I. **Announcements**: Please check & sign attendance roster. Not on list? See Pat during break/class. *Lab 1 Histology* Thursday, 10 am – 5 pm sections in 130 HUE. Much fun!!

II. **Introduction**: Staff, office hr, required sources, course overview, grading, expectations & success. Q?

III. **Human Physiology** LS ch 1, DC Module 1,
   A. What? cf: Anatomy LS p 1
   B. Where? Body Levels of Organization LS pp1-6, DC pp1-5
   C. How? Different Study Approaches LS p 1

IV. **Homeostasis** LS ch 1, DC Module 1
   A. What? Maintenance of ECF LS p 8
   B. Where? ECF = Plasma + Interstitium LS fig 1-4 p 8
   C. How? Simplified Homeostatic Model cf: LS fig 1-7 p 14 Balances LS p 9, DC pp 5-6
   D. Why? Cell survival! LS fig 1-5 p 9, DC p 5
ANATOMY vs PHYSIOLOGY
STRUCTURE vs FUNCTION
WHAT? vs HOW?
WHERE? vs WHY?
1. Arthroscopy clean-up
2. Debridement complete
3. Microfracture with awl
4. Punctuate bleeding
High-Tibial Osteotomy (HTO) to Realign the Joint

1. Oscillating saw cut
2. R plate/scaffolding insert
3. Align, stabilize w/screws & pack defect
Body Levels of Organization

1. Molecular
2. Cellular
3. Tissue
4. Organ
5. System

Entire Organism, like you & me!
Nerve conducts

Muscle contracts

Connective connects!!

Epithelial covers
Epithelial tissue gives rise to glands: (a) exocrine & (b) endocrine
Which body systems?
Announcements
Lab 1 Histology today!

Homeostasis LS ch 1, DC Module 1
A. What? Maintenance of ECF LS p 8
B. Where? ECF = Plasma + Interstitium + ? LS fig 1-4 p 8
C. Homeostatic Balances? LS p 9, DC pp 5-6
D. Why? Cell survival! LS fig 1-5 p 9, DC p 5
E. Physiology in the News H<sub>2</sub>O? Are we like watermelons?
F. How are balances maintained? Simplified Homeostatic Model cf: LS fig 1-7 p 14; T°C + BP balance e.g. + vs. - FB

Cell Anatomy, Physiology & Compartmentalization LS ch 2
B. Basic survival skills LS ch 1 p 3
C. Organelles ≡ Intracellular specialty shops Endoplasmic Reticulum (ER), Golgi, Lysosomes, Peroxisomes & Mitochondria, LS fig 2-1, 2-2, 2-3 pp 20-3
Where is extracellular fluid?
ICF = Intracellular

ECF = Extracellular

Plasma (within CV System)

Interstitium (eg, between muscle cells)

https://www.youtube.com/watch?v=B658Yn3INYc
Homeostasis or Homeokinesis?

https://www.khanacademy.org/partner-content/mit-k12/chem-and-bio/v/homeostasis
Dr. Evonuk’s 6 Balances

- Metabolic
  - ANA-
  - CATA-
- H$_2$O
- pH
- $T_0C$
- O$_2$/CO$_2$
- Ion$^+/$-
- pH
- Electricity
- Bicarbonate and pH Balance
Drink about 1 L per 1000 calories energy expenditure!!

Human ~ 2/3 H$_2$O
~ 60 – 70 %

= ~40 – 48 kg H$_2$O

NB: So 2000 kcal →
drink 2000 mL
≡ 67.63 fl oz
≡ ~ 8 cups!
Invariably, Negative Feedback
NB: Though most often negative feedback, there are exceptions:

Selected +FB eg:

LH Surge + Ovulation
Oxytocin + Uterine Contraction
Blood Clotting Cascade
cAMP Cascade
Na+ influx during AP
70% H₂O = 49L

ICF = 35L

ECF = 14L
  \[ \text{Interstitium} = 11L \]
  \[ \text{Plasma} = 3L \]

INPUT

Dietary Drink  1200 mL
Dietary Eat    400 mL
Oxidation      400 mL
Total          2000 mL

OUTPUT

Urine         1000 mL
Sweat + Insensible  900 mL
Feces         100 mL
Total         2000 mL

\[ \text{H}_2\text{O} \]

ICF = 35L + ECF = 14L + Interstitium = 11L + Plasma = 3L

\[ \text{Total} = 2000 \text{ mL} \]

\[ \text{BALANCE!} \]
Blood Pressure Homeostasis

- Venous Pooling: Downward arrow indicates a decrease in blood pressure (BP).
- Baroreceptors/Pressure Receptors: Located in Carotids & Aorta.
- Seated to Standing: Illustrates the change from seated to standing posture.

**NB:** Corrective Change $\Delta$ Opposes Original Input $I$

- Electrochemical Signal $I'\rightarrow C$
- CV Control Center
- Brain Stem
- Electrochemical Signal eg, Symp Accel N

- Blood Pressure (BP) Homeostasis: Short-term vs long-term!
- Baroreceptors: Red dashed triangle indicating an upward arrow for BP.
- HR: Heart rate.
- VC: Venous Pooling.

- $E\rightarrow Ef$
- $O$
I. Announcements
Registered? AEC Notes? **Come to office hr!**

II. Connections
Videos + Q about Homeostatic Model for BP

III. Cell Anatomy, Physiology & Compartmentalization
LS ch 2
B. Basic survival skills ch 1 p 3
C. Organelles ≡ Intracellular specialty shops w/membranes
   1. Endoplasmic Reticulum (ER) 2. Golgi 3. Lysosomes
   fig 2-1, 2-2, 2-3, 2-4, 2-5, 2-6, 2-7, 2-8 pp 20-7 tab 2-1 p 36
D. What about vaults? LS 2006, p 32
E. **Physiol News** Moms eggs execute Dad’s mitochondria?

IV. Anaerobic vs Aerobic Metabolism Overview
Many sources!
Mathews & Fox 1976...LS 2012 pp 26-33, fig 2-15 p 33

V. Introduction to Genetics
LS 2012 ch 2 p 20-1 + Appendix C
A. What’s a gene? Where? p A-18, fig C-2, C-3
B. Why are genes important? p A-18
C. What’s DNA & what does it look like? pp A-18 thru A-20
D. How does information flow in the cell? fig C-6
E. How does DNA differ from RNA? pp A-20 thru A-22
G. How are proteins made? fig C-7, C-9

...Anatomy & Physiology Lab Thurs! Fun again!
Why Compartments? Advantage?

*Incompatible* reactions can take place

*Simultaneously!!*
Basic Cell Survival Skills?
1. Get food
2. Use food
3. Rid wastes
4. Move
5. Reproduce

How to live?

Nucleus or nose?
1 Sample Cartoon of 100 Trillion (100 x 10^{12}) Cells!

Rough & Smooth Endoplasmic Reticulum (ER): Protein & Lipid Synthesizing Factories

Smooth ER:
1. packages new proteins in transport vesicles
2. stores calcium in muscles

Ribosomes
Sacs
Tubules

fig 2-2 LS 2012
Instructions for building proteins leave the nucleus and enter the cytoplasm.

Proteins (colored strands) are assembled on ribosomes attached to the ER or free in the cytoplasm.

Ribosomes

1. Rough ER

2. Transport vesicles

3. Golgi complex

4. Secretory vesicles

5. Secretion (exocytosis)

6. Lysosome

fig 2-3 LS 2012
**Lysosomes vs. Peroxisomes**

- **Lysosome**: Contains hydrolytic enzymes for degrading proteins and other macromolecules.
- **Peroxisome**: Contains oxidative enzymes for metabolizing certain molecules, such as fatty acids.

Diagram showing the structural differences between lysosomes and peroxisomes.
I. **Announcements**  
Anatomy & Physiology Lab today!  
Be sure to complete p 3-7 dietary record in LM < lab next wk!  
Help with estimating serving sizes for Nutrition Lab 3. Q?

II. **Cell Organelle Connections**  
Little organs or specialty shops!

III. **Physiology News**  
♀ vs ♂ Mitochondria; Vaults? Sci News

IV. **Anaerobic vs Aerobic Metabolism Connections**  
LS ch 2 pp 26-33  
A. Take-home points + key differences fig 2-15 + vpl  
B. Few details: Glycolysis, CAC, ETC fig 2-9, 2-10, 2-11, 2-12

V. **Introduction to Genetics**  
LS pp 20-1 + Appendix C  
A. What’s a gene? Where? p A-18, fig C-2, C-3  
B. Why are genes important? p A-18  
C. What’s DNA & what does it look like? pp A-18 thru A-20  
D. How does information flow in the cell? fig C-6  
E. How does DNA differ from RNA? pp A-20 thru A-22  
G. How are proteins made? Class skit! fig C-7, C-9
Film: Neutrophil engulfing bacterium

http://devreotes.johnshopkins.edu/videos

L. Nilsson, Nat Geog 1986
Catalase Enzyme Reaction in Peroxisomes
Neutralize Toxin at Production Site!

\[
2\text{H}_2\text{O}_2 \rightarrow 2\text{H}_2\text{O} + \text{O}_2
\]
Mitochondria: Energy Organelles
Inside a fertilized egg, with its two sets of chromosomes (blue), the protein ubiquitin (red) tags sperm mitochondria (yellow).

AEROBIC \( w/O_2 \) = MITOCHONDRIUM

ANAEROBIC \( w/o O_2 \) = CYTOSOL

1. Immediate/ATP-PC
2. Glycolysis
% ATP Supplied

Cytosol

ATP-PC/Immediate
15 - 30 s

Mitochondria

Anaerobic

Glycolysis

1.5 – 3 m

Aerobic

Oxygen System
≥ 3 – 5 m

Performance Time

Power Output

Modified after Mathews & Fox
Cleave One High Energy Phosphate Bond To Do Work!!

7 – 10 KiloCalories/KCal

Adenosine

1. Synthesis of Macromolecules
   Make big things from little things!

2. Membrane Transport
   Move things! Microscopic!

3. Mechanical Work
   Move things! Macroscopic!
Anaerobic vs. Aerobic Metabolism

**Anaerobic Glycolysis**
"sugar dissolving" without $O_2$. Net of 2 ATP per molecule of glucose

**Aerobic Metabolism**
+mitochondrial processing of glucose with $O_2$. Net of 32 ATP per molecule of glucose
Goals of Aerobic Metabolism

AEROBIC (w/O₂) = MITOCHONDRION

CITRIC ACID CYCLE

- harvest electrons
- "cash in"

ELECTRON TRANSPORT CHAIN for ATP Energy!!
Announcements

Nutrition Analyses this Thursday!
Please record diet on p 3-7 LM & begin analysis using
https://www.supertracker.usda.gov/
Bring flash drive? Q?

Introduction to Genetics
LS 2012 ch 2 p 20-1 + Appendix C
A. How does DNA differ from RNA? pp A-20 thru A-22
C. How & where are proteins made? fig C-7, C-9
D. Class skit: Making proteins @ ribosomes!

Nutrition Primer
Sizer & Whitney (S&W) Sci Lib
A. Essential Nutrients: H₂O, 1° Carbohydrates, 2° Fats, 3° Proteins, Vitamins, Minerals; Macro- vs Micro-?
B. Blue Zones? US AMDR? Adjusted Macronutrient Dist...
Pondering Paleo, Marlene Zuk, Nutrition Action Sep 2015.
C. Dietary Guidelines: USDA, AICR, Eat Like the Rainbow!
D. Diet or exercise? Diet composition & endurance? Zuti & Golding 1976! Fasting?
E. Beware of Nutrition Quackery S. Kleiner & Monaco 1990!

Nutrition in the News
Gain weight by drinking calories?

Introduction to Digestion
Steps + hydrolysis
What are DNA’s major functions?
Heredity + Day-to-Day Cell Function
What does DNA look like? Double-helix!!

LS fig C-2
Gene = Stretch of DNA that codes for a protein

Gene

DNA Double Helix

Histones

Supercoiling

cf: LS fig C-3
What does DNA do, day-to-day?

DNA ↦ RNA ↦ Protein

Transcription ↦ Translation

Replication

Nucleus → Cytoplasm

@ ribosomes

cf: LS fig C-6
# DNA vs RNA?

<table>
<thead>
<tr>
<th>DNA Characteristics</th>
<th>RNA Characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Double-stranded</td>
<td>1. Single-stranded</td>
</tr>
<tr>
<td>2. Deoxyribose</td>
<td>2. Ribose</td>
</tr>
<tr>
<td>(without oxygen)</td>
<td>(with oxygen)</td>
</tr>
<tr>
<td>Thymine</td>
<td>Uracil</td>
</tr>
<tr>
<td>(can copy itself)</td>
<td>template</td>
</tr>
<tr>
<td>5. Nucleus (+mitochondria)</td>
<td>5. 1⁰ Cytoplasm</td>
</tr>
<tr>
<td></td>
<td>(but Nucleus origin)</td>
</tr>
<tr>
<td></td>
<td>6. mRNA, rRNA, tRNA</td>
</tr>
</tbody>
</table>
**Triplets of bases code for amino acids, the building blocks of proteins**

<table>
<thead>
<tr>
<th>DNA code word</th>
<th>mRNA codon</th>
<th>tRNA anti-codon</th>
</tr>
</thead>
<tbody>
<tr>
<td>TAT</td>
<td>AUA</td>
<td>UAU</td>
</tr>
<tr>
<td>ACG</td>
<td>UGU</td>
<td>ACG</td>
</tr>
<tr>
<td>TTT</td>
<td>AAA</td>
<td>UUU</td>
</tr>
<tr>
<td>TAC</td>
<td>AUG</td>
<td>UAC</td>
</tr>
</tbody>
</table>
Translation? Ribosomes Make Proteins

LS 2012 fig C-7
Macronutrients & Micronutrients

**Macronutrients**

H₂O/Water

1° Carbohydrates

2° Fats/Triglycerides/Lipids

3° Proteins

**Micronutrients**

Vitamins (A, D, E, K; C + B)

Minerals (K⁺, Na⁺, Ca²⁺, Mg²⁺, Fe²⁺, Zn²⁺, …)

**Sample Food Sources**

- Water, other drinks, fruits & vegetables
- Grains, vegetables, fruits, dairy products
- Meats, full-fat dairy products, oils
- Meats, legumes, dairy vegetables

**NB**: Need only minute quantities!

- Vegetables, vegetable oils, fruits, citrus, grains, dairy
- Fruits, vegetables, grains, nuts, dairy, meats, processed foods

**Energy nutrients = yield ATP**
The World’s Longest-Lived People!

Blue Zones!

Lomo Linda, CALIFORNIA
Sardinia, ITALY
Okinawa, JAPAN
Ikaria, GREECE
Nicoya, COSTA RICA

M Poulain & Coworkers. Experimental Gerontology, Sep 2004
1. Eat a little bit better!
2. Move a little bit more!
3. Socialize more!
4. Strong sense of purpose!

https://en.wikipedia.org/wiki/Blue_Zone
https://bluezones.com/
70% Sweet Potatoes
12% Rice
7% Grains & Wheat
6% Soy & legumes
4% Additional vegetables
3% Fruit
2% Oils
1% Nuts (Protein)
1% Other potatoes
1% Seaweed
1% Sugars
1% Fish
1% Dairy
1% Eggs
1% Pork-Meat
1% Flavorings & Alcohol

85% Carbohydrates
9% Protein
6% Fat
85-10-5
1785 Calories

96% Vegan Diet
98% Vegetarian
99% PescaVeg
<4% Animal Prod
<1% Fish
<1% Meat-Pork

Note: These are the Actual Food Measurements of the Centenarians, not the diet of All island Okinawans or the ones who died, but the ones who lived.
I. **Announcements** Data + flash drive for today’s lab! Q?
If you want notebook to study for Exam I on Tues Oct 24th
turn in prior to lecture next Tues Oct 17th. Sample Exam Q?

II. **Nutrition Connections + Nutritional Physiology in the News**
A. *Pondering Paleo*. Animal sources, inflammation & disease?
B. Lifestyle modifications & reducing disease risk?
C. Shake the salt habit! *UC Berkeley Newsletter.*
D. Drink Your Calories? *Public Employees Benefit ...*
E. *Dietary Guidelines*: USDA, AICR, Eat Like the *Rainbow!*
F. Diet or exercise better? Diet composition & endurance?
G. *Beware of Nutrition Quackery* S. Kleiner & Monaco 1990!

III. **Gastrointestinal Physiology** DC Module 3 pp 17-23, LS ch 15+
A. Steps of digestion Dr. Evonuk + LS pp 437-9; DC p 23
B. Hydrolysis + monomer to polymer: central linking themes!
C. What’s missing? LS fig 15-1 p 438
D. GI-Donut analogy + Control mechanisms. Dr. Brilla @ WWU
E. Gut secretions LS p 438, 440-1
F. Organ-by-organ review LS tab 15-1 pp 440-1 + DC fig 3-1
Pondering Paleo?

Evolutionary Biologist
Behavioral Ecologist
U Minnesota

http://www.nutritionaction.com/daily/how-to-diet/pondering-paleo/
Dietary Choline & L-Carnitine

The pathway linking diet, gut microbes and TMAO to a growing collection of disease states

TMAO = Trimethyl Amine

Hepatic FMOs

Gut Flora

With the right food choices, physical activity, and not smoking, we could prevent about ~90% of diabetes, 80% of heart disease & 70% of stroke!
More Reasons to Shake the Salt Habit

Stop me!

①↓blood vessel vasodilation w/in 30 min by ingesting 1500 mg Na+!

②↑Ca²⁺ excretion ↑bone loss, risk of osteoporosis & fractures.

③May directly impair kidney function & ↑risk of kidney stones.

④GI cancer risk, inflammation?

UCB Wellness Letter Jun 2011 p 5
5 times per wk? ≡ 106,600 calories/yr ≡ ± 30.5 lb fat/yr

Starbucks Cinnamon Dolce Latte, whipped cream | 410 calories
Jogging | 50 min.

Better choices!
1. Vary your veggies. Fill ½ your plate with fruits & vegetables!

2. Focus on fruits. Whole fruit preferable to juice, but any fruit counts! Fill ½ your plate with fruits & vegetables!

3. Make at least ½ of your grains whole grains!

4. Go lean with protein. Keep protein to < ¼ plate! Nuts, beans, peas, seeds, poultry, lean meat, seafood,…

5. Get your calcium-rich foods. Buy skim or 1% milk. Go easy on cheese!

MyPlate launched June 2, 2011
Diet & Health Guidelines for Cancer Prevention

1. Choose a diet rich in variety of plant-based foods.
2. Eat plenty of vegetables & fruits.
3. Maintain a healthy weight & be physically active.
4. Drink alcohol only in moderation, if at all.
5. Select foods low in fat & salt.

And always, remember...

Do not smoke or use tobacco in any form.

American Institute for Cancer Research (AICR)
Your plate should be the size of a Frisbee, not a manhole cover.

When it comes to colorful foods, Fruit Loops don’t count.

A surprising number of people get 1/5 of their calories from sodas or other liquids.

If you look at the label & need a chemistry degree to read it, put the item back on the shelf!


NB: Each group 500 kcal deficit/day, 16 weeks
Dietary Composition & Physical Endurance

eg, Atkins!

High-fat diet
Normal mixed diet
High-carbohydrate diet

~ 1/3 endurance!

Maximum endurance time:
57 min
114 min
167 min
Negative Effects of Low Carbohydrate

1. ↑ fatigue/exhaustion central & peripheral!
2. ↓ glucose – brain+spinal cord, rbcs thrive upon.
3. ↓ variety which reduces intake of phytochemicals, vitamins, minerals & fiber.
4. ↑ risk of respiratory infections.

+ gall stones, ↓ thermoregulation...
To Help Lower Body Wt & %Fat
EXERCISE!! +Minimize These!!

FAT  9 Kcal/g
ETOH 7 Kcal/g
CARB 4 Kcal/g
PRO 4 Kcal/g

NB: Minimize not Eliminate!
Moderation not Abstinence!!
60-day Fast???

Lost 60 lb!! Wow!!

Yet

\[
\begin{align*}
&26 \text{ lb Water} \\
&20 \text{ lb Lean Body Mass} \\
&14 \text{ lb Fat}
\end{align*}
\]

Fat < \(\frac{1}{4}\) total wt loss!
Successful Dieting – National Weight Control Registry

- 5000 people, ≥ 30 lb weight loss, ≥ 5 yr
- High-carbohydrate (55-60%), low-fat (24%) diet with the rest (~16-21%) from protein
- Wholesome vs. high-sugar carbohydrates including fruits, vegetables, high-fiber foods
- Conscious of calories knowing that total calories count, no matter what diet type
- Eight of 10 ate breakfast daily which may help better manage calories during the day
- Self-monitor, weigh themselves ≥ 1x/wk & many still keep food dairies
- Much planned physical activity, 60-90 min/d, 10,000 walking + looked for other ways to be active

http://www.nwcr.ws/Research/published%20research.htm
UC Berkeley Wellness Engagement Calendar, September 2013
Which Diets are Best?

- Not Plant-based
- Lower Carbohydrate

- Peer-Reviewed = Text Books
- Not Peer-Reviewed = Opinion

- Plant-based
- Lower Fat
I. **Announcements**

Exam I one week from today, Oct 24th!
Summary & Review, Sunday Oct 22nd, 6-7:30 pm, here! Q?

II. **Gastrointestinal Physiology**

DC Module 3 pp 17-23, LS ch 15+
B. How is the gut controlled?
C. Organ-by-organ review A&P LS tab 15-1 pp 440-1 +...
D. Zymogen? = Inactive precursor LS fig 15-9 p 452...
   [http://www.cdc.gov/ulcer](http://www.cdc.gov/ulcer) Beyond the Basics LS p 456
G. Large intestine? LS fig 15-24 pp 472-4

III. **Cardiovascular System**

DC Mod 4, LS ch 9, Torstar, G&H+…
A. Circulatory vs. Cardiovascular (CV)? CV vs. Lymphatic
   CV Pulmonary & Systemic circuits DC pp23-31+LS p229+
   DC fig 4-1 p 24, LS fig 9-2b p 231
B. Arteries, capillaries, veins, varicosities? G&H, Torstar, DC
C. ♥ layers, box, chambers, valves, inlets, outlets
   LS fig 9-4 p 233, fig 9-2a p 231; DC pp 23-6
D. Normal vs. abnormal blood flow thru ♥ & CVS LS, Fox+…
Hi gang!!
You need me for digestion!!

H₂O + Enzyme
Polymer to Monomer (Many to One)

Central-linking theme!!

Carbohydrate

Protein + Fat

Glucose

Amino Acids

Fatty Acids + Glycerol
GI-DONUT ANALOGY

GI LUMEN

BODY
# Gut Secretions

<table>
<thead>
<tr>
<th>Secretion</th>
<th>Release Site</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Mucus</td>
<td>into GI Lumen</td>
</tr>
<tr>
<td>2. Enzymes</td>
<td>into GI Lumen</td>
</tr>
<tr>
<td>3. $\text{H}_2\text{O}, \text{ acids, bases}^+$</td>
<td>into GI Lumen</td>
</tr>
<tr>
<td>4. Hormones</td>
<td>into Blood</td>
</tr>
</tbody>
</table>
1. **Mouth**

   - **Ingestion** entry way
   - salivary gland secretion
   - mucus + enzymes
   - enzymatic digestion: carbohydrate
   - mastication = chewing
   - deglutition = swallowing

2. **Esophagus**

   - **Rapid transit**
   - peristalsis
   - secretion mucus

3. **Stomach**

   - **Mixing** peristalsis
   - secretion mucus + HCl
   - + enzymes
   - enzymatic digestion:
     - protein + butter fat!

4. **Liver-Gall Bladder**

   - **Emulsification** = detergent action of bile
   - + secretion

5. **Pancreas**

   - **Secretion** mucus + NaHCO₃ + enzymes
   - enzymatic digestion:
     - carbohydrate, fat, protein

6. **Small Intestine**

   - **Absorption**
   - Secretion mucus
   - + enzymes
   - enzymatic digestion: carbohydrate, fat, protein
   - Peristalsis

7. **Large Intestine**

   - **Dehydration**
   - secretion + absorption
   - storage + peristalsis
Zymogen = an inactive precursor
Ulcer Facts

• Most ulcers are caused by an infection, not spicy food, acid or stress.
• The most common ulcer symptom is burning pain in the stomach.
• Your doctor can test you for *H. pylori* infection.
• Antibiotics are the new cure for ulcers.
• Eliminating *H. pylori* infections with antibiotics means that your ulcer can be cured for good.
**NB:** Figure-8 loop

Pulmonary Systemic

- Pulmonary arteries
- Pulmonary veins
- Vena cavae
- Aorta and branches
- Right ventricle
- Left ventricle
- Arterioles
- Venules
- Capillary beds of lungs where gas exchange occurs
- Capillary beds of all body tissues where gas exchange occurs

D Chiras 2013 fig 4-1b
Dual Pump Action & Parallel Circulation
Lymphatic System Blockage in Elephantiasis from Mosquito-borne Parasitic Filaria Worm
Human ❤️ = 4-chambered box? 2 separate pumps?

Upper = Atria

Lower = Ventricles

Pulmonary | Systemic

RA | LA

RV | LV

R  ❤️  L  ❤️

Primer Pumps

Power Pumps
Human $\heartsuit = 4$ unique valves? 

2 valve sets?

**Semilunar** = *Half-moon shaped*

1. Pulmonic/Pulmonary
2. Aortic

**AV** = *Atrioventricular*

3. $\text{R AV}$ = Tricuspid
4. $\text{L AV}$ = Mitral/Bicuspid
Veins ➔ Atria ➔ Ventricles ➔ Arteries

http://www.nhlbi.nih.gov/health/health-topics/topics/hhw/contraction.html
I. **Announcements** Exam I next session; 12 n & 1 pm lab sections go directly to 112 HUE & 130 HUE. All others here (100 WIL)! Review: Sunday, 6 pm here! Lab notebooks. Q?

II. **Cardiovascular Connections** LS 2012 ch 9, Torstar Books+

III. **CV Physiology in News** AHA + NHLBI websites. Nic? ACSM, AHA, DHHS Healthy people exercise guidelines!

IV. **CV Pathophysiology & Risk Reduction** LS ch 9, 10 +…
A. AMI, CVA, CVD, PVD, TIA, HTN? + surgical treatments
B. Atherosclerosis? LS fig 9-27, 9-25, 9-26 pp 266-8
C. How to minimize risk of CVDs? Treatment triad: Exercise, Diet, Drugs+Surgery
D. Food choices make a difference? What’s HAPOC?
Cardiac Cycle

**Systole**
Contract & Empty

**Diastole**
Relax & Fill
Guidelines: Healthy Adults < 65 yr

Do moderately intense aerobic exercise
30 min/d, 5 d/wk

OR

Do vigorously intense aerobic exercise
20 min/d, 3 d/wk

AND

Do 8-10 strength-training exercises
8-12 repetitions/each exercise, 2 d/wk
How much strength?

- 2-3 days/wk
- 8-10 exercises for major muscle groups
- ≥ 1 set/exercise
- 8-12 (most) or 10-15 (frail/> 50-60 yr) repetitions/set
Did you know?

- Every 40 seconds, someone has a heart attack in the US!
- ~630,000 Americans die of heart disease each yr – that’s 1 in every 4 deaths. Heart disease is the leading cause of death for both men and women.
- Heart disease costs the US ~ $200 billion per yr in health care, medications & lost productivity. By 2035, CVD costs are projected to top $1 trillion annually.

Heart Disease Death Rates, 2011-2013
Adults, Ages 35+, by County

Rates are spatially smoothed to enhance the stability of rates in counties with small populations.

Data Source: National Vital Statistics System
National Center for Health Statistics

https://www.cdc.gov/dhdsp/data_statistics/fact_sheets/fs_heart_disease.htm
Area of cardiac muscle deprived of blood supply if coronary vessel is blocked at point A:

Right coronary artery

Right ventricle

Area of cardiac muscle deprived of blood supply if coronary vessel is blocked at point B:

Left coronary artery

Left ventricle

**FIGURE 9-35**

Extent of myocardial damage as a function of the size of the occluded vessel
Treatment Triad

- Exercise
- Dietary Modification
- Drugs/Surgery

NB: Last blasted resort!!
CABG

Coronary Artery Bypass Graft
Pick an abundance of whole grains, legumes, nuts, vegetables & fruits!
Fish Oil Intakes & Cardiovascular Death Rates

Cardiovascular Deaths per 100,000 Population

- Ireland: 0.09%
- USA: 0.13%
- France: 0.14%
- Japan: 0.37%

S&W 2011
fig 5-12 p 167
Healthy Oils to Minimize Atherosclerosis

HAPOC?