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
Lab 3: Nutritional Analyses via 2 Programs

ChooseMyPlate.gov

https://www.supertracker.usda.gov/

In Lab Today!
Sample Exam I Questions

Sample 1. What is human physiology? (+2) How does it differ from human anatomy? (+2)

Sample 2. Give 2 examples of when positive feedback may occur normally in the human body. (+4)

Sample 3. Cells are progressively organized into
   a. organs, systems, tissues, then the whole body
   b. tissues, organs, systems, then the whole body
   c. systems, tissues, organs, then the whole body
   d. None of the above are correct.
Pondering Paleo?

Evolutionary Biologist
Behavioral Ecologist
U Minnesota

http://www.nutritionaction.com/daily/how-to-diet/pondering-paleo/
Gut Bacteria Involved in Inflammation & Atherosclerosis?

Meat & Eggs → L-Carnitine & Choline → Trimethyl Amine (TMA) → TMAO → Inflammation & Atherosclerosis

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

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

“With the right food choices, physical activity, and not smoking, we could prevent about 80 percent of heart disease, about 90 percent of diabetes, and 70 percent of stroke,” says Walter Willett, chair of the nutrition department at the Harvard School of Public Health in Boston. “Those are the three pillars. They really do make a difference.”

The right food choices are simple: Eat less red meat, sweets, refined grains, and salt, and drink fewer sugary beverages. Replace unhealthy foods with vegetables, fruit, beans, and whole grains, and with smaller amounts of fish, poultry, and low-fat dairy. Those foods aren’t just good for our health. They can also help protect the Earth.

Here’s why—and how—to eat real.
Can Lifestyle Modifications Alter Blood Pressure, Cardiovascular & Kidney Disease Risk?

↓ 5-20 mm Hg
↓ 4-9 mm Hg
↓ 2-8 mm Hg
↓ 5-20 mm Hg
↓ 8-14 mm Hg
↓ 2-4 mm Hg

Do the DASH!

American Heart Association © 2017
More Reasons to Shake the Salt Habit

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?

Stop me!

UCB Wellness Letter Jun 2011 p 5
5 times per wk? \(\equiv 106,600 \text{ calories/yr} \equiv \pm 30.5 \text{ lb fat/yr}\)
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!

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

**Figure 4-9.** Changes in body weight, body fat, and lean body weight for diet, exercise, and combination groups. (From Zuti W. B., and Golding, L. A.: Comparing diet and exercise as weight reduction tools. *Phys. Sportsmed.* 4:49–53, 1976.)

*NB:* Each group 500 kcal deficit/day, 16 weeks
Exercise is better than dieting in lowering body fat & preserving muscles!
Dietary Composition & Physical Endurance

- High-fat diet
- Normal mixed diet
- High-carbohydrate diet

Maximum endurance time:
- High-fat diet: 57 min
- Normal mixed diet: 114 min
- High-carbohydrate diet: 167 min

eg, Atkins! ~ 1/3 endurance!
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...
We’re better at storing fat vs carbohydrate!

Dietary Fat → 3 % Kcal

Body Fat

Dietary Carbohydrate → 23 % Kcal
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!!
I'm not sure I believe you! Why can't I just starve to lose weight?
TOTAL FAST = No Energy Nutrients (No Carbohydrates, Fats or Proteins)

ONLY

1. Water
2. Vitamins
3. Minerals

ML Pollock & JH Wilmore 1990.
60-day Fast???

Lost 60 lb!! Wow!!

Yet

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

\[\text{Fat} < \frac{1}{4} \text{ total wt loss!}\]
You can lose weight by starving – but it's mostly water & muscle! Also, there can be complications!
Potential Complications of Total Fasting

Nausea, diarrhea, persistent vomiting, postural hypotension, nutritional deficiencies, menstrual irregularities, and...sudden death.

Positive Aspect??

General loss of appetite within first 2 days, maintained throughout fasting period.

ML Pollock & JH Wilmore 1990.
Emphasize ABCs + Variety & Moderation!
All of these factors help to build a nutritious diet.
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 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  \( \Downarrow \)  Lower Carbohydrate

Peer-Reviewed = Text Books  \( \rightarrow \)  Research

Not Peer-Reviewed = Trade Book  \( \rightarrow \)  Opinion

Mediterranean Diet
Kleiner's & Monaco's Top 10 Hit List for Nutrition Quackery

1. Treatment based on unproven theory calling for non-toxic, painless therapy.

2. Author's/purveyor's credentials aren't recognized in scientific community.

3. No reports in scientific, peer-reviewed literature but rather mass media used for marketing.

4. Purveyors claim medical establishment is against them & play on public's paranoia about phantom greed of medical establishment.

5. Treatments, potions, drugs manufactured according to secret formula.

6. Excessive claims promising miraculous cures, disease prevention or life extension.

7. Emotional images rather than facts used to support claims.

8. Treatments require special nutritional support including health food products, vitamins and/or minerals.

9. Clients are cautioned about discussing program to avoid negative.

10. Programs based on drugs or treatments not labeled for such use.
Digestion Steps

1. Ingestion
2. Mechanical Digestion
3. Chemical Digestion
4. Peristalsis
5. Absorption
6. Storage
7. Defecation

Hydrolysis of Energy Nutrients

Hi gang!!
You need me for digestion!!

\[ \text{H}_2\text{O} + \text{Enzyme} \]
Maltose + Water → Glucose + Glucose

Disaccharide → Monosaccharides

Peptide (portion of protein molecule) + Water → Amino acid + Amino acid

Fat + Water → Fatty acids + Glycerol

Carbohydrate-digesting enzymes

Protein-digesting enzyme

Triglyceride-digesting enzyme

SI Fox 2009 fig 18.1 p 614
What's missing?

**Figure 15-1** An example of hydrolysis. In this example, the disaccharide maltose (the intermediate breakdown product of polysaccharides) is broken down into two glucose molecules by the addition of $\text{H}_2\text{O}$ at the bond site.
Polymer to Monomer
(Many to One)

...Central-linking theme!!

Carbohydrate

Protein + Fat

Glucose

Amino Acids

Fatty Acids + Glycerol
GI-DONUT ANALOGY

GI LUMEN

BODY
Common Control Mechanisms

1. Local (autoregulation)
2. Nervous (rapidly-acting)
3. Hormonal (slower-acting/reinforcing)
Longitudinal $\rightarrow$ Shortens L

Circular $\rightarrow$ ↓d or Width

Body wall

Serosa

Submucosa

Mucosa

Lumen

Outer longitudinal muscle

Inner circular muscle

Muscularis externa

Duct of large accessory digestive gland (i.e., liver or pancreas) emptying into digestive-tract lumen
Myenteric motor plexus!

Meissner’s sensory & secretory plexus!

cf: G&H fig 62-2
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. $\text{H}_2\text{O}$, 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 +
NaHCO$_3$ + enzymes
*enzymatic digestion:*
carbohydrate, fat, protein

6. **Small Intestine**

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

7. **Large Intestine**

*Dehydration*
secretion + absorption
storage + peristalsis
Where does enzymatic digestion of protein begin?
Zymogen = an inactive precursor
Why is the pancreas so unique?
Endocrine + Exocrine functions; Makes enzymes for digesting all 3 energy nutrients!
What are other accessory organs of digestion, that is, off-shoots of the primary tube?
Stomach (partly removed to show underlying pancreas)

Liver

Common bile duct

Gallbladder

Pancreatic duct

Duodenum

Pancreas
Liver: Amazing Recycling of Bile Salts!

1. Secreted bile salts consist of 95% old, recycled bile salts and 5% newly synthesized bile salts.

2. 95% of bile salts are reabsorbed by terminal ileum.

3. Reabsorbed bile salts are recycled by enterohepatic circulation.

4. 5% of bile salts are lost in feces.

Liver

Bile salts

Cholesterol

Common bile duct

Gallbladder

Stomach

Sphincter of Oddi

Duodenum

Hepatic portal vein

Colon

Terminal ileum

KEY

= Enterohepatic circulation of bile salts

LS 2012 fig 15-11 p 462
What is the **major function** of the small intestine? Absorption!!
http://www.cdc.gov/ulcer/
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.
Peering through the pylorus into the duodenum, we see some blood and a vessel sticking out of the wall, just at the front edge of a small but deep ulcer.

In the second photograph, a disposable metal clip is applied to the ulcer. The patient remained well and left hospital three days later.