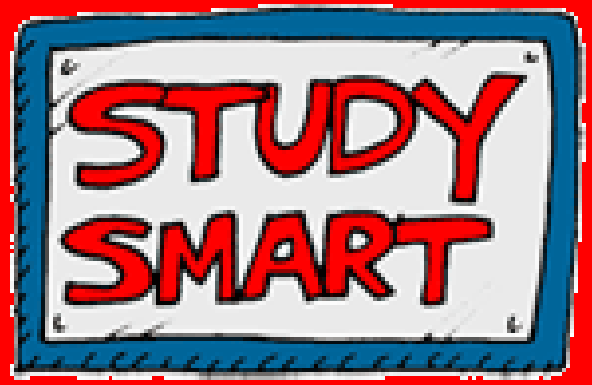
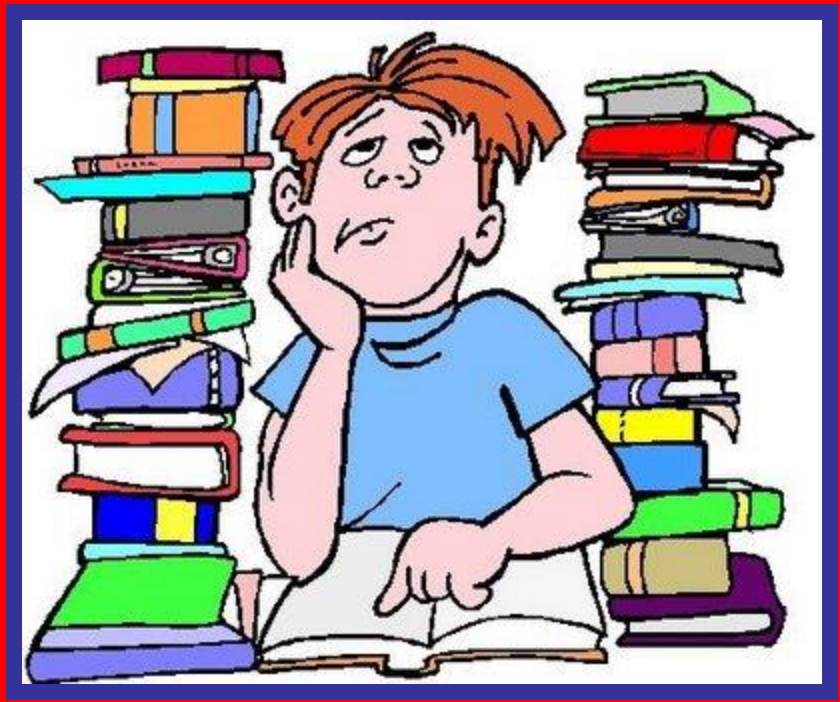
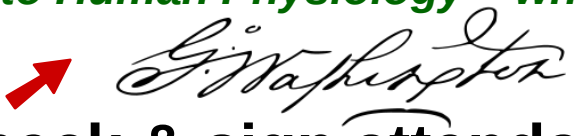
Midterm Review Slides





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



BI 121 Lecture 1

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?

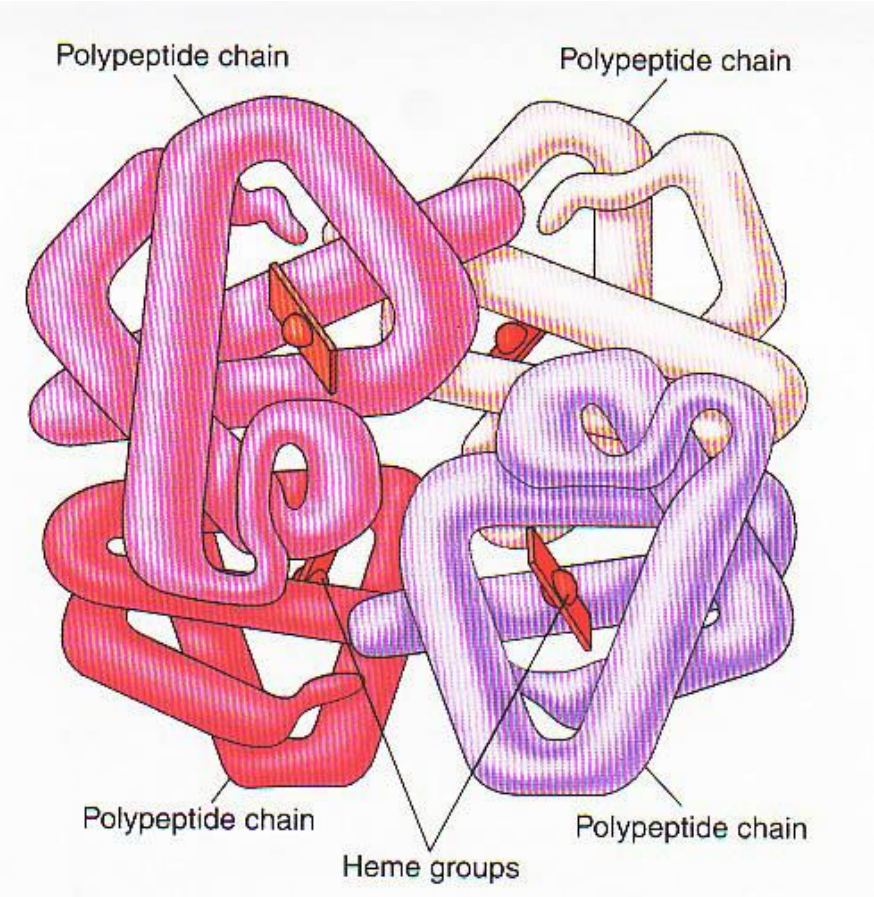
III. ***Human Physiology*** LS ch 1, DC Module 1
- A. What? cf: Anatomy LS p 1
- B. Where?Body Levels of Organization LS pp1-6, DC pp1-5
- C. How? Different Study Approaches LS p 1
- D. Why? Security+Decision-Making Power LS p xxi, DC p v

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	vs	PHYSIOLOGY
STRUCTURE	vs	FUNCTION
WHAT?	vs	HOW?
WHERE?	vs	WHY?

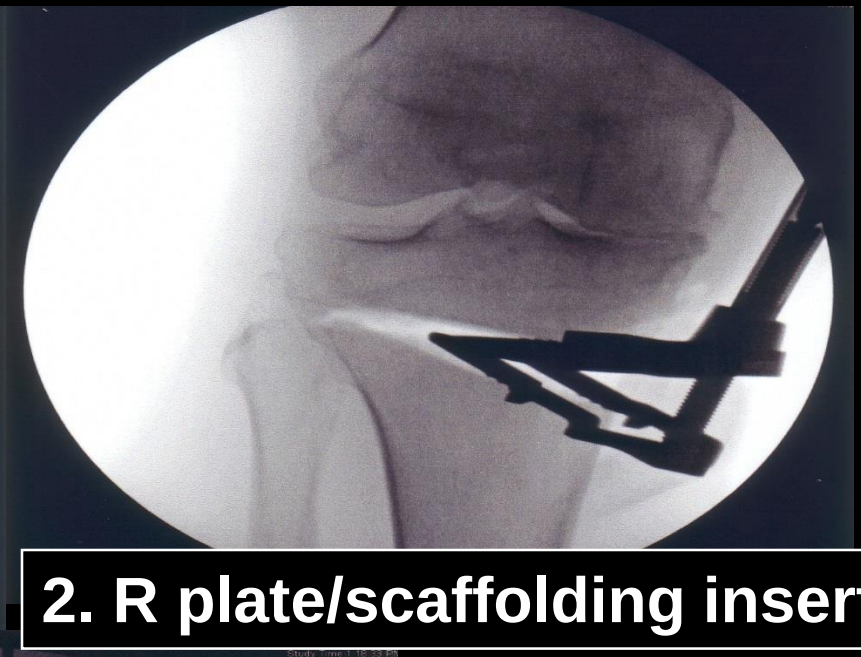
vs

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



High-Tibial Osteotomy (HTO) to Realign the Joint

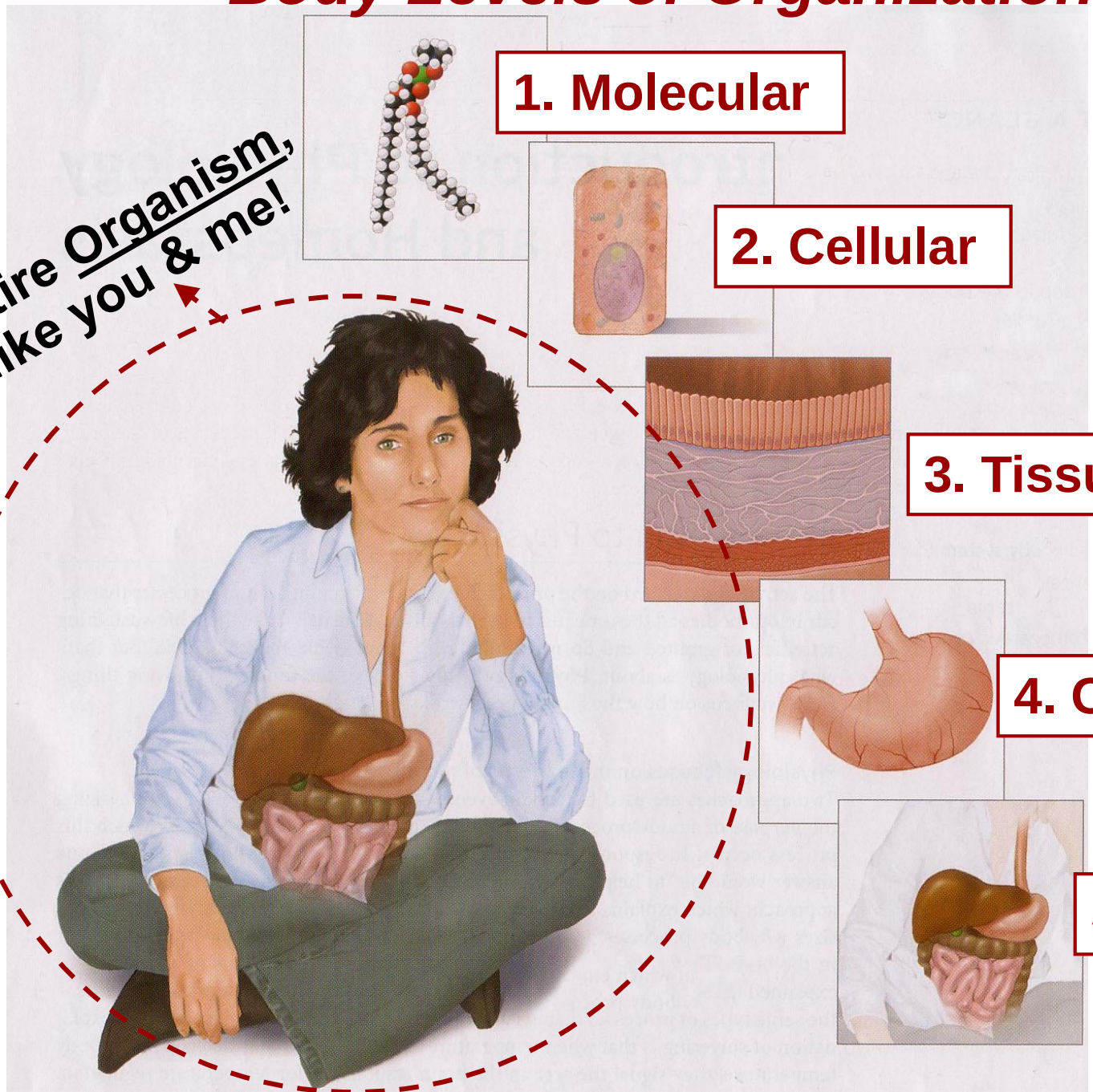
1. Oscillating saw cut



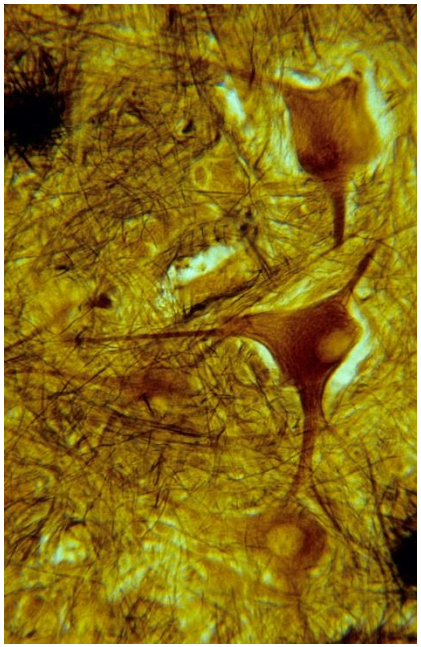
2. R plate/scaffolding insert

3. Align, stabilize w/screws & pack defect

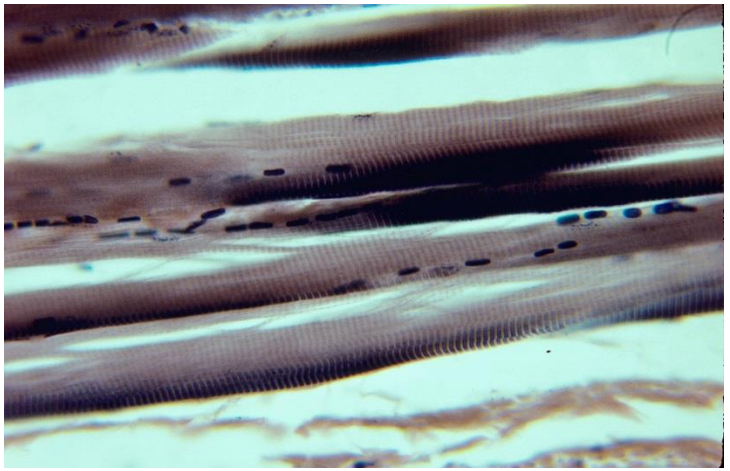
Body Levels of Organization



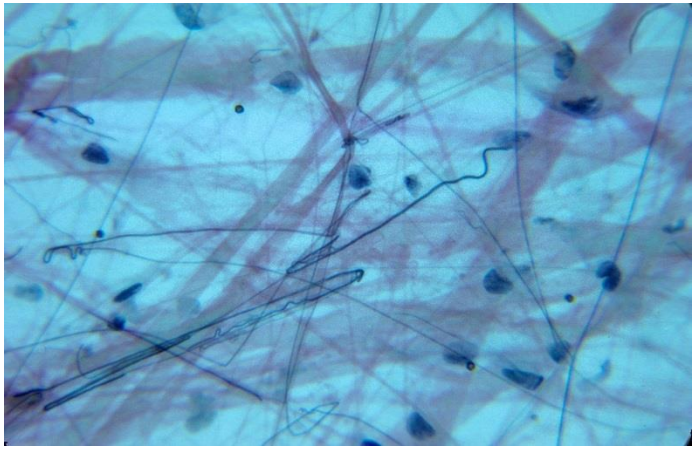
LS fig 1-1 p 2



Nerve conducts



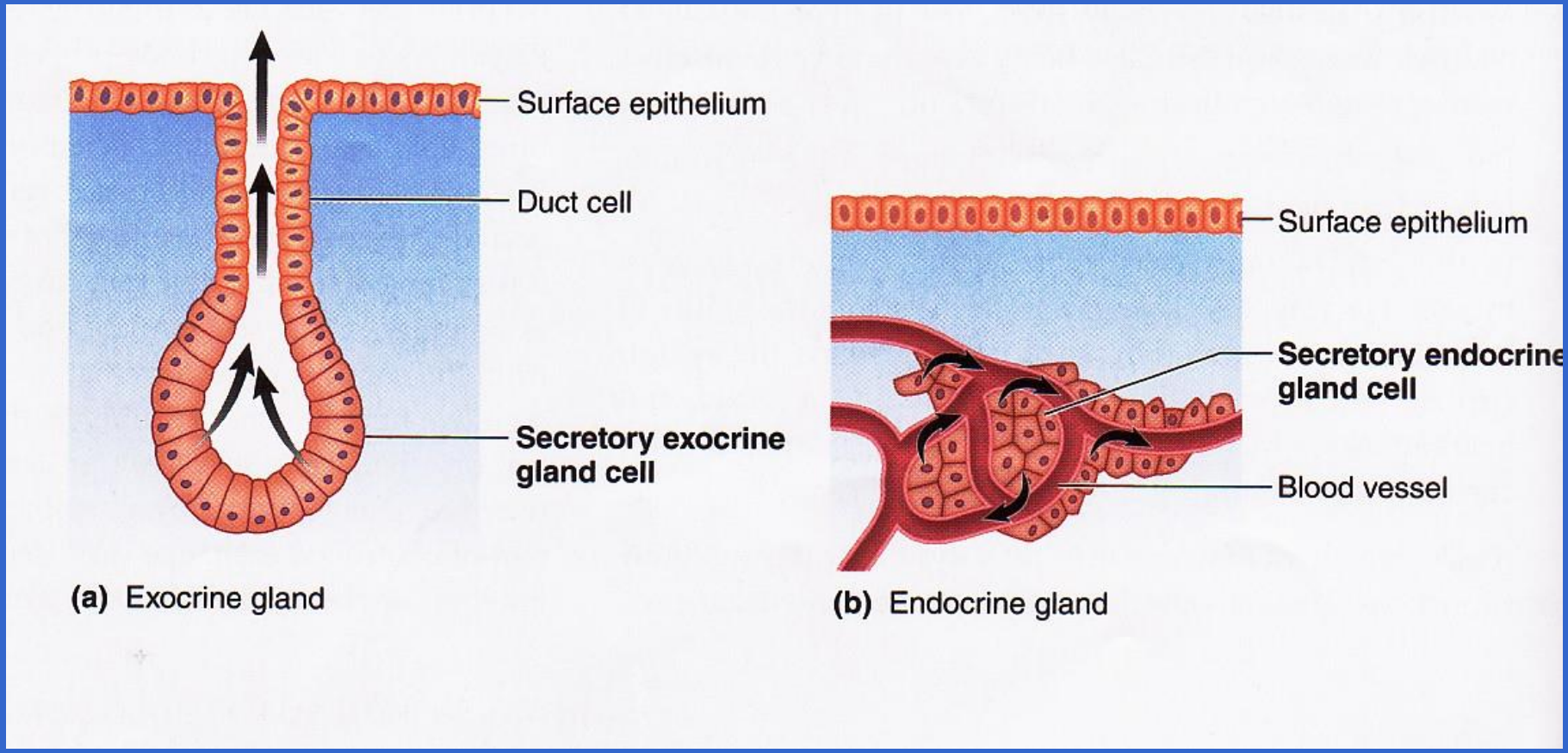
Muscle contracts



Connective connects!!

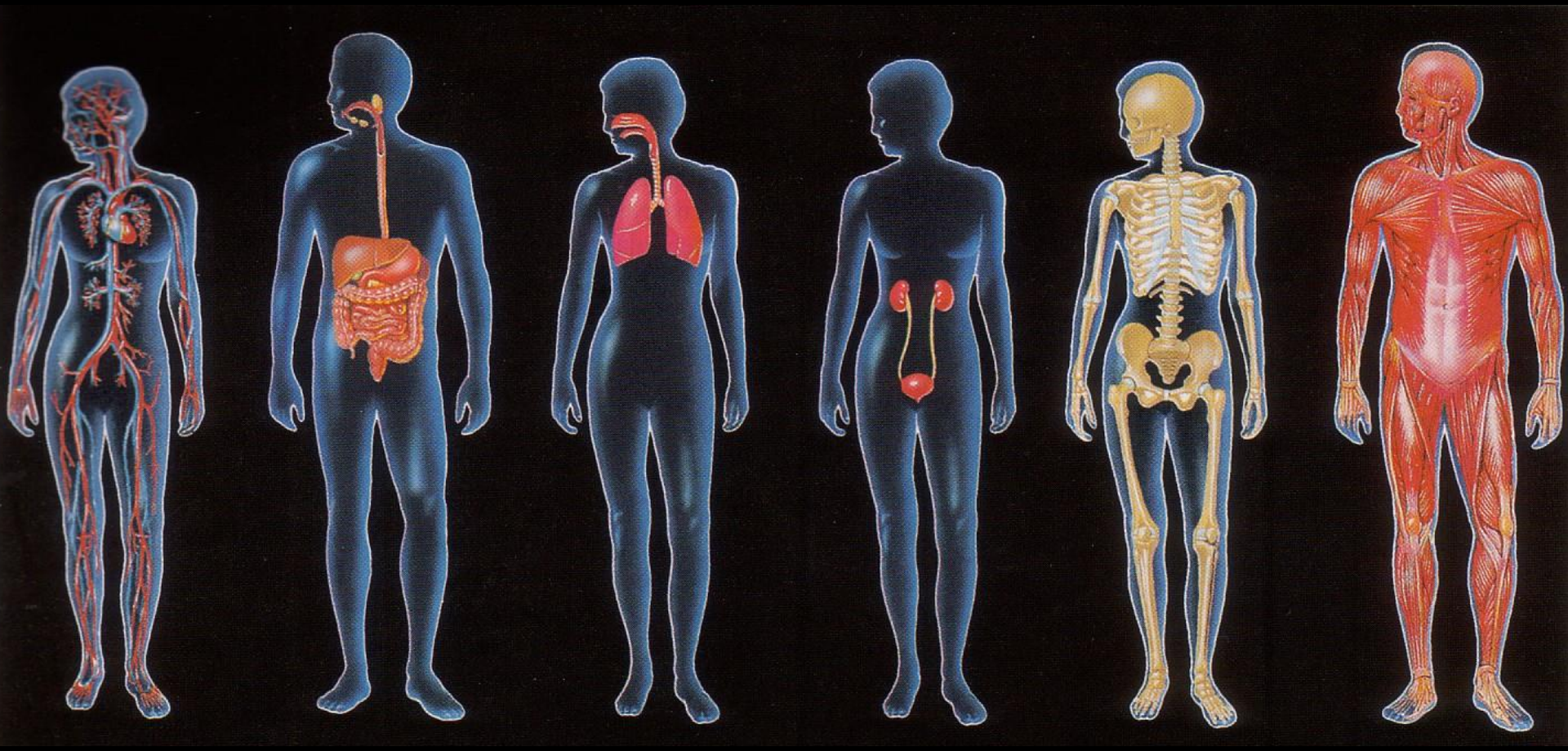
Epithelial covers

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



LS fig 1-3 p 4

Which body systems?



LS fig 1-4 p 6

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

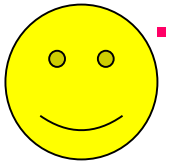
milieu interieur?

Claude Bernard

100 trillion cells working intimately

Walter B. Cannon

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.* H_2O, 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

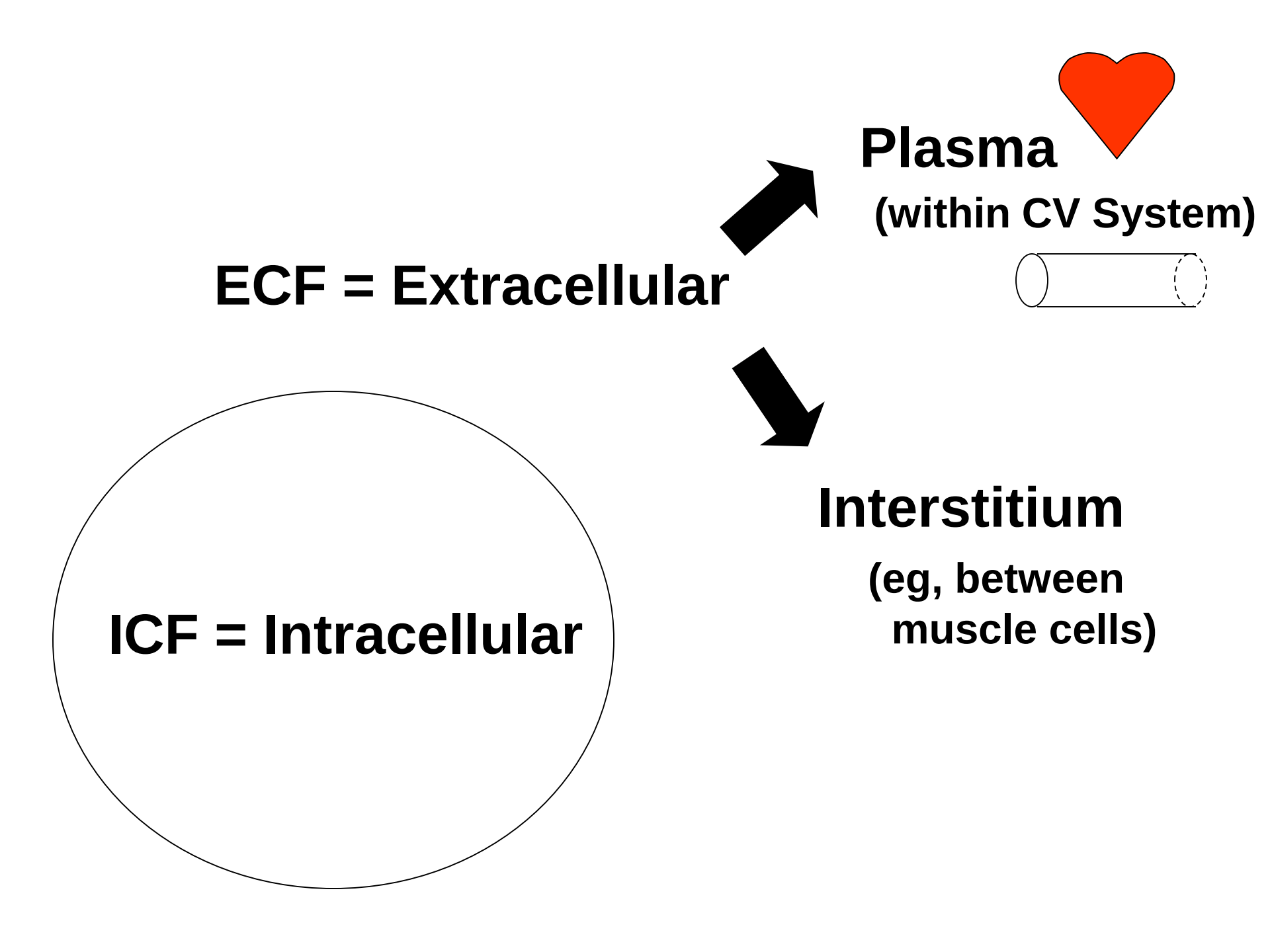
B. Basic survival skills ch 1 p 3

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

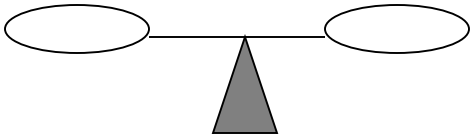
D. ***Physiol News*** Moms eggs execute Dad's mitochondria?

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


Plasma
(within CV System)
ECF = Extracellular
Interstitium
(eg, between
muscle cells)
ICF = Intracellular

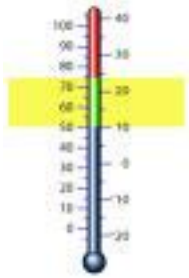
Metabolic

ANA- CATA-



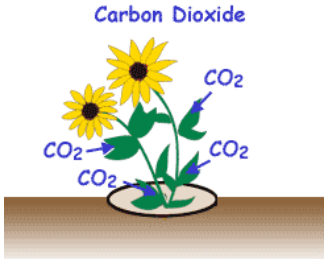
H_2O

T°C



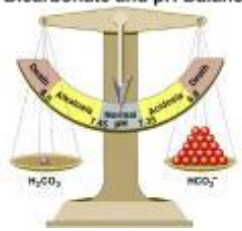
Dr. Evonuk's 6 Balances

O_2/CO_2



$Ion^{+/-}$

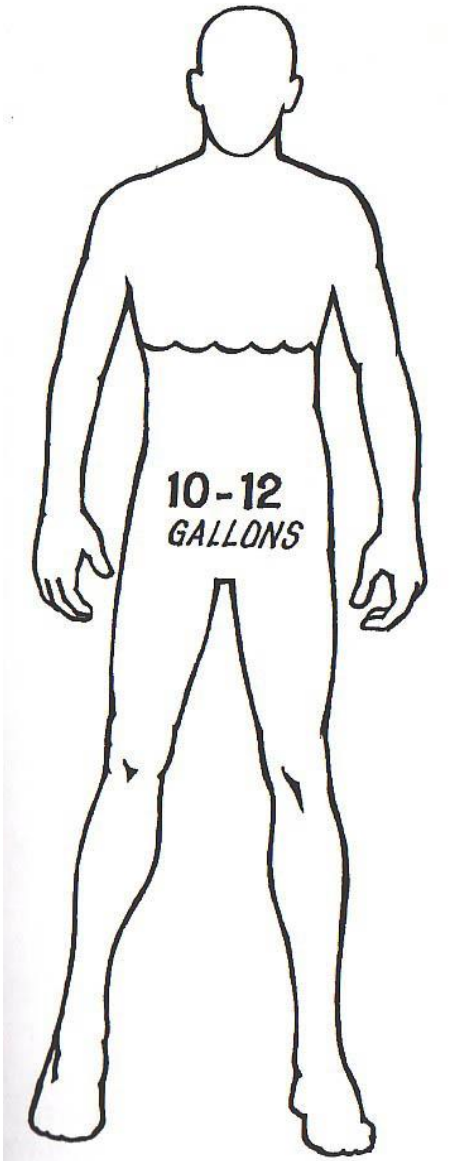
pH



Drink about 1 L per 1000 calories energy expenditure!!

Human ~ 2/3 H_2O

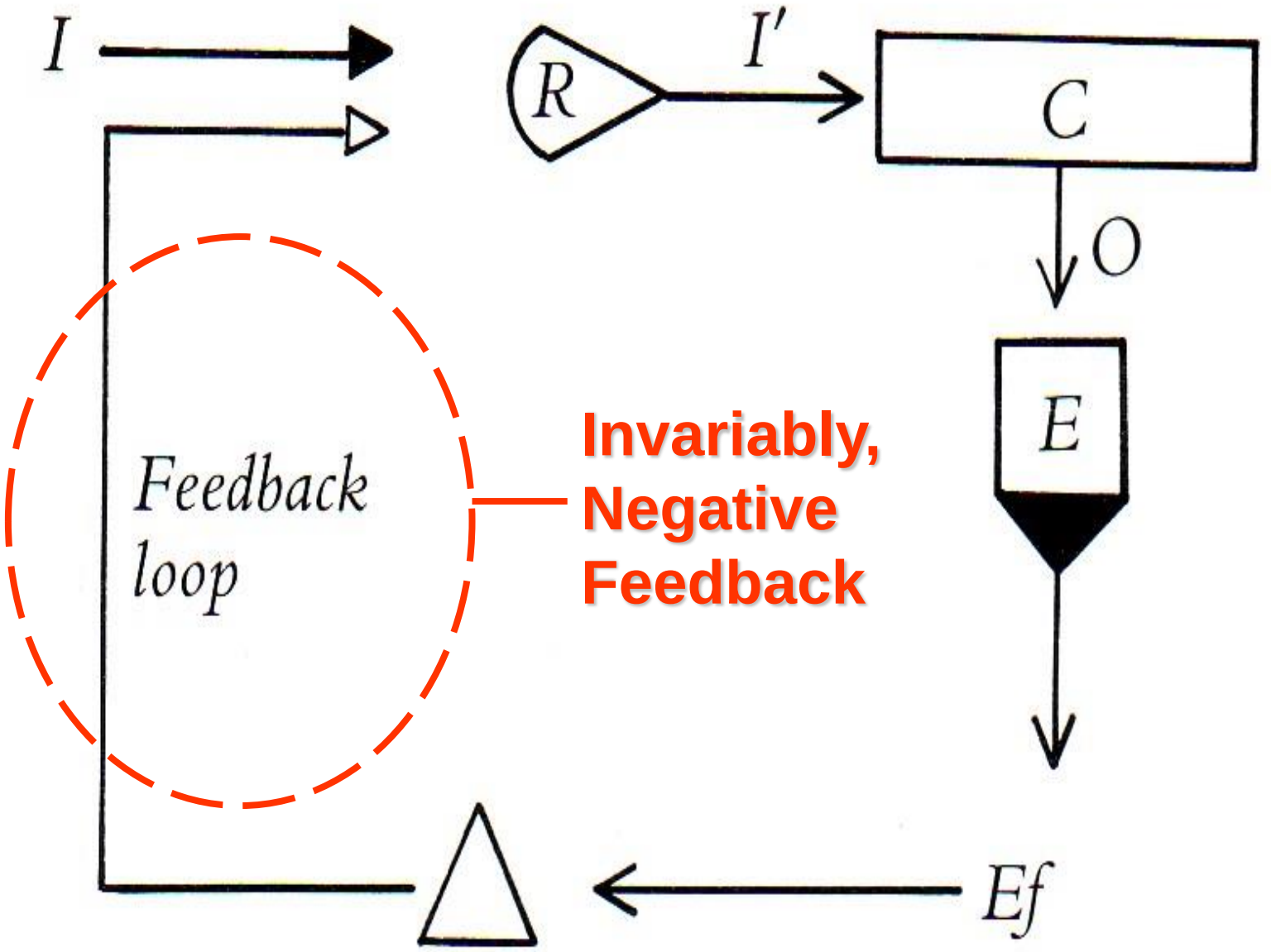
~ 60 – 70 %



150 lb /68 kg

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

= ~40 – 48 kg H_2O

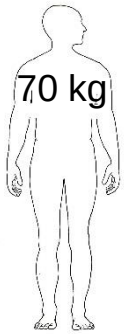

I
R
I′
C
O
E
Feedback loop
Invariably, Negative Feedback
Ef

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

70% H_2O
= 49L



eg

ICF =
35L

+

ECF = 14L

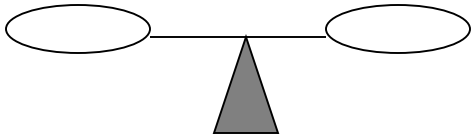
(Interstitium = 11L
Plasma = 3L)

H_2O

INPUT

Dietary Drink	1200 mL
Dietary Eat	400 mL
Oxidation	400 mL
Total =	2000 mL

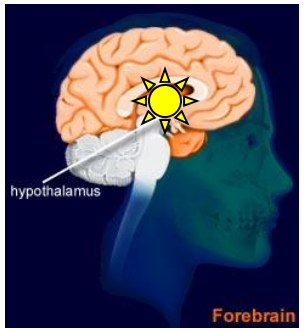
BALANCE!



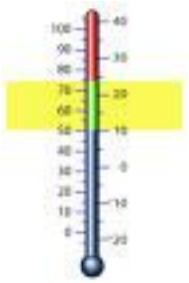
OUTPUT

Urine	1000 mL
Sweat + Insensible	900 mL
Feces	100 mL
Total =	2000 mL

Controller =
Hypothalamus
with Set Point



ToC



ToC

Lethal

42oC

Protein Denaturation

True Diurnal Variation

110oF

Set Point

37oC

98.6oF

35oC

Mild Hypothermia

Profound Hypothermia

33oC

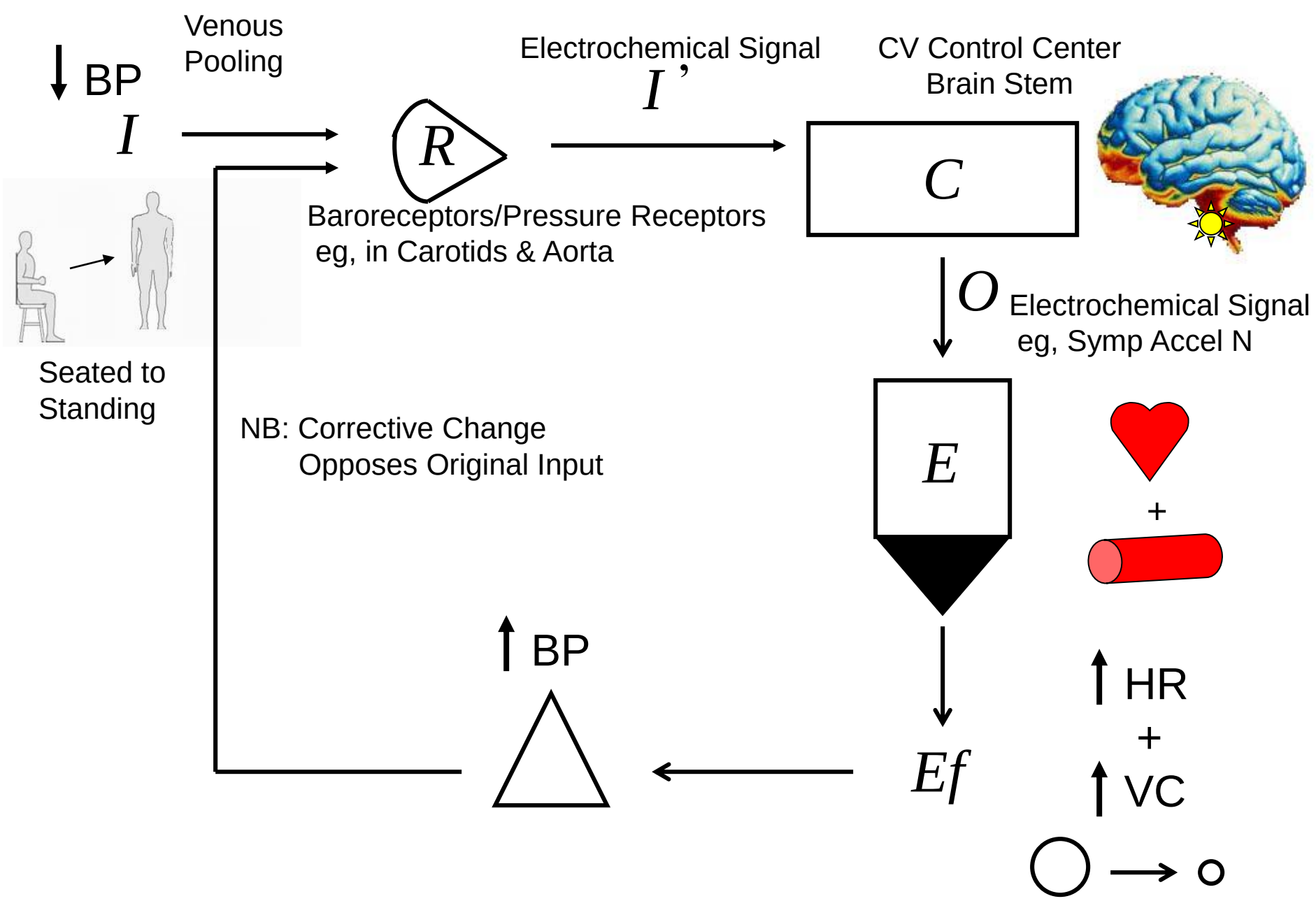
< 30oC

Lethal

29oC

0600 1400 0600 1400

Time of Day


BP
I
Venous
Pooling
R
Baroreceptors/Pressure Receptors
eg, in Carotids & Aorta
Electrochemical Signal
I'
CV Control Center
Brain Stem
C
O
Electrochemical Signal
eg, Symp Accel N
E
+
Ef
BP
HR
+
VC
Seated to
Standing
NB: Corrective Change
Opposes Original Input

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

I. ***Announcements*** **Q from lecture or lab?**

II. ***Cell Physiology Connections*** **LS ch 2 pp 20-34, fig 2-1…2-8**

- **A. Organelles ≡ ICF specialty shops: 1. Endoplasmic Reticulum 2. Golgi Apparatus 3. Lysosomes 4. Peroxisomes 5. Mitochondria tab 2-1 p 36**
- **B. Exocytosis vs. Endocytosis fig 2-5 a & b, p 25**
- **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**

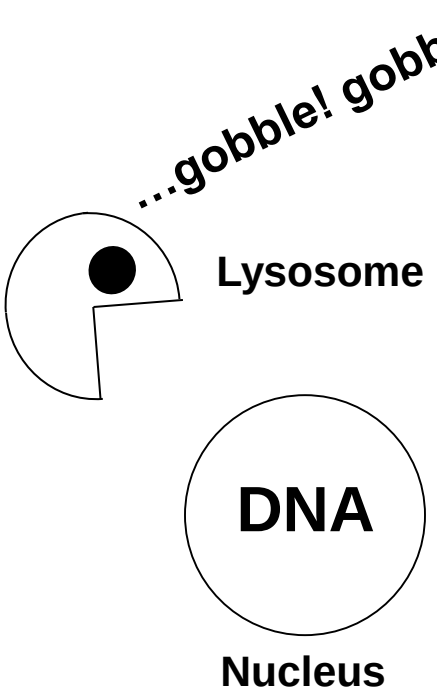
IV. ***Introduction to Genetics*** **LS 2012 ch 2 p 20-1 + Appendix C**

- **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?

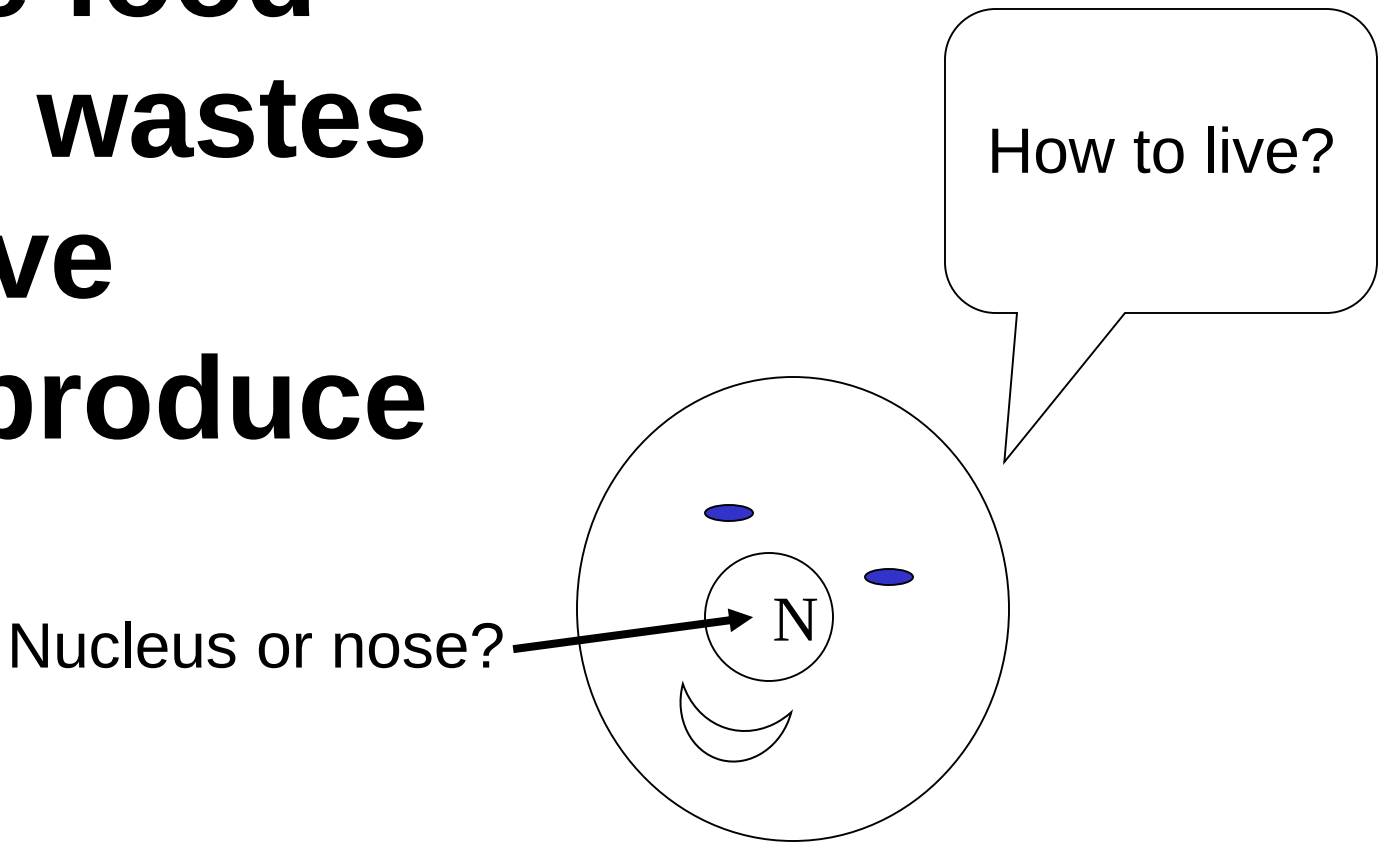
<u>*Incompatible*</u> reactions can take place

<u>*Simultaneously*</u>!!



Basic Cell Survival Skills?

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



Secretion of Proteins Produced by ER

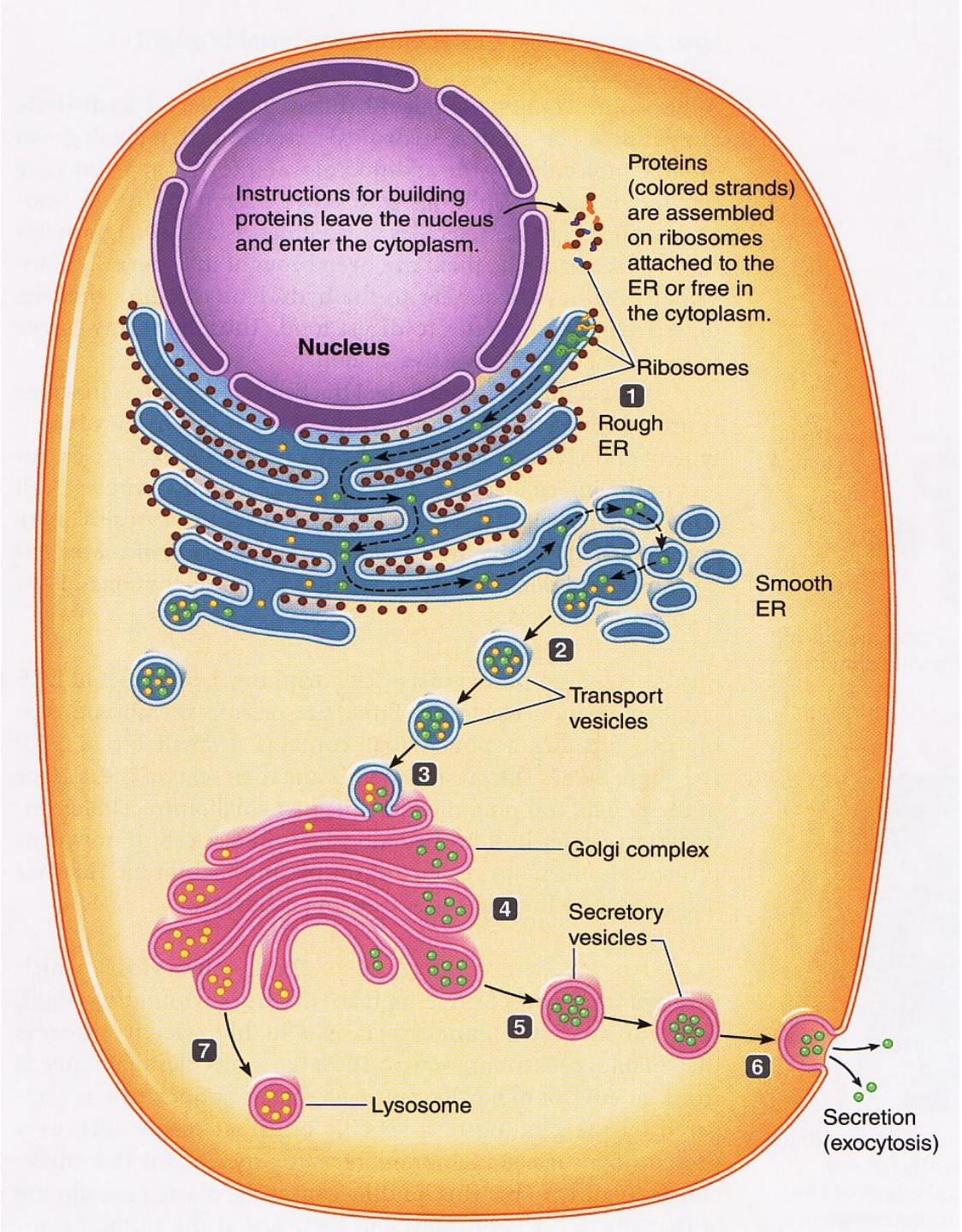


fig 2-3 LS 2012

Lysosomes vs. *Peroxisomes*

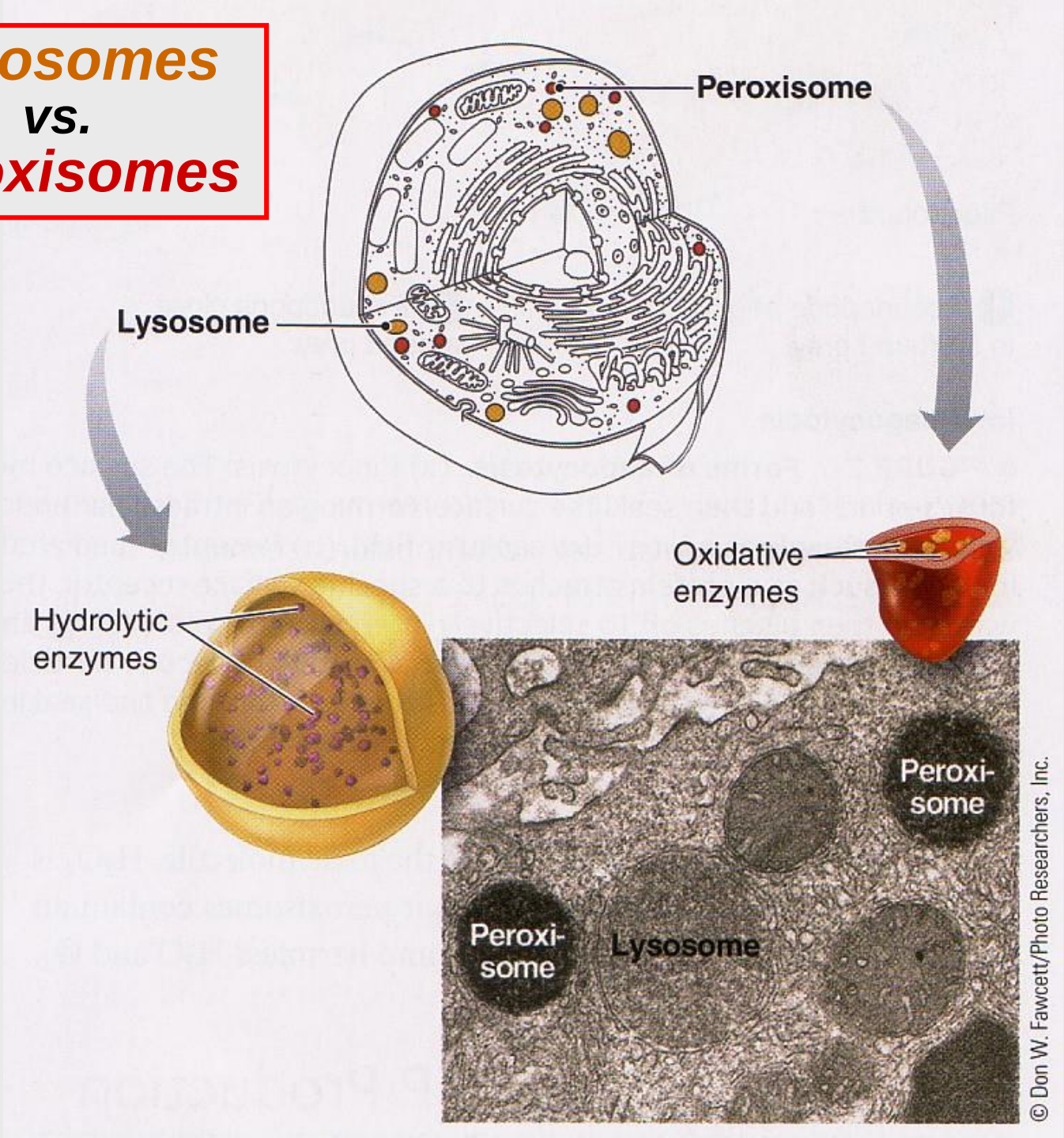


fig 2-6 LS 2012

Phagocytosis: Cell Eating!

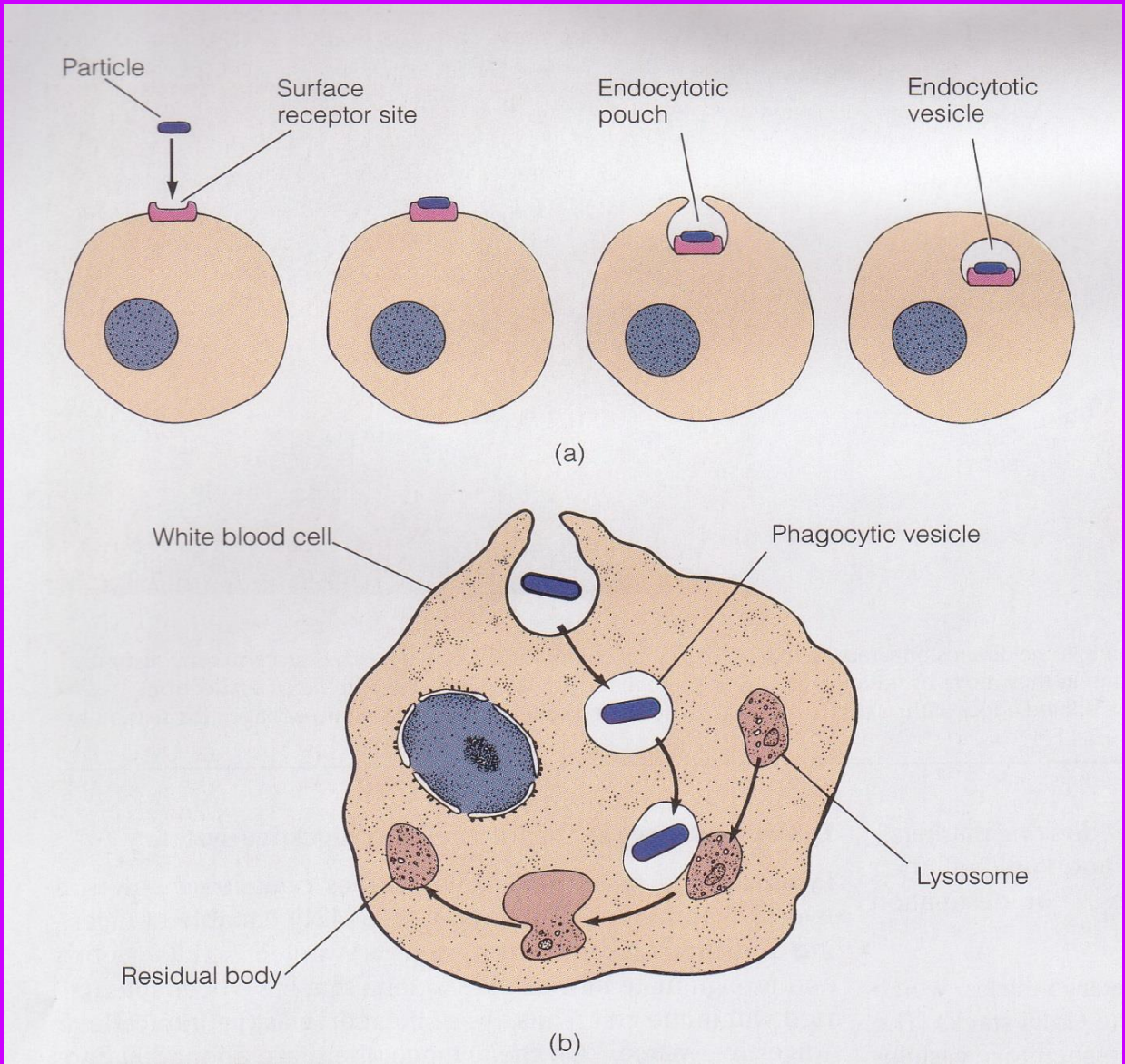
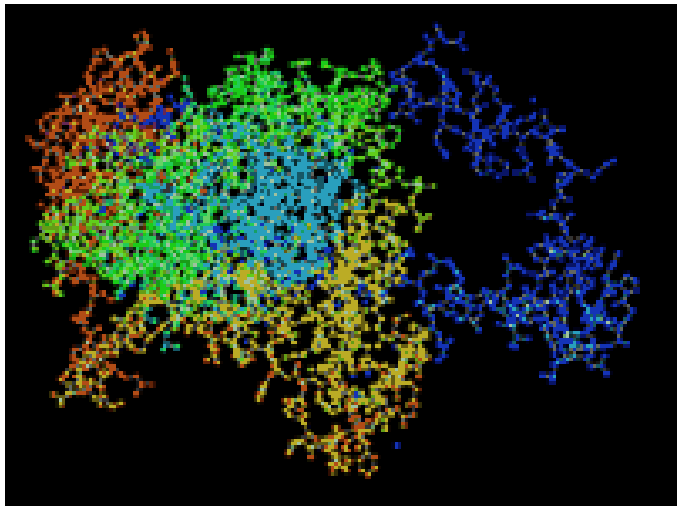


fig 2-7 LS 2006

Catalase Enzyme Reaction in Peroxisomes Neutralize Toxin at Production Site!



Mitochondria: Energy Organelles

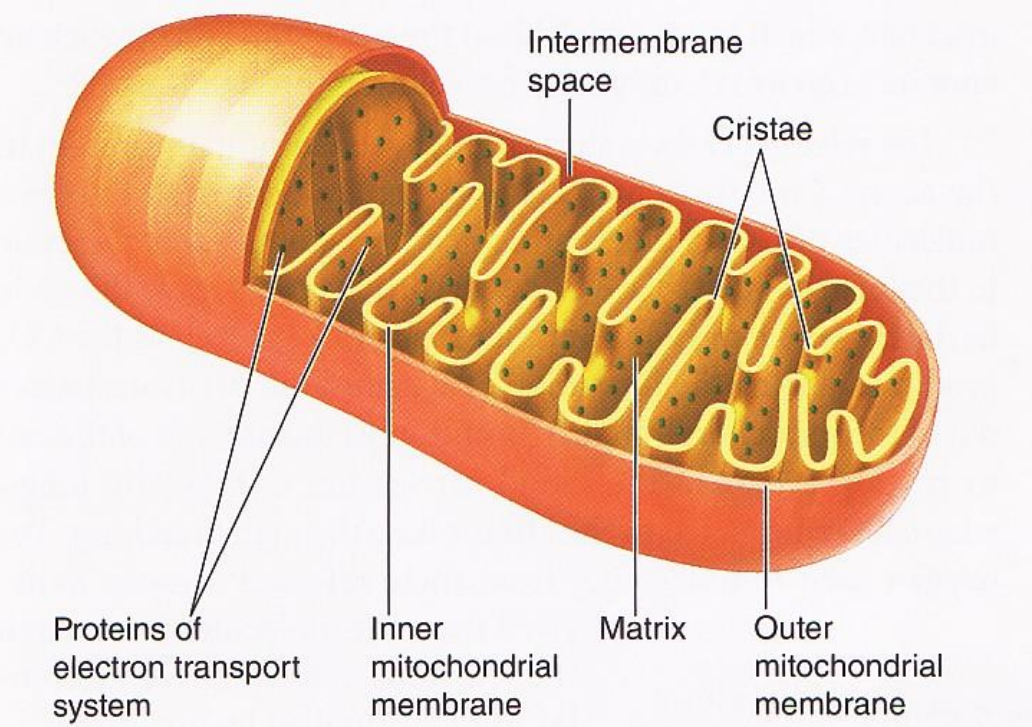


fig 2-8 LS 2012

Mom's eggs execute Dad's mitochondria

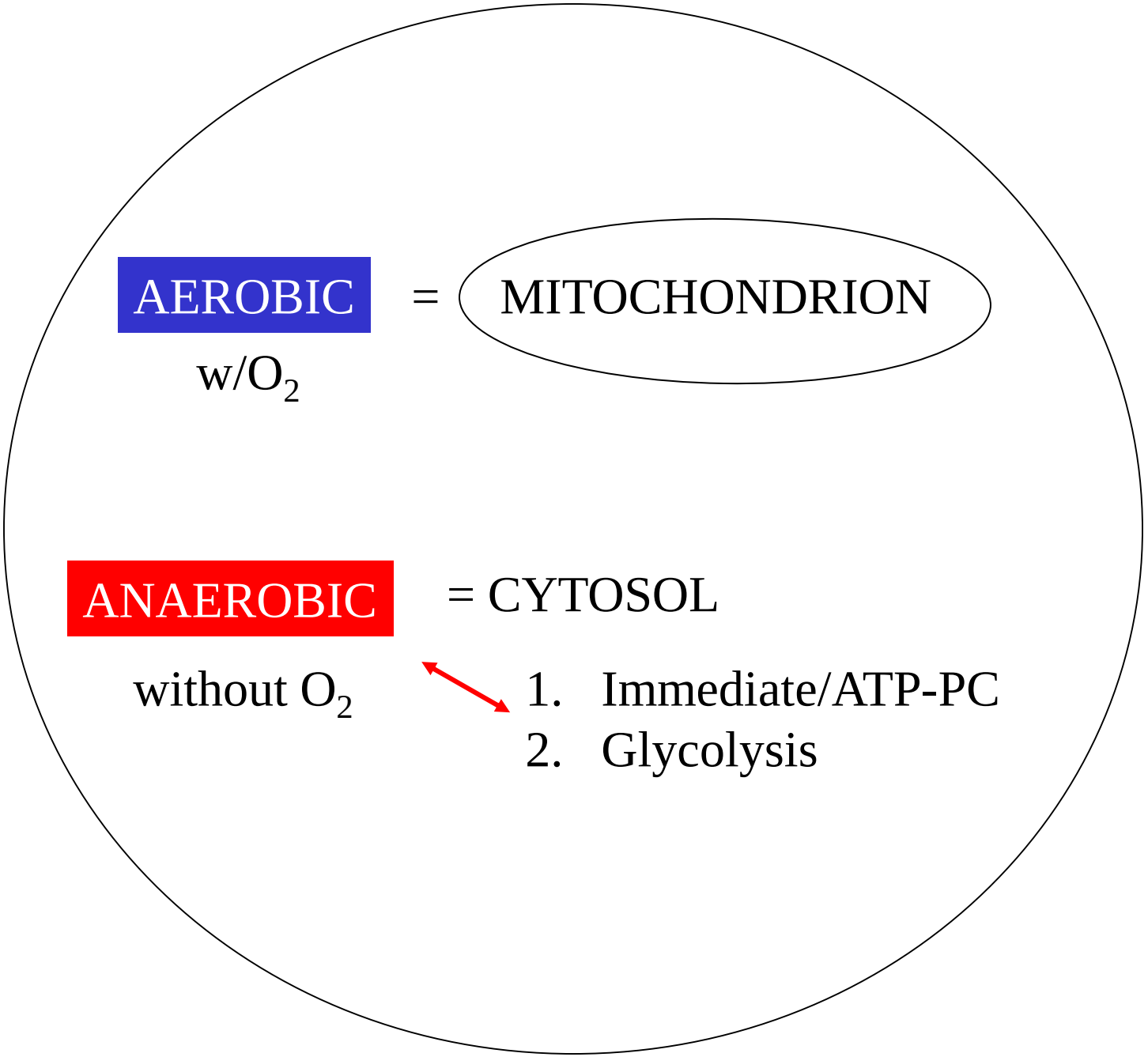
In "Hamlet," Rosencrantz and Guildenstern deliver a letter to the rulers of England that carries the ill-fated duo's own death sentence. Perhaps Shakespeare knew a bit about reproductive biology.

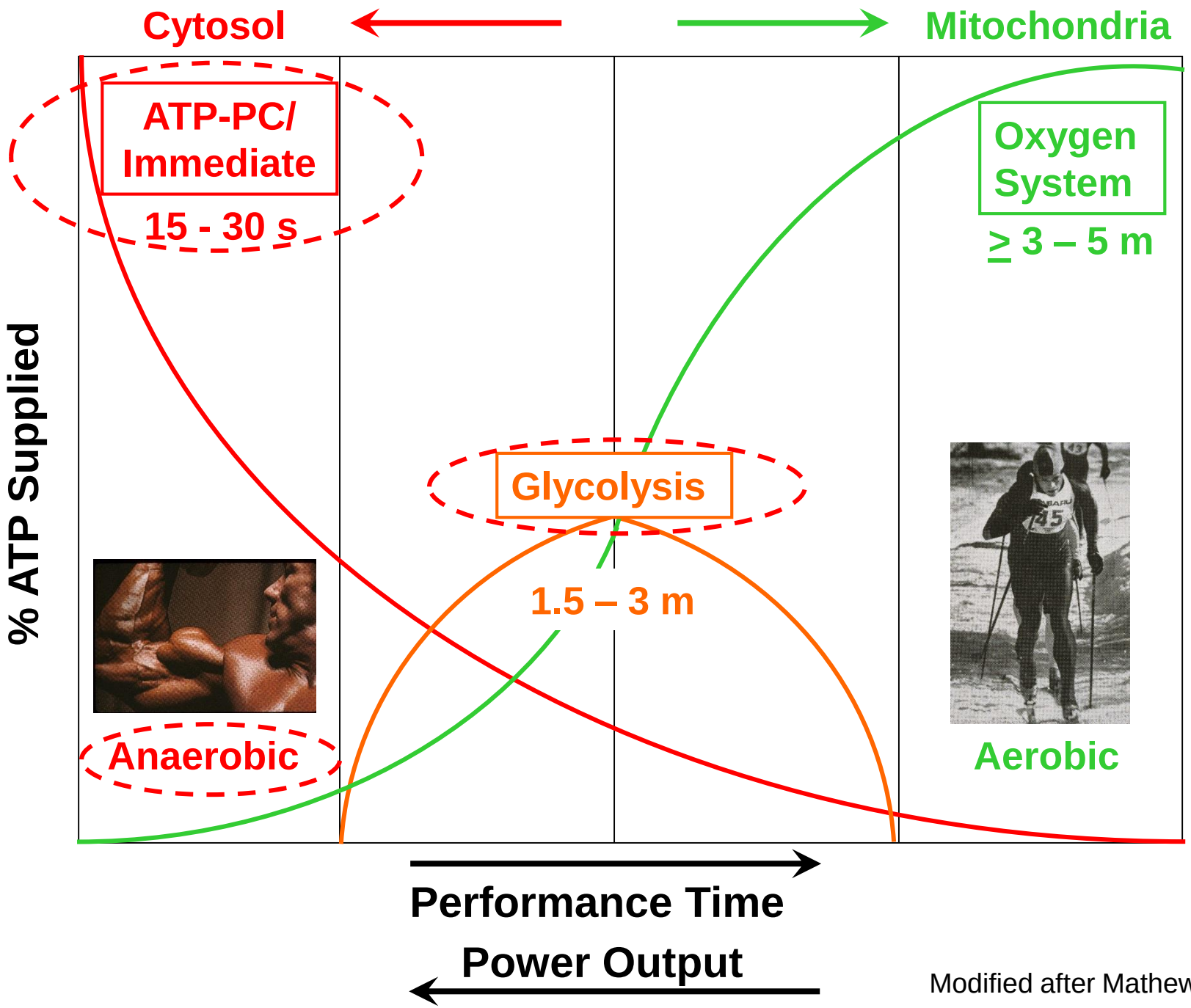
Scientists have now found that during a sperm's creation, its mitochondria—energy-producing units that power all cells—acquire molecular tags that mark them for destruction once the sperm fertilizes an egg. This death sentence, a protein called ubiquitin, may explain why mammals inherit the DNA within 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.**

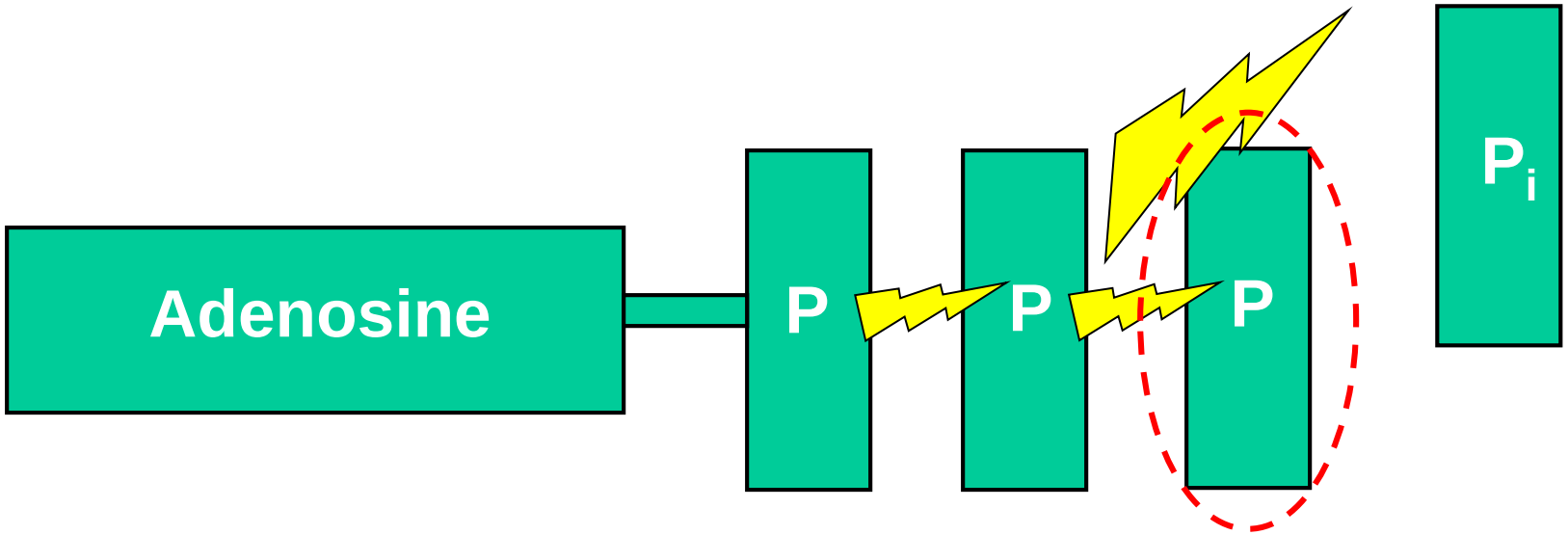

AEROBIC
=
MITOCHONDRION
w/O_2
ANAEROBIC
= CYTOSOL
without O_2
1. Immediate/ATP-PC
2. Glycolysis



Modified after Mathews & Fox

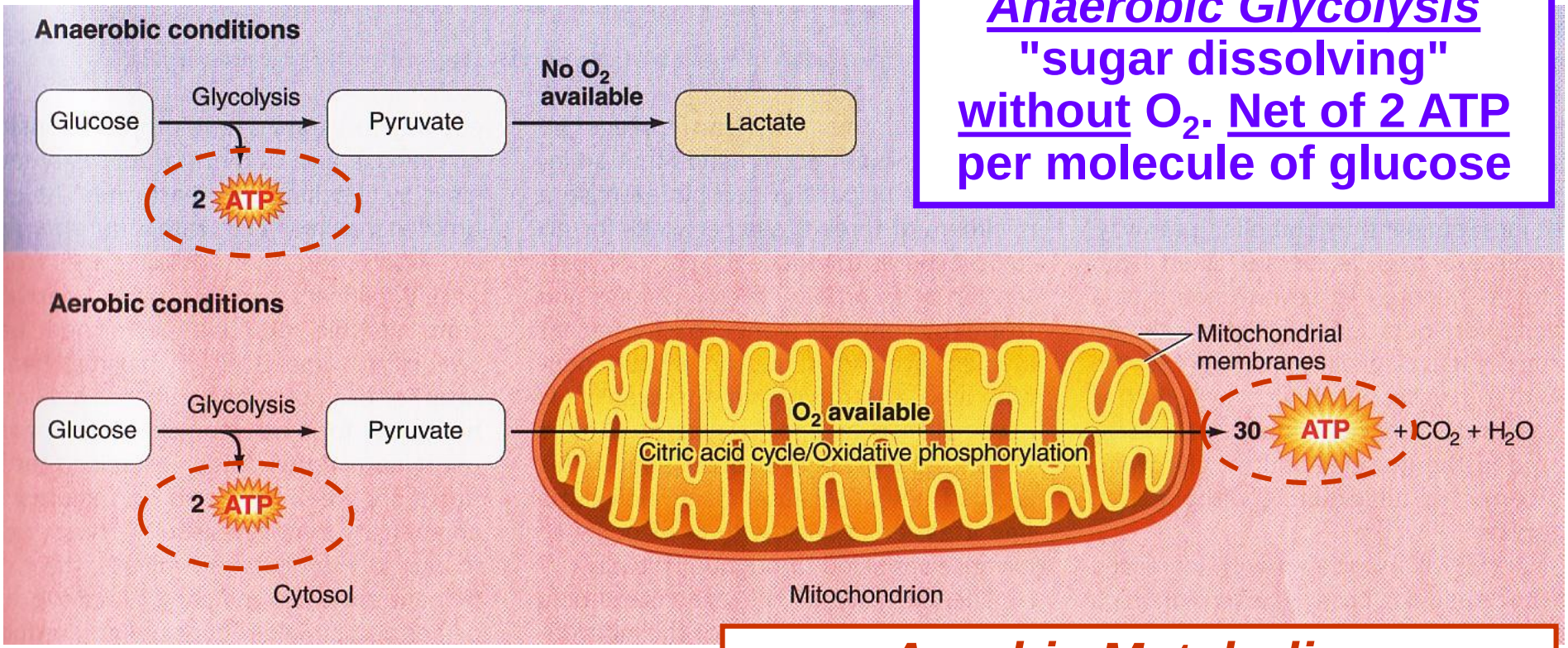
Cleave One High Energy Phosphate Bond To Do Work!!

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



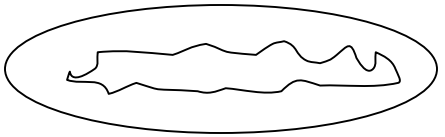
Anaerobic Glycolysis
"sugar dissolving" without O_2. Net of 2 ATP per molecule of glucose

Aerobic Metabolism
+mitochondrial processing of glucose with O_2. Net of 32 ATP per molecule of glucose

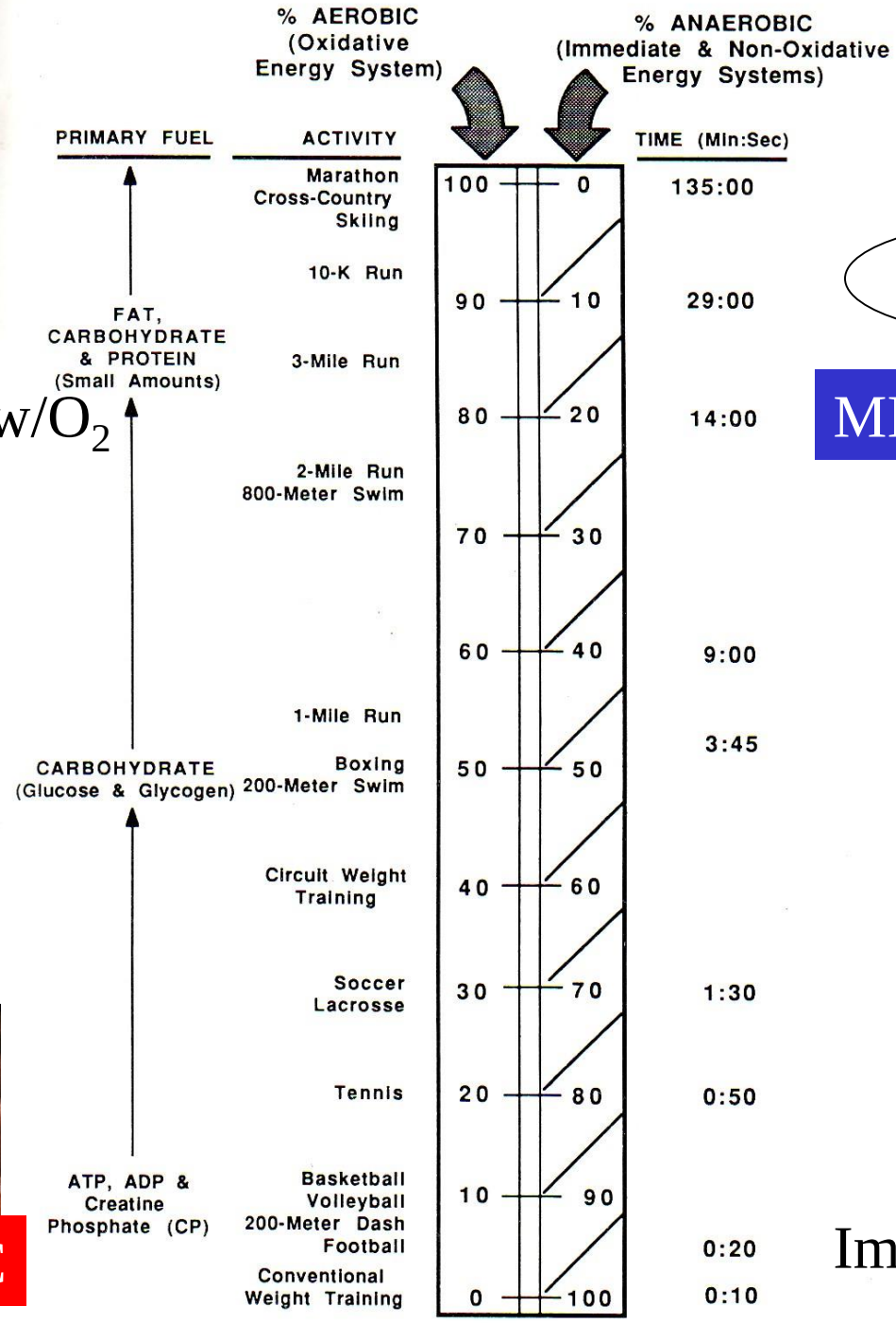
fig 2-15 LS 2012

AEROBIC w/O_2

ANAEROBIC



MITOCHONDRIA



CYTOSOL

Glycolysis

Immediate/ATP-PC

BI 121 Lecture 4

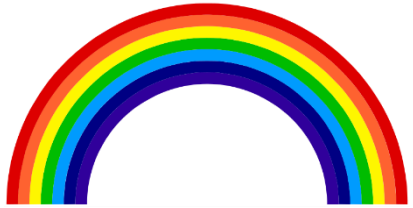
Anatomy & Physiology Lab today!...
Exam I next Thursday > 4th of July!!

I. ***Announcements*** **Nutrition Analysis Lab next Thursday! Please record your diet on p 3-7 LM & begin analysis using *https://www.supertracker.usda.gov/* Estimating quantities. Q?**

II. ***Cell Metabolism Connections*** **LS 2012 fig 2-9 thru 2-12 +…**

III. ***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!**



IV. ***Nutrition Primer*** **DC Module 2, Sizer & Whitney(S&W) Sci Lib**

- A. **Essential Nutrients: H_2O, 1^0 Carbohydrates, 2^0 Fats, 3^0 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+**

4 oz → 3 oz

Deck of Cards

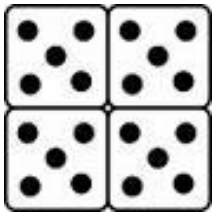
or

≡ 1 c

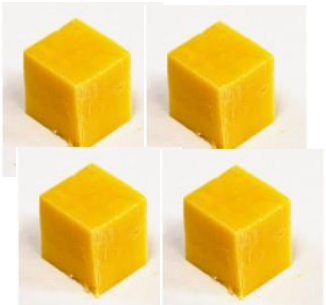
≡

raw → cooked

≡ 1/3 c



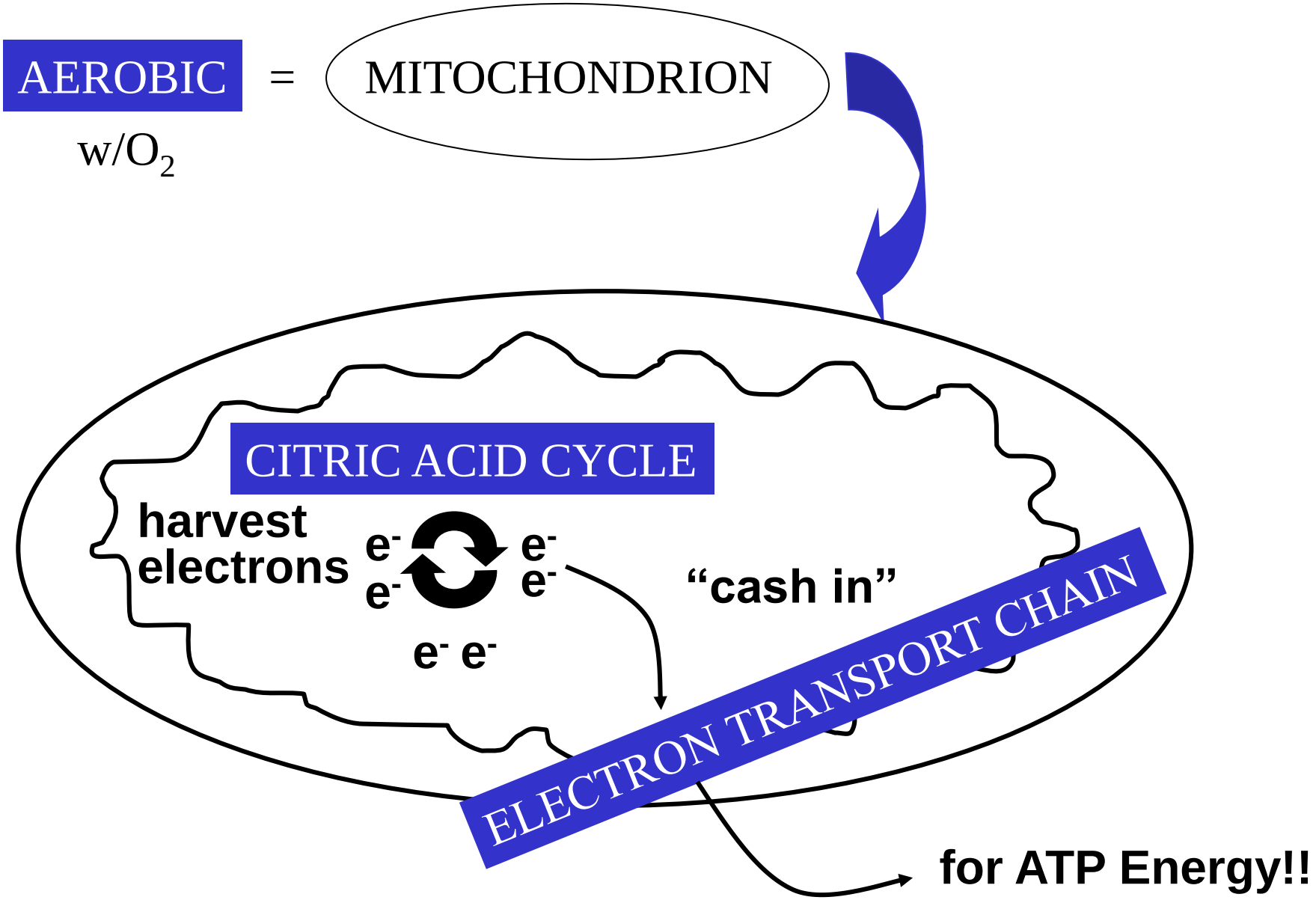
≡ 1 oz



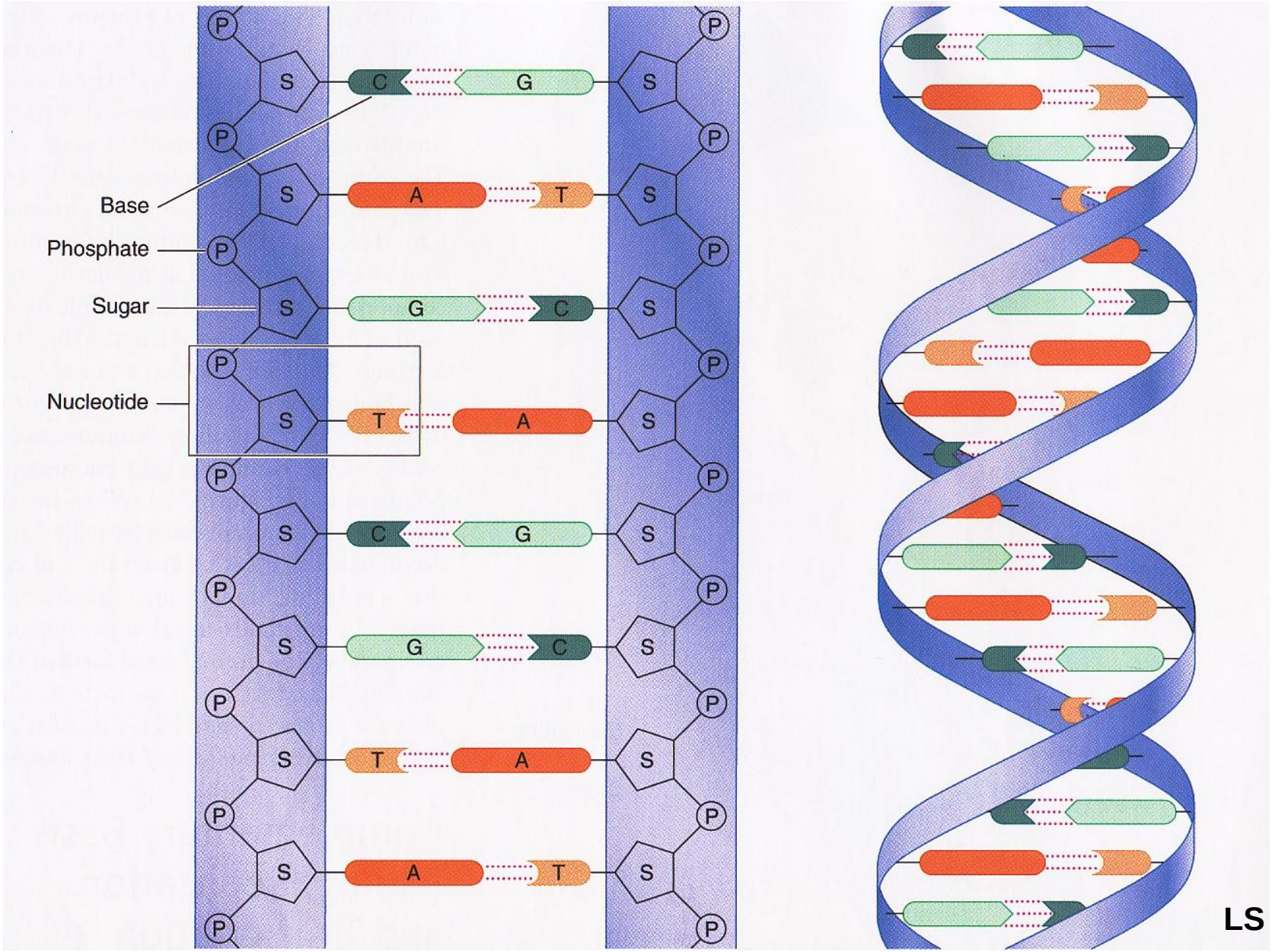
≡ ¼ c

≡ 1.5 oz

Goals of Aerobic Metabolism

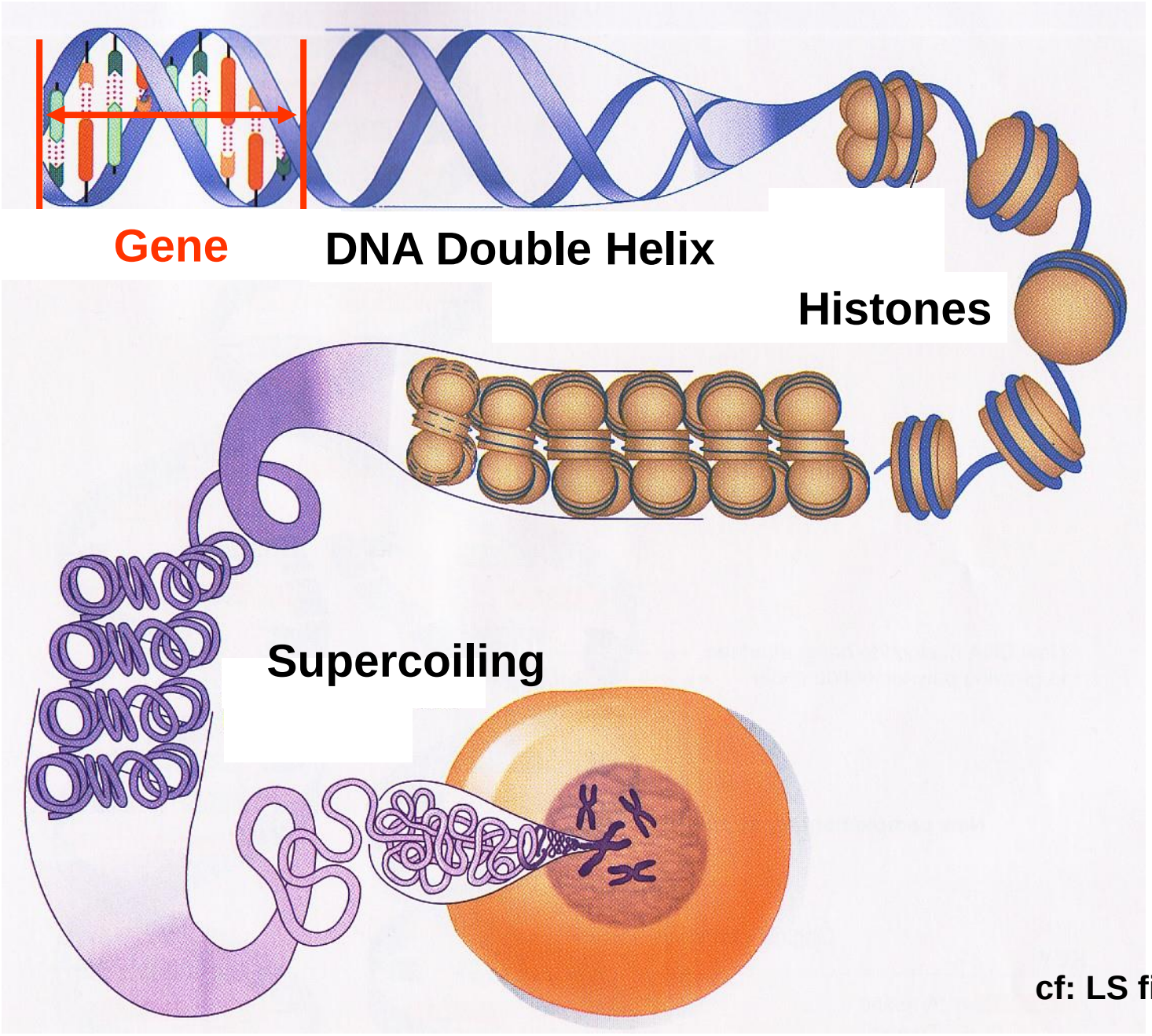


What does DNA look like? Double-helix!!



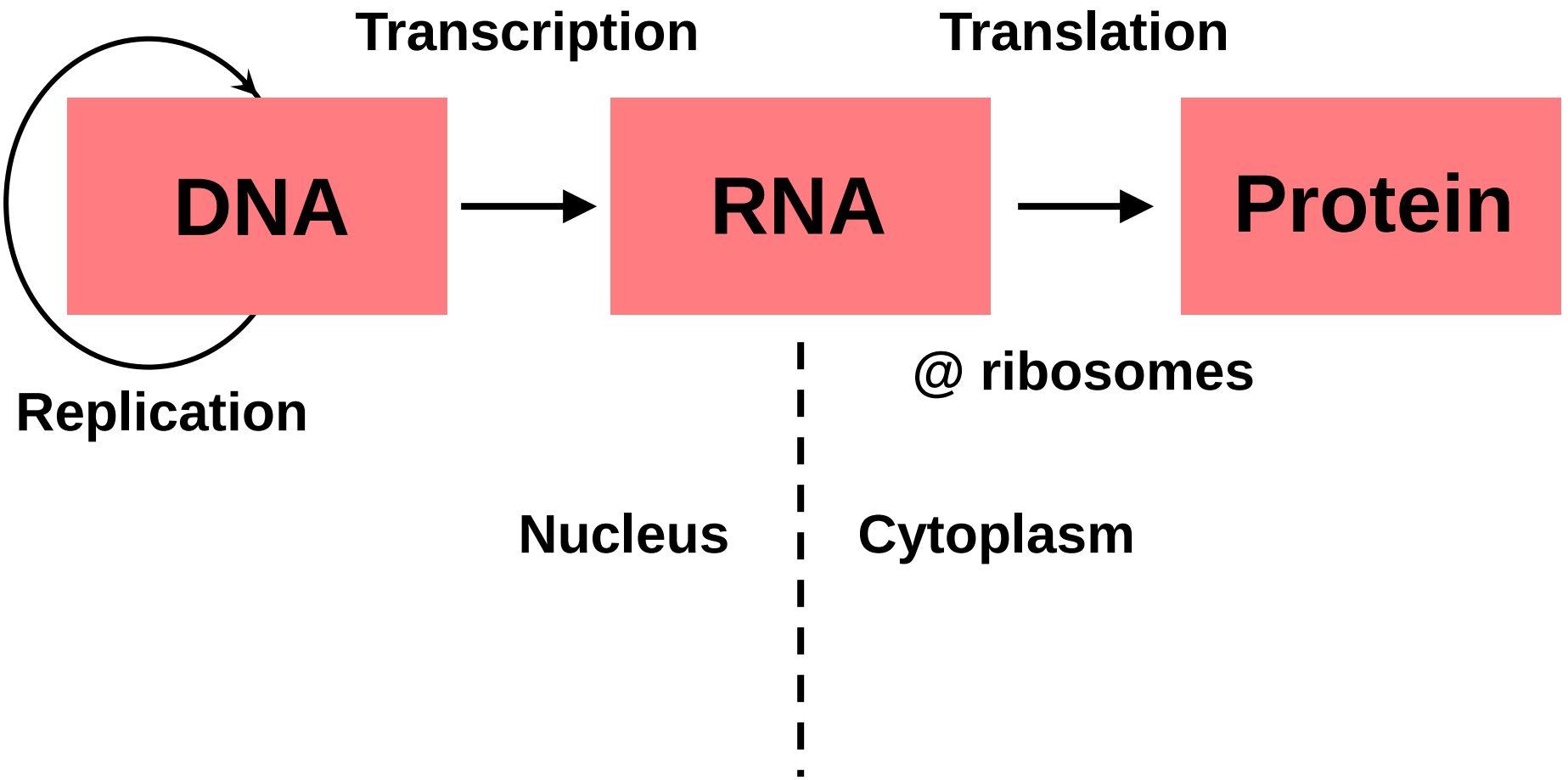
LS fig C-2

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



cf: LS fig C-3

What does DNA do, day-to-day?



cf: LS fig C-6

DNA vs *RNA*?

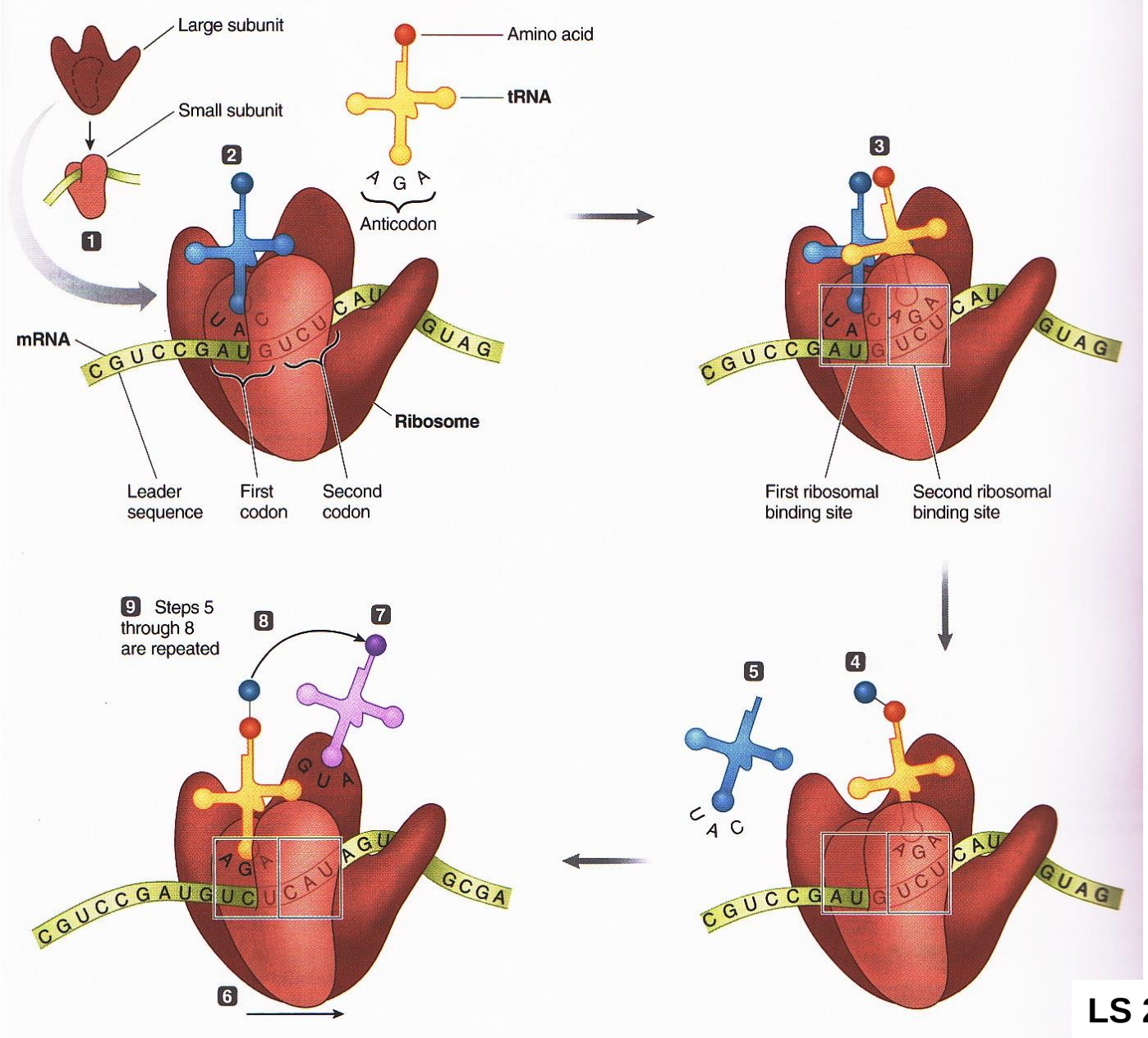
1. Double-stranded
2. Deoxyribose (without oxygen)
3. A, T, C, G
   Thymine
4. Self-replicative (can copy itself)
5. Nucleus (+mitochondria)

1. Single-stranded
2. Ribose (with oxygen)
3. A, U, C, G
   Uracil
4. Needs DNA as template
5. 1^0 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



LS 2012 fig C-7

BI 121 Lecture 5

Nutrition Lab 3 Thursday! More personal data…

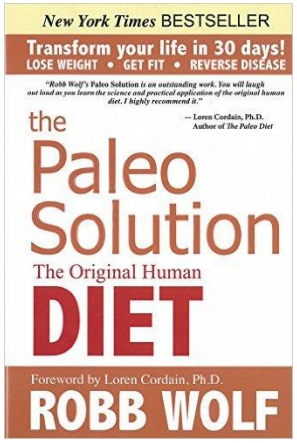
I. ***Announcements*** Data + Flashdrive for Thursday's lab! Q? Thanks for recording dietary data on LM p 3-7 & exploring ***https://www.supertracker.usda.gov/***. Sample Exam Questions.

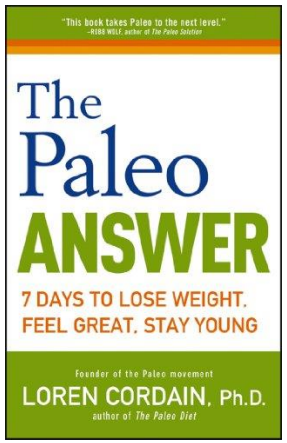
II. ***Nutritional Physiology in the News*** Pondering Paleo *Nutrition Action Health Letter,* Marlene Zuk, U Minn. Animal sources, inflammation & disease? Drink Your Calories? *PEBB* Shake the salt habit! *UC Berkeley Newletter*. Successful Dieting?

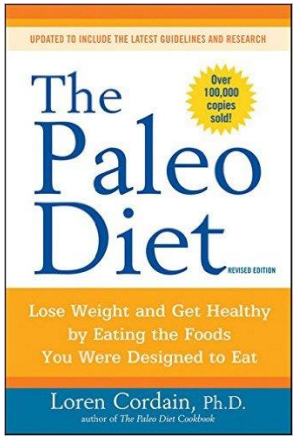
III. ***Nutrition Primer*** DC Module 2, Sizer & Whitney (S&W) Sci Lib
   - A. Dietary Guidelines: USDA, AICR, Eat Like the ***Rainbow***!
   - B. Best path to weight loss? Diet or exercise or both? Dietary composition & endurance? Fasting? Zuti & Golding 1976; Sacks ***AHA NPAM*** 2009; AMDR?
   - C.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

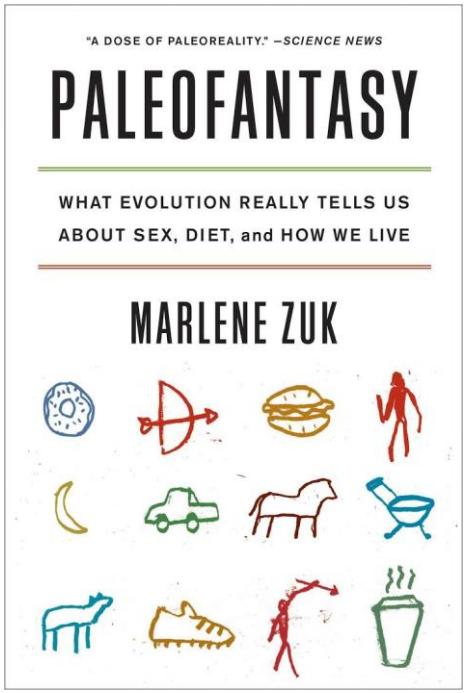
Pondering Paleo?





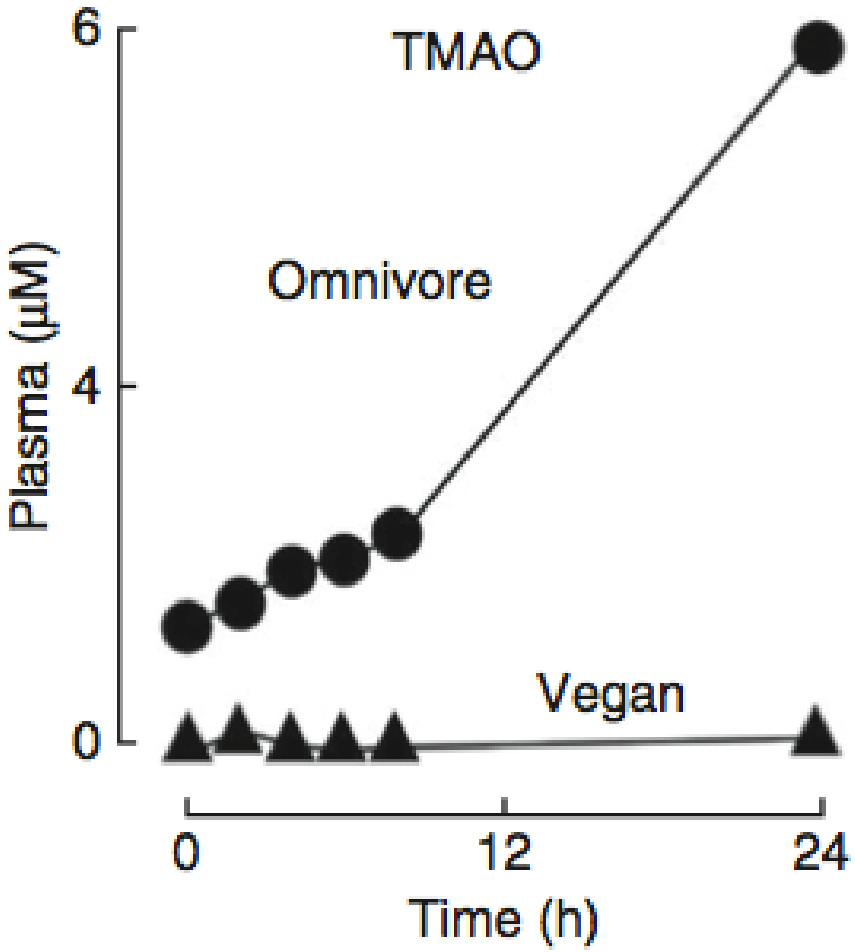


Evolutionary Biologist
Behavioral Ecologist
U Minnesota



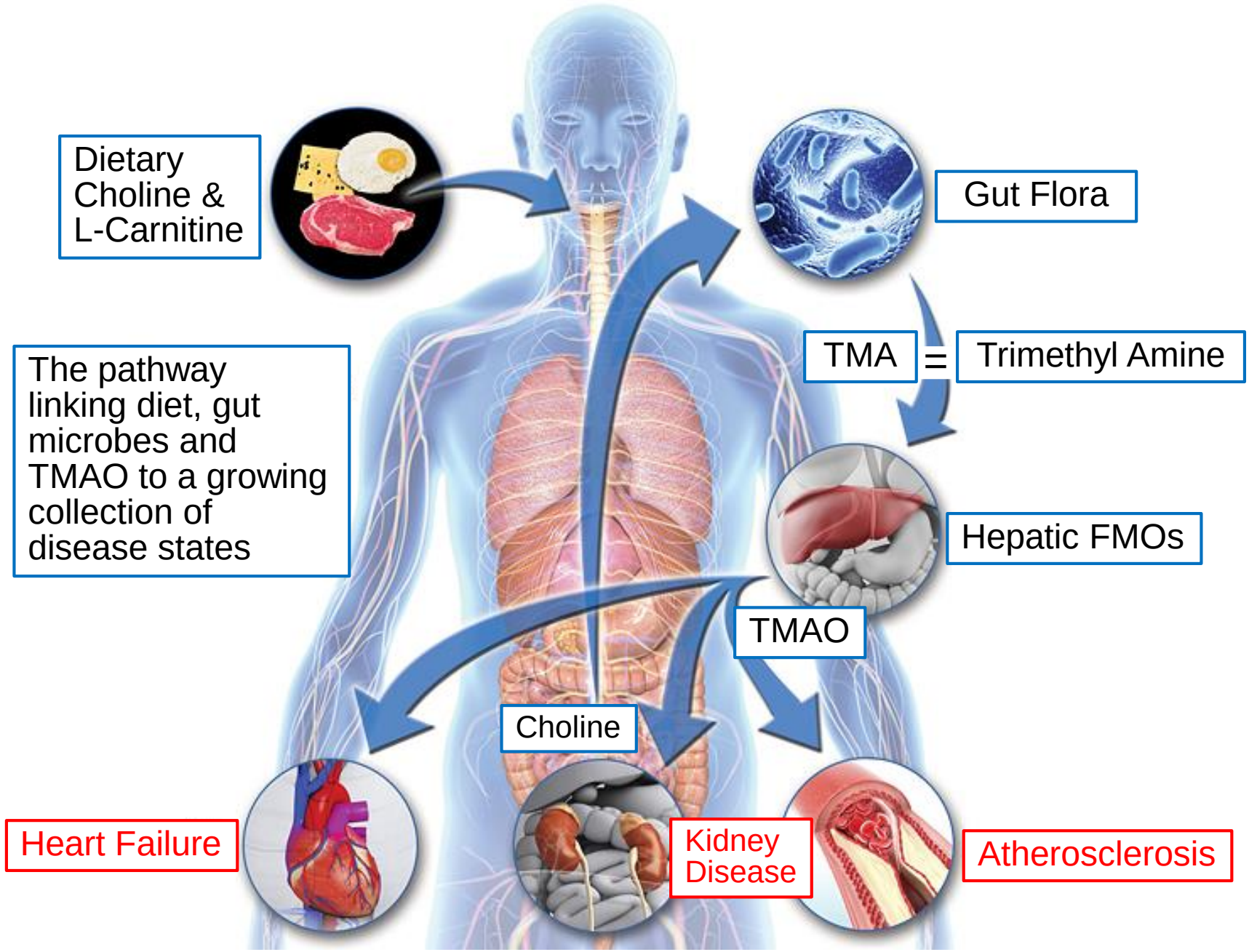
http://www.nutritionaction.com/daily/how-to-diet/pondering-paleo/

Gut Bacteria Involved in Inflammation & Atherosclerosis?



Meat & Eggs → L-Carnitine & Choline → Trimethyl Amine (TMA) → TMAO → ***Inflammation & Atherosclerosis***

https://consultqd.clevelandclinic.org/2015/02/gut-flora-dependent-tmao-new-studies-extend-its-reach-beyond-the-arteries-to-the-heart-and-kidneys/



http://www.nejm.org/doi/full/10.1056/NEJMoa1109400#t=article

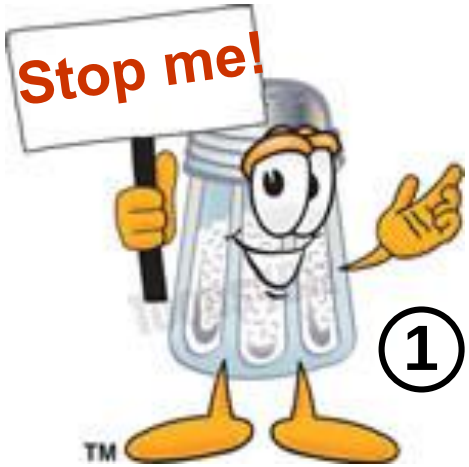
5 times per wk? ≡ 106,600 calories/yr ≡ ± 30.5 lb fat/yr

≡

Starbucks Cinnamon Dolce Latte, whipped cream *Venti (20 oz.)*	410 calories
Jogging	50 min.

Better choices!

More Reasons to Shake the Salt Habit



① ↓blood vessel vasodilation w/in 30 min by ingesting 1500 mg Na+!

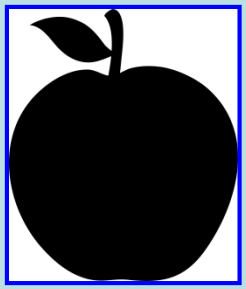
② ↑Ca^{2+} excretion ↑bone loss, risk of osteoporosis & fractures.

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

④ GI cancer risk, inflammation?

UCB Wellness Letter Jun 2011 p 5

Successful Dieting – National Weight Control Registry



- 5000 people, ≥ 30 lb weight loss, ≥ 5 yr
- High-carbohydrate (55-60%), low-fat (24%) diet with the rest (~16-21%) from protein

- Wholesome *vs.* high-sugar carbohydrates including fruits, vegetables, high-fiber foods
- Conscious of calories knowing that total calories count, no matter what diet type

- Eight of 10 ate breakfast daily which may help better manage calories during the day
- Self-monitor, weigh themselves ≥ 1x/wk & many still keep food dairies

- Much planned physical activity, 60-90 min/d, 1^0 walking + looked for other ways to be active

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

UC Berkeley Wellness Engagement Calendar, September 2013

Macronutrients & Micronutrients Essential for Life

Macronutrients	Sample Food Sources
H_2O/Water	Water, other drinks, fruits & vegetables
1^0 Carbohydrates	Grains, vegetables, fruits, dairy products
2^0 Fats/Triglycerides/Lipids	Meats, full-fat dairy products, oils
3^0 Proteins	Meats, legumes, dairy vegetables
Micronutrients	***NB*: Need only minute quantities!**
Vitamins (A, D, E, K; C + B)	Vegetables, vegetable oils, fruits, citrus, grains, dairy
Minerals (K^+, Na^+, Ca^{2+}, Mg^{2+} Fe^{2+}, Zn^{2+},…	Fruits, vegetables, grains, nuts, dairy, meats, processed foods

↗ *Energy nutrients = yield ATP*

MyPlate launched June 2, 2011

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!**

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

1. **Vary your veggies. Fill ½ your plate with fruits & vegetables!**

4. **Go lean with protein. Keep protein to < ¼ 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 <u>always</u>, remember...

Do not smoke or use tobacco in any form.

American Institute for Cancer Research (AICR)

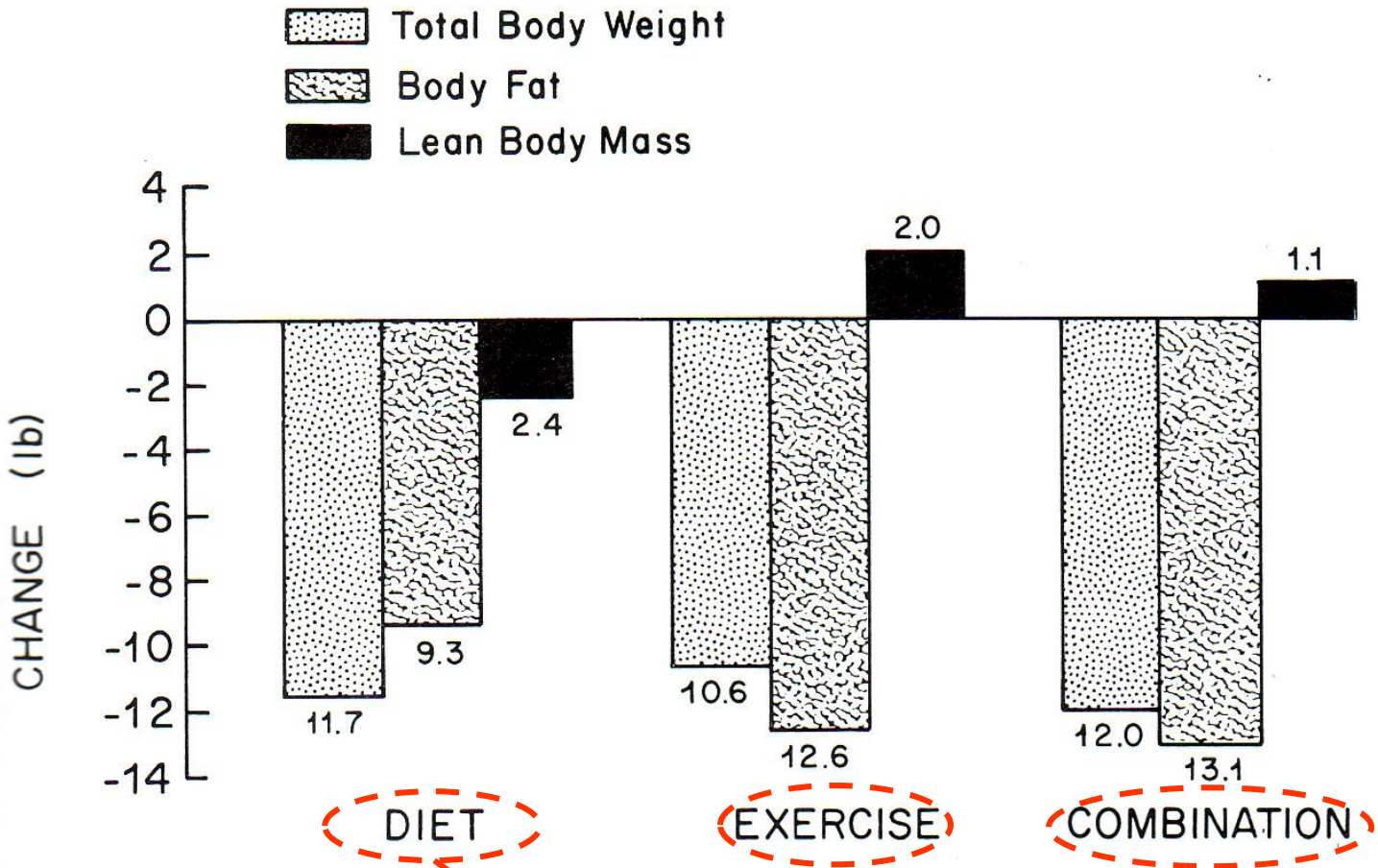
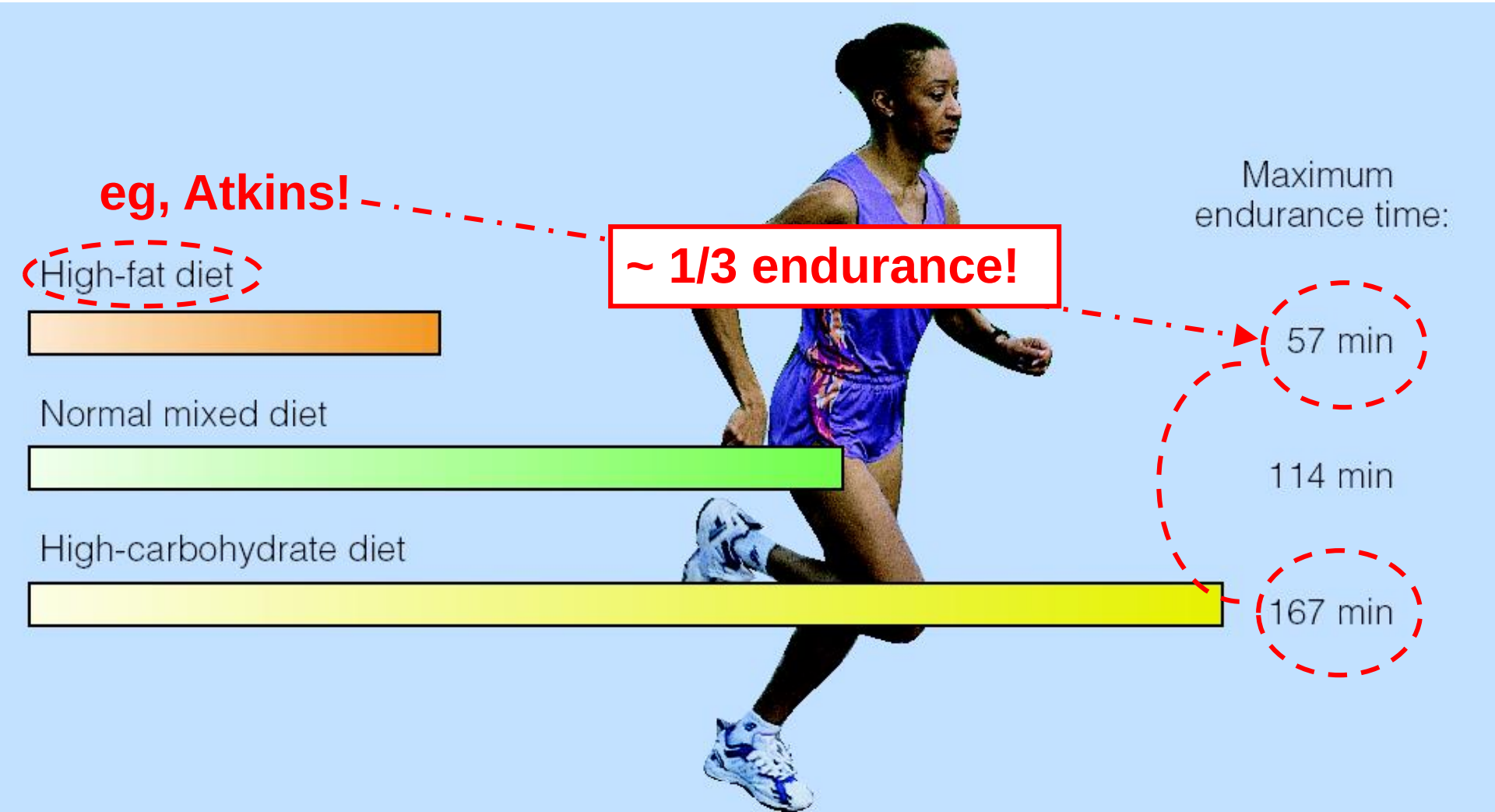


Figure 4–9. Changes in body weight, body fat, and lean body weight for diet, exercise, and combination groups. (From Zuti W. B., and Golding, L. A.: Comparing diet and exercise as weight reduction tools. **Phys. Sportsmed.** 4:49–53, 1976.)

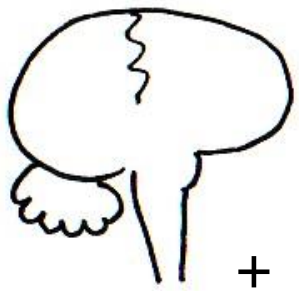
***NB*: Each group 500 kcal deficit/day, 16 weeks**

Dietary Composition & Physical Endurance



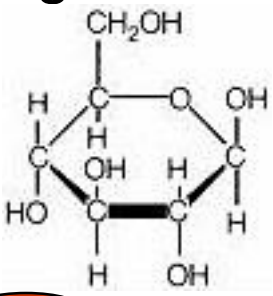
cns

2



+

glucose



rbcs

3

Negative Effects of Low Carbohydrate

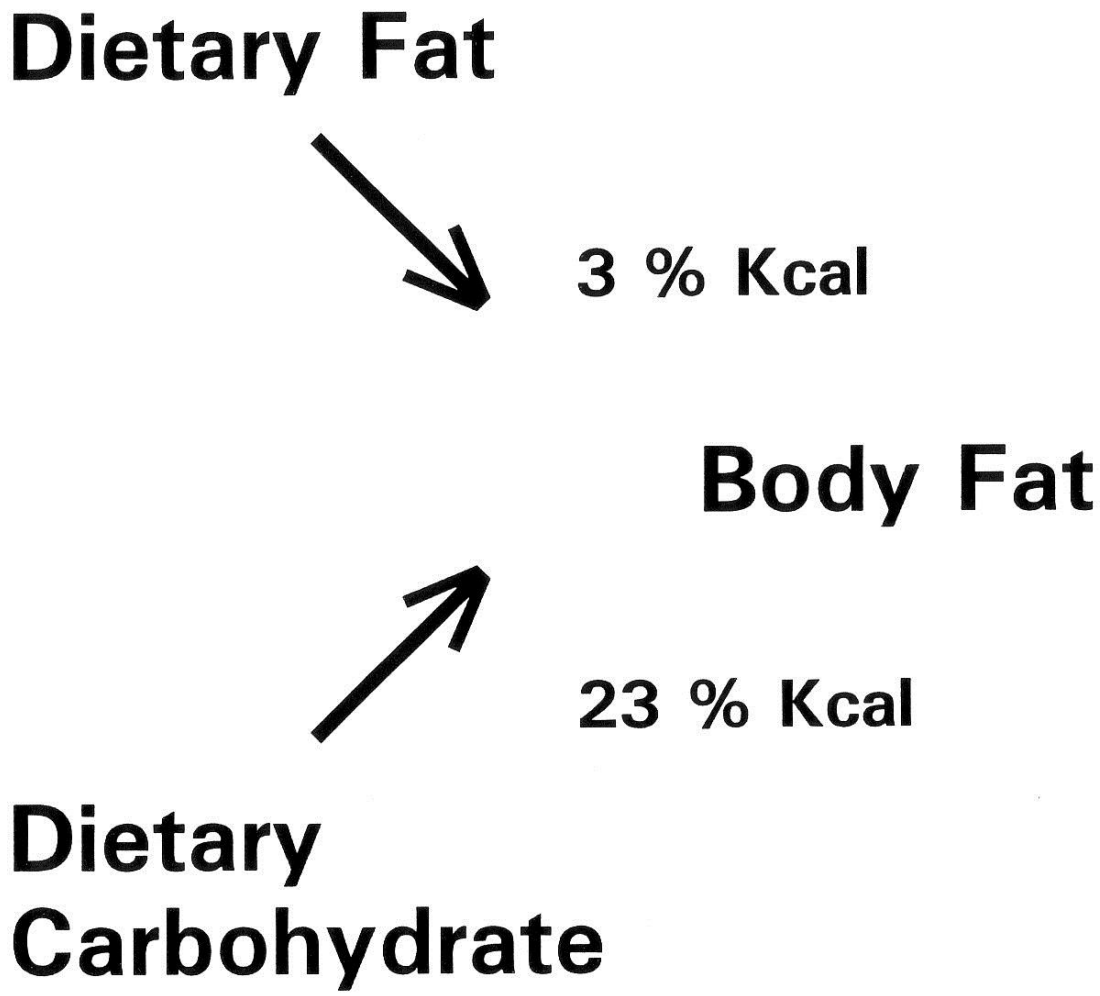
1

4

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!!

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

> ¾ **26 lb Water**

20 lb Lean Body Mass

14 lb Fat

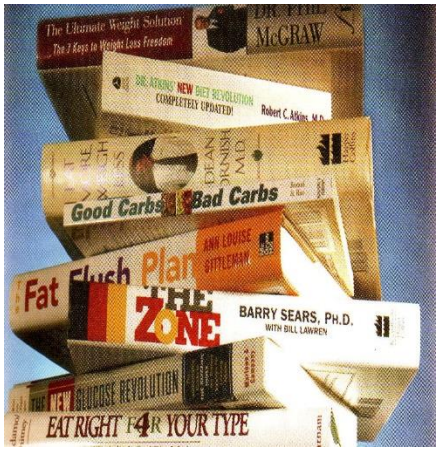
Fat < ¼ total wt loss!

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

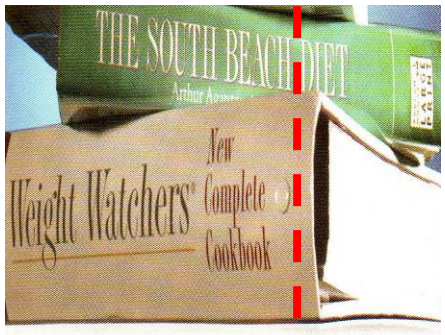
1. **Treatment based on unproven theory calling for non-toxic, painless therapy.**
2. **Author's/purveyor's credentials aren't recognized in scientific community.**
3. **No reports in scientific, peer-reviewed literature but rather mass media used for marketing.**
4. **Purveyors claim medical establishment 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.**

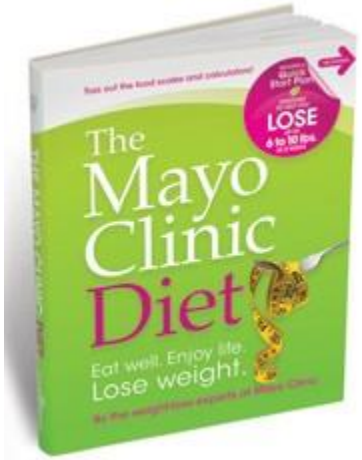
NOT PEER-REVIEWED =

TRADE BOOKS



PEER-REVIEWED = TEXTS → RESEARCH





AHA + DASH + MAYO CLINIC

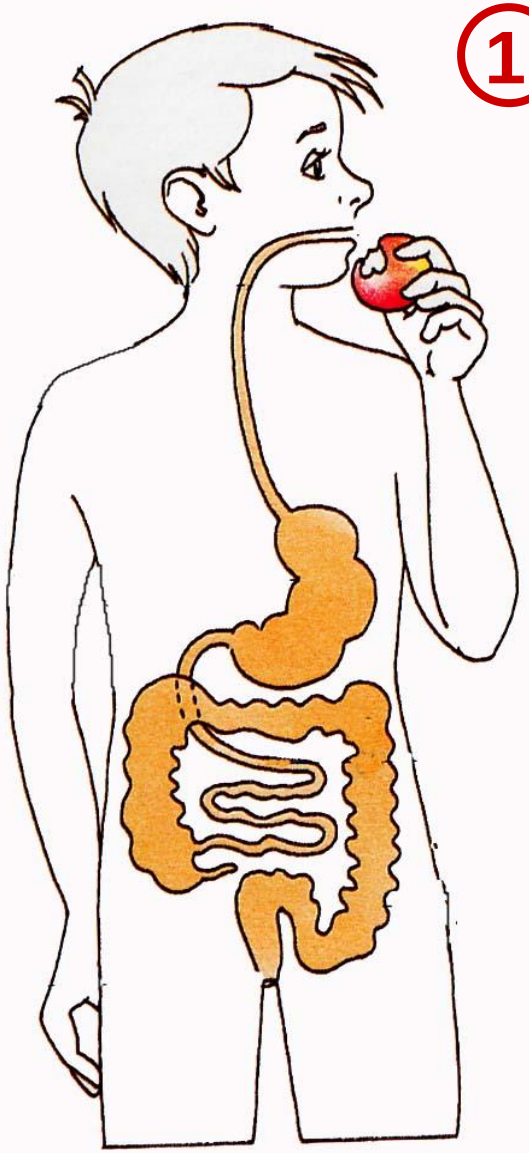
LOWER CARBOHYDRATE

LOWER FAT

ELIMINATE CALORIES or FOOD GROUPS ENCOURAGE FASTING

ADEQUACY BALANCE CONSISTENCY & MODERATION

Digestion Steps

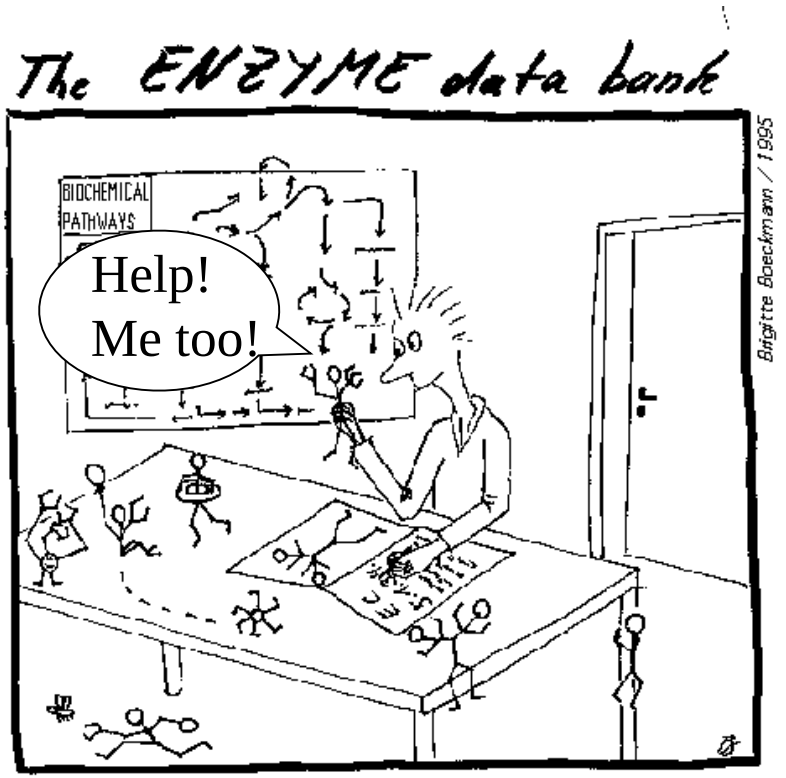


1. Ingestion
2. Mechanical Digestion
3. Chemical Digestion
4. Peristalsis
5. Absorption
6. Storage
7. Defecation

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

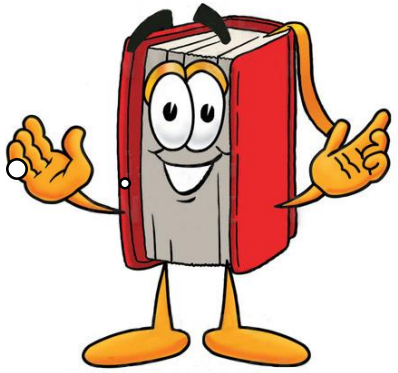
Hydrolysis of Energy Nutrients

+



H_2O + Enzyme

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 ≡ ~33%

Fat 39 g x 9 kcal/g = 351 kcal

% Fat = 351/567 = 0.619 ≡ ~ 62%

Protein 8 g x 4 kcal/g = 32 kcal

% Protein = 32/567 = 0.056 ≡ ~ 6%

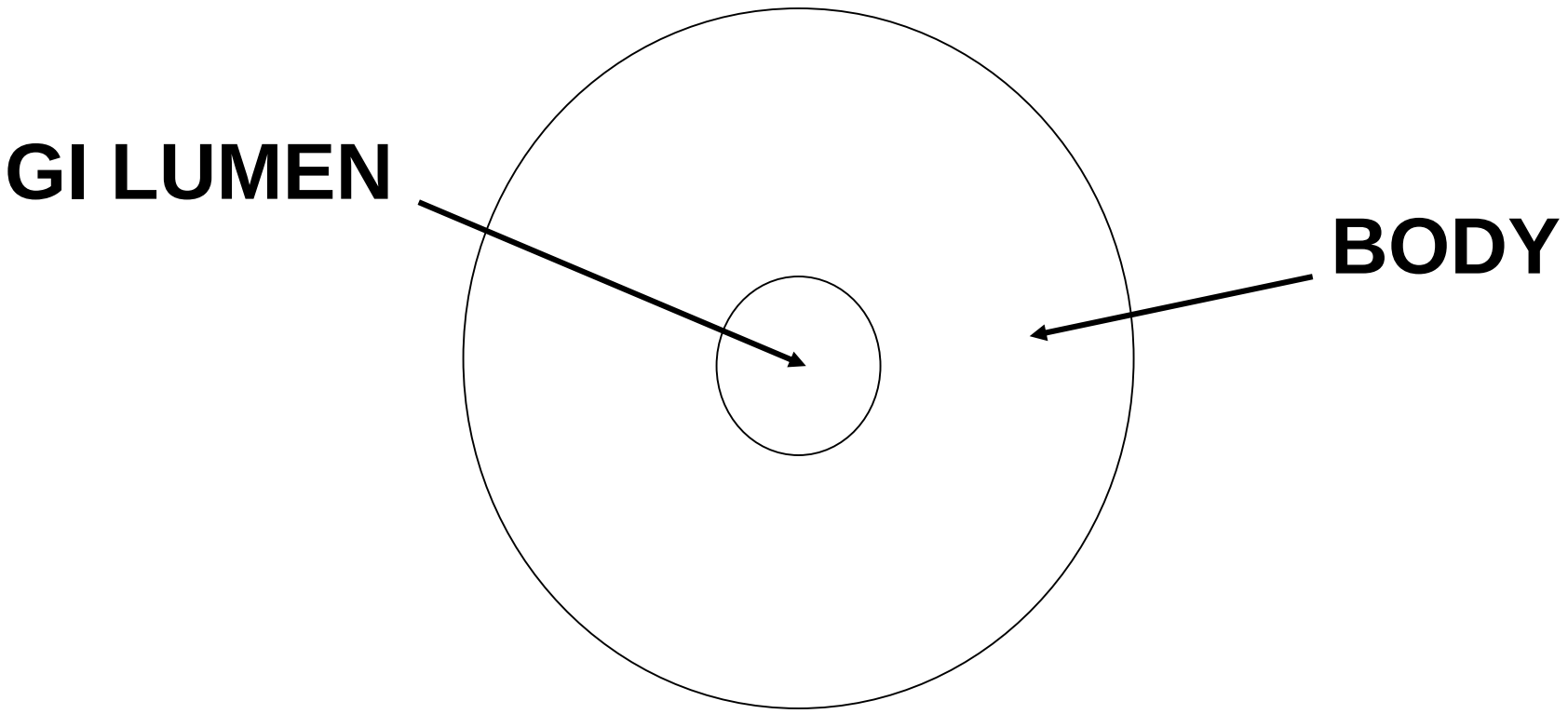
∑ = 567 kcal

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 ≤ 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.**

AICR Newsletter, Summer 2006

GI-DONUT ANALOGY



Gut Secretions

Secretion	***Release Site***
1. Mucus	**into GI Lumen**
2. Enzymes	**into GI Lumen**
3. H_2O, 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

3. Stomach

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

4. Liver-Gall Bladder

Emulsification =
detergent action of bile
+ secretion

5. Pancreas

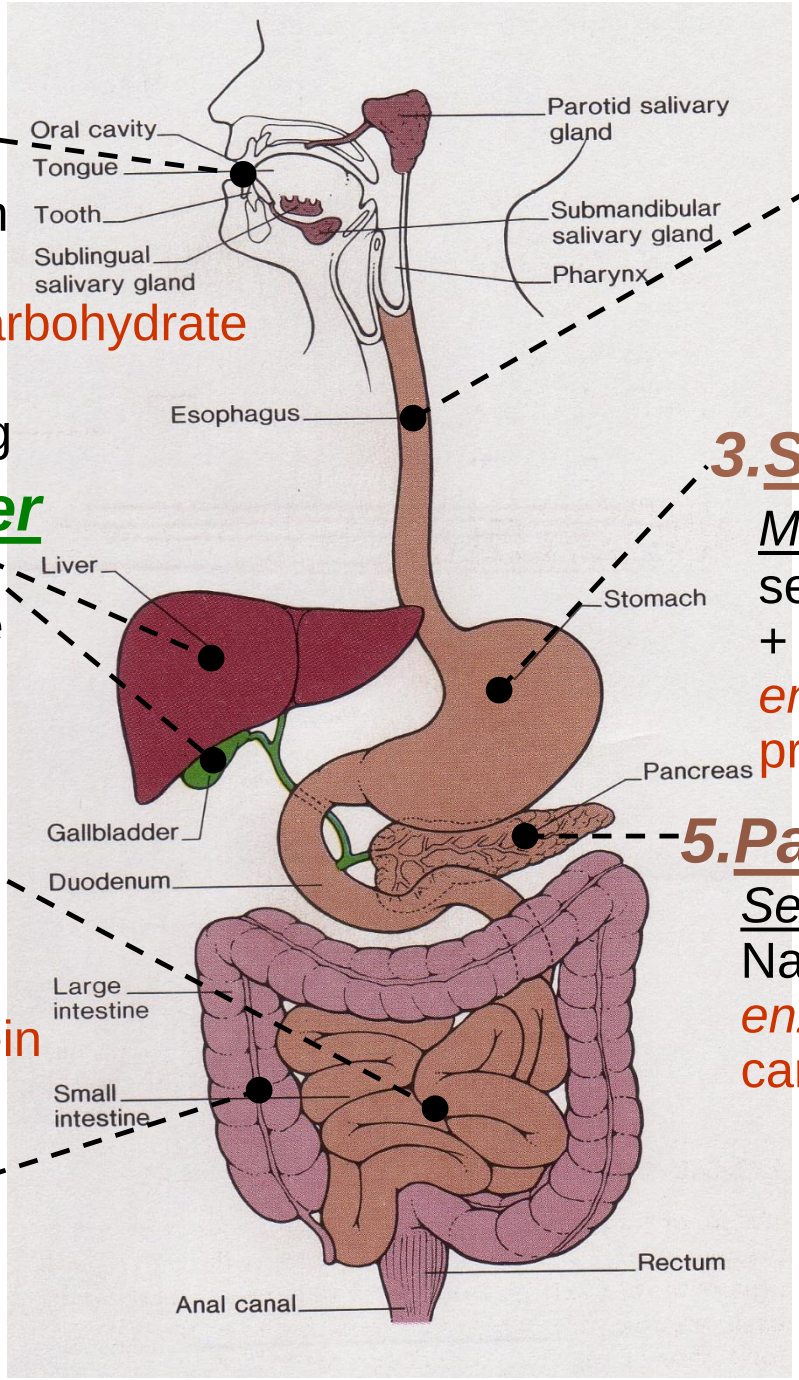
Secretion mucus +
$NaHCO_3$ + enzymes
enzymatic digestion:
carbohydrate, fat, protein

6. Small Intestine

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

7. Large Intestine

Dehydration
secretion + absorption
storage + peristalsis



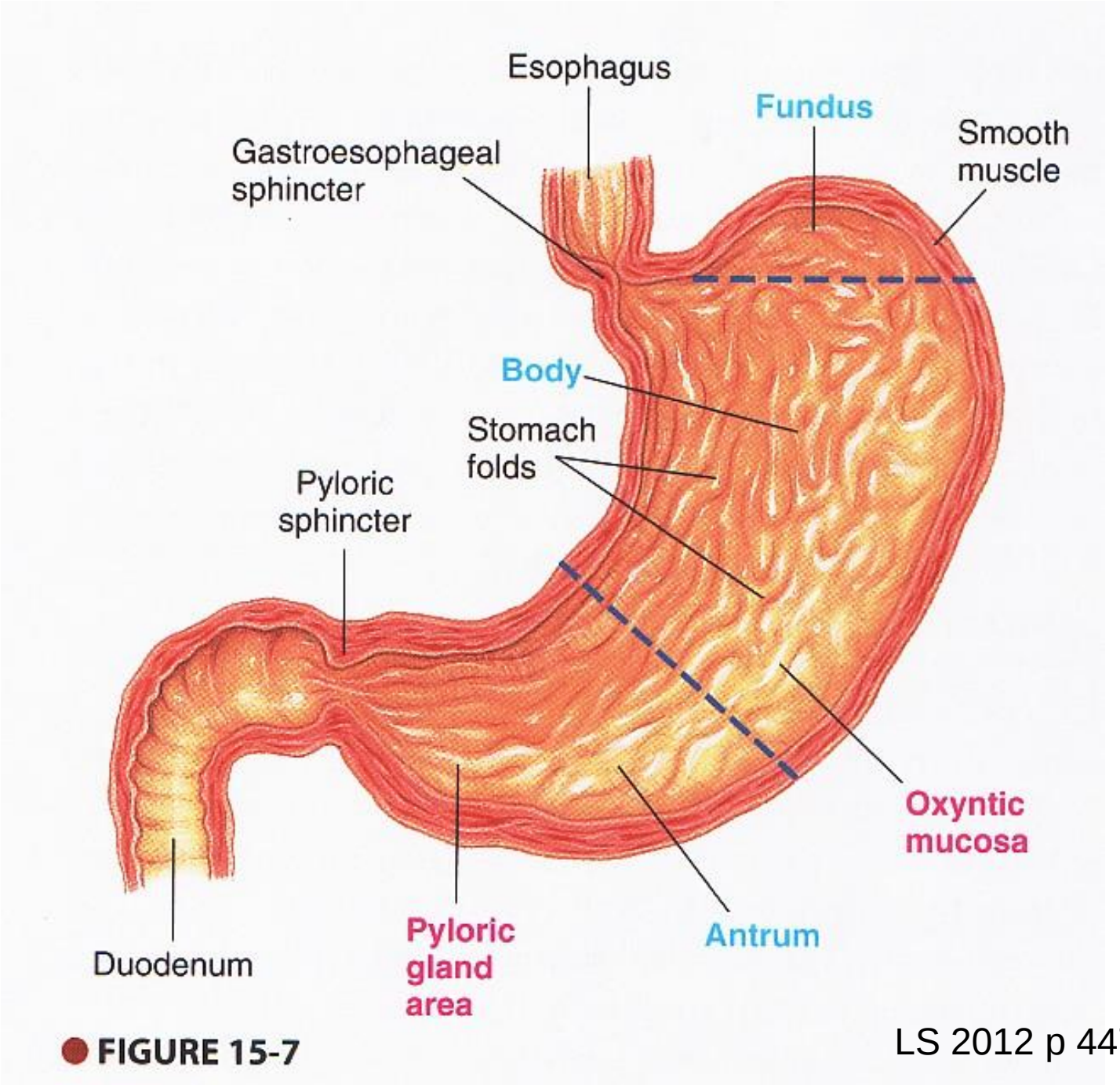
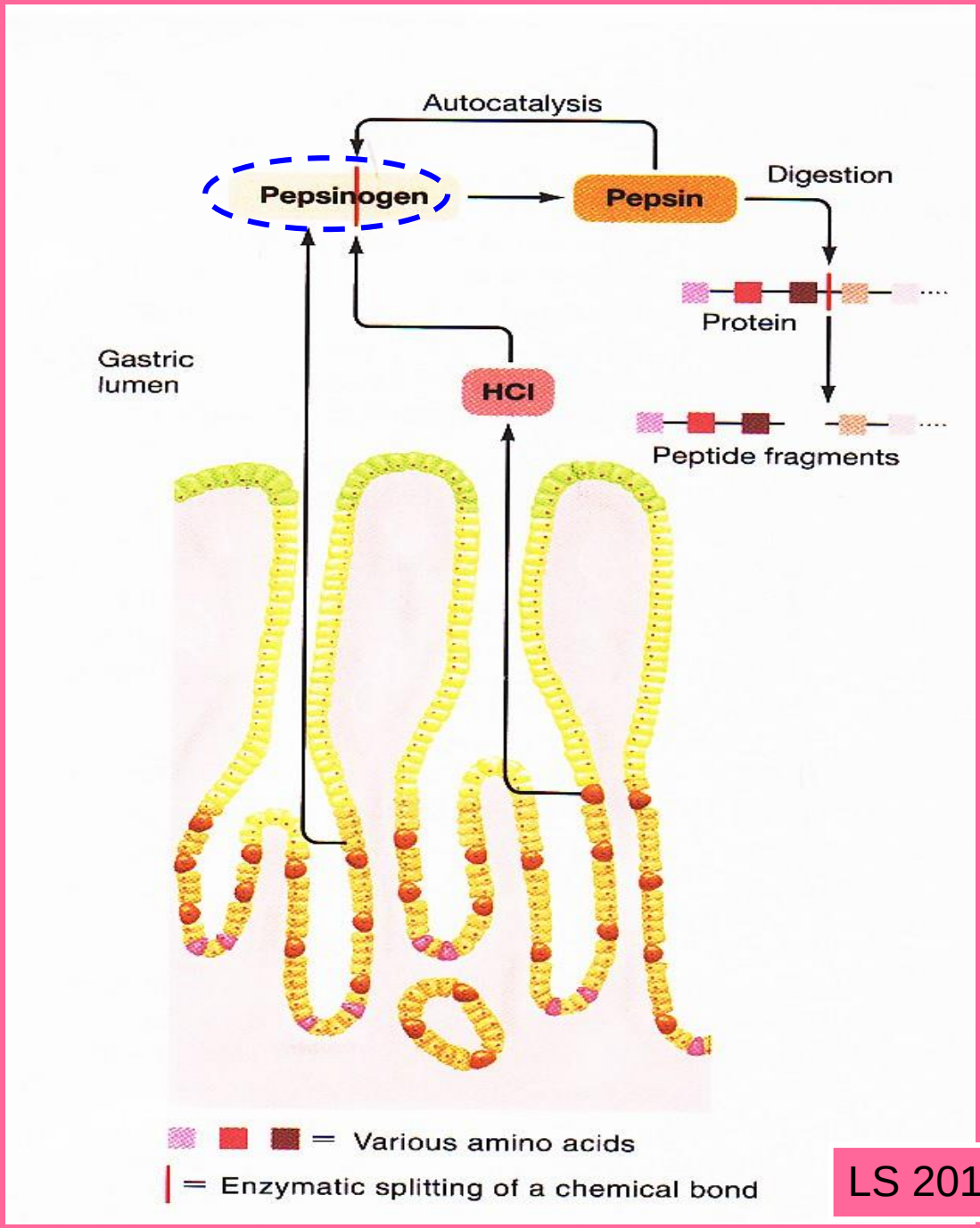


FIGURE 15-7

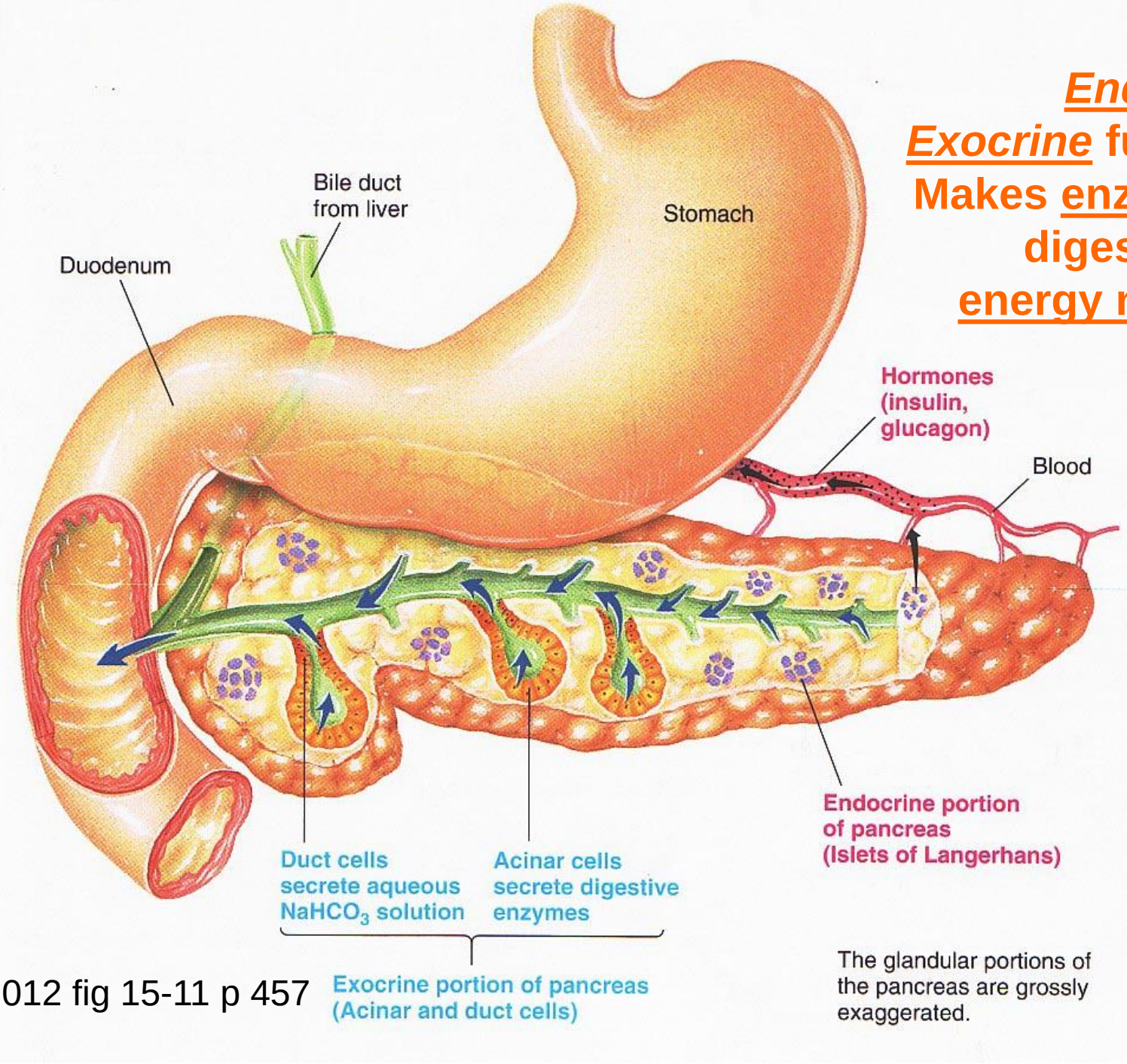
LS 2012 p 447

Zymogen= an inactive precursor

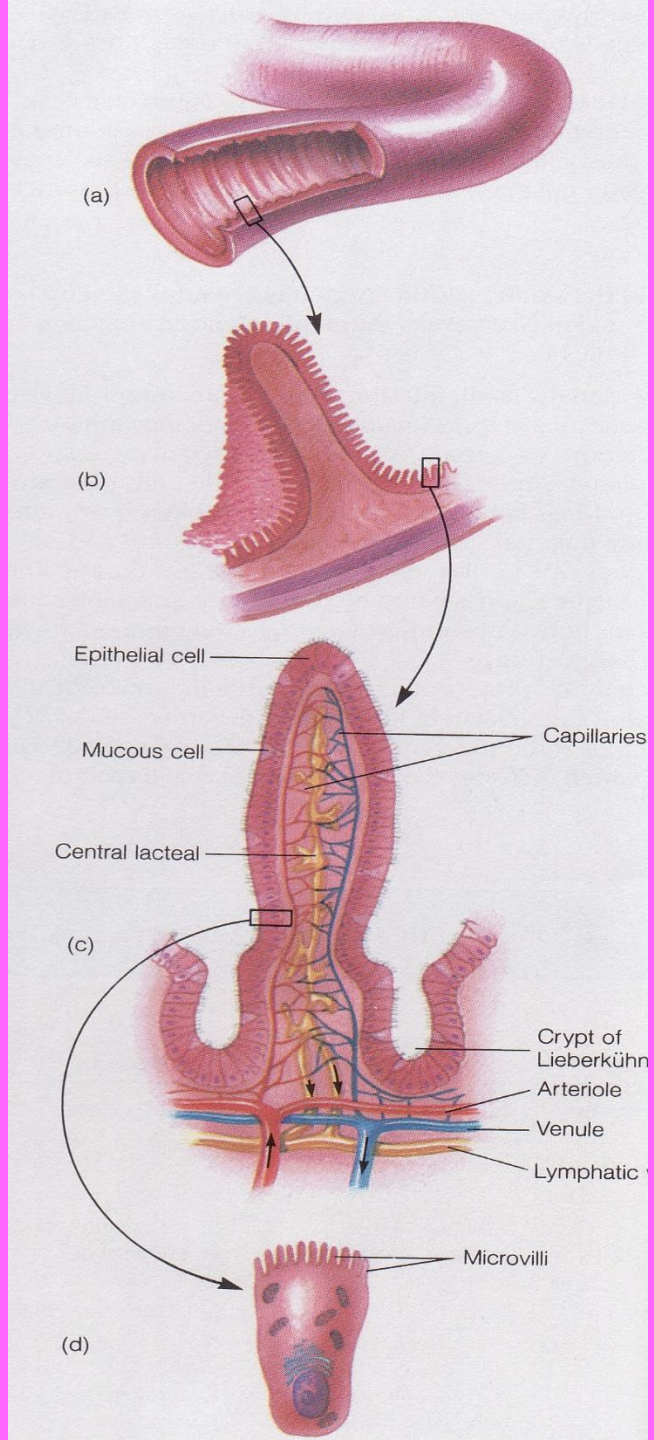


LS 2012 fig 15-9 p 452

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



LS 2012 fig 15-11 p 457



LS 2012 fig 15-20 p 467

Ulcer Facts

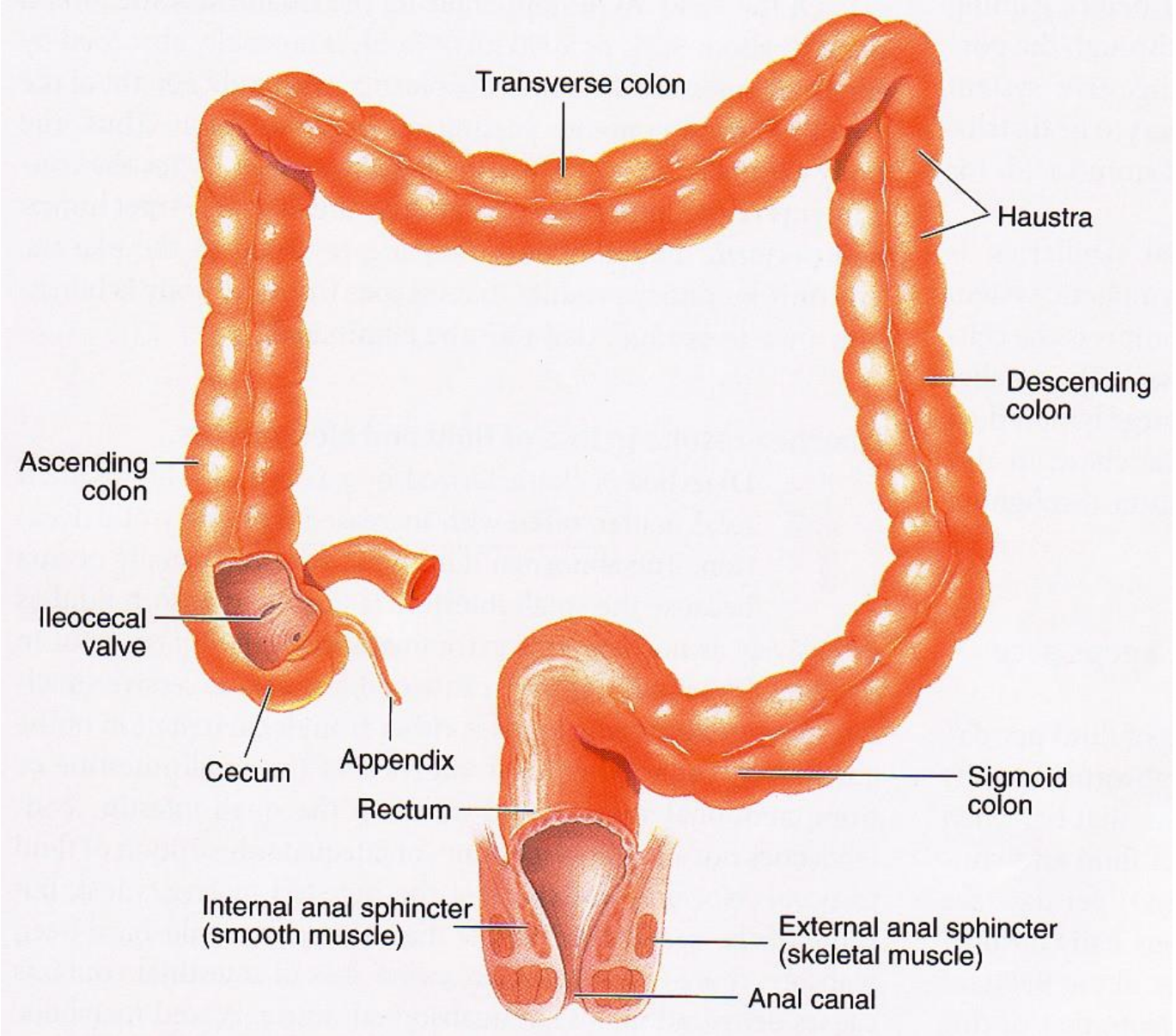
- Most ulcers are caused by an infection, not spicy food, acid or stress.
- The most common ulcer symptom is burning pain in the stomach.
- Your doctor can test you for *H. pylori* infection.
- Antibiotics are the new cure for ulcers.
- Eliminating *H. pylori* infections with antibiotics means that your ulcer can be cured for good.

Table 15-5 Digestive Processes for the Three Major Categories of Nutrients

Nutrients	Enzymes for Digesting the Nutrients	Source of Enzymes	Site of Action of Enzymes	Action of Enzymes	Absorbable Units of the Nutrients
Carbohydrates	Amylase	Salivary glands	Mouth and (mostly) body of stomach	Hydrolyzes polysaccharides to disaccharides (maltose)	
		Exocrine pancreas	Small-intestine lumen		
	Disaccharidases (maltase, sucrase, lactase)	Small-intestine epithelial cells	Small-intestine brush border	Hydrolyze disaccharides to monosaccharides	Monosaccharides, especially glucose
Proteins	Pepsin	Stomach chief cells	Stomach antrum	Hydrolyzes protein to peptide fragments	
	Trypsin, chymotrypsin, carboxypeptidase	Exocrine pancreas	Small-intestine lumen	Attack different peptide fragments	
	Aminopeptidases	Small-intestine epithelial cells	Small-intestine brush border	Hydrolyze peptide fragments to amino acids	Amino acids
Fats	Lipase	Exocrine pancreas	Small-intestine lumen	Hydrolyzes triglycerides to fatty acids and monoglycerides	Fatty acids and monoglycerides
	Bile salts (not an enzyme)	Liver	Small-intestine lumen	Emulsify large fat globules for attack by pancreatic lipase	

LS 2012 p 446

Large Intestine Structure & Function



LS 2012 fig 15-24 p 472