Wastes (e.g., urea)
  - Should NOT CONTAIN:
    - blood cells

Blood $\rightarrow$ Convoluted tubules
2) Tubular Reabsorption

- Salts and nutrients are actively reabsorbed into the blood from the convoluted tubules.
- **Active transport**, only molecules with carrier proteins are reabsorbed.
- Once the salt concentration is higher in the peritubular capillary, water flows **passively**.

Convoluted tubules → Blood
3) Tubular Secretion

- Substances actively secreted from blood to convoluted tubules
- Helps the body get rid of substances that were not filtered during glomerular filtration
- Too large, e.g., medications

Blood → Convoluted tubules
Urine Production

Three Steps:

1) Glomerular Filtration
   - Blood → Convoluted tubule
   - Filter small molecules from the blood

2) Tubular Reabsorption
   - Convoluted tubule → Blood
   - Reabsorb nutrients, salts, water

3) Tubular Secretion
   - Blood → Convoluted tubule
   - Large molecules
Urinalysis Lab

• What molecules do we expect to see in the urine?
• What might high amounts of certain molecules indicate?
Urinalysis Lab

- Leukocytes (blood) – can indicate infection or internal trauma
- pH – alkaline can indicate infection
- Protein – Can indicate recent muscle exertion or pregnancy; also renal disease, hypertension, tumors
- Glucose – May be high after sugary meal; may indicate diabetes
Dissection - Kidney

p. 105 fetal pig; appendix lab manual

• Remove Liver, Spleen, Stomach, Intestines (except last 5 centimeters)
• Locate **Kidney** behind **peritoneum**
• Locate **renal arteries, renal veins, and ureters**
• Cut one kidney in half (frontal cut)
• Locate **Renal Pelvis, Renal Cortex, Renal Medulla**
• Trace **ureter** to **urinary bladder**
• Trace urinary bladder to the **urethra**
Kidney Dissection

- Cut in half length-wise
Kidney Dissection

• Locate:
  – Renal cortex
  – Renal medulla
  – Renal pelvis
  – Renal pyramids
Reproductive Systems
Sexual VS Asexual Reproduction

- Asexual: single parent produces offspring with identical genes
  - Primary method for single-celled organisms:
    - Archaea, bacteria, protists
    - Budding: produces mother and daughter cells
- Some animals and plants
  - Fragmentation, vegetative propagation
  - Most animals and plants also have sexual reproduction
Sexual Reproduction

- Combines DNA of two individuals: fusion of **haploid gametes** to produce **diploid zygote**
  - Egg cell fertilized by sperm cell to produce individuals with unique genetics
Monoecious VS Diecious

• Most animals **diecious** (separate sexes), some **monoecious**, or hermaphroditic (produce both male and female gametes).
  – Sequential hermaphroditism: individuals change sex.
Sex Cells and Organs

• **Gametes**: sex cells
  – Male gametes = **Sperm**
  – Female gametes = **Eggs**

• **Gonads**: sex organs that produce gametes
  – Male gonads = **testes**
  – Female gonads = **ovaries**
Production of Sperm

• Male gonads are paired **testes** suspended in the sacs within the **scrotum**
  – Testes produce **sperm** in the **seminiferous tubules**
  – Sperm matures in the **epididymides** (tightly coiled tubules just outside testes)
  – Once mature, sperm propelled into **vas deferens**, which conducts and stores sperm.
  – Sperm enters **ejaculatory ducts** during sexual arousal
Production of Semen

- As sperm passes from vas deferens to ejaculatory duct, **seminal vesicles** at base of bladder secrete a thick fluid containing fructose and other nutrients.
- Below bladder, **prostate gland** secretes milky alkaline fluid to increase mobility and survival of sperm.
- **Bulbourethral gland**: below prostate on either side of urethra; provides mucus to cleanse urethra; precedes the rest of the semen.
# Semen - Recap

<table>
<thead>
<tr>
<th>Sperm</th>
<th>Percent of Semen</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sperm (from seminiferous tubules)</td>
<td>&gt;10%</td>
<td>Fertilization</td>
</tr>
<tr>
<td>Seminal Vesicle Secretions</td>
<td>60%</td>
<td>Nutrients, smooth muscle contractions</td>
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<td>30%</td>
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<td>Bulbourethral Fluids</td>
<td>Trace</td>
<td>Enters urethra first, cleanses of acid residue from urine</td>
</tr>
</tbody>
</table>

- **Semen - Recap**

- **Sperm**
  - Sperm (from seminiferous tubules) >10%
  - Seminal Vesicle Secretions 60%
  - Prostatic Fluids 30%
  - Bulbourethral Fluids Trace

- **Function**
  - Fertilization
  - Nutrients, smooth muscle contractions
  - Alkaline fluid to help sperm survive, antibiotic to prevent male UTI
  - Enters urethra first, cleanses of acid residue from urine
Human Male Reproductive System

- urinary bladder
- pubic bone
- vas deferens
- erectile tissue of penis
- urethra
- penis
- glans penis
- foreskin
- ureter (cut)
- seminal vesicle
- ejaculatory duct
- prostate gland
- bulbourethral gland
- anus
- vas deferens
- epididymis
- testis
- scrotum
Human Female Reproductive System

- **Ovaries**: female gonads; produce eggs and sex hormones
- **Oviducts** (fallopian tubes): extend from ovary to uterus. Not attached to ovary; *fimbriae* sweep over ovaries.
  - transport ova, site of fertilization
- **Uterus**: thick-walled, muscular organ; size/shape of inverted pear, lined by *endometrium*.
  - embryos complete development
- **Cervix**: narrow ended opening of uterus.
- **Vaginal canal**: opening to the female reproductive system for copulation/birth.
Human Female Reproductive System - External

- **Vulva**: external genital organs
- **Mons pubis**: adipose tissue above pubic bone
- **Labia majora** and **labia minora** – folded skin on either side of vagina
- **Glans clitoris**: homologous to penis in male
Human Female Ovarian Cycle

- Regulated by gonadotrophic hormones: **follicle stimulating hormone (FSH)** and **luteninizing hormone (LH)**

**Follicular Phase: Day 1 - 13**
- FSH causes a follicle to mature
- Follicle secretes estrogen; build up in hypothalamus and pituitary gland (in brain)
- Hypothalamus causes a surge in LH by pituitary gland, causing ovulation

**Ovulation – Day 14**
- **Ovulation**: Follicle bursts, releasing an oocyte (or egg)

**Luteal phase – Day 15 – 28**
- Follicle becomes **corpus luteum** (glandlike structure) which secretes **progesterone**
- Progesterone rises, signals pituitary gland to produce less LH, so luteal phase ends.
Human Female Uterine Cycle

- Controlled by sex hormones **estrogen** and **progesterone**

- **Day 1-5:** low hormones, endometrium disintegrates and blood vessels rupture, blood passes out of vagina during **menstruation** or **menstrual period**.

- **Day 6-13:** Proliferation phase: increased estrogen by ovarian follicle causes endometrium to thicken and become vascular/glandular.

- **Day 14:** Ovulation.

- **Day 15 – 28:** Secretory phase: increased progesterone by corpus luteum causes endometrium to double in thickness and uterine glands to mature and produce thick secretions; can receive developing embryo.
Fertilization and Pregnancy

- Fertilized in oviduct, travels down oviduct to uterus
- Embeds in lining of endometrium several days following fertilization: implantation
- Placenta develops; produces human chorionic gonadotropin (HCG)
Genital System Dissections – p 106 - 110

Female

• Locate Ovaries (posterior to kidneys)
• Trace oviducts to uterine horns, then to uterus
• From uterus, note the cervix and follow to vagina
• Note external genital structures: vulva, clitoris, labia majora
• Trace from kidney to urethra
Male

• Locate Scrotum and Testes
• Locate epididymis – trace cranially to spermatic cord containing vas deferens
• Follow vas deferens to urethra, noting the seminal vesicles (if possible), prostate gland, and bulbourethral gland
• Follow urethra to body opening
Activities

• Fetal Pig Dissection
  – Kidneys first
  – Reproductive System, your pig
  – Reproductive System, switch pigs

• Urinalysis lab