BI 121 Lecture 5

I. **Announcements** Lab 3 tomorrow Nutritional Analyses.

II. **Nutritional Physiology in the News**
    UCB Wellness Letter, June 2011, Salt–beyond hypertension

III. **Nutrition Primer** DC Module 2, Sizer & Whitney (S&W) Sci Lib
    A. Essential Nutrients: H₂O, 1⁰ Carbohydrates, 2⁰ Fats, 3⁰ Proteins, Vitamins, Minerals; Macro- vs Micro-?
    B. Dietary Guidelines: USDA, AICR, Eat Like the *Rainbow*!
    D. *Nutrition Quackery, Balanced Approach* Kleiner, Monaco+

IV. **Digestion** LS 2012 ch 15, pp 437-9, DC Module 3 pp 17-23
    A. Steps of digestion Dr. Evonuk + LS pp 437-9; DC p 23
    B. Hydrolysis: the central linking theme! LS p 438, Fox 2009
    C. What’s missing? LS fig 15-1 p 438
    D. GI-Donut analogy? Dr. Lorraine Brilla WWU
    F. Organ-by-organ review LS tab 15-1 pp 440-1 + DC fig 3-1
Sample Midterm 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.
More Reasons to Shake the Salt Habit

Stop me!

1. Blood vessel vasodilation within 30 min by ingesting 1500 mg Na+!
2. $\text{Ca}^{2+}$ excretion, bone loss, risk of osteoporosis & fractures.
4. GI cancer risk, inflammation?

UCB Wellness Letter Jun 2011 p 5
Macronutrients & Micronutrients
Essential for Life

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

**NB**: Need only minute quantities!

**Energy nutrients = yield ATP**
USDA Food Pyramid 1992

Key
- Fat (naturally occurring and added)
- Sugars (added)

Fats, oils, and sweets
Use Sparingly

Milk, yogurt, and cheese group
2-3 Servings

Vegetable group
3-5 Servings

Meat, poultry, fish, dry beans, eggs, and nuts group
2-3 Servings

Fruit group
2-4 Servings

Bread, cereal, rice, and pasta group
6-11 Servings
US Modifications to 1992 Food Pyramid 2005

Fats, oils, and sweets
Use sparingly

“good” fats!

saturated & trans fats!

Milk, yogurt, and cheese group
2–3 servings

3 or more!

Vegetable group
3–5 servings

5 or more!

Meat, poultry, fish, dry beans, eggs, and nuts group
2–3 servings

eg, fish, nuts

4 or more!

Fruit group
2–4 servings

1/2 whole grain

Bread, rice, pasta group
6–11 servings

Regular Physical Activity: Exercise! Exercise!!

KEY
- Fat (naturally occurring and added)
- Sugars (added)
1. ↑emphasis on ↓kcal + ↑exercise. 😊
2. 9-A-Day! 4 fruit + 5 vegetable servings.
3. > 3 of 6 whole grains → ½ whole grains!
4. 3 servings of dairy, eg 3 c fat-free milk.
5. ↓saturated + trans fats + ↑unsaturated/ “good” fats, eg Ω-3 fish, walnuts.
6. Drink in moderation if at all.
7. Practice food safety.
MyPlate launched June 2, 2011!

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!
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!


NB: Each group 500 kcal deficit/day, 16 weeks
Compared to dieting, exercise is superior in inducing % body fat reduction & preserving lean body mass!
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!!

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

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

Fat < $\frac{1}{4}$ total wt loss!

76.7%
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.
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
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>Energy Nutrient</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.
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.
NOT PEER-REVIEWED = TRADE BOOKS

PEER-REVIEWED = TEXTS → RESEARCH

AHA + DASH + MAYO CLINIC

LOWER CARBOHYDRATE

ELIMINATE CALORIES or FOOD GROUPS

ENCOURAGE FASTING

LOWER FAT

ADEQUACY

BALANCE

CONSISTENCY & MODERATION
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
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 H$_2$O at the bond site.
Polymer to Monomer (Many to One)

Carbohydrate → Glucose

Protein + Fat → 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. 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
   - Mucus + enzymes
   - Enzymatic digestion: protein + butter fat

4. **Liver-Gall Bladder**
   - Emulsification = detergent action of bile
   - Secretion mucus

5. **Pancreas**
   - Secretion mucus + NaHCO₃
   - Mucus + 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
**Common Control Mechanisms**

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