

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

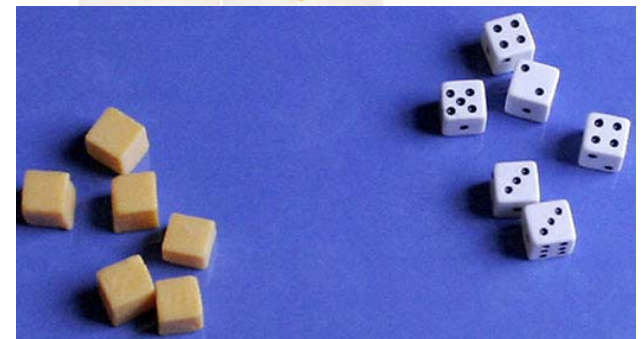
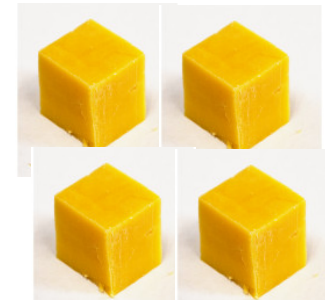


≡

4 oz → 3 oz



raw → cooked



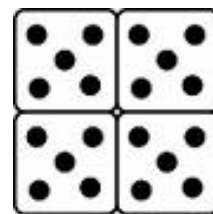
or



≡ 1 c



≡ 1/3 c



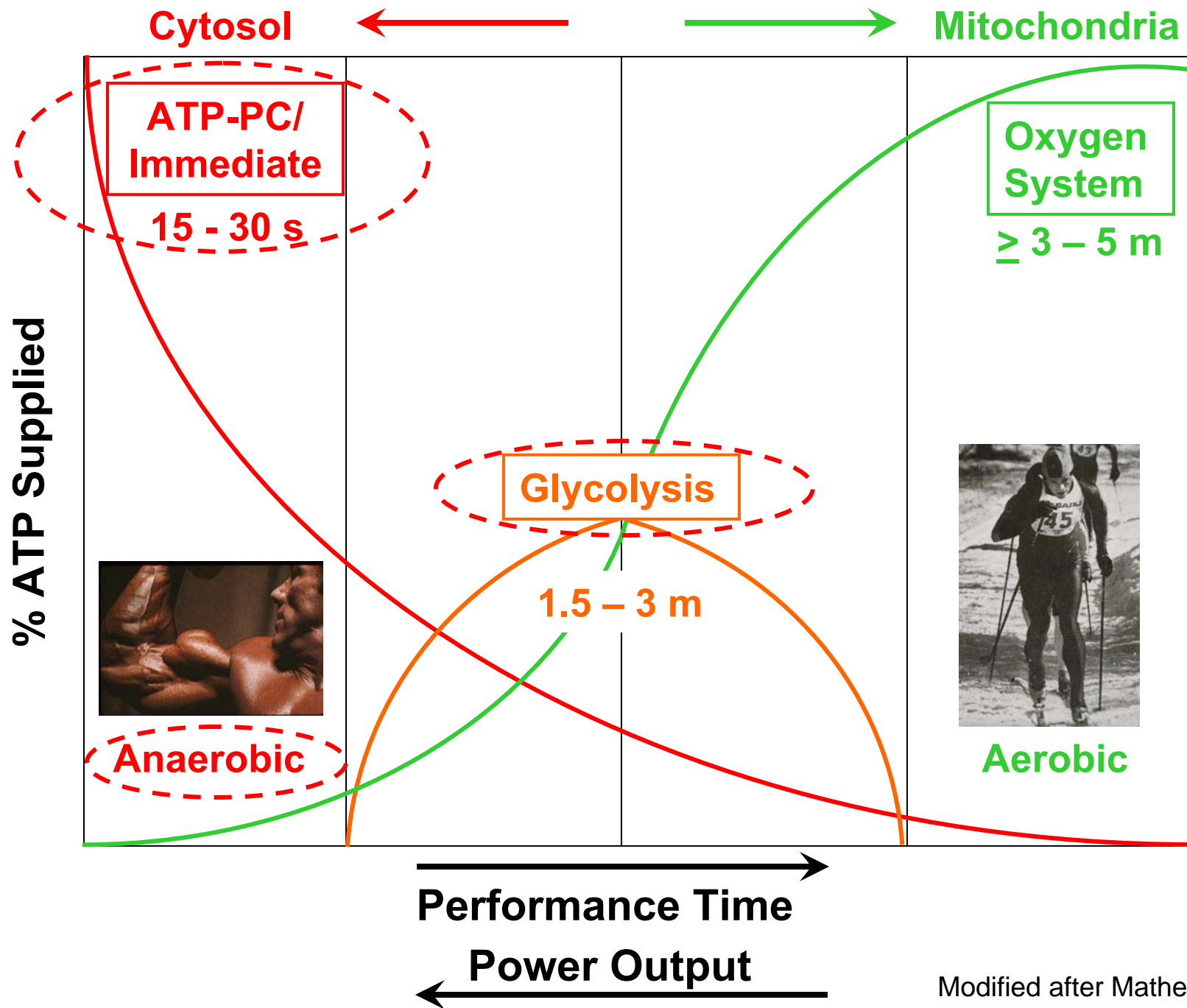
≡ 1 oz



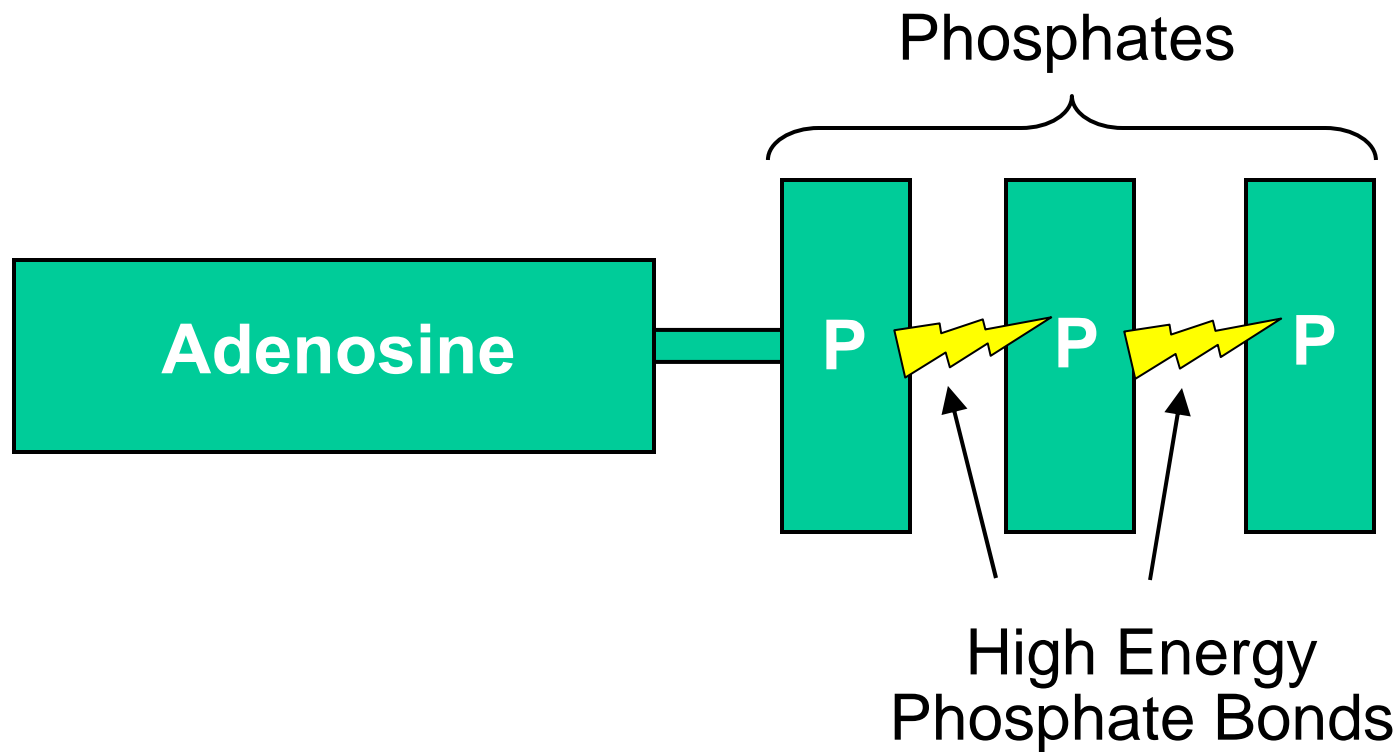
≡ 1/4 c



≡ 1.5 oz

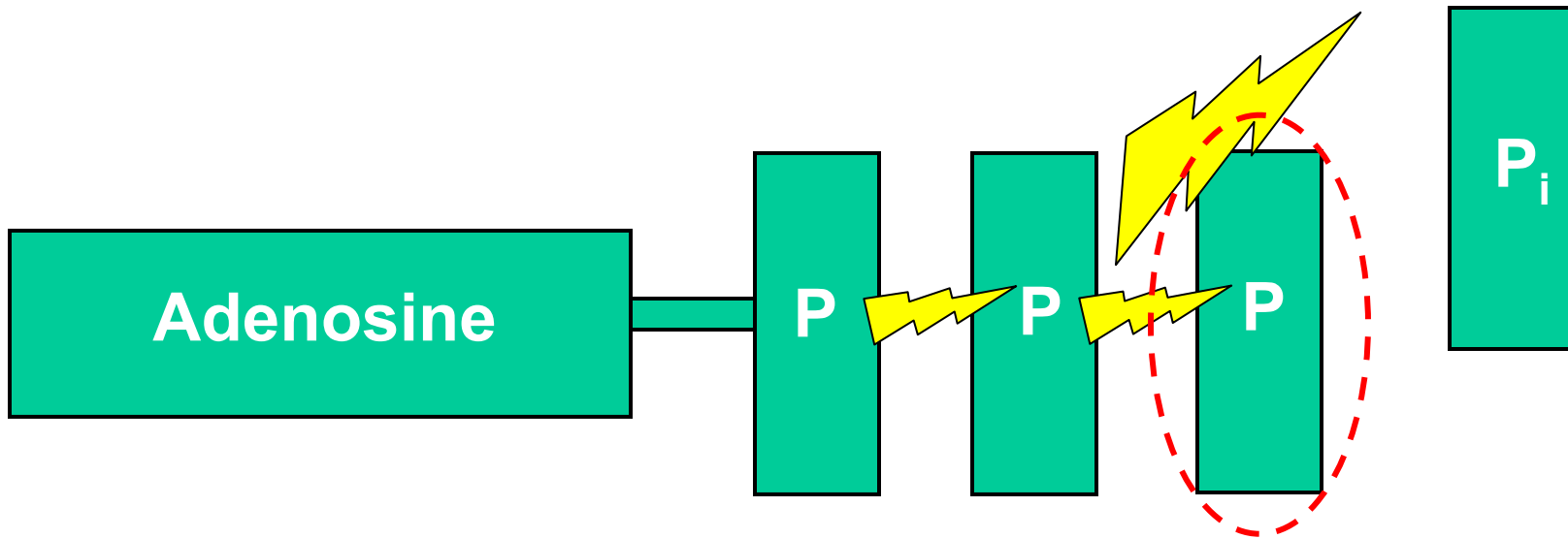


**ATP = Adenosine Tri Phosphate
The Common Energy Currency
or the Cash Cells Understand!!**



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*

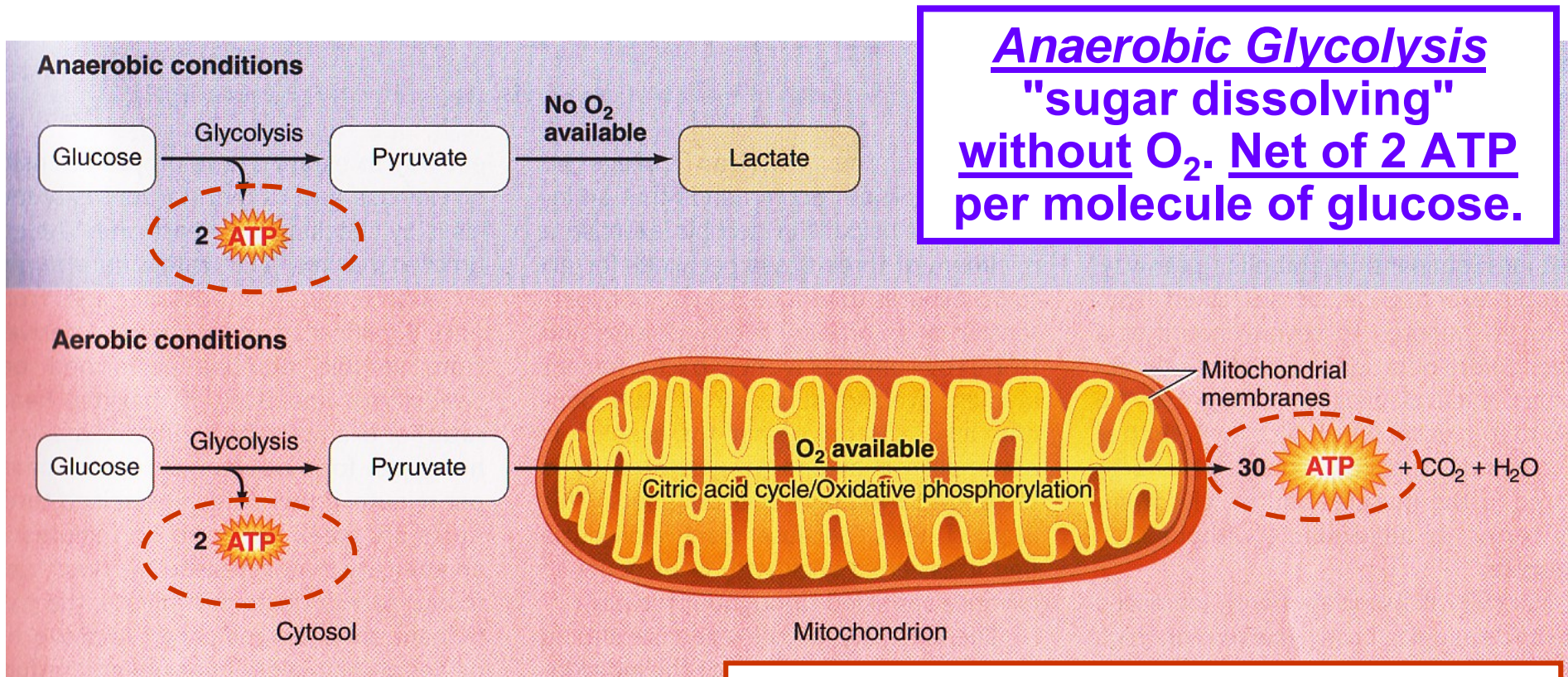
Move things!
Microscopic!

③ *Mechanical
Work*

Move things!
Macroscopic!



Anaerobic vs. Aerobic Metabolism



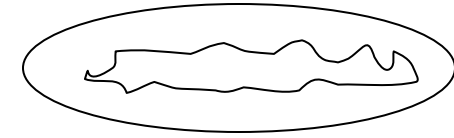
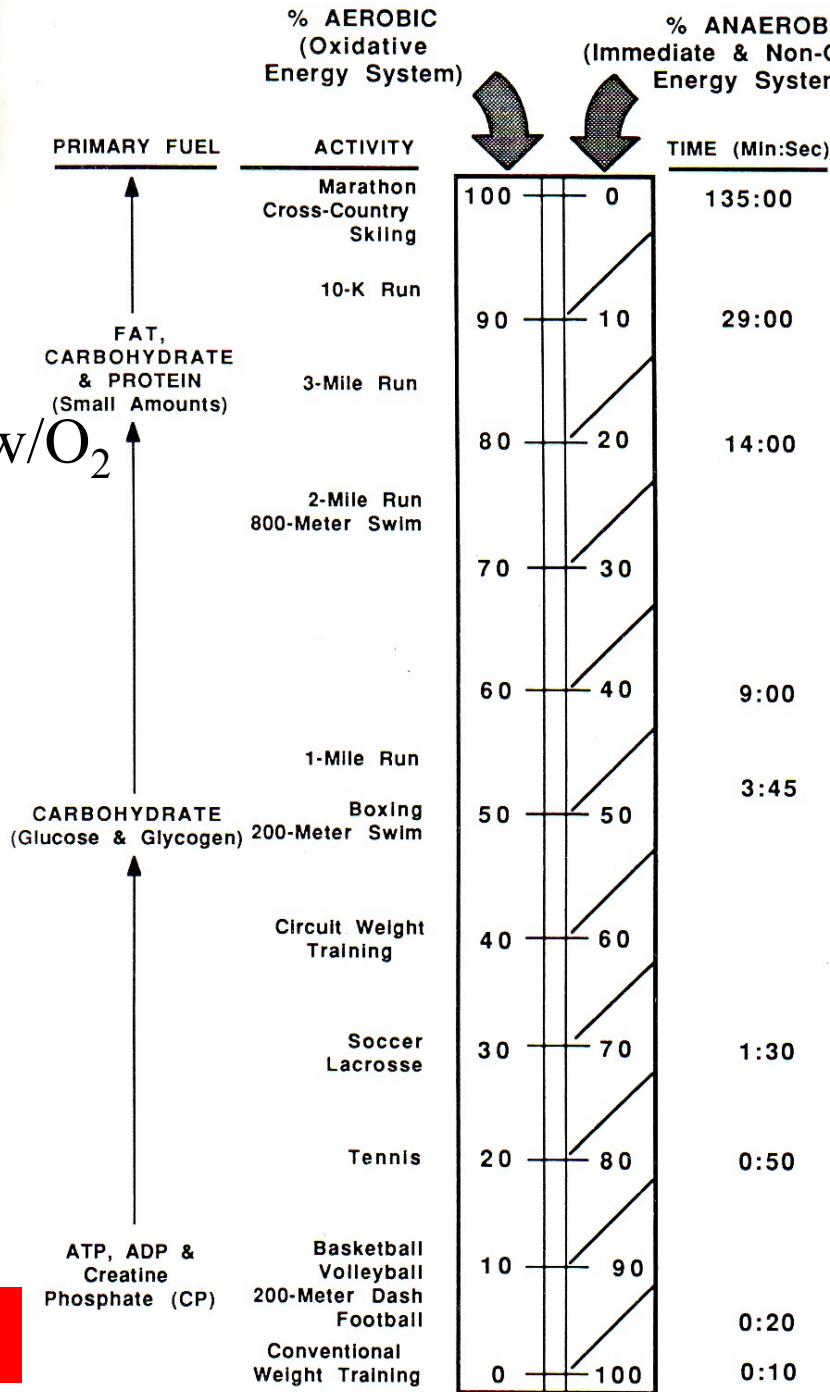
Anaerobic Glycolysis
"sugar dissolving"
without O₂. Net of 2 ATP
per molecule of glucose.

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



AEROBIC

w/O₂



MITOCHONDRIA

CYTOSOL

Glycolysis



Immediate/ATP-PC



ANAEROBIC

Stages of Cellular Metabolism/Respiration

**Anaerobic
Glycolysis
Cytosol**

**Aerobic
Metabolism
Mitochondria**

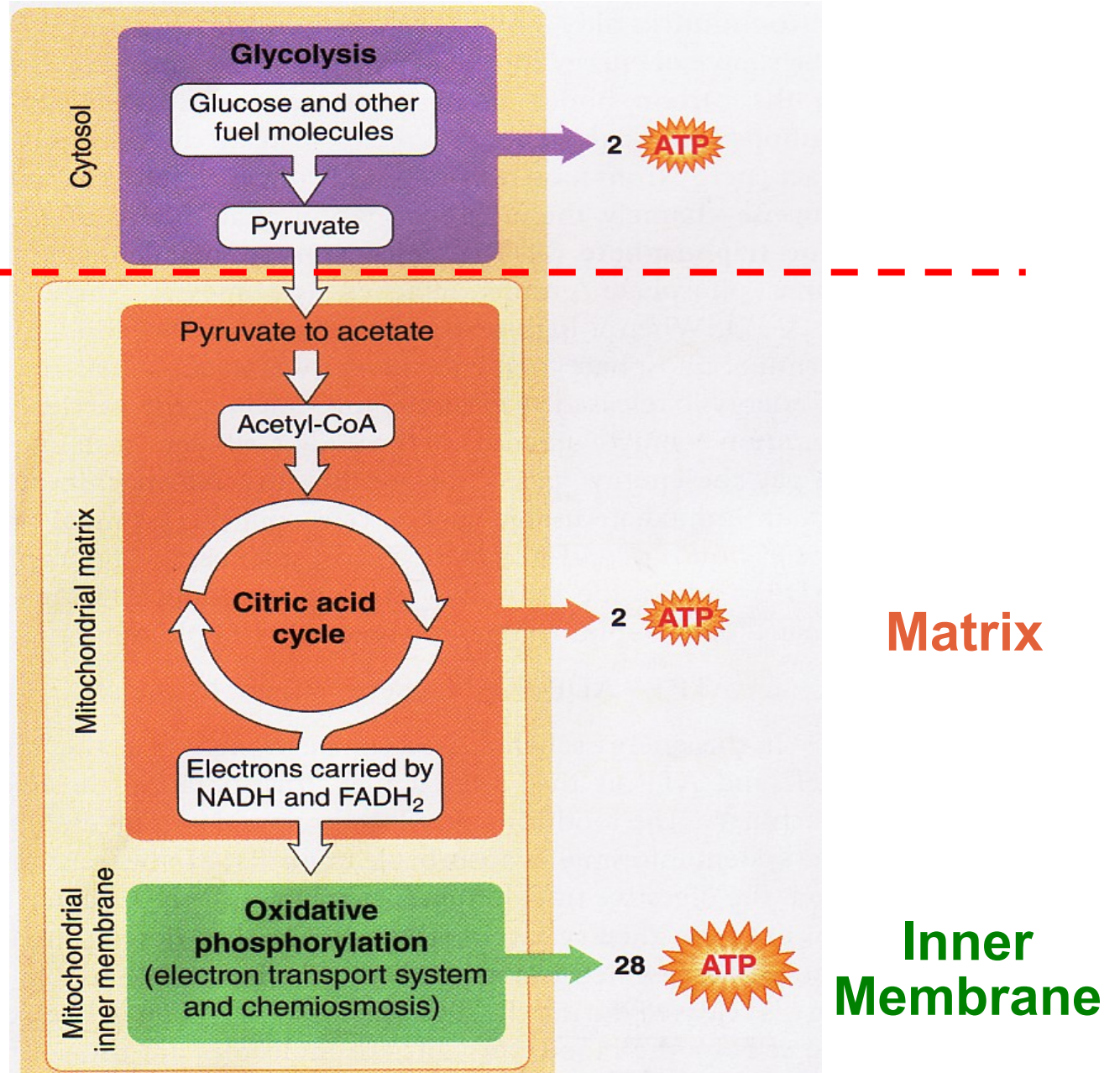


fig 2-9 LS 2012

Glycolysis "sugar dissolving/splitting" produces small amounts of ATP

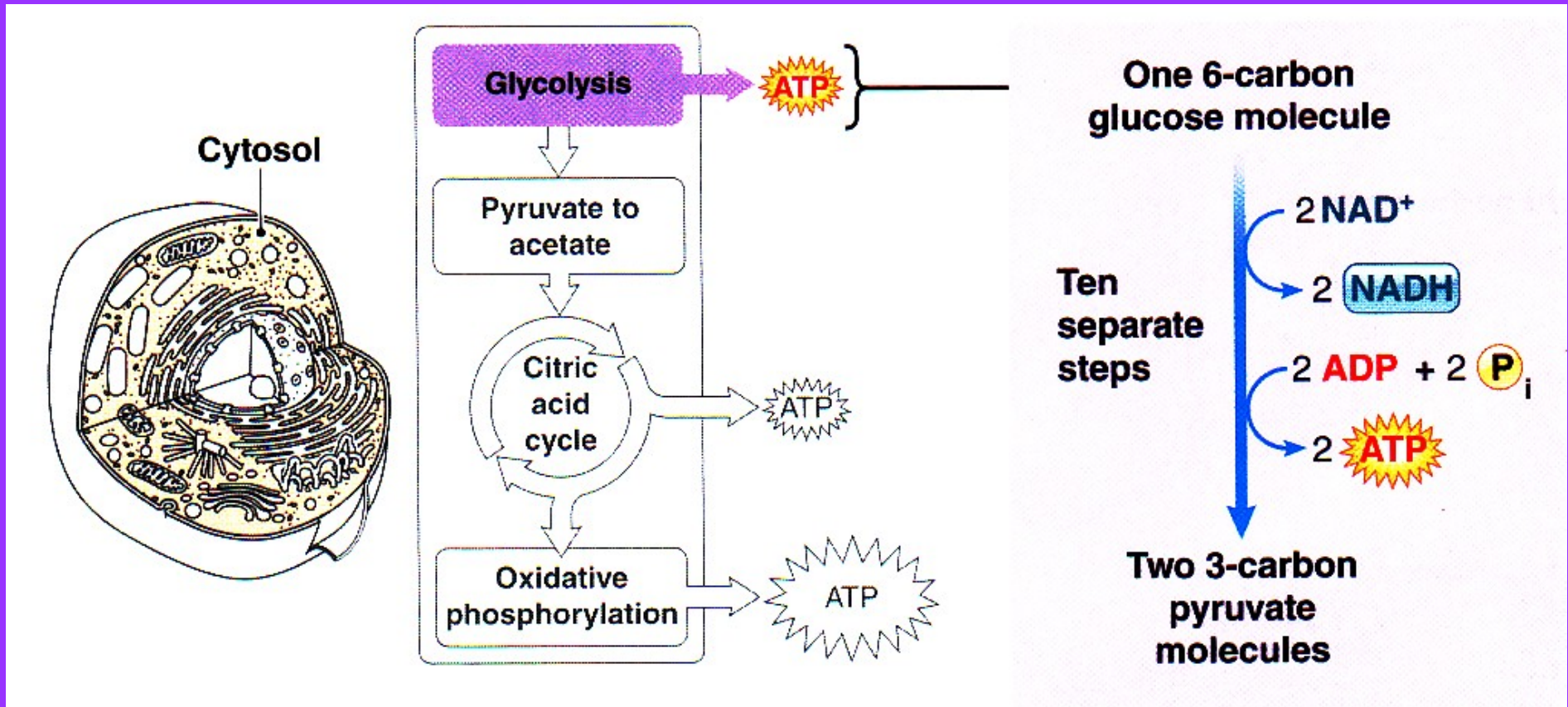
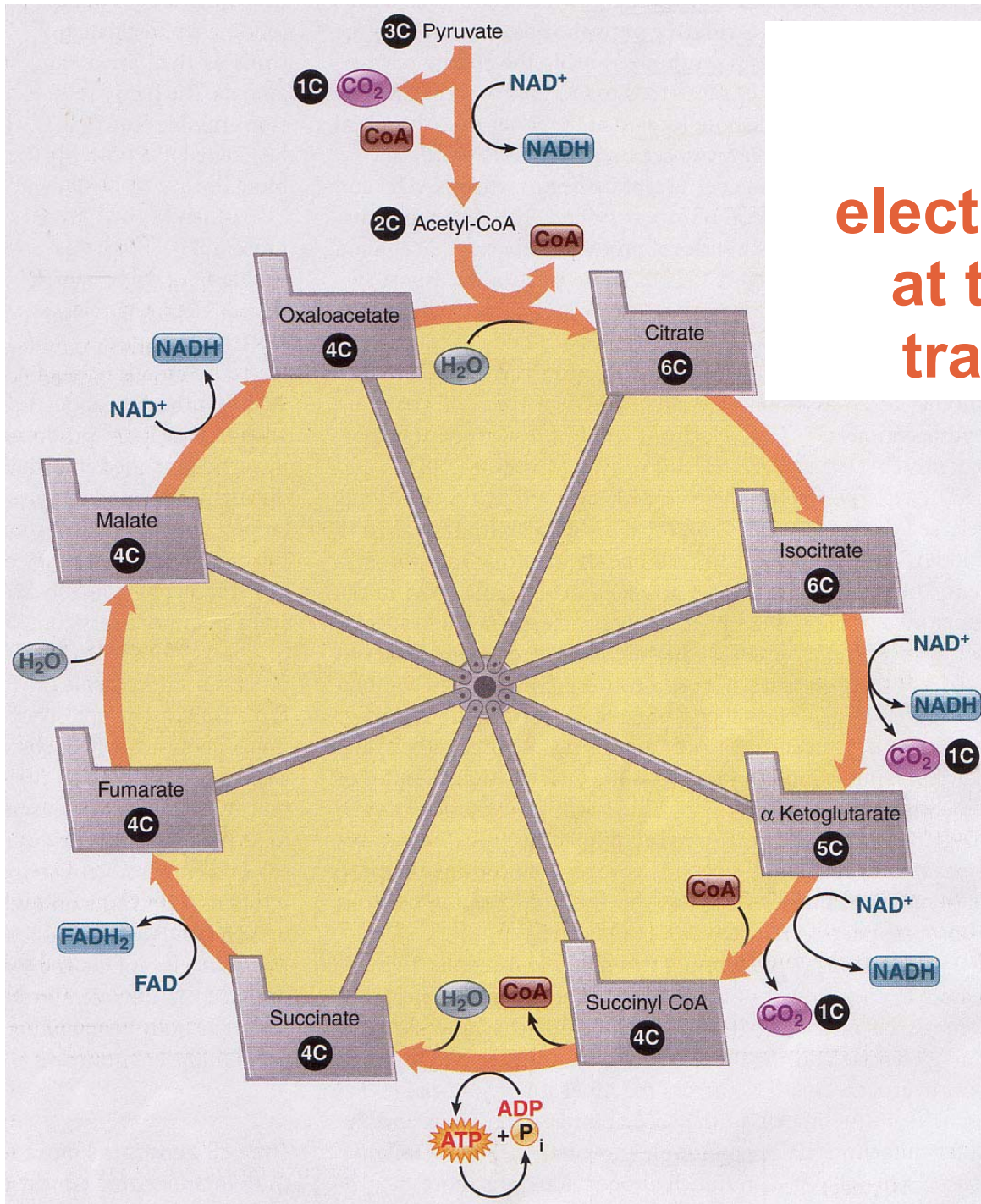


fig 2-10 LS 2012



Citric Acid Cycle
 produces pairs of
 electrons for cashing in
 at the nearby electron
 transport chain (ETC)



fig 2-11 LS 2012
 + David Oganessian
<http://pixdaus.com>

Cashing in electrons at the Electron Transport Chain (ETC) produces an abundance of ATP energy molecules!

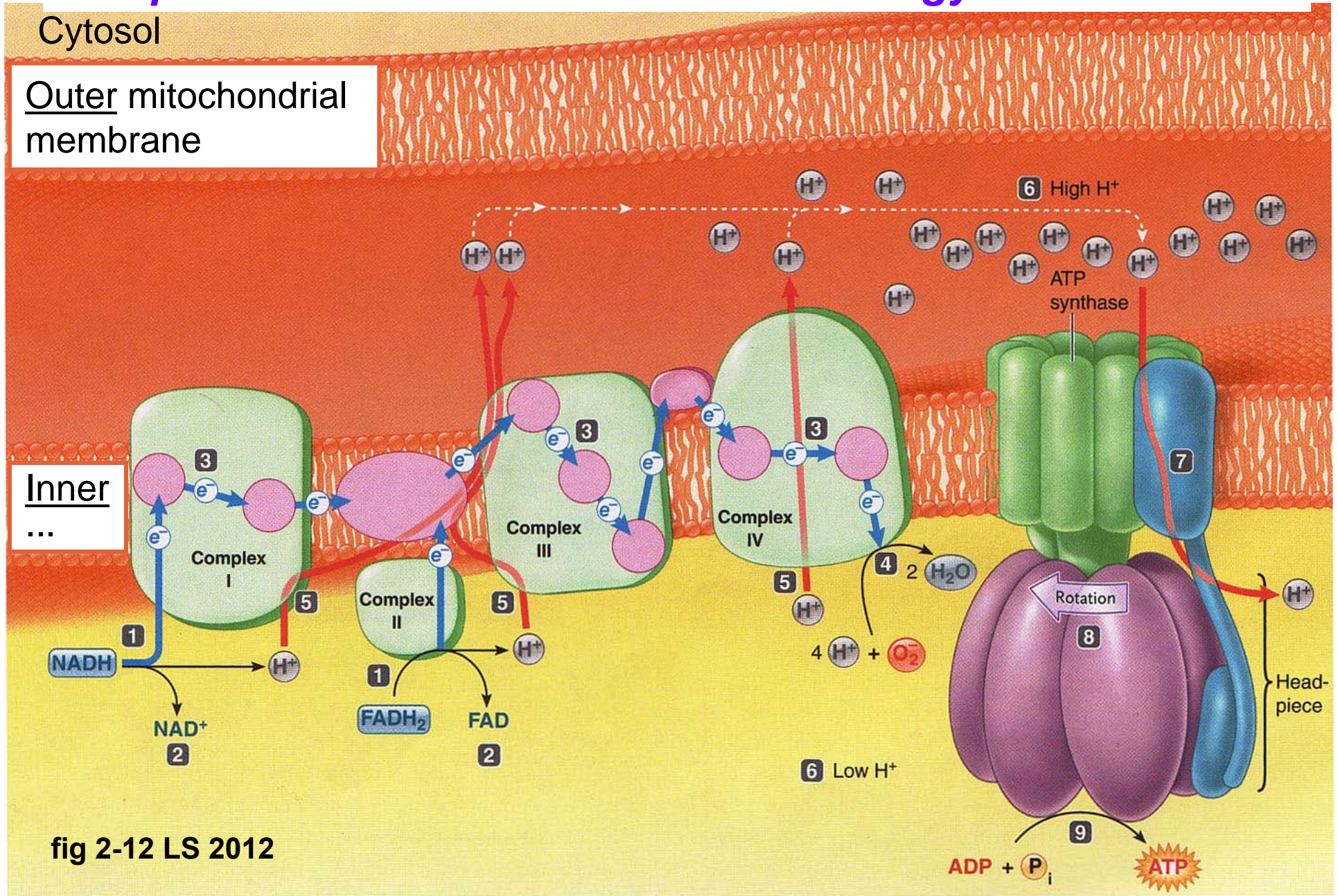
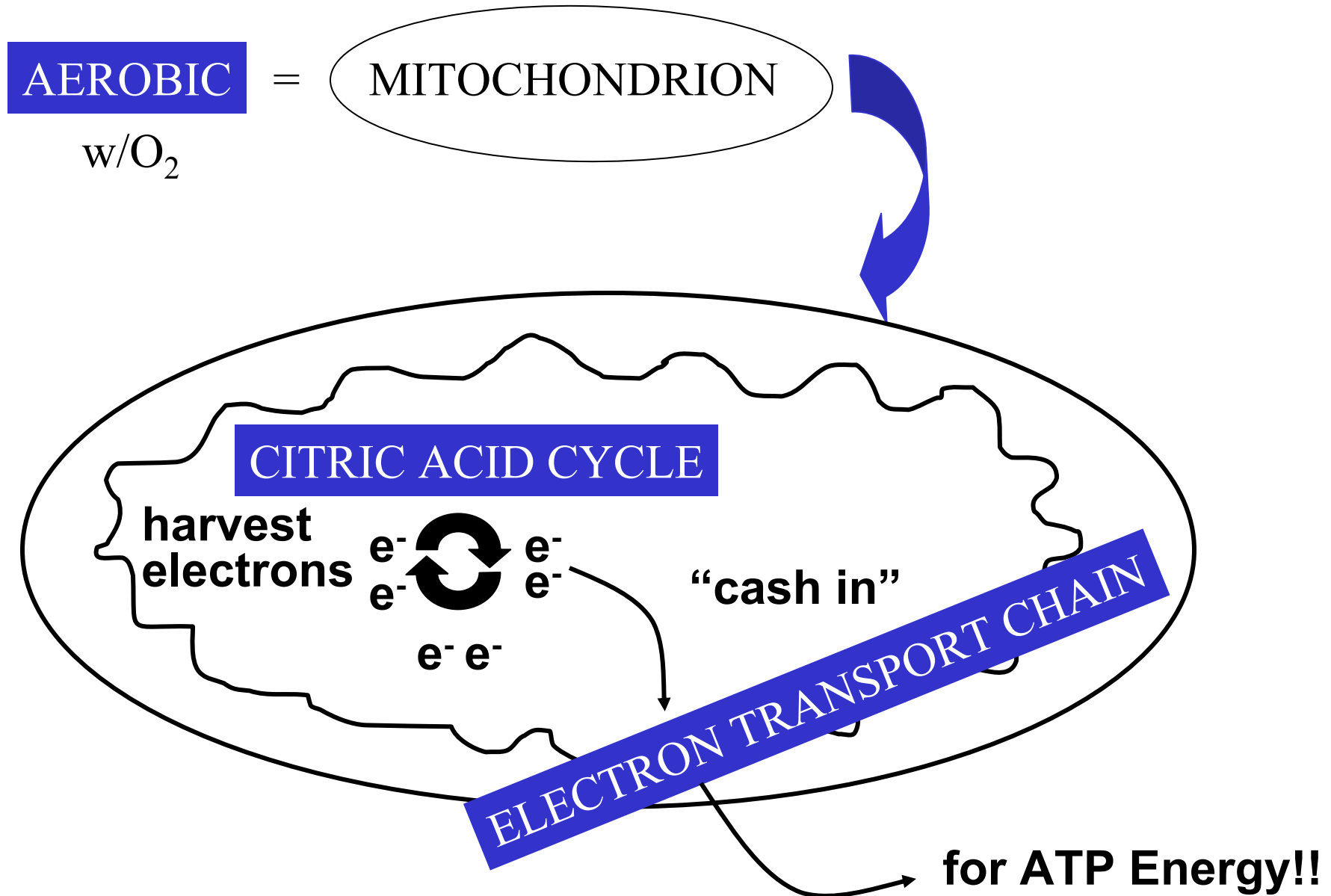
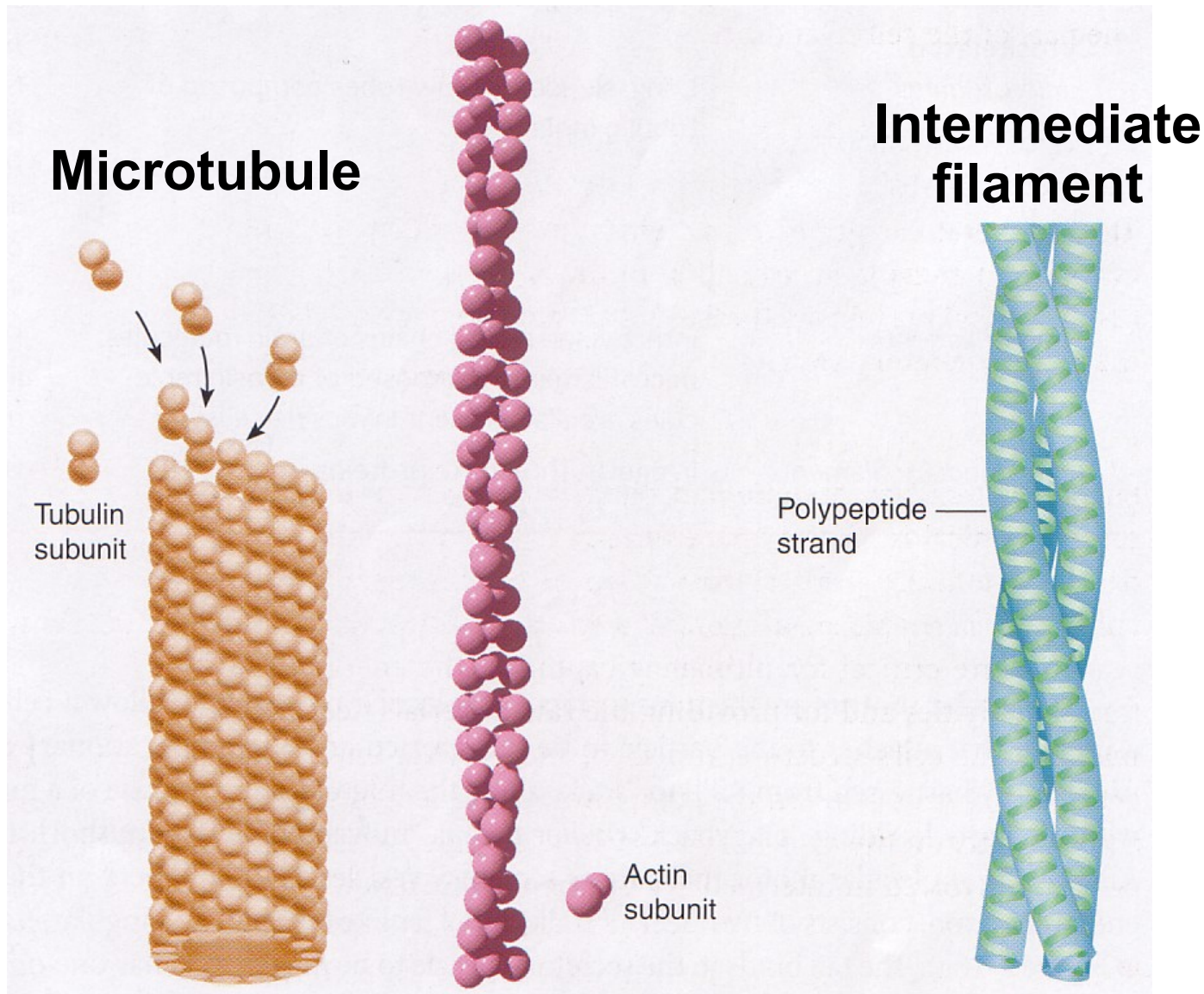


fig 2-12 LS 2012

Goals of Aerobic Metabolism

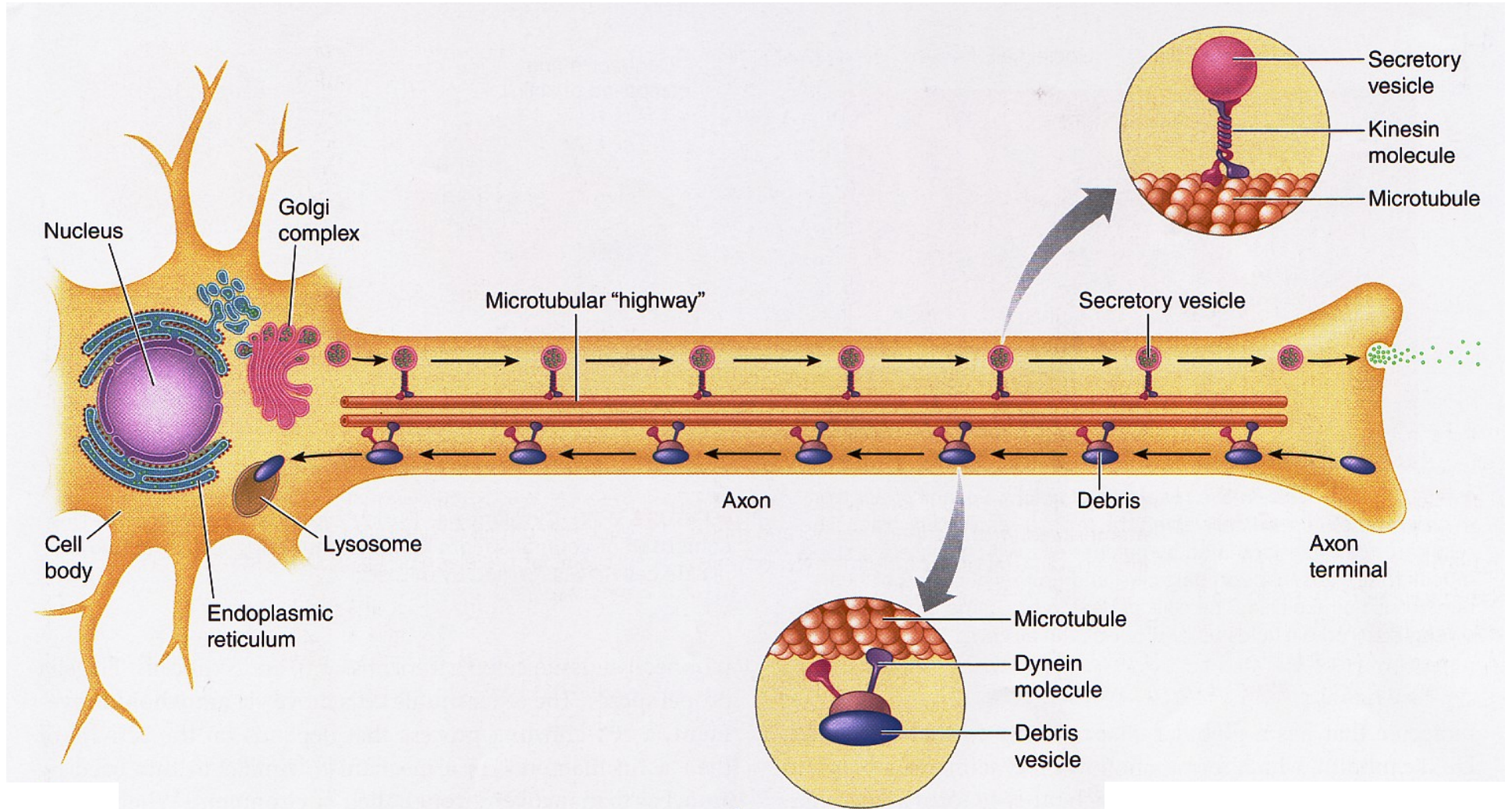


Cytoskeleton: Cell "Bone & Muscle"

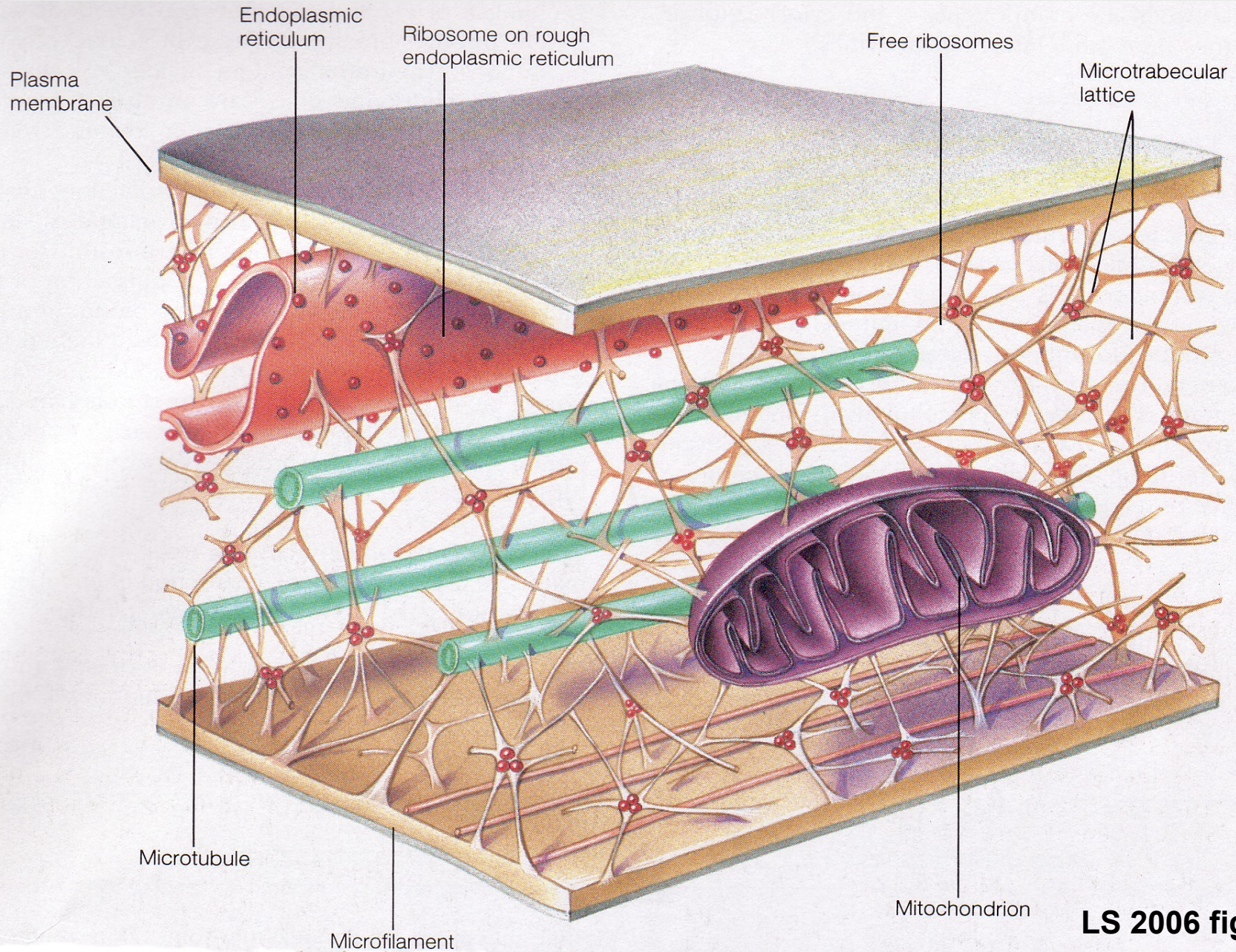


Microfilament

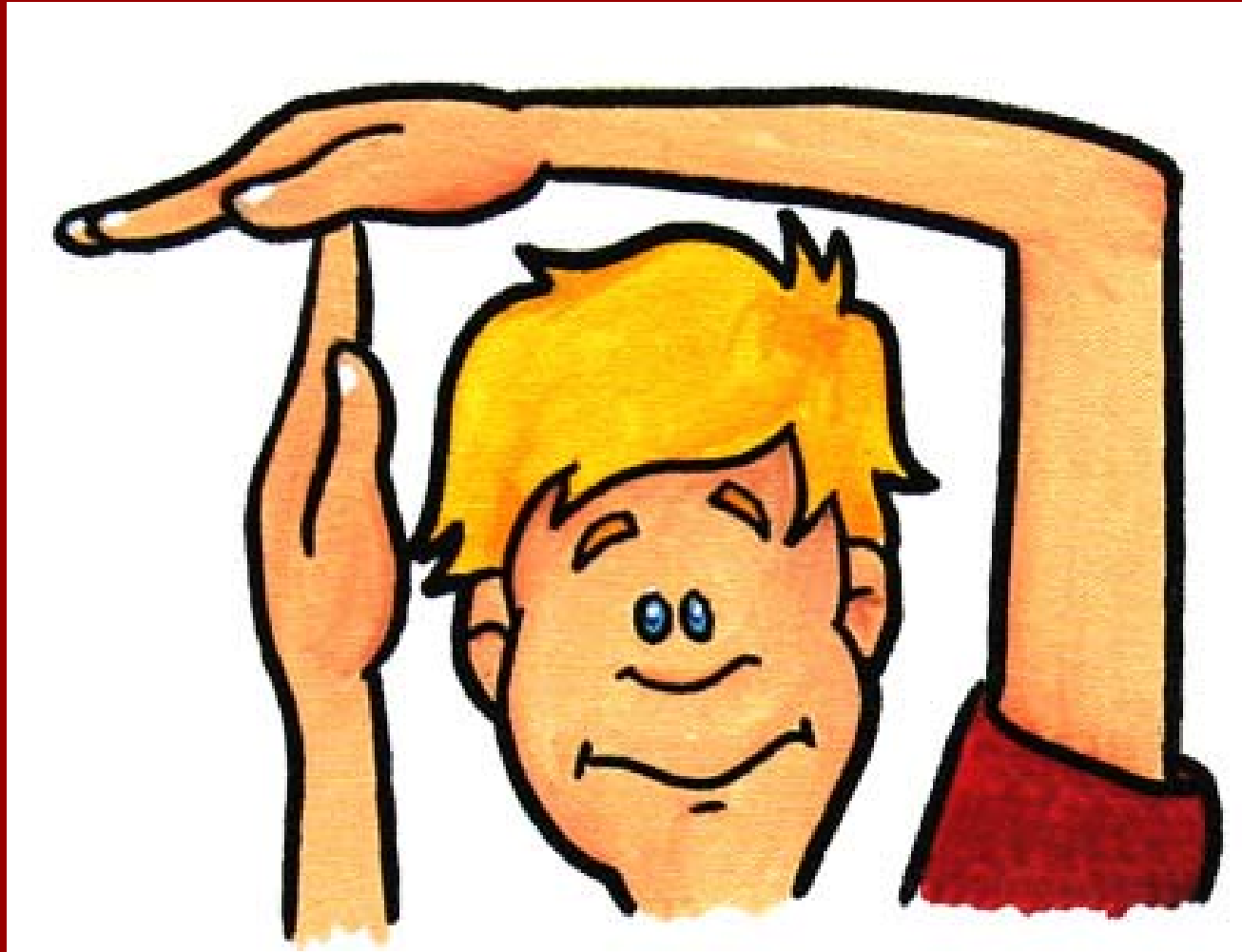
Microtubular Highway!!



4th Component: Microtrabecular Lattice?



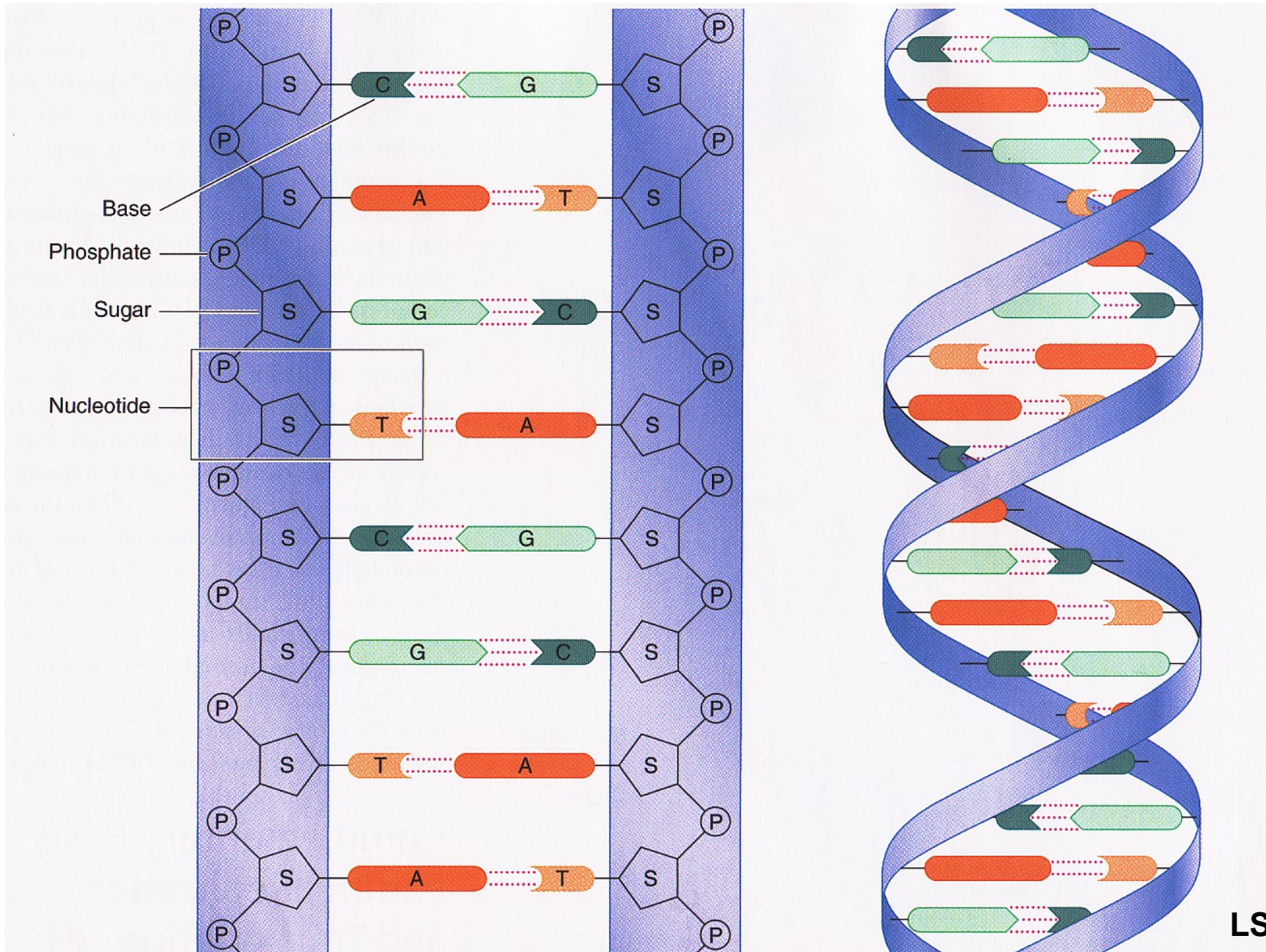
Time-out for questions!



What are DNA's major functions? Heredity + Day-to-Day Cell Function

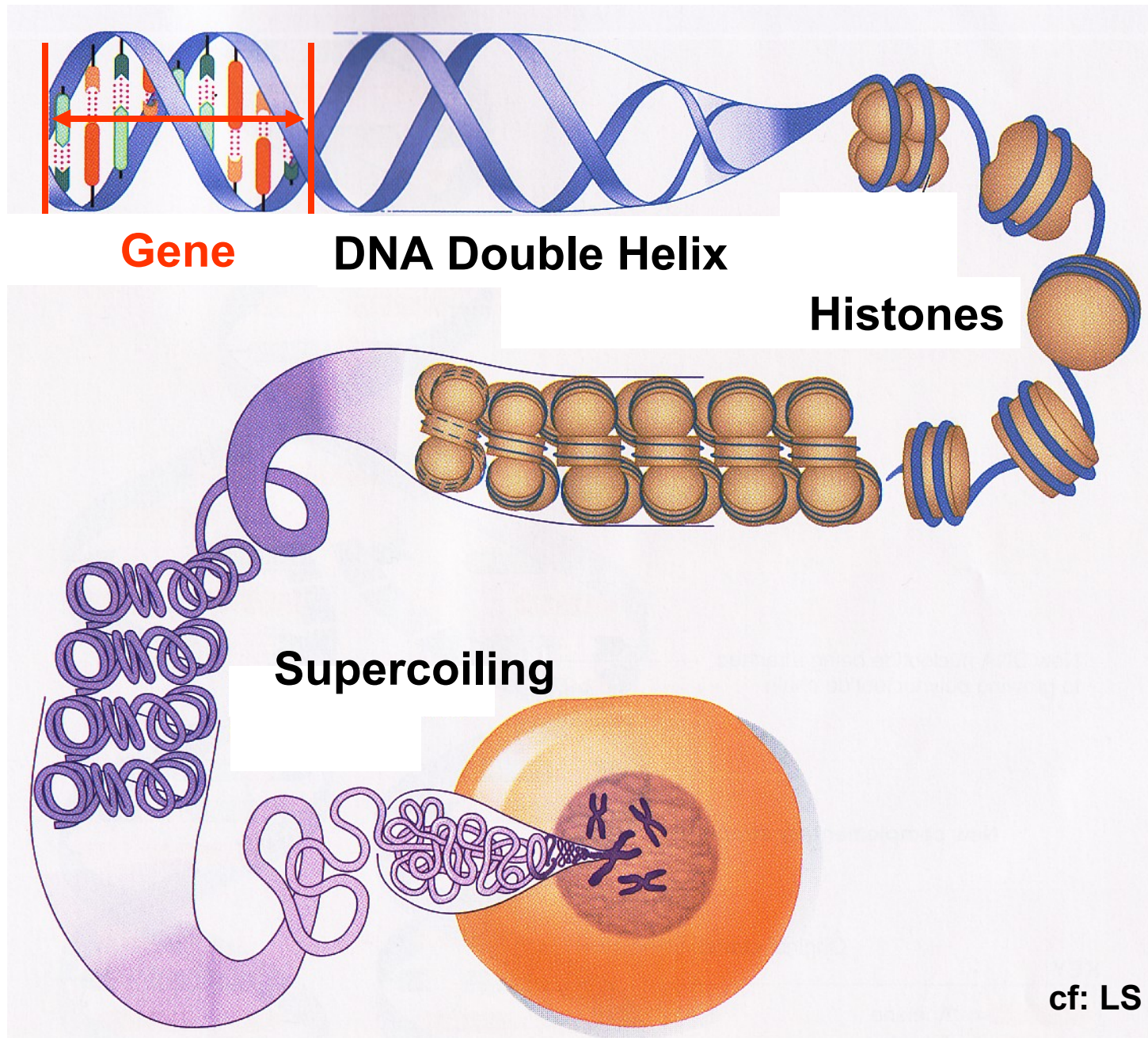


What does DNA look like? Double-helix!!



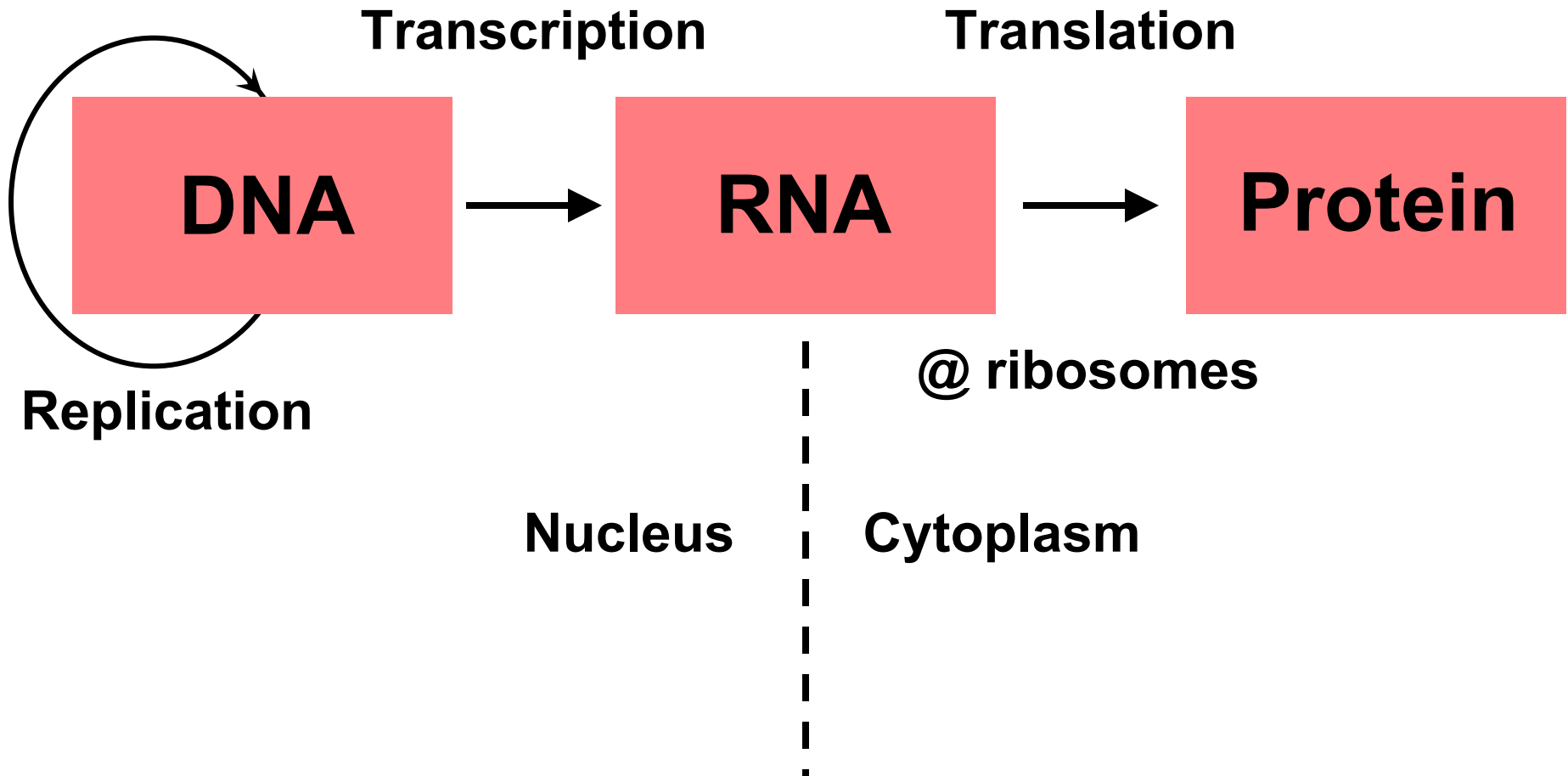
LS fig C-2

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



cf: LS fig C-3

What does DNA do, day-to-day?



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

code word

TAT

ACG

TTT

TAC

mRNA

codon

AUA

UGC

AAA

AUG

tRNA

anti-codon

UAU

ACG

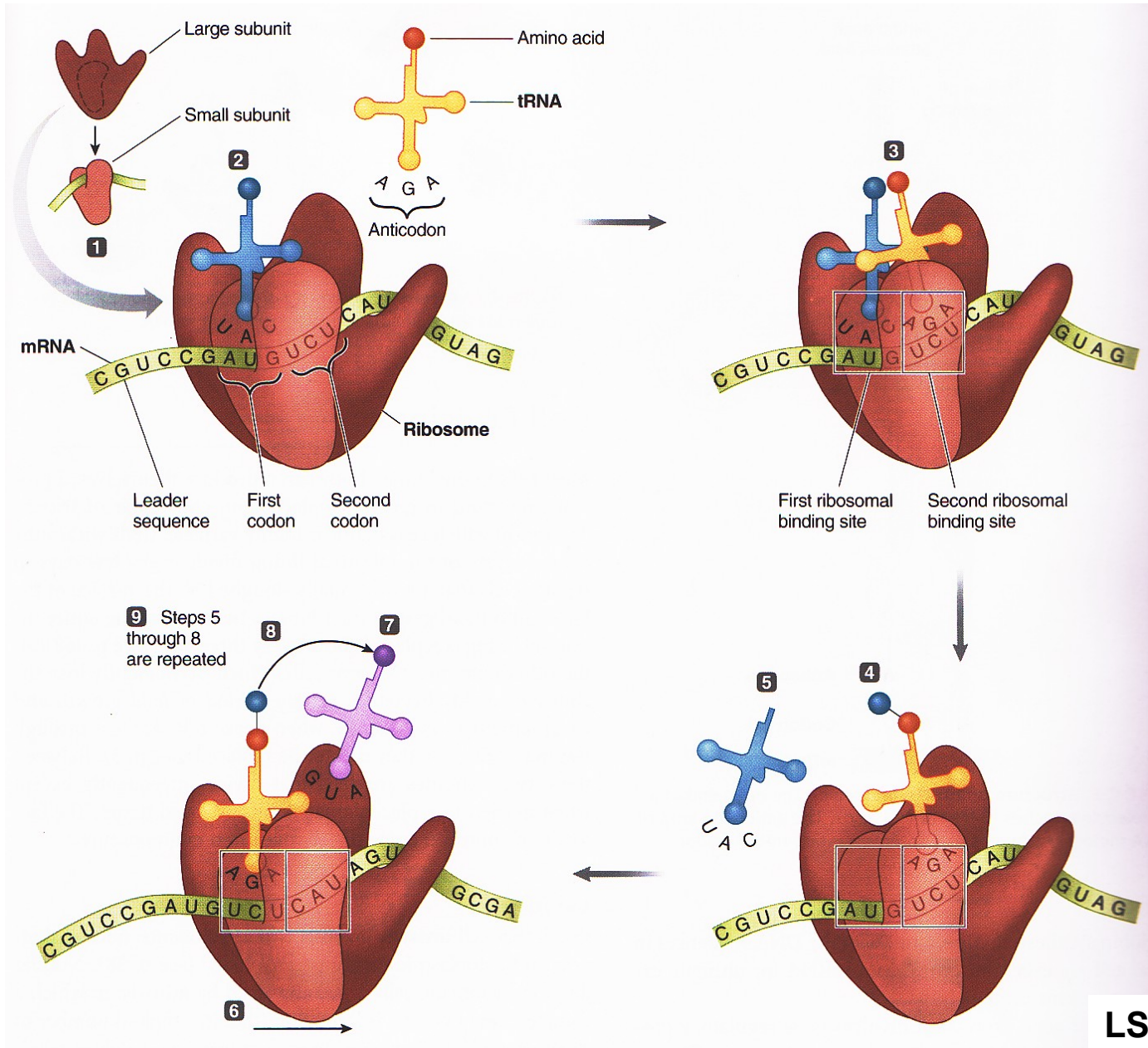
UUU

UAC

		Second base of codon				
		U	C	A	G	
First base of codon	U	UUU] Phe UUC] UUA] Leu UUG]	UCU] Ser UCC] UCA] UCG]	UAU] Tyr UAC] UAA] Stop UAG] Stop	UGU] Cys UGC] UGA] Stop UGG] Trp	U
	C	CUU] Leu CUC] CUA] CUG]	CCU] Pro CCC] CCA] CCG]	CAU] His CAC] CAA] Gln CAG]	CGU] Arg CGC] CGA] CGG]	C
	A	AUU] Ile AUC] AUA] AUG] Met Start	ACU] Thr ACC] ACA] ACG]	AAU] Asn AAC] AAA] Lys AAG]	AGU] Ser AGC] AGA] Arg AGG]	A
	G	GUU] Val GUC] GUA] GUG]	GCU] Ala GCC] GCA] GCG]	GAU] Asp GAC] GAA] Glu GAG]	GGU] Gly GGC] GGA] GGG]	G
						Third base of codon

D. Silverthorn, *Physiology: An Integrated Approach*. San Francisco: Pearson Education, 2010.

Translation? Ribosomes Make Proteins



LS 2012 fig C-7

Class Skit, Questions & Discussion!



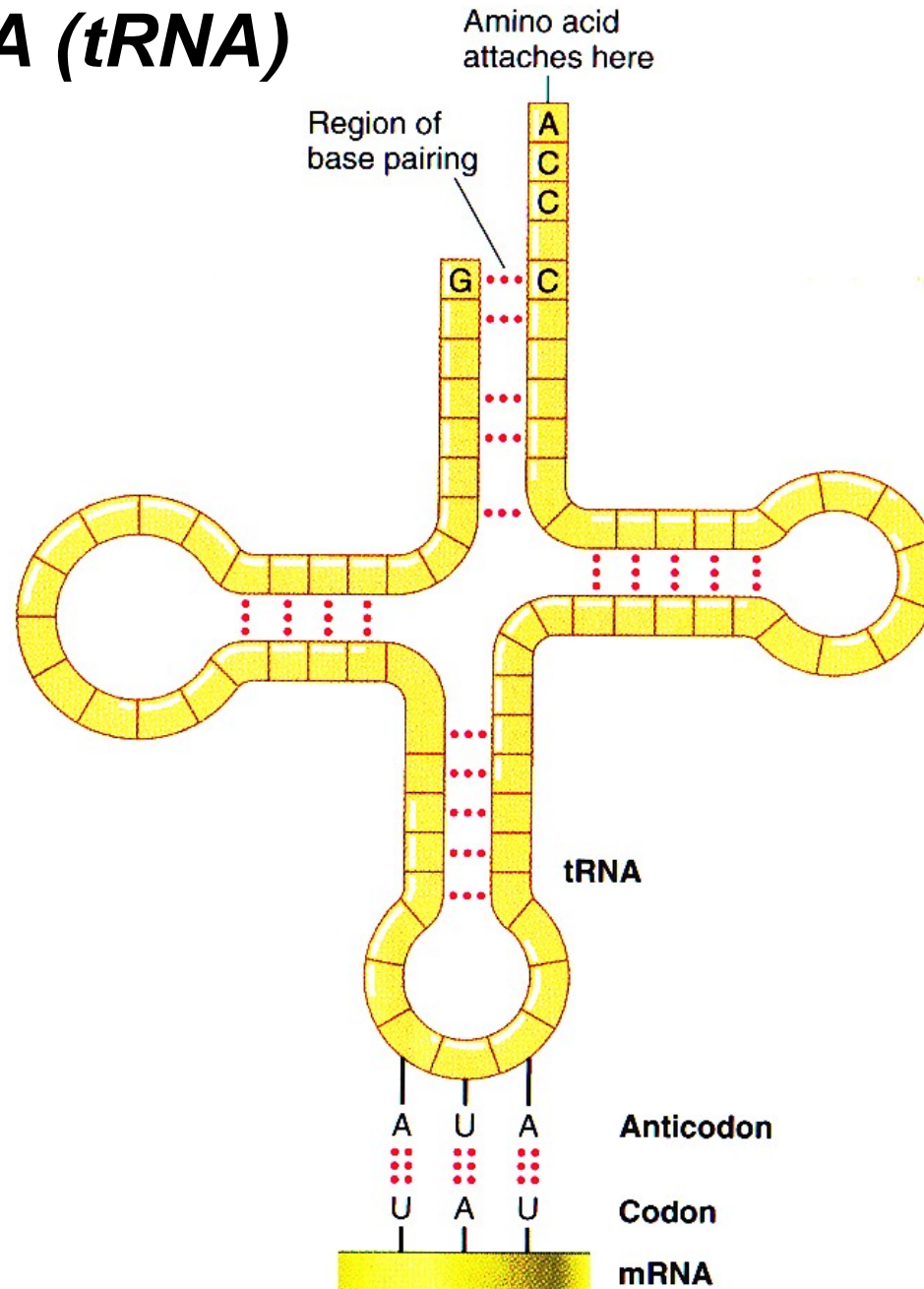
A *protein synthesizing factory*, where *translation* takes place!

What's a ribosome?

You rock, baby!

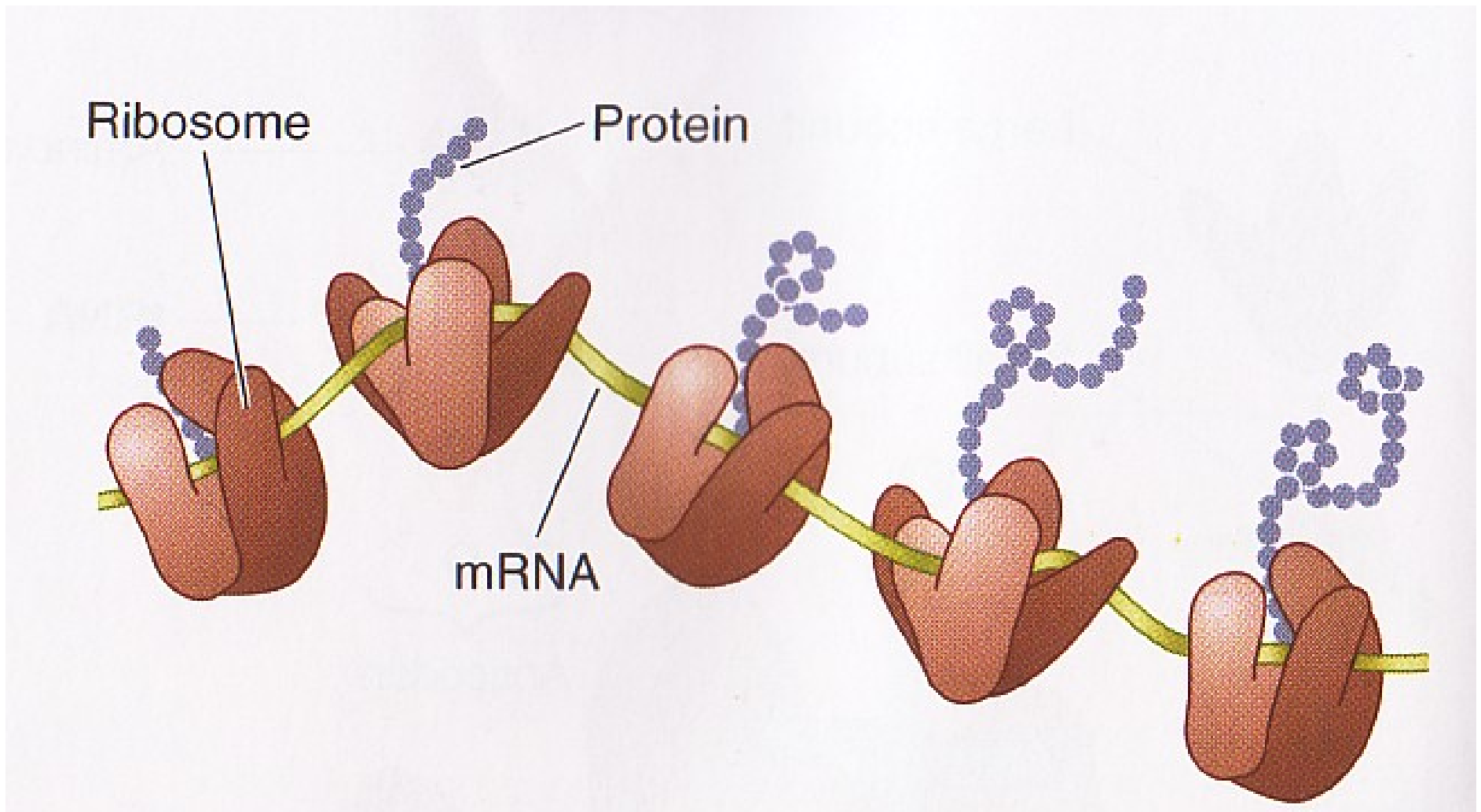


Transfer RNA (tRNA)



LS fig C-8

A Polyribosome. Which Way is Synthesis?





**TIME
OUT**

**QUESTIONS,
DISCUSSION, BREAK!**

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!

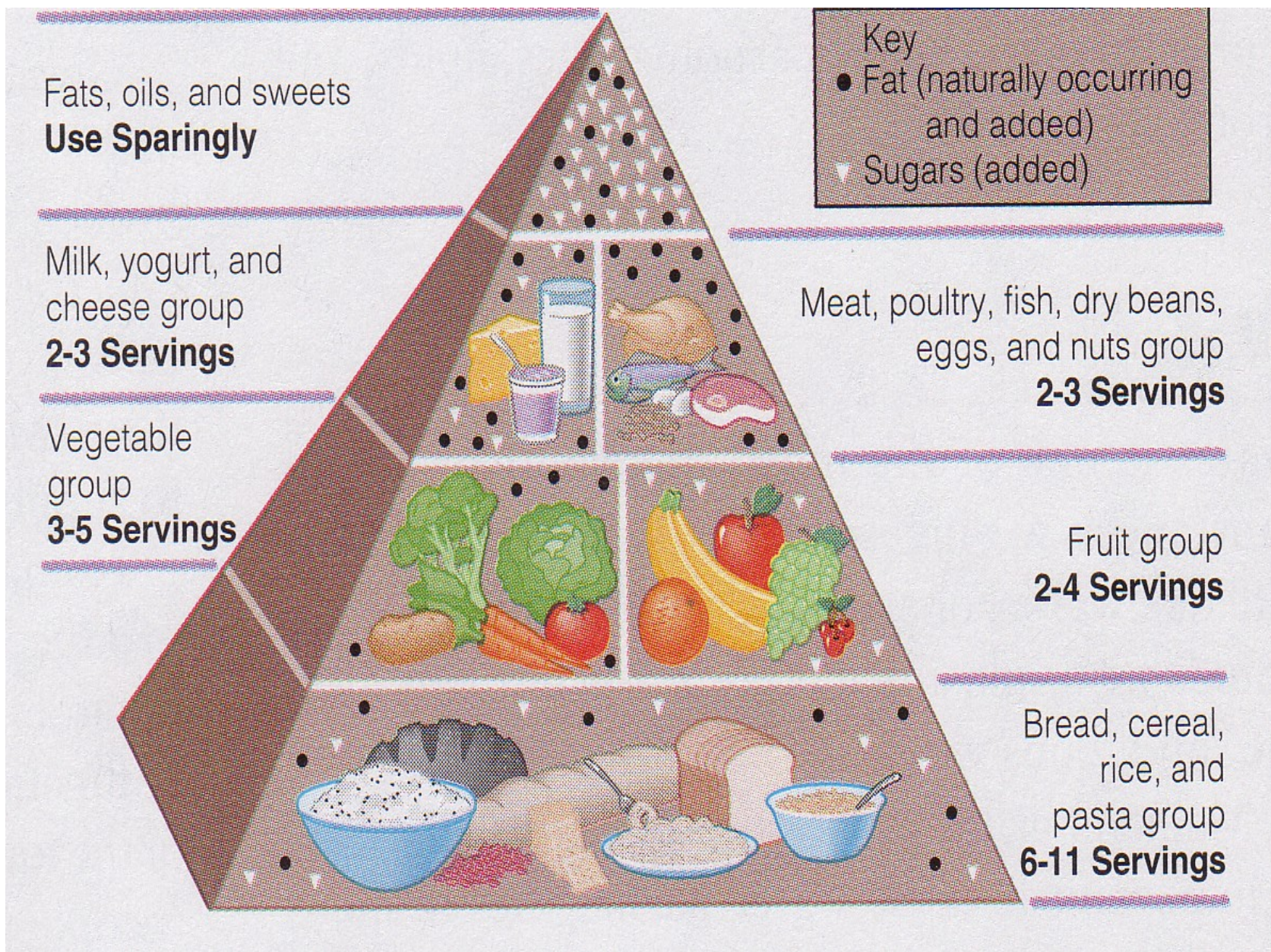
Vegetables, vegetable oils,
fruits, citrus, grains, dairy

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

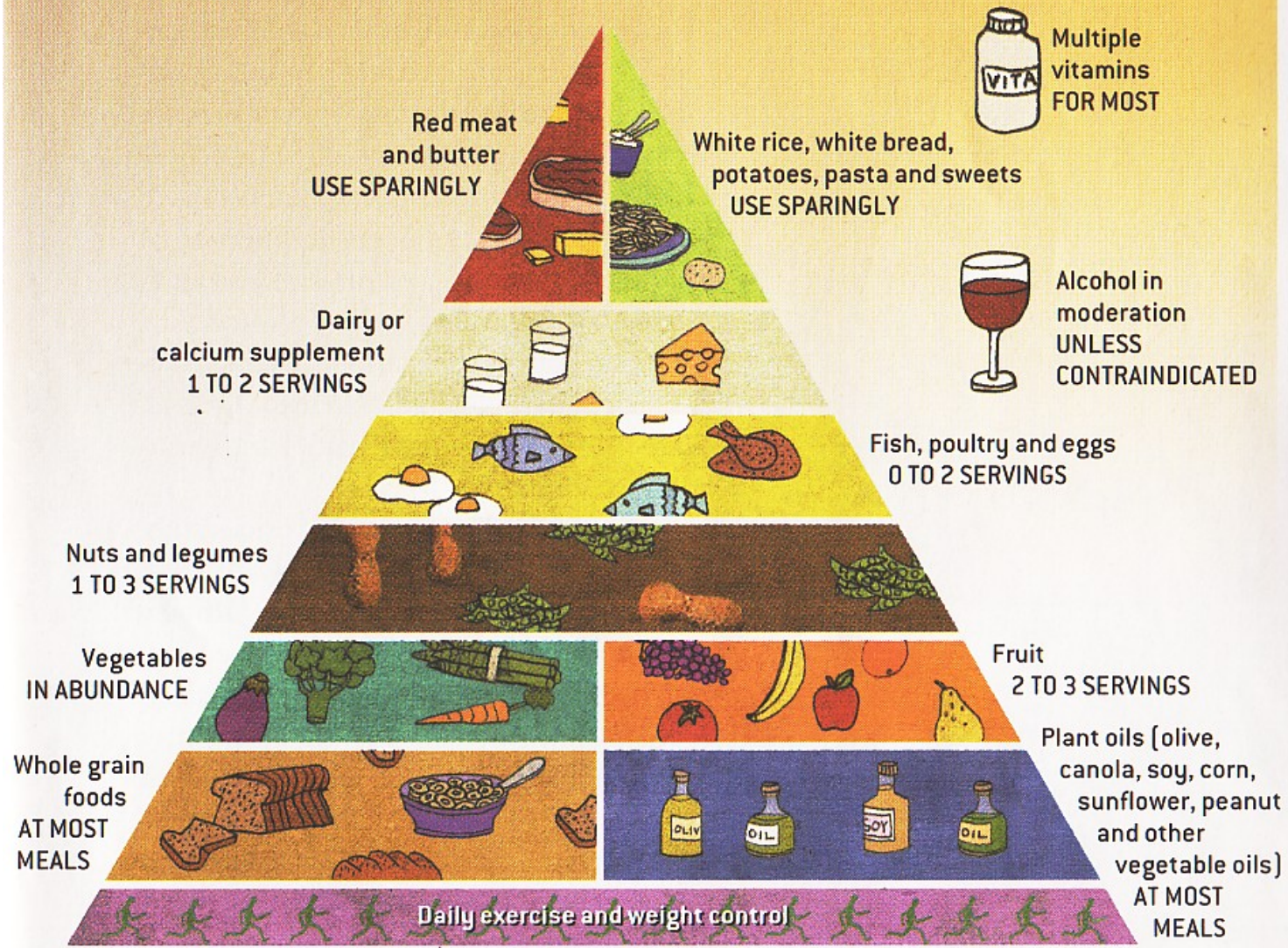
✓ **Energy nutrients = yield ATP**



USDA Food Pyramid 1992

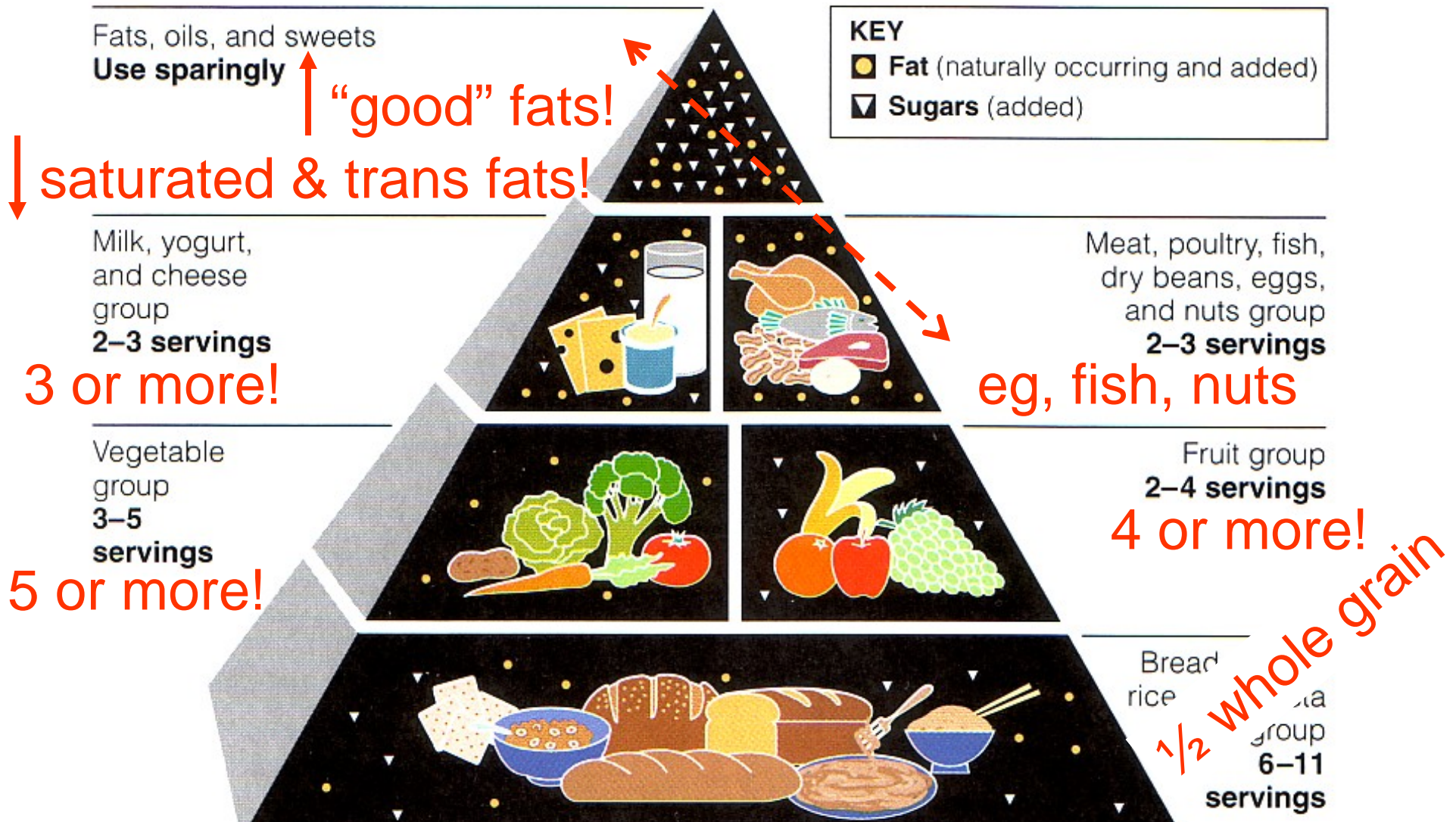


Willett & Stampfer Suggestions 2003



NEW FOOD PYRAMID

US Modifications to 1992 Food Pyramid 2005



Regular Physical Activity: Exercise! Exercise!!

Dietary Guidelines for Americans 2005 Food Guidance System

Hooray!



1. ↑ emphasis on ↓ kcal + ↑ exercise.
2. 9-A-Day! 4 fruit + 5 vegetable servings.
3. ≥ 3 of 6 whole grains \longrightarrow $\frac{1}{2}$ whole grains!
4. 3 servings of dairy, eg 3 c fat-free milk.
5. ↓ saturated + trans fats + ↑ unsaturated/
“good” fats, eg Ω -3 fish, walnuts.
6. Drink in moderation if at all.
7. Practice food safety.

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

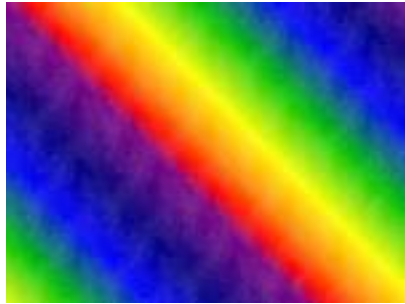
- 1. Choose a diet rich in variety of plant-based foods.**
- 2. Eat plenty of vegetables & fruits.**
- 3. Maintain a healthy weight & be physically active.**
- 4. Drink alcohol only in moderation, if at all.**
- 5. Select foods low in fat & salt.**
- 6. Prepare & store food safely.**

And always, remember...

Do not smoke or use tobacco in any form.



American Institute for Cancer Research (AICR)



Eating the Rainbow Hawaiian Style!!



Your plate should be the size of a Frisbee, not a manhole cover.

When it comes to colorful foods, Fruit Loops don't count.

A surprising number of people get 1/5 of their calories from sodas or other liquids.

If you look at the label & need a chemistry degree to read it, put the item back on the shelf!



SOURCE: P. Rath, *Honolulu Advertiser*, Sept 11, 2008 citing D. Chong & N. Kerr.



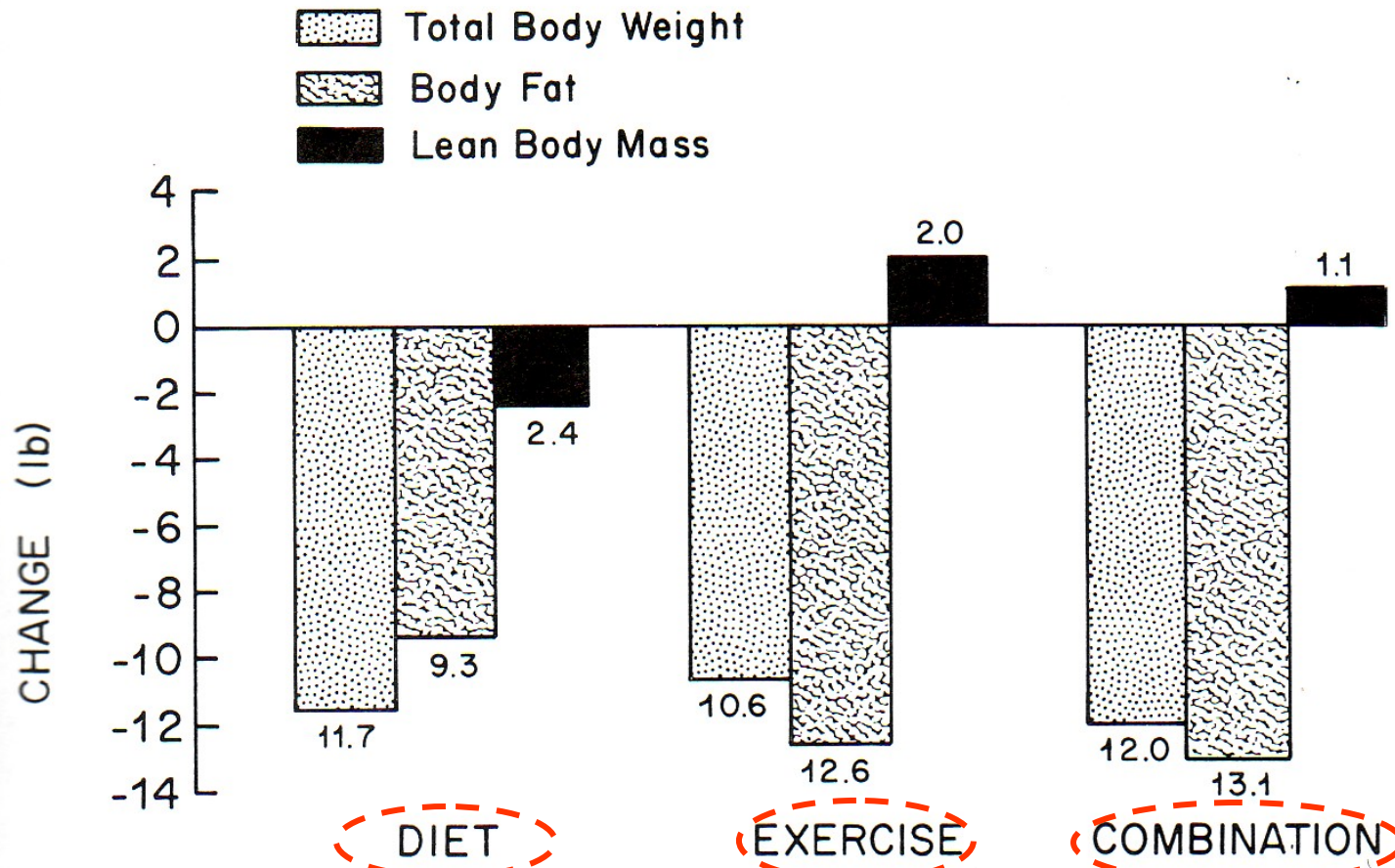


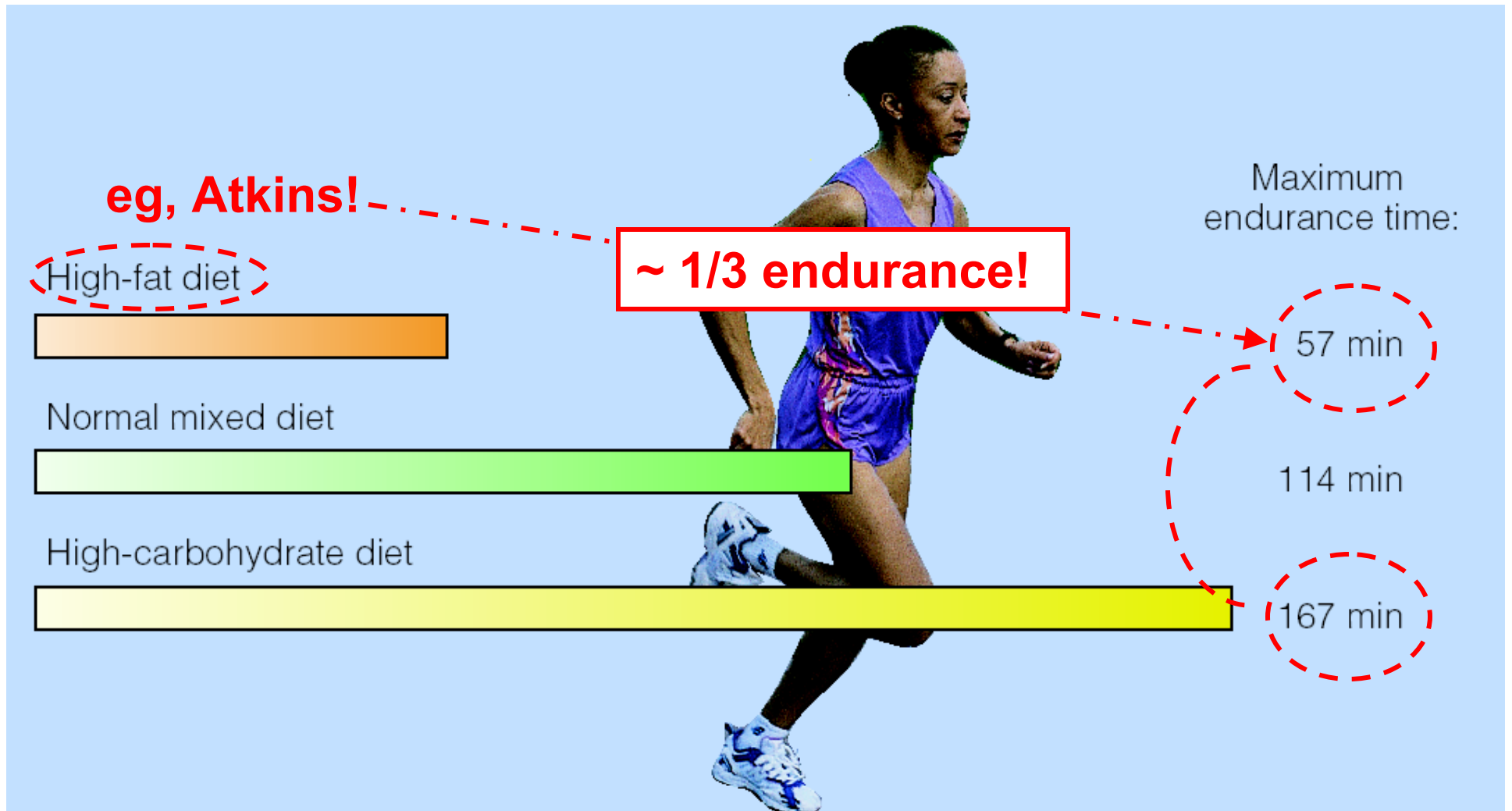
Figure 4-9. Changes in body weight, body fat, and lean body weight for diet, exercise, and combination groups. (From Zuti W. B., and Golding, L. A.: Comparing diet and exercise as weight reduction tools. *Phys. Sportsmed.* 4:49-53, 1976.)

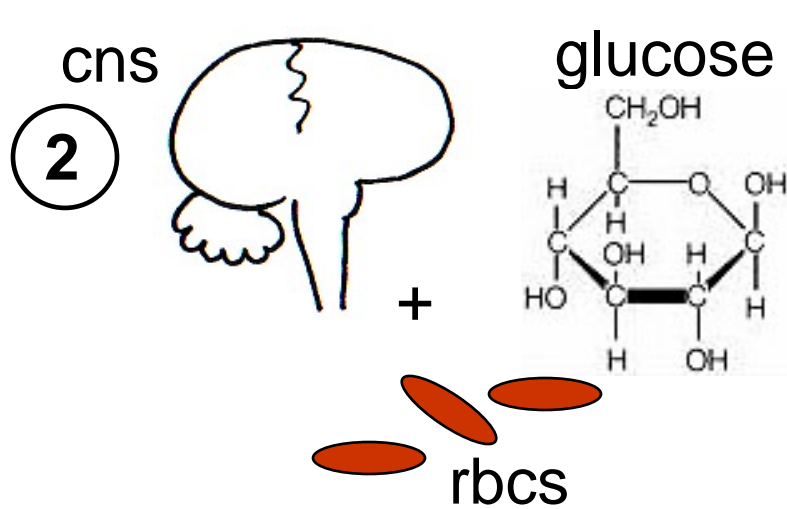
NB: Each group 500 kcal deficit/day, 16 weeks



**Compared to dieting,
exercise is superior in
inducing % body fat
reduction & preserving
lean body mass!**

Dietary Composition & Physical Endurance





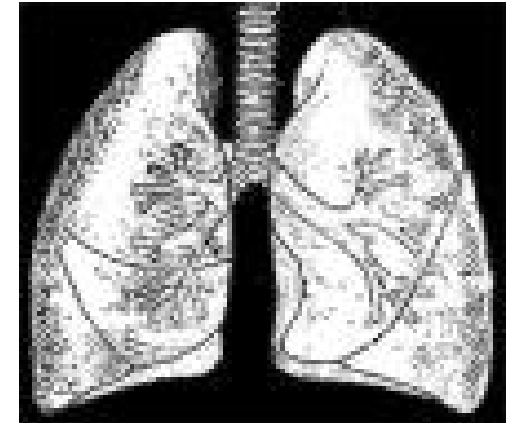
Negative Effects of Low Carbohydrate

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...

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!!***

***I'm not sure I believe you!
Why can't I just starve to
lose weight?***



TOTAL FAST =
No Energy Nutrients
(No Carbohydrates, Fats
or Proteins)

ONLY

- 1. Water**
- 2. Vitamins**
- 3. Minerals**

60-day Fast???

Lost 60 lb!! Wow!!

Yet

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

Fat < 1/4 total wt loss!

***You can lose weight by
starving – but it's mostly
water & muscle! Also, there
can be complications!***



Potential Complications of Total Fasting

**Nausea, diarrhea, persistent vomiting,
postural hypotension, nutritional
deficiencies, menstrual irregularities,
and...sudden death.**

Positive Aspect??

**General loss of appetite within
first 2 days, maintained
throughout fasting period.**

Council on Nutrition, Physical Activity and Metabolism (NPAM) Spring 2009



Dietary Carbohydrate, Fat and Protein in Weight-Loss Diets: A Report and Insider's Reflections on the Pounds Lost Trial

Frank M. Sacks, MD

Well-controlled studies of energy-reduced diets conducted in controlled environments showed that the macronutrient composition of the diet did not affect weight loss (1). Nonetheless, theories persisted that specific macronutrients would be superior for weight loss. For example, the traditional paradigm for low-fat, high-carbohydrate diets was based on the lower energy density of carbohydrate compared to fat, and the metabolic efficiency of converting dietary fat to body fat (2). Indeed strict vegetarians sustain lower body weight for

years on low-fat diets (3). However, meaningful differences in body weight usually were not achieved in population-based trials of conventional low-fat diets (4). Thus, higher-fat, Mediterranean-style diets were proposed to be better for long-term weight loss because of their variety and satisfaction. Two trials found

that Mediterranean diets were superior to low-fat diets for weight loss (5,6). Others claimed that a radically different approach that used low-carbohydrate, high-fat, and high-protein foods could produce weight loss without attention to reducing intake because of the satiety of protein-rich foods. Low-carbohydrate diets succeeded in the first few months with more rapid weight loss than low-fat diets but by one year, none of the trials found that weight loss on low-carbohydrate

Continued on page 26



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.

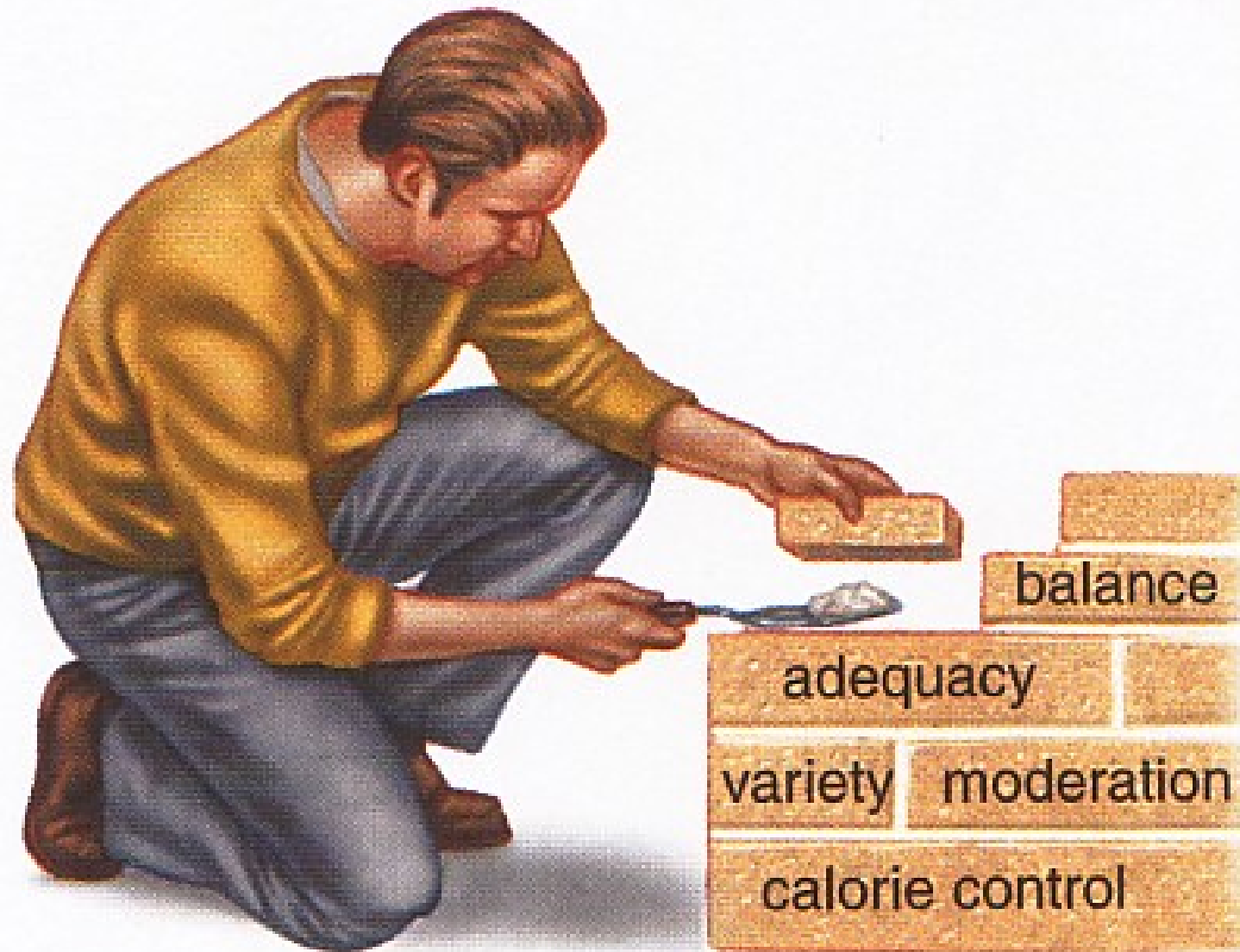
***US Dietary Recommended Intakes (DRI)
Committee Acceptable Macronutrient
Distribution Ranges (AMDR)!***

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

Emphasize ABCs + Variety & Moderation!



*All of these factors help to build
a nutritious diet.*



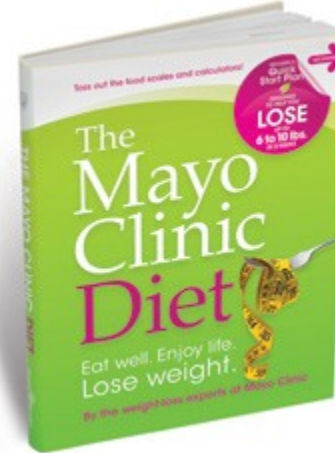
Kleiner's & Monaco's Top 10 Hit List for Nutrition Quackery

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**

