BI 358 Lecture 6 Quiz 2 next Tues in lab → GI + Nutrition. AEC?

I. **Announcements** DietOrganizer redo? 129 HUE, Fri 10 am-2 pm

II. **Nutritional Connections**
   A. Successful Dieting? US Weight Control Registry
      UC Berkeley Wellness, Jan 2016
   B. Energy regulation + neural centers G&H fig 72-2, 72-1, tab 72-2
   C. Why lower sodium intake? Sodium & cancer?
   D. Hawaiian simplicity! Eating the rainbow!

III. **Blood + Body Resistance to Infection**
    G&H ch 33, 34, LS, Stuart Fox, Daniel Chiras (DC), Basiro Davey
    A. Blood: cell + fragments vs liquid (plasma vs serum) LS
    B. Red blood cells, white blood cells, platelets, Demo? LS, DC
    C. Red blood cell production, hemoglobin
       G&H pp 445-51, fig 33-1 thru 33-6 +..., Fox
    D. Pathogen? Microbe that causes disease, Davey pp 5-6
    E. Barriers to infection Davey fig 2.1 p 12, fig 2.2 p 13
    F. National Geographic, The Wars Within, Lennart Nilsson
       http://www.lennartnilsson.com/
    G. WBC effectors: Innate & adaptive immunity G&H pp 455-64
       G&H fig 34-1 + Davey fig 2.2 p 13, fig 3.4 p 24, fig 3.12 p 36
    H. **Medical Physiology News** Handwashing to prevent infection!
       US Centers for Disease Control
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 steps + looked for other ways to be active

http://www.nwcr.ws/Research/published%20research.htm

UC Berkeley Wellness Engagement Calendar, September 2013
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

Federal exercise guidelines include strength training for all

**Adults**: Moderate to Vigorous Exercise

≥ 30 min, 5 d/wk

**Children**: Moderate to Vigorous Exercise

≥ 60 min, 5 d/wk
Control of Energy Balance by **Hypothalamic Neurons**

↓ Energy Expenditure

**Agouti-related Protein**

+ **Neuropeptide Y**

↑ Energy Expenditure

**Pro-opiomelanocortin**

+ **Cocaine & Amphetamine-regulated Transcript**

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G&H 2016 fig 72-2 p 891, G&H 2011 fig 71-2 p 847
<table>
<thead>
<tr>
<th>Feeding = Anorexigenic</th>
<th>Feeding = Orexigenic</th>
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<tbody>
<tr>
<td>Cocaine- &amp; amphet-regulated tr (CART)</td>
<td>Agouti-related protein (AGRP)</td>
</tr>
<tr>
<td>α-Melanocyte stimulating h…(α-MSH)</td>
<td>Neuropeptide Y (NPY)</td>
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<tr>
<td>Leptin</td>
<td>Melanin-concentrated h…(MCH)</td>
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<tr>
<td>Serotonin</td>
<td>Orexins A &amp; B</td>
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<tr>
<td>Norepinephrine</td>
<td>Endorphins</td>
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<tr>
<td>Corticotropin releasing h…(CRH)</td>
<td>Galanin (GAL)</td>
</tr>
<tr>
<td>Insulin</td>
<td>Amino Acids (Glutamate &amp; GABA)</td>
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<tr>
<td>Cholecystokinin (CCK)</td>
<td>Cortisol</td>
</tr>
<tr>
<td>Glucagon-like peptide (GLP)</td>
<td>Ghrelin</td>
</tr>
<tr>
<td>Peptide YY (PYY)</td>
<td>Endocannabinoids/Anandamide</td>
</tr>
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G&H 2016 tab 72-2 p 891, G&H 2011 tab 71-2 p 847
More Reasons to Shake the Salt Habit

Stop me!

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

②↑Ca^{2+} excretion ↑bone loss, risk of osteoporosis & fractures.

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

④GI cancer risk, inflammation?

UCB WellnessLetter Jun 2011, Jan 2012
Sodium (Na) Intakes of U.S. Adults

- Intake < 2400 mg = 1 tsp of Salt (NaCl ≈ 40% Na)
- Body requirement < 1500 mg ↓ BP
- < 500 mg/d = ~¼ tsp Salt/d!

Daily Averages (milligrams):

- Blacks
- Whites
- Other

BP: Blood Pressure
Sodium Reduction as a Means to Prevent Cardiovascular Disease and Stroke

1. **Approximately 90% of Americans** will develop high blood pressure or **hypertension** over their lifetime.

2. **BP-related diseases:** stroke, CHD, heart failure & kidney disease are **leading causes of morbidity & mortality** in the US & throughout the world.

3. **Independent of its effects on BP, excess sodium intake adversely affects the heart, kidneys & blood vessels.**

4. **Reducing sodium intake** to < 1500 mg/d should reduce American deaths from CVD & stroke by 20%.

[http://www.heart.org/HEARTORG/GettingHealthy/NutritionCenter/HealthyDietGoals/Sodium-Salt-or-Sodium-Chloride_UCM_303290_Article.jsp](http://www.heart.org/HEARTORG/GettingHealthy/NutritionCenter/HealthyDietGoals/Sodium-Salt-or-Sodium-Chloride_UCM_303290_Article.jsp)
**Dietary Approaches to Stop Hypertension (DASH)**

Fruits & vegetables + low-fat dairy products

[http://www.nhlbi.nih.gov/health/health-topics/topics/dash](http://www.nhlbi.nih.gov/health/health-topics/topics/dash)
Eating the Rainbow Hawaiian Style!!

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!

Break for discussion/questions!
What's in Blood? Plasma & Blood Cells

- Plasma (55% of whole blood)
- Buffy coat: platelets and leukocytes (<1% of whole blood)
- Erythrocytes (45% of whole blood)
- Platelets
- Leukocytes (white blood cells)
- Erythrocytes (red blood cells)

Packed cell volume, or hematocrit
Dermal bone production of red blood cells

![Graph showing the decline in cellularity of different bones with age.](image-url)

- **Vertebra**
- **Sternum**
- **Rib**
- **Tibia (shaft)**
- **Femur (shaft)**

*G&H 2011 fig 32-1 p 414* 
*G&H 2016 fig 33-1 p 446*
Pluripotent Hematopoietic Stem Cell Lines

- PHSC (Pluripotent hematopoietic stem cell)
- CFU-S (Colony-forming unit—spleen)
- CFU-GM (Colony-forming unit—granulocytes, monocytes)
- CFU-M (Colony-forming unit—megakaryocytes)
- CFU-B (Colony-forming unit—blast)
- CFU-E (Colony-forming unit—erythrocytes)

- Granulocytes (Neutrophils) (Eosinophils) (Basophils)
- Monocytes
  - Macrophages
- Megakaryocytes
  - Platelets
- T lymphocytes
- B lymphocytes

Erythrocytes

G&H 2016 fig 33-2 p 446
G&H 2011 fig 32-2 p 414
Red Blood Cell Genesis

Proerythroblast

Basophil erythroblast

Polychromatophil erythroblast

Orthochromatotic erythroblast

Reticulocyte

Erythrocytes

Microcytic, hypochromic anemia

Sickle cell anemia

Megaloblastic anemia

Erythroblastosis fetalis

G&H 2016 fig 33-3 p 447

G&H 2011 fig 32-3 p 415
Erythropoietin Regulates RBC Production

Hematopoietic Stem Cells

Kidney

Erythropoietin

Proerythroblasts

Red Blood Cells

Tissue Oxygenation

Decreases

Factors that decrease oxygenation
1. Low blood volume
2. Anemia
3. Low hemoglobin
4. Poor blood flow
5. Pulmonary disease
Hemoglobin Formation

Citric Acid Cycle

I. $2 \text{succinyl-CoA} + 2 \text{glycine} \rightarrow \text{protoporphyrin IX}$

II. $4 \text{pyrrole} \rightarrow \text{protoporphyrin IX}$

III. $\text{protoporphyrin IX} + \text{Fe}^{2+} \rightarrow \text{heme}$

IV. $\text{heme} + \text{polypeptide} \rightarrow \text{hemoglobin chain (}\alpha\text{ or }\beta\text{)}$

V. $2 \alpha\text{ chains} + 2 \beta\text{ chains} \rightarrow \text{hemoglobin A}$
NB: CO carbon monoxide binds with ~200-fold greater affinity than O₂.
What a difference one amino acid can make!

Amino acid sequence of normal hemoglobin:

Val → His → Leu → Thr → Pro → Glu → Glu

Amino acid sequence of sickle-cell hemoglobin:

Val → His → Leu → Thr → Pro → Val → Glu
Megakaryocyte

Platelets/Thrombocytes

Immune Response

1. Detect invader or ID toxic product.
2. Communicate to network.
3. Recruit coordinated, multi-pronged attack.
4. Amplify & if yes to success, then –
5. Suppress

Limit  Destroy

Davey 1990 p 6
Pathogen?

Microbes that cause disease!

- Bacteria
- Viruses
- Protozoa
- Fungi
- + Multicellular Parasites, e.g., ticks & lice

Davey 1990 p 5
Pathogens & Parasites Cause:

1. 70-80% of deaths in less developed countries

2. Tens of millions of deaths due to infectious diseases

3. > 20 million childhood deaths per year in Asia, Africa & Latin America due to diarrheal infections alone

4. Yet < 2% deaths in modern, industrialized countries!

World Health Organization 2018 Statistics


Davey 1990 p 5
Why such striking differences across the world?

1. Poor sanitation

2. Contaminated water supply

3. Contaminated food supply

4. Malnutrition

5. Existing infections

6. Patchy, inadequately-funded vaccinations

7. AIDS superimposed on top of 1-6!

Davey 1990 p 5
FIGURE 2.1 Summary of the main physical, chemical and mechanical barriers to infection entering the human body.
Good phagocytes!

Davey 1990 p 13
Figure 33-2  Movement of neutrophils by *diapedesis* through capillary pores and by *chemotaxis* toward an area of tissue damage.  G&H 2011
Hand-washing

The right way to wash your hands:
Thoroughly wash with soap and warm running water — rubbing your hands together for at least 10 seconds.

Hand-washing is the single most effective thing you can do to reduce the spread of colds and other infectious disease.

It’s not necessary to use anti-bacterial soaps when washing up. Regular soap and water do the job just fine.

Also, using germicidal soaps too often may produce antibiotic-resistant bacteria.

Source: Hospital Infections Program, U.S. Centers for Disease Control and Prevention

NB: Happy Birthday Song 20-30 sec!!

http://www.squidsoap.com/