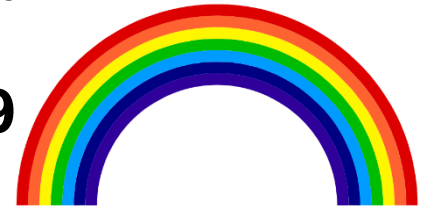


Anatomy & Physiology Lab today!...
Exam I next Wednesday < 4th of July!!



BI 121 Lecture 4

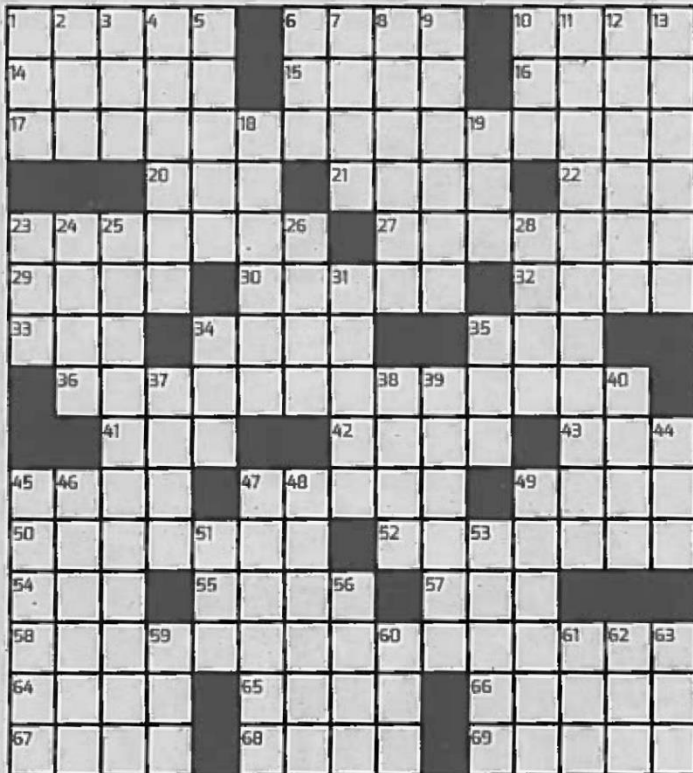
- I. Announcements Nutrition Analysis Lab next Tuesday!**
Thanks for recording your diet on p 3-7 in LM. Estimating serving sizes, hints for recording (do sooner vs. later)...Q?
- II. Cell Physiology, Mitochondria & Metabolism Connections**
LS 2012 fig 2-9 thru 2-12, 2-15 +...Mathews & Fox 1976!
- III. 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: 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. **Blue Zones?** Pondering Paleo, Marlene Zuk, NAHL 2015...
 - D. Carbohydrate confusion. Minimize what? Simple sugars



Biology can help you with all phases of your life! In fact, it is the science of life!

55 One-in-a-million
 57 Messenger ____
 58 Answer to the algebra problem

FUN & GAMES: CROSSWORD



ACROSS

- 1 Goose egg
- 6 "Major" beast
- 10 Porter's regretful Miss
- 14 From Basra, say
- 15 Time to stuff stockings
- 16 [sigh]
- 17 Start of an algebra problem
- 20 Toby filler
- 21 To ____ (perfectly)
- 22 Heating option
- 23 Least fresh
- 27 Throw one's support behind
- 29 "____ nerve!"
- 30 Poet with a "fanatic's heart"
- 32 Passage preventers, often
- 33 Québec assent
- 34 Jettison
- 35 Outgoing flight stat
- 36 The rest of the algebra problem
- 41 Kitty
- 42 "L'____ c'est moi"
- 43 Alternative to Yahoo!

- 45 It has feathers and flies
- 47 Black Sabbath's genre
- 49 Benchmarks: Abbr.
- 50 Think tank types
- 52 Like stir-fry
- 54 Meditation sounds
- 55 One-in-a-million
- 57 Messenger ____
- 58 Answer to the algebra problem
- 64 Steaming
- 65 Causes of some celebrity clashes
- 66 Link with
- 67 Fictional Flanders and Devine
- 68 Kind of day for a competitive cyclist
- 69 Historic English county

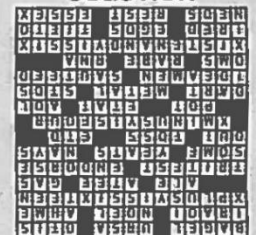
DOWN

- 1 Beiderbecke of jazz
- 2 Dadaist Jean
- 3 Guy's mate
- 4 Regard as identical
- 5 Fine cotton thread
- 6 Prefix with -form
- 7 Parks in front of a bus?

- 8 Sonnet part
- 9 Xenophobes' fear
- 10 Muesli morsel
- 11 Mrs. Robinson's movie
- 12 "Fine with me"
- 13 Classic quintet
- 18 Response to "Who, me?"
- 19 Marked, in a way
- 23 Menu general
- 24 Gumbo thickener
- 25 "Wow!"
- 26 Actress Harper of "No Country for Old Men"
- 28 Savvy about
- 31 Until now
- 34 Cause of a boom and bust?
- 35 Young newt
- 37 Smidge
- 38 "Take ____ a sign"
- 39 Subject of a cap, in sports
- 40 Didn't go by foot
- 44 "Dropped" drug
- 45 Compound in Agent Orange
- 46 Venerate
- 47 More Scroogelike
- 48 Tee off
- 49 Equilibrium
- 51 "Battlefield fare: Abbr.

- 53 Pull together
- 56 Slaughter in baseball
- 59 Some highlight reel features, for short
- 60 Summer hrs.
- 61 Parisian's possessive
- 62 Ore suffix
- 63 Affectionate sign-off

SOLUTION



4 oz → 3 oz



Deck of Cards



or



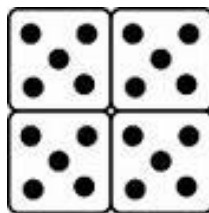
≡ 1 c

≡

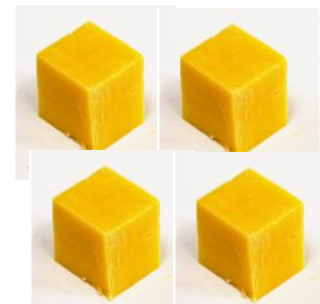
raw → cooked



≡ 1/3 c



≡ 1 oz



≡ 1/4 c



≡ 1.5 oz



Cell type, size, number?

Estimating numbers is always a challenge!

$300 \times 10^{12} ? 10^{15} ?$

$30 \times 10^{12} ? , 100 \times 10^{12} ?$

$10^9 ? 10^{12} ?$

10^3 ✓



Scientists don't know everything!

AEROBIC

w/O₂

=

MITOCHONDRION

ANAEROBIC

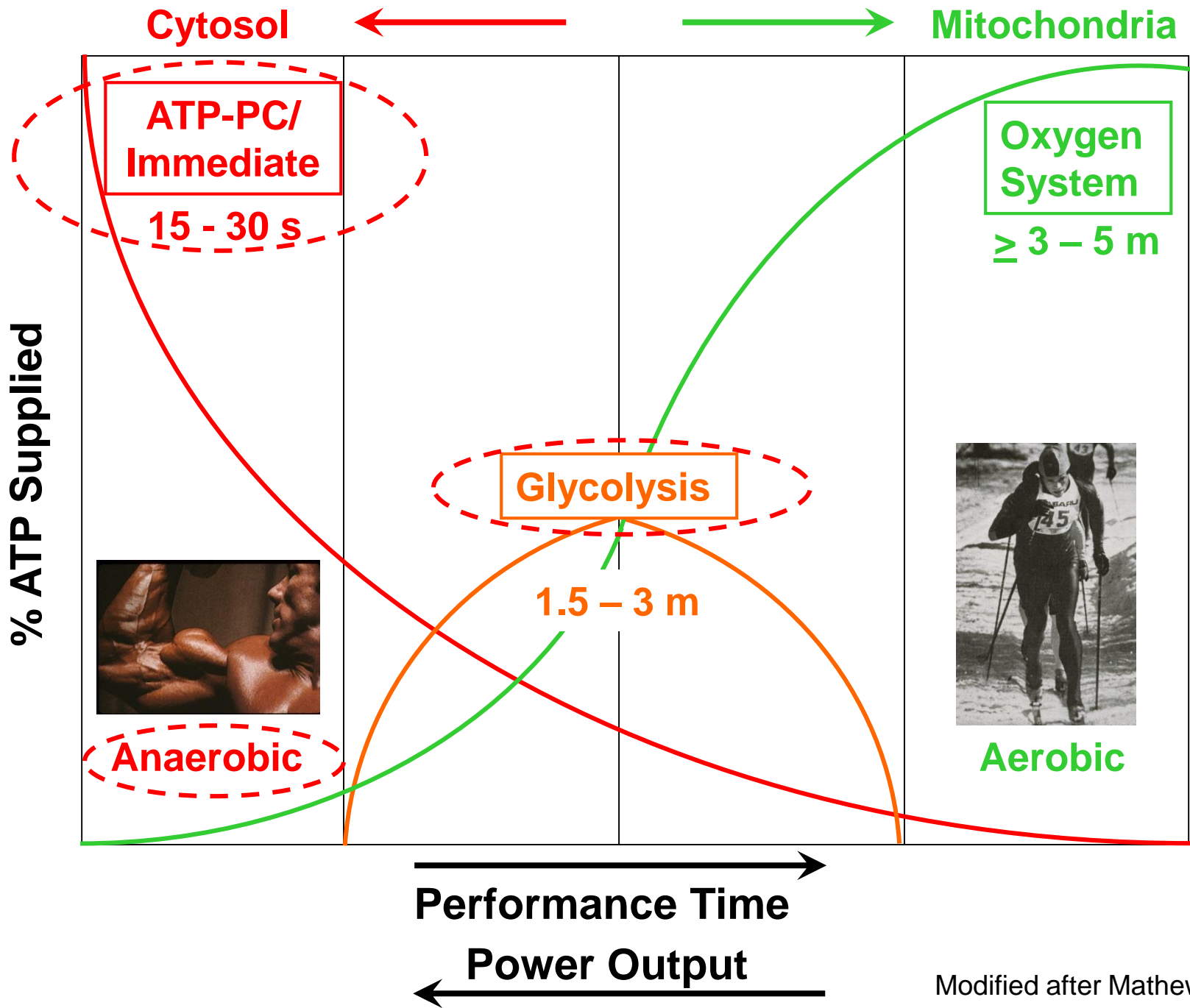
without O₂

= CYTOSOL

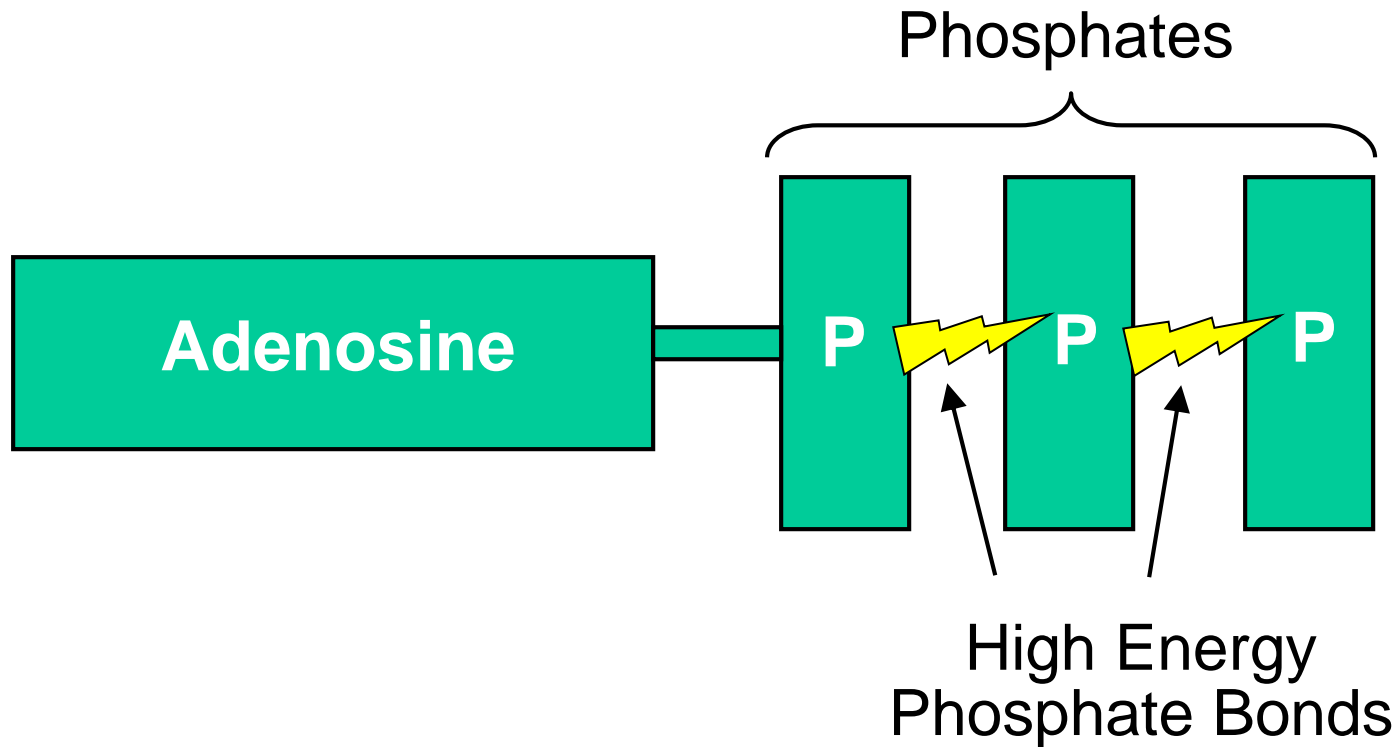


1. Immediate/ATP-PC
2. Glycolysis

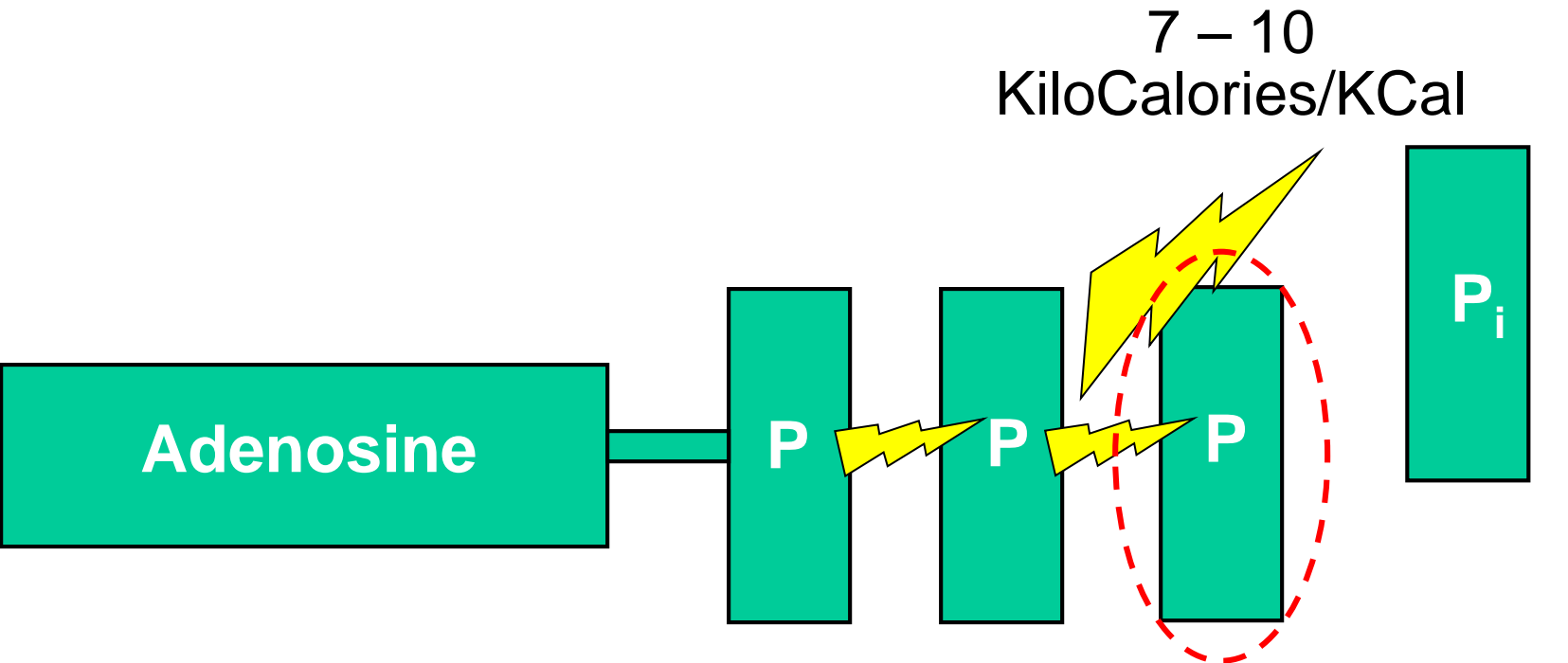




ATP = Adenosine Tri Phosphate
*The Common Energy Currency
or the Cash Cells Understand!!*



Cleave One High Energy Phosphate Bond To Do Work!!



① *Synthesis of Macromolecules*

Make big things from little things!

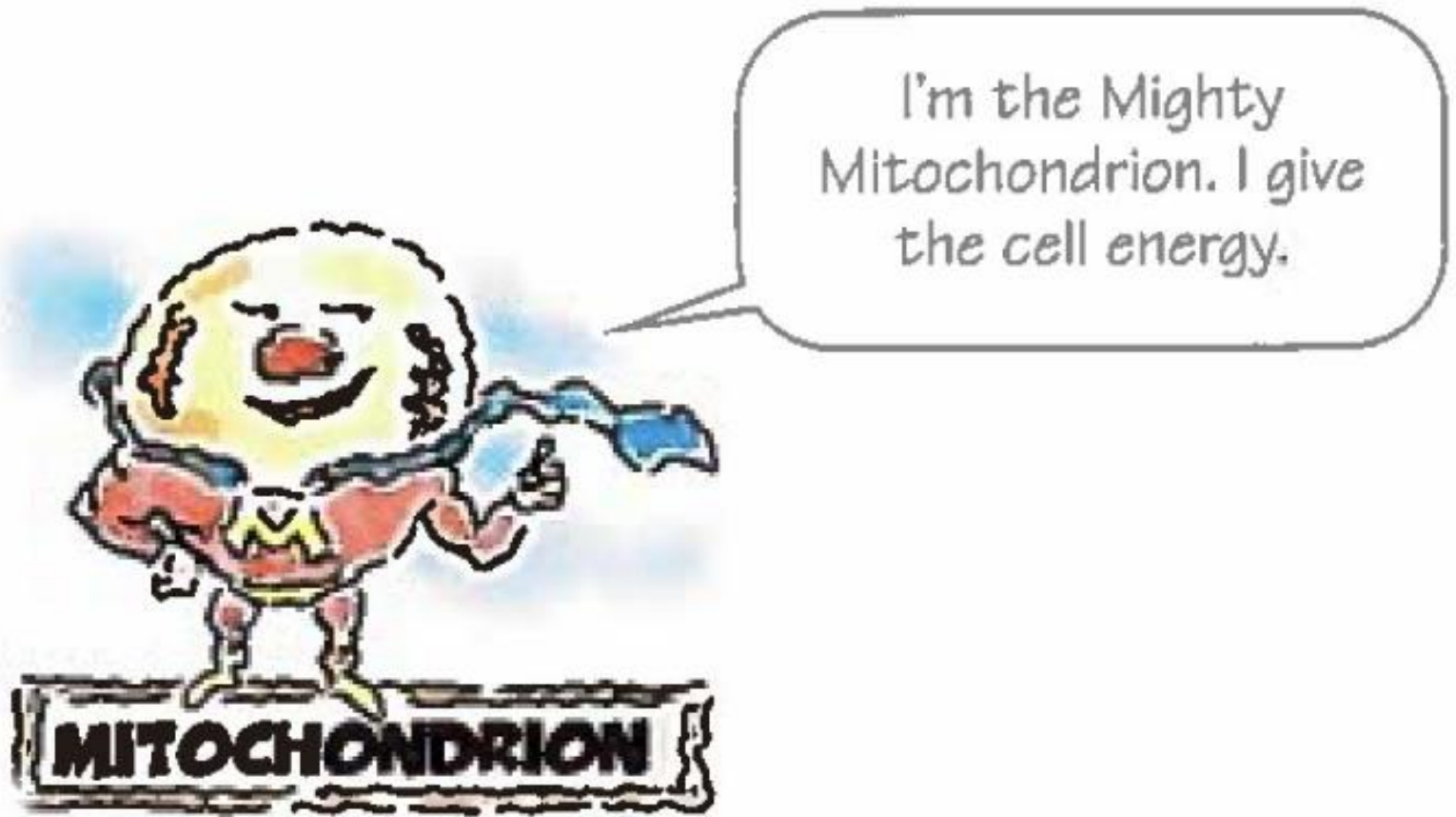
② *Membrane Transport*

Move things!
Microscopic!

③ *Mechanical Work*

Move things!
Macroscopic!

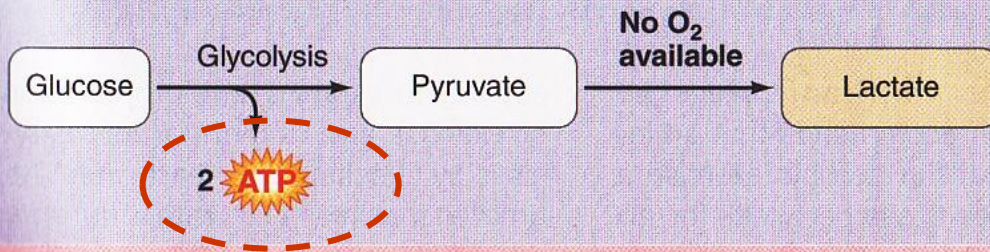




SOURCE: Bot Roda, Illustrator. *Anatomy & Physiology made Incredibly Visual!*
Wolters Kluwer Health, Lippincott Williams & Wilkins, 2009.

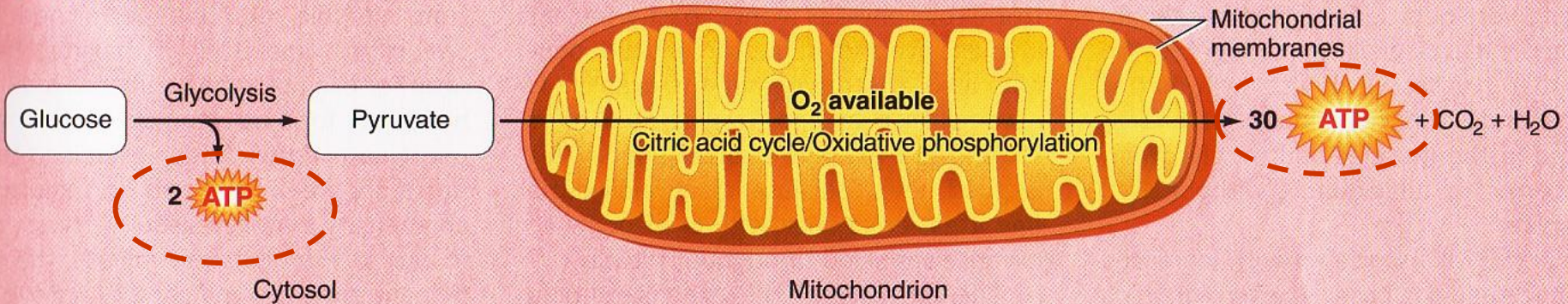
Anaerobic vs. Aerobic Metabolism

Anaerobic conditions



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

Aerobic conditions

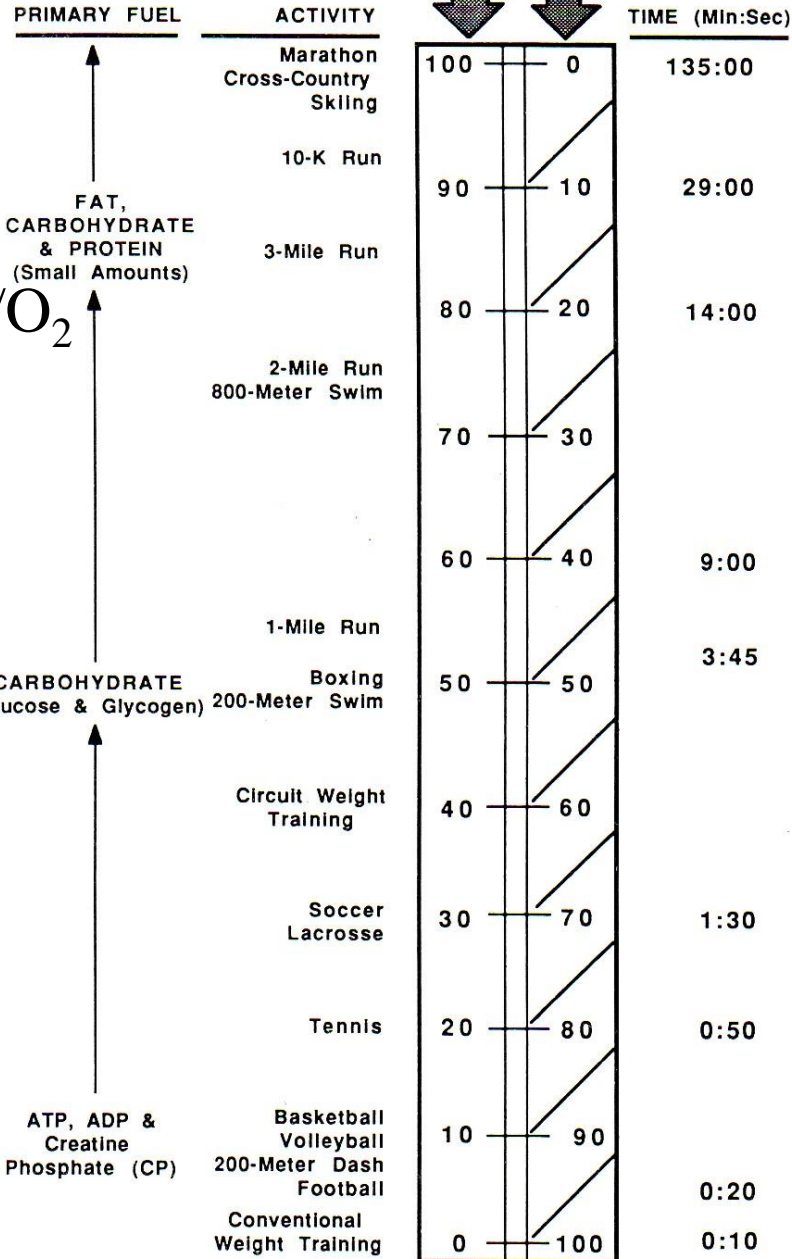


Aerobic Metabolism
+mitochondrial processing of
glucose with O₂. Net of 32 ATP
per molecule of glucose



AEROBIC

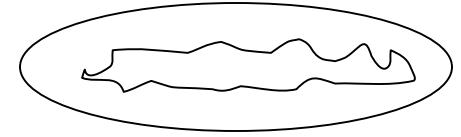
w/O₂



FAT,
CARBOHYDRATE
& PROTEIN
(Small Amounts)

CARBOHYDRATE
(Glucose & Glycogen)

ATP, ADP &
Creatine
Phosphate (CP)



MITOCHONDRIA

CYTOSOL

Glycolysis



Immediate/ATP-PC



ANAEROBIC

Stages of Cellular Metabolism/Respiration

**Anaerobic
Glycolysis
Cytosol**

**Aerobic
Metabolism
Mitochondria**

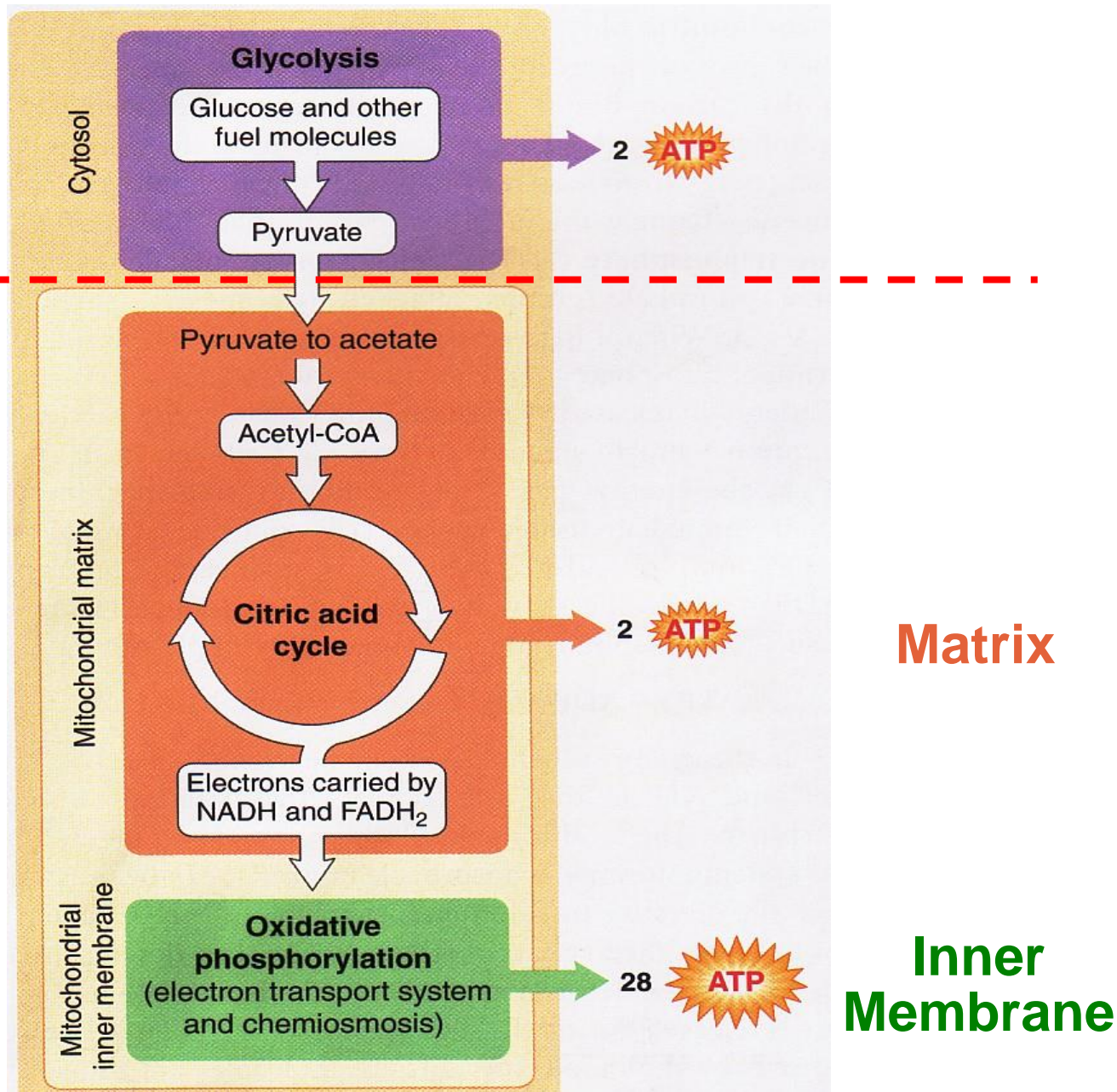


fig 2-9 LS 2012

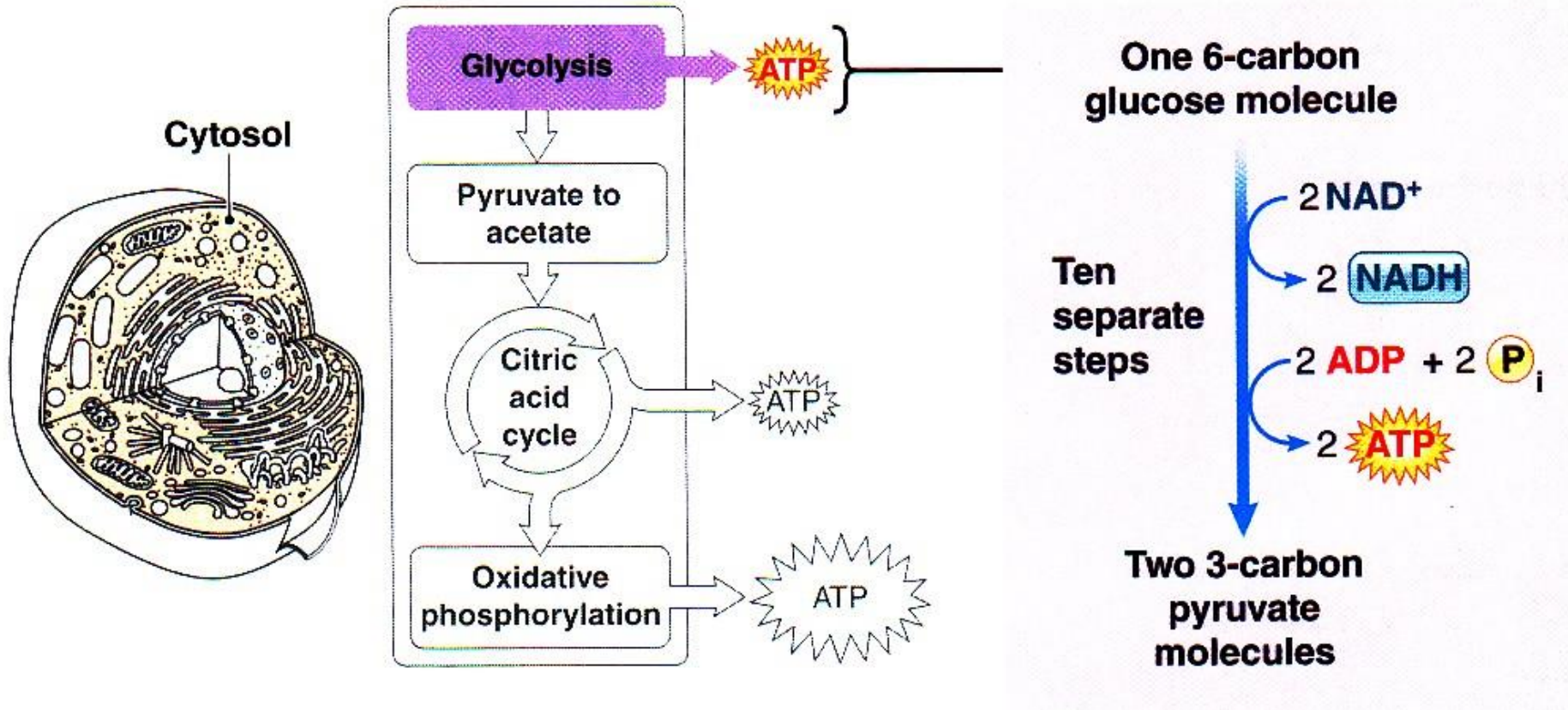


fig 2-10 LS 2012

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

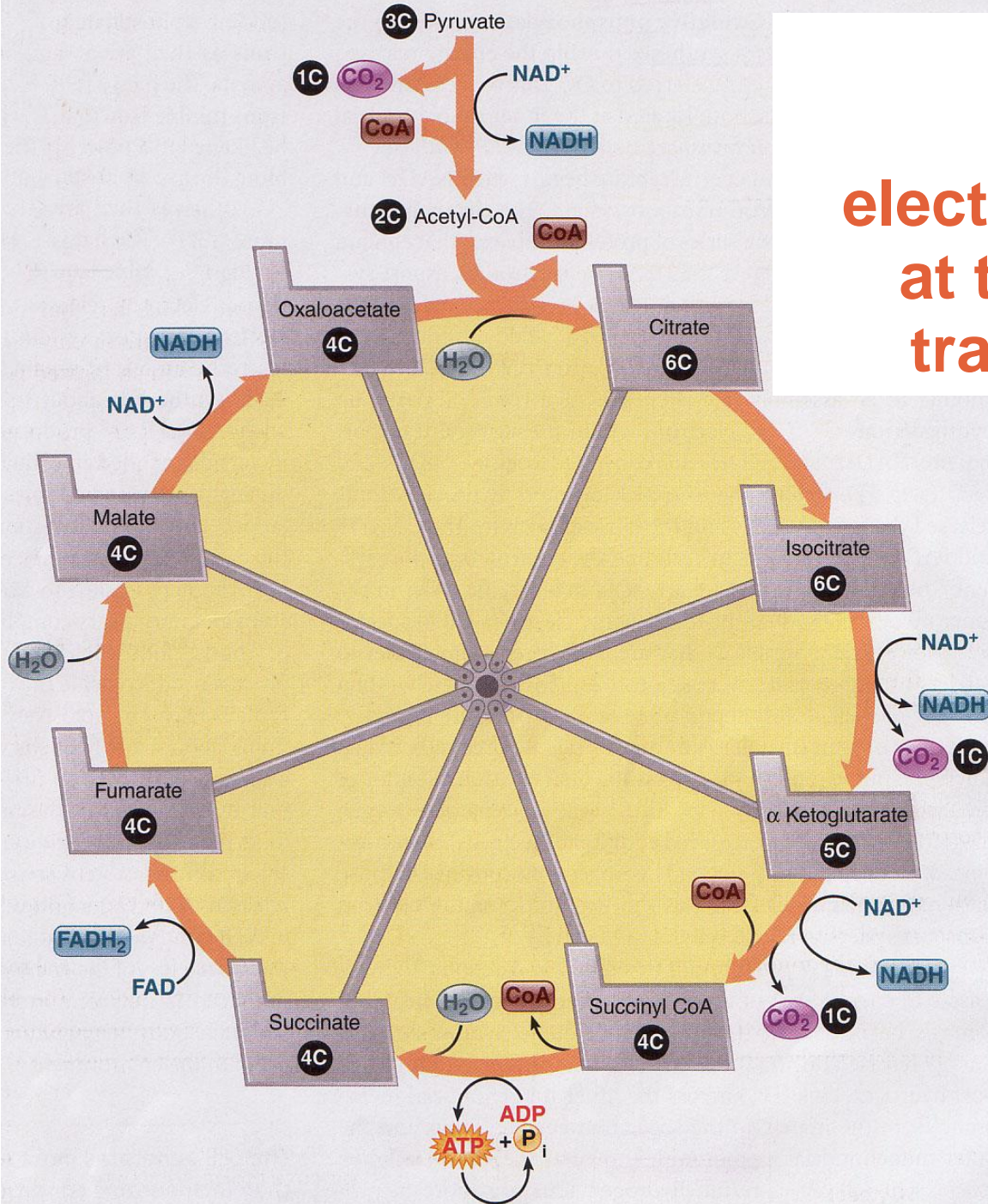


fig 2-11 LS 2012
+ David Oganessian
<http://pixdaus.com>

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

Cytosol

Outer mitochondrial membrane

MitoSciences®

Rod Capaldi
U of O Biology



Inner
...

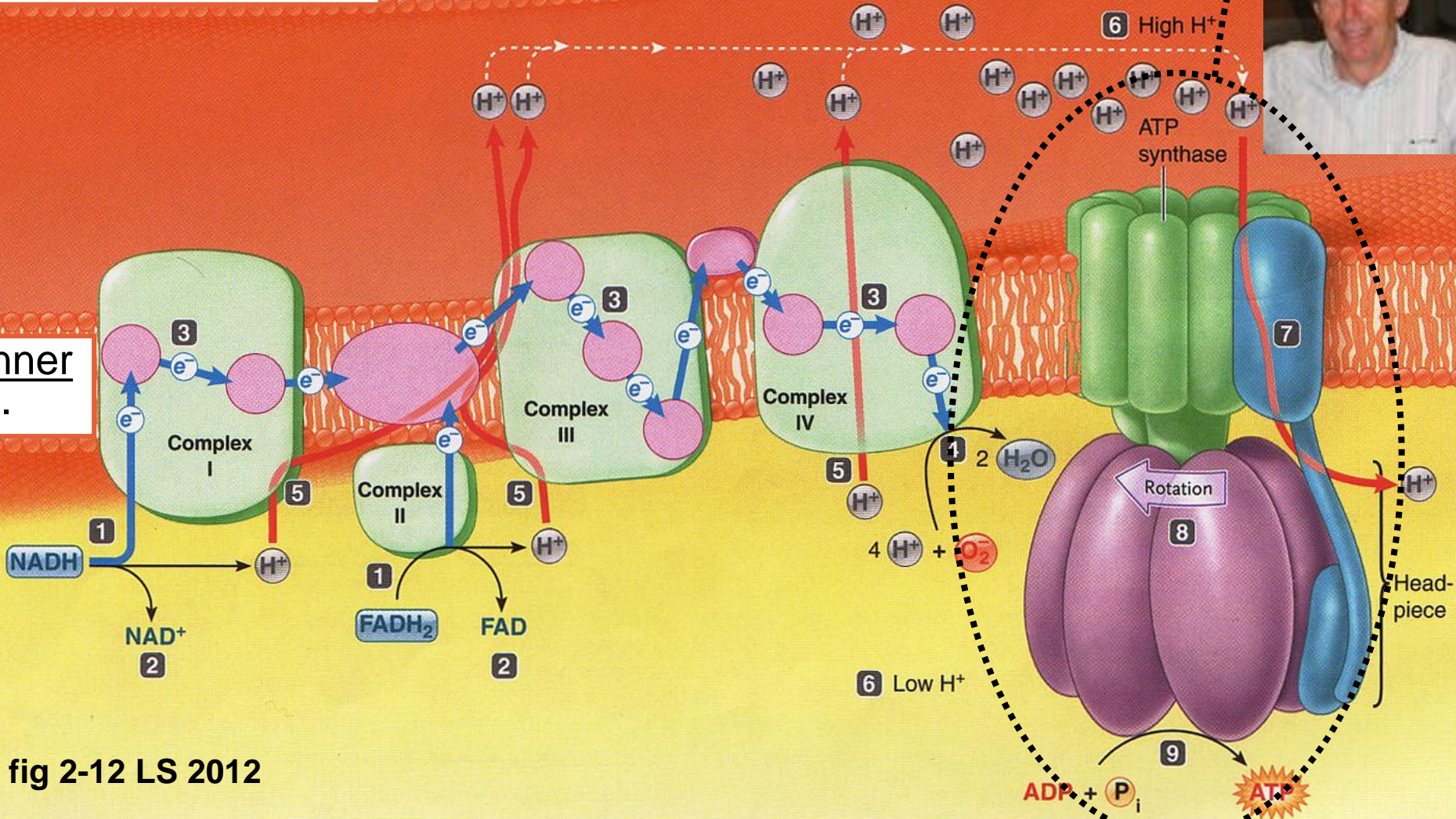


fig 2-12 LS 2012

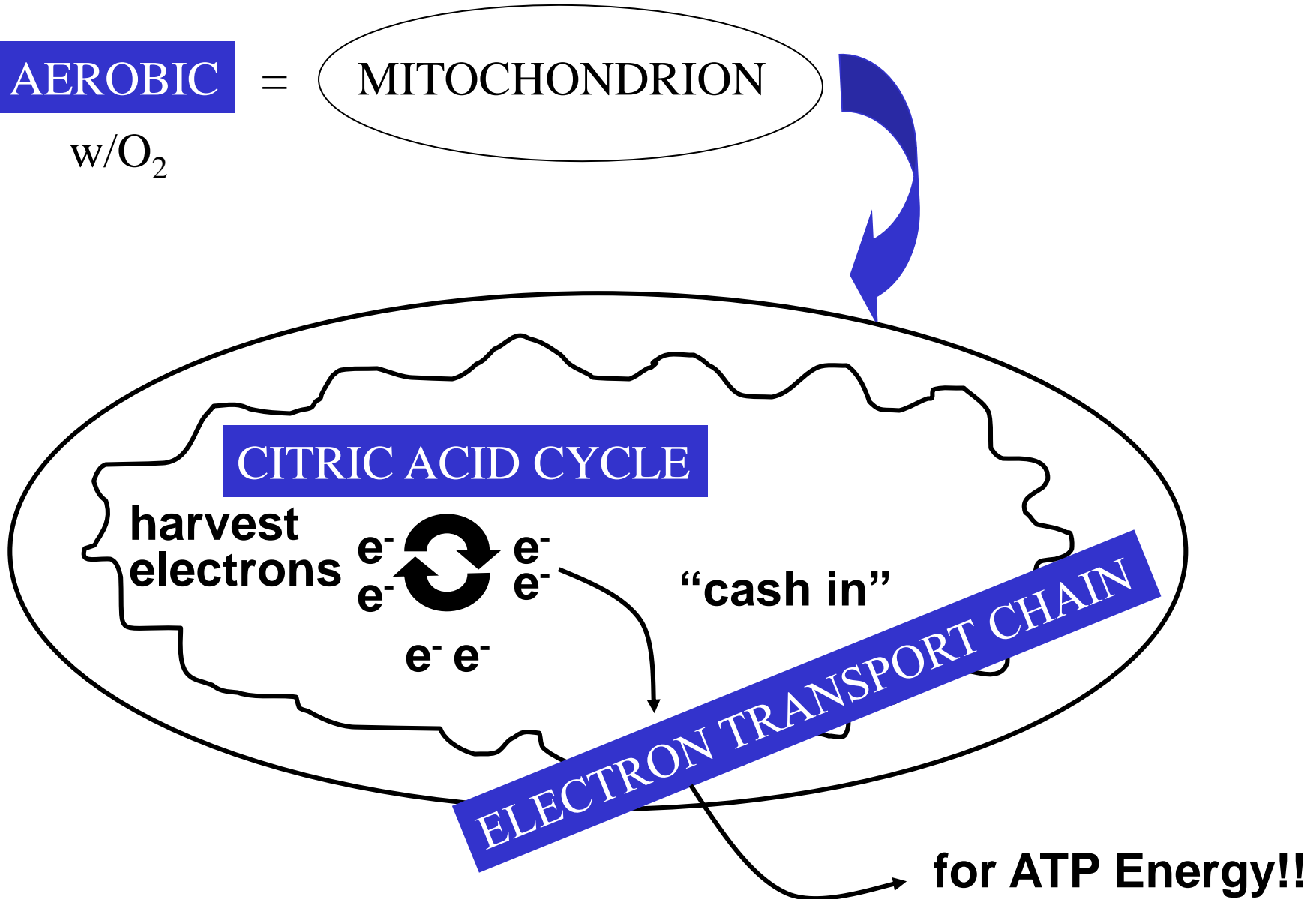
Goals of Aerobic Metabolism

AEROBIC

=

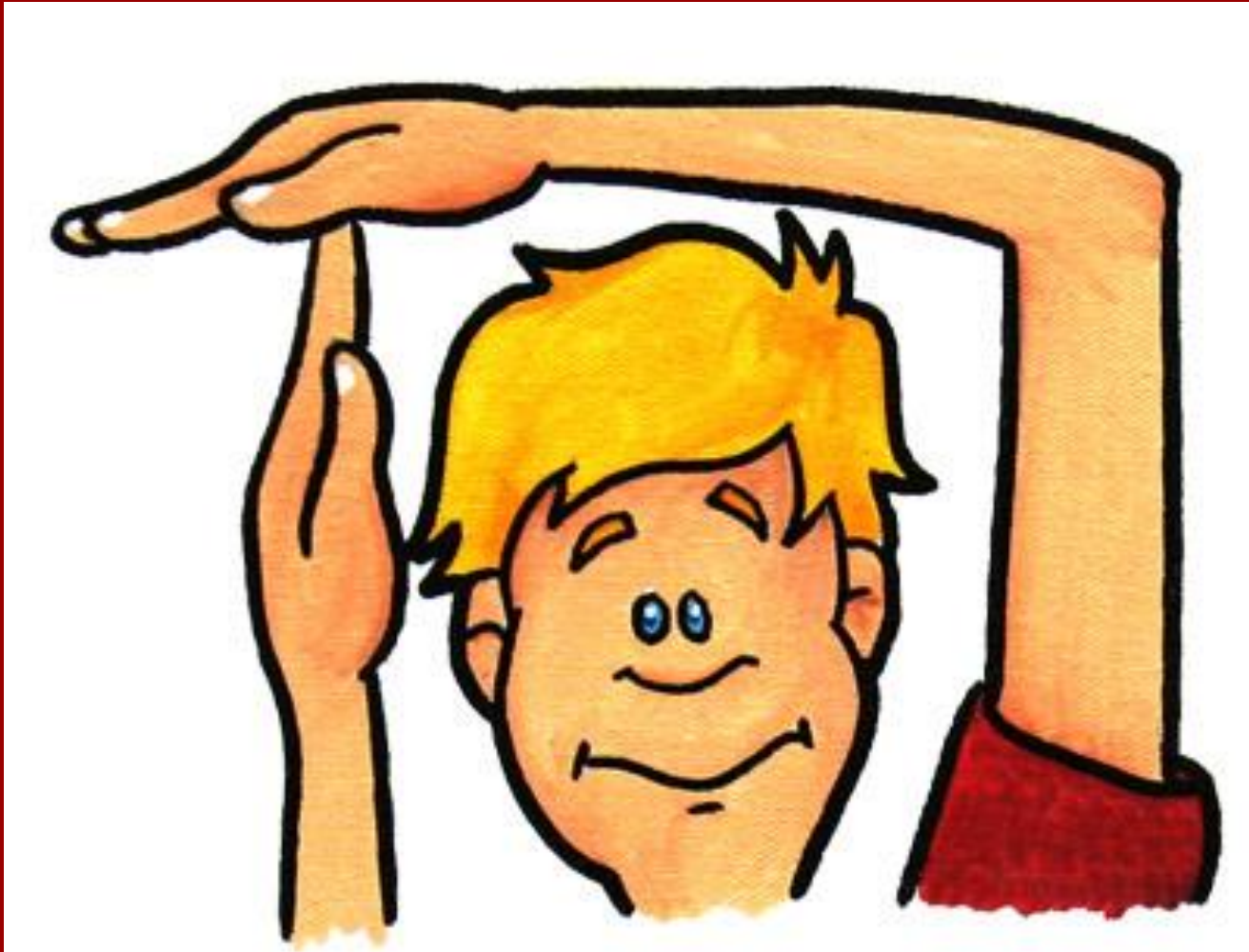
MITOCHONDRION

w/O₂



for ATP Energy!!

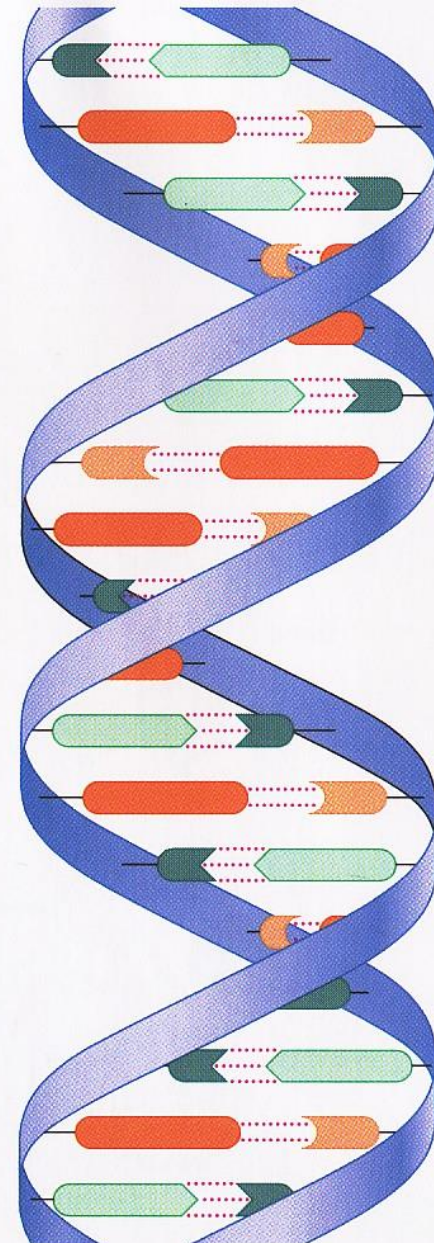
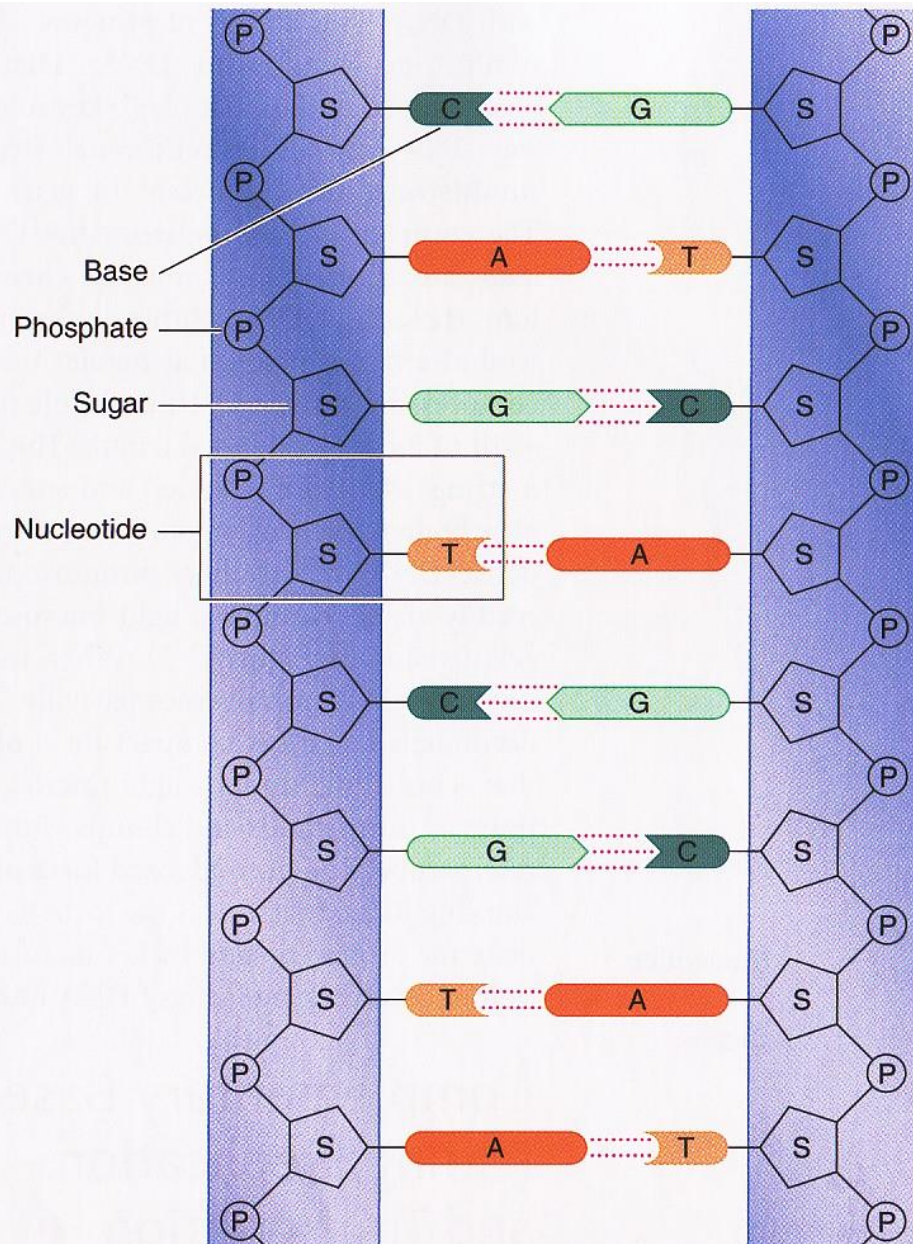
Time-out for questions!



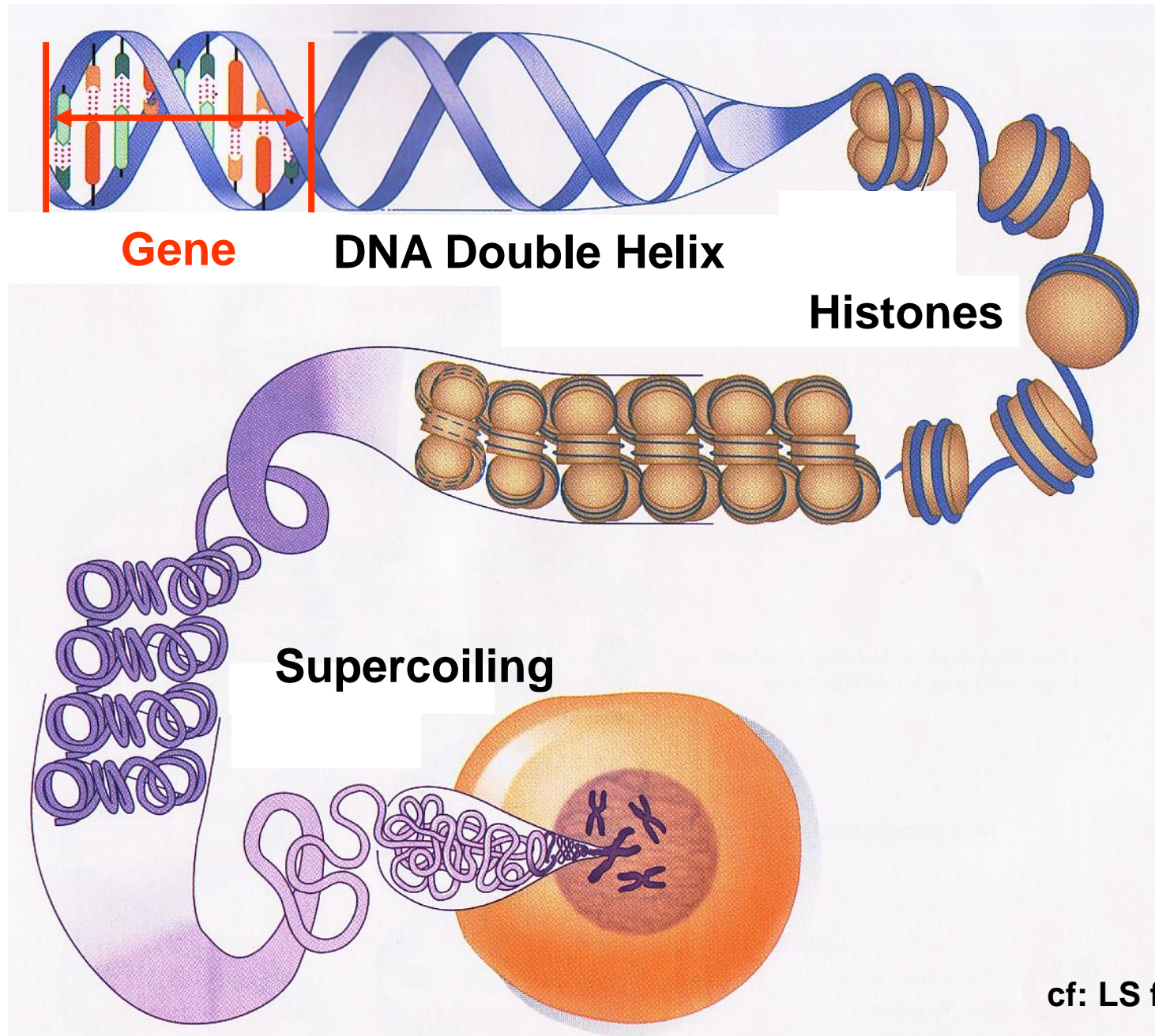
What are DNA's major functions? Heredity + Day-to-Day Cell Function



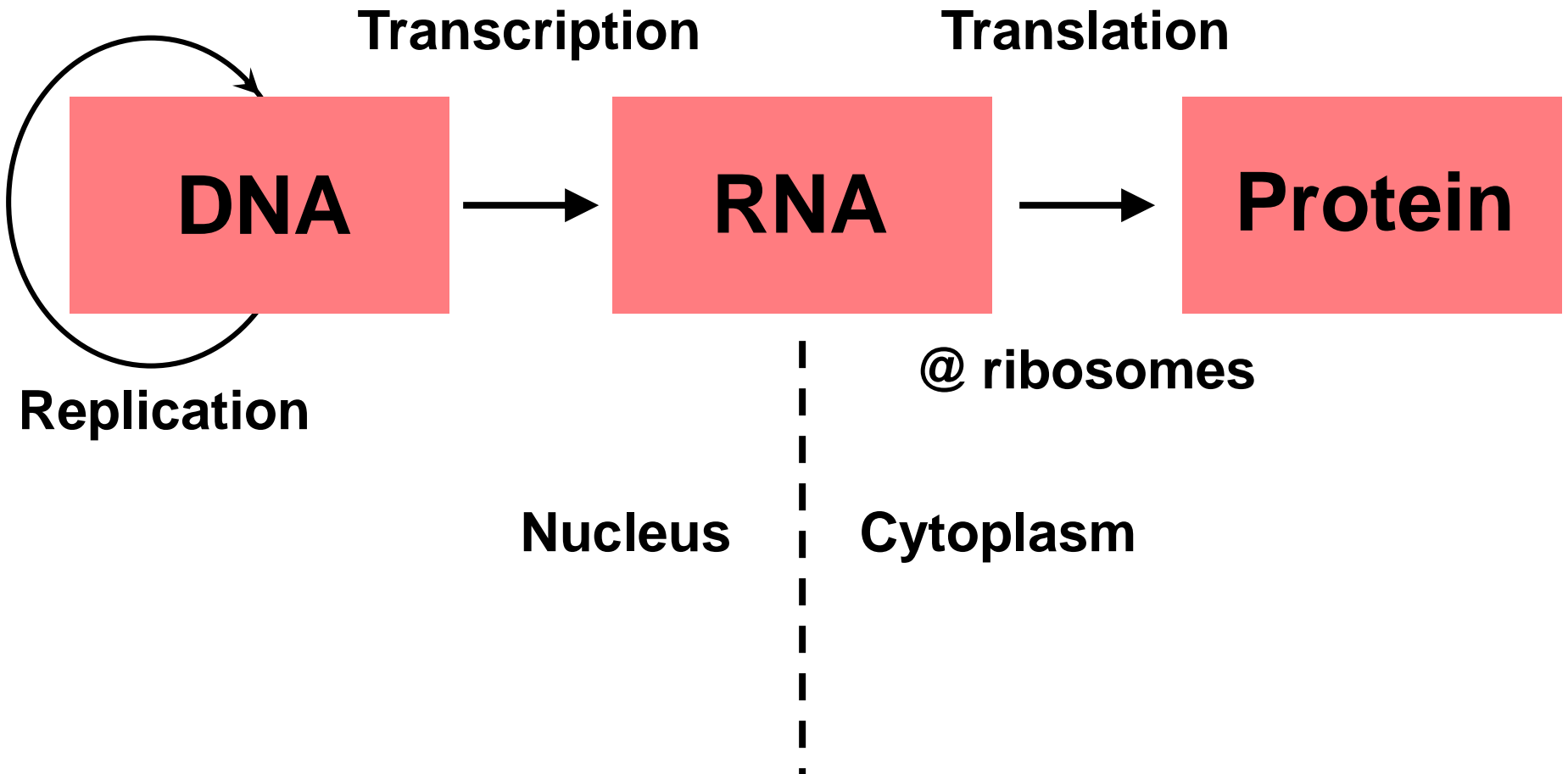
What does DNA look like? Double-helix!!



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



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

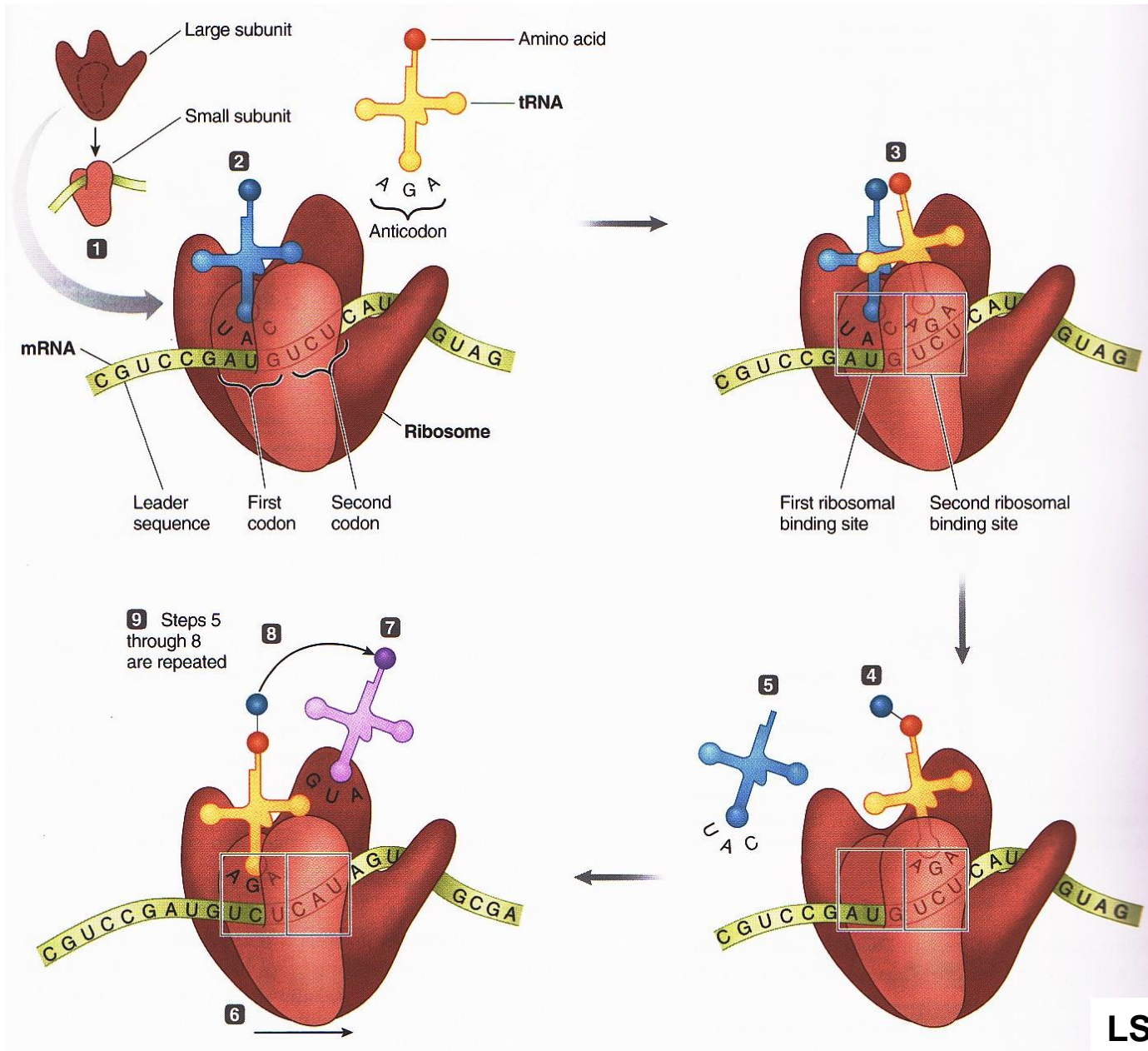
TAC

AUG

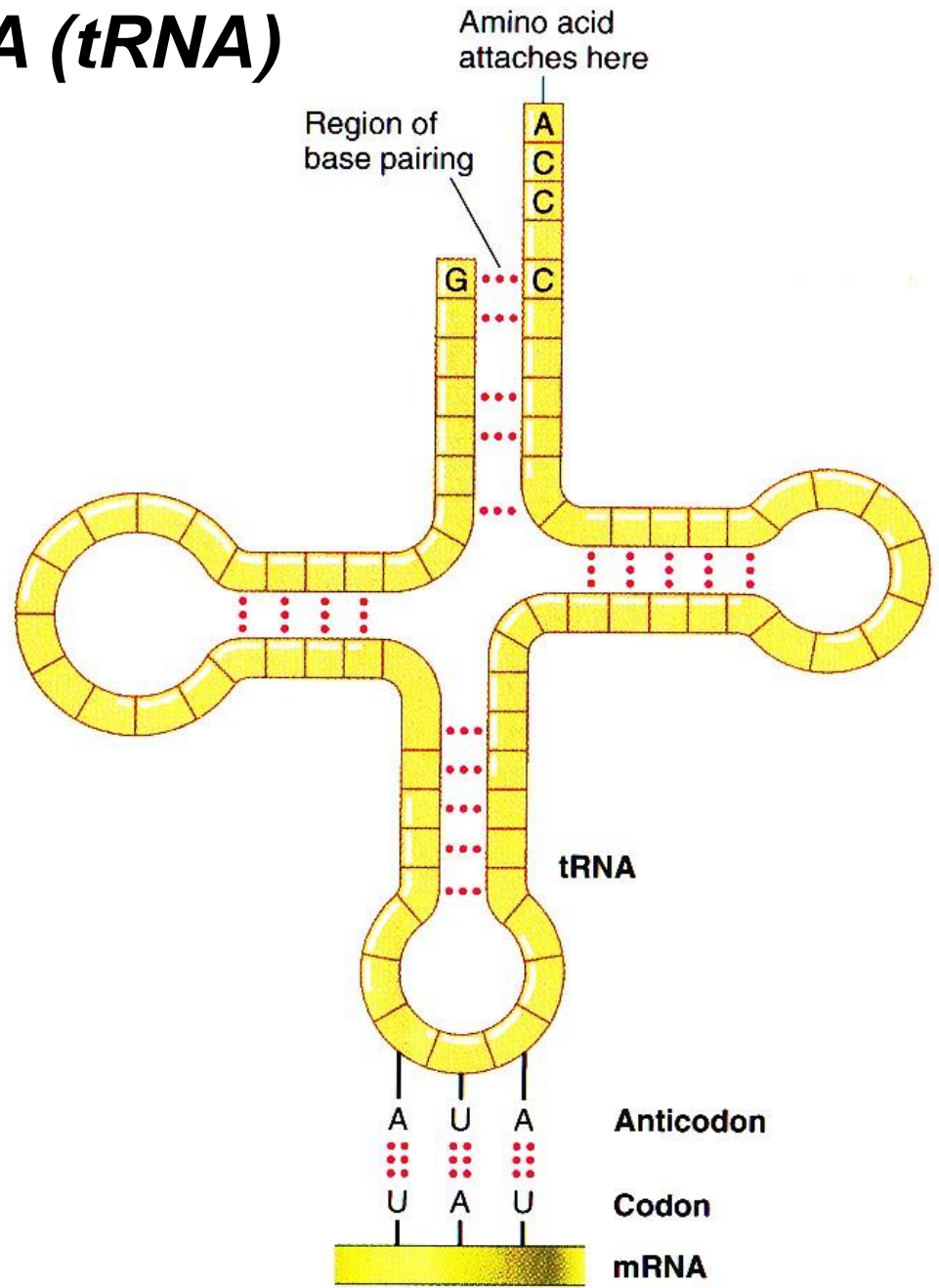
UAC

		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	Third base of codon
	C	CUU] Leu CUC] CUA] CUG]	CCU] Pro CCC] CCA] CCG]	CAU] His CAC] CAA] Gln CAG]	CGU] Arg CGC] CGA] CGG]	U
	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]	C
	G	GUU] Val GUC] GUA] GUG]	GCU] Ala GCC] GCA] GCG]	GAU] Asp GAC] GAA] Glu GAG]	GGU] Gly GGC] GGA] GGG]	A
					G	

Translation? Ribosomes Make Proteins

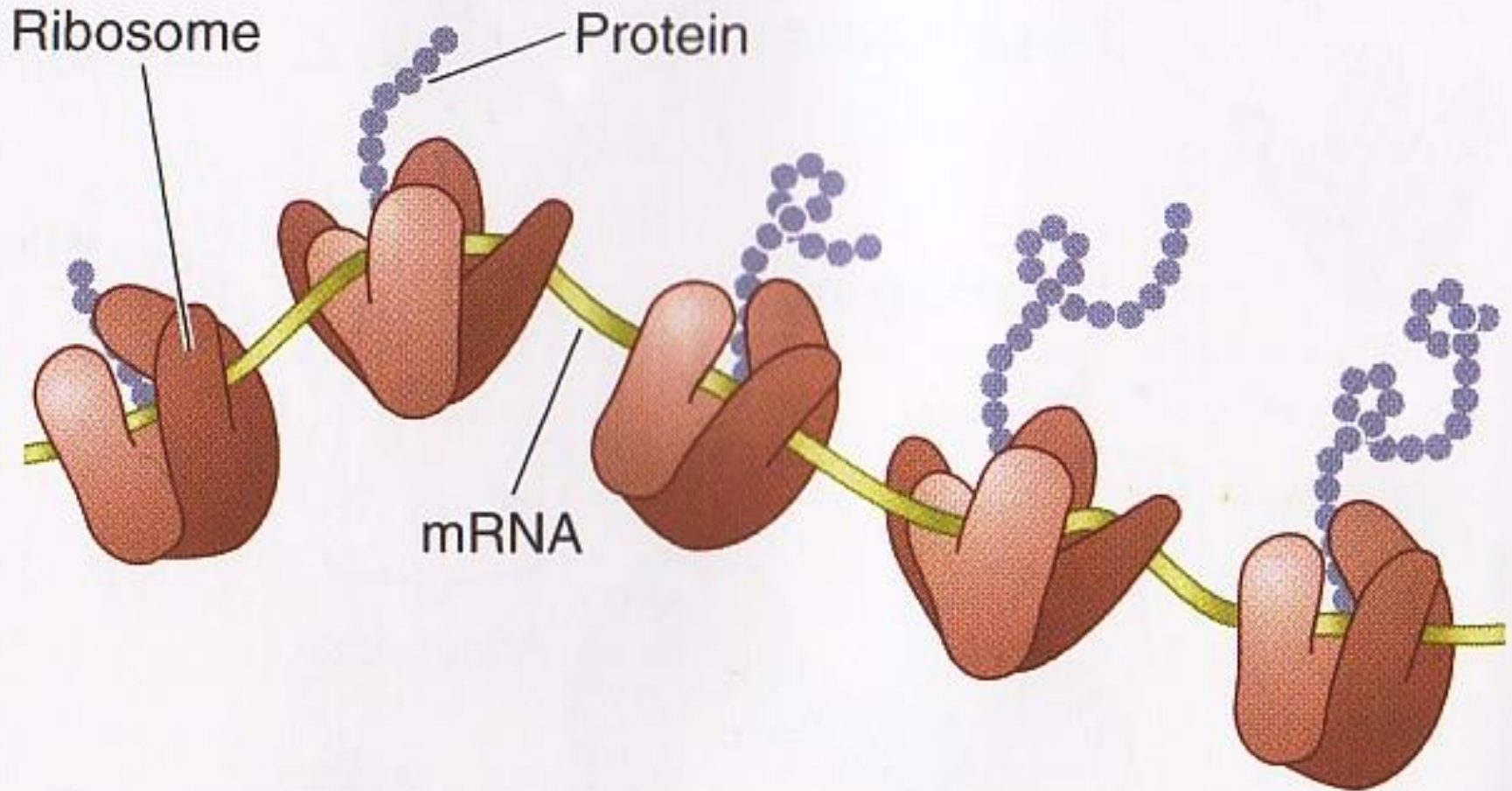


Transfer RNA (tRNA)



LS fig C-8

A Polyribosome. Which Way is Synthesis?



Class Skit, Questions & Discussion!



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

What's a ribosome?

You rock, baby!



Questions + Discussion



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⁺,...)

✓ *Energy nutrients = yield ATP*

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



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!

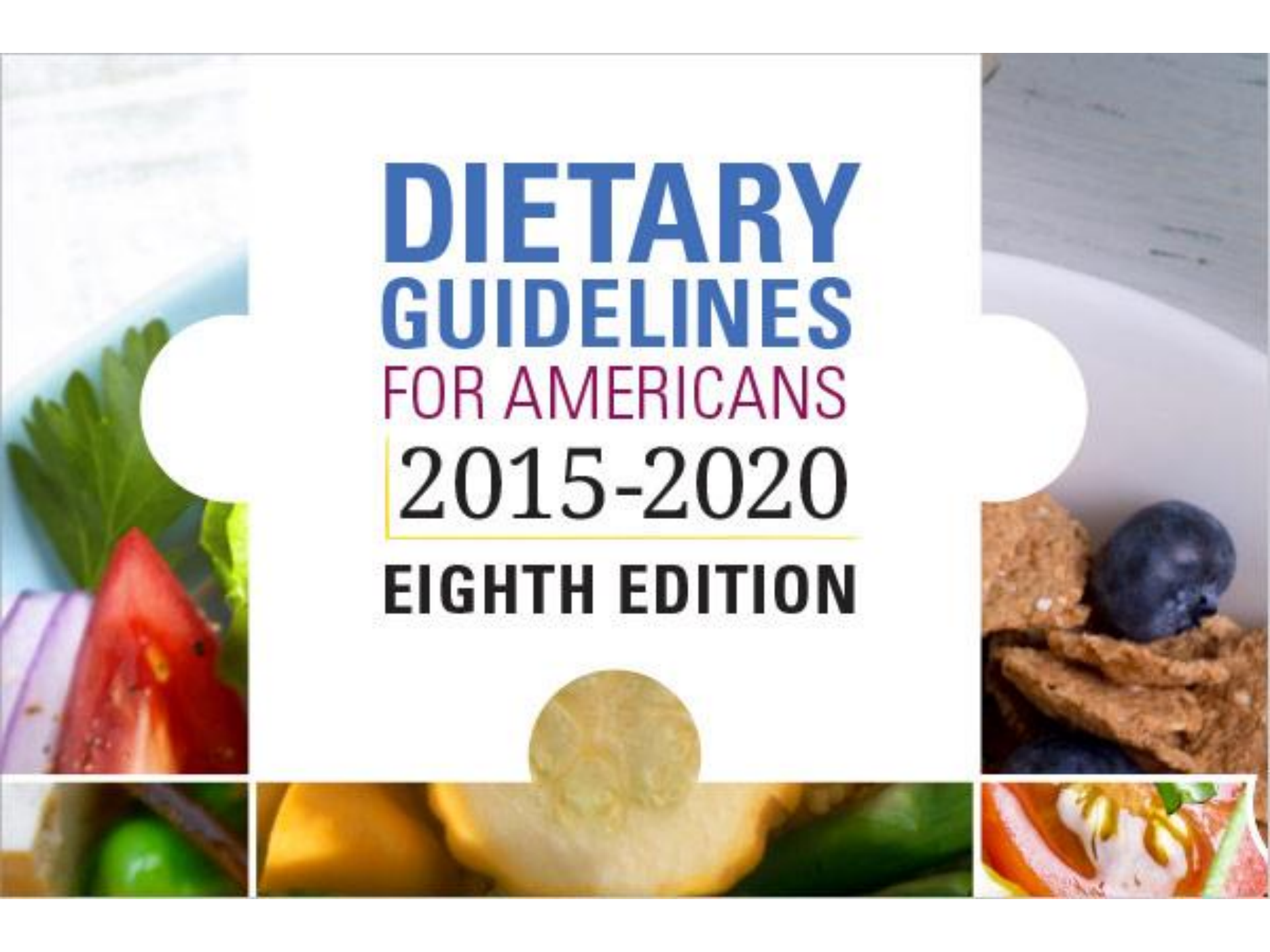


3. Make at least $\frac{1}{2}$ of your grains whole grains!

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,...



**DIETARY
GUIDELINES
FOR AMERICANS
2015-2020
EIGHTH EDITION**

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/>

Diet & Health Guidelines for Cancer Prevention

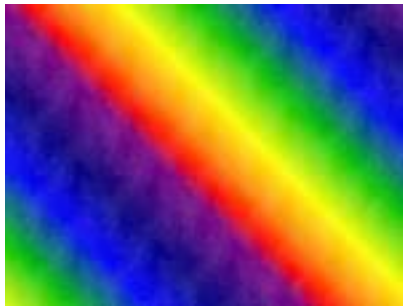
- 1. Choose a diet rich in variety of plant-based foods.**
- 2. Eat plenty of vegetables & fruits.**
- 3. Maintain a healthy weight & be physically active.**
- 4. Drink alcohol only in moderation, if at all.**
- 5. Select foods low in fat & salt.**
- 6. Prepare & store food safely.**

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.



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

Plant-based!

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



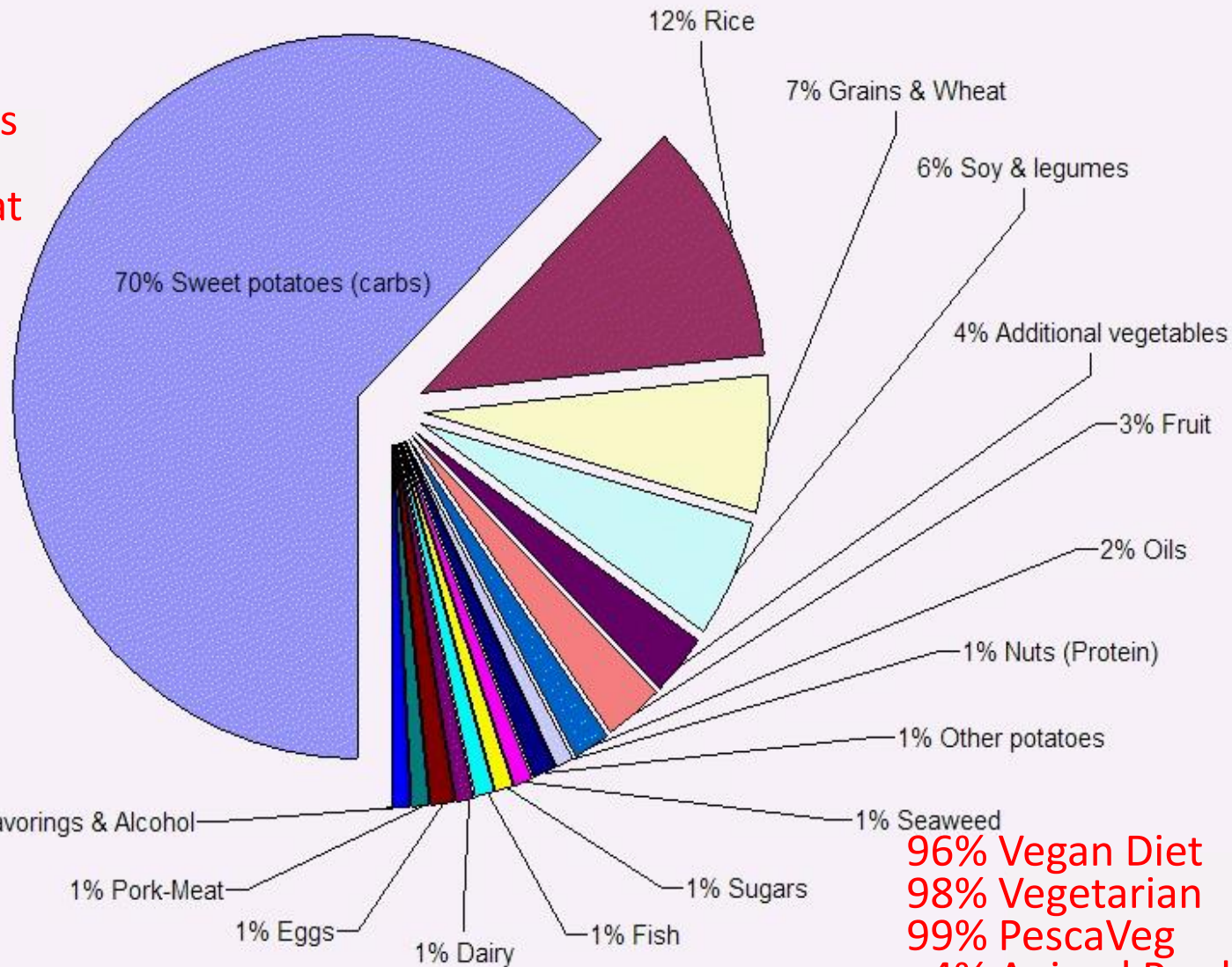
https://en.wikipedia.org/wiki/Blue_Zone

<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



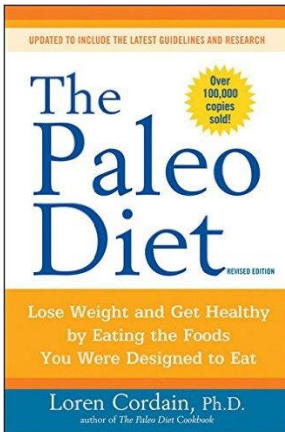
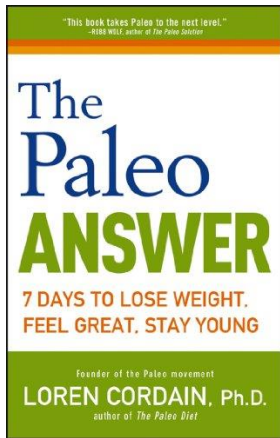
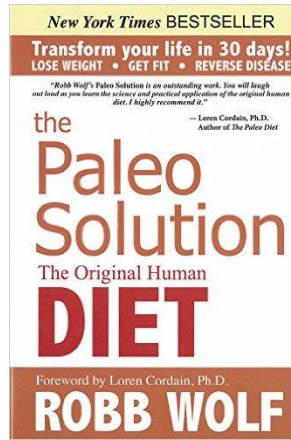
85% Carbohydrates
 9% Protein
 6% Fat
 85-10-5
 1785 Calories

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

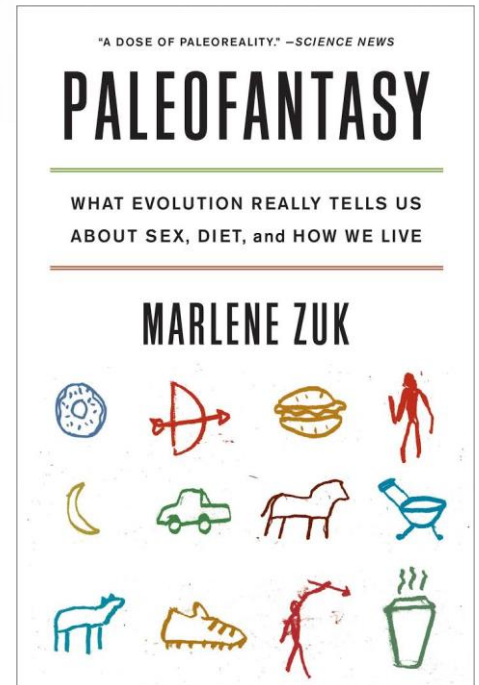
SCIENTIFIC STUDY: "The Diet of the World's Longest-Lived People and Its Potential Impact on Morbidity and Life Span"
 JOURNAL: Annals of the Academy of Sciences - Volume 1114: 434-455 (2007).

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.

Pondering Paleo?



**Evolutionary Biologist
Behavioral Ecologist
U Minnesota**



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

How much protein do you need?

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

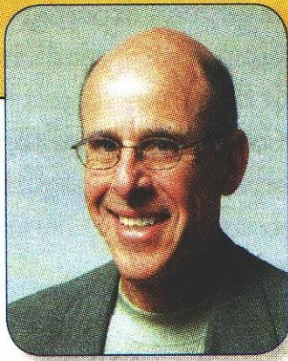
50 kg or 110 lb female ? ~ 40 g/d

80 kg or 176 lb male ? ~ 64 g/d



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

**Average US woman gets 35% > RDA!
Average US man 65% >RDA!**



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% 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.

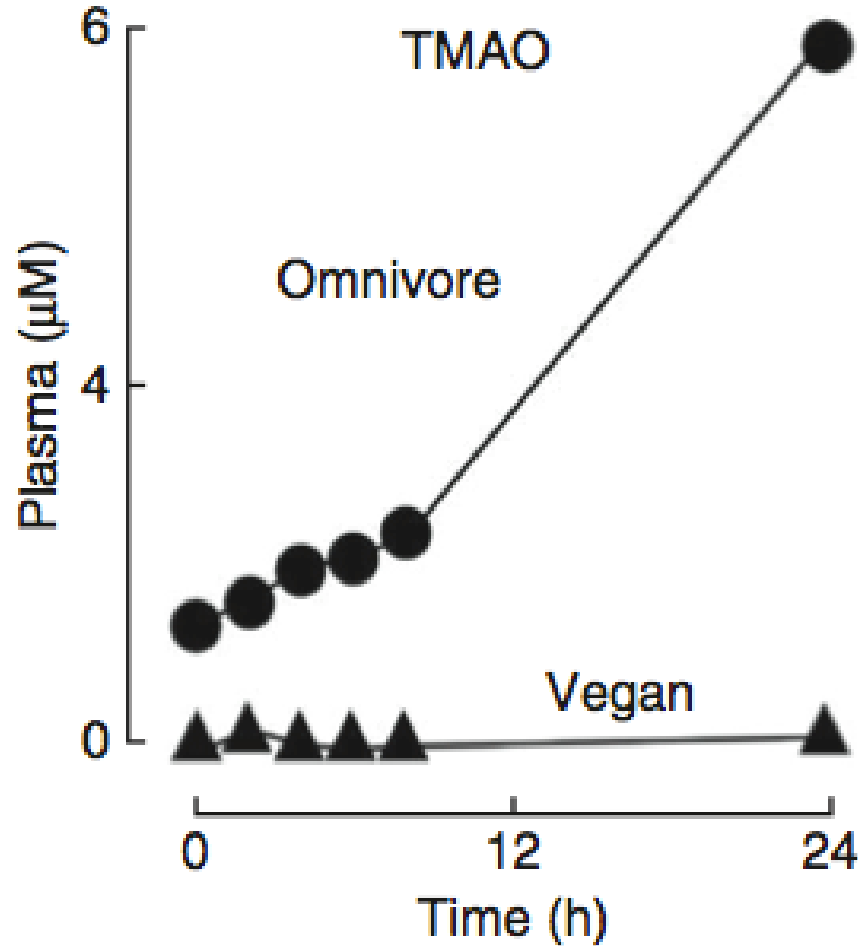
In fact, IARC cited estimates that 34,000 cancer deaths per year worldwide can be attributed to diets high in processed meat. In contrast, tobacco causes nearly 2 million cancer deaths per year.

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.

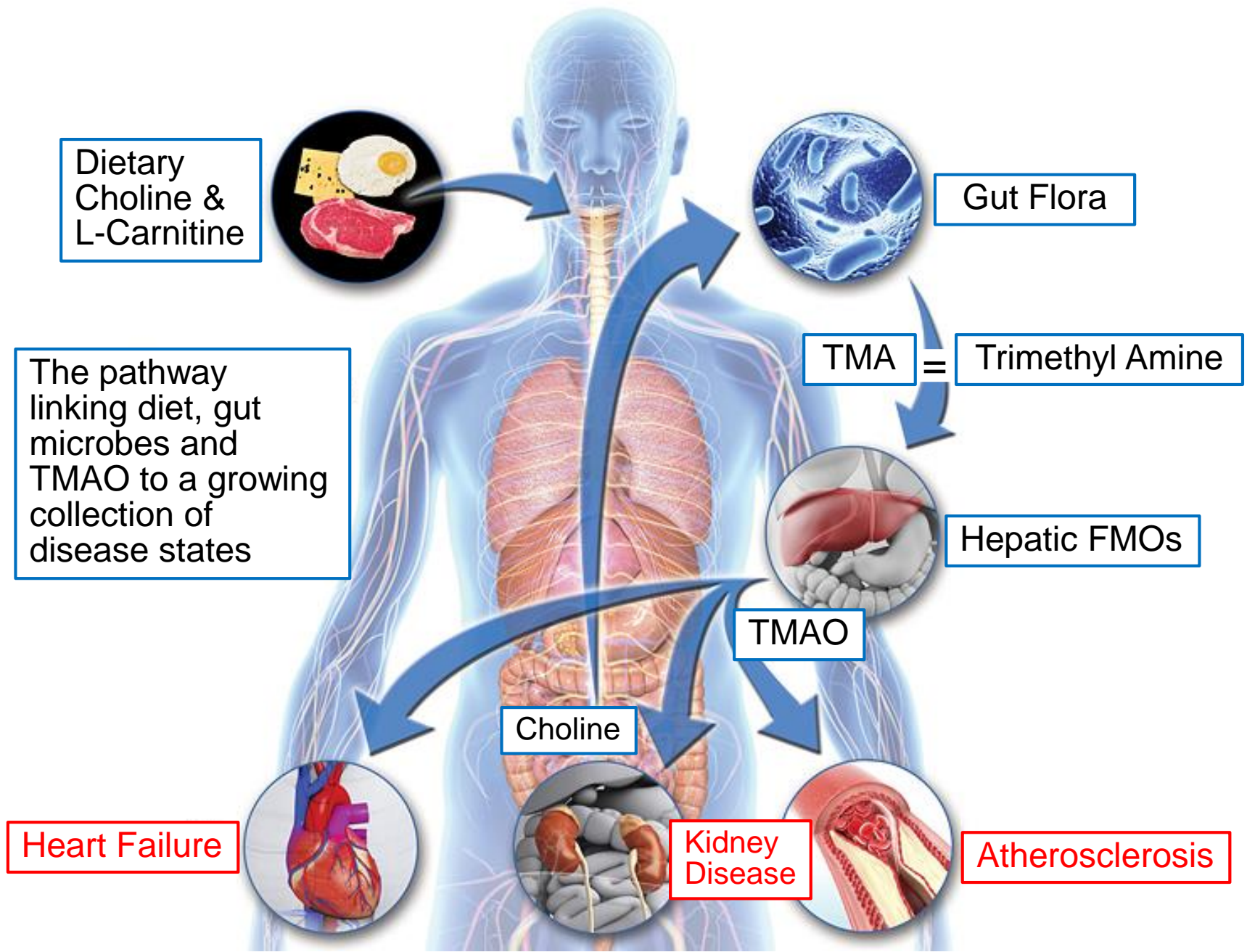
And there's a far surer way to reduce the risk of colorectal cancer than tinkering with your diet: Get screened.

Gut Bacteria Involved in **Inflammation & Atherosclerosis**?

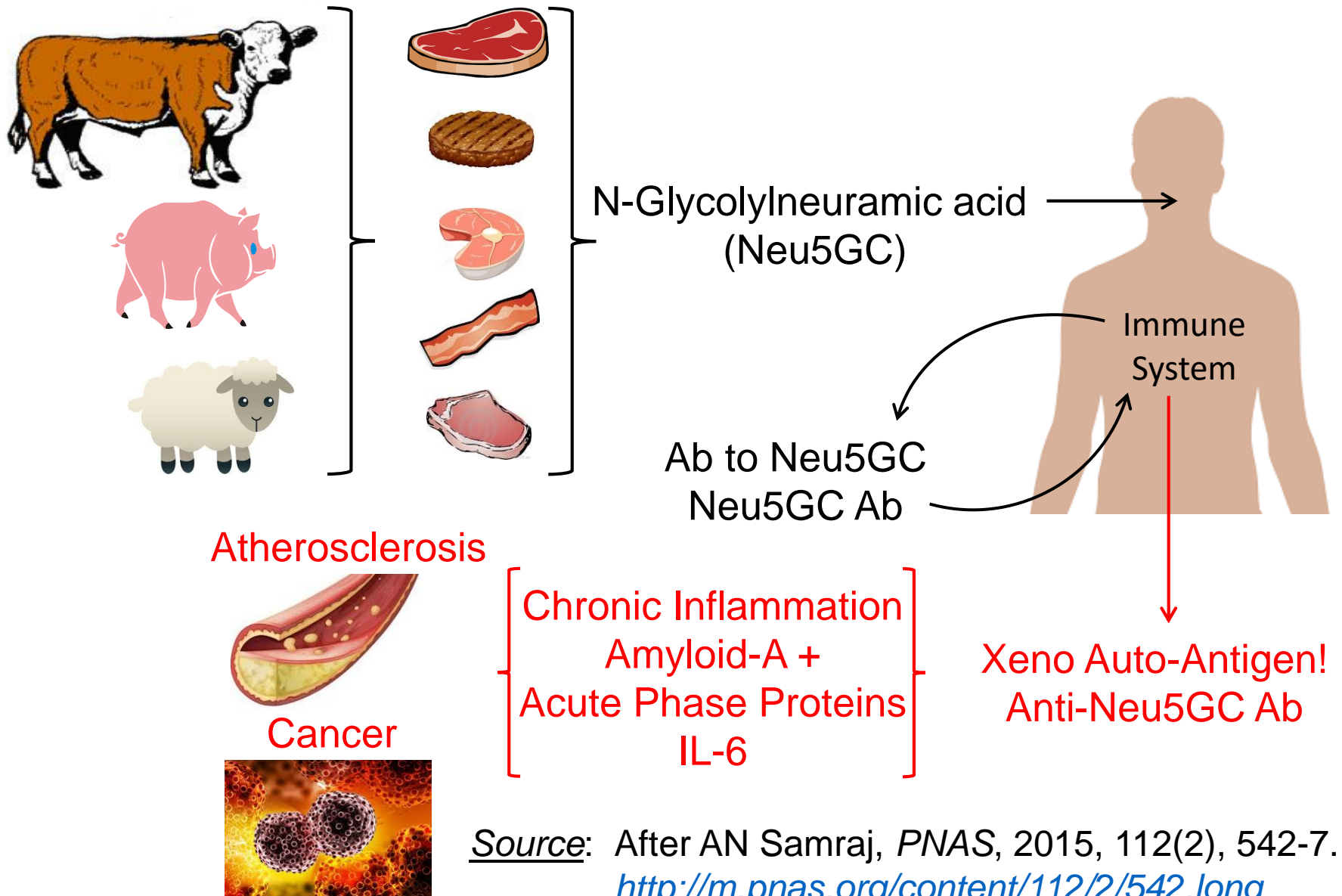


Meat & Eggs → L-Carnitine & Choline → Trimethyl Amine (TMA) →
TMAO → **Inflammation & Atherosclerosis**

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



Red Meat-Derived Glycan Promotes Inflammation & Disease



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

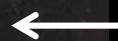
Nutrition *Action*

OCTOBER 2016 \$2.50

HEALTH LETTER®
CENTER FOR SCIENCE IN THE PUBLIC INTEREST

Carbohydrate Confusion

Should you avoid carbs
at all costs?



No, ↑ *complex*
↓ *simple!*
Emphasize a
plant-based
diet!

Our Planet
AT RISK

The Best
SPREADS

3 Veggie
Dips

Actor Halle Berry "swears by the ketogenic diet,"
according to *Women's Health* magazine.

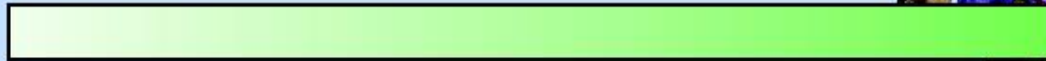
Dietary Composition & Physical Endurance

eg, Atkins!

High-fat diet



Normal mixed diet



High-carbohydrate diet



~ 1/3 endurance!

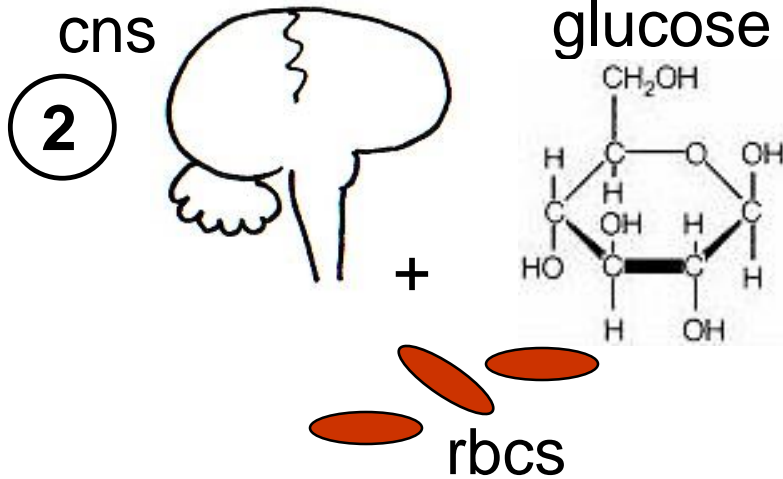
Maximum endurance time:

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...

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

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

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

<https://www.ncbi.nlm.nih.gov/pubmed/29466592>

<https://www.ncbi.nlm.nih.gov/pubmed/19246357>

***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

26 lb Water

20 lb Lean Body Mass

14 lb Fat

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

> $\frac{3}{4}$

***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.**