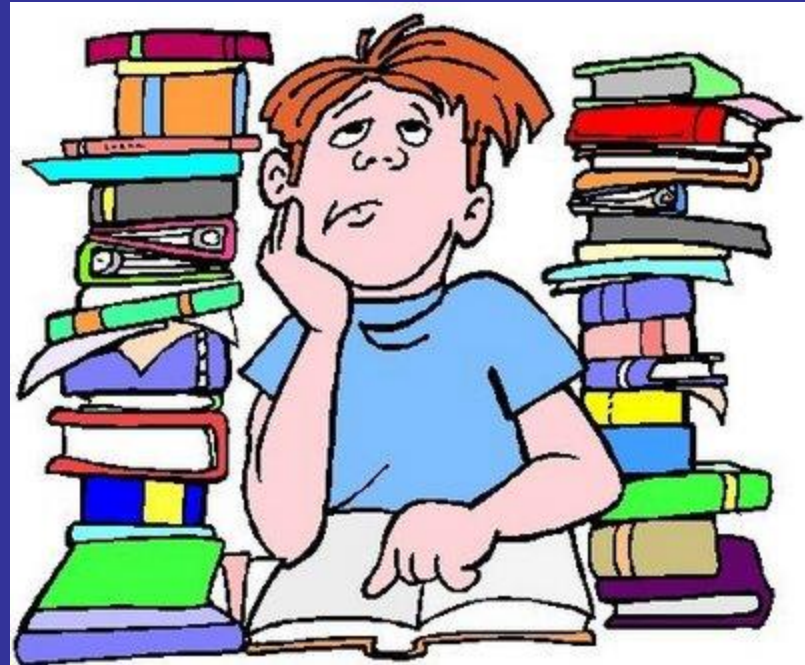
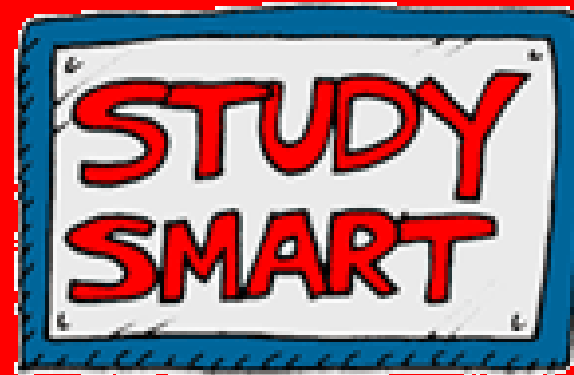


Exam I Review Slides





G. Waples

BI 121 Lecture 1

- I. Announcements**: Please check & sign attendance roster. Not on list? See Pat during break/> class. *Lab 1 Histology* tomorrow in 130 HUE: 12 n & 1 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 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

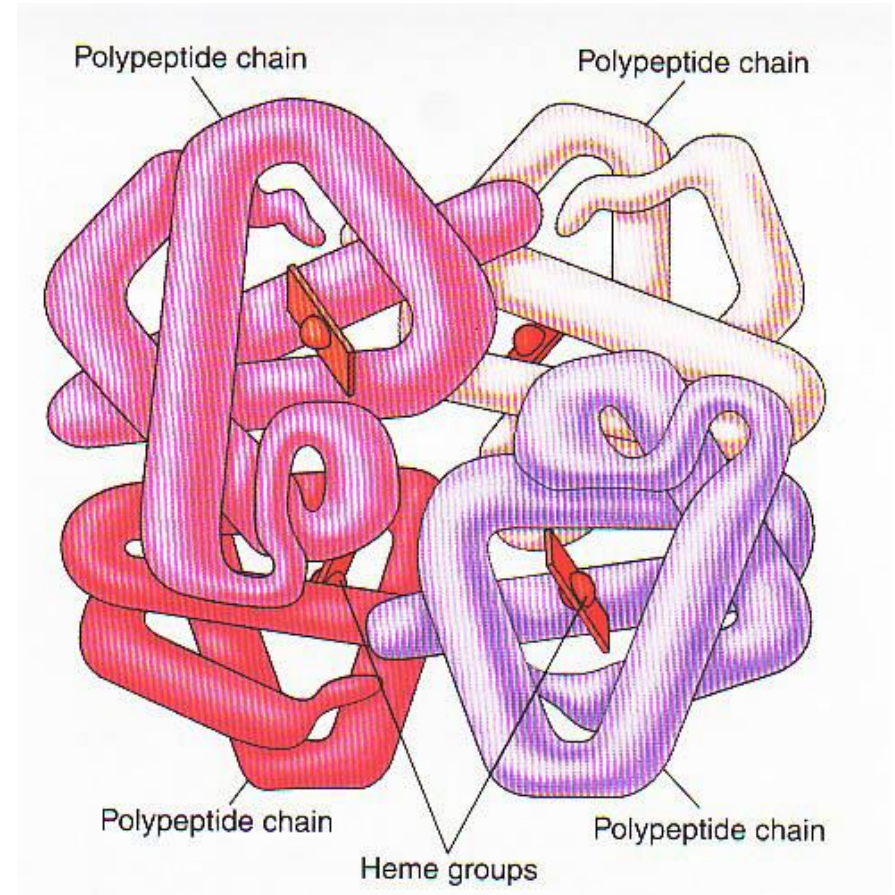
WHY?



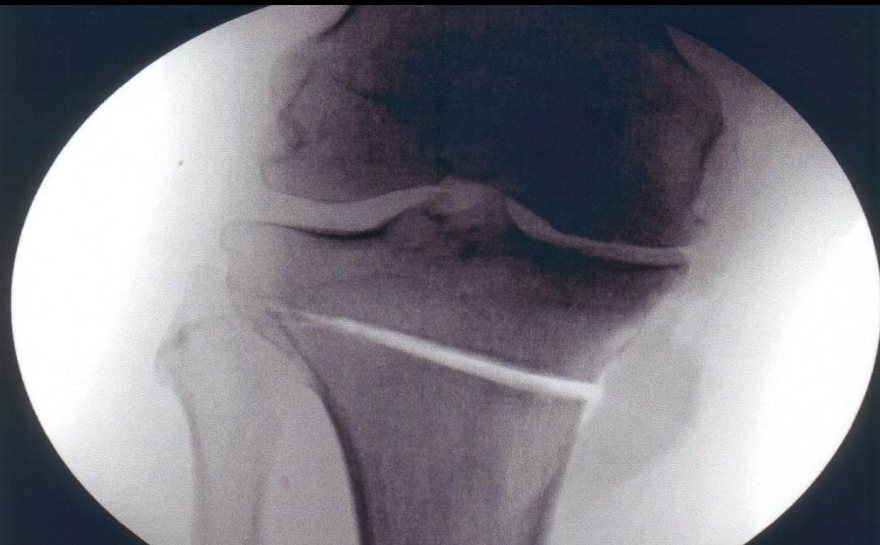
VS



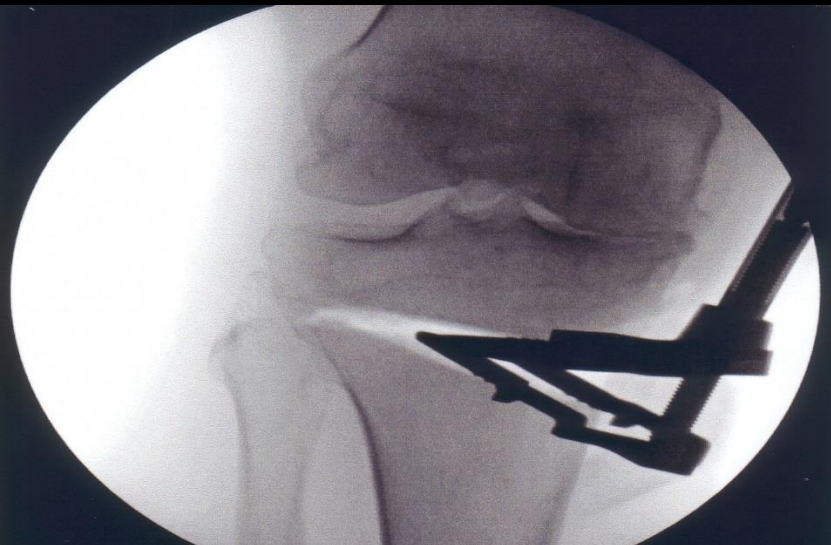
Structure begets *function*!
Structure gives rise to *function*!
Structure & *function* are inseparable!



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

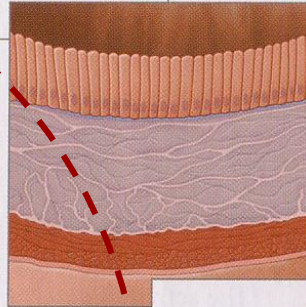
1. Molecular



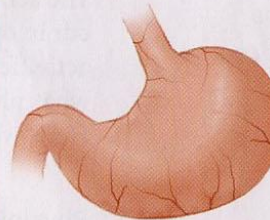
2. Cellular



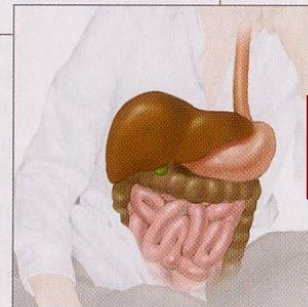
3. Tissue



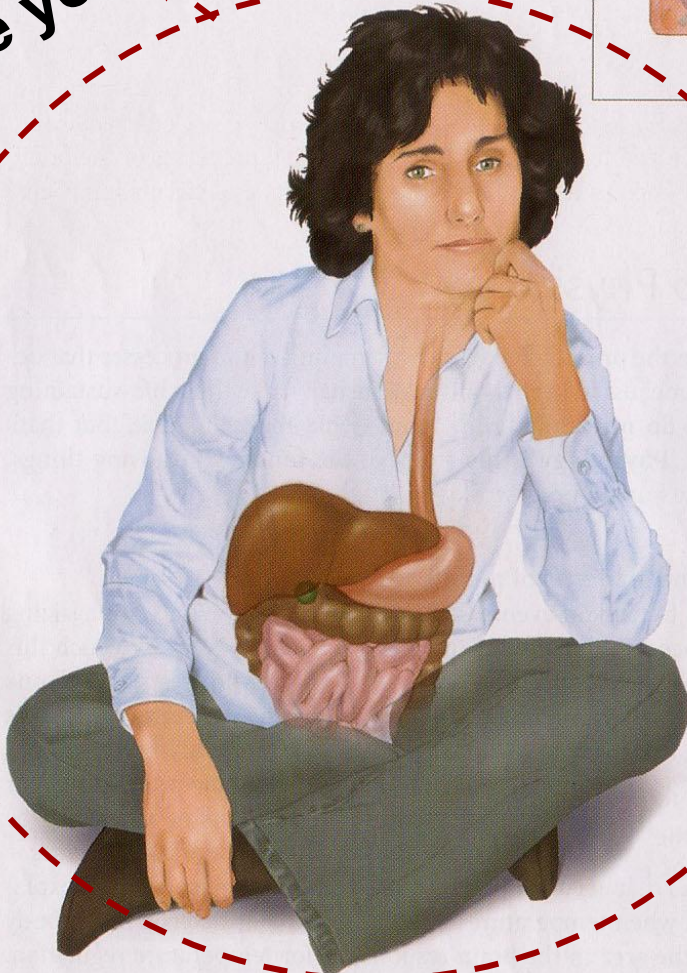
4. Organ

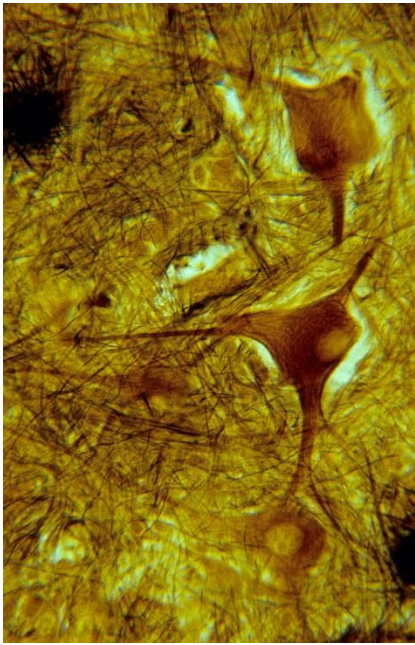


5. System

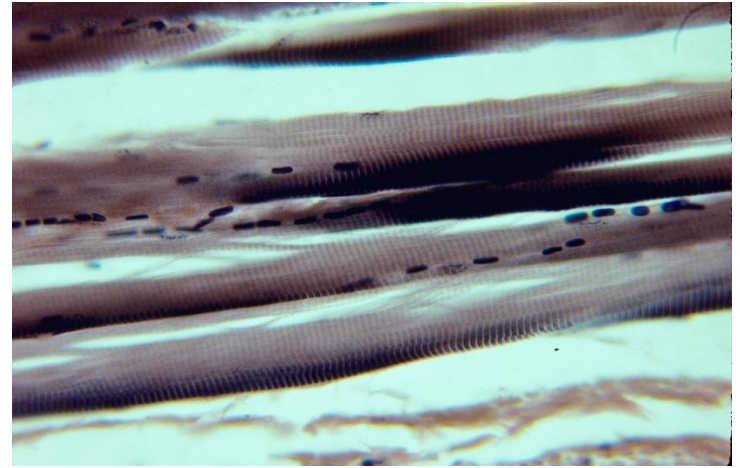


Entire Organism,
like you & me!

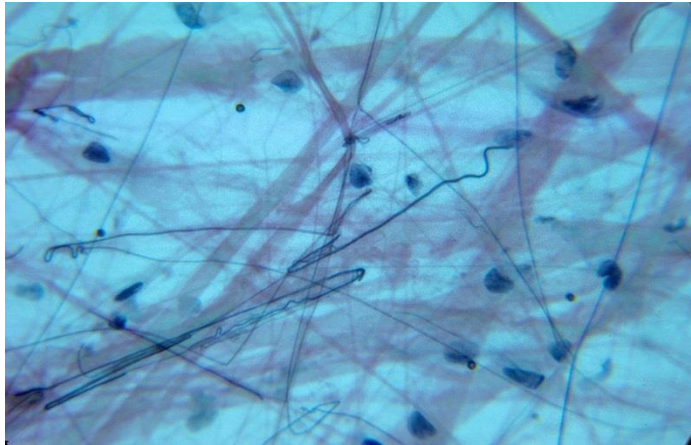




Nerve conducts



Muscle contracts

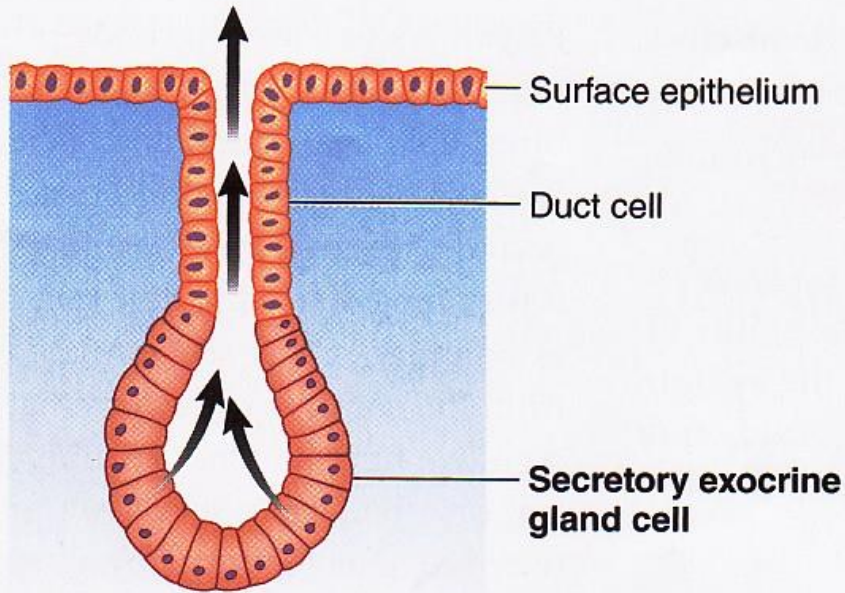


Connective connects!!

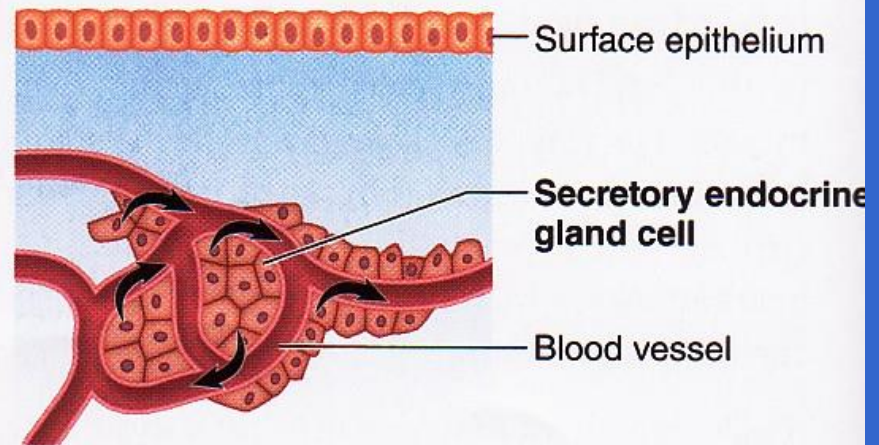


Epithelial covers

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

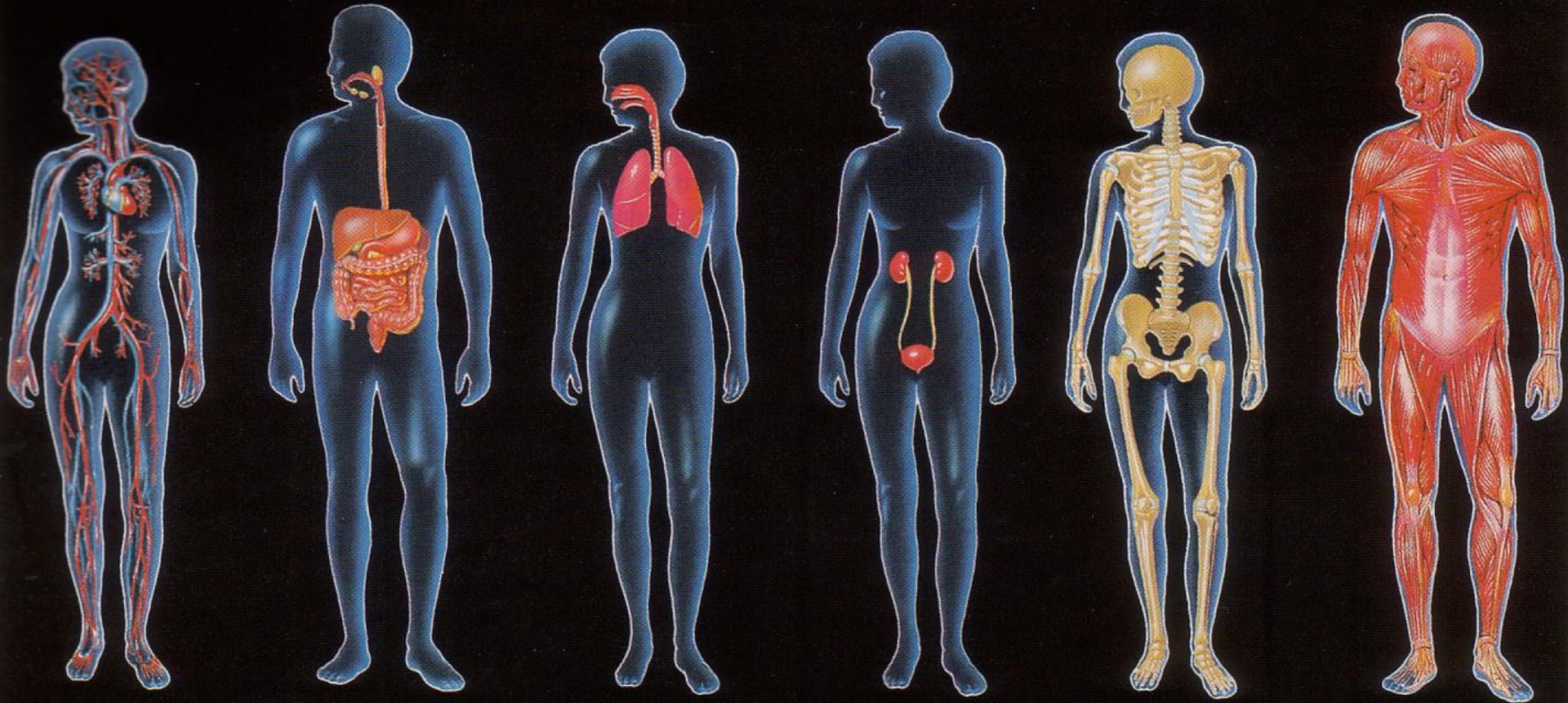


(a) Exocrine gland



(b) Endocrine gland

Which body systems?

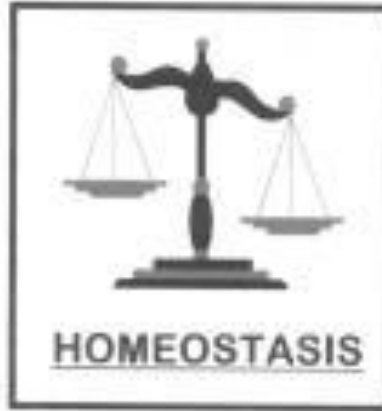


***Maintenance of a relative constancy in the
Internal environment = ECF = fluid outside of cells***

**milieu
interieur?**



Claude Bernard

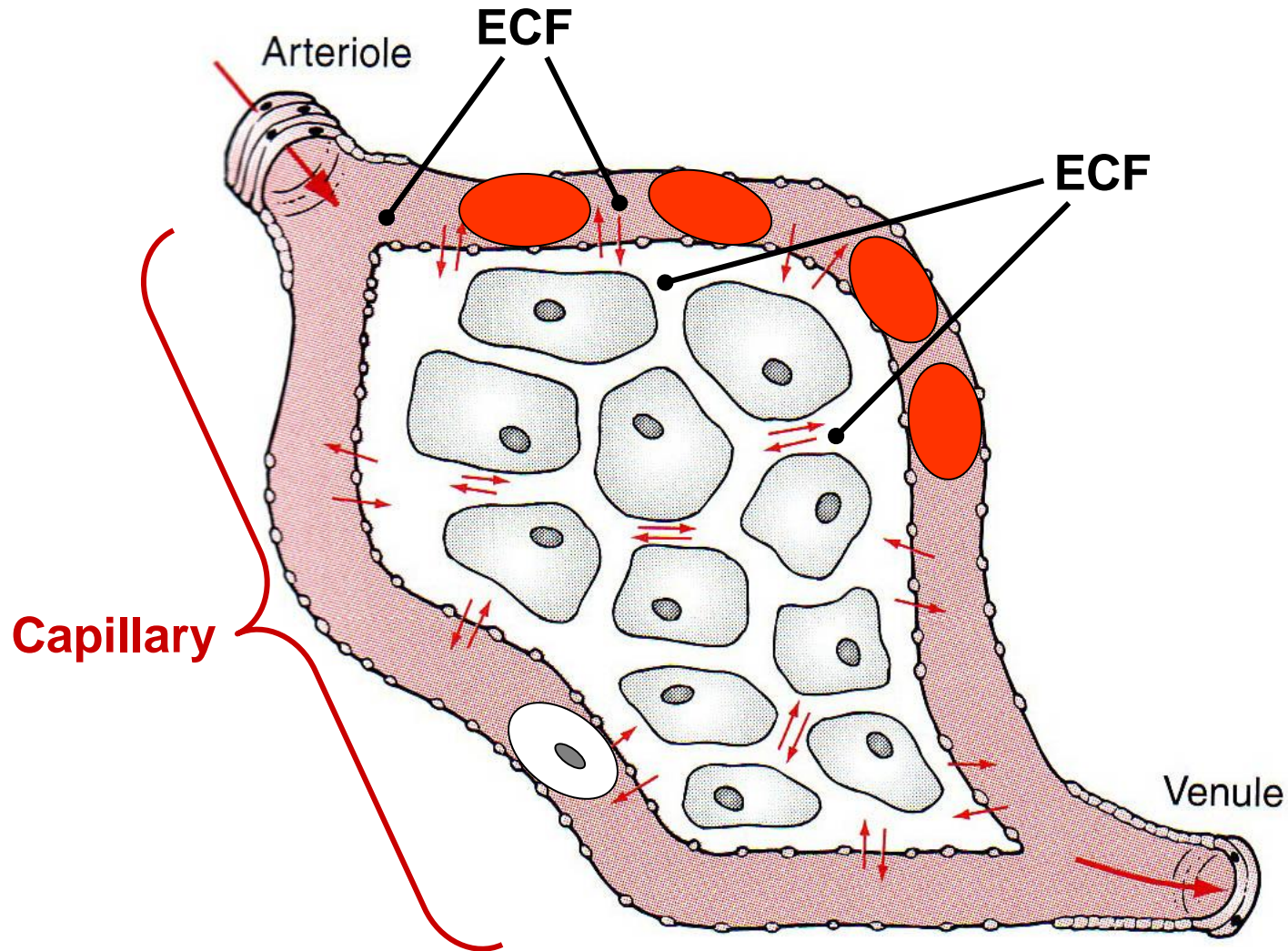


**100 trillion
cells working
intimately**



Walter B. Cannon

Where is extracellular fluid?



As long as between/outside cells, **ECF everywhere?**



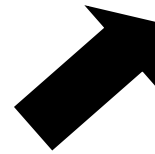
Thanks for signing attendance roster & noting late arrival or early departure time!



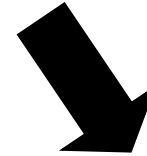
BI 121 Lecture 2

- I. Announcements Lab 1 Histology today! 130 HUE. Fun!
Please record your diet on p 3-7 LM & analyze it by Friday with <https://www.supertracker.usda.gov/> Estimating quantities. Q?
- 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
 - A. How big? What boundaries? Why compartments? pp 19-21
 - 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

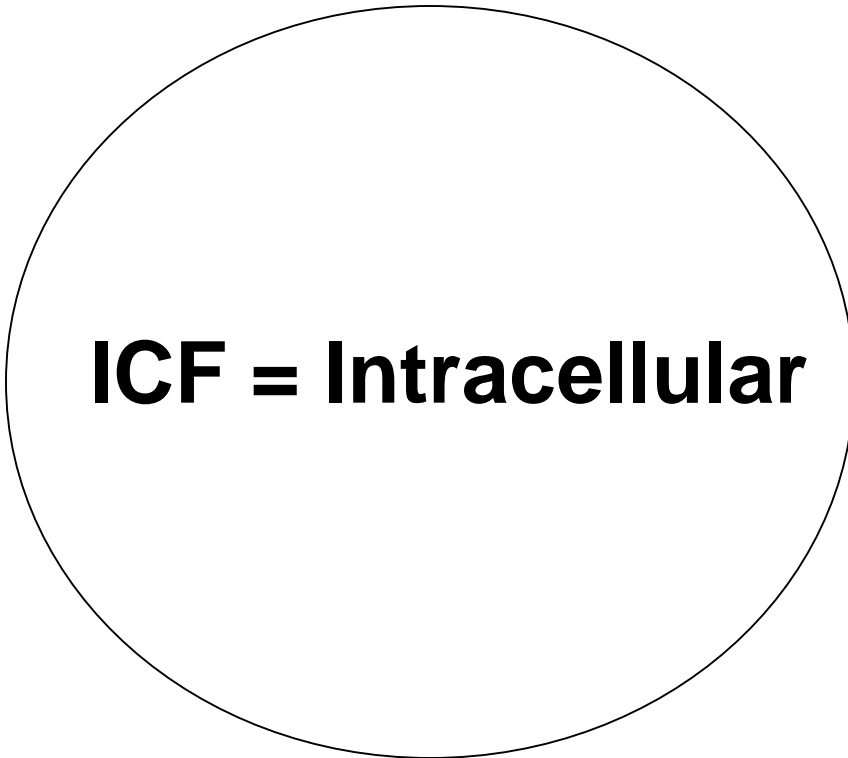
ECF = Extracellular



Plasma 
(within CV System)



Interstitium
(eg, between
muscle cells)

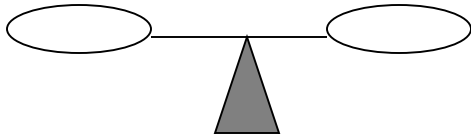


ICF = Intracellular

Metabolic

ANA-

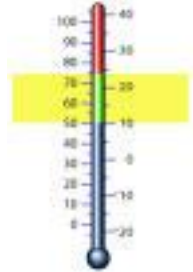
CATA-



H₂O



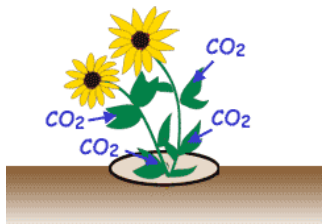
T_oC



Dr. Evonuk's 6 Balances

O₂/CO₂

Carbon Dioxide



Ion^{+/-}

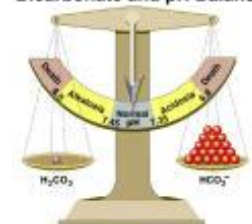


Captain Calcium



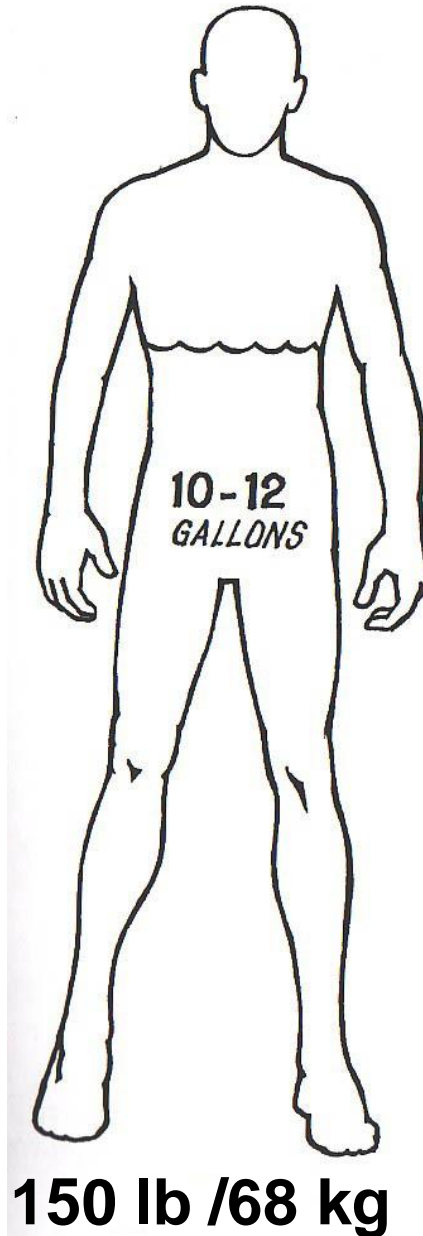
pH

Bicarbonate and pH Balance



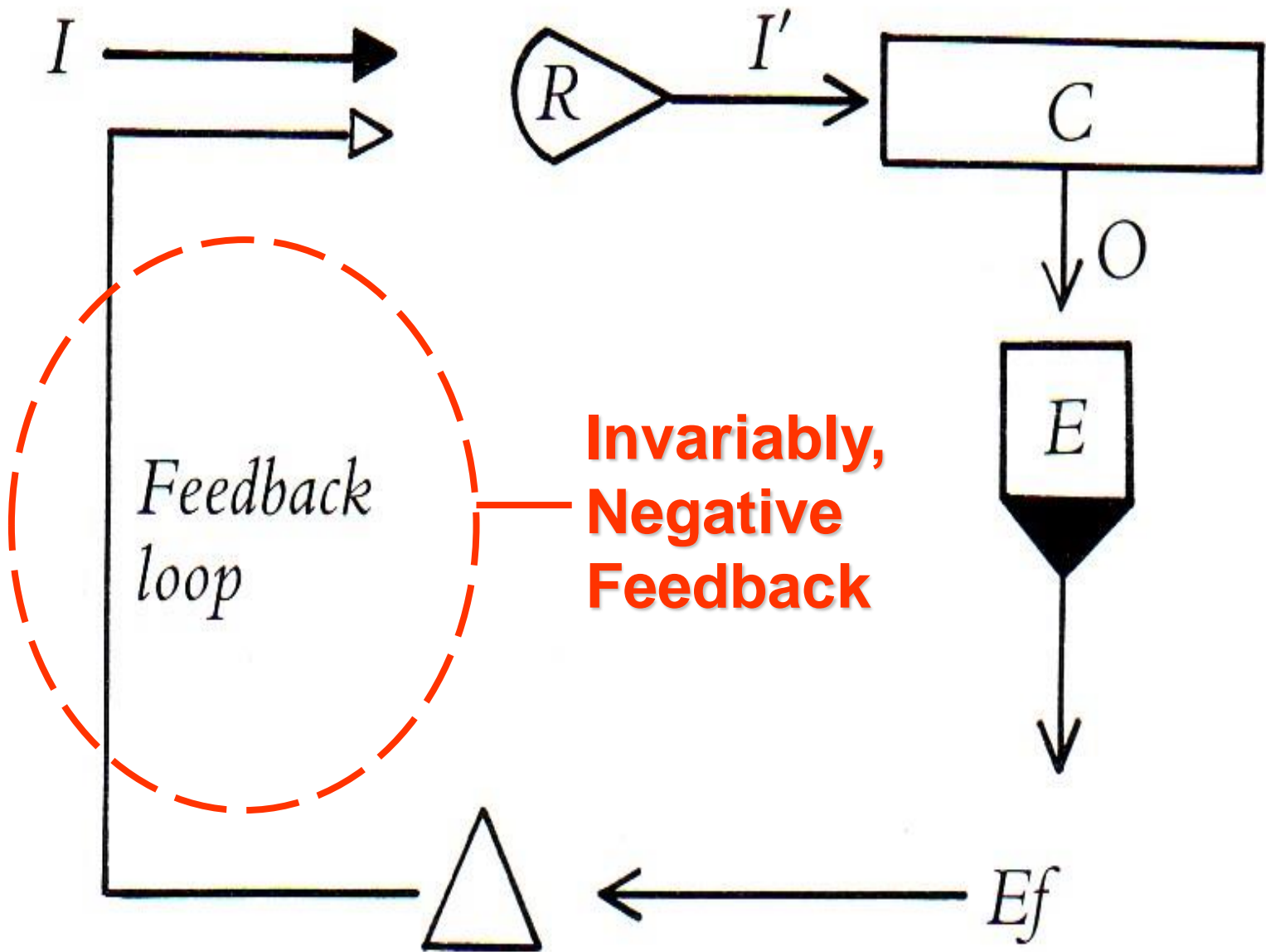
Drink about 1 L per 1000 calories energy expenditure!!

**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

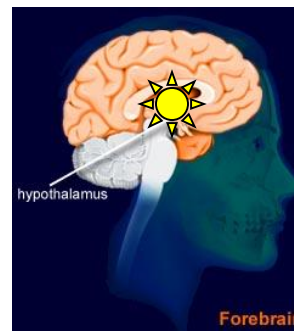
Oxytocin + Uterine Contraction

Blood Clotting Cascade

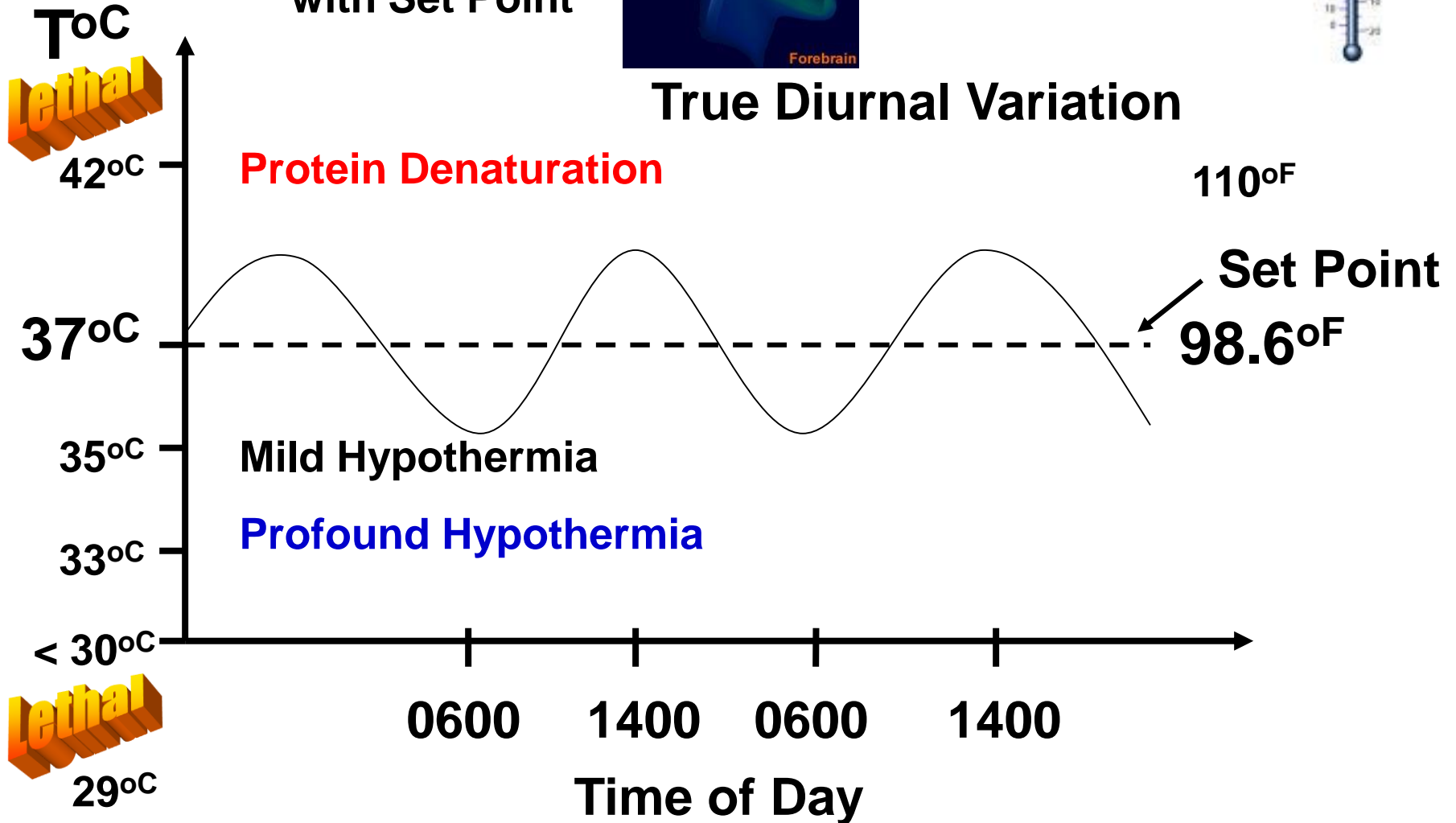
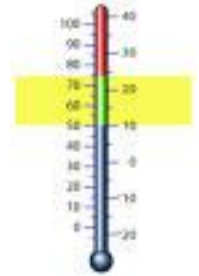
cAMP Cascade

Na⁺ influx during AP

Controller =
Hypothalamus
with Set Point

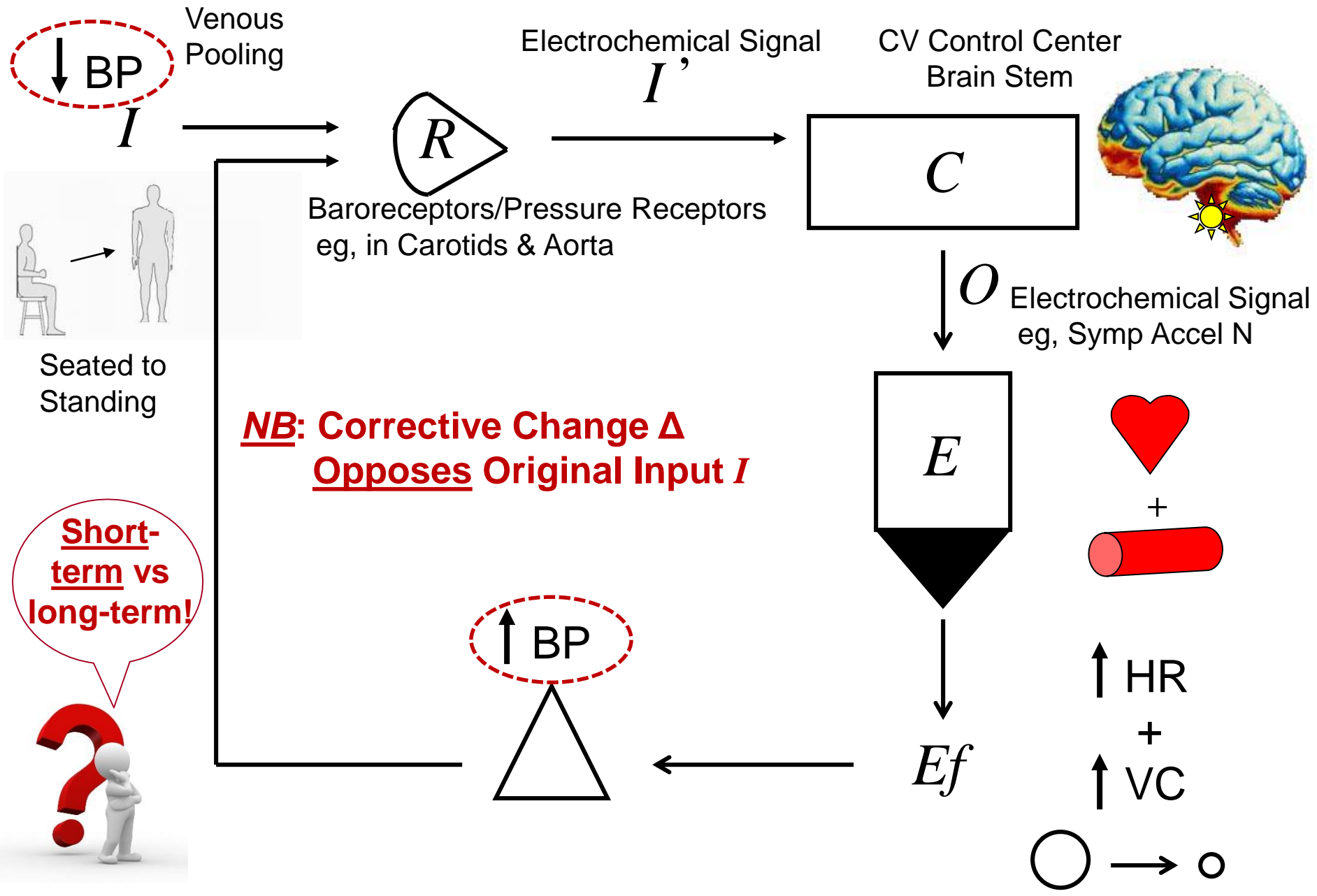


T_{bC}



<https://www.khanacademy.org/partner-content/mit-k12/chem-and-bio/v/homeostasis>

Blood Pressure Homeostasis



BI 121 Lecture 3



...Anatomy & Physiology Lab Thurs! Fun again!

I. Announcements AEC Notes? aec.uoregon.edu/peer-notetaking

II. Connections Q re: Homeostatic Model for BP? Active work!

III. Cell Anatomy, Physiology & Compartmentalization LS ch 2

A. How big? What boundaries? Why compartments? pp19-21

B. Basic survival skills ch 1 p 3

C. Organelles ≡ 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

D. What about vaults? LS 2006, p 32

E. **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

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

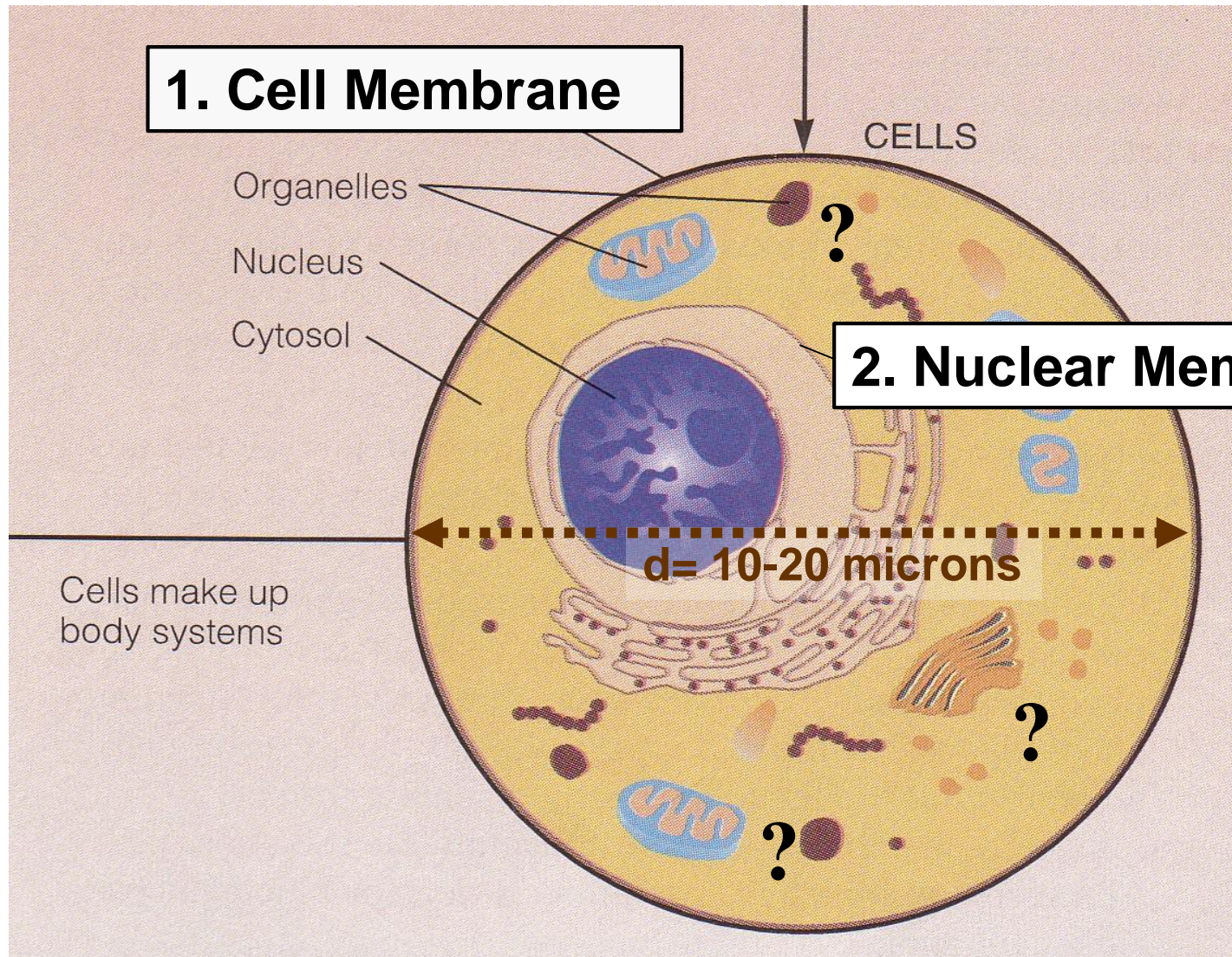
D. How does information flow in the cell? fig C-6

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

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

G. How are proteins made? fig C-7, C-9

How Big? 100 Cells Lengthwise = 1 mm!!

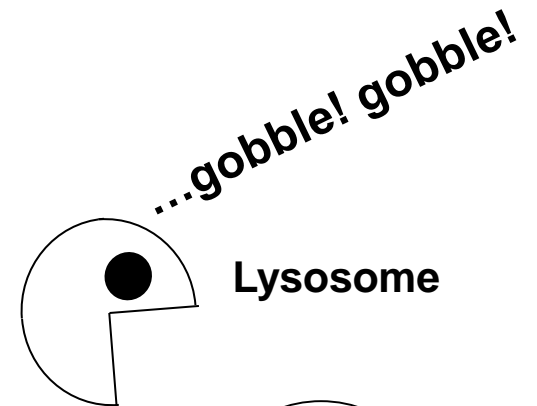


<http://opb.pbslearningmedia.org/resource/tdc02.sci.life.cell.nucleus/nucleus-cytoplasm-membrane/>

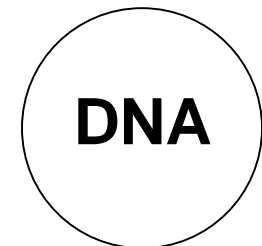
Why Compartments? Advantage?

**Incompatible reactions can
take place**

Simultaneously!!



Lysosome



Nucleus

1 Sample Cartoon of 100 Trillion (100×10^{12}) Cells!

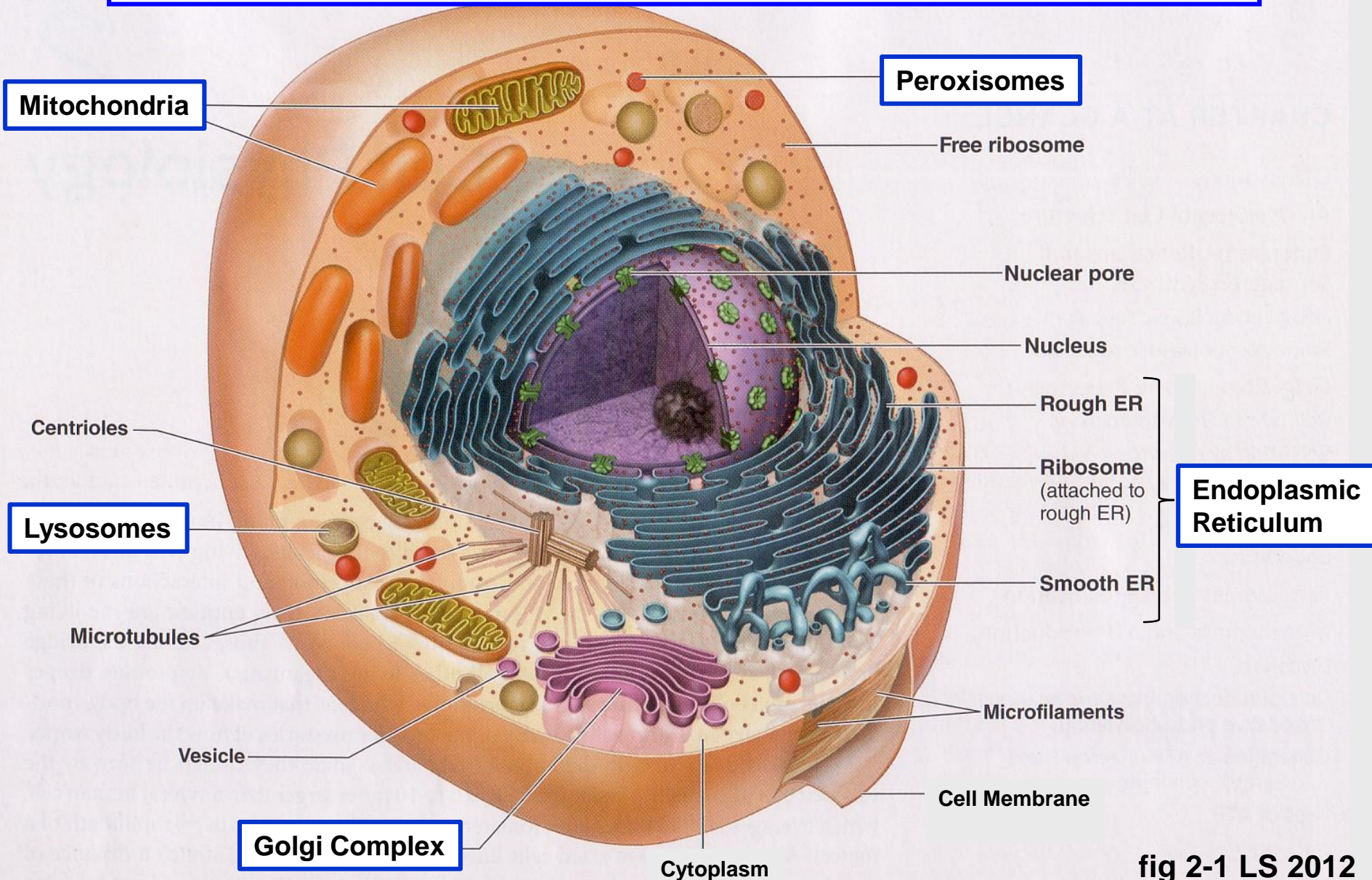
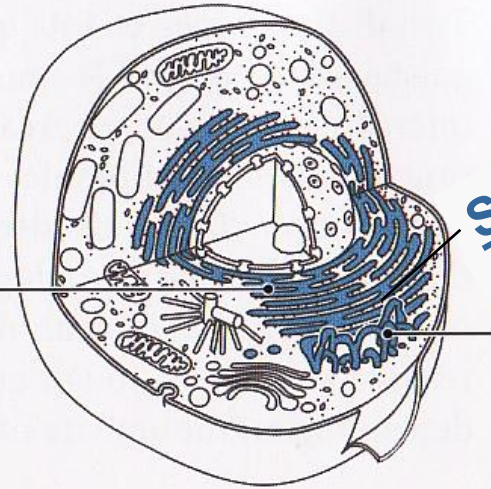


fig 2-1 LS 2012

<http://opb.pbslearningmedia.org/resource/tdc02.sci.life.cell.organelles/organelles-in-the-cytoplasm/>

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



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

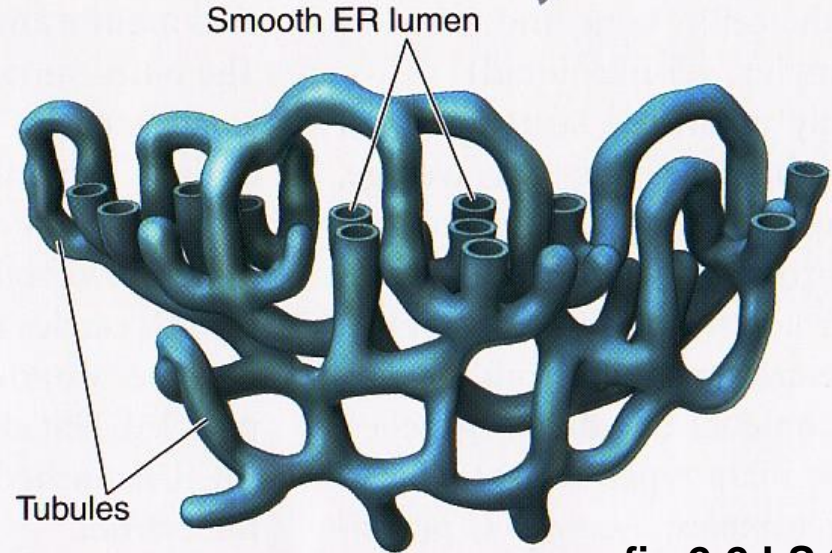
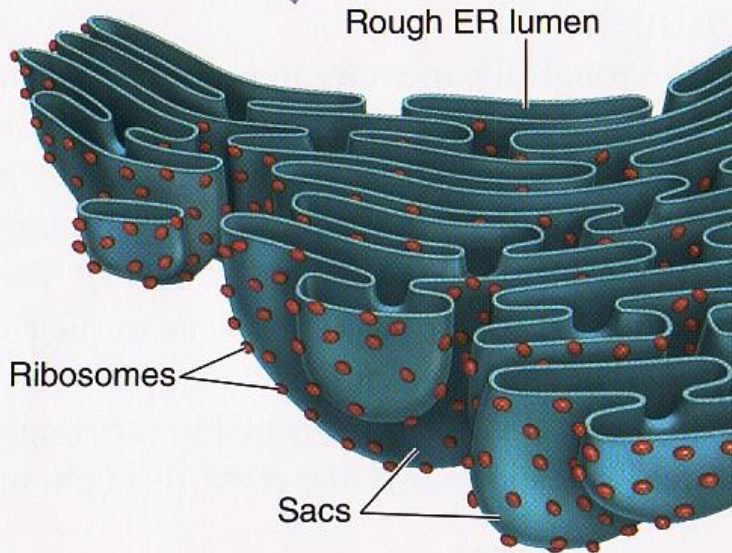


fig 2-2 LS 2012

Secretion of Proteins Produced by ER

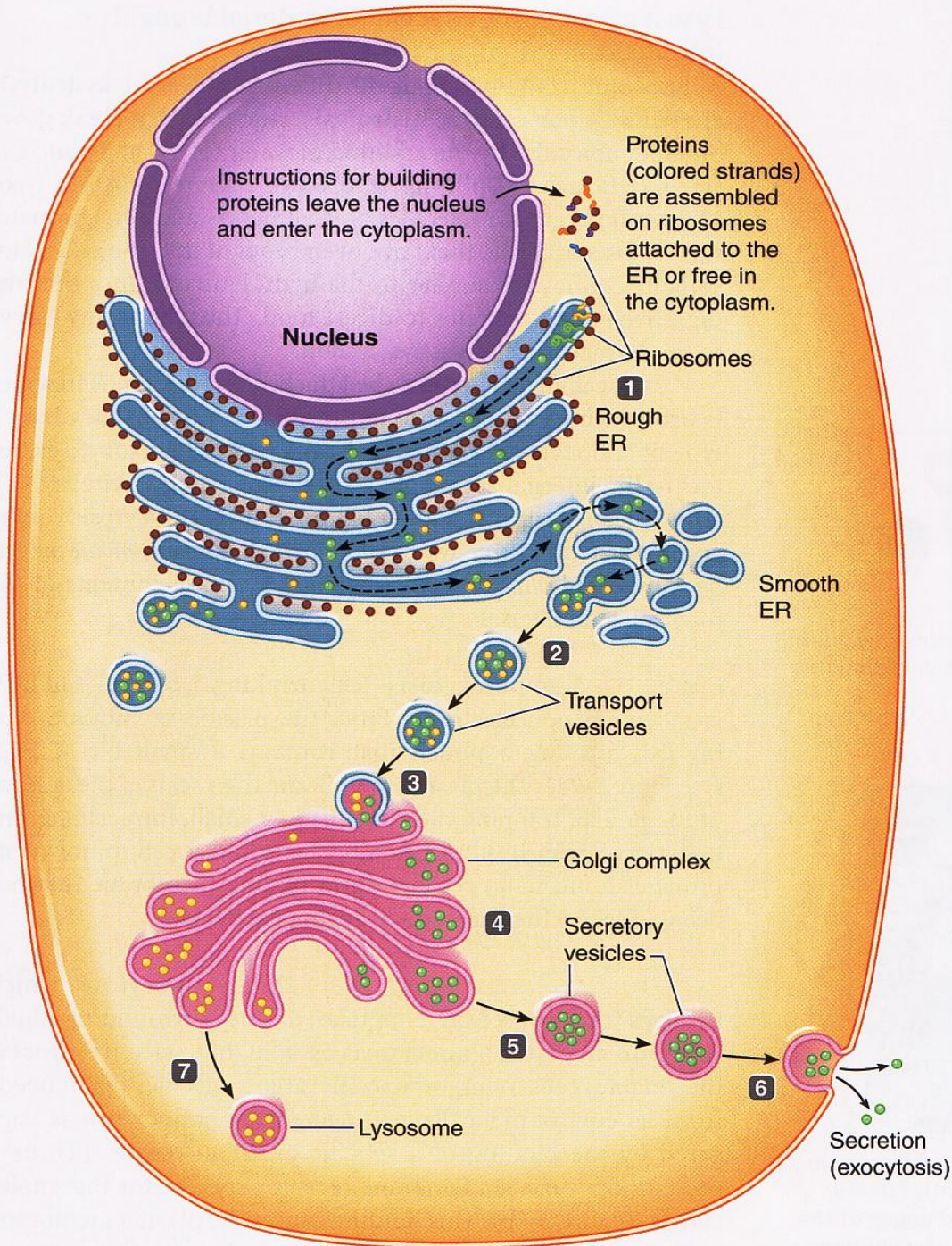
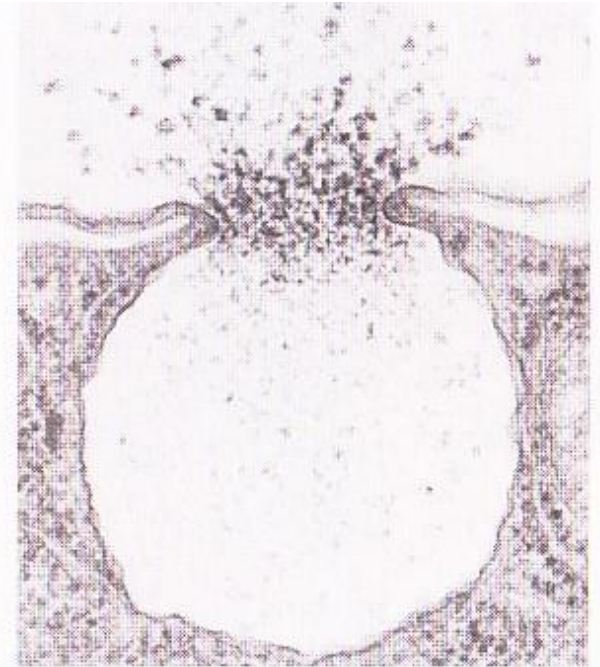
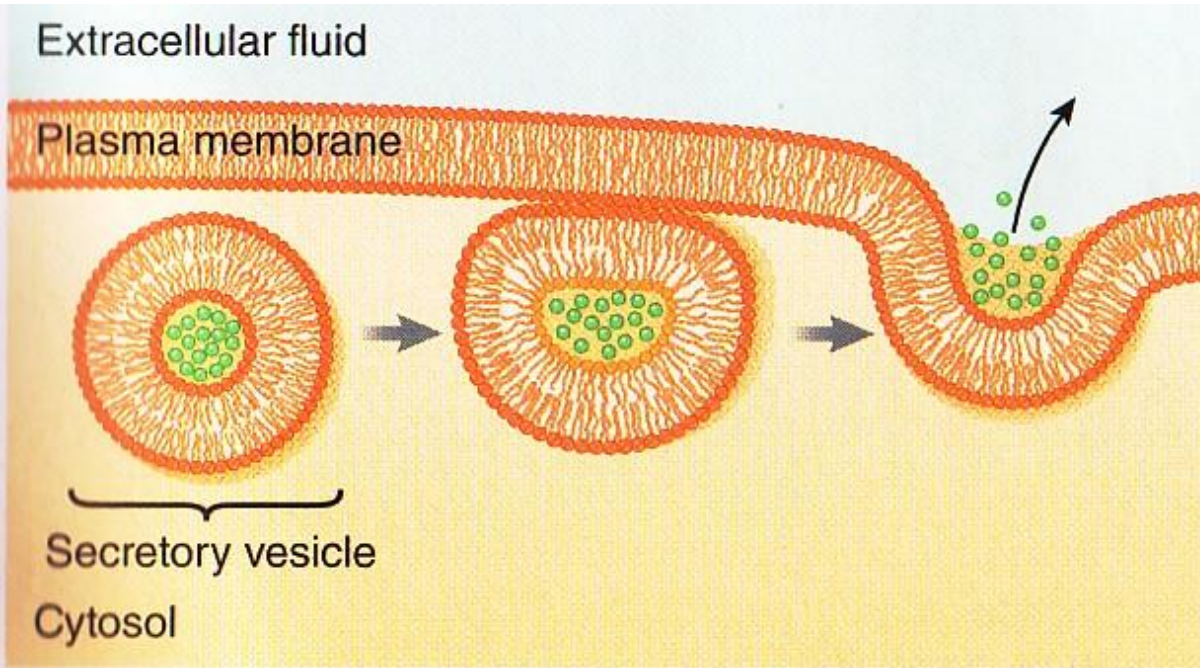


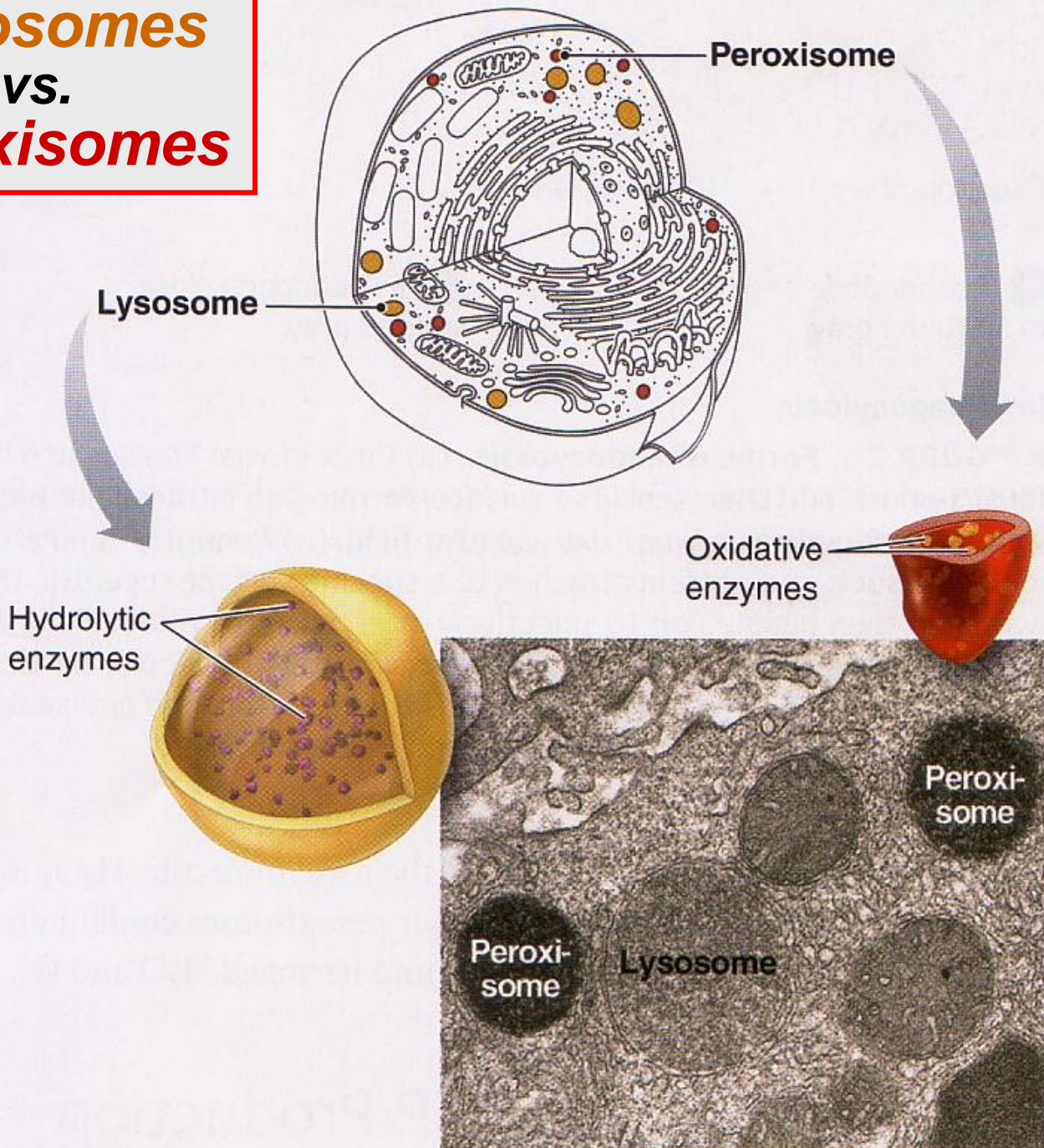
fig 2-3 LS 2012

Exocytosis: Primary Means of Secretion



(a) Dr. Birgit Satir, Albert Einstein College of Medicine

Lysosomes **vs.** **Peroxisomes**



© Don W. Fawcett/Photo Researchers, Inc.

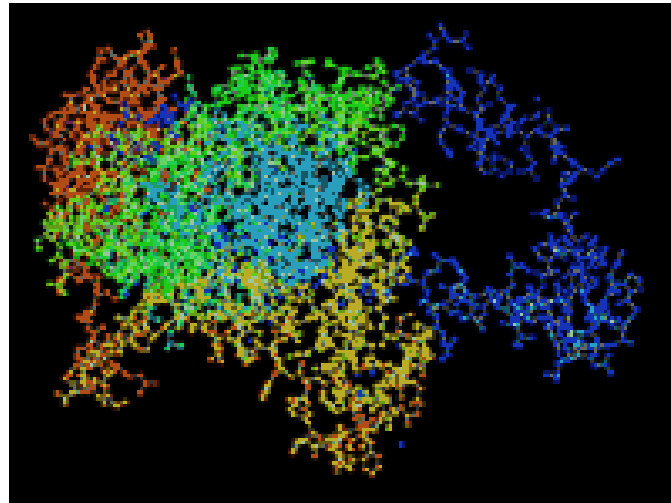
fig 2-6 LS 2012



Film: Neutrophil engulfing bacterium

<http://devreotes.johnshopkins.edu/videos>

Catalase Enzyme Reaction in Peroxisomes Neutralize Toxin at Production Site!



Anatomy & Physiology Lab today!...
Exam I next Thursday > 4th of July!!



BI 121 Lecture 4

I. Announcements Nutrition Analysis Lab next Thursday!
Please record your diet on p 3-7 LM & complete analysis by tomorrow using <https://www.supertracker.usda.gov/> Q?

II. Physiol News Moms eggs execute Dad's mitochondria?

III. Cell Physiology, Mitochondria & Metabolism Connections

LS 2012 fig 2-9 thru 2-12, 2-15 +...Mathews & Fox 1976

IV. Introduction to Genetics LS ch 2 p 20-1 + Appendix C

A. What's a gene? DNA? Why important? pp A-18 thru A-20 +

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!



V. 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!**

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.



Inside a fertilized egg, with its two sets of chromosomes (**blue**), the protein ubiquitin (**red**) tags sperm mitochondria (**yellow**).

SOURCE: Sutovsky P, Moreno RD, Ramalho-Santos J, Dominko T, Simerly C, Schatten G. *Nature* 1999;402(6760), 371-2.

AEROBIC

w/O₂

=

MITOCHONDRION

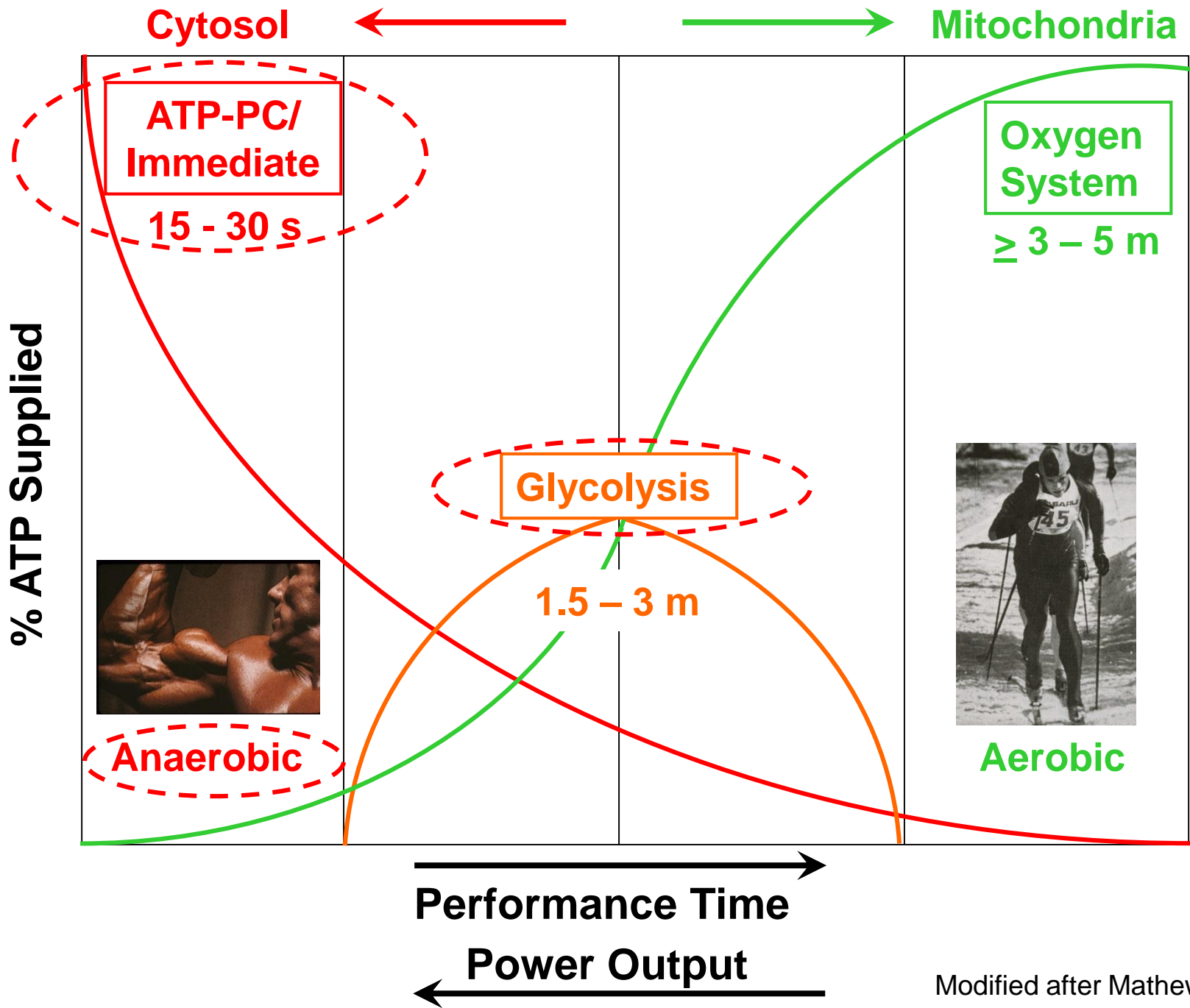
ANAEROBIC

without O₂

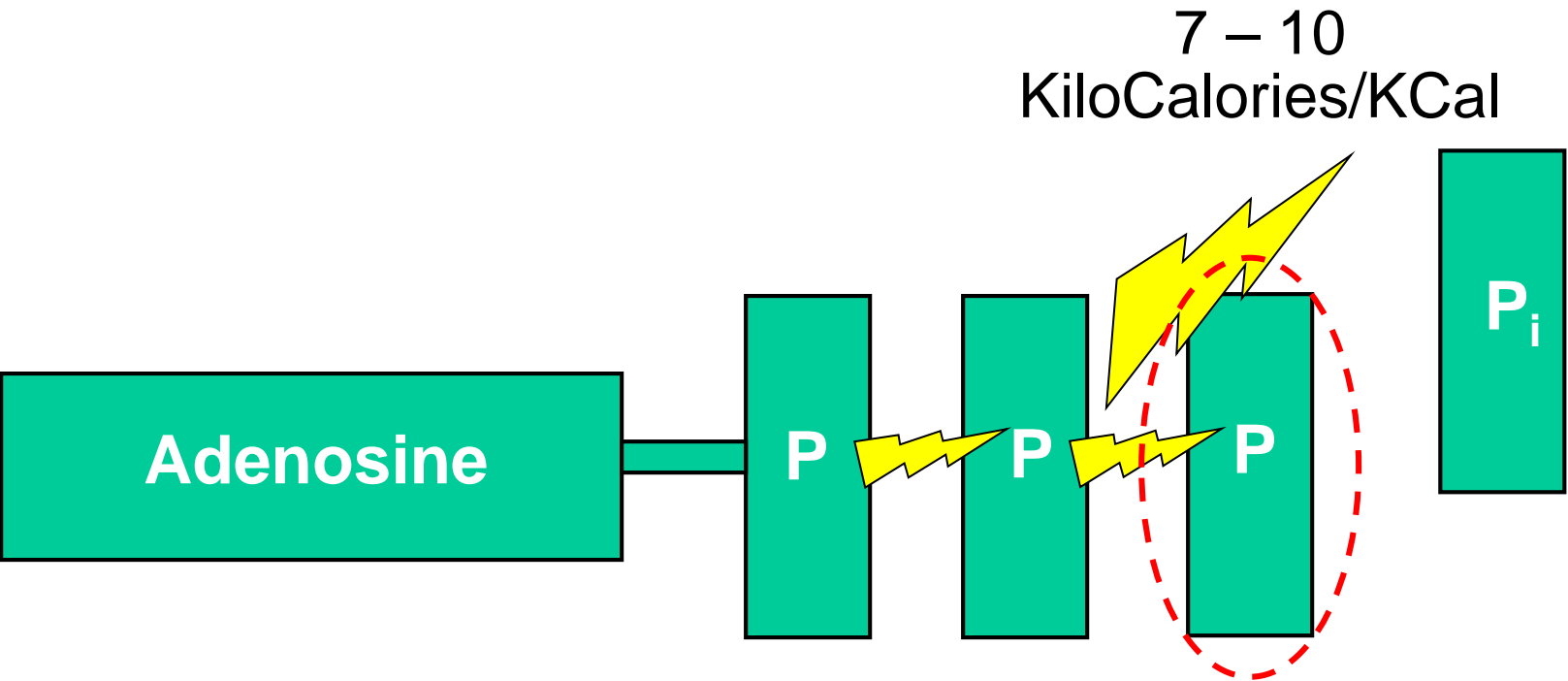
= CYTOSOL



1. Immediate/ATP-PC
2. Glycolysis



Cleave One High Energy Phosphate Bond To Do Work!!



- 1 *Synthesis of Macromolecules*
- 2 *Membrane Transport*
- 3 *Mechanical Work*

Make big things
from little things!

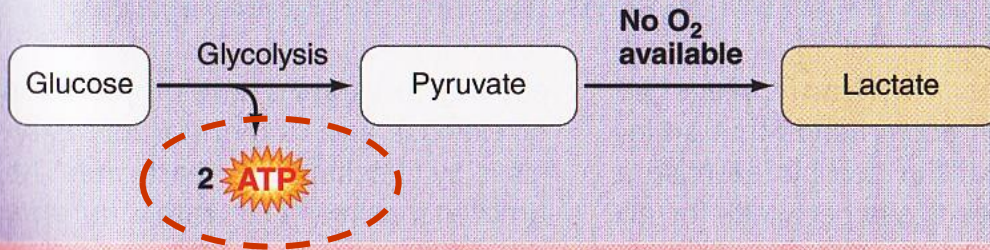
Move things!
Microscopic!



Move things!
Macroscopic!

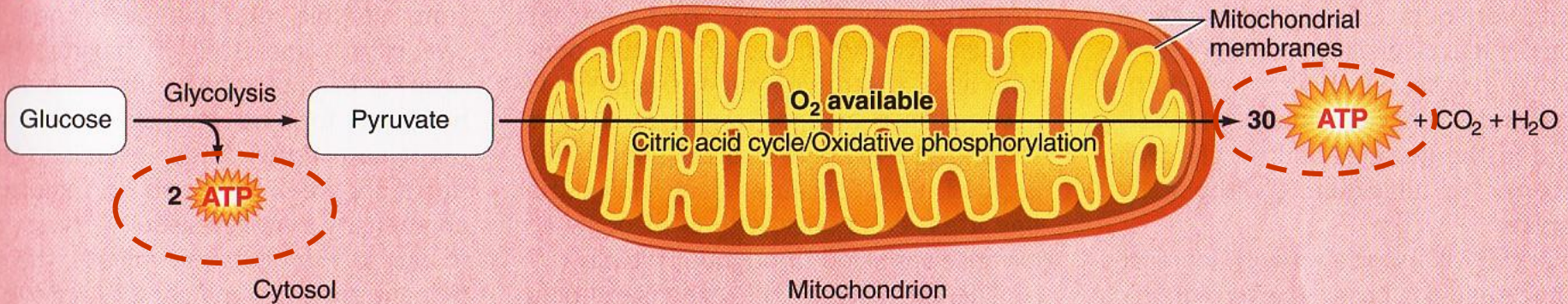
Anaerobic vs. Aerobic Metabolism

Anaerobic conditions



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

Aerobic conditions



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



AEROBIC

w/O₂

PRIMARY FUEL

FAT,
CARBOHYDRATE
& PROTEIN
(Small Amounts)

CARBOHYDRATE
(Glucose & Glycogen)

ATP, ADP &
Creatine
Phosphate (CP)

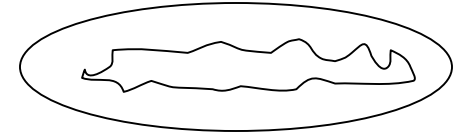
% AEROBIC
(Oxidative
Energy System)

% ANAEROBIC
(Immediate & Non-Oxidative
Energy Systems)

ACTIVITY

TIME (Min:Sec)

ACTIVITY	% AEROBIC (Oxidative Energy System)	% ANAEROBIC (Immediate & Non-Oxidative Energy Systems)	TIME (Min:Sec)
Marathon	100	0	135:00
Cross-Country Sking	90	10	29:00
10-K Run	80	20	14:00
3-Mile Run	70	30	9:00
2-Mile Run	60	40	3:45
800-Meter Swim	50	50	3:45
1-Mile Run	40	60	3:45
Boxing	30	70	1:30
200-Meter Swim	20	80	0:50
Circuit Weight Training	10	90	0:20
Soccer	0	100	0:10
Lacrosse			
Tennis			
Basketball			
Volleyball			
200-Meter Dash			
Football			
Conventional Weight Training			



MITOCHONDRIA

CYTOSOL

Glycolysis



Immediate/ATP-PC



ANAEROBIC

Stages of Cellular Metabolism/Respiration

**Anaerobic
Glycolysis
Cytosol**

**Aerobic
Metabolism
Mitochondria**

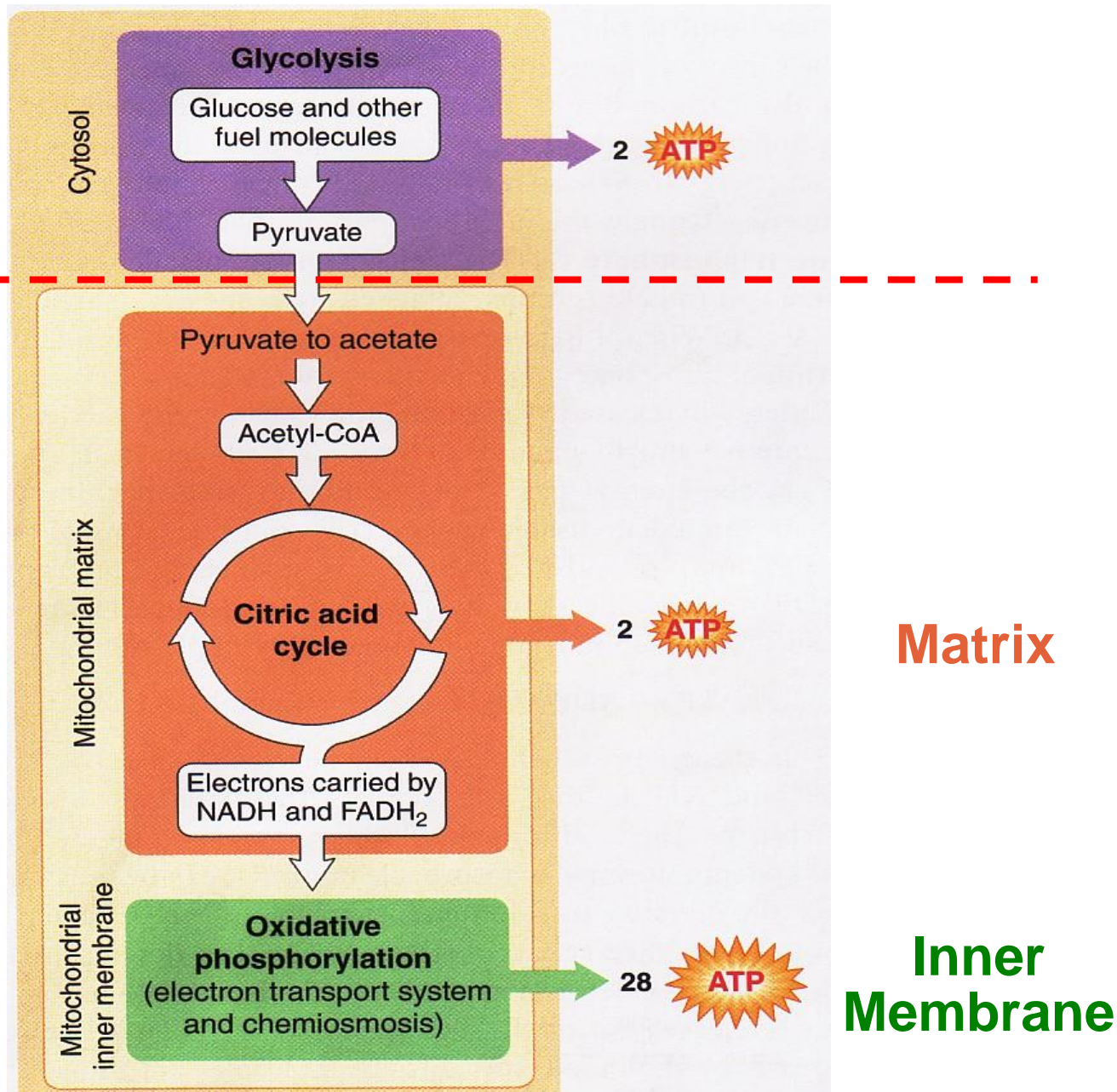


fig 2-9 LS 2012

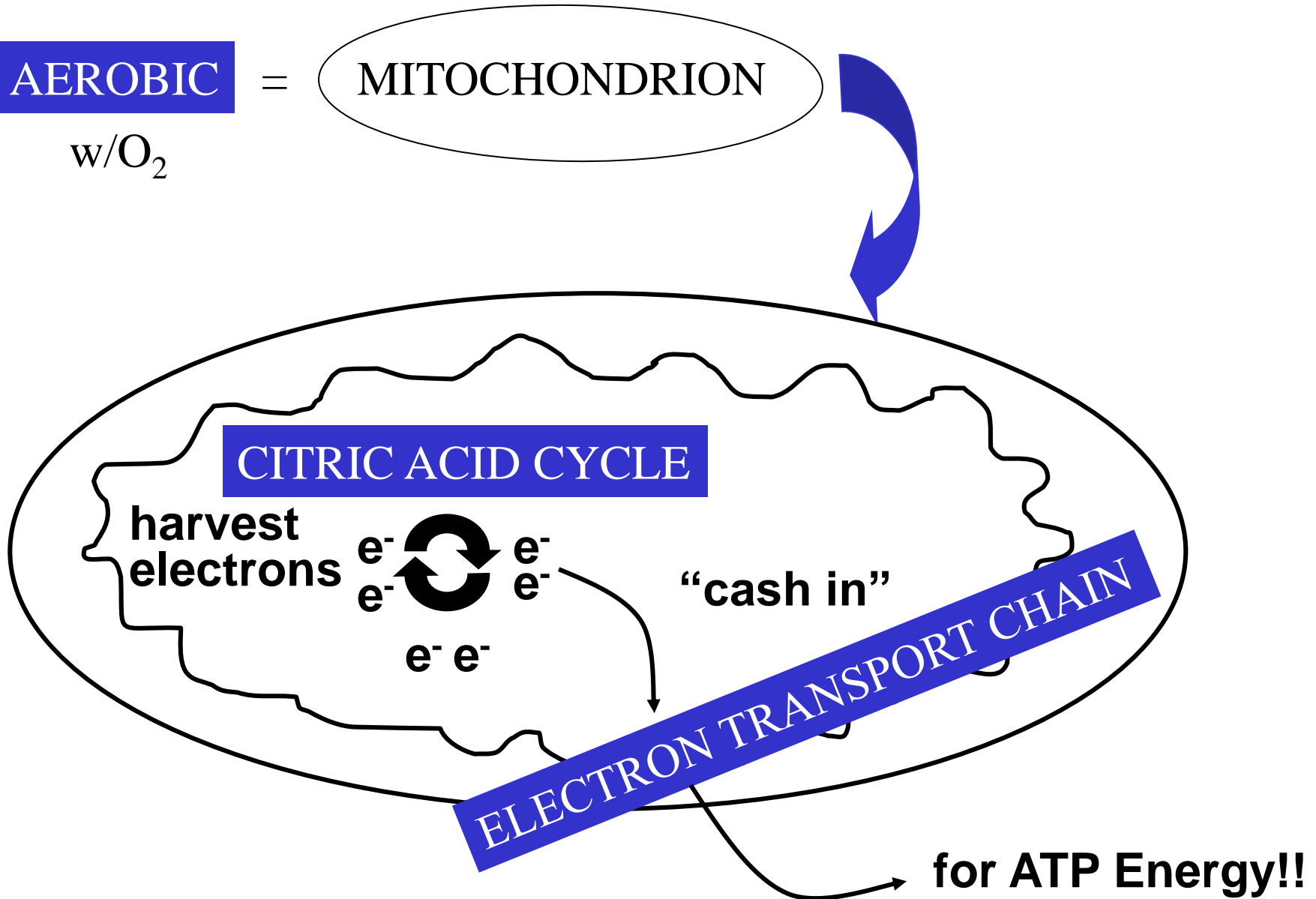
Goals of Aerobic Metabolism

AEROBIC

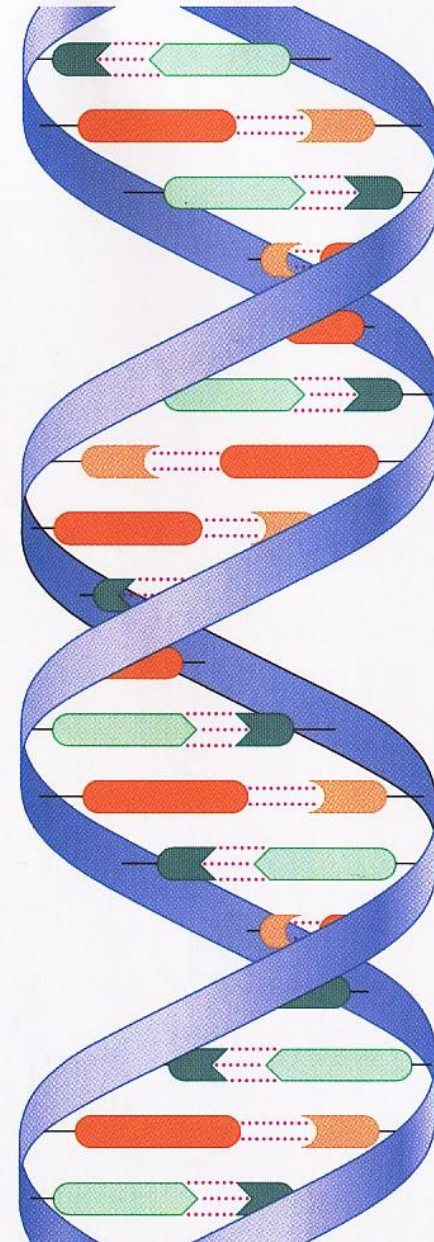
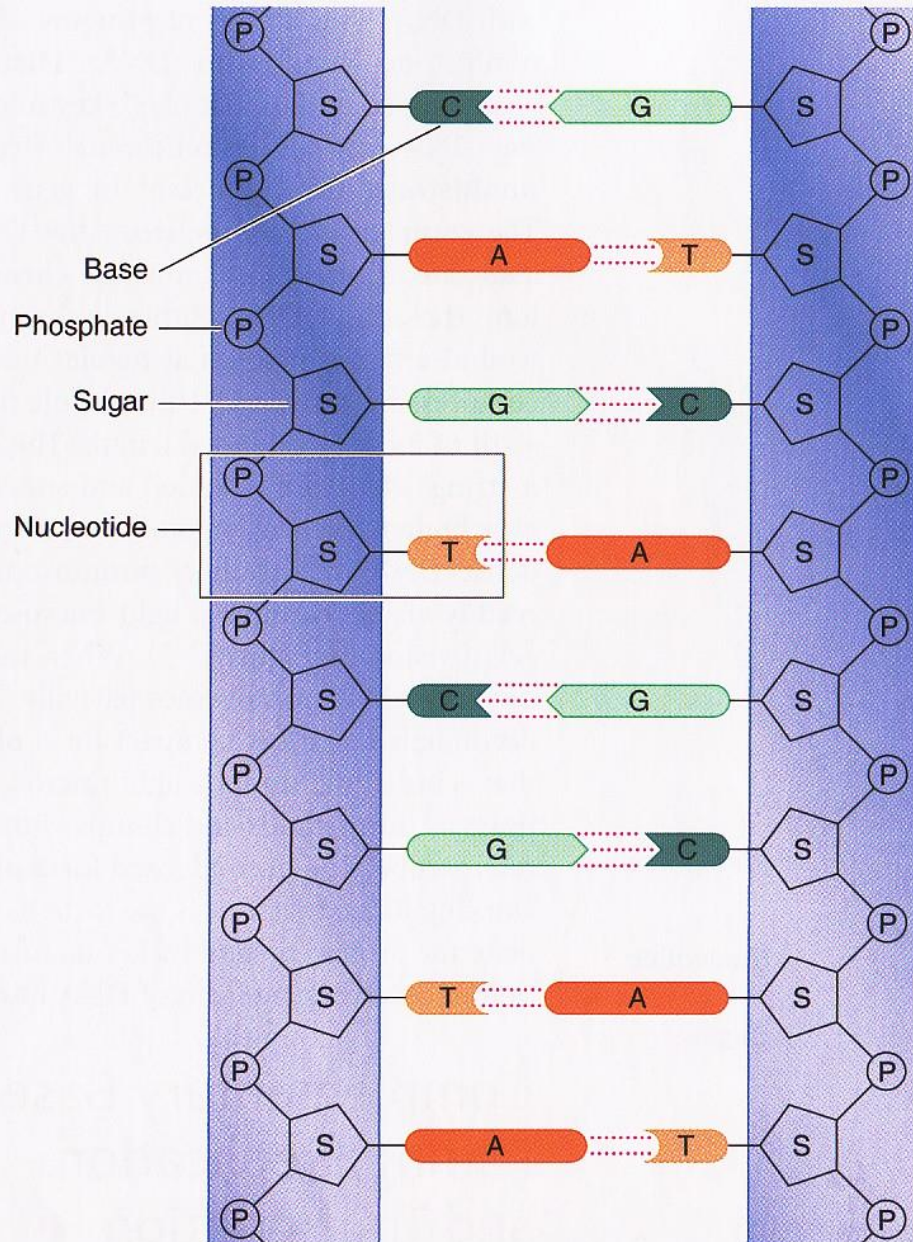
=

MITOCHONDRION

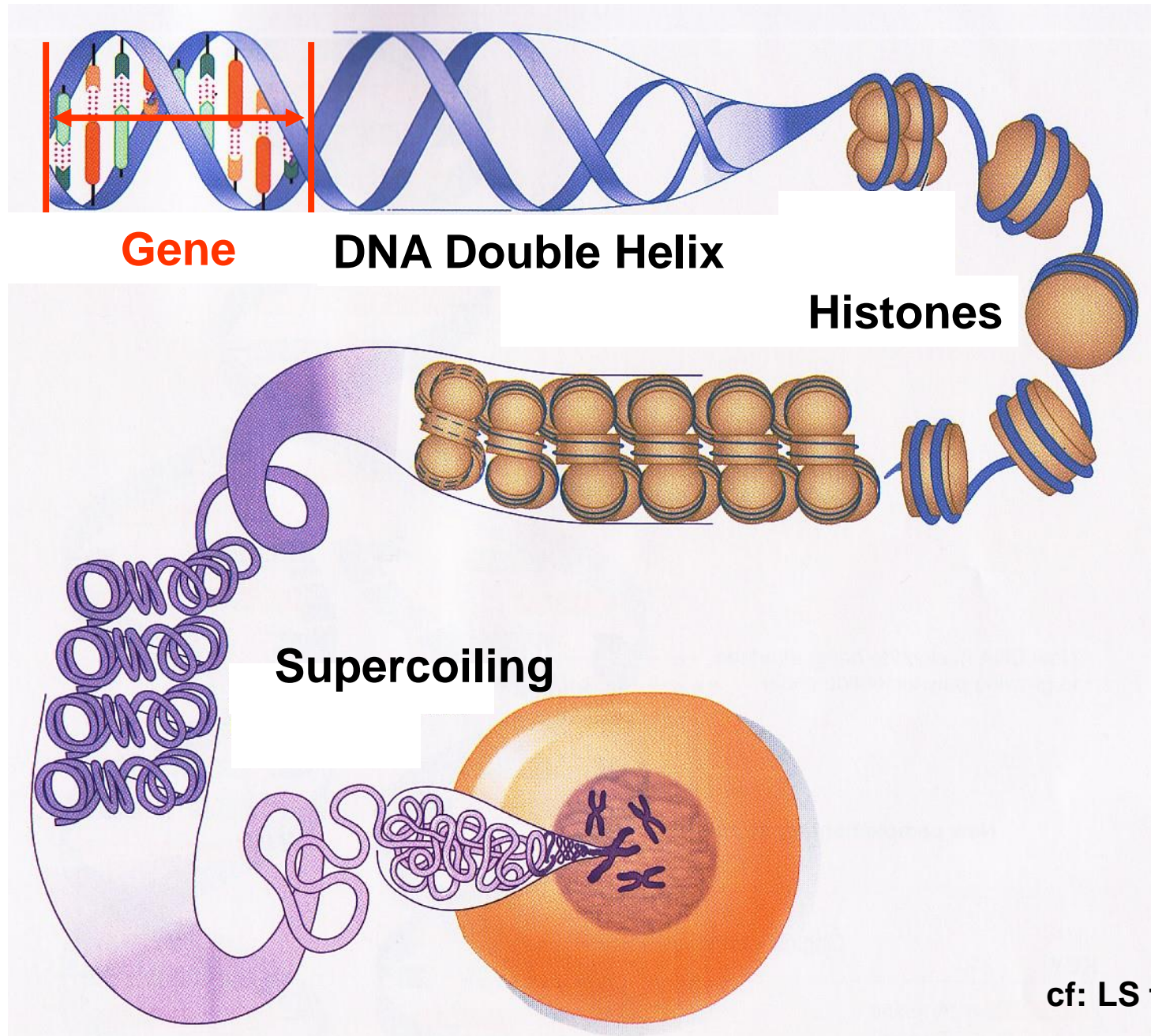
w/O₂



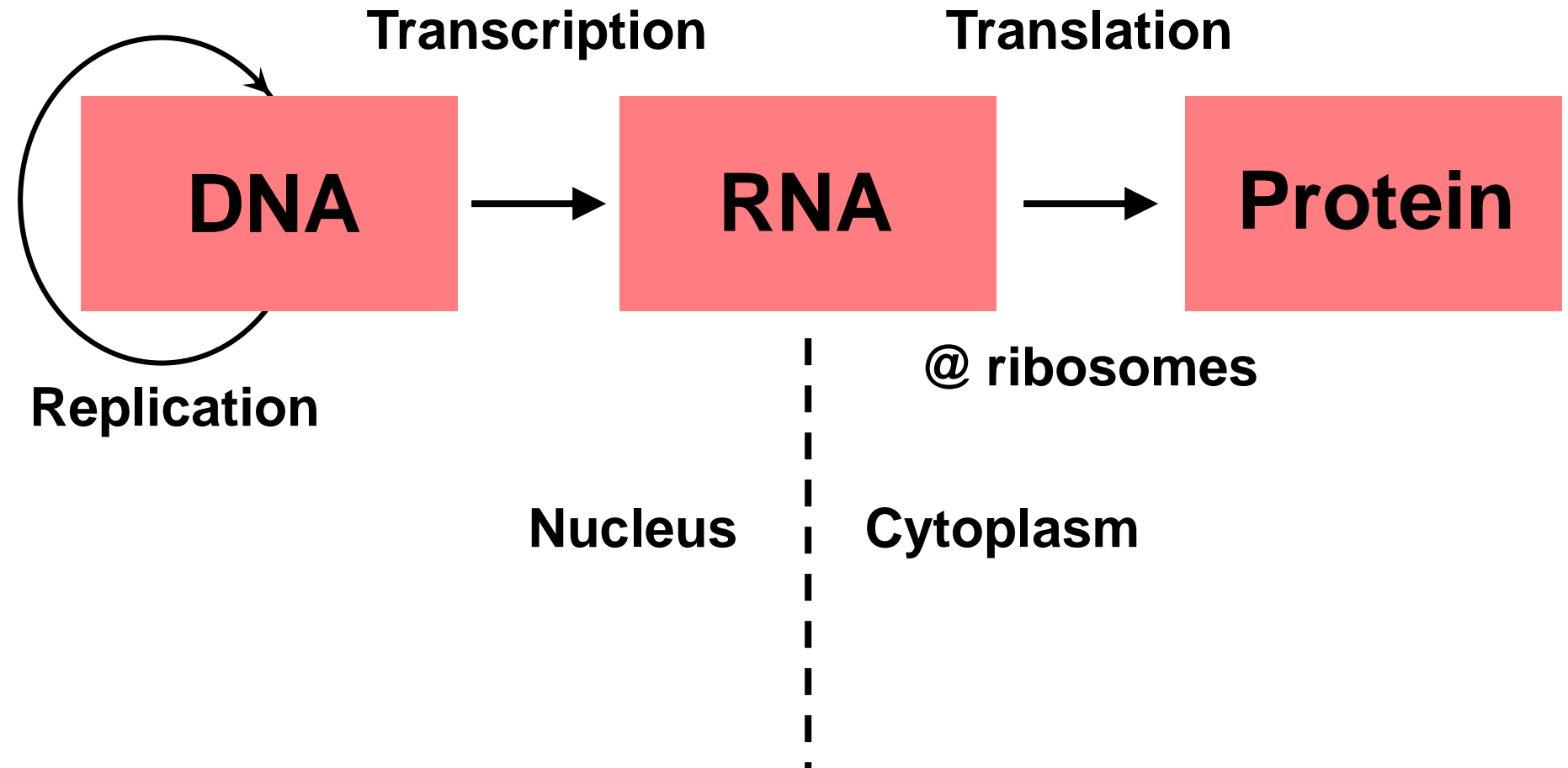
What does DNA look like? Double-helix!!



Gene = *Stretch of DNA that codes for a protein*



What does DNA do, day-to-day?



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^o Cytoplasm
(but Nucleus origin)

6. mRNA, rRNA, tRNA

*Triplets of bases code for amino acids,
the building blocks of proteins*

DNA

mRNA

tRNA

code word

codon

anti-codon

TAT

AUA

UAU

ACG

UGC

ACG

TTT

AAA

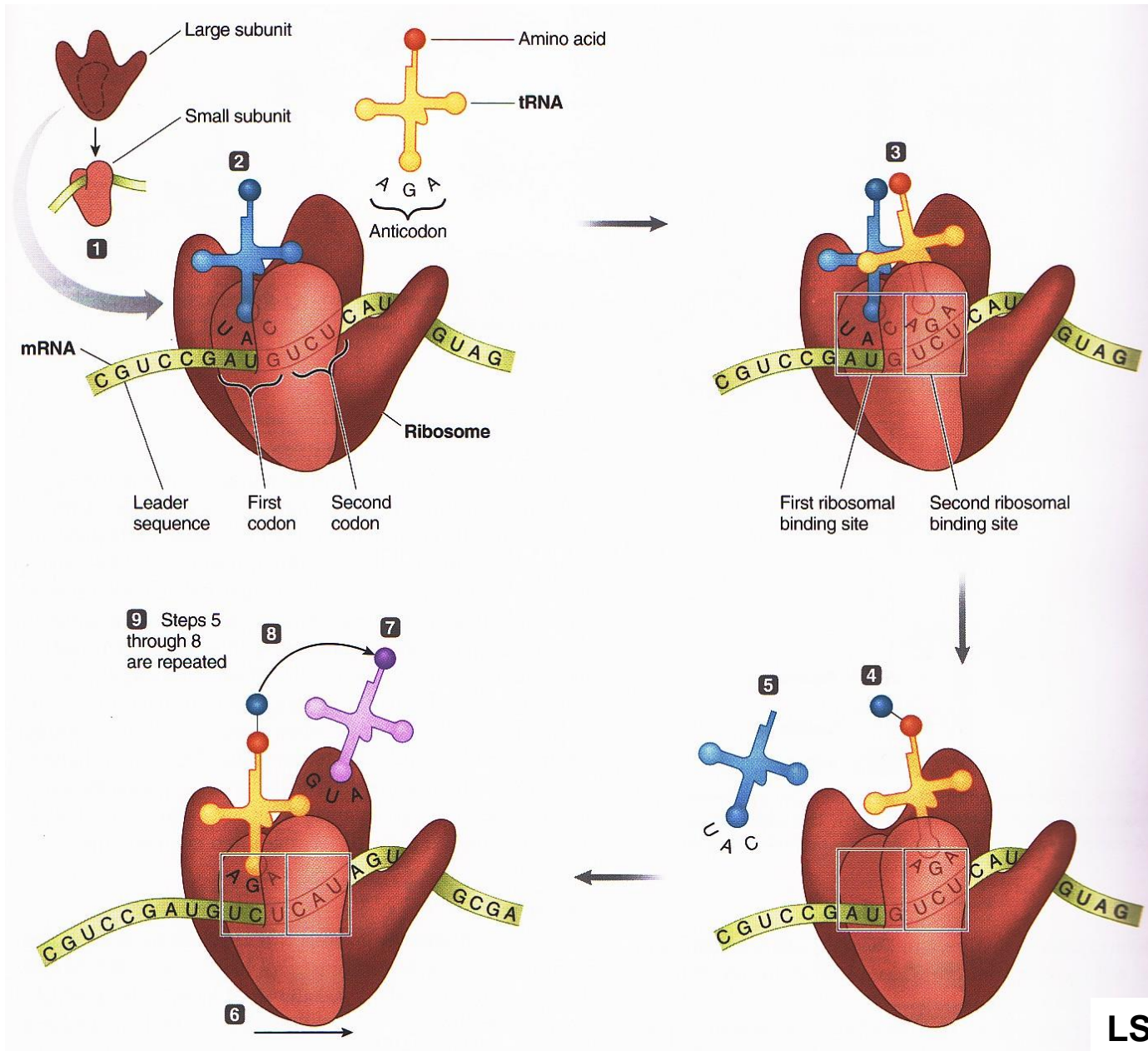
UUU

TAC

AUG

UAC

Translation? Ribosomes Make Proteins

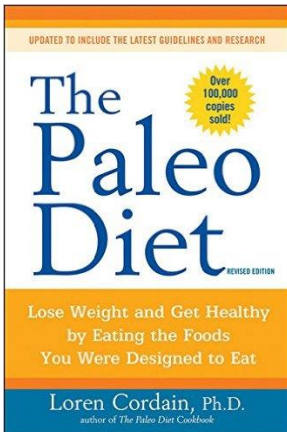
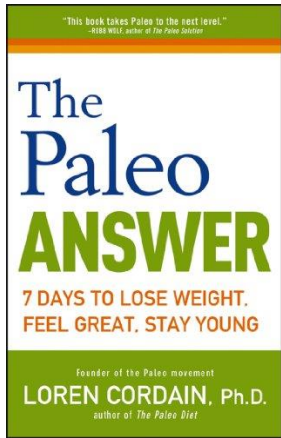
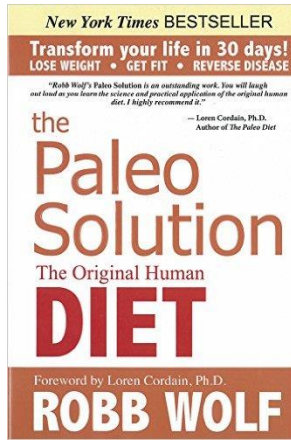




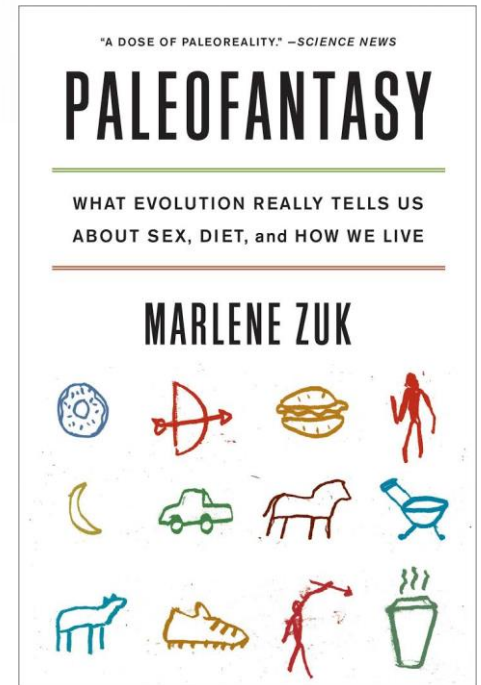
BI 121 Lecture 5

- I. Announcements** Data + Flashdrive for Thursday's lab! Q? Thanks for recording dietary data on LM p 3-7 & finishing <https://www.supertracker.usda.gov/>. Sample Exam Questions.
- 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

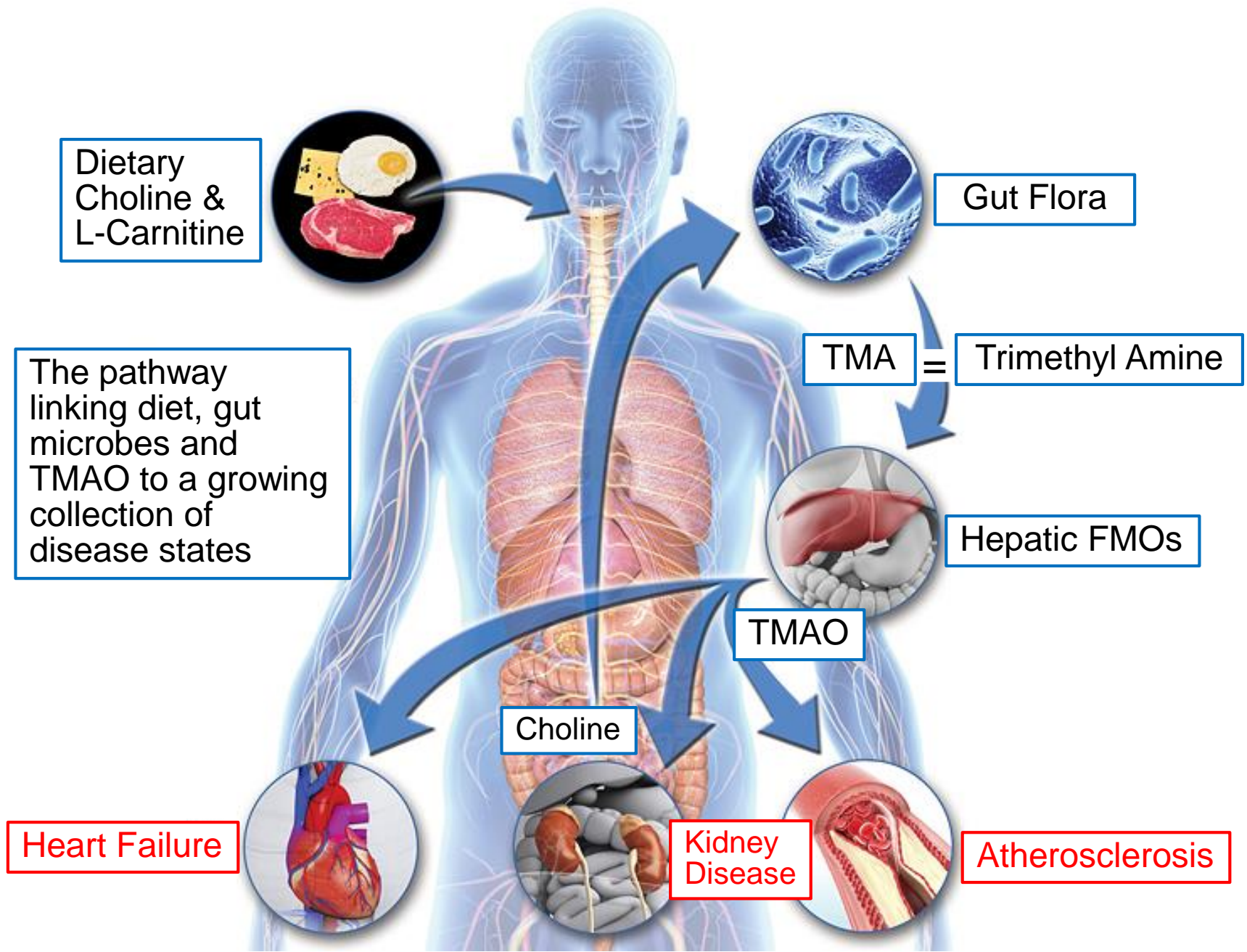
Pondering Paleo?



**Evolutionary Biologist
Behavioral Ecologist
U Minnesota**



<http://www.nutritionaction.com/daily/how-to-diet/pondering-paleo/>



Nutrition Action

OCTOBER 2011 \$2.50

HEALTH LETTER®
CENTER FOR SCIENCE IN THE PUBLIC INTEREST

Eat Real, America!

"With the right food choices, physical activity, and not smoking, we could prevent about 80 percent of heart disease, about 90 percent of diabetes, and 70 percent of stroke," says Walter Willett, chair of the nutrition department at the Harvard School of Public Health in Boston. "Those are the three pillars. They really do make a difference."

The right food choices are simple: Eat less red meat, sweets, refined grains, and salt, and drink fewer sugary beverages. Replace unhealthy foods with vegetables, fruit, beans, and whole grains, and with smaller amounts of fish, poultry, and low-fat dairy. Those foods aren't just good for our health. They can also help protect the Earth.

Here's why—and how—to eat real.

Continued on page 3.

With the right food choices, physical activity, and not smoking, we could prevent about ~90% of diabetes, 80% of heart disease & 70% of stroke!

Photo: © Marisa at Beaudinmau/120

FOOD DAY

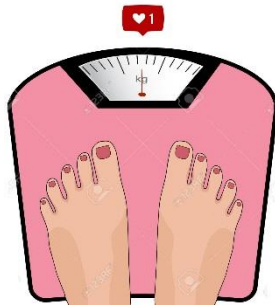
OCTOBER 24, 2011

JOIN US AT FOODDAY.ORG

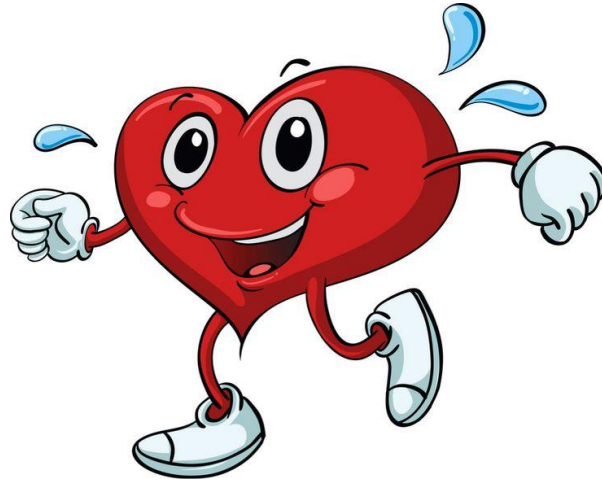
40

CSPI • 1971-2011

Can Lifestyle Modifications Alter Blood Pressure, Cardiovascular & Kidney Disease Risk?



↓ 5-20 mm Hg



↓ 4-9 mm Hg



↓ 2-8 mm Hg

**Do the
DASH!**



↓ 8-14 mm Hg



↓ 2-4 mm Hg

5 times per wk? \equiv 106,600 calories/yr \equiv \pm 30.5 lb fat/yr



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

410 calories

Jogging | **50 min.**



**Better
choices!**

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)

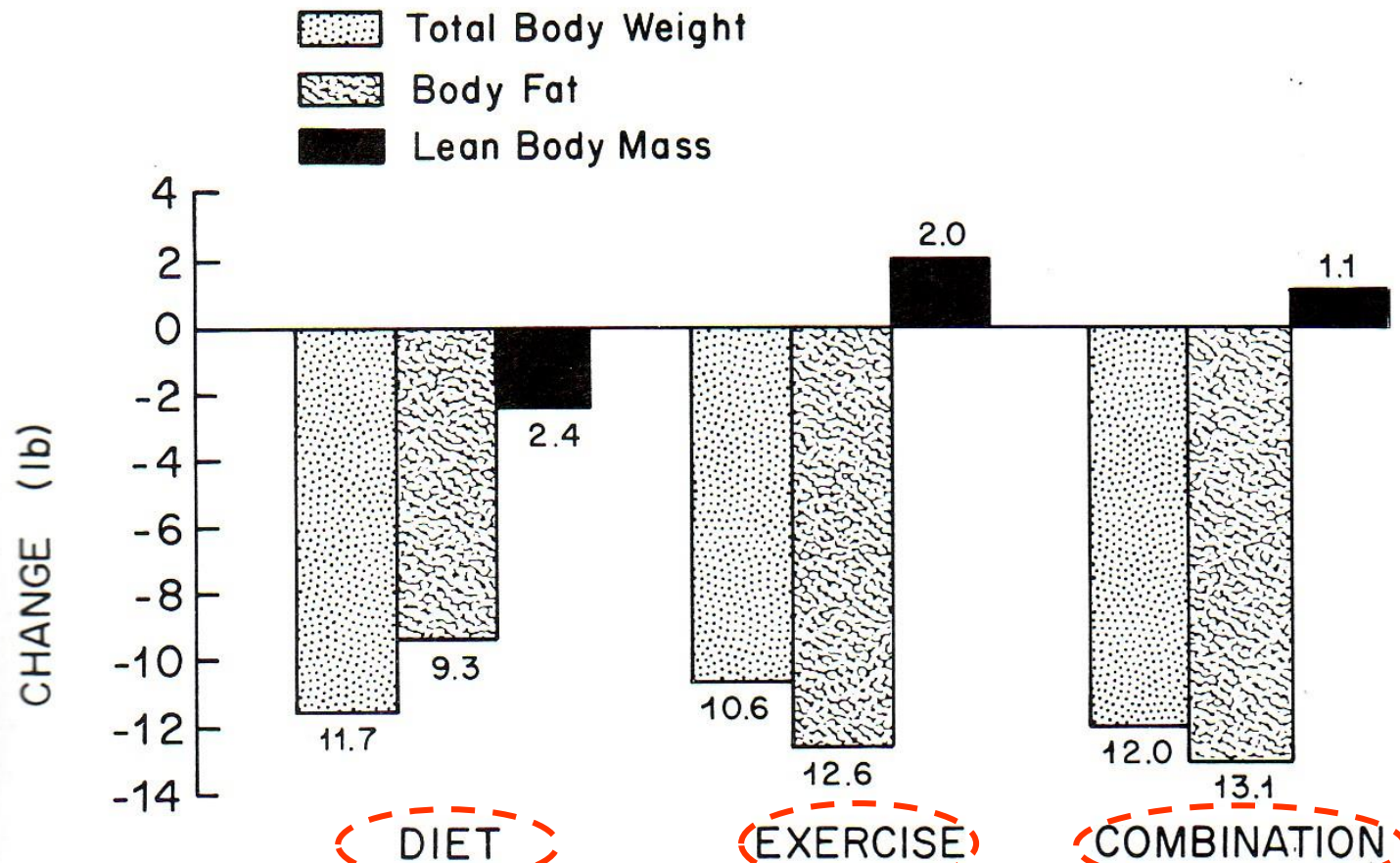


Figure 4-9. Changes in body weight, body fat, and lean body weight for diet, exercise, and combination groups. (From Zuti W. B., and Golding, L. A.: Comparing diet and exercise as weight reduction tools. *Phys. Sportsmed.* 4:49-53, 1976.)

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

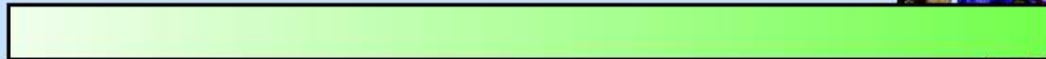
Dietary Composition & Physical Endurance

eg, Atkins!

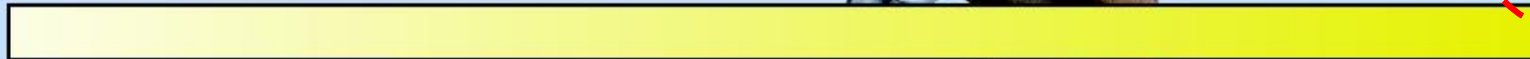
High-fat diet



Normal mixed diet



High-carbohydrate diet



~ 1/3 endurance!

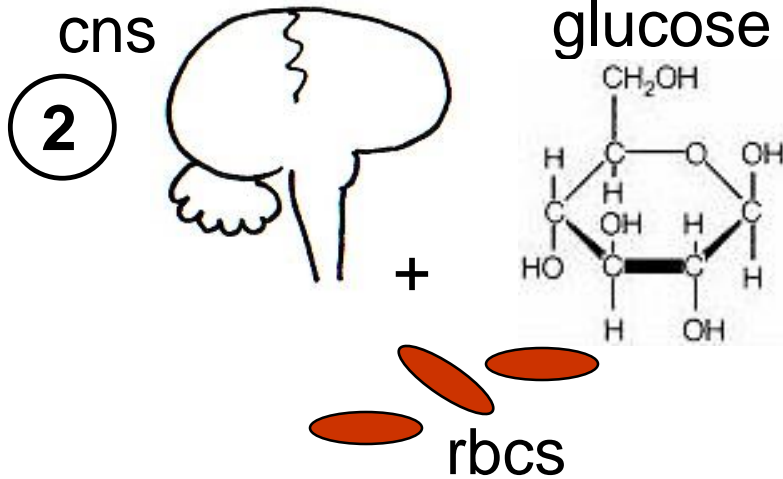
Maximum endurance time:

57 min

114 min

167 min





Negative Effects of Low Carbohydrate

1



- 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.

4



+ gall stones,
↓ thermoregulation...

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

26 lb Water

20 lb Lean Body Mass

14 lb Fat

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

> $\frac{3}{4}$

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

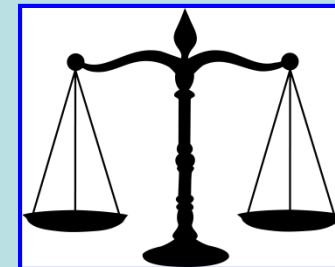
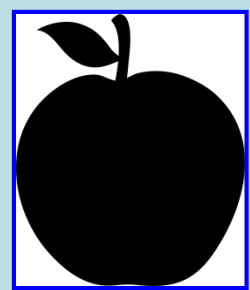
- Eight of 10 ate breakfast daily which may help better manage calories during the day

- Self-monitor, weigh themselves ≥ 1 x/wk & many still keep food dairies

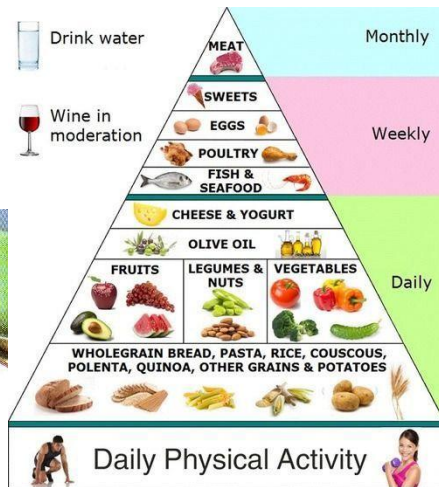
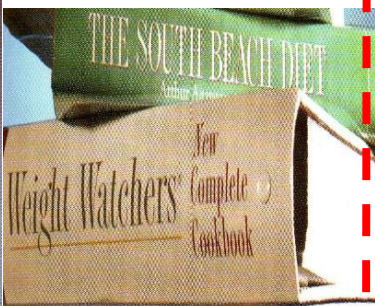
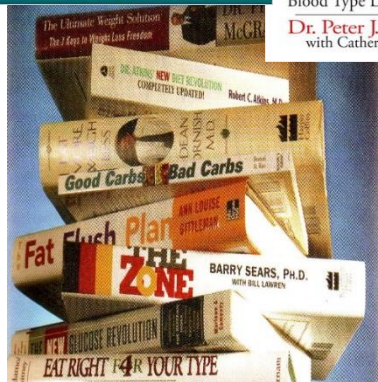
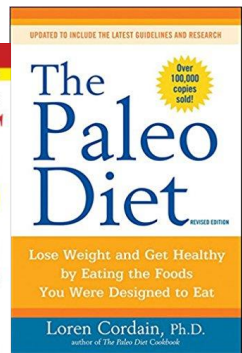
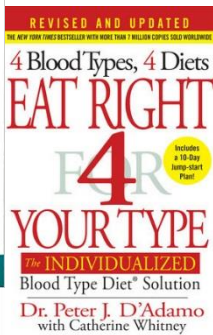
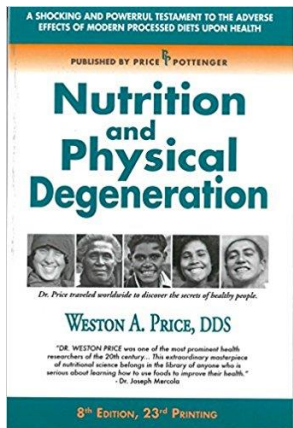
- Much planned physical activity, 60-90 min/d, 1⁰ walking + looked for other ways to be active

<http://www.nwcr.ws/Research/published%20research.htm>

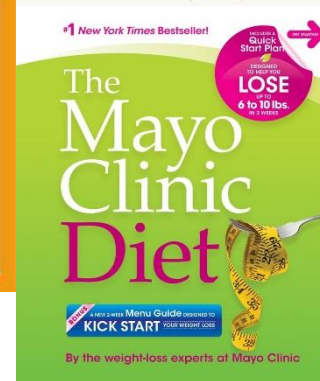
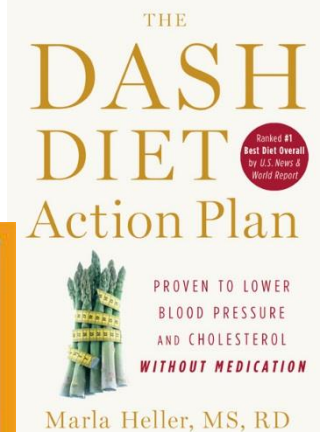
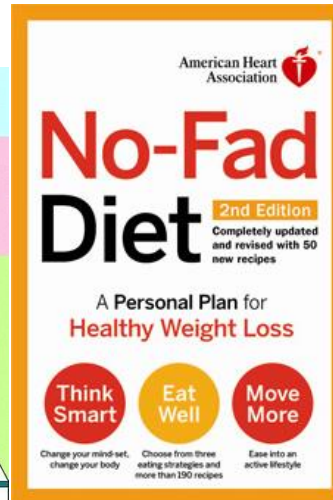
UC Berkeley Wellness Engagement Calendar, September 2013



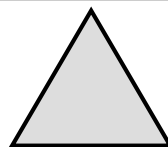
Which Diets are Best?



Mediterranean Diet



Not Plant-based
Lower Carbohydrate



Plant-based
Lower Fat

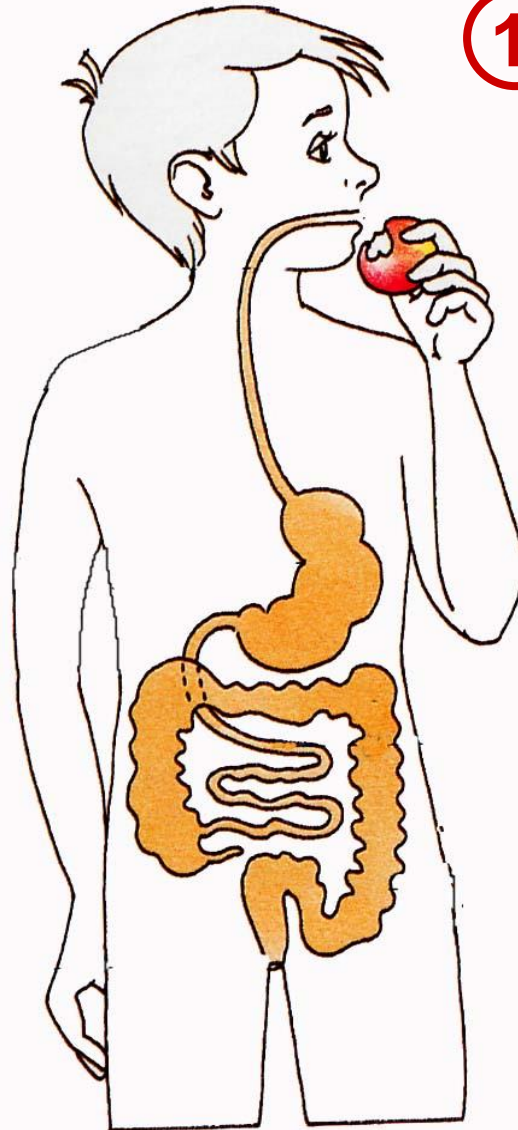


Not Peer-Reviewed = Trade Book
→ Opinion



Peer-Reviewed = Text Books
→ Research

Digestion Steps



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

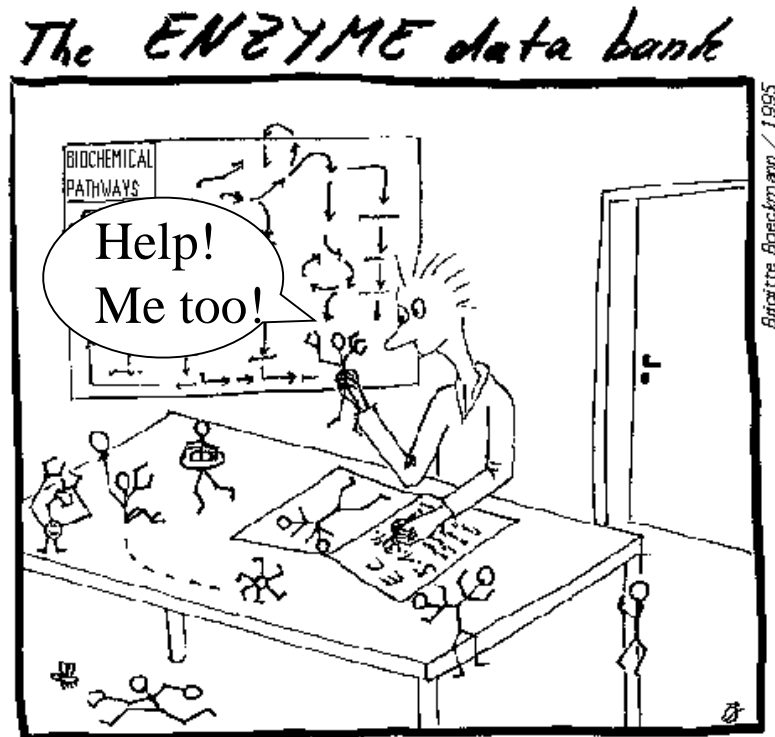
SOURCE: Dr. Eugene Evonuk, 1989. cf. L Sherwood, 2012 pp 437-8.

Hydrolysis of Energy Nutrients

Hi gang!!
You need me
for digestion!!



+

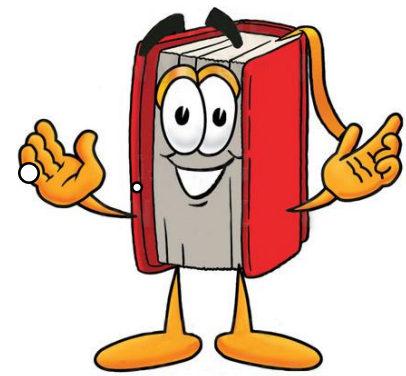


H₂O

+

Enzyme

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

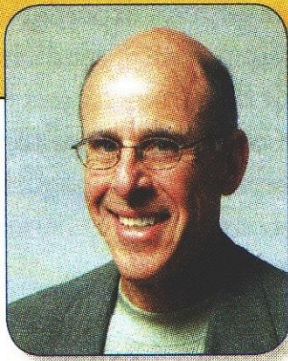


BI 121 Lecture 6

- I. Announcements** Next session Q? ~1/2 review, then Exam I.
Fun Lab 3 Nutrition after Exam I! Q?
- II. Nutrition News + Connections** Be a whiz at healthy grilling!
American Institute for Cancer Research, Grilling Quiz!
Dietary Guidelines for Americans 2015-2020, Blue Zones?
- 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

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 in a day!** Cook small portions/kebabs.



John Swartzberg, M.D.
Chair, Editorial Board

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 $5\% + (18\% \text{ of } 5\%) = 6\%$. 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 Guidelines for Americans 2015-2020

Released January 7, 2016

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/>

The World's Longest-Lived People!

○ Blue Zones! ○



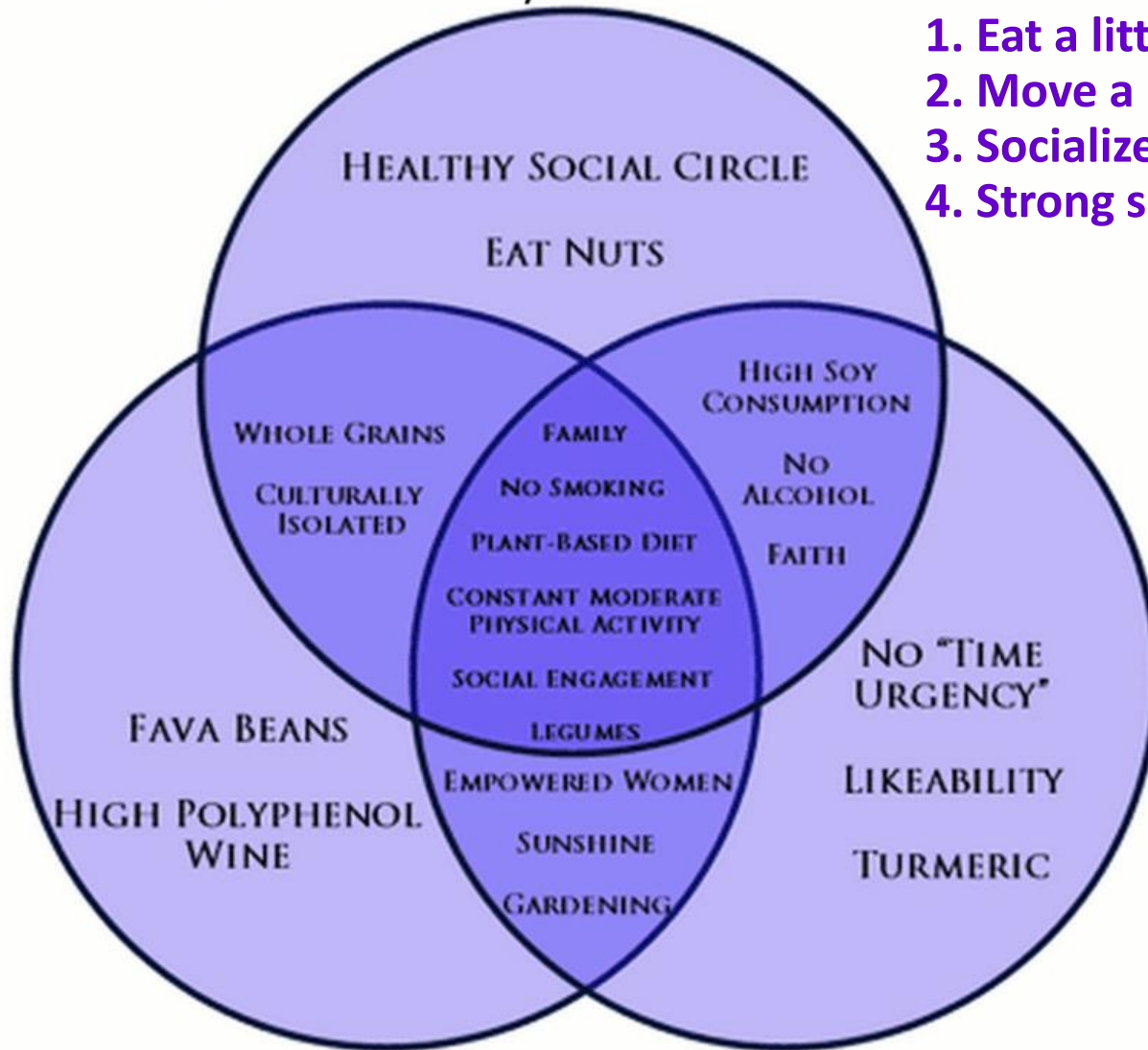
<https://www.cbsnews.com/news/blue-zones-do-people-who-live-in-certain-areas-live-longer/>, Aug 2013.

Buettner, D. *National Geographic*, Nov 2005.

M Poulain & Coworkers. *Experimental Gerontology*, Sep 2004

Loma Linda, United States

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



Sardinia,
Italy

Okinawa,
Japan

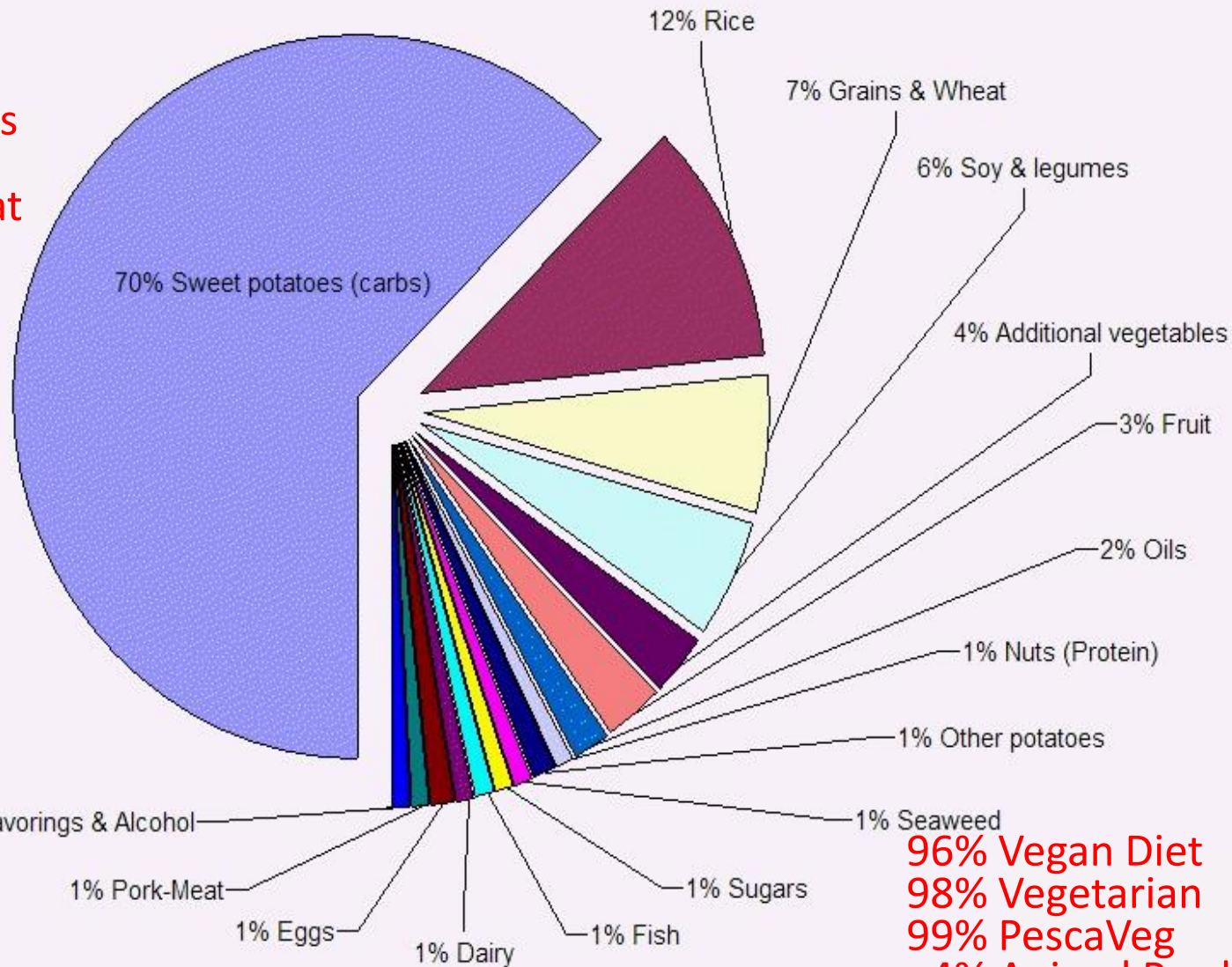
https://en.wikipedia.org/wiki/Blue_Zone

<https://bluezones.com/>

<http://www.sciencedirect.com/science/article/pii/S0531556504002141>

OKINAWA LONGEVITY DIET

- 70% Sweet Potatoes
- 12% Rice
- 7% Grains & Wheat
- 6% Soy & legumes
- 4% Additional vegetables
- 3% Fruit
- 2% Oils
- 1% Nuts (Protein)
- 1% Other potatoes
- 1% Seaweed
- 1% Sugars
- 1% Fish
- 1% Dairy
- 1% Eggs
- 1% Pork-Meat
- 1% Flavorings & Alcohol



85% Carbohydrates
 9% Protein
 6% Fat
 85-10-5
 1785 Calories

96% Vegan Diet
 98% Vegetarian
 99% PescaVeg
 <4% Animal Prod
 <1% Fish
 <1% Meat-Pork

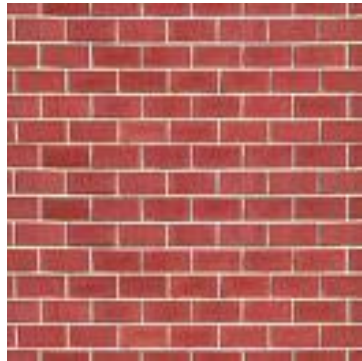
SCIENTIFIC STUDY: "The Diet of the World's Longest-Lived People and Its Potential Impact on Morbidity and Life Span"
 JOURNAL: Annals of the Academy of Sciences - Volume 1114: 434-455 (2007).

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.

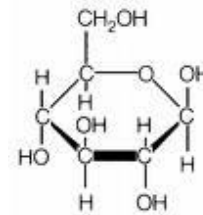
Polymer to Monomer (Many to One)



...Central-linking theme!!

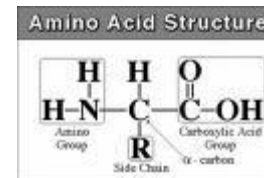


Carbohydrate

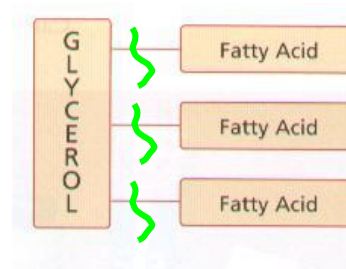
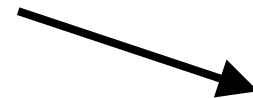


Glucose

Protein
+
Fat

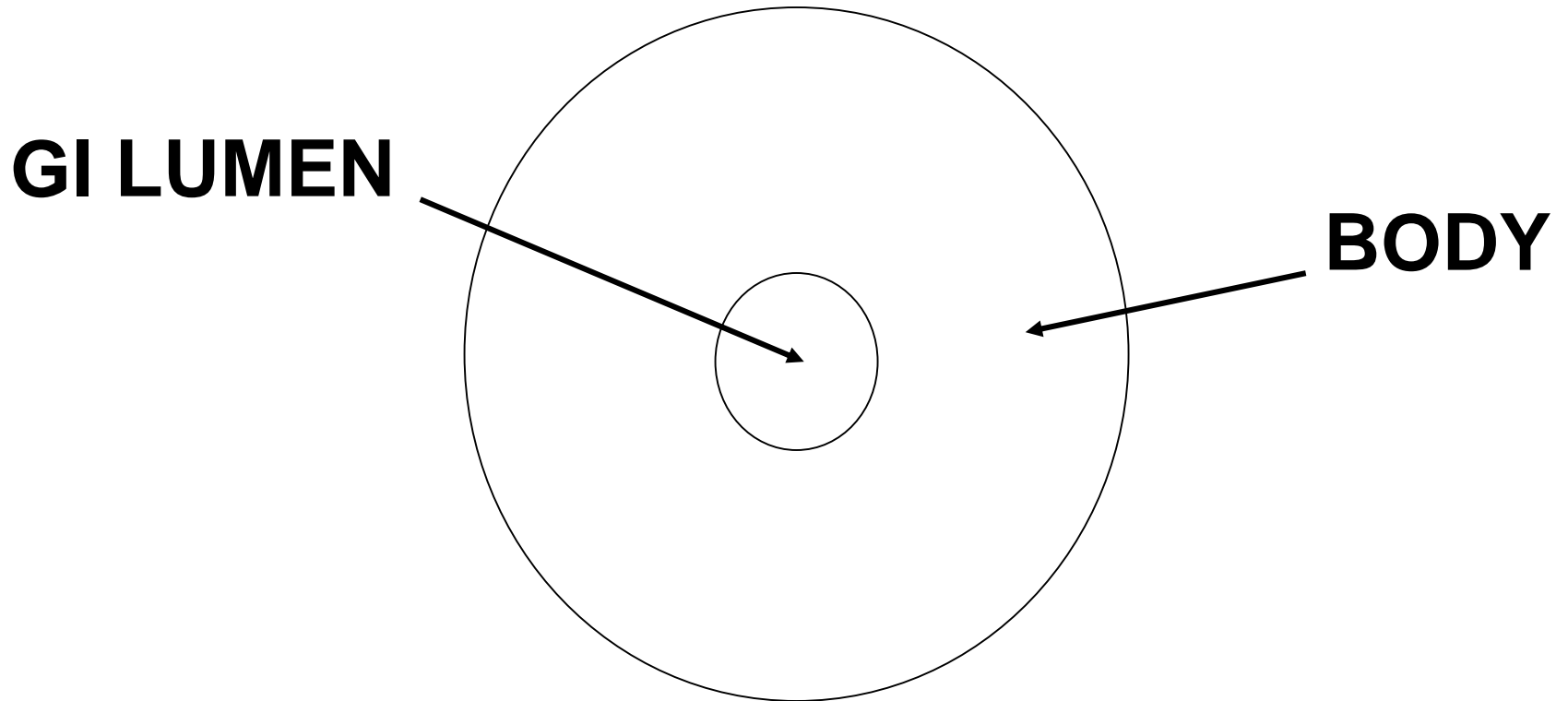


Amino Acids



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+

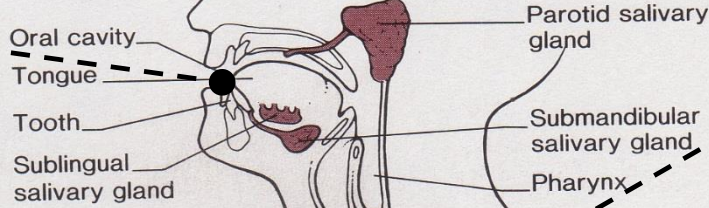
into GI Lumen

4. Hormones

into Blood

1. Mouth

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



2. Esophagus

Rapid transit
peristalsis
secretion mucus

Esophagus

3. Stomach

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

Stomach

5. Pancreas

Secretion mucus +
 NaHCO_3 + enzymes
enzymatic digestion:
carbohydrate, fat, protein

Pancreas

Liver

Gallbladder

Duodenum

Large intestine

Small intestine

Anal canal

Rectum

4. Liver-Gall Bladder

Emulsification =
detergent action of bile
+ secretion

6. Small Intestine

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

Liver

Gallbladder

Duodenum

Large intestine

Small intestine

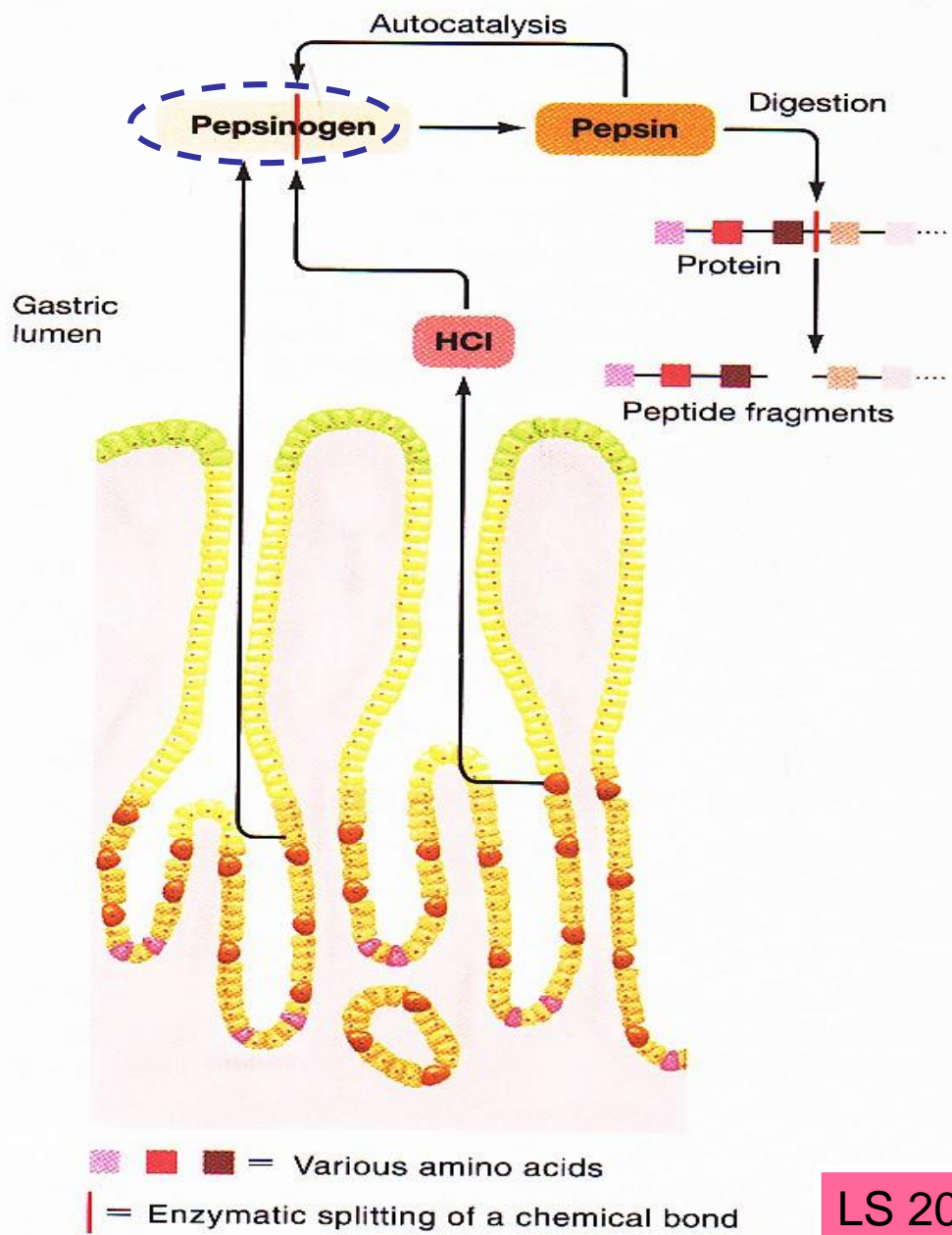
Anal canal

Rectum

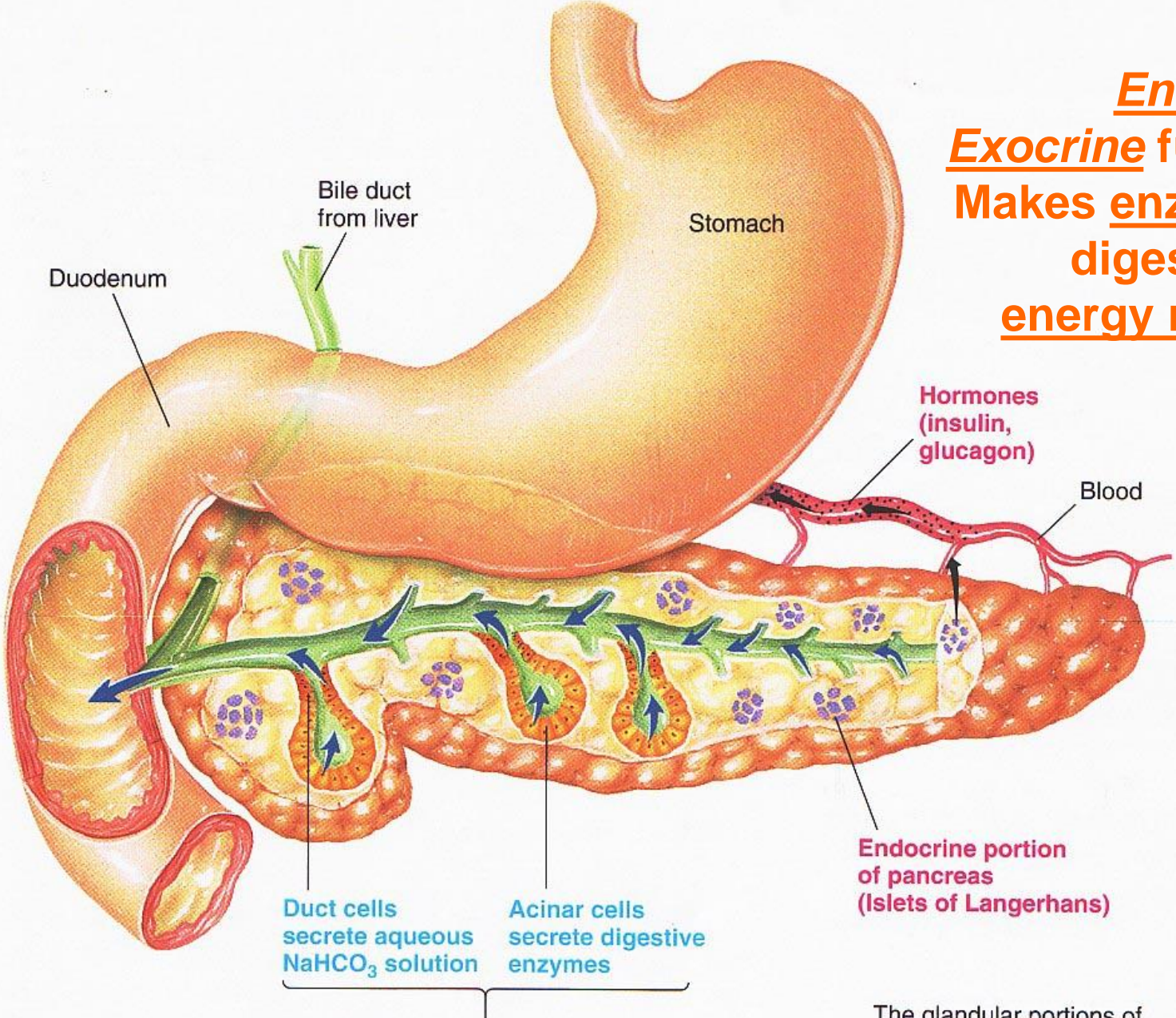
7. Large Intestine

Dehydration
secretion + absorption
storage + peristalsis

**Zymogen =
an inactive
precursor**



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.

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

