
II. **Nutritional Physiology in the News**  Pondering Paleo Nutrition Action Health Letter, Marlene Zuk, U Minn. Animal sources, inflammation & disease? Drink Your Calories? PEBB Shake the salt habit! UC Berkeley Newsletter. Successful Dieting?

III. **Nutrition Primer**  DC Module 2, Sizer & Whitney (S&W) Sci Lib
   A. Dietary Guidelines: USDA, AICR, Eat Like the **Rainbow**!
   B. Best path to weight loss? Diet or exercise or both? Dietary composition & endurance? Fasting? Zuti & Golding 1976; Sacks **AHA NPAM** 2009; AMDR?
   C. 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 + monomer to polymer: central linking themes! LS p 438, Fox 2009 +
   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

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

In Lab Thursday!
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 $\rightarrow$ L-Carnitine & Choline $\rightarrow$ Trimethyl Amine (TMA) $\rightarrow$ TMAO $\rightarrow$ *Inflammation & Atherosclerosis*

[Image of a graph showing plasma levels of TMAO over time comparing omnivores and vegans.]

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

Dietary Choline & L-Carnitine

Gut Flora

Hepatic FMOs

TMA = Trimethyl Amine

Choline

TMAO

Heart Failure

Kidney Disease

Atherosclerosis

5 times per wk? \( \equiv 106,600 \text{ calories/yr} \equiv \pm 30.5 \text{ lb fat/yr} \)

Better choices!

Starbucks Cinnamon Dolce Latte, whipped cream (Venti, 20 oz.) = 410 calories

Jogging = 50 min.

Better choices!
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.


4. GI cancer risk, inflammation?

UCB Wellness Letter Jun 2011 p 5
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 diaries

• 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
**Macronutrients & Micronutrients**

**Essential for Life**

### Macronutrients

- **H$_2$O/Water**
- **1$^0$ Carbohydrates**
- **2$^0$ Fats/Triglycerides/Lipids**
- **3$^0$ Proteins**

### Micronutrients

- **Vitamins** (A, D, E, K; C + B)
- **Minerals** ($K^+$, $Na^+$, $Ca^{2+}$, $Mg^{2+}$, $Fe^{2+}$, $Zn^{2+}$, ...)

**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!

**NB: Energy nutrients = yield ATP**
US Modifications to 1992 Food Pyramid 2005

- Regular Physical Activity: Exercise! Exercise!!
- Fats, oils, and sweets: Use sparingly
  
  - “good” fats!
  - Saturated & trans fats!

- 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, rice, and cereal group: 6–11 servings

- 1/2 whole grain

3 or more!

5 or more!
Dietary Guidelines for Americans 2005
Food Guidance System

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.
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)
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
Exercise is better than dieting in lowering body fat & preserving muscles!
Dietary Composition & Physical Endurance

- eg, Atkins!

High-fat diet: ~ 1/3 endurance!

Normal mixed diet: 57 min

High-carbohydrate diet: 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!
To Help Lower Body Wt & %Fat
EXERCISE!! + *Minimize These!!*

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Calories/g</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

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

Fat < \( \frac{1}{4} \) total wt loss!
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.
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...
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.
<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.

- 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.
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!!

\[ H_2O + \text{Enzyme} \]
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 $\text{H}_2\text{O}$ at the bond site.
Polymer to Monomer
(Many to One)

...Central-linking theme!!

Carbohydrate
Protein + Fat

Glucose
Amino Acids
Fatty Acids + Glycerol

Fat
Protein
Glycogen
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 $\rightarrow$ $\downarrow$ d or Width

Body wall
Serosa
Submucosa
Mucosa
Lumen
Outer longitudinal muscle
Inner circular muscle
Muscularis externa
Myenteric plexus
Submucous plexus

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

Serousa
Epithelium
Submucosa
Lumen
Lamina Propria
Longitudinal Muscle
Circular Muscle
Muscularis Externa
Glands
## 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 <strong>Blood</strong></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
Peristalsis

7. **Large Intestine**

*Dehydration*
secretion + absorption
storage + peristalsis