BI 121 Lecture 6  Nutrition Lab 3 today! More fun about me...

I. **Announcements** Nutrition Lab Today! Got Data? Q?
   If you want notebook to study for Exam I on Oct 28th,
   turn in prior lecture next Tuesday, Oct 21st. Sample Exam Q.

II. **Nutrition Connections** Sizer & Whitney (S&W) Sci Lib + DC
   A. Diet or exercise? Diet composition & endurance? Fasting?
      Zuti & Golding 1976; Sacks [AHA NPAM Council](https://www.americanheart.org/en) 2009;
      AMDR? Adjusted Macronutrient Distribution Range!
   B. **Beware of Nutrition Quackery** S. Kleiner & Monaco 1990!

III. **Gastrointestinal Physiology** DC Module 3 pp 17-23, LS ch 15+
   A. Steps of digestion, hydrolysis central theme LS pp 437-9
   B. What’s missing? LS fig 15-1 p 438
   D. How is the gut controlled?
   E. Organ-by-organ review A&P LS tab 15-1 pp 440-1 +...
   F. 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
   I. Large intestine? LS fig 15-24 pp 472-4
Lab 3: Nutritional Analyses via 2 Programs

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.

**NB:** Each group 500 kcal deficit/day, 16 weeks
Exercise is better than dieting in lowering body fat & preserving muscles!
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...
We’re better at storing fat vs carbohydrate!

Dietary Fat

3 % Kcal

Body Fat

23 % Kcal

Dietary Carbohydrate
To Help Lower Body Wt & %Fat
EXERCISE!! +Minimize These!!

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>FAT</td>
<td>9 Kcal/g</td>
</tr>
<tr>
<td>ETOH</td>
<td>7 Kcal/g</td>
</tr>
<tr>
<td>CARB</td>
<td>4 Kcal/g</td>
</tr>
<tr>
<td>PRO</td>
<td>4 Kcal/g</td>
</tr>
</tbody>
</table>

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

\[ > \frac{3}{4} \quad \left\{ \begin{array}{l}
26 \text{ lb Water} \\
20 \text{ lb Lean Body Mass} \\
14 \text{ lb Fat}
\end{array} \right. \]

Fat < \frac{1}{4} \text{ total wt loss!}
You can lose weight by starving – but it's mostly water & muscle! Also, there are lots of problems!
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.
Dietary Carbohydrate, Fat and Protein in Weight-Loss Diets: A Report and Insider’s Reflections on the Pounds Lost Trial

Frank M. Sacks, MD

Well-controlled studies of energy-reduced diets conducted in controlled environments showed that the macronutrient composition of the diet did not affect weight loss (1). Nonetheless, theories persisted that specific macronutrients would be superior for weight loss. For example, the traditional paradigm for low-fat, high-carbohydrate diets was based on the lower energy density of carbohydrate compared to fat, and the metabolic efficiency of converting dietary fat to body fat (2). Indeed strict vegetarians sustain lower body weight for years on low-fat diets (3). However, meaningful differences in body weight usually were not achieved in population-based trials of conventional low-fat diets (4). Thus, higher-fat, Mediterranean-style diets were proposed to be better for long-term weight loss because of their variety and satisfaction. Two trials found that Mediterranean diets were superior to low-fat diets for weight loss (5,6). Others claimed that a radically different approach that used low-carbohydrate, high-fat, and high-protein foods could produce weight loss without attention to reducing intake because of the satiety of protein-rich foods. Low-carbohydrate diets succeeded in the first few months with more rapid weight loss than low-fat diets but by one year, none of the trials found that weight loss on low-carbohydrate diets is superior to that found on low-fat diets. Continued on page 26
Dr. Sacks’ Conclusions:
We conclude that healthful diets with varying emphases on carbohydrate, fat & protein levels can all achieve clinically meaningful weight loss & maintenance of weight loss over a 2-yr period. The results give people who need to lose weight the flexibility to choose a diet that they can stick with, as long as it’s heart healthy. Such diets can also be tailored for individuals based on their personal & cultural preferences & in this regard may have the best chance for long-term success.
**US Dietary Recommended Intakes (DRI)**

Committee Acceptable Macronutrient Distribution Ranges (AMDR)

<table>
<thead>
<tr>
<th><strong>Energy Nutrient</strong></th>
<th>% Total Calories</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carbohydrate</td>
<td>45-65%</td>
</tr>
<tr>
<td>Fat</td>
<td>20-35%</td>
</tr>
<tr>
<td>Protein</td>
<td>10-35%</td>
</tr>
</tbody>
</table>
Emphasize ABCs + Variety & Moderation!
All of these factors help to build a nutritious diet.

- balance
- adequacy
- variety
- moderation
- calorie control
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.
Lower Carbohydrate

Eliminate Calories or Food Groups
Encourage Fasting

Lower Fat

Adequacy Balance Consistency & Moderation

Not Peer-Reviewed = Trade Books

Peer-Reviewed = Texts → Research

AHA + DASH + Mayo Clinic
5 times per wk? \equiv 106,600 \text{ calories/yr} \equiv \pm 30.5 \text{ lb fat/yr}

Better choices!
More Reasons to Shake the Salt Habit

1. Blood vessel vasodilation within 30 min by ingesting 1500 mg Na+!
2. \( \text{Ca}^{2+} \) excretion \( \uparrow \) bone loss, risk of osteoporosis & fractures.
3. May directly impair kidney function & \( \uparrow \) risk of kidney stones.
4. GI cancer risk, inflammation?

Stop me!  
I'm outta here!!

UCB Wellness Letter Jun 2011 p 5
Digestion Steps

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

Hi gang!!
You need me for digestion!!

H₂O + Enzyme

Hydrolysis of Energy Nutrients
Disaccharide

Glucose + Glucose

Monosaccharides

Peptide (portion of protein molecule)

Amino acid + Amino acid

Fat + Water

Fatty acids + Glycerol

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)

- Carbohydrate
- Protein + Fat
- Fat
- Glucose
- Amino Acids
- Fatty Acids
- Glycerol

...Central-linking theme!!
GI-DONUT ANALOGY

GI LUMEN

BODY
Common Control Mechanisms

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

Circular → ↓d or Width
Muscularis Externa
Glands
Serosa
Epithelium
Submucosa
Lumen
Lamina Propria
Meissner's sensory & secretory plexus!
Longitudinal Muscle
Circular Muscle
H Howard 1990

Myenteric motor 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. H₂O, 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?
FIGURE 15-7

- Esophagus
- Fundus
- Smooth muscle
- Gastroesophageal sphincter
- Body
- Stomach folds
- Pyloric folds
- Pyloric gland area
- Antrum
- Duodenum
- Oxytic mucosa
Zymogen = an inactive precursor

LS 2012 fig 15-9 p 452
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?
Liver: Amazing Recycling of Bile Salts!

- Secreted bile salts consist of 95% old, recycled bile salts and 5% newly synthesized bile salts.
- Reabsorbed bile salts are recycled by enterohepatic circulation.
- 5% of bile salts are lost in feces.
- 95% of bile salts are reabsorbed by terminal ileum.

KEY
- Blue arrows: Enterohepatic circulation of bile salts
What is the **major function** of the small intestine? Absorption!!
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.
Clipping a Duodenal Ulcer

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.
<table>
<thead>
<tr>
<th>Nutrients</th>
<th>Enzymes for Digesting the Nutrients</th>
<th>Source of Enzymes</th>
<th>Site of Action of Enzymes</th>
<th>Action of Enzymes</th>
<th>Absorbable Units of the Nutrients</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carbohydrates</td>
<td>Amylase</td>
<td>Salivary glands</td>
<td>Mouth and (mostly) body of stomach</td>
<td>Hydrolyzes polysaccharides to disaccharides (maltose)</td>
<td>Monosaccharides, especially glucose</td>
</tr>
<tr>
<td></td>
<td>Disaccharidases (maltase, sucrase, lactase)</td>
<td>Exocrine pancreas</td>
<td>Small-intestine lumen</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Proteins</td>
<td>Pepsin</td>
<td>Stomach chief cells</td>
<td>Stomach antrum</td>
<td>Hydrolyzes protein to peptide fragments</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Trypsin, chymotrypsin, carboxypeptidase</td>
<td>Exocrine pancreas</td>
<td>Small-intestine lumen</td>
<td>Attack different peptide fragments</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Aminopeptidases</td>
<td>Small-intestine epithelial cells</td>
<td>Small-intestine brush border</td>
<td>Hydrolyze peptide fragments to amino acids</td>
<td>Amino acids</td>
</tr>
<tr>
<td>Fats</td>
<td>Lipase</td>
<td>Exocrine pancreas</td>
<td>Small-intestine lumen</td>
<td>Hydrolyzes triglycerides to fatty acids and monoglycerides</td>
<td>Fatty acids and monoglycerides</td>
</tr>
<tr>
<td></td>
<td>Bile salts (not an enzyme)</td>
<td>Liver</td>
<td>Small-intestine lumen</td>
<td>Emulsify large fat globules for attack by pancreatic lipase</td>
<td></td>
</tr>
</tbody>
</table>
Large Intestine Structure & Function

- Transverse colon
- Haustra
- Descending colon
- Ascending colon
- Ileocelecal valve
- Cecum
- Appendix
- Rectum
- Sigmoid colon
- Internal anal sphincter (smooth muscle)
- External anal sphincter (skeletal muscle)
- Anal canal

LS 2012 fig 15-24 p 472