Exam I Review Slides

STUDY SMART
I. **Announcements**: Please check & sign attendance roster. Not on list? See Pat during break/class. *Lab 1 Histology Thursday in 130 HUE: 10 am - 5 pm sections. Much fun!!*

II. **Introduction**: Staff, office hr, required sources, course overview, grading, expectations & success. Q?

III. **Human Physiology** LS ch 1, DC Module 1
   A. What? cf: Anatomy LS p 1
   B. Where? Body Levels of Organization LS pp 1-6, DC pp 1-5
   C. How? Different Study Approaches LS p 1

IV. **Homeostasis** LS ch 1, DC Module 1
   A. What? Maintenance of ECF LS p 8
   B. Where? ECF = Plasma + Interstitium LS fig 1-4 p 8
   C. How? Simplified Homeostatic Model cf: LS fig 1-7 p 14 Balances LS p 9, DC pp 5-6
   D. Why? Cell survival! LS fig 1-5 p 9, DC p 5
ANATOMY vs PHYSIOLOGY
STRUCTURE vs FUNCTION
WHAT? vs HOW?
WHERE? vs WHY?
Structure-Function: L Hip Fracture & Fixation w/Screws

112017

112117

10 cm
L Hip Osteonecrosis & L Hip Replacement

1.5 cm proud!

Shortening of Neck!

Fraying!

1.5 cm proud!
Nerve conducts

Muscle contracts

Connective connects!!

Epithelial covers
Epithelial tissue gives rise to glands: (a) exocrine & (b) endocrine
Which body systems?
Homeostasis is essential for cell survival!
Maintenance of a relative constancy in the Internal environment = ECF = fluid outside of cells

milieu interieur?

100 trillion cells working intimately

Claude Bernard

Walter B. Cannon
I. **Announcements** Lab 1 Histology today! 130 Huestis (HUE) Fun! Worksheets. Readings: DC, LS, LM? **NB:** UO Biology blog vs. Canvas [http://blogs.uoregon.edu/bi121/fall-2018/](http://blogs.uoregon.edu/bi121/fall-2018/)

II. **Homeostasis** LS ch 1, DC Module 1
   
   A. **What?** Maintenance of ECF LS p 8
   B. **Where?** ECF = Plasma + Interstitium + ? LS fig 1-4 p 8
   C. **Homeostatic Balances?** LS p 9, DC pp 5-6
   D. **Why?** Cell survival! LS fig 1-5 p 9, DC p 5
   E. **Physiology in the News** H₂O? Are we like watermelons?
   F. **How** are balances maintained? Simplified Homeostatic Model *cf:* LS fig 1-7 p 14; T°C + BP balance e.g. + vs. - FB

III. **Cell Anatomy, Physiology & Compartmentalization** LS ch 2
   
   B. Basic survival skills LS ch 1 p 3
   C. Organelles ≡ Intracellular specialty shops
   Endoplasmic Reticulum (ER), Golgi, Lysosomes, Peroxisomes & Mitochondria, LS fig 2-1, 2-2, 2-3 pp 20-3
Maintenance of a relative constancy in the Internal environment = ECF = fluid outside of cells

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Walter B. Cannon
Where is extracellular fluid?

As long as between/outside cells, ECF everywhere?

G&H 2011
ICF = Intracellular

ECF = Extracellular

Interstitium
(eg, between muscle cells)

Plasma
(within CV System)

https://www.youtube.com/watch?v=B658Yn3INYc
Dr. Evonuk’s 6 Balances

Metabolic
ANA- CATA-

H₂O

ToC

O₂/CO₂

Ion+/-

pH
Drink about 1 L per 1000 calories energy expenditure!!

Human ~ 2/3 H₂O
~ 60 – 70 %

= ~40 – 48 kg H₂O

NB: So 2000 kcal →
drink 2000 mL
≡ 67.63 fl oz
≡ ~ 8 cups!
National Academy of Medicine 2018
~9 ½ cups of fluid per day for women
~12 cups per day for men

That includes all fluids: water, coffee, tea, juice, milk, but doesn’t include the 2-3 cups of liquid you get from your food!

Invariably, Negative Feedback

Feedback loop
I. **Announcements**

Q from last time? **Come to office hr!**

II. **Connections**

Homeostatic model: BP, $\text{H}_2\text{O} + T$ °C regulation

III. **Cell Anatomy, Physiology & Compartmentalization**

- Basic survival skills ch 1 p 3
- Organelles $\equiv$ Intracellular specialty shops w/membranes
  - 1. Endoplasmic Reticulum (ER)
  - 2. Golgi
  - 3. Lysosomes
  - 4. Peroxisomes
  - 5. Mitochondria. LS 2012 pp 20-34
    - fig 2-1, 2-2, 2-3, 2-4, 2-5, 2-6, 2-7, 2-8 pp 20-7 tab 2-1 p 36
- What about vaults? LS 2006, p 32
- **Physiol News** Moms eggs execute Dad’s mitochondria?

IV. **Anaerobic vs Aerobic Metabolism Overview**

- Many sources!
  - Mathews & Fox 1976...LS 2012 pp 26-33, fig 2-15 p 33

V. **Introduction to Genetics**

- LS 2012 ch 2 p 20-1 + Appendix C
  - What’s a gene? Where? p A-18, fig C-2, C-3
  - Why are genes important? p A-18
  - What’s DNA & what does it look like? pp A-18 thru A-20
  - How does information flow in the cell? fig C-6
  - How does DNA differ from RNA? pp A-20 thru A-22
Blood Pressure Homeostasis

- **BP**: Venous Pooling
- **BP**: Electrochemical Signal $I'$
- **BP**: Baroreceptors/Pressure Receptors eg, in Carotids & Aorta
- **BP**: CV Control Center Brain Stem

**NB**: Corrective Change $\Delta$ Opposes Original Input $I$

- **BP**: Seated to Standing
- **BP**: Short-term vs long-term!

**BP**: Electrochemical Signal eg, Symp Accel N
70% H₂O = 49L

ICF = 35L

EG 70 kg

INPUT
Dietary Drink 1200 mL
Dietary Eat 400 mL
Oxidation 400 mL
Total = 2000 mL ✓ BALANCE!

OUTPUT
Urine 1000 mL
Sweat + Insensible 900 mL
Feces 100 mL
Total = 2000 mL ✓
Controller = Hypothalamus with Set Point

True Diurnal Variation

Protein Denaturation

Mild Hypothermia

Profound Hypothermia

https://www.khanacademy.org/partner-content/mit-k12/chem-and-bio/v/homeostasis
How Big? 100 Cells Lengthwise = 1 mm!!

1. Cell Membrane

2. Nuclear Membrane

Why Compartments? Advantage?

*Incompatible* reactions can take place

*Simultaneously!!*
Basic Cell Survival Skills?

1. Get food
2. Use food
3. Rid wastes
4. Move
5. Reproduce

How to live?

Nucleus or nose?
1 Sample Cartoon of 100 Trillion (100 x 10^{12}) Cells!

Rough & Smooth Endoplasmic Reticulum (ER): Protein & Lipid Synthesizing Factories

Smooth ER:
1. packages new proteins in transport vesicles
2. stores calcium in muscles

fig 2-2 LS 2012
**Golgi Complex: Final Processing, Packaging & Distribution**

- **Golgi complex**
- Transport vesicle from ER, about to fuse with the Golgi membrane
- Golgi lumen
- Golgi sacs
- Vesicles containing finished product

*Fig 2-4 LS 2012*
Secretion of Proteins Produced by ER

Instructions for building proteins leave the nucleus and enter the cytoplasm.

Proteins (colored strands) are assembled on ribosomes attached to the ER or free in the cytoplasm.

1. Rough ER
2. Transport vesicles
3. Golgi complex
4. Secretory vesicles
5. Transport vesicles
6. Secretion (exocytosis)
7. Lysosome

fig 2-3 LS 2012
Lysosomes vs. Peroxisomes

- Lysosome
  - Hydrolytic enzymes
- Peroxisome
  - Oxidative enzymes

fig 2-6 LS 2012
I. **Announcements**  Anatomy & Physiology Lab today! Motivation to Study! Remember to complete p 3-7 dietary record in LM < Lab 3 next wk! Estimating serving sizes. Q?

II. **Cell Physiology**… Lysomes, Peroxisomes, Mitochondria

III. **Anaerobic vs Aerobic Metabolism**

   LS ch 2 pp 26-33, fig 2-15, 2-9, 2-10, 2-11, 2-12 +…

   A. Anaerobic: Cytosol ATP-PC immediate vs. Glycolysis
   B. Aerobic: Mitochondria citric acid cycle, electron transport

IV. **Introduction to Genetics**

   LS pp 20-1 + Appendix C

   A. What’s a gene? Where? p A-18, fig C-2, C-3
   B. Why are genes important? p A-18
   C. What’s DNA & what does it look like? pp A-18 thru A-20
   D. How does information flow in the cell? fig C-6
   E. How does DNA differ from RNA? pp A-20 thru A-22
   G. How are proteins made? Class skit! fig C-7, C-9

**Structure-function = fun!**
Catalase Enzyme Reaction in Peroxisomes
Neutralize Toxin at Production Site!

\[ 2\text{H}_2\text{O}_2 \rightarrow 2\text{H}_2\text{O} + \text{O}_2 \]
Phagocytosis: Cell Eating!
Mitochondria: Energy Organelles
Mom’s eggs execute Dad’s mitochondria

In “Hamlet,” Rosencrantz and Guildenstern deliver a letter to the rulers of England that carries the ill-fated duo’s own death sentence. Perhaps Shakespeare knew a bit about reproductive biology.

Scientists have now found that during a sperm’s creation, its mitochondria—energy-producing units that power all cells—acquire molecular tags that mark them for destruction once the sperm fertilizes an egg. This death sentence, a protein called ubiquitin, may explain why mammals inherit the DNA within mitochondria only from their mothers, a biospecies mitochondrial inheritance. Sperm mitochondria sometimes avoid destruction when two different species of mice mate, and Schatten’s team has shown this also holds true in cattle. It’s hard to understand how an egg distinguishes between paternal mitochondria of closely related species, says Schon.

When paternal mitochondria escape destruction in normal mating, the resulting embryo may suffer. Schatten notes that a colleague has found sperm mitochondria in some defective embryos from infertility clinics.

AEROBIC

w/\text{O}_2

= MITOCHONDRION

ANAEROBIC

without \text{O}_2

= CYTOSOL

1. Immediate/ATP-PC
2. Glycolysis
WOW! 
I’M CHAMP!

https://jissn.biomedcentral.com/articles/10.1186/s12970-017-0173-z
https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3407788/
ATP Supplied

Performance Time

Power Output

ATP

- PC/

Immediate

15 - 30 s

Glycolysis

Oxygen System

≥ 3 – 5 m

Mitochondria

Cytosol

Anaerobic

Aerobic

Modified after Mathews & Fox
Cleave One High Energy Phosphate Bond To Do Work!!

7 – 10 KiloCalories/KCal

1. Synthesis of Macromolecules
   Make big things from little things!

2. Membrane Transport
   Move things! Microscopic!

3. Mechanical Work
   Move things! Macroscopic!

Adenosine

$\text{P}_3$
Anaerobic vs. Aerobic Metabolism

**Anaerobic Glycolysis**
"sugar dissolving" without O$_2$. Net of 2 ATP per molecule of glucose

Aerobic Metabolism
+ mitochondrial processing of glucose with O$_2$. Net of 32 ATP per molecule of glucose
Goals of Aerobic Metabolism

AEROBIC = MITOCHONDRION

w/O₂

CITRIC ACID CYCLE

harvest electrons e⁻ e⁻ e⁻ e⁻ e⁻ e⁻ e⁻ e⁻

“cash in”

ELECTRON TRANSPORT CHAIN

for ATP Energy!!
What are DNA’s major functions?
Heredity + Day-to-Day Cell Function
What does DNA look like? Double-helix!!
Gene = Stretch of DNA that codes for a protein
I. **Announcements** Nutrition Analyses this Thursday! Please record diet on p 3-7 LM. Bring flash drive. Q?

II. **Introduction to Genetics** LS 2012 ch 2 p 20-1 + Appendix C
   A. How does DNA differ from RNA? pp A-20 thru A-22
   C. How & where are proteins made? fig C-7, C-9
   D. Class skit: Making proteins @ ribosomes!

III. **Nutrition Primer** 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*!
   C. *Blue Zones*? Pondering Paleo, Marlene Zuk, *NAHL* 2015...
   D. How much protein? Excess animal protein & disease?
   E. Carbohydrate confusion. Minimize what? Simple sugars
   F. Anti-aging diets, total vs intermittent fasting? *NAHL* 2018
   G. *Beware of Nutrition Quackery* S. Kleiner & Monaco
   H. Best diets? Exercise? Practical guidelines for wt loss!

IV. **Introduction to Digestion** Steps + hydrolysis
What does DNA do, day-to-day?

DNA → Transcription → RNA → Translation → Protein

- Replication
- Nucleus: DNA
- Cytoplasm: RNA @ ribosomes

cf: LS fig C-6
**DNA vs RNA?**

1. Double-stranded
2. Deoxyribose (without oxygen)
3. A, T, C, G Thymine
4. Self-replicative (can copy itself)
5. Nucleus (+mitochondria)

1. Single-stranded
2. Ribose (with oxygen)
3. A, U, C, G Uracil
4. Needs DNA as template
5. 1° Cytoplasm (but Nucleus origin)
6. mRNA, rRNA, tRNA
**Triplets of bases code for amino acids, the building blocks of proteins**

<table>
<thead>
<tr>
<th>DNA code word</th>
<th>mRNA codon</th>
<th>tRNA anti-codon</th>
</tr>
</thead>
<tbody>
<tr>
<td>TAT</td>
<td>AUA</td>
<td>UAU</td>
</tr>
<tr>
<td>ACG</td>
<td>UGC</td>
<td>ACG</td>
</tr>
<tr>
<td>TTT</td>
<td>AAA</td>
<td>UUU</td>
</tr>
<tr>
<td>TAC</td>
<td>AUG</td>
<td>UAC</td>
</tr>
</tbody>
</table>
Translation? Ribosomes Make Proteins

1. mRNA
2. Large subunit
3. Small subunit
4. Amino acid
5. tRNA
6. Anticodon
7. Leader sequence
8. First codon
9. Second codon

Steps 5 through 8 are repeated.

First ribosomal binding site
Second ribosomal binding site

LS 2012 fig C-7
## Macronutrients & Micronutrients Essential for Life

### Macronutrients

<table>
<thead>
<tr>
<th>Type</th>
<th>Sample Food Sources</th>
</tr>
</thead>
<tbody>
<tr>
<td>H₂O/Water</td>
<td>Water, other drinks, fruits &amp; vegetables</td>
</tr>
<tr>
<td>1️⃣ Carbohydrates</td>
<td>Grains, vegetables, fruits, dairy products</td>
</tr>
<tr>
<td>2️⃣ Fats/Triglycerides/Lipids</td>
<td>Meats, full-fat dairy products, oils</td>
</tr>
<tr>
<td>3️⃣ Proteins</td>
<td>Meats, legumes, dairy vegetables</td>
</tr>
</tbody>
</table>

### Micronutrients

<table>
<thead>
<tr>
<th>Type</th>
<th>Sample Food Sources</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vitamins (A, D, E, K; C + B)</td>
<td>Vegetables, vegetable oils, fruits, citrus, grains, dairy</td>
</tr>
<tr>
<td>Minerals (K⁺, Na⁺, Ca²⁺, Mg²⁺ Fe²⁺, Zn²⁺,...)</td>
<td>Fruits, vegetables, grains, nuts, dairy, meats, processed foods</td>
</tr>
</tbody>
</table>

**NB: Need only minute quantities!**

**✓ Energy nutrients = yield ATP**
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!
A healthy eating pattern includes:

- **Variety of vegetables** from all subgroups: dark green, red & orange, legumes, starchy & other
- **Fruits**, especially whole fruits
- **Grains**, at least half of which are whole grains
- **Fat-free or low-fat dairy**, including milk, yogurt, cheese &/or fortified soy beverages
- **Variety of protein foods** including seafood, lean meats & poultry, eggs, legumes & nuts, seeds & soy products
- **Oils** (healthy)

A healthy eating pattern limits:

- **Saturated fats** & **trans fats**, added **sugars** & **sodium**
- **Balance calories with physical activity** to manage weight.

http://health.gov/dietaryguidelines/2015/
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.
The World’s Longest-Lived People! Blue Zones!

Lomo Linda, CALIFORNIA
Sardinia, ITALY
Okinawa, JAPAN
Nicoya, COSTA RICA
Ikaria, GREECE

1. Eat a little bit better!
2. Move a little bit more!
3. Socialize more!
4. Strong sense of purpose!

- Loma Linda, United States
  - Plant-based!
- Sardinia, Italy
  - High polyphenol wine
  - Fava beans
- Okinawa, Japan
  - Likeability
  - Turmeric
  - No "time urgency"
  - No alcohol
  - No smoking
  - Family
  -整日
  - Empowered women
  - Social engagement
  - Gardening
  - Sunshine
  - Legumes
  - Whole grains
  - Culturally isolated
  - No soy consumption

https://en.wikipedia.org/wiki/Blue_Zone
https://bluezones.com/
85% Carbohydrates 9% Protein 6% Fat 85-10-5 1785 Calories

Note: These are the Actual Food Measurements of the Centenarians, not the diet of All island Okinawans or the ones who died, but the ones who lived.
Pondering Paleo?

Evolutionary Biologist
Behavioral Ecologist
U Minnesota

http://www.nutritionaction.com/daily/how-to-diet/pondering-paleo/
How much protein do you need?

Not much! 0.8 g/kg or 0.36 g/lb of body wt/d

50 kg or 110 lb female? ~ 40 g/d
80 kg or 176 lb male? ~ 64 g/d

Boneless, skinless, cooked chicken breast 6-8 oz, 53-70 g of protein!

Average US woman gets 35% > RDA!
Average US man 65% > RDA!
WHO says to cut down on meat?

When I saw the headlines in October that meat was linked to cancer, I braced myself for the inevitable brouhaha. The news was that the International Agency for Research on Cancer (IARC), part of the World Health Organization (WHO), concluded that processed meats like hot dogs, bacon, and ham almost certainly increase the risk of colorectal cancer — by 18% per daily serving — and that red meat probably does as well.

But we've heard about this link many times before. Over the past 20 years, many observational studies have found that people who regularly eat red or processed meats have higher rates of several cancers, notably of the colon and rectum. And lab studies have shown that compounds formed when meat is processed (that is, smoked, salted, or cured) or cooked at high temperatures can cause cancer in animals or cells. All that research served as the basis of the IARC conclusions. But even in 2007 the World Cancer Research Fund, another key group of experts, concluded that there was "convincing" evidence that these meats increase the risk of colorectal cancer. And since 2002, WHO has advised people to moderate their consumption of processed meat, as do the still-pending 2015 Dietary Guidelines for Americans.

What elicited the most heated reaction in the press and blogosphere and especially from the meat industry was the fact that the IARC put processed meats in its Group 1—"carcinogenic to humans"—which includes tobacco smoking and asbestos. (It put red meats in Group 2A—"probably carcinogenic"). The IARC clearly explained that this classification merely indicates the strength of the evidence that something causes cancer, not the degree of risk. In fact, it said that the increased risk from red or processed meat is "small" for individuals, though potentially important for public health since so many people eat meat.

What about that 18% increase in risk? The IARC estimated that for every serving of processed meat (just under 2 ounces) or red meat (3½ ounces) eaten daily for years, the lifetime risk of colorectal cancer goes up by about 18%. But this is what's known as relative risk, which can be misleading. For instance, the lifetime risk of developing colorectal cancer in the U.S. is about 5%. An 18% increase does not mean 5% + 18% = 23%, but rather 5% + (18% of 5%) = 6%. That means one extra case of colorectal cancer per 100 meat eaters. In contrast, smoking increases the lifetime risk of lung cancer by roughly 2,000%—from about 1 per 100 people to about 20 per 100. So while IARC may classify both processed meat and smoking as Group 1 carcinogens, there's no comparison in their risks.

In fact, IARC cited estimates that 34,000 cancer deaths per year worldwide can be attributed to diets high in processed meat. In contrast, tobacco causes nearly 2 million cancer deaths per year.

I should add that I don't think it has been clearly established that meat causes cancer. Proving that foods cause or help prevent cancer is difficult for many reasons. Notably, the observational studies upon which the IARC classifications were largely based can only find associations— they cannot prove cause and effect.

That said, there are plenty of other reasons to moderate your intake of red meats and limit processed ones. There's strong evidence linking them to cardiovascular disease and a variety of other disorders, though it's not clear which compounds in them are the possible culprits. What's more, eating more plant-based foods and less meat is better for the planet, resulting in less greenhouse gas production.

And there's a far surer way to reduce the risk of colorectal cancer than tinkering with your diet: Get screened.
Dietary Choline & L-Carnitine

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

Red Meat-Derived Glycan Promotes Inflammation & Disease

N-Glycolylneuramic acid (Neu5GC)

Ab to Neu5GC
Neu5GC Ab

Immune System

Atherosclerosis
Cancer

Chronic Inflammation
Amyloid-A +
Acute Phase Proteins
IL-6

Xeno Auto-Antigen!
Anti-Neu5GC Ab

Source: After AN Samraj, PNAS, 2015, 112(2), 542-7.
http://m.pnas.org/content/112/2/542.long
Carbohydrate Confusion

Should you avoid carbs at all costs?

Our Planet AT RISK

The Best SPREADS

3 Veggie Dips

No, ↑ complex
↓ simple!

Emphasize a plant-based diet!
I. **Announcements** Data + flash drive/e-mail for today’s lab! If you want to be sure to have your notebook to study for Exam I on Tuesday Oct 23rd, best to turn in prior to lecture next Tuesday Oct 16th. Review Session Sunday Oct 21st, 6-7 pm. Q? Sample Exam Q? Be sure to see *Active Learning Questions*!


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-Doughnut analogy Dr. Brilla @ WWU
E. Common control mechanisms
F. Gut layers & secretions LS p 438, 440-1
G. Organ-by-organ review LS tab 15-1 pp 440-1 + DC fig 3-1
H. Accessory organs of digestion
I. Ulcers? Causes?
Why Eat Whole Grains?

Based on existing evidence, eating whole grains is definitely good for our health.

Shengmin Sang, Professor of Food Science & Human Health North Carolina A&T

Fiber ↑ fullness, motility, beneficial bacteria, wt control
↓ cholesterol, insulin response, inflammation, diabetes and CVD risk...

B-vitamins thiamin, niacin, riboflavin ↑ energy metabolism

Folate ↑ red blood cells, ↓ neural tube defects

Iron ↑ O₂ carrying, ↓ iron-deficiency anemia in women

Magnesium ↑ bone building & muscle energy release

Selenium an anti-oxidant, protects body cells & ensures a healthy immune system...

https://www.choosemyplate.gov/grains-nutrients-health
Dietary Composition & Physical Endurance

- **High-fat diet**: ~ 1/3 endurance!
- **Normal mixed diet**: 57 min
- **High-carbohydrate diet**: 114 min, 167 min

eg, Atkins!
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!!

<p>| | |</p>
<table>
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<tr>
<td>FAT</td>
<td>9 Kcal/g</td>
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<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>
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</table>

**NB:** *Minimize* not *Eliminate*! *Moderation* not *Abstinence*!!

*DIETFITS* (2018) + *Pounds Lost Trial* (2009) indicate that reducing overall calories is more important than macronutrient composition of the diet!

**60-day Fast???

Lost 60 lb!! Wow!!

Yet

\[
\begin{align*}
> \quad & \frac{3}{4} \\
\{ & 26 \text{ lb Water} \\
& 20 \text{ lb Lean Body Mass} \\
& 14 \text{ lb Fat}
\end{align*}
\]

Fat $< \frac{1}{4}$ total wt loss!
CALERIE STUDY
Comprehensive Assessment of Long-term Effects of Reducing Intake of Energy

- 2-yr kcal restriction, assess biomarkers longer, healthier life
- 218 people, 21 – 51 yr, ½ overwt, ½ normal wt
- Usual diet or cut kcal by 25% (achieved ~ 12% so < ½ goal)
- If cut calories, lost 10% body wt ~ 17 lb & kept off for 2 yr
- Cardiometabolic Δs: ↓ Cholesterol, ↓ Inflammatory markers, ↑ control blood sugar control w/o adverse sexual or immune function Δs

Some bone loss, but attributed to weight loss.

Human Intermittent Fasting Studies

- ~100 overweight or obese women
- ½ cut 25% kcal every day
- ½ ate normally 5 d, but only 650 kcal/d for 2 d/wk
- After 3 – 6 mo, each group lost ~ same amount of wt but women on 5:2 diet had better insulin function!
- Likely easier for most humans to restrict for only 2 d/wk!


NB: Each group 500 kcal deficit/day, 16 weeks
**Which Diets are Best?**

- Plant-based: Lower Fat
- Not Plant-based: Lower Carbohydrate

**Not Peer-Reviewed** = Trade Book → Opinion

**Peer-Reviewed** = Text Books → Research

- Mediterranean Diet

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**Nutrition and Physical Degeneration**

**The Paleo Diet**

**No-Fad Diet**

**The South Beach Diet**

**The DASH Diet Action Plan**

**The Mayo Clinic Diet**

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**ChooseMyPlate.gov**
5 times per wk? ≡ 106,600 calories/yr ≡ ± 30.5 lb fat/yr

Better choices!
Eat Breakfast, Eat Early, Downsize, Go Low!

Eating early & less late (< ~ 6:30 pm) may help insulin work efficiently!

Smaller amount vs plate size!

Fruits & vegetables for low-calorie density!

Sleep More, Eat Less

Wondering why you’re so hungry? Maybe it’s because you’re not getting enough sleep.

Researchers allowed 12 healthy young lean men to sleep for either four or eight hours in a laboratory. After one night of four hours of sleep, the men ate 22 percent more calories the next day than they did after eight hours. They also reported being more hungry before breakfast and dinner.

In a separate study, scientists found that a single night with only four hours of sleep led to insulin resistance in nine healthy lean men and women in their 40s. After the night of restricted sleep, the participants were less able to move blood sugar into their cells, which suggests that their bodies were at least temporarily resistant to insulin. Insulin resistance can lead to heart disease, diabetes, and possibly breast cancer.

What to do: Get enough sleep. Most adults need 7 to 8 hours a night. (School-aged children need at least 9 hours.) Other studies that limit adults’ sleep find higher levels of ghrelin (which makes people hungry) and lower levels of leptin (which makes people feel full) in their blood. Changes in ghrelin, leptin, and insulin resistance may explain why studies find a higher risk of obesity, heart disease, diabetes, and high blood pressure in people who get too little sleep.

http://www.vivo.colostate.edu/hbooks/pathphys/endocrine/gi/ghrelin.html

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
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!!

\[ H_2O + \text{Enzyme} \]

Hydrolysis of Energy Nutrients
Put Lab Notebook in box based on your lab time. Thanks!!

I. **Announcements** Exam I one week from today, Oct 23rd! Discussion+Review, Sunday Oct 21st, 6-7:30 pm, here! Q?

II. **Gastrointestinal Physiology** DC Mod 3 pp 17-23, LS ch 15+
   A. Central-linking themes: hydrolysis, polymer to monomer
   C. Control + Organ-by-organ review LS tab 15-1 pp 440-1 +...
   D. Zymogen? = Inactive precursor LS fig 15-9 p 452...
   G. Large intestine? LS fig 15-24 pp 472-4

II. **Cardiovascular System** DC Mod 4, LS ch 9, Torstar, G&H+…
   A. Circulatory vs. Cardiovascular (CV)? CV vs. Lymphatic
      CV Pulmonary & Systemic circuits DC pp23-31+LS p229+
      DC fig 4-1 p 24, LS fig 9-2b p 231
   B. Arteries, capillaries, veins, varicosities? G&H, Torstar, DC
   C. ❤️ layers, box, chambers, valves, inlets, outlets
      LS fig 9-4 p 233, fig 9-2a p 231; DC pp 23-6
   D. Normal vs. abnormal blood flow thru ❤️ & CVS LS, Fox+…
Polymer to Monomer
(Many to One)

Carbohydrate
+ Glucose

Protein + Fat

Amino Acids

Fatty Acids + Glycerol

...Central-linking theme!!
GI-Doughnut Analogy

GI Lumen

Body

Me?
Body wall

Serosa

Submucosa

Lumen

Outer longitudinal muscle

Inner circular muscle

Muscularis externa

Mucosa

Myenteric plexus

Submucous plexus

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

Longitudinal $\rightarrow$ Shortens L

Circular $\rightarrow$ ↓d or Width

LS 2012 fig 15-2 p 442
# 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. $H_2O$, 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 + NaHCO₃ + 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
Zymogen = an inactive precursor
Why Do Some People Have Trouble Digesting Milk?

- Ability to digest milk carbohydrates varies
  - Lactase
    - Made by small intestine
- Symptoms of intolerance
  - Gas, diarrhea, pain, nausea?
- Milk allergy?
- Nutritional consequences
- Milk tolerance and strategies
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.
I. **Announcements**  
Exam I next session; 1 & 2 pm lab sections go directly to 13 KLA & 21 KLA. All others (except AEC) here (100 WIL)! Review: Sunday, 6 pm 123 PAC! Lab Manuals. Q?

II. **Cardiovascular Connections**  
LS 2012 ch 9, Torstar Books+

III. **CV Physiology in News**  
AHA + ACSM exercise guidelines!

IV. **CV Pathophysiology & Risk Reduction**  
LS ch 9, 10 +…

A. AMI, CVA, CVD, PVD, TIA, HTN? + surgical treatments
B. Atherosclerosis? LS fig 9-27, 9-25, 9-26 pp 266-8
C. How to minimize risk of CVDs? Treatment triad:  
1. Exercise, 2. Diet, 3. Drugs+Surgery
D. Food choices  
makes a difference?  
Plant-based diet!  
What’s HAPOC?
Cardiac Cycle

**Systole**
- Contract
- & Empty

**Diastole**
- Relax
- & Fill
(a) Location of the heart valves in a longitudinal section of the heart.
Heart Valves Ensure Unidirectional Blood Flow!

Mom's valve!

Right AV valve
Left AV valve
Aortic or pulmonary valve

(b) Heart valves in closed position, viewed from above

Right atrium
Right AV valve
Direction of backflow of blood
Chordae tendineae
Septum
Right ventricle
Papillary muscle

(c) Prevention of eversion of AV valves

*FIGURE 9-4* Heart valves.
Human $\heartsuit = 4$ unique valves?
2 valve sets?

**Semilunar** = *Half-moon shaped*

1. Pulmonic/Pulmonary
2. Aortic

**AV** = *Atrioventricular*

3. $\mathbb{R}AV = $ Tricuspid
4. $\mathbb{L}AV = $ Mitral/Bicuspid
Veins → Atria → Ventricles → Arteries

Superior vena cava (from head)

Right atrium

Inferior vena cava (from body)

Right ventricle

Endocardium

Myocardium

Pericardium

Left atrium

Left ventricle

Aorta

https://www.nhlbi.nih.gov/health-topics/how-heart-works
https://www.youtube.com/watch?v=zJXAlh9VDDU
How much aerobic?

Continuous exercise

≥ 50% muscle mass

≥ Conversational pace

20-60 min/session

3-5 days/wk


How much strength?

- 2-3 days/wk
- 8-10 exercises for major muscle groups
- ≥ 1 set/exercise
- 8-12 (most) or 10-15 (frail/> 50-60 yr) repetitions/set
AMI
CVDs
CVA
TIA
HTN
PVD
FIGURE 9-35

Extent of myocardial damage as a function of the size of the occluded vessel
Treatment Triad

NB: Last blasted resort!!

Drugs/Surgery

Exercise

Dietary Modification
CABG
Coronary Artery By-pass Graft
*Apple* type of obesity predisposed to CVD!

*Pear* type of fat pattern... implies lower disease risk!

Eat more apples... to help prevent the apple type of obesity!
Fish Oil Intakes & Cardiovascular Death Rates

Cardiovascular Deaths per 100,000 Population

- Ireland: 0.09%
- USA: 0.13%
- France: 0.14%
- Japan: 0.37%

S&W 2011
fig 5-12 p 167
Healthy Oils to Minimize Atherosclerosis

HAPOC?