Lab and Lecture Final Review

By Eddie Hoppe

Respiratory Anatomy
Respiratory Physiology
Digestive Anatomy
Digestive Physiology
Urinary Anatomy
Urinary Physiology
Reproductive System: Male
Reproductive System: Female
Heredity
Respiratory Anatomy

Function:
The exchange of oxygen and carbon dioxide in the lungs
Respiratory Anatomy

**Figure 22.6 Action of Some of the Intrinsic Laryngeal Muscles on the Vocal Cords.**
(a) Adduction of the vocal cords by the lateral cricoarytenoid muscles. (b) Adducted vocal cords seen with the laryngoscope. (c) Abduction of the vocal cords by the posterior cricoarytenoid muscles. (d) Abducted vocal cords seen with the laryngoscope.
Respiratory Anatomy

1. Trachea
2. Bronchiole
3. Dimpled in surface
4. Terminal bronchioles
5. Location of carina
6. Apex
7. Superior lobe
8. Oblique fissure
9. Posterior fissure
10. Inferior lobe

Right terminal bronchiole
Left Terminal Bronchiole
Anterior View
Respiratory Physiology

The alveoli are the gas exchange structures in the lungs
TV - Tidal Volume: ~500 mL, is the amount of air inspired during normal, relaxed breathing (what you use when you breathe normally)

IRV - Inspiratory Reserve volume: ~ 3,100 mL is the additional air that can be forcibly inhaled after the inspiration of a normal TV.

ERV – Expiratory Reserve Volume: ~1,200 mL, is the additional air that can be forcibly exhaled after the expiratory of a normal TV.

RV - Residual Volume: ~1,200 mL, is the volume of air still remaining in the Lungs after the ERV is exhaled.
A patient comes into your respiratory clinic and you measure the following:

**Respiratory Volumes**

<table>
<thead>
<tr>
<th>Volume Type</th>
<th>Volume Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tidal Volume</td>
<td>500mL</td>
</tr>
<tr>
<td>Inspiratory Reserve</td>
<td>2,500mL</td>
</tr>
<tr>
<td>Expiratory Reserve</td>
<td>1,500mL</td>
</tr>
<tr>
<td>Respiratory Rate</td>
<td>10 Breaths/Min</td>
</tr>
<tr>
<td>Vital Capacity</td>
<td>4,500mL</td>
</tr>
<tr>
<td>Minute Respiratory Volume</td>
<td>5,000mL</td>
</tr>
</tbody>
</table>

**Respiratory Volumes**

<table>
<thead>
<tr>
<th>Volume Type</th>
<th>Volume Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tidal Volume</td>
<td>500mL</td>
</tr>
<tr>
<td>Expiratory Reserve</td>
<td>1,200mL</td>
</tr>
<tr>
<td>Inspiratory Reserve</td>
<td>2,800mL</td>
</tr>
<tr>
<td>Vital Capacity</td>
<td>4,500mL</td>
</tr>
</tbody>
</table>
Digestive Anatomy

**Ingestion**

**Digestion**
- Mechanical (physical breakdown)
- Chemical (chemical breakdown)

**Absorption**
- Facilitated and simple diffusion

**Defecation**

*Your body’s ability to break down molecules (digestion) small enough so that you can absorb them as nutrients*
General Histology of GI Tract

**Mucosa**
Depending on the section of the digestive tract, it *protects* the digestive tract wall, *secretes* substances, and *absorbs* the end products of digestion.

**Submucosa**
Consists of areolar connective tissue containing blood vessels, lymphatic vessels, and nerve fibers.

**Muscularis Externa**
Two-three layer of muscle. Smooth muscle propels food by peristalsis.

**Serosa**
Membrane that covers the muscularis externa of the digestive tract in the peritoneal cavity.

**Mesentery**
Refers to the peritoneum responsible for connecting the *jejunum* and *ileum* (parts of the small intestine) to the back wall of the abdomen.
Oral Cavity

Teeth: 32 total in adults
2 incisors: front teeth for cutting
1 Canine to pierce and tear
2 premolars to grind and crush
3 molars to grind and crush
Fig 23.9

1. Ducts of sublingual gland
2. Parotid duct
3. Submandibular duct

Lecture: extrinsic gland
Stomach

What are the greater and lesser omentums and what do they attach to? (see below for explanation)
Lecture: Stomach Physiology

- Surface mucous cell (secretes mucus)
- Mucous neck cell (secretes mucus)
- Parietal cell (secretes hydrochloric acid and intrinsic factor)
- Chief cell (secretes pepsinogen and gastric lipase)
- G cell (secretes the hormone gastrin)

Key:
- Proton pump (H^+K^+ATPase)
- Carboxic anhydrase
- Carbonic anhydrase
- Diffusion
- Chloride ion channel
- Potassium ion channel
Liver, Gallbladder, and Pancreas

- Right hepatic duct
- Left hepatic duct
- Common hepatic duct from liver
- Cystic duct from gallbladder
- Common bile duct
- Pancreatic duct from pancreas
- Hepato-pancreatic ampulla
- Key:
  - Liver
  - Gallbladder
  - Pancreas
  - Duodenum
  - 5th crus

Diagram showing:
- Right lobe of liver
- Left lobe of liver
- Common hepatic duct
- Left hepatic duct
- Common bile duct
- Pancreatic duct (duct of Wirsung)
- Hepatopancreatic ampulla (ampulla of Vater)
- Falciform ligament
- Diaphragm
- Coronary
- Fallopian canal
- Round ligament
- Common hepatic duct
- Cystic duct
- Neck
- Body
- Fundus
- Pancreas
- Tail
- Body
- Jejunum
- Uncinate process

The Academic Support Center @ Daytona State College (Science 57 Page 17 of 54)
Small Intestines

Don’t - Duodenum
Jump - Jejunum
In - Ileum
Small Intestines: Villi

Where are Payer’s Patches Concentrated?

What do lacteals transport?

1. Absorptive cell
2. Villus (greatly enlarged)
3. Hepatic portal vein
4. Thoracic duct
5. Lymphatic vessel
Large Intestines

1, 2, 5, 8 refer to regions of colon
6 refers to the longitudinal muscle of the colon

What is a haustrum? (explanation below)
What is the mesocolon?
Digestive Physiology

Chemical Digestion
- Breaking down larger molecules into smaller molecules using hydrolytic enzymes

Diagram:
- Polysaccharides: salivary amylase - salivary glands, pancreatic amylase - pancreas
  - Maltose: maltase - intestinal cells
  - Glucose
- Proteins: pepsin - stomach, trypsin - pancreas
  - Peptides
    - Peptidases - intestinal cells
  - Amino acids
- Fats: lipase - pancreas
  - Monoglycerides + fatty acids
Chemical Digestion using Hydrolytic Enzymes

Substrate (polysaccharide) → Enzyme + Substrate → Products (disaccharide)

- Starch
- Hydrolytic enzyme (amylase)
- Maltose

***Hydrolytic enzymes work by adding $H_2O$ to the compound, which breaks the covalent bonds

Hydro = water, lysis = breaking

***Enzymes work best at specific pH levels and temperatures
Enzymes involved in Lab

- **Amylase** converts complex sugars (starch) to Maltose.
  - Goal: How does temperature and pH affect amylase activity?
  - **Optimal pH for amylase activity is 7; optimal temp. is ~35°C**

- **Cellulose** is a carbohydrate found in the cell walls of plants.
  - Goal: Is cellulose broken down by amylase, pepsin or bacteria?

  Animals such as termites and herbivores such as cows, koalas, and horses all digest cellulose however not with the action of an enzyme. They use anaerobic bacteria.

- **Pepsin** breaks down proteins to amino acids (in the stomach).
  - Goal: How does pH affect the activity of pepsin?
  - **Optimal pH for pepsin is 2 (the pH of stomach acid), the enzyme denatures at pH levels which are too basic or too acidic (and stops working)**

- **Bile** emulsifies fat in water and **lipase** breaks fat into smaller acidic molecules.
  - Goal: How do bile, lipase and pH levels affect fat breakdown?
  - * Breaking down triglycerides into fatty acids and monoglycerides produced a lower pH.
  - * Optimal pH for lipase is around 8
Hydrolytic Enzyme and Substrates in Chemical Digestion: carbohydrates

Polysaccharide (starch) → Salivary amylase
Pancreatic Amylase → Disaccharide (maltose) → Monosaccharide (glucose)
Hydrolytic Enzyme and Substrates in Chemical Digestion: **proteins**

Polymer (Protein) → Peptides (2 or more amino acids) → Monomer (amino acids)

- Pepsin
- Trypsin

![Peptide structures](image)
Enzyme and Substrates in Chemical Digestion: **fats**

- **Triglyceride Globule**
  - Emulsification by **Bile**
  - Leads to **Small Triglyceride Droplets**
  - Hydrolysis by **Lipase**
  - Results in **Monoglyceride and 2 fatty acids**
Lab Experiment for Sugars

- Know the reagents used to detect the presence of complex or simple sugars and the colors which indicated a positive result.

- **Benedict**’s – “is a bright blue solution that changes to green to orange to reddish brown with increasing amounts of maltose”

- **IKI** – “starts out caramel-color and turns blue-black in the presence of starch”
Lab Experiment for Proteins

- The enzyme which breaks down proteins in the stomach is pepsin.

- Clear colored synthetic peptide, BAPNA, will release a yellow dye when broken down (hydrolyzed) by pepsin.

- The yellow dye is detected by a spectrophotometer.
Lab Experiment for Lipids

- When triglycerides are broken down by lipase, they yield a monoglyceride and 2 fatty acids.

- Fatty acids are acidic, therefore they are detected by pH detectors.

- If lipase broke down a lipid, the pH detector will detect a lower pH.
Lecture: Absorption

Notice the following:

1. The broken down molecules which are digested
   - Monosaccharides
   - Amino acids
   - Monoglycerides and fatty acids

2. All require the help of a transmembrane protein to get absorbed EXCEPT fats which are hydrophobic.
EXTRA: Fat Digestion: Micelle Formation

The Academic Support Center @ Daytona State College (Science 57 Page 32 of 54)
**EXTRA**: Fat Digestion

**Chylomicron Exocytosis**

Diagram illustrating the process of fat digestion and chylomicron exocytosis. The diagram shows the conversion of triglycerides and fatty acids into micelles, which are then transported across the enterocyte membrane by simple diffusion and exocytosis. The products are then transported through the lymphatic system and eventually into the bloodstream via the blood capillary.
Urinary Anatomy

Function:
✓ Removal of waste product from the body (mainly urea and uric acid)
✓ Regulation of electrolyte balance (e.g., sodium, potassium, and calcium)
✓ Regulation acid-base homeostasis
✓ Controlling blood volume and maintaining blood pressure
Renal Anatomy

Where are the kidneys located anatomically?

1. 
2. 
3. 
4. 
5. 
6. 
7. 
8. 
9. 
10.
Urinary Bladder

1. Ureteral openings
2. Detrusor muscle
3. Hip bone (pubis)
4. Rugae of mucosa
5. Peritoneum
6. [Diagram]
Urinary Physiology
Urinary Physiology

- Characteristics of Urine

What makes the color? *Urochrome*

What is the normal pH? *6.5 - 7.0*

Is the specific gravity (or Density) greater or lesser than pure water? *Greater than pure water*
## Urinary Physiology

### Normal Constituents of Urine

**TABLE 26.3**

<table>
<thead>
<tr>
<th>SUBSTANCE</th>
<th>FILTERED* (ENTERS GLOMERULAR CAPSULE PER DAY)</th>
<th>REABSORBED (RETURNED TO BLOOD PER DAY)</th>
<th>URINE (EXCRETED PER DAY)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water</td>
<td>180 liters</td>
<td>178–179 liters</td>
<td>1–2 liters</td>
</tr>
<tr>
<td>Proteins</td>
<td>2.0 g</td>
<td>1.9 g</td>
<td>0.1 g</td>
</tr>
<tr>
<td>Sodium ions (Na⁺)</td>
<td>579 g</td>
<td>575 g</td>
<td>4 g</td>
</tr>
<tr>
<td>Chloride ions (Cl⁻)</td>
<td>640 g</td>
<td>633.7 g</td>
<td>6.3 g</td>
</tr>
<tr>
<td>Bicarbonate ions (HCO₃⁻)</td>
<td>275 g</td>
<td>274.97 g</td>
<td>0.03 g</td>
</tr>
<tr>
<td>Glucose</td>
<td>162 g</td>
<td>162 g</td>
<td>0 g</td>
</tr>
<tr>
<td>Urea</td>
<td>54 g</td>
<td>24 g</td>
<td>30 g¹</td>
</tr>
<tr>
<td>Potassium ions (K⁺)</td>
<td>29.6 g</td>
<td>29.6 g</td>
<td>2.0 g⁷</td>
</tr>
<tr>
<td>Uric acid</td>
<td>8.5 g</td>
<td>7.7 g</td>
<td>0.8 g</td>
</tr>
<tr>
<td>Creatinine</td>
<td>1.6 g</td>
<td>0 g</td>
<td>1.6 g</td>
</tr>
</tbody>
</table>
Urinary Physiology

Compounds in Excess → Name the Disorder

- Glucose in the Urine (Glycosuria) → Diabetes Mellitus
- Albumin in Urine (Albuminuria) → Kidney trauma, Excess protein intake
- Excess Ketones (Ketonuria) → Low carbohydrate Diet
- RBCs in Urine (Hematuria) → Urinary Infection Menses
- Nitrates → Urinary Infection (E. Coli)
Reproductive Anatomy: Male
Reproductive Anatomy: Female
Female Reproductive Anatomy

1. Anchors Ovary
2. 
3. 
4. Anchors Fallopian Tubes
5. Anchors ovaries
6. Ureter
7. 
8. Anchors Uterus
9. 

Mesosalpinx
Mesovarium
Mesometrium
Endometrium
Myometrium
Perimetrium
Wall of uterus
Heredity

Not genetically identical because the genes were shuffled during Meiosis

Genetically identical because the cell copied its DNA during Mitosis
Extra: Meiosis

2 rounds of nuclear division unlike mitosis which only does 1.
Terminology

- **Mitosis** – process of copying genes and making 2 genetically identical, daughter cells which are diploid
- **Meiosis** – Process of shuffling genes and making 4 genetically unique haploid cells \(<\text{creates genetic variation}\rangle

- **Diploid cells in humans** – Contains 23 pairs of chromosomes (46 chromosome total)
- **Haploid cells in humans** – Contains **23 chromosomes** total (half that of diploid cells)

- **Gametes** – sperm or eggs (are haploid)
- **Zygote** – fertilized egg (combined haploid cells make a diploid cell)
More Terminology

- **Chromosome** – organized and condensed form of DNA (before meiosis or mitosis)
  - **during interphase they are not condensed into chromosomes**
  - Autosomes – 22 pairs in humans
  - Sex Chromosome – 1 pair in humans (XX and XY for female or male)

- **Allele** – an alternative form of a gene (one member of a pair) that is located at a specific position on a specific chromosome. These DNA codings (genes) determine distinct traits that can be passed on from parents to offspring.
  - Ex. One chromosome contains a gene for eye color. Another chromosome also contains a gene for eye color. These genes are alleles.

- **Homozygous** – refers to having identical alleles for a single trait within the 2 homologous chromosomes.
- **Heterozygous** – refers to having two different alleles for a single trait within the 2 homologous chromosomes.

- **Dominant gene** – an allele which is dominant
- **Recessive gene** – an allele which is recessive

- **Genotype** – the combination of alleles, or genes (dominant and/or recessive).
- **Phenotype** – physical characteristic as a result of an allele
Extra: Karyotype

This is a model which represents all of the paired up, homologous (alike), chromosomes in humans.

Before mitosis or meiosis, they line up or “get ready” to separate via metaphase.
Summary

- Within the nucleus of your cell you have 46 chromosomes which can pair up to give you 23 pairs of alike (homologous) chromosomes (which differ due to slight mutations from parent's gametes)
  - Having homologous chromosomes is good because you will have multiple copies of one gene
- Within each chromosome you have many genes
  - Genes code for traits (blue eyes, brown hair, tall)
  - A gene can be dominant or recessive
- During meiosis, these genes are shuffled and then separated into four genetically unique cells (called gametes)
  - Each cell has only 1 copy of each gene (making it haploid), which collectively add up to 23 chromosomes.
- During sexual reproduction, these gametes (eggs and sperm) pair up to become a diploid cell with 2 copies of each gene.
  - 23 chromosomes + 23 chromosomes = 46 chromosomes
  - Since 23 are alike, they are referred to as pairs of chromosomes. Humans have 23 pairs.
- Note that an organism has 2 copies of each gene. An allele refers to 1 copy of the gene.
  - The mother and father each give one allele. 1 allele + 1 allele = 2 alleles.
  - If one allele is dominant over the other, than that physical characteristic or phenotype will prevail.
  - A Punnet Square demonstrates this.
**Key:**

Y: Dominant allele for the color **yellow**

y: Recessive allele for the color **green**

**Genotype:**

Genotype: 1 YY: 2 Yy: 1 yy

Phenotype: 3 yellow : 1 green

Genotype: 2 Yy : 2 yy

Phenotype: 2 yellow : 2 green
Incomplete dominance genetic traits
(RR = red, WW = white, RW = pink)

A purebreed red flower pollinates with a purebreed white flower. The combination yields pink flowers. This is not complete dominance because a single allele does not dictate the color of the plant (phenotype).
**Sex linked genetic traits** (H = dominant normal blood clotting, h = recessive blood does not clot)

**Notice:**
Sex linked traits are traits determined by genes on the sex chromosomes.

The Y chromosome does not carry the sex linked trait. Therefore, the father will display the phenotype of whatever is on his X chromosome has.

**Sex-linked**
H = normal & h = hemophilia
Cross: \(XX^h \times X^hY\)

<table>
<thead>
<tr>
<th></th>
<th>X</th>
<th>(X^h)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(X^h)</td>
<td>(X^hX)</td>
<td>(X^hX^h)</td>
</tr>
<tr>
<td>(Y)</td>
<td>(XY)</td>
<td>(X^hY)</td>
</tr>
</tbody>
</table>

**Genotypic ratio:** 1:1:1:1  
\((X^hX = 25\% \quad X^hX^h = 25\% \quad XY = 25\% \quad X^hY = 25\%)\)

**Phenotypic ratio:** 1:1:1:1  
Female carrier = 25\%  Female hemophilia = 25\%  
Male normal = 25\%  Male hemophilia = 25\%
Questions

Prepared by
E. Hoppe – SI Leader

Edited by
D. Leonard – Learning Specialist & K. Martin – Peer Tutor
The Academic Support Center @ Daytona State College
http://www.daytonastate.edu/asc/ascsciencehandouts.html