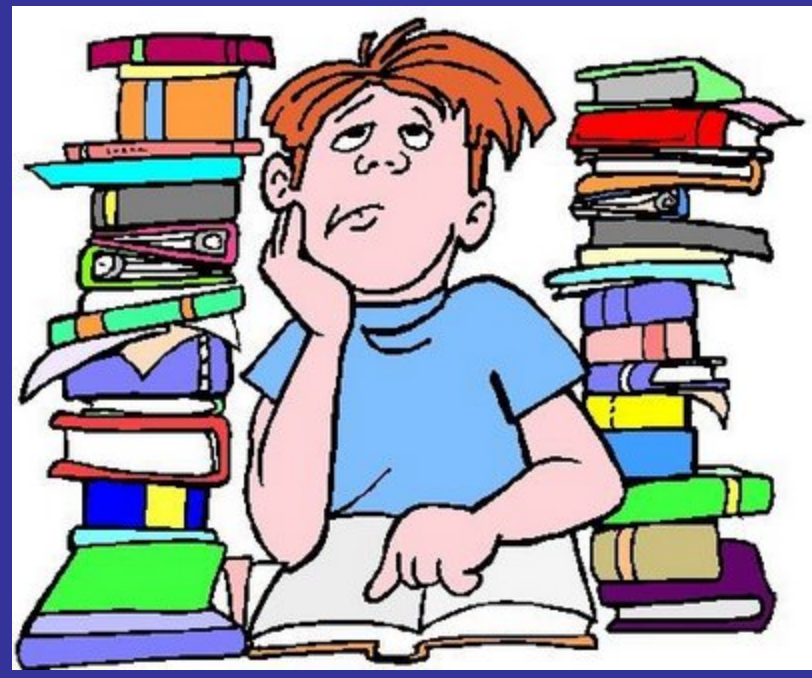
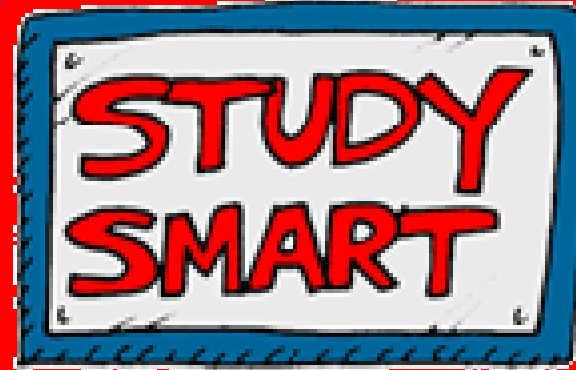
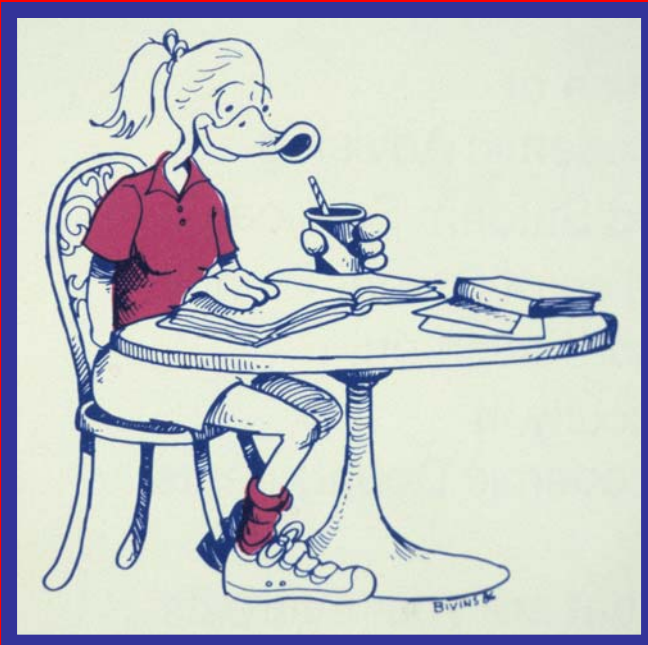


Midterm Review Slides



...Welcome to Human Physiology – what makes us tick!

BI 121 Lecture 1



G. Waples

I. Announcements: Please check & sign attendance roster.

Not on list? See Pat during a break or after class. *Lab 1 Histology* tomorrow in 130 HUE: 12 n & 1 pm sections.

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 pp1-6, DC pp1-5

C. How? Different Study Approaches LS p 1

D. Why? Security+Decision-Making Power LS p xxi, DC p v

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
STRUCTURE
WHAT?
WHERE?

VS

PHYSIOLOGY

VS

FUNCTION

VS

HOW?

VS

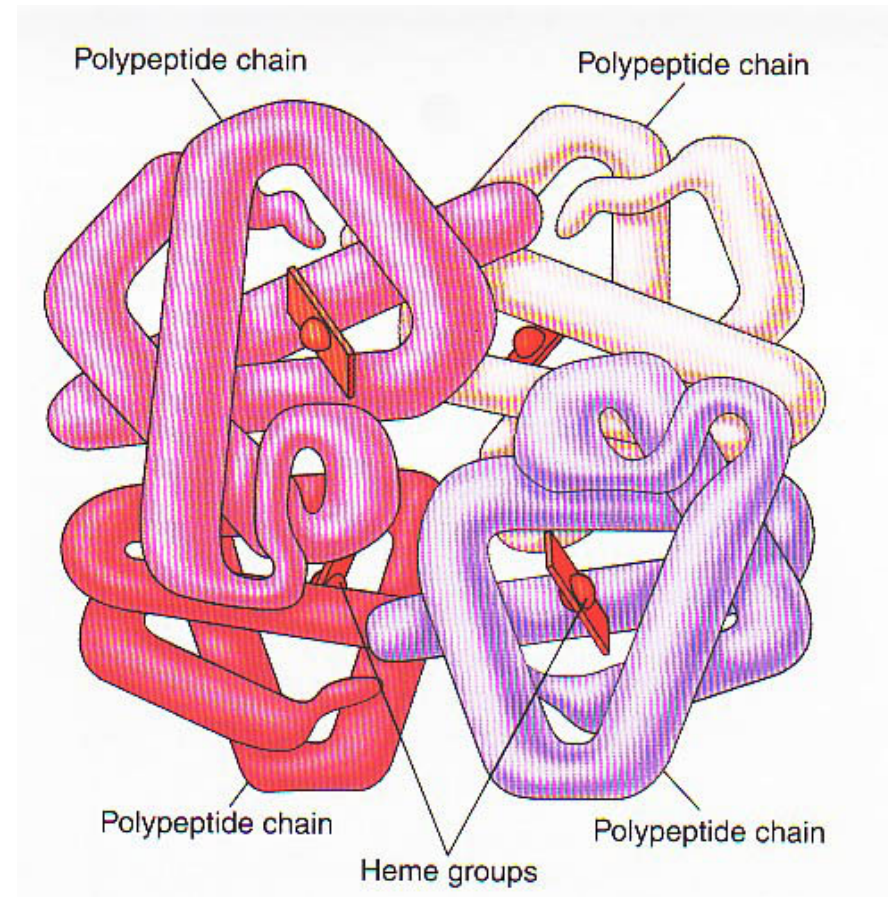
WHY?



VS



Structure begets *function*!
Structure gives rise to *function*!
Structure & *function* are inseparable!



Preoperative Diagnoses: R Knee

Degenerative Joint Disease (DJD) = arthritis

Varus malalignment = bow-leg



Procedures:

Arthroscopy & microfracture

High Tibial Osteotomy (HTO)

Packing bone graft substitute



Blocks/Medications:

Femoral n. block

General anesthesia

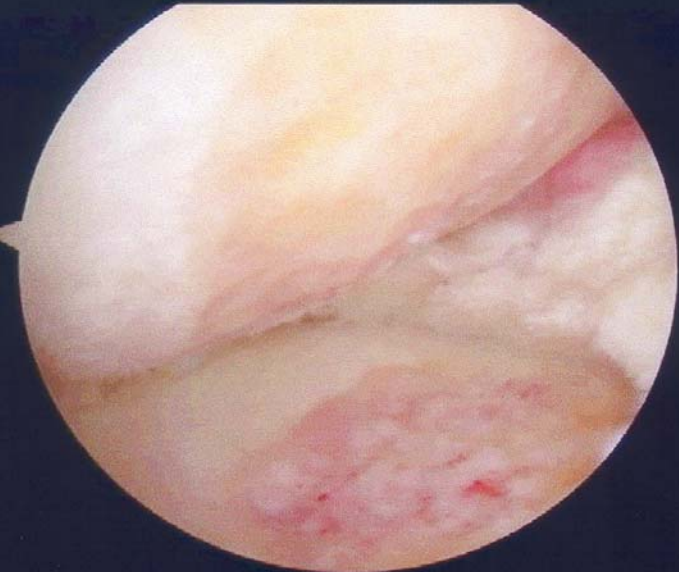
IV Morphine, Oral Oxycontin + Oxycodone,

Tylenol, Injectable Lovenox (enoxaparin Na)

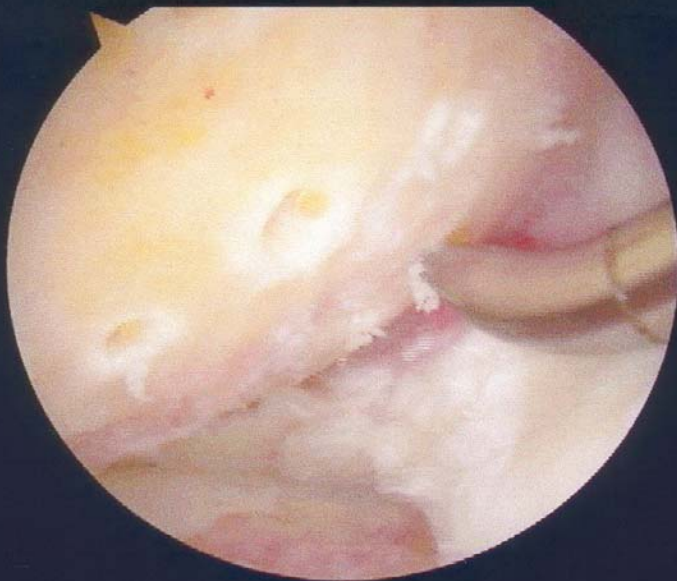
William Sterett, MD
Ben Hogan, PAC
Vail Summit Orthopedics



1. Arthroscopy clean-up



2. Debridement complete



3. Microfracture with awl



4. Punctuate bleeding

High-Tibial Osteotomy (HTO) to Realign the Joint



1. Oscillating saw cut

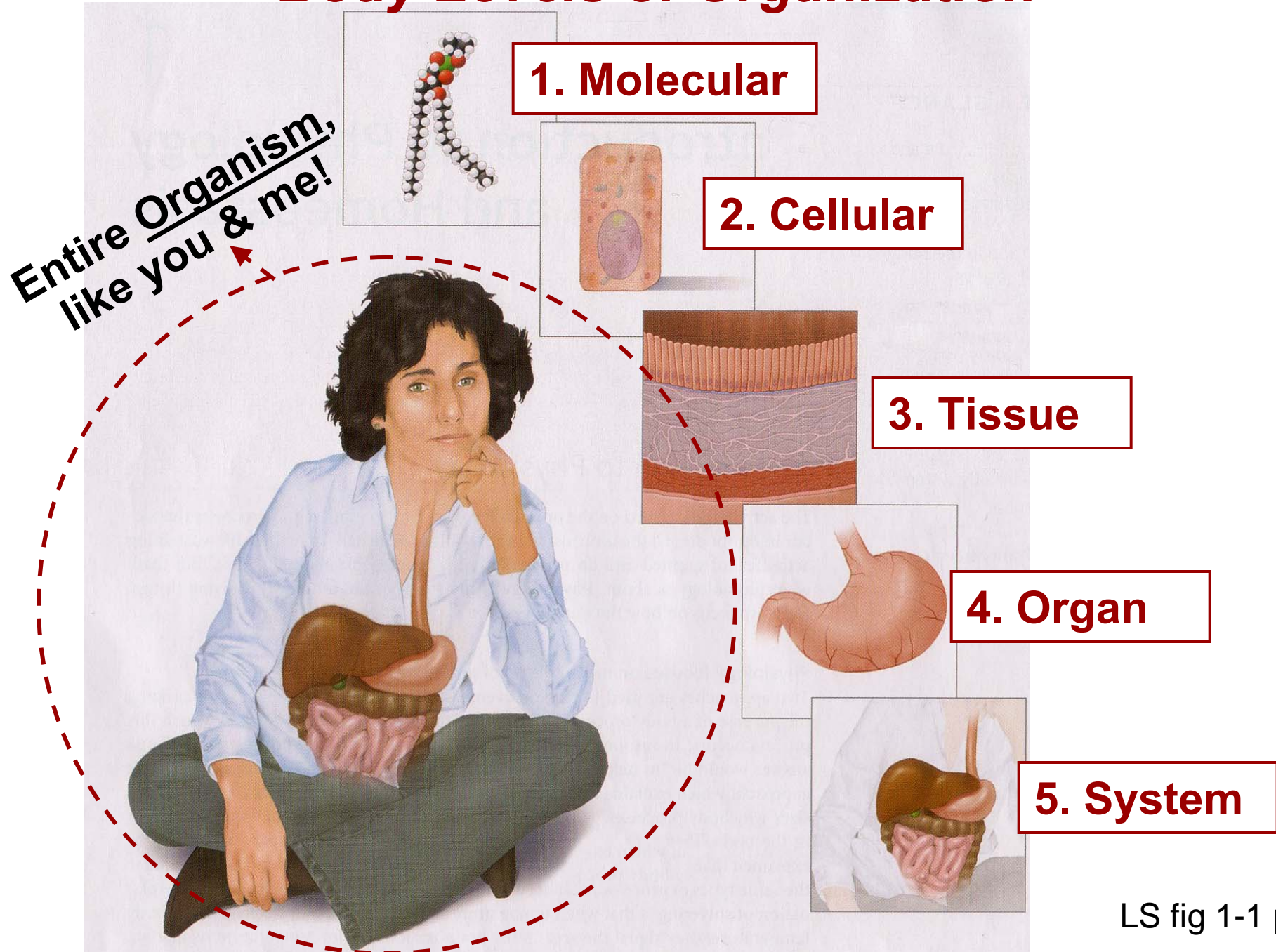


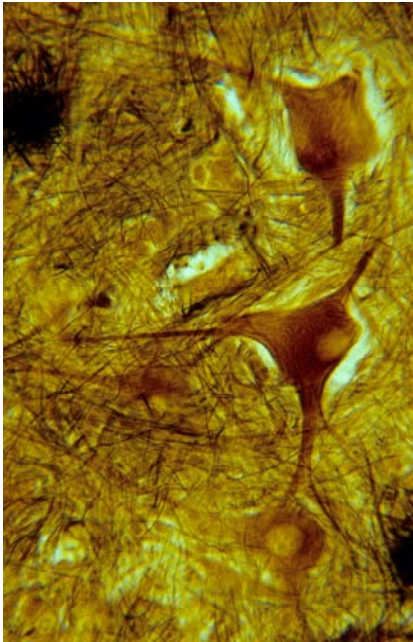
2. R plate/scaffolding insert



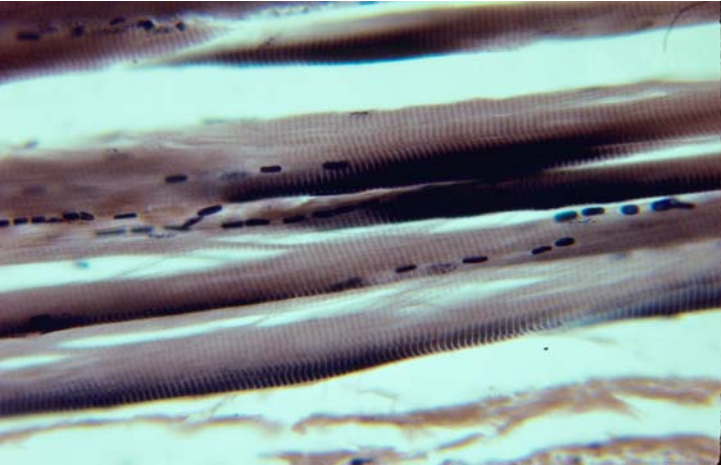
3. Align, stabilize w/screws & pack defect

Body Levels of Organization

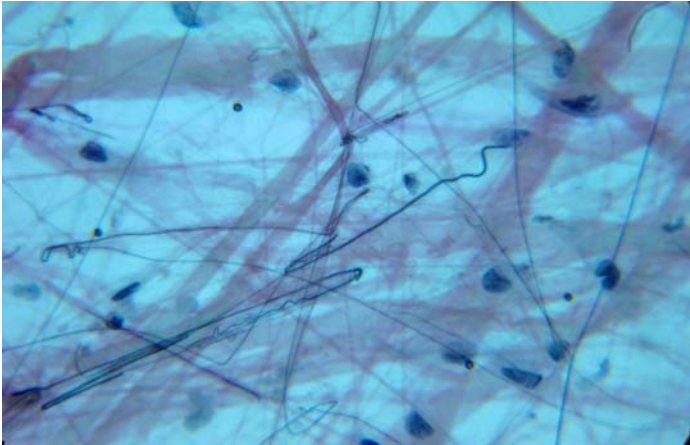




Nerve conducts



Muscle contracts

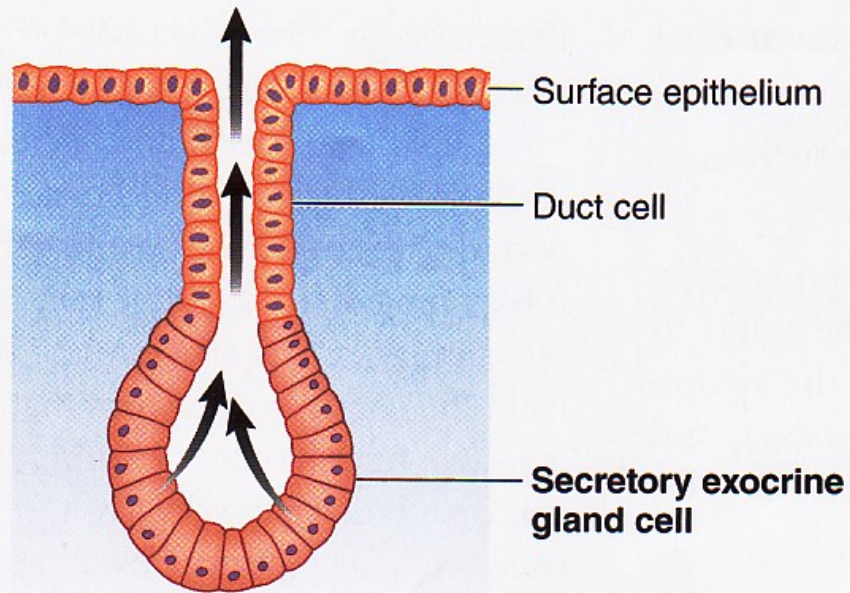


Connective connects!!

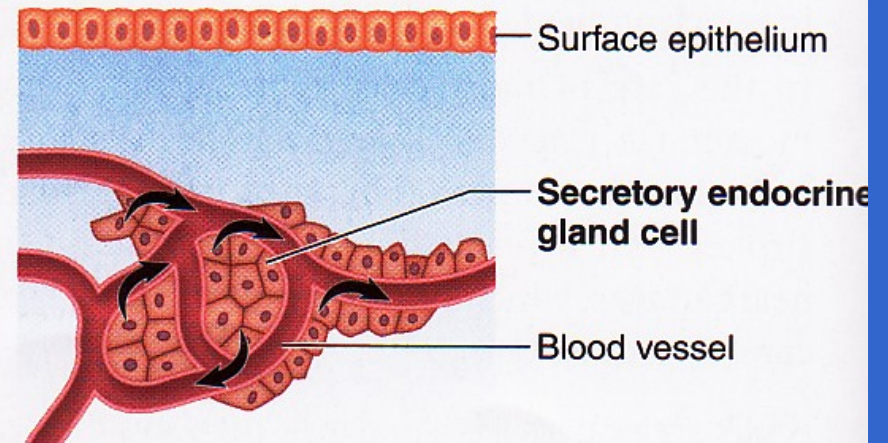


Epithelial covers

Epithelial tissue gives rise to glands: (a) exocrine & (b) endocrine

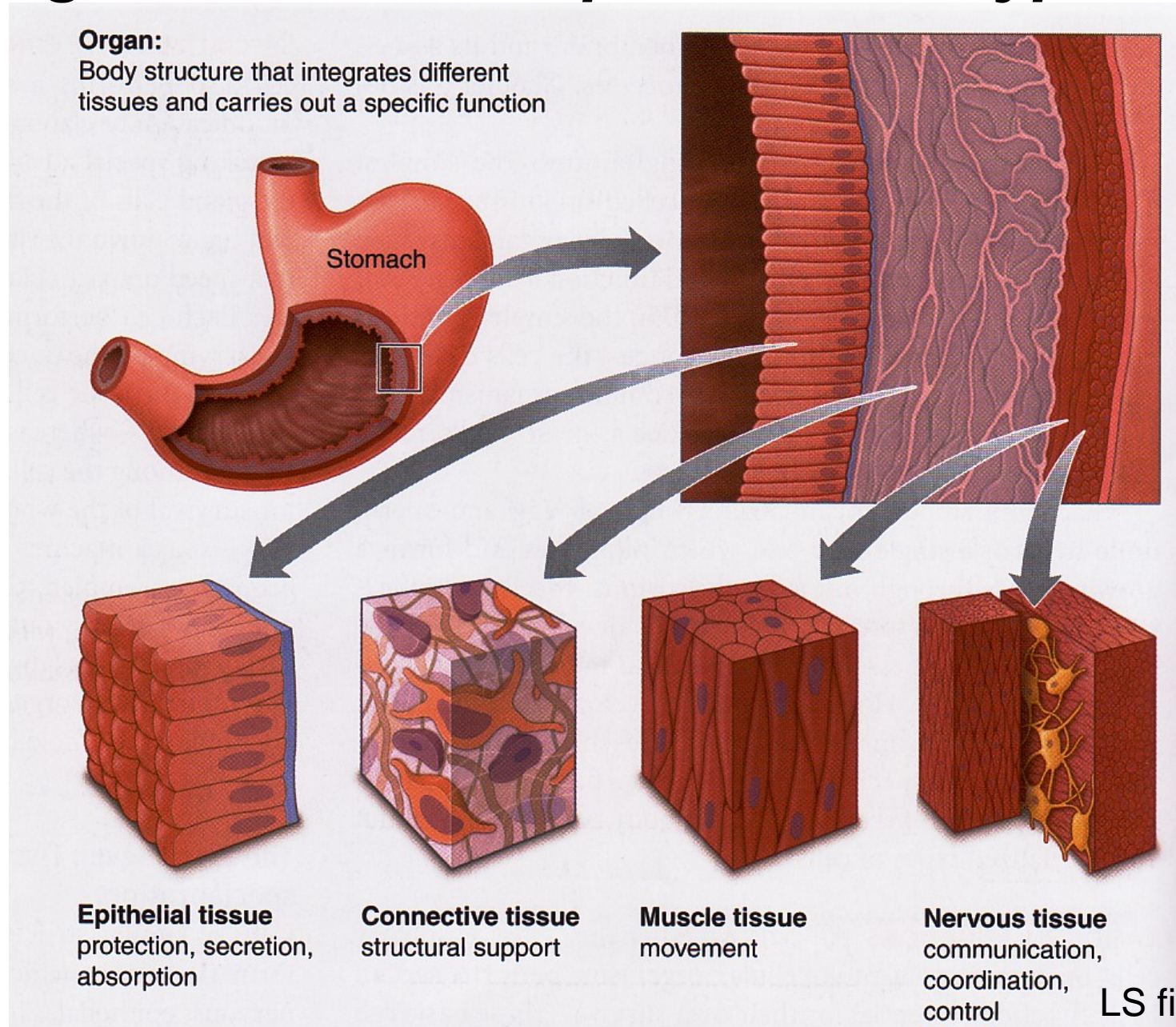


(a) Exocrine gland

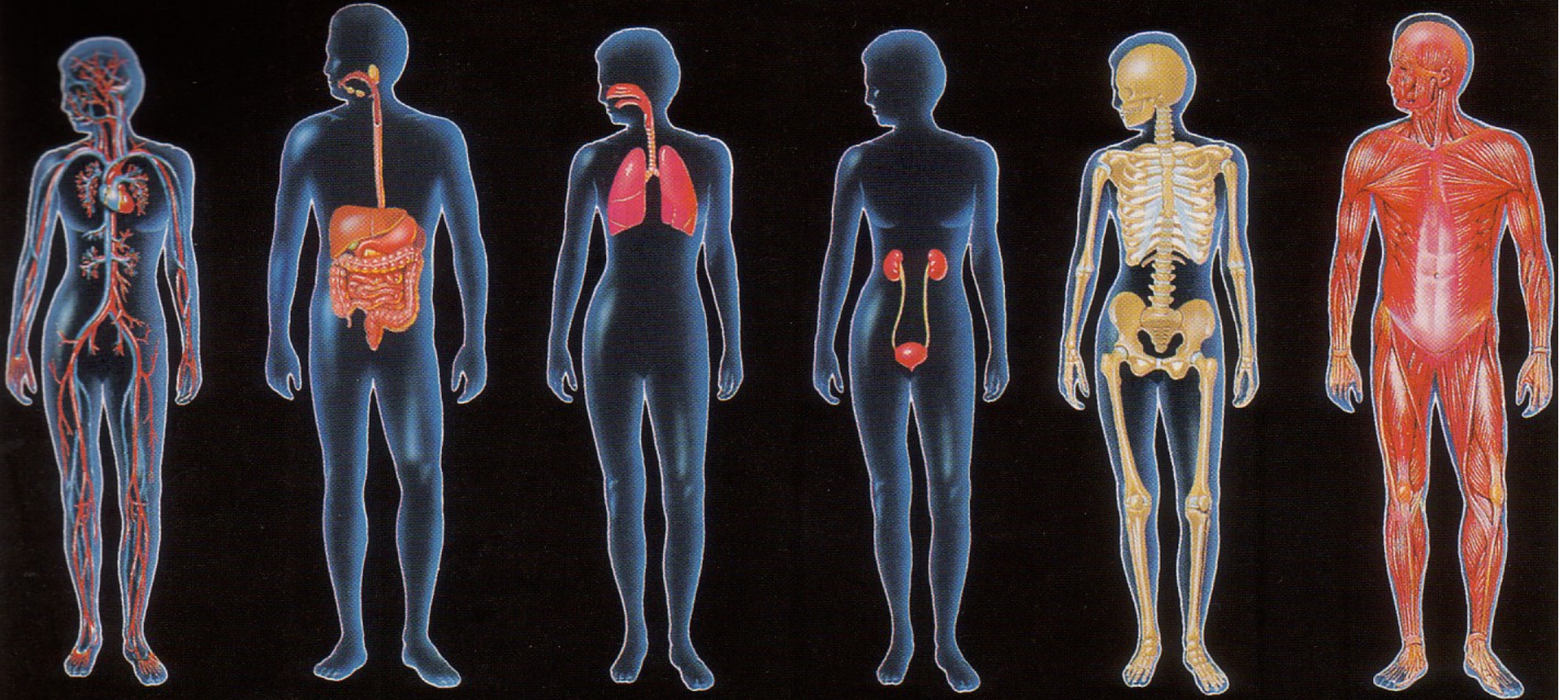


(b) Endocrine gland

Organs are made up ≥ 2 tissue types



Which body systems?



BI 121 Lecture 2

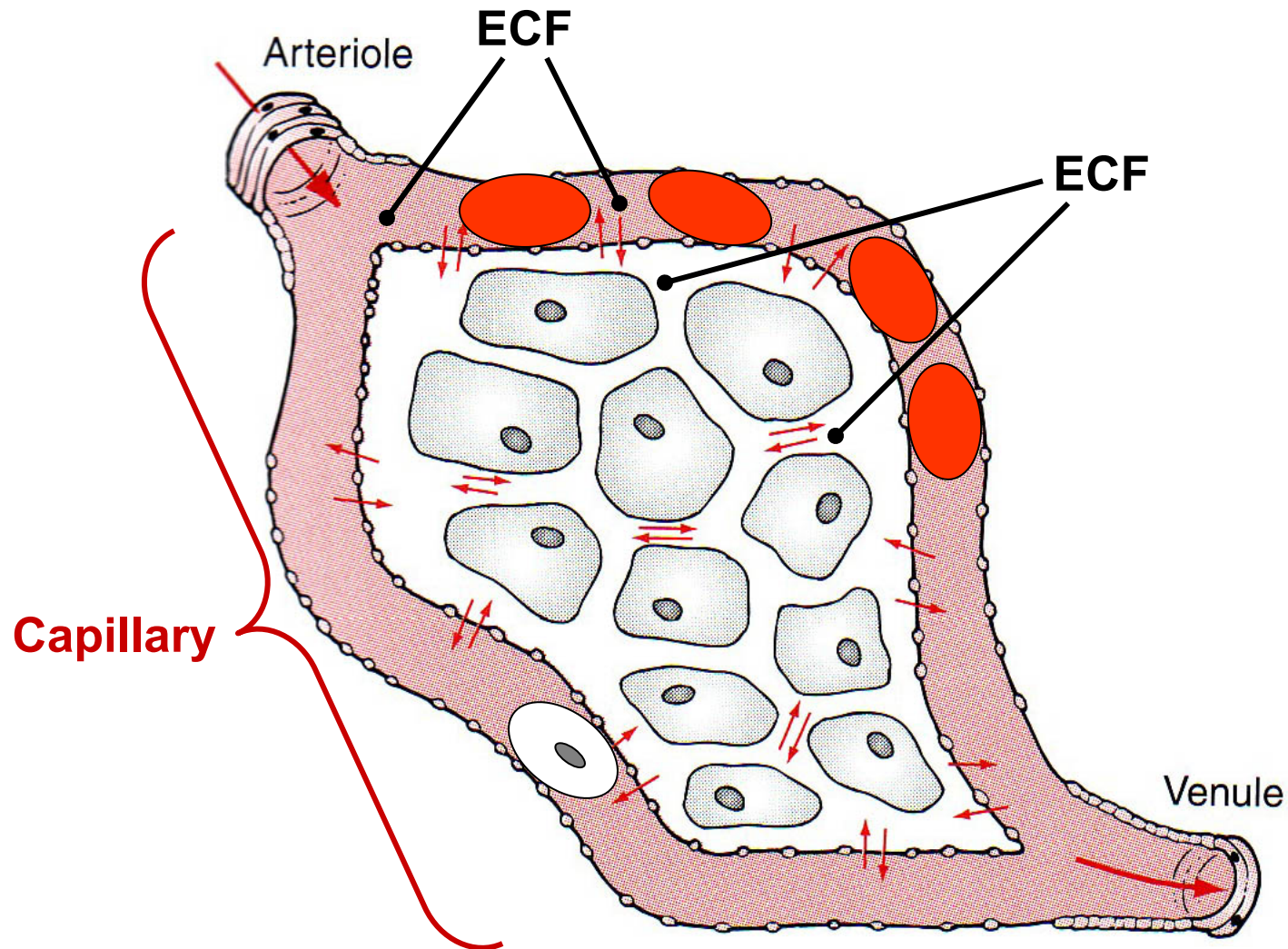


...Histology exploratory fun!!
Thanks for signing in!



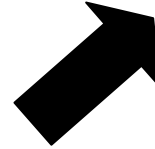
- I. Announcements Lab today 12 n & 1 pm. Q last time?
- II. Connections Extracellular fluid (ECF) & Homeostasis
 - A. ECF: Plasma vs. Interstitium?
 - B. Dr Evonuk Balances LS pp 5 - 15
 - C. Physiology in the News Are we like watermelons?
 - D. Simplified Model DO Norris *cf*: fig 1- 8 LS
 - E. Negative feedback? Positive feedback? LS pp 14 - 15
 - F. Balances & e.g. H₂O, T°C, BP Dr Evonuk + LS pp 8 - 10
- III. Cell Anatomy, Physiology & Compartmentalization ch 2 (LS)
 - A. How big? What boundaries? Why compartments? pp19-21
 - B. Basic survival skills ch 1 p 3
 - C. Organelles ≡ Membranous, cytoplasmic specialty shops!
 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
 - D. Physiol News Moms eggs execute Dad's mitochondria?
 - E. What about vaults? LS 2006, p 32 + *Science News*

Where is extracellular fluid?

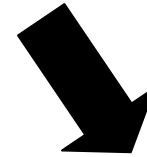


As long as between/outside cells, ECF everywhere?

ECF = Extracellular



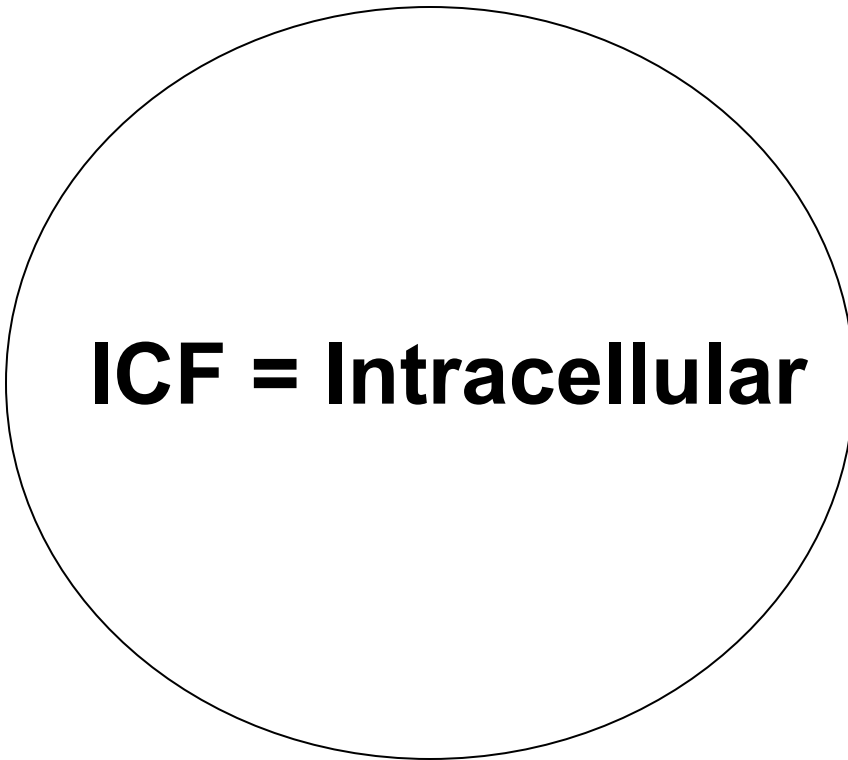
Plasma
(within CV System)



Interstitial

(eg, between
muscle cells)

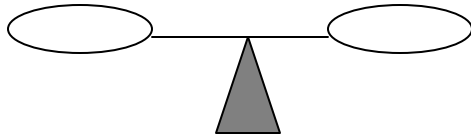
ICF = Intracellular



Metabolic

ANA-

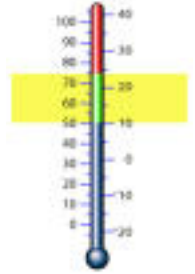
CATA-



H₂O

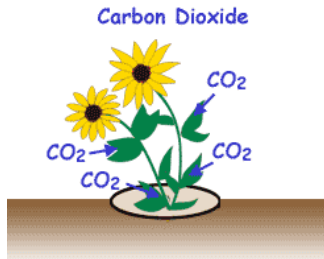


ToC



Dr. Evonuk's 6 Balances

O₂/CO₂

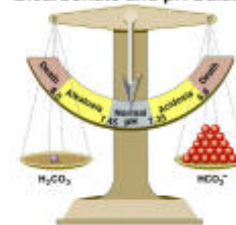


Ion^{+/-}



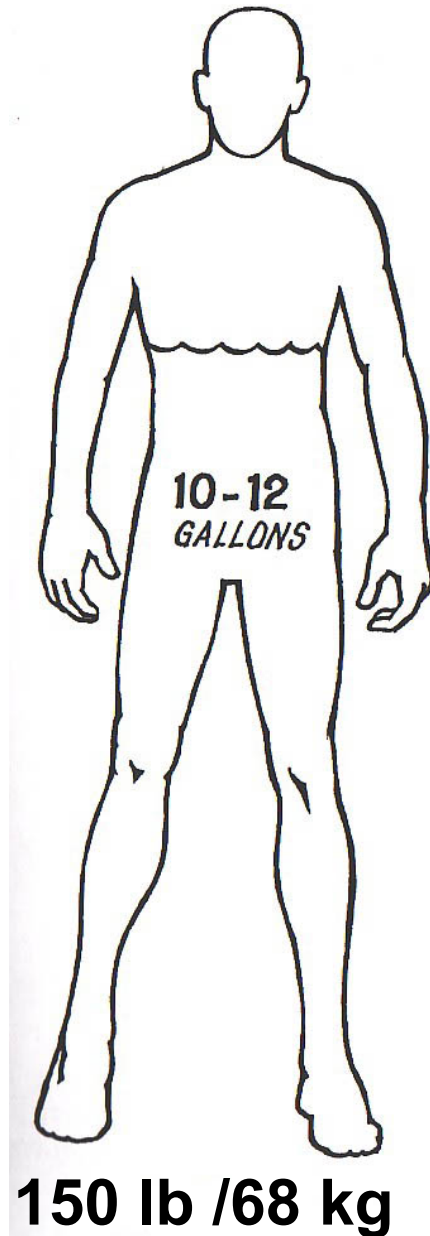
pH

Bicarbonate and pH Balance



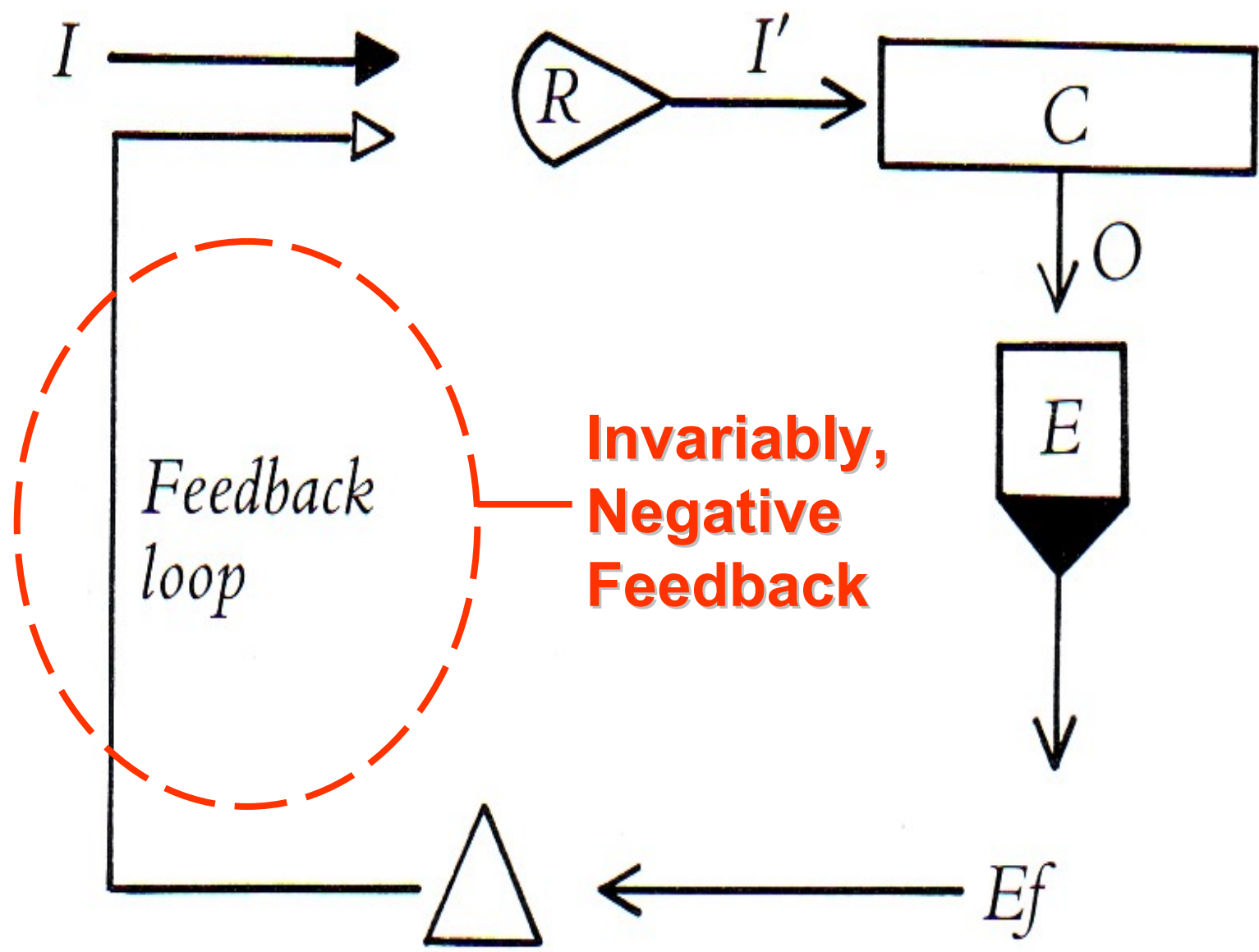
Drink about 1 L per 1000 calories energy expenditure!!

Human ~ 2/3 H₂O
~ 60 – 70 %



**NB: So 2000 kcal →
drink 2000 mL
≡ 67.63 fl oz
≡ ~ 8 cups!**

= ~40 – 48 kg H₂O



NB: Though most often **negative** feedback, there are exceptions:

Selected +FB eg:

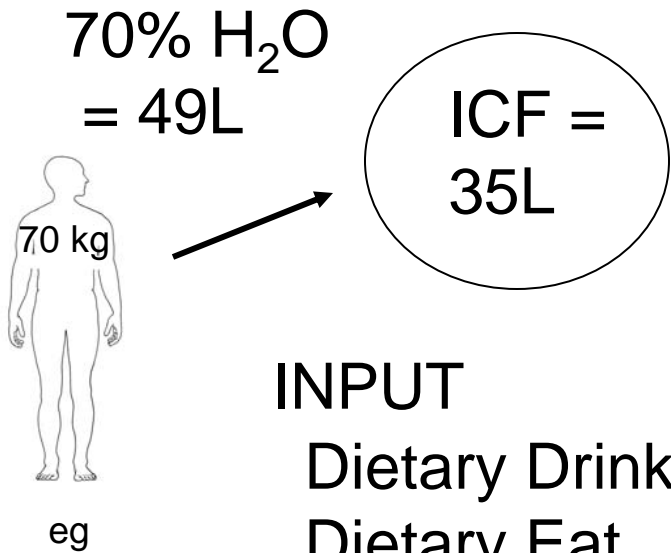
LH Surge + Ovulation

Oxytocin + Uterine Contraction

Blood Clotting Cascade

cAMP Cascade

Na⁺ influx during AP



+ ECF = 14L

[Interstitium = 11L
Plasma = 3L]

INPUT

Dietary Drink	1200 mL
Dietary Eat	400 mL
Oxidation	400 mL

Total = 2000 mL ✓

H₂O

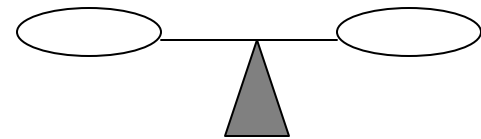


BALANCE!

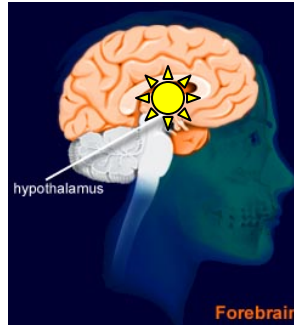
OUTPUT

Urine	1000 mL
Sweat + Insensible	900 mL
Feces	100 mL

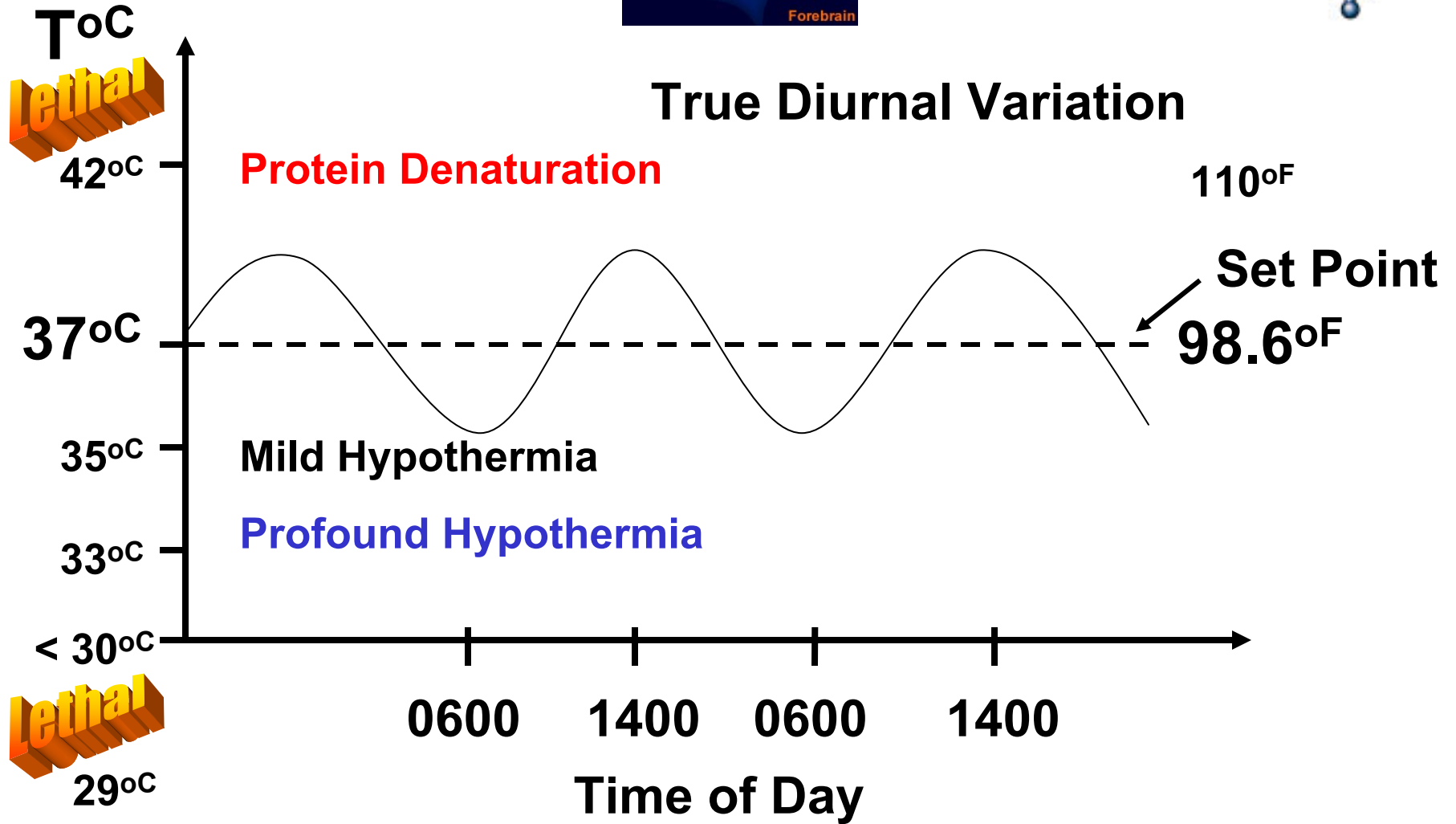
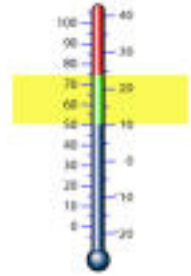
Total = 2000 mL ✓

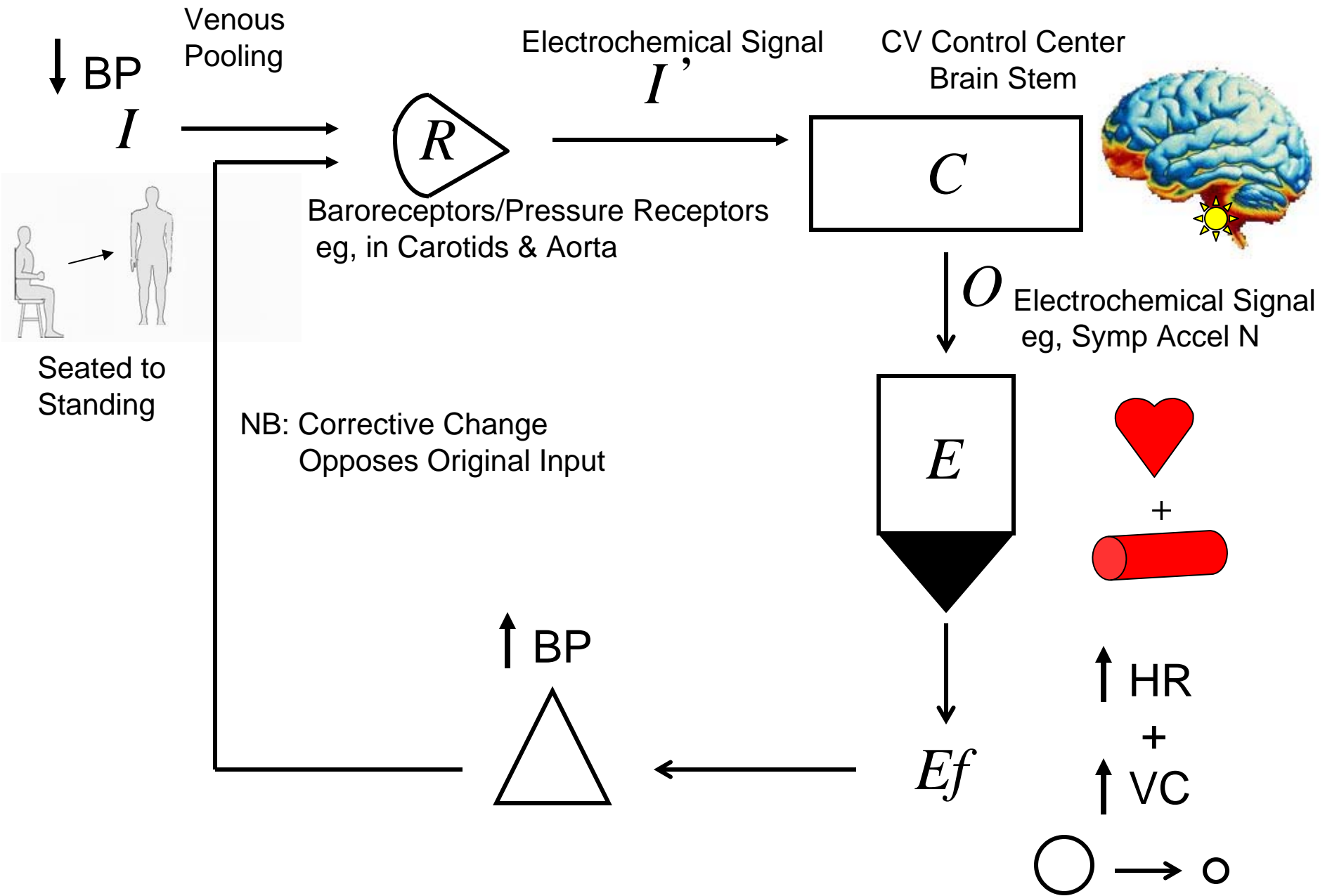


Controller =
Hypothalamus
with Set Point



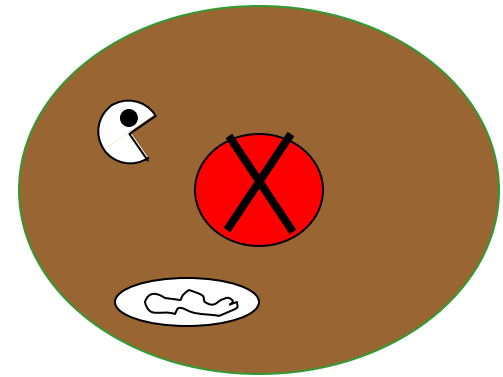
T_oC





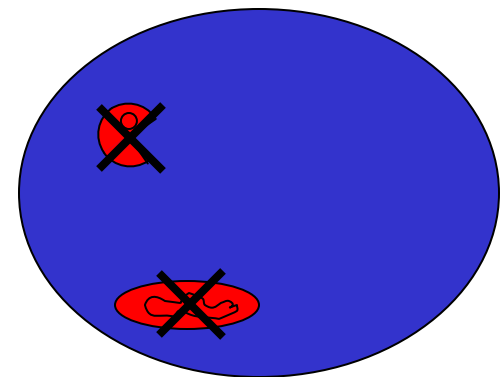
Cytoplasm = Cell - Nucleus

[Extract nucleus; includes organelles]



Cytosol = Cytoplasm - Organelles

[Extract organelles; complex gel-liquid]



BI 121 Lecture 3 **Anatomy & Physiology Lab tomorrow!...**



I. Announcements Q from lecture or lab?

II. Cell Physiology Connections LS ch 2

A. Compartment advantage + Cell survival skills!

B. Organelles \equiv ICF specialty shops: 1. ER– rough & smooth
2. Golgi+ 3. Lysosomes 4. Peroxisomes 5. Mitochondria
pp 20-34, fig 2-1 thru 2-8, pp 20-7, tab 2-1 p 36

C. **Physiol News** Moms eggs execute Dad's mitochondria?

D. What about vaults? LS 2006, p 32 + *Science News*

III. Anaerobic vs Aerobic Metabolism Summary LS ch 2 pp 26-33

A. Key differences fig 2-15 + vpl

B. Selected details: Glycolysis, CAC, ETC, fig 2-9 thru 2-12

IV. Introduction to Genetics LS 2012 ch 2 p 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

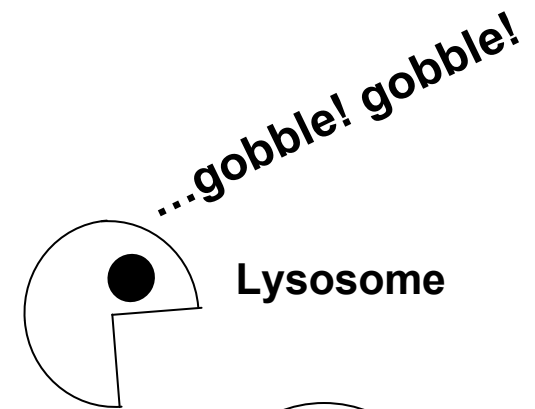
E. How does DNA differ from RNA? pp A-20 thru A-22

F. Genetic code? pp A-22, A-23

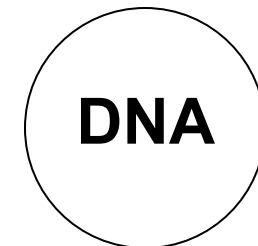
Why Compartments? Advantage?

**Incompatible reactions can
take place**

Simultaneously!!



Lysosome

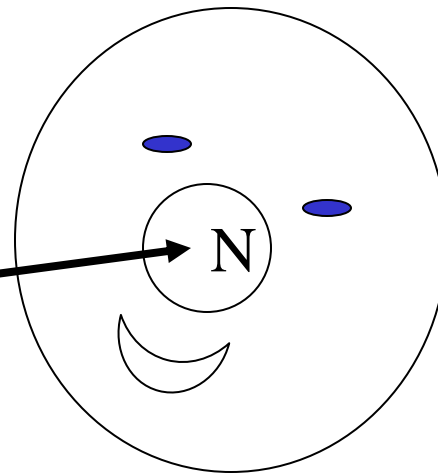


Nucleus

Basic Cell Survival Skills?

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

Nucleus or nose?



How to live?

**1 e.g. Cell of
100 Trillion!**

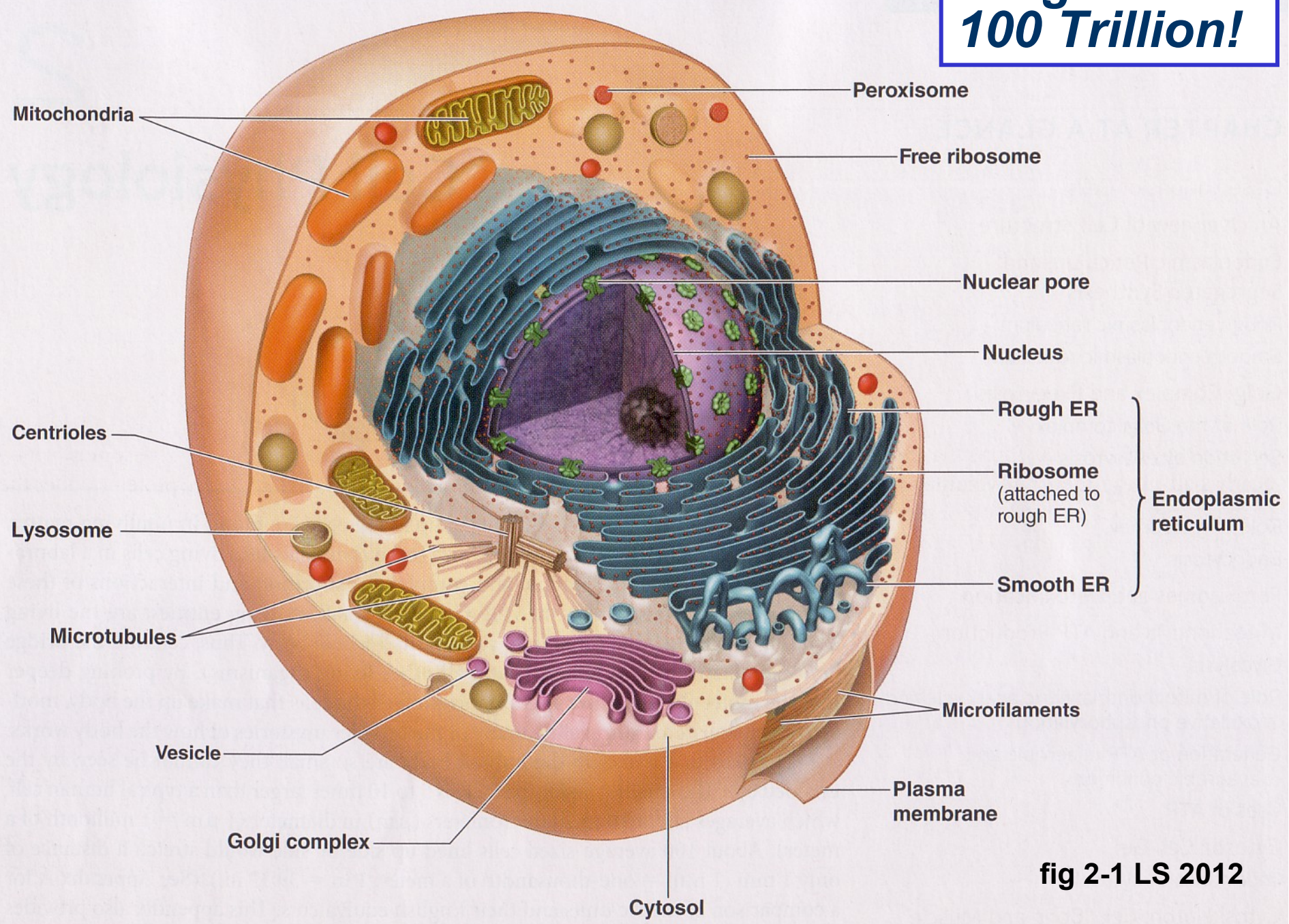


fig 2-1 LS 2012

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

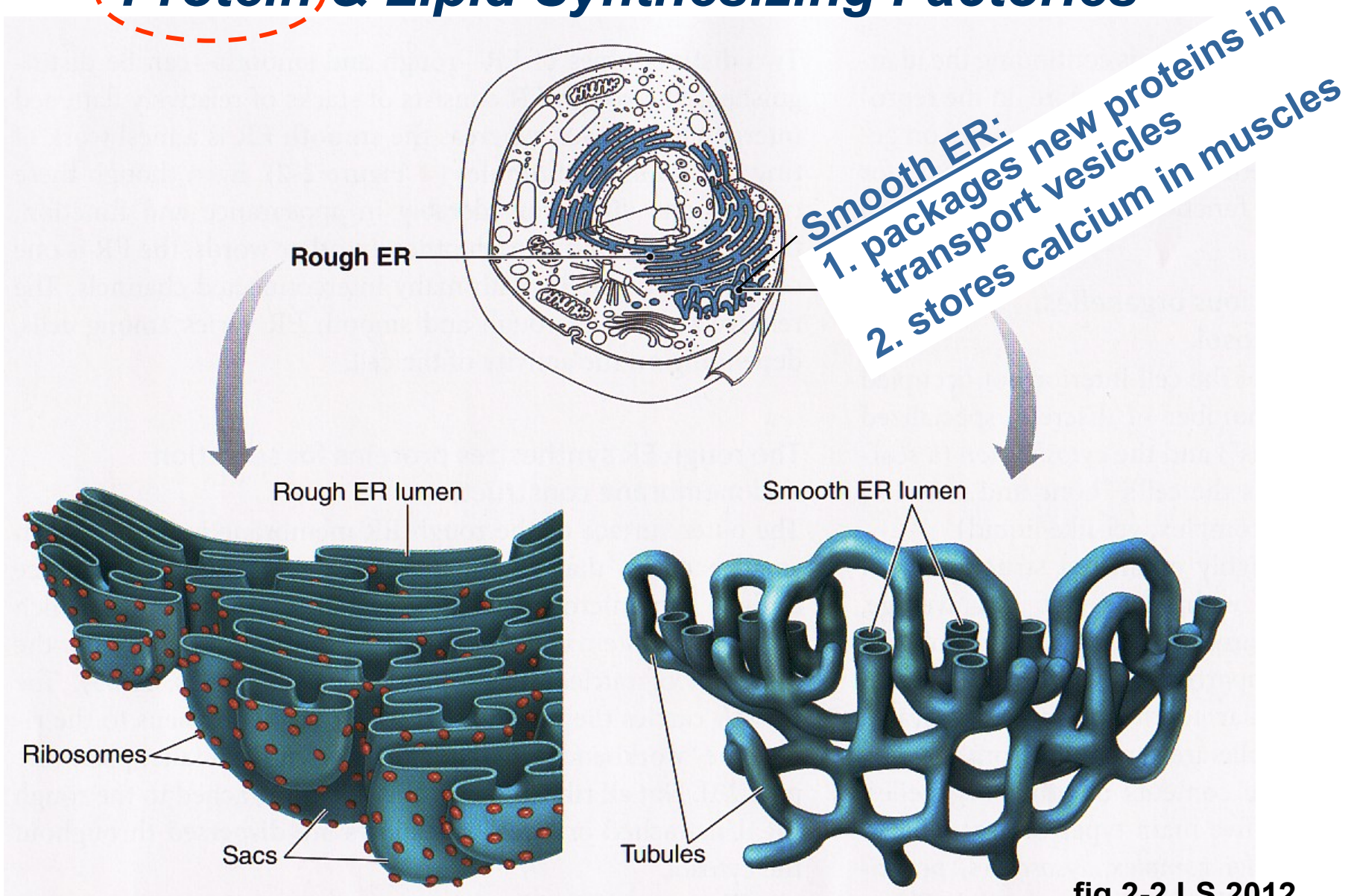


fig 2-2 LS 2012

Secretion of Proteins Produced by ER

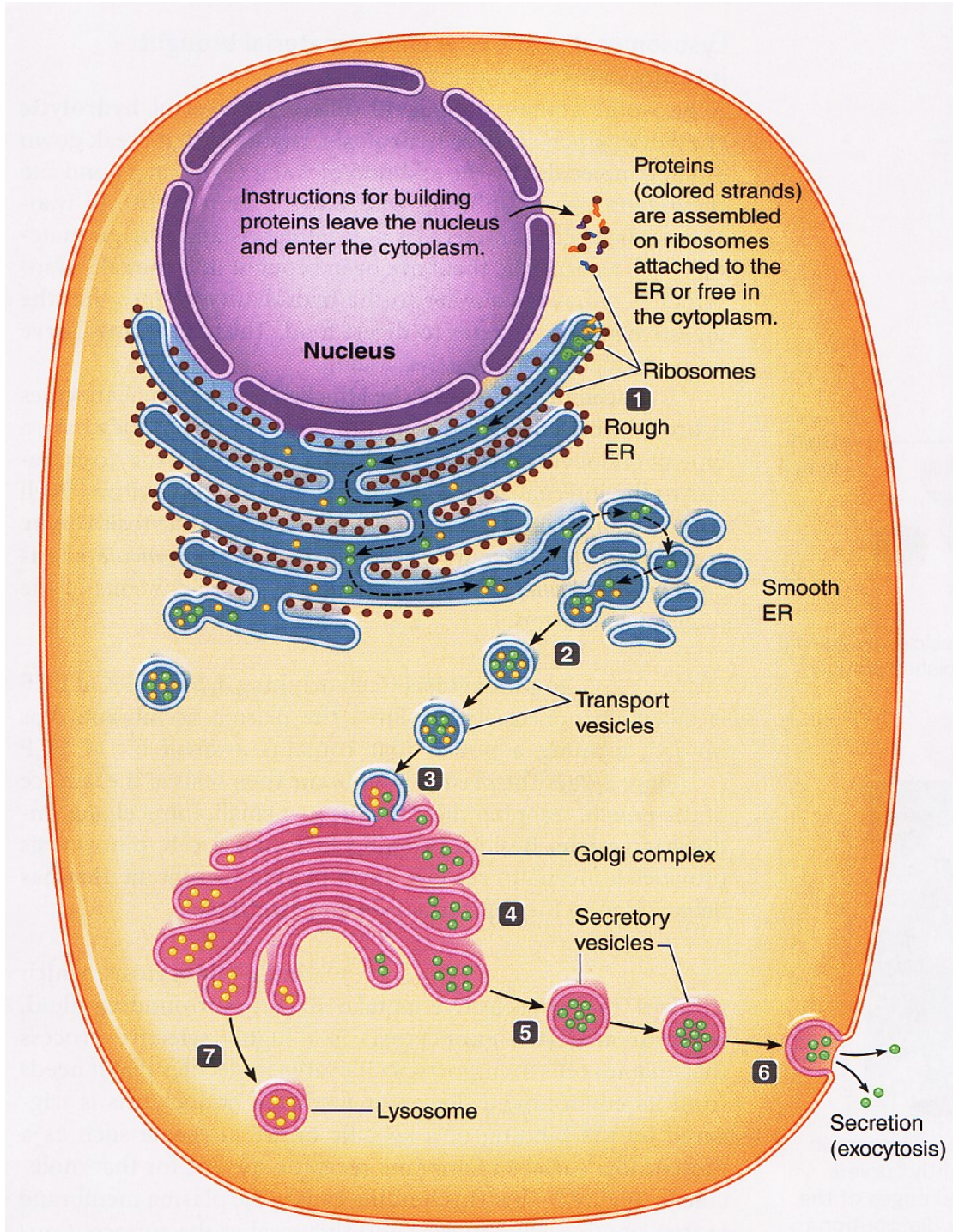
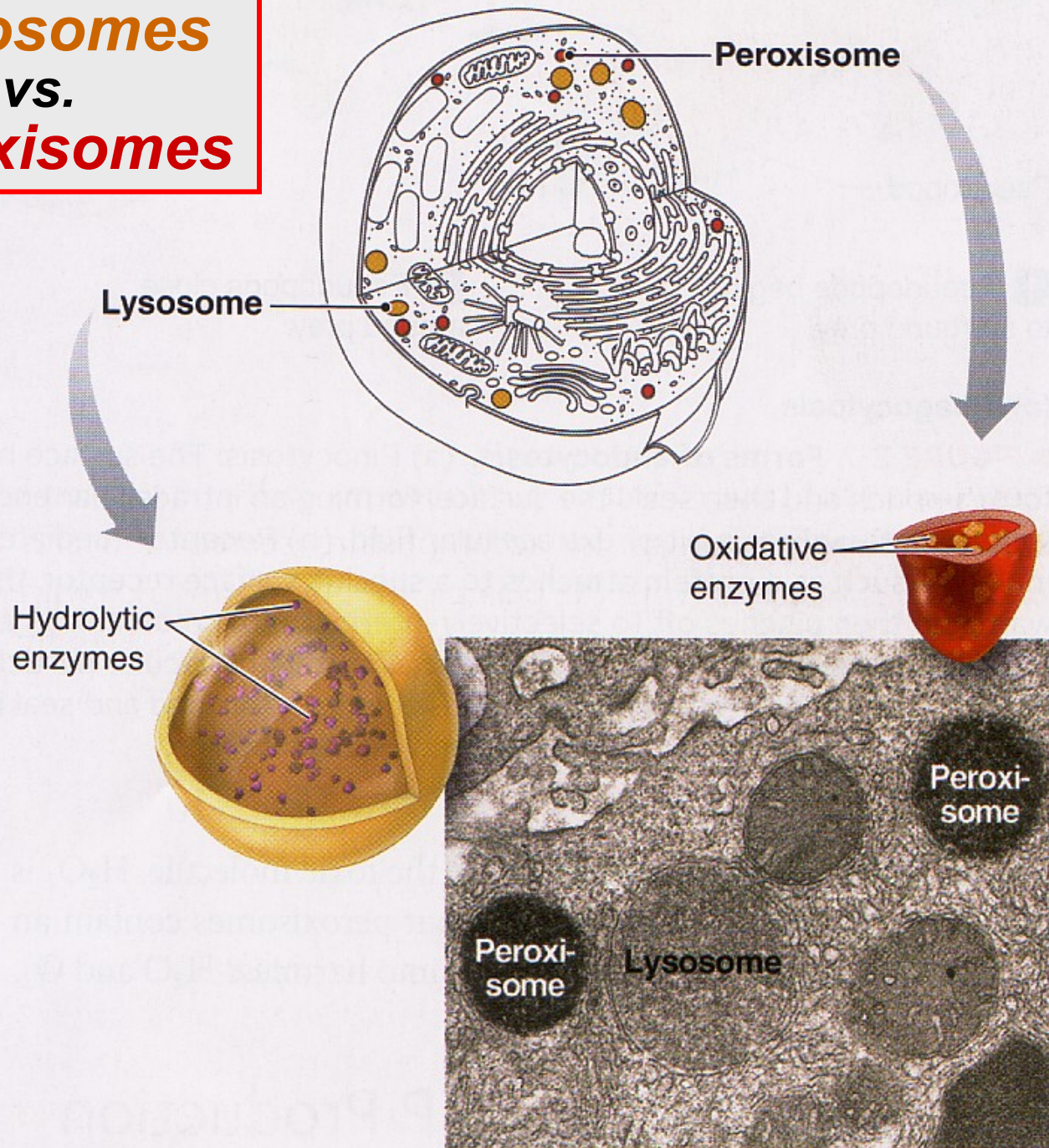


fig 2-3 LS 2012

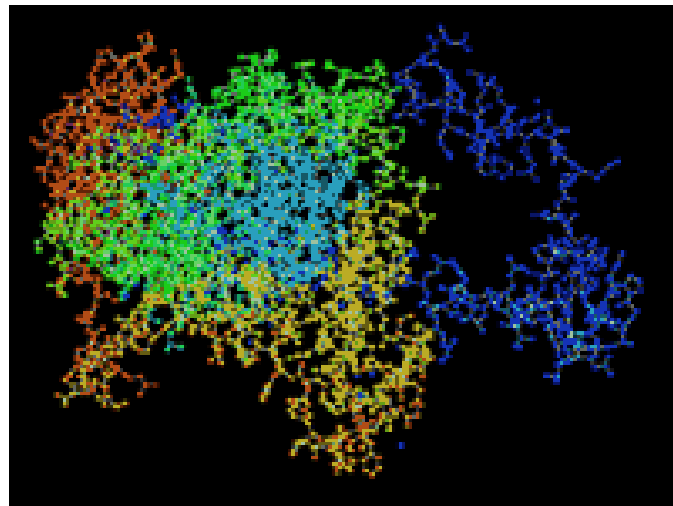
Lysosomes vs. Peroxisomes



© Don W. Fawcett/Photo Researchers, Inc.

fig 2-6 LS 2012

***Catalase Enzyme Reaction in Peroxisomes
Neutralize Toxin at Production Site!***



Mitochondria: Energy Organelles

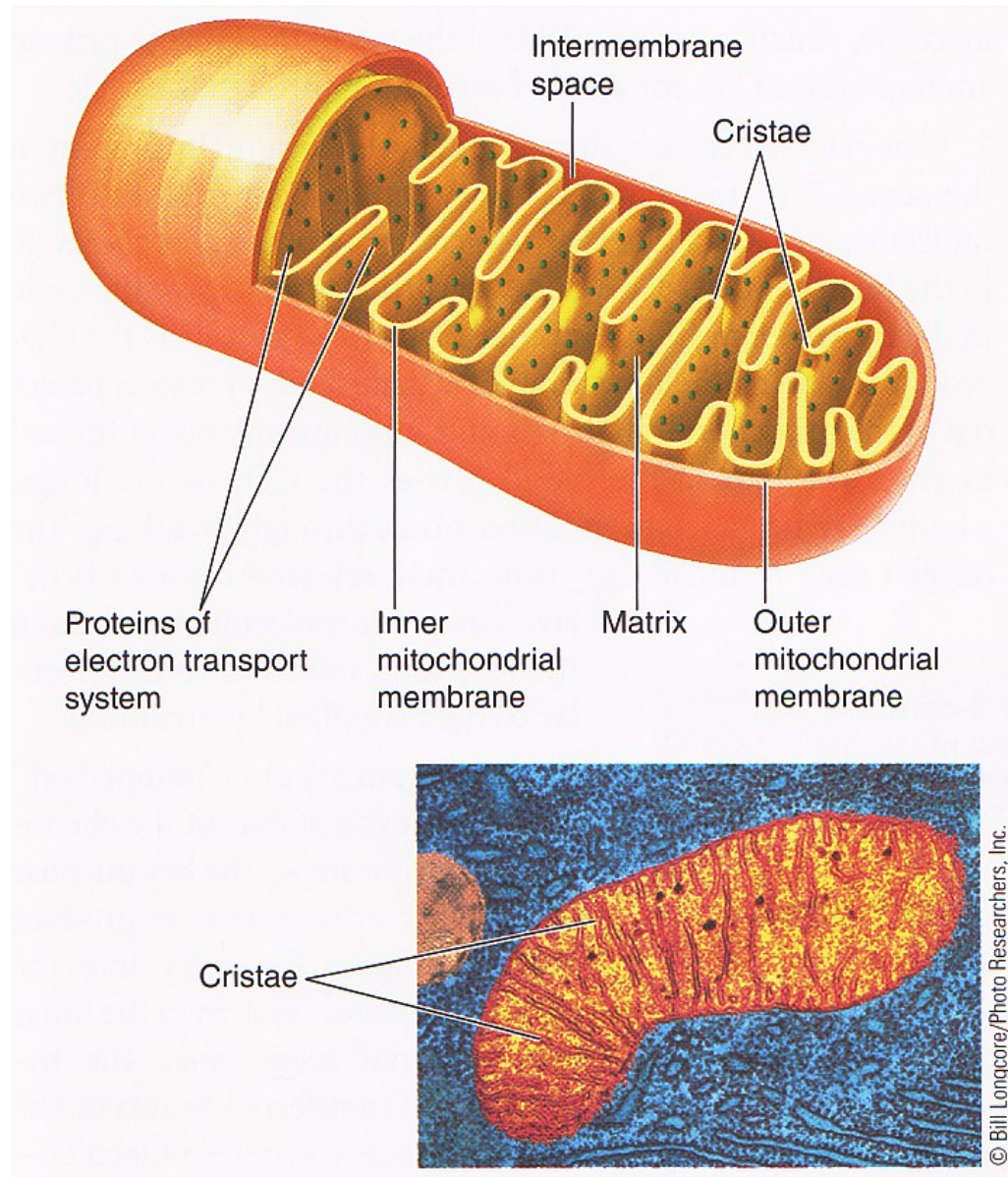


fig 2-8 LS 2012

Mom's eggs execute Dad's mitochondria

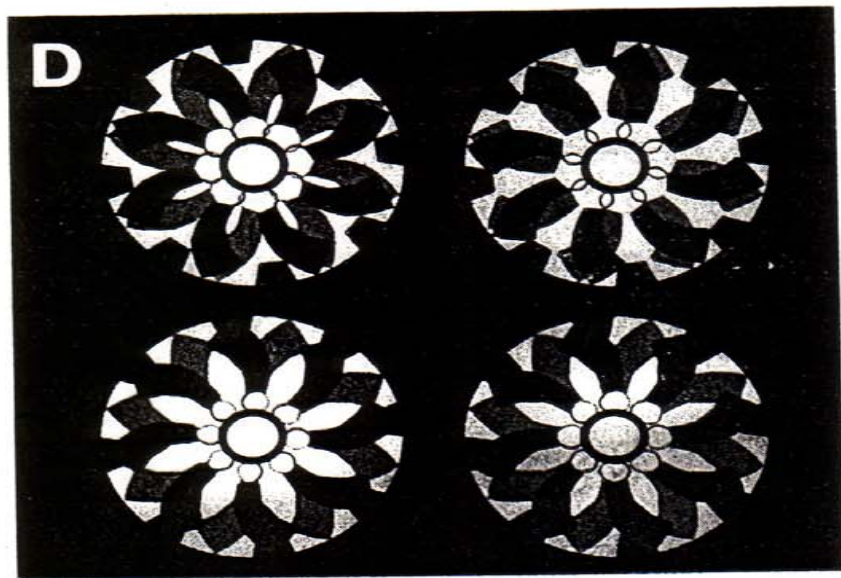
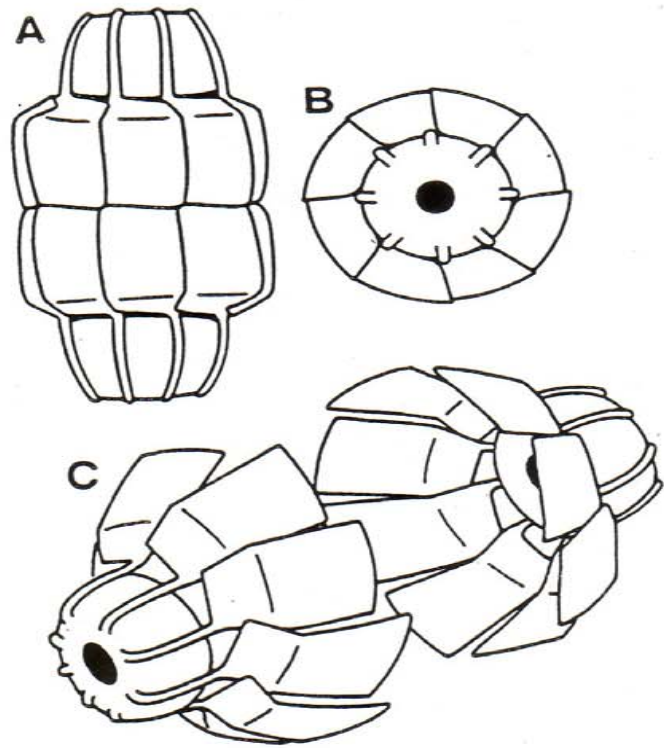
In "Hamlet," Rosencrantz and Guildenstern deliver a letter to the rulers of England that carries the ill-fated duo's own death sentence. Perhaps Shakespeare knew a bit about reproductive biology.

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 bio-

species 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.

SOURCE: John Travis, *Science News* 2000;157(1), 5.



AEROBIC

w/O₂

=

MITOCHONDRION

ANAEROBIC

without O₂

= CYTOSOL



1. Immediate/ATP-PC
2. Glycolysis

BI 121 Lecture 4

Anatomy & Physiology Lab today!...



- I. Announcements Nutrition Analysis Lab next Tuesday!**
Please record your diet on p 3-7 LM & begin analysis using <https://www.supertracker.usda.gov/> Estimating quantities. Q?
- II. Anaerobic & Aerobic Metabolism Connections LS ch 2 +**
- III. Introduction to Genetics LS 2012 ch 2 p 20-1 + Appendix C**
 - A. What's a gene? Where located? Why important?
p A-18, fig C-2, C-3
 - B. How does information flow in the cell? fig C-6
 - C. How does DNA differ from RNA? pp A-20 thru A-22
 - D. Genetic code? pp A-22, A-23
 - E. How & where are proteins made? fig C-7, C-9
 - F. Class skit: Making proteins @ ribosomes!
- IV. Nutrition Primer DC Module 2,Sizer & Whitney(S&W) Sci Lib**
 - A. Essential Nutrients: H₂O, 1^o Carbohydrates, 2^o Fats, 3^o Proteins, Vitamins, Minerals; Macro- vs Micro-?
 - B. Dietary Guidelines: USDA, AICR, Eat Like the **Rainbow!**
 - C. Diet or exercise? Diet composition & endurance? Fasting?
Zuti & Golding 1976; Sacks **AHA NPAM Council** 2009;
AMDR? Adjusted Macronutrient Distribution Range!
 - D. ***Nutrition Quackery, Balanced Approach*** Kleiner, Monaco+



Deck of Cards

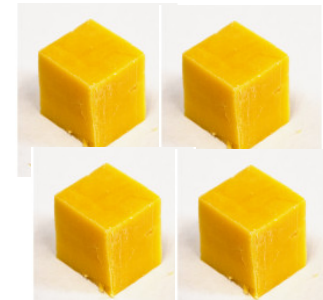


≡

4 oz → 3 oz



raw → cooked



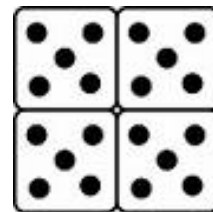
or



≡ 1 c



≡ 1/3 c



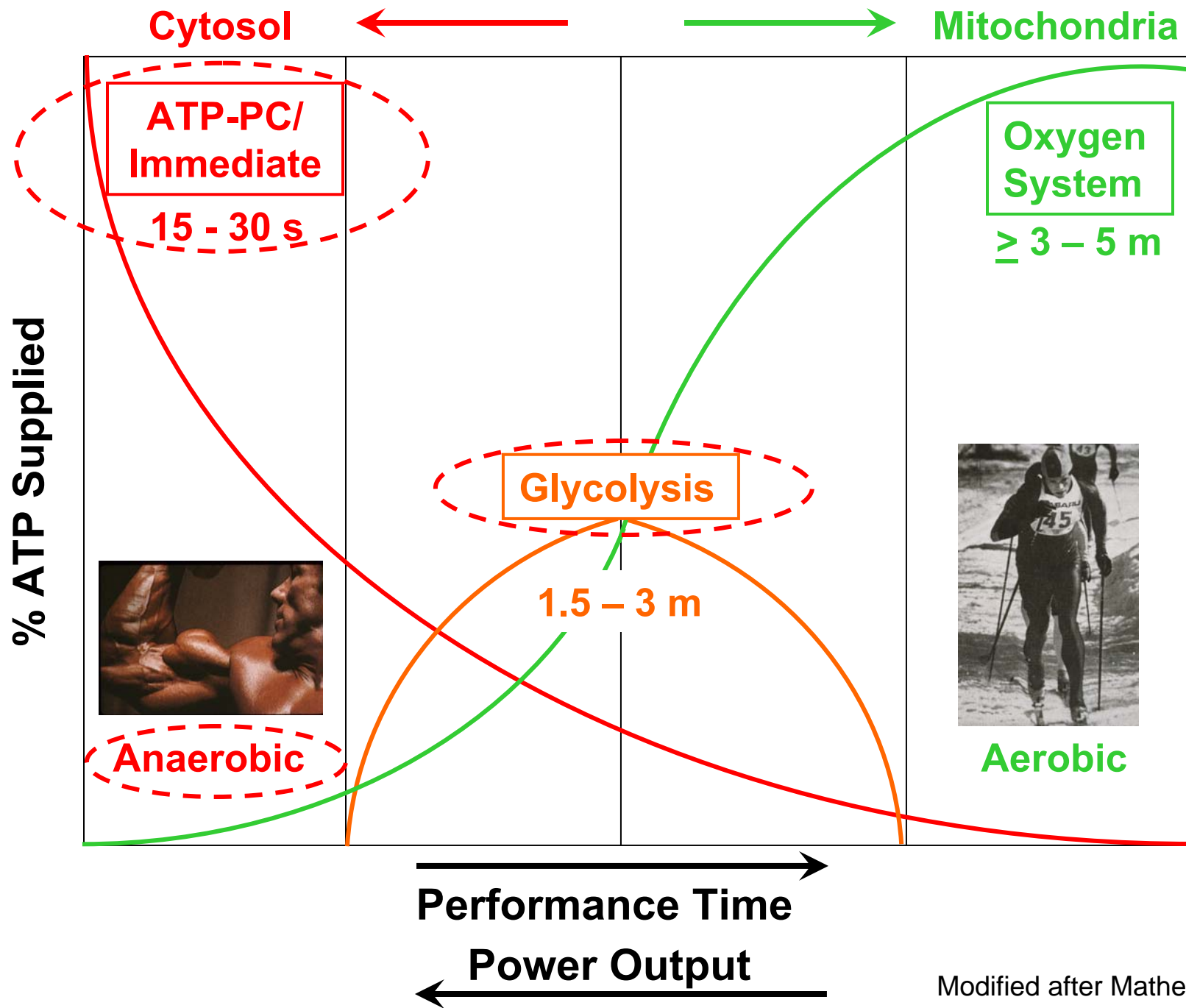
≡ 1 oz



≡ 1/4 c



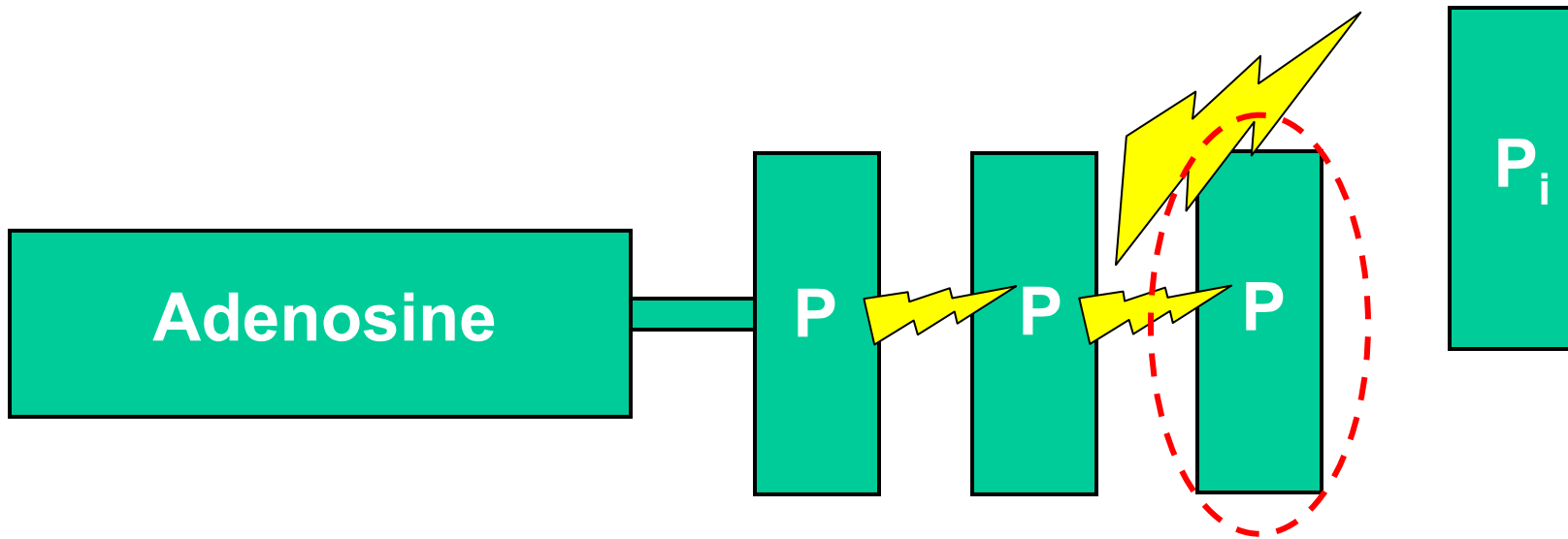
≡ 1.5 oz



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*

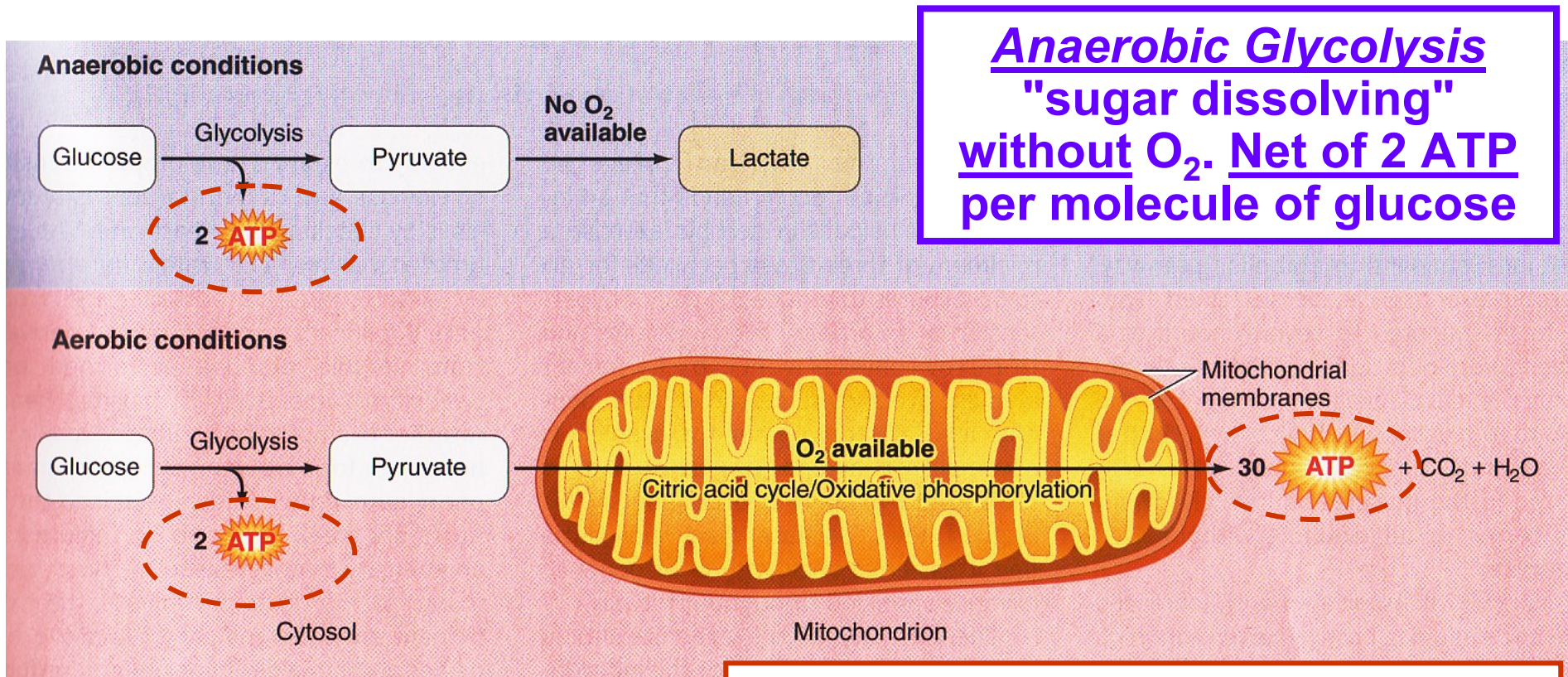
Move things!
Microscopic!

③ *Mechanical
Work*

Move things!
Macroscopic!



Anaerobic vs. Aerobic Metabolism



Anaerobic Glycolysis
"sugar dissolving"
without O₂. Net of 2 ATP
per molecule of glucose

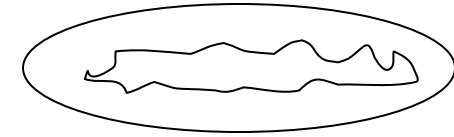
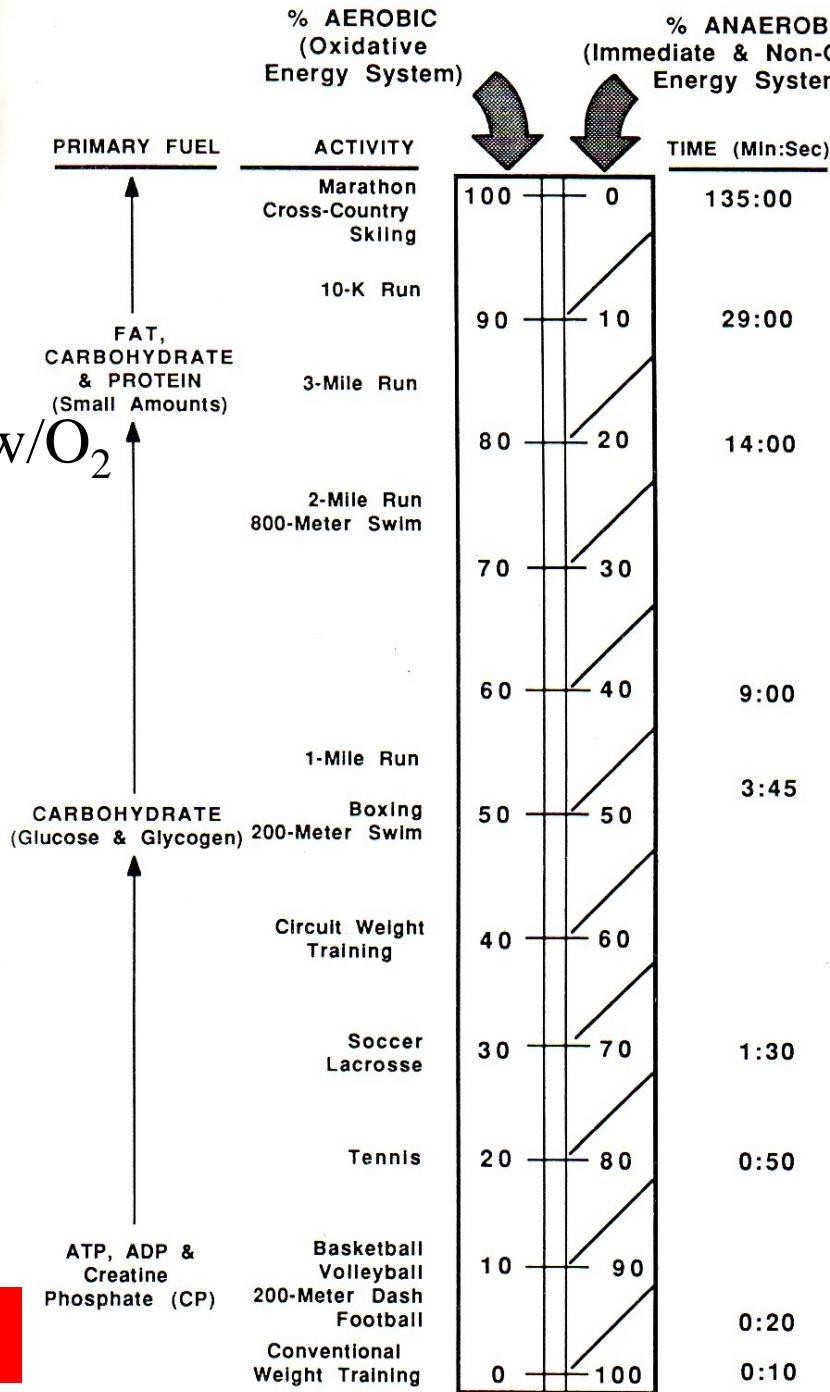
Aerobic Metabolism
+mitochondrial processing of
glucose with O₂. Net of 32 ATP
per molecule of glucose

fig 2-15 LS 2012



AEROBIC

w/O₂



MITOCHONDRIA

CYTOSOL

Glycolysis



Immediate/ATP-PC



ANAEROBIC

Stages of Cellular Metabolism/Respiration

**Anaerobic
Glycolysis
Cytosol**

**Aerobic
Metabolism
Mitochondria**

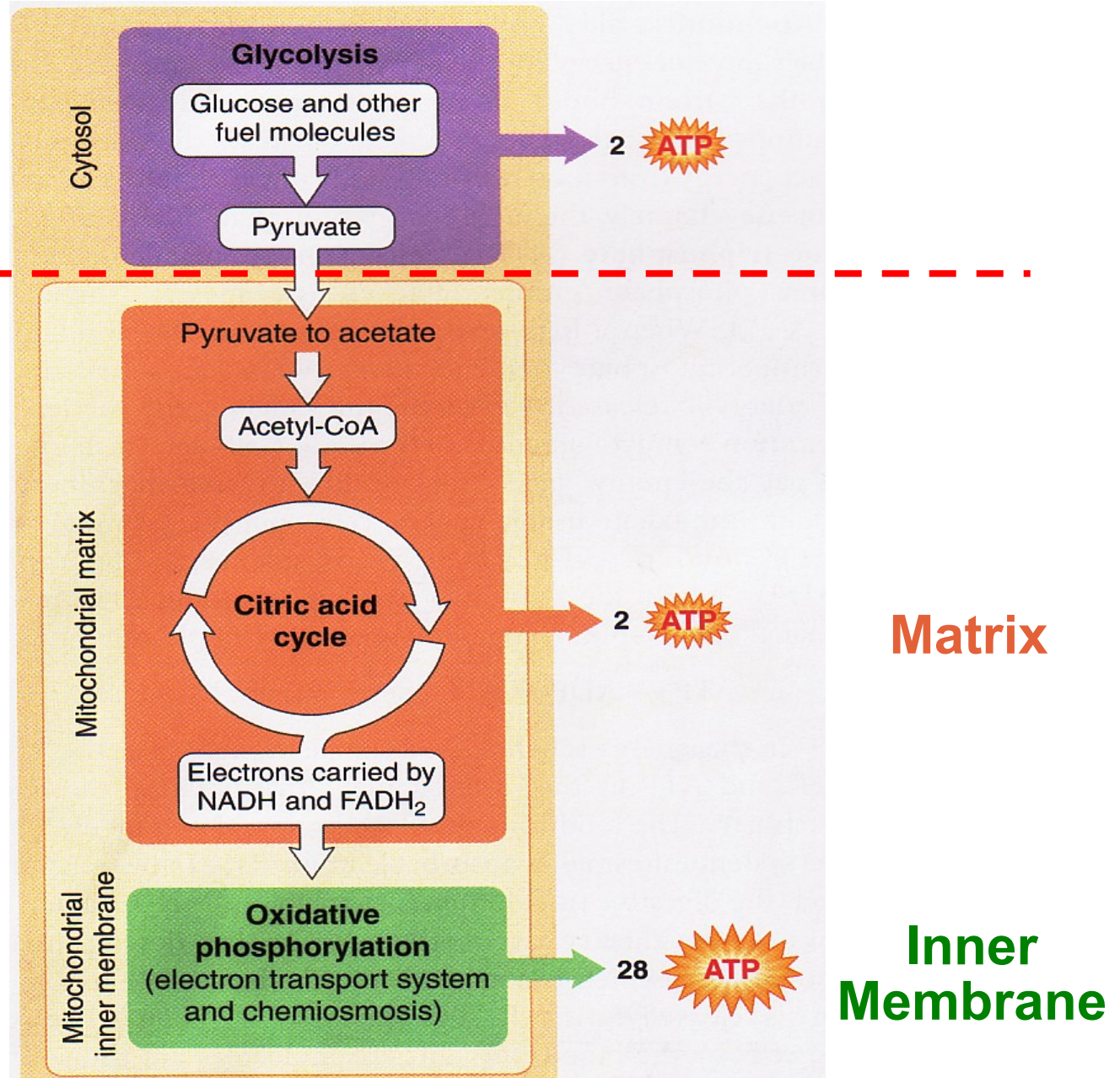
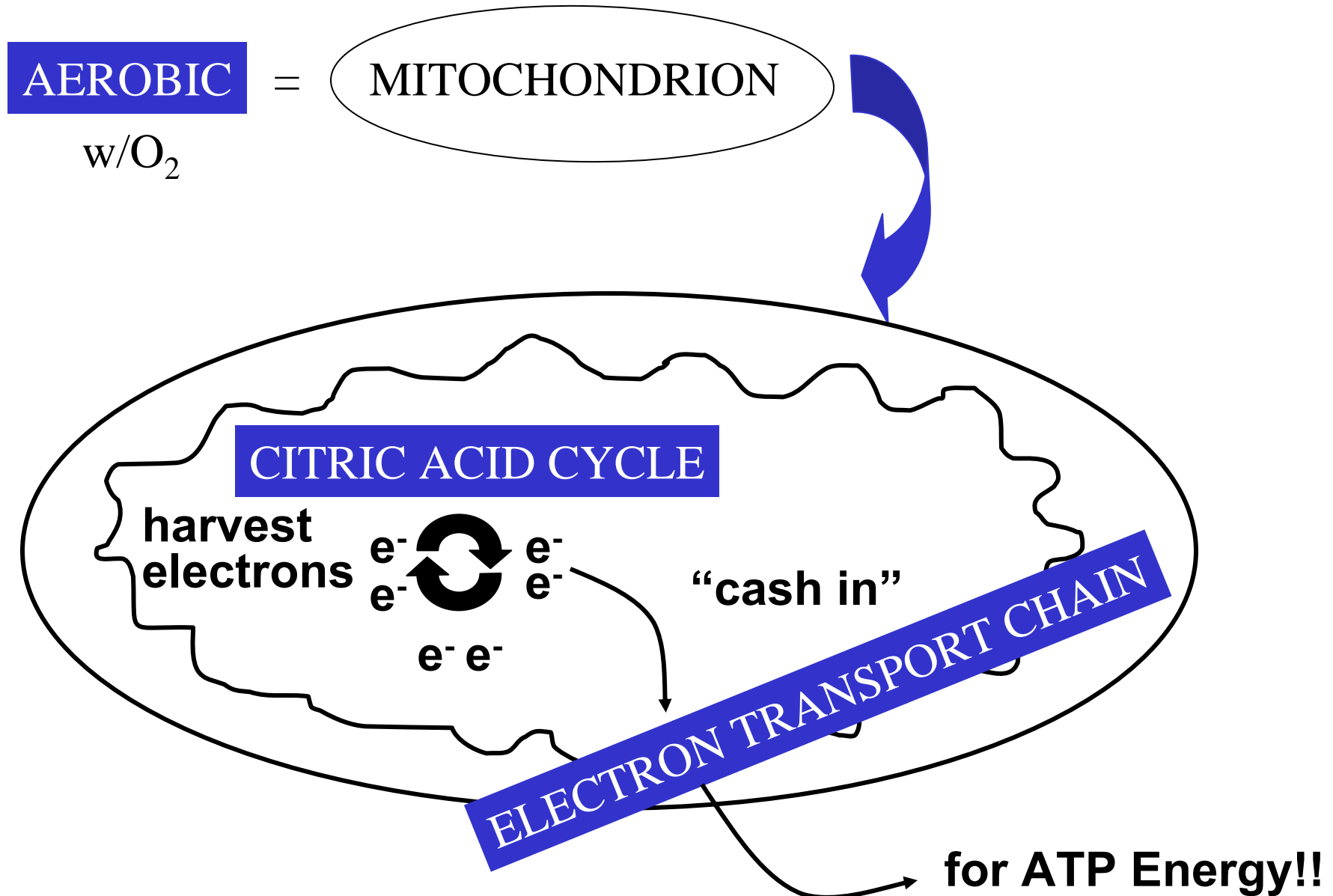


fig 2-9 LS 2012

Goals of Aerobic Metabolism



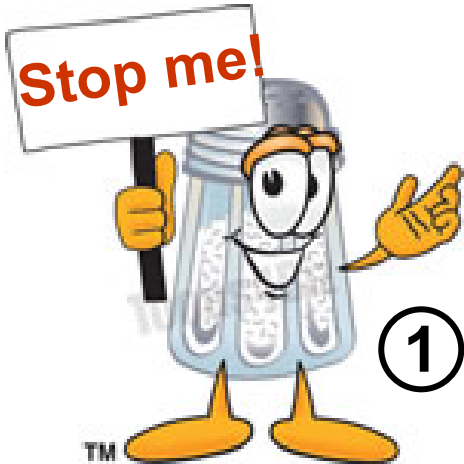
BI 121 Lecture 5

Yes, more fun!...



- I. Announcements Lab 3 tomorrow Nutritional Analyses. Thanks for recording dietary data on LM p 3-7 & exploring <https://www.supertracker.usda.gov/>. Sample MT Questions.
- 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**!
 - C. Diet or exercise? Diet composition & endurance? Fasting? Zuti & Golding 1976; Sacks AHA NPAM Council 2009; AMDR? Adjusted Macronutrient Distribution Range!
 - 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
 - E. Gut secretions: What? Where? Why? LS p 438, 440-1
 - F. Organ-by-organ review LS tab 15-1 pp 440-1 + DC fig 3-1

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.

③ May directly impair kidney function & ↑ risk of kidney stones.

④ GI cancer risk, inflammation?



I'm outta here!!



Macronutrients & Micronutrients Essential for Life

Macronutrients

H₂O/Water

✓ 1^o Carbohydrates

✓ 2^o Fats/Triglycerides/Lipids

✓ 3^o 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

NB: Need only minute quantities!

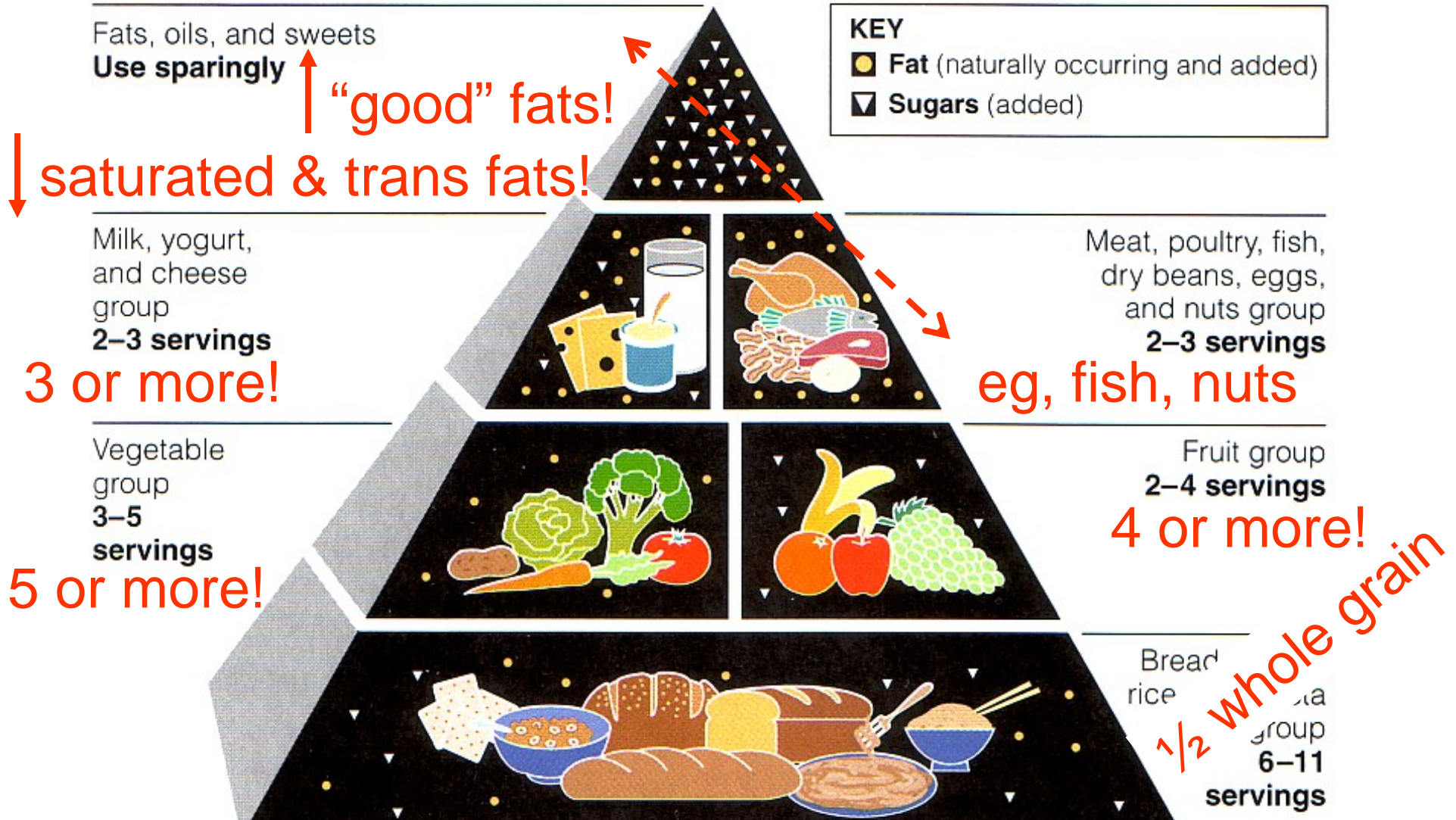
Vegetables, vegetable oils,
fruits, citrus, grains, dairy

Fruits, vegetables, grains,
nuts, dairy, meats,
processed foods

✓ **Energy nutrients = yield ATP**



US Modifications to 1992 Food Pyramid 2005



Regular Physical Activity: Exercise! Exercise!!

MyPlate launched June 2, 2011!

2. Focus on fruits.
Whole fruit preferable to juice, but any fruit counts!
Fill $\frac{1}{2}$ your plate with fruits & vegetables!



3. Make at least $\frac{1}{2}$ of your grains whole grains!

5. Get your calcium-rich foods. Buy skim or 1% milk. Go easy on cheese!

1. Vary your veggies.
Fill $\frac{1}{2}$ your plate with fruits & vegetables!

4. Go lean with protein. Keep protein to $< \frac{1}{4}$ plate! Nuts, beans, peas, seeds, poultry, lean meat, seafood,...

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.**
- 6. Prepare & store food safely.**

And always, remember...

Do not smoke or use tobacco in any form.



American Institute for Cancer Research (AICR)

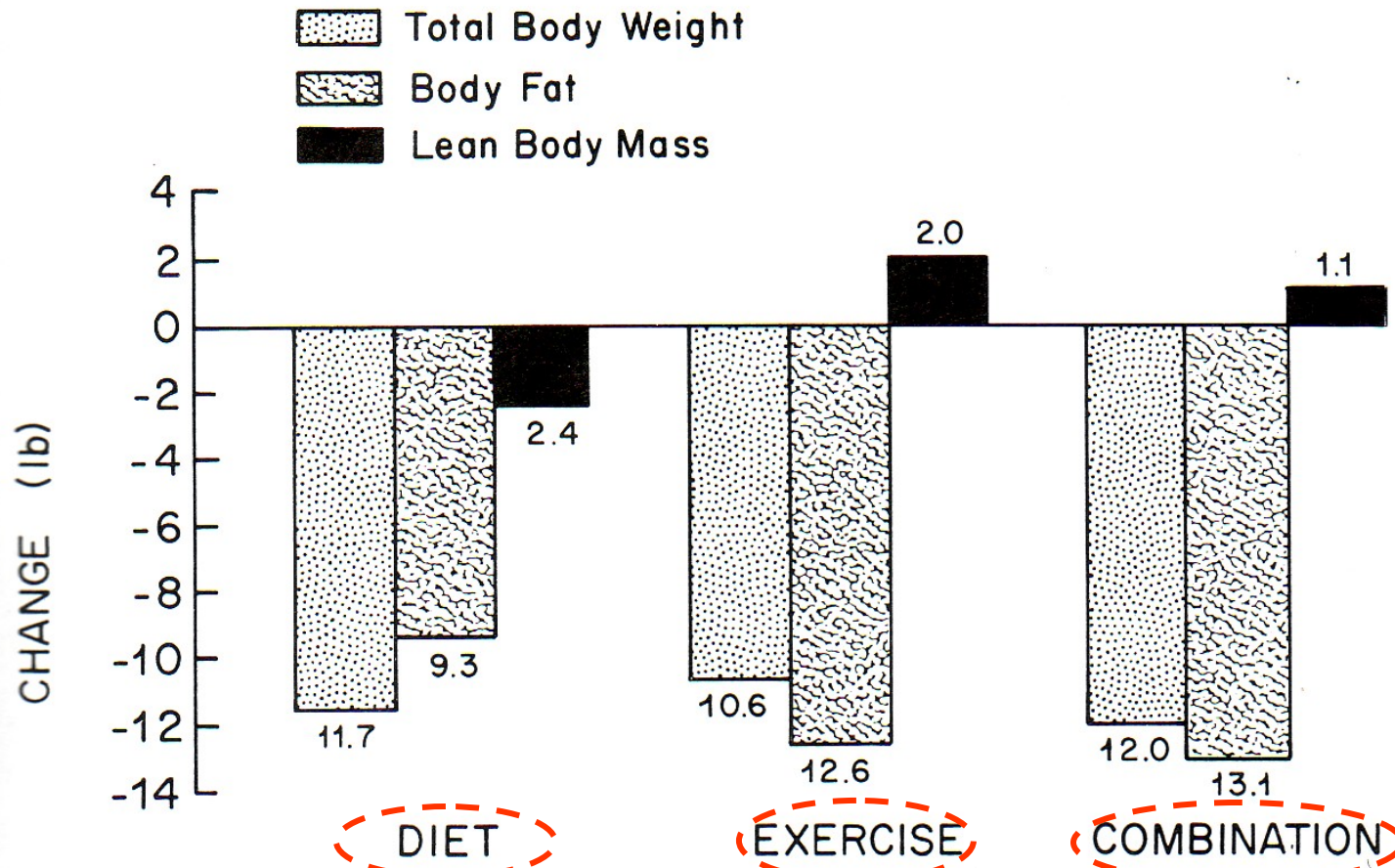
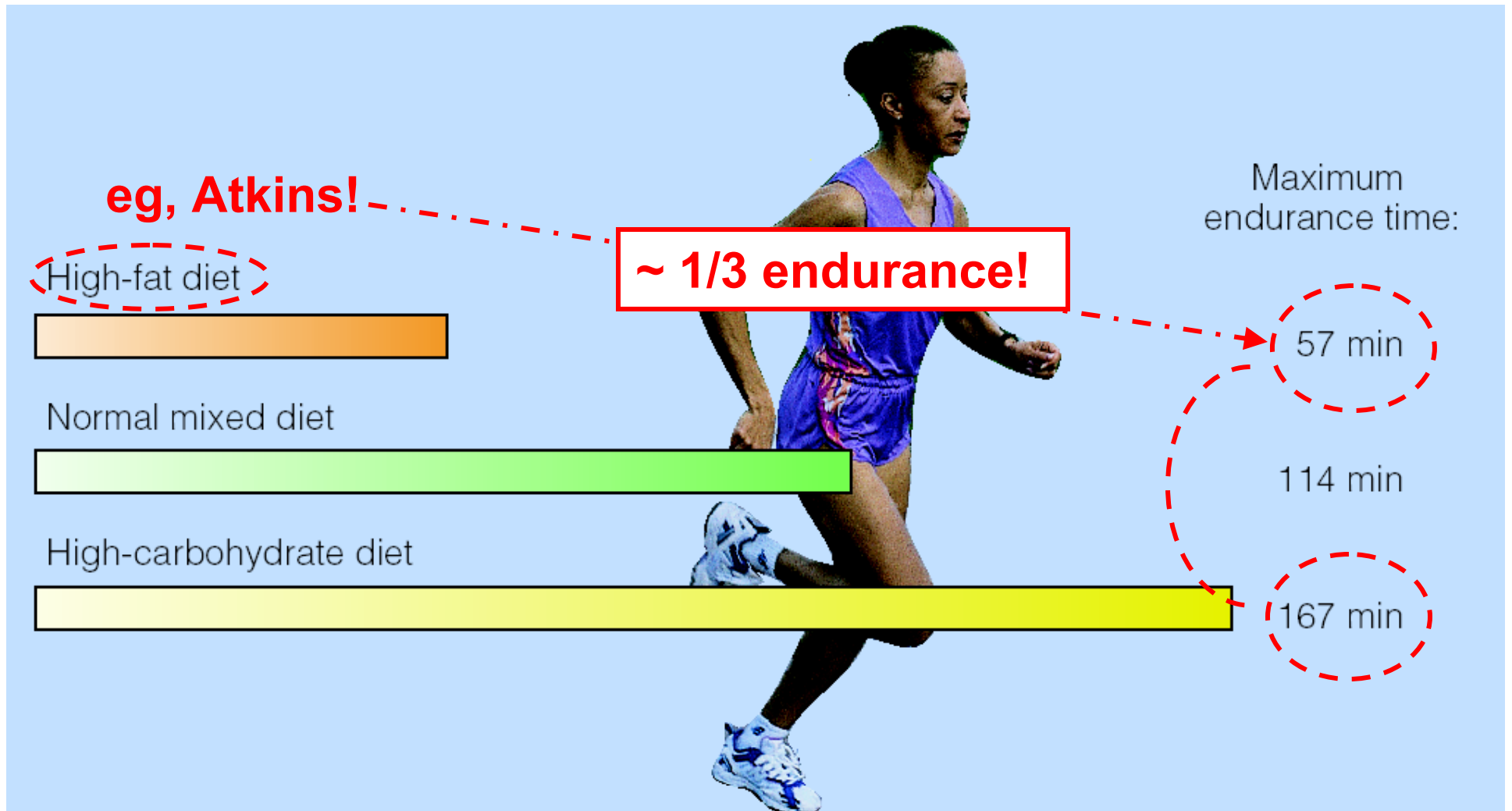


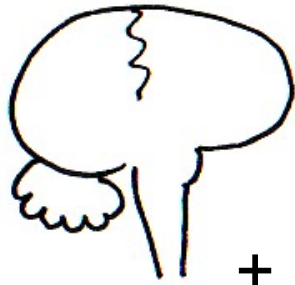
Figure 4-9. Changes in body weight, body fat, and lean body weight for diet, exercise, and combination groups. (From Zuti W. B., and Golding, L. A.: Comparing diet and exercise as weight reduction tools. *Phys. Sportsmed.* 4:49-53, 1976.)

NB: Each group 500 kcal deficit/day, 16 weeks

Dietary Composition & Physical Endurance

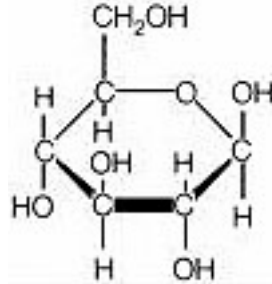


② cns



+

glucose

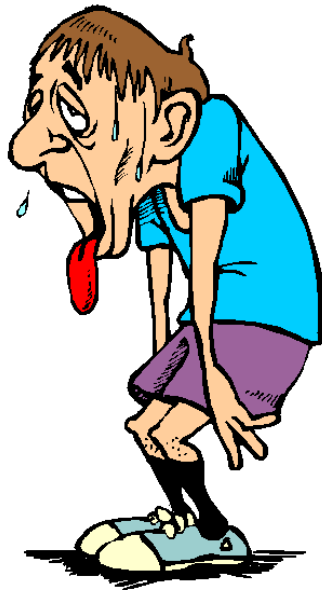


rbc's



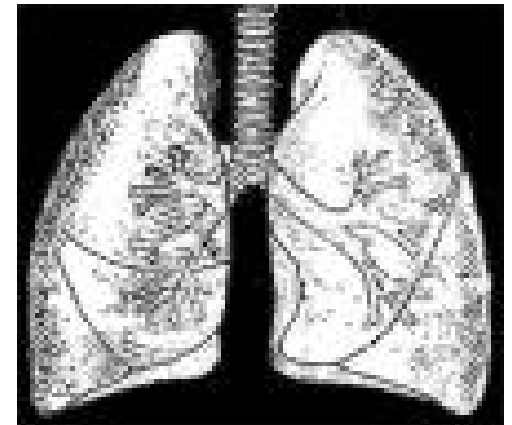
Negative Effects of Low Carbohydrate

①



- ① ↑ fatigue/exhaustion central & peripheral!
- ② ↓ glucose – brain+spinal cord, rbc's thrive upon.
- ③ ↓ variety which reduces intake of phytochemicals, vitamins, minerals & fiber.
- ④ ↑ risk of respiratory infections.

④



+ 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!!***

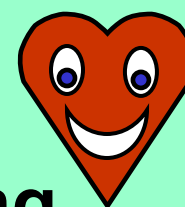
60-day Fast???

Lost 60 lb!! Wow!!

Yet

76.7% {
26 lb Water
20 lb Lean Body Mass
14 lb Fat

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



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)!***

<u>Energy Nutrient</u>	<u>% Total Calories</u>
Carbohydrate	45-65%
Fat	20-35%
Protein	10-35%

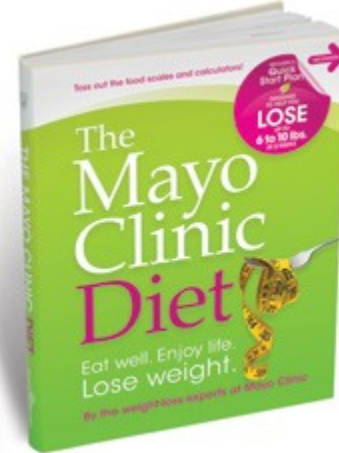
Kleiner's & Monaco's Top 10 Hit List for Nutrition Quackery

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** 



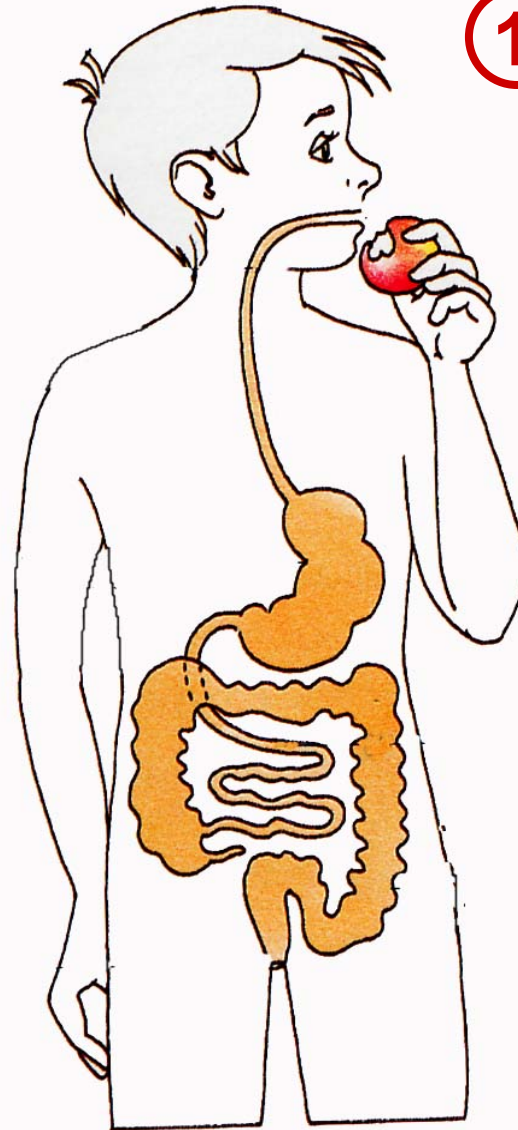
 **LOWER
CARBOHYDRATE**

**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

SOURCE: Dr. Eugene Evonuk, 1989. cf. L Sherwood, 2012 pp 437-8.

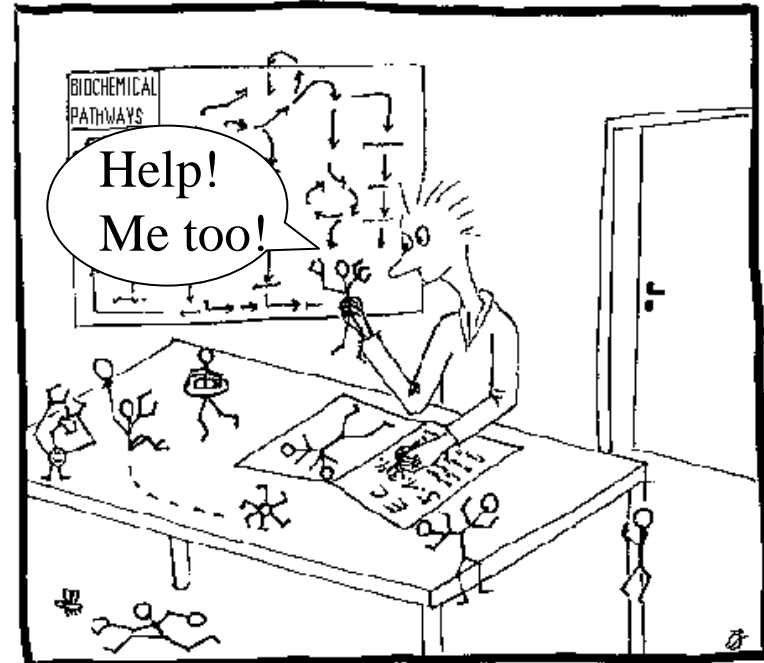
Hydrolysis of Energy Nutrients

Hi gang!!
You need me
for digestion!!



+

The ENZYME data bank



H₂O

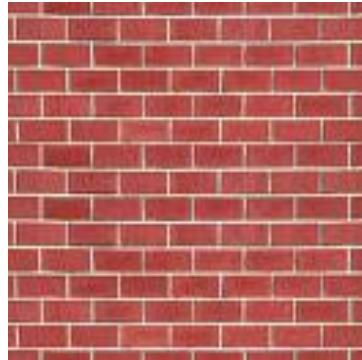
+

Enzyme

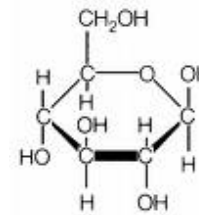
Polymer to Monomer (Many to One)



...Central-linking theme!!

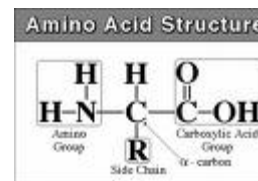


Carbohydrate

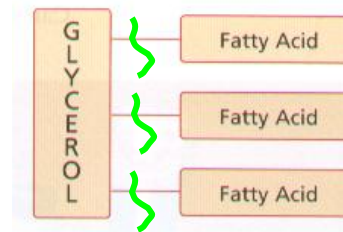


Glucose

Protein
+
Fat

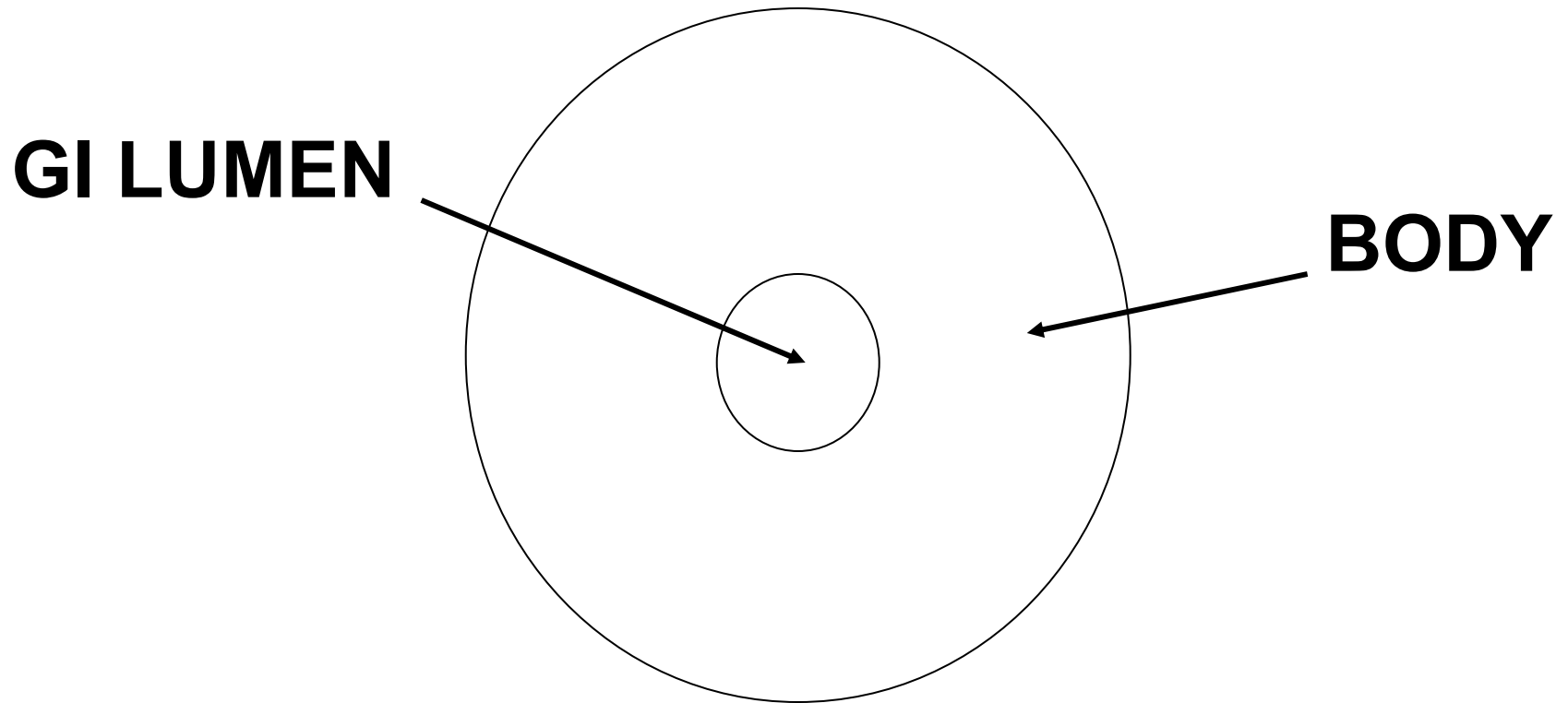


Amino Acids



Fatty Acids
+
Glycerol

GI-DONUT ANALOGY



Gut Secretions

Secretion

Release Site

1. Mucus

into GI Lumen

2. Enzymes

into GI Lumen

3. H₂O, acids, bases+

into GI Lumen

4. Hormones

into Blood

1. Mouth

Ingestion entry way
salivary gland secretion
mucus + enzymes
enzymatic digestion: carbohydrate
mastication = chewing
deglutition = swallowing

4. Liver-Gall Bladder

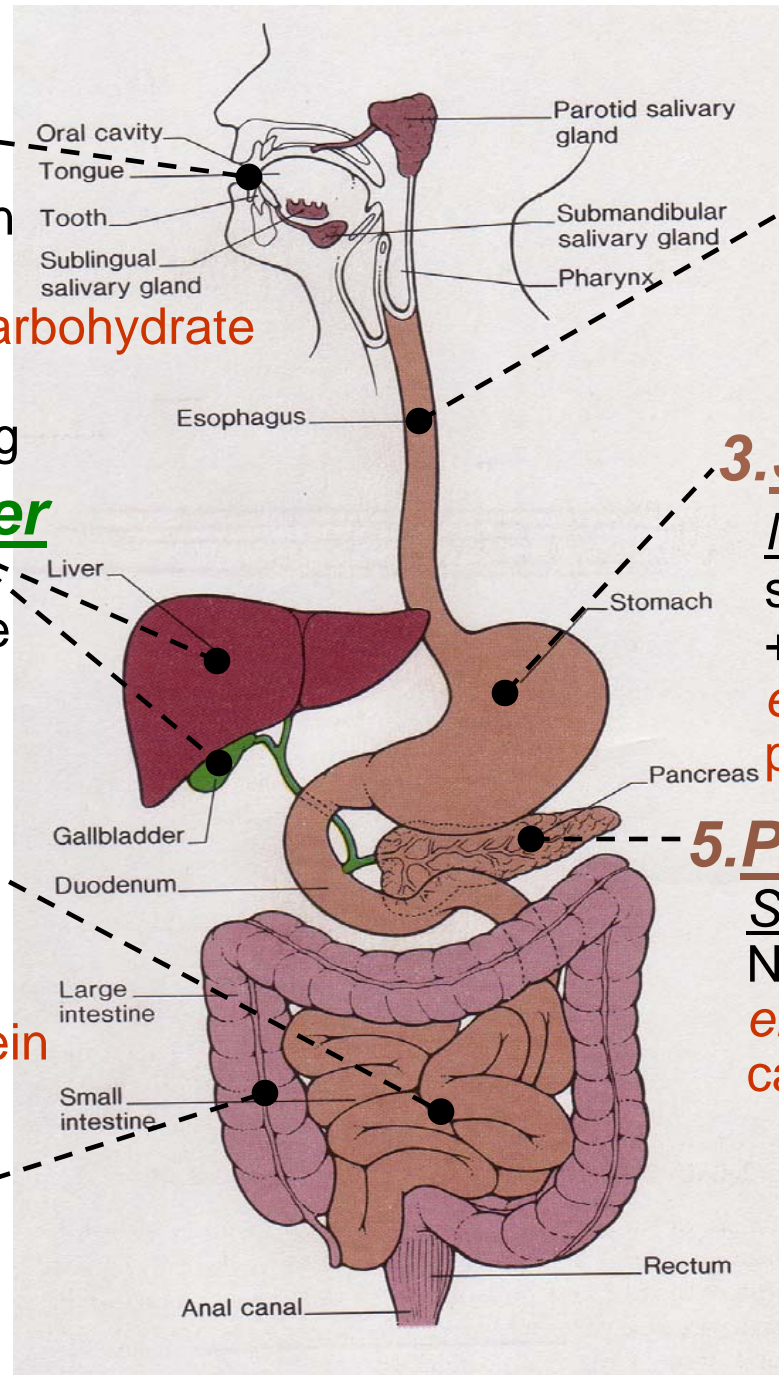
Emulsification =
detergent action of bile
+ secretion

6. Small Intestine

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

7. Large Intestine

Dehydration
secretion + absorption
storage + peristalsis



2. Esophagus

Rapid transit
peristalsis
secretion mucus

3. Stomach

Mixing peristalsis
secretion mucus + HCl
+ enzymes
enzymatic digestion:
protein + butter fat!

5. Pancreas

Secretion mucus +
NaHCO₃ + enzymes
enzymatic digestion:
carbohydrate, fat, protein

Common Control Mechanisms

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

Hey – I'll be ready
because I book it!!



BI 121 Lecture 6 + Q + ½ Midterm Review

- I. Announcements Next session Q? ~½ review, then Midterm.**
Fun Lab 3 Nutrition today! Sample Suisse Calculation? Q?
- II. Nutrition in the News Be a whiz at healthy grilling!**
American Institute for Cancer Research, Grilling Quiz!
- III. Digestion Connections LS ch 15, DC Module pp 17-23**
 - A. Histology of the gut LS fig 15-2, 15-3 p 442-3
 - B. Stomach protein digestion + zymogens? LS fig 15-7, 15-9
 - C. Accessory organs: Pancreas & Liver + Recycling!
LS pp 457-63
 - D. Small intestine? Ulcers? LS fig 15-20, 15-22 pp 467-8
<http://www.cdc.gov/ulcer> Beyond the Basics LS p 456
 - E. Summary of chemical digestion LS tab 15-5 p 466
 - F. Large intestine? LS fig 15-24 pp 472-4
- IV. Midterm Review Discussion + Q?**

How Do I Calculate the % of Total Calories from Carbohydrate, Fat & Protein?

Carbohydrate 46 g x 4 kcal/g = 184 kcal

% Carbohydrate = $184/567 = 0.326 \equiv \sim 33\%$

Fat 39 g x 9 kcal/g = 351 kcal

% Fat = $351/567 = 0.619 \equiv \sim 62\%$

Protein 8 g x 4 kcal/g = 32 kcal

% Protein = $32/567 = 0.056 \equiv \sim 6\%$

$\Sigma = 567$ kcal

American Institute for Cancer Research (AICR) Healthy Grilling Quiz Summary

1. Marinade, marinade, marinade! By doing so, you can decrease carcinogens formed during grilling by $\leq 96\%$!
2. Cover the grill with aluminum foil, turn gas down or wait for low-burning embers, cook to the side.
3. Best choices for grilling include vegetables and fruits (no HCAs + enzymes to inactivate HCAs!), and lean meats (e.g., fish & skinless chicken ↓ PAHs).
4. Flip meat every minute to reduce charring & remove charred portions prior to eating.
5. To limit cancer risk, eat no more than 3 oz grilled red meat. Cook small portions/kebabs.

★ Myenteric motor plexus!

Serosa

cf: G&H fig 62-2

LOCAL

Epithelium

Submucosa

Lumen

Lamina
Propria

Muscularis
Externa

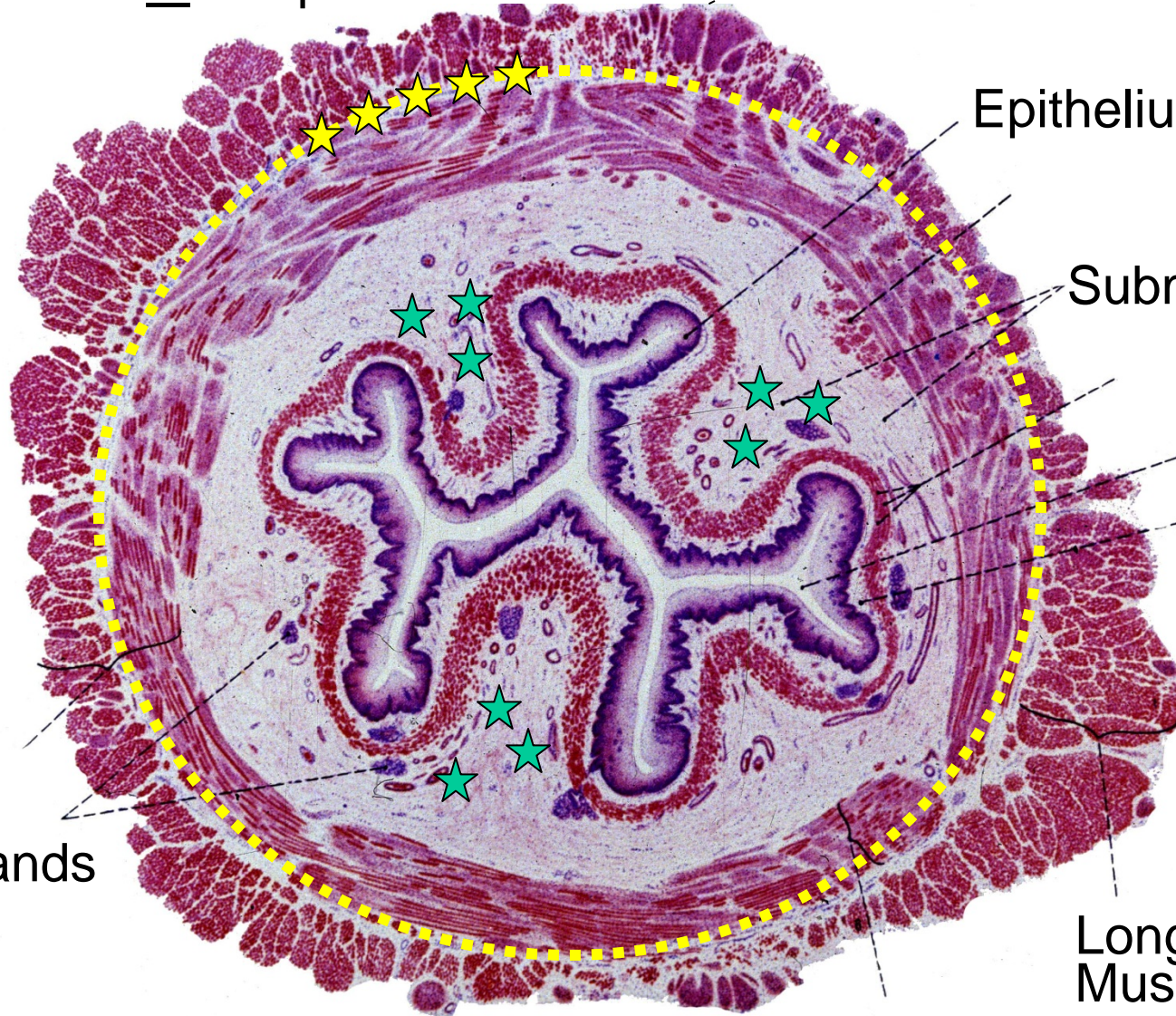
Glands

Longitudinal
Muscle

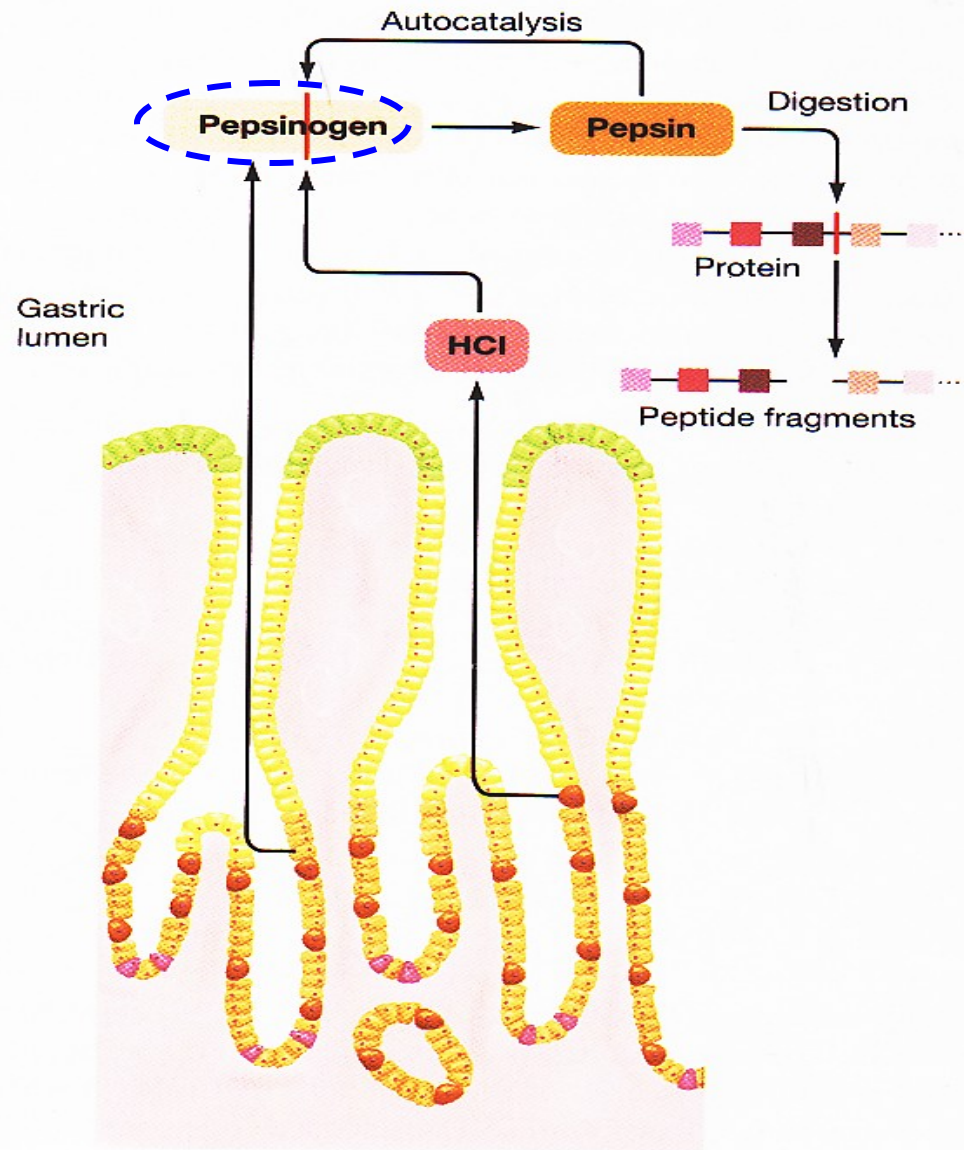
★ Meissner's sensory &
secretory plexus!

Circular
Muscle

H Howard 1990



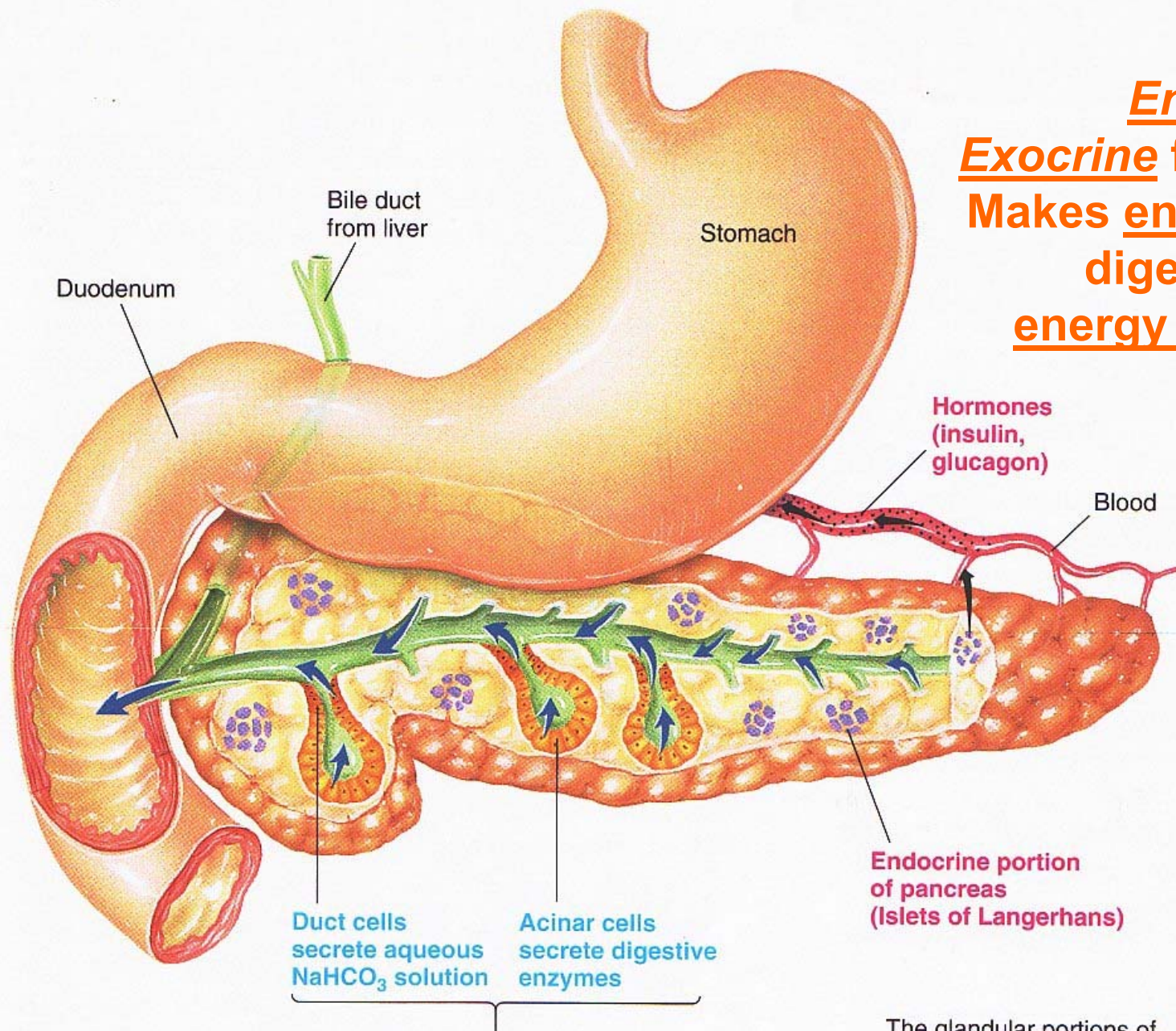
*Zymogen =
an inactive
precursor*



■ ■ ■ = Various amino acids

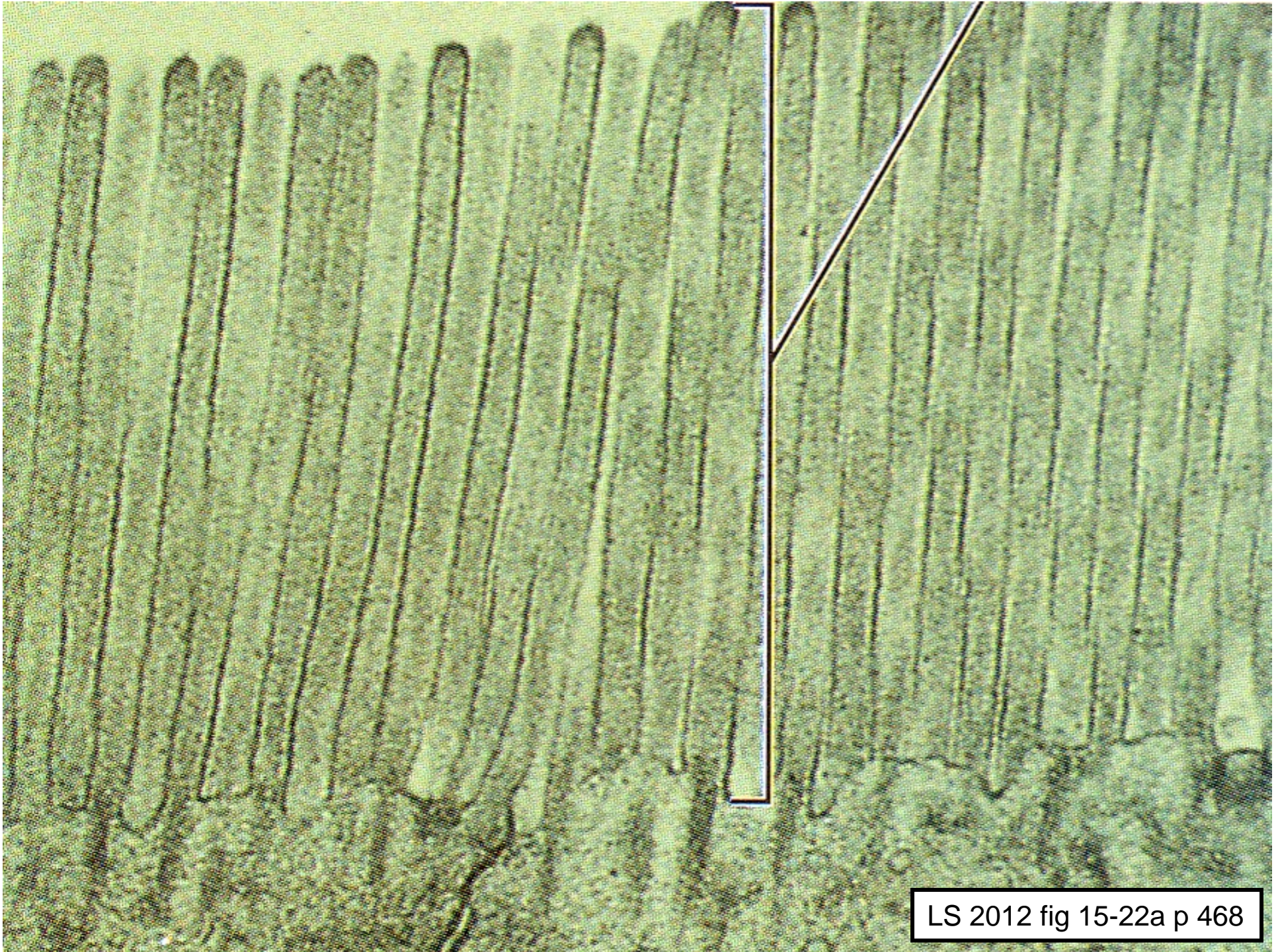
| = Enzymatic splitting of a chemical bond

**Endocrine + Exocrine functions;
Makes enzymes for
digesting all 3
energy nutrients!**



LS 2012 fig 15-11 p 457 **Exocrine portion of pancreas (Acinar and duct cells)**

The glandular portions of the pancreas are grossly exaggerated.



LS 2012 fig 15-22a p 468

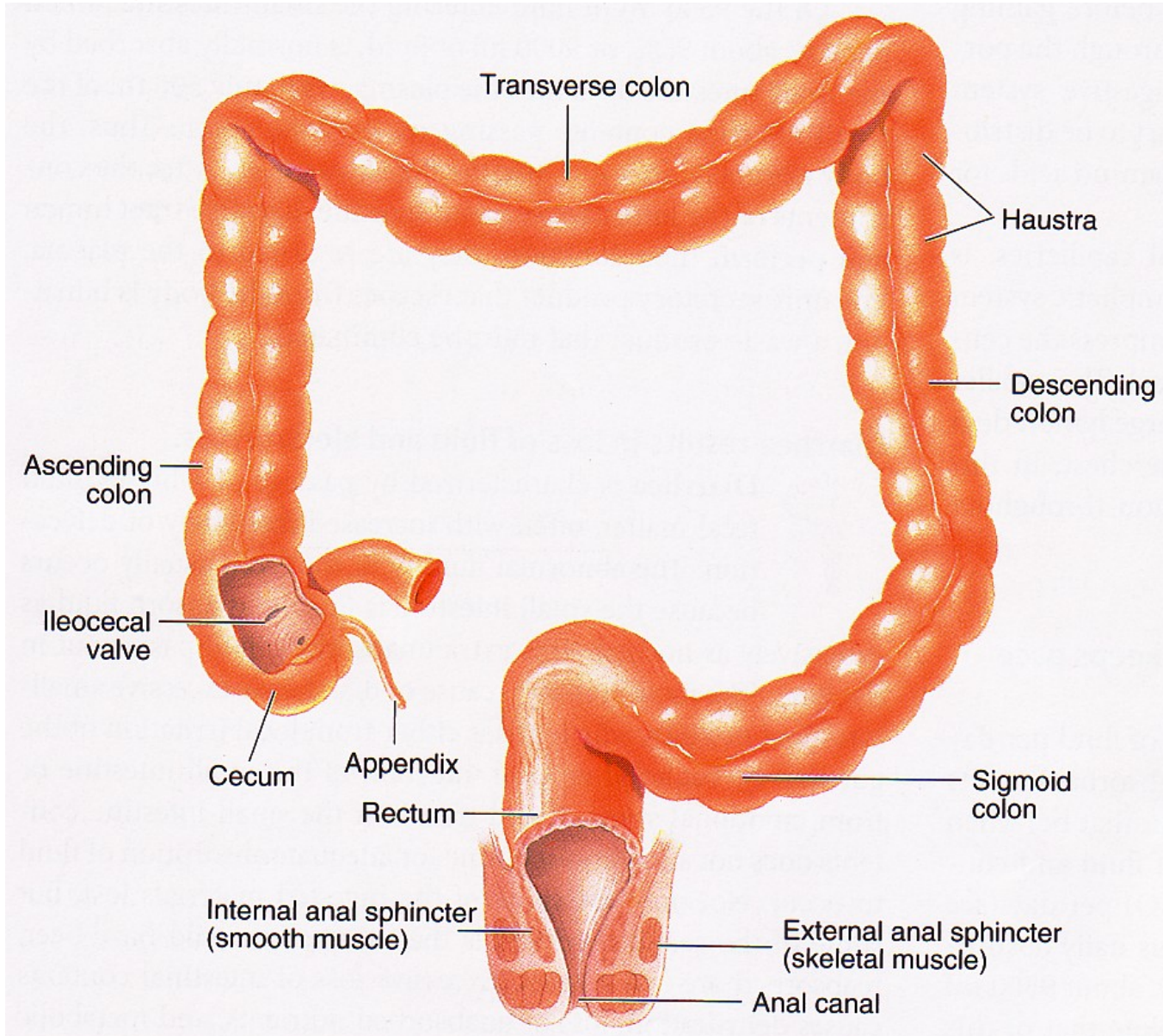


<http://www.cdc.gov/ulcer/>

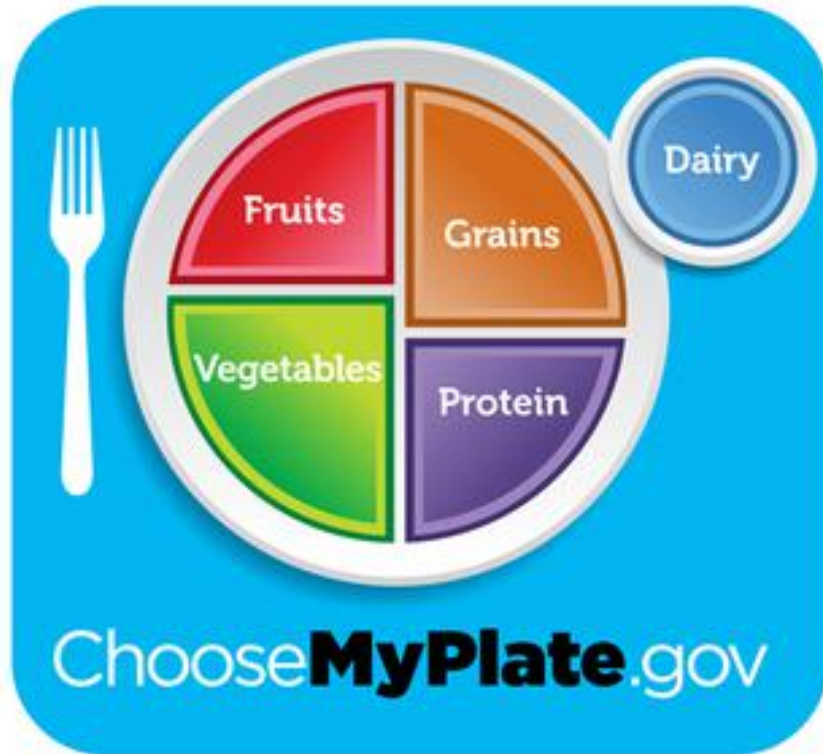
Ulcer Facts

- 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.

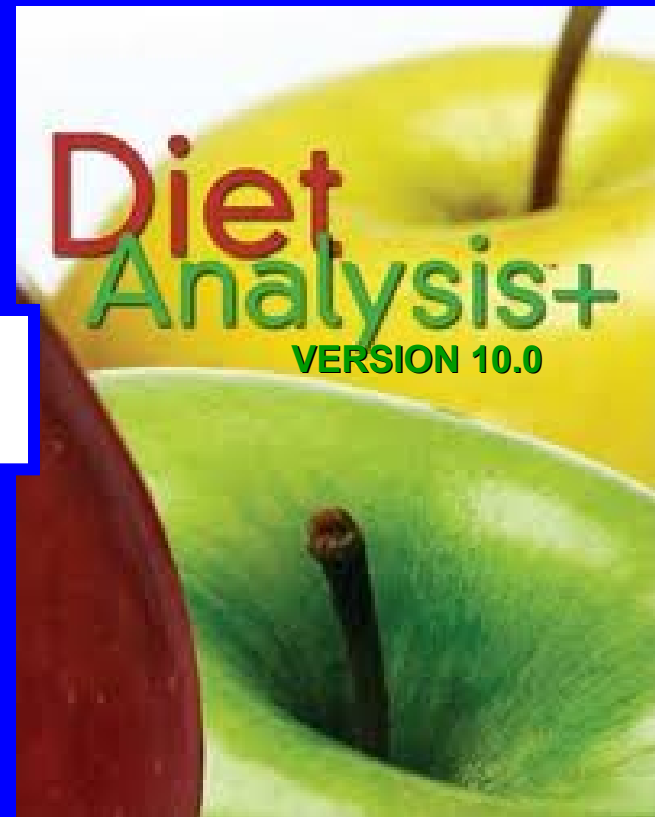
Large Intestine Structure & Function



Lab 3: Nutritional Analyses via 2 Programs



+



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