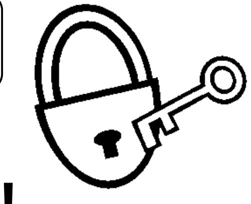
BI 121 Lecture 4



I. ***Announcements*** **Anatomy & Physiology Lab today!**
Be sure to complete p 3-7 dietary record in LM < lab next wk!
Help with estimating serving sizes for Nutrition Lab 3. Q?

II. ***Cell Organelle Connections*** **Little organs or specialty shops!**

III. ***Physiology News*** **♀ *vs* ♂ Mitochondria; Vaults? *Sci News***

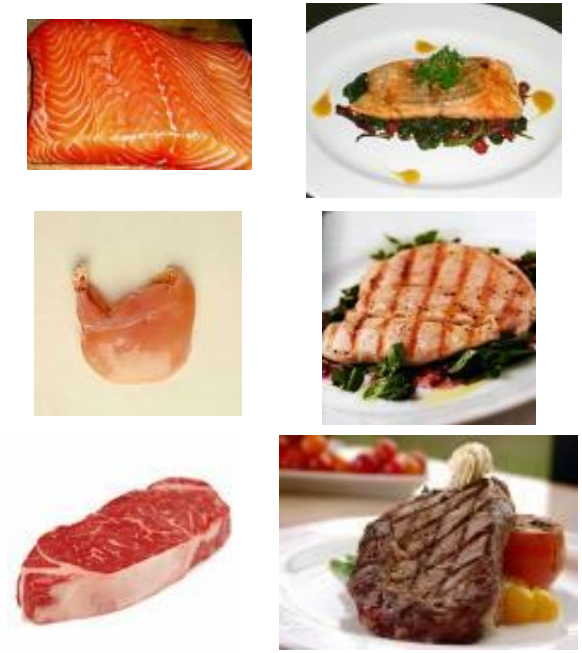
IV. ***Anaerobic vs Aerobic Metabolism Connections***
LS ch 2 pp 26-33
A. Take-home points + key differences fig 2-15 + vpl
B. Few details: Glycolysis, CAC, ETC fig 2-9, 2-10, 2-11, 2-12

V. ***Introduction to Genetics*** **LS pp 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? Class skit! fig C-7, C-9

or

≡ 1 c

4 oz → 3 oz

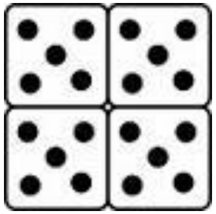


raw → cooked

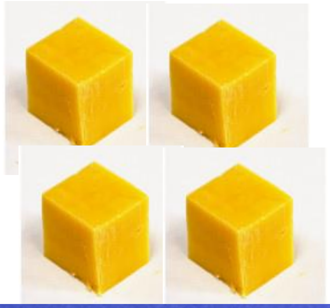
≡

Deck of Cards

≡ 1/3 c



≡ 1 oz



≡ ¼ c

≡ 1.5 oz

Lysosomes *vs.* *Peroxisomes*

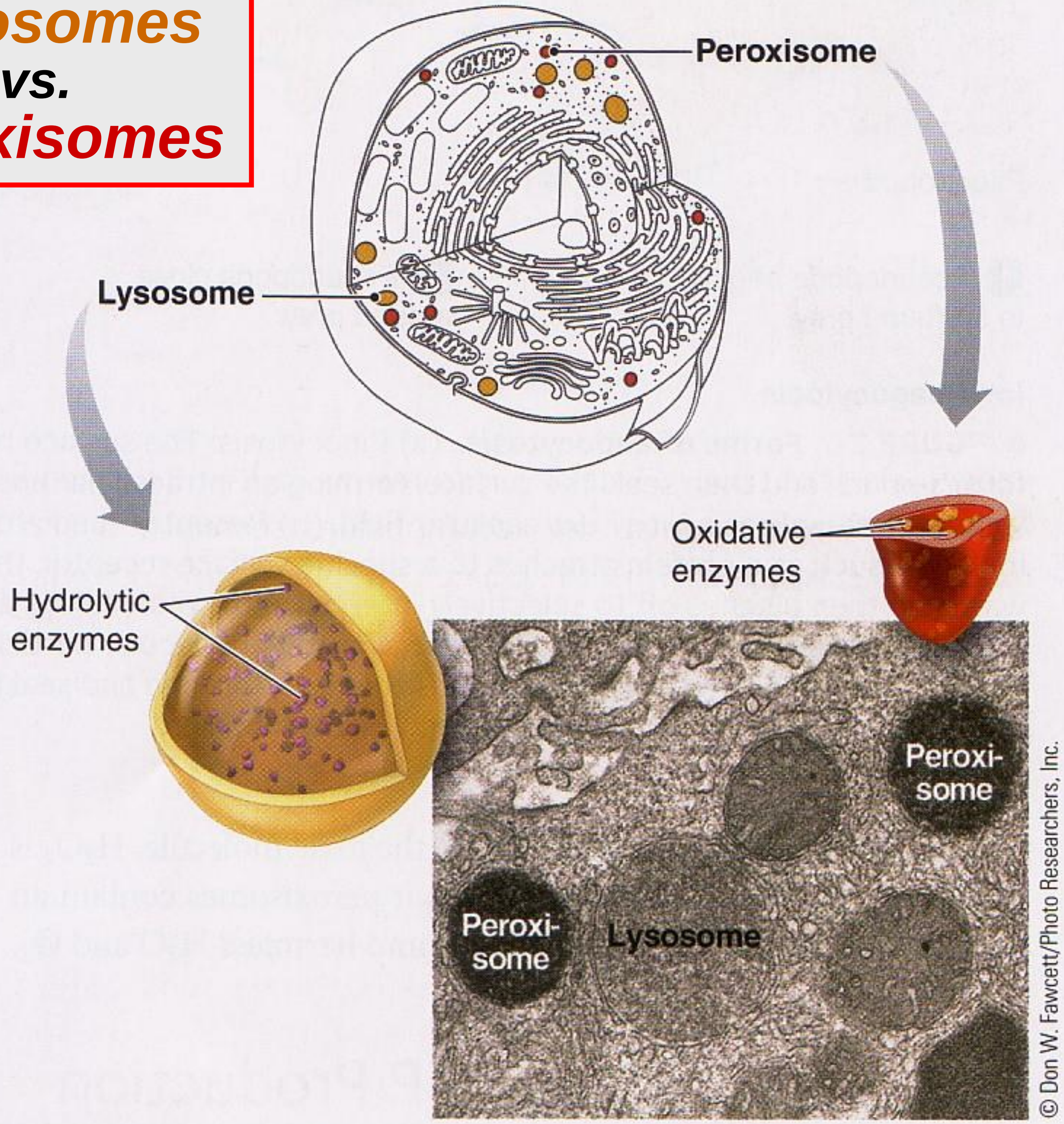


fig 2-6 LS 2012

Phagocytosis: Cell Eating!

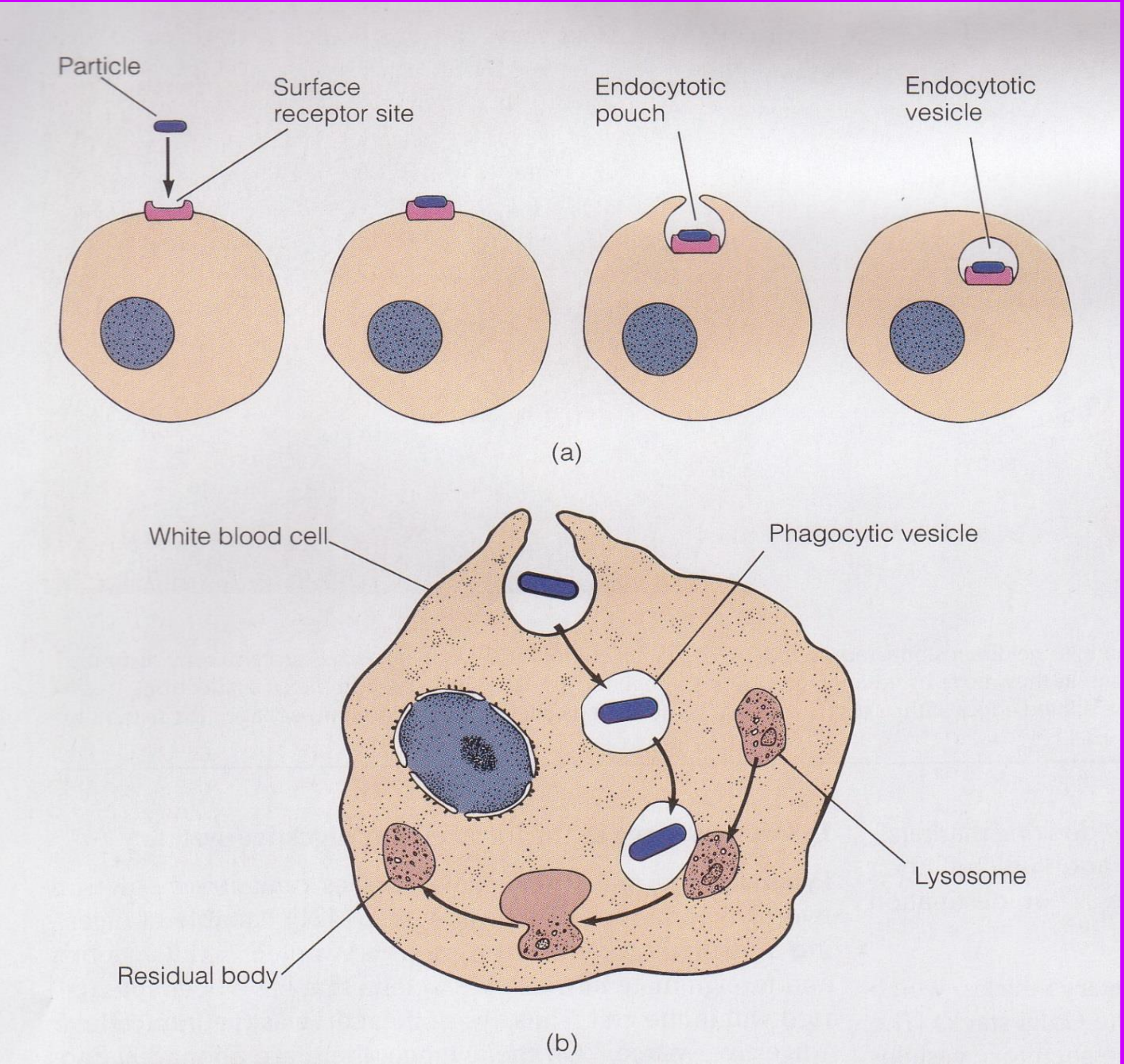
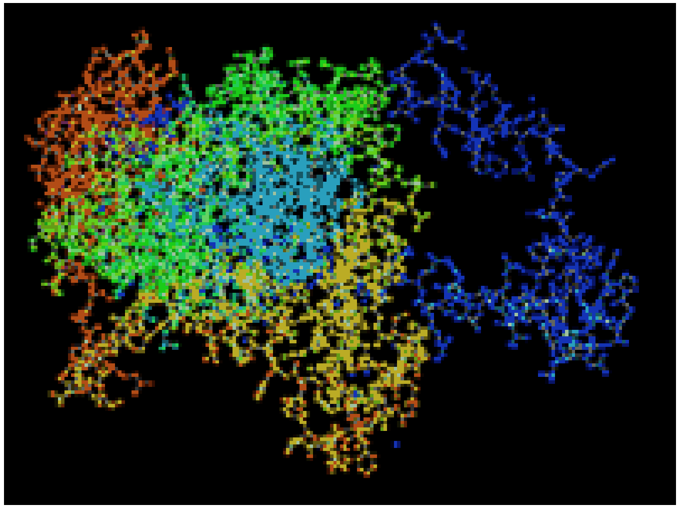


fig 2-7 LS 2006


Film: Neutrophil engulfing bacterium
http://devreotes.johnshopkins.edu/videos
L. Nilsson, Nat Geog 1986
10,000 x

Catalase Enzyme Reaction in Peroxisomes Neutralize Toxin at Production Site!



Catalase

$$2H_2O_2 \longrightarrow 2H_2O + O_2$$

Mitochondria: Energy Organelles

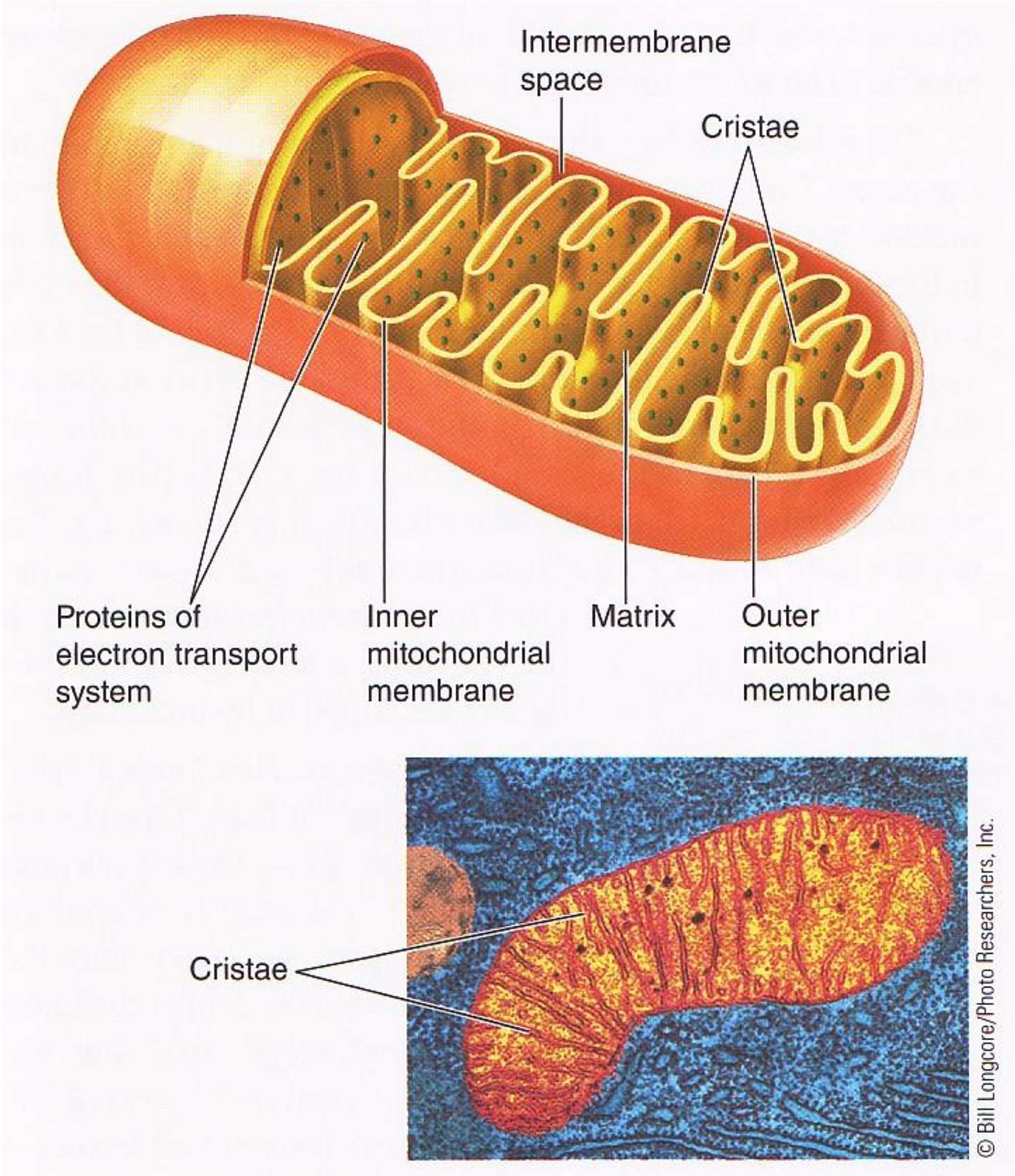
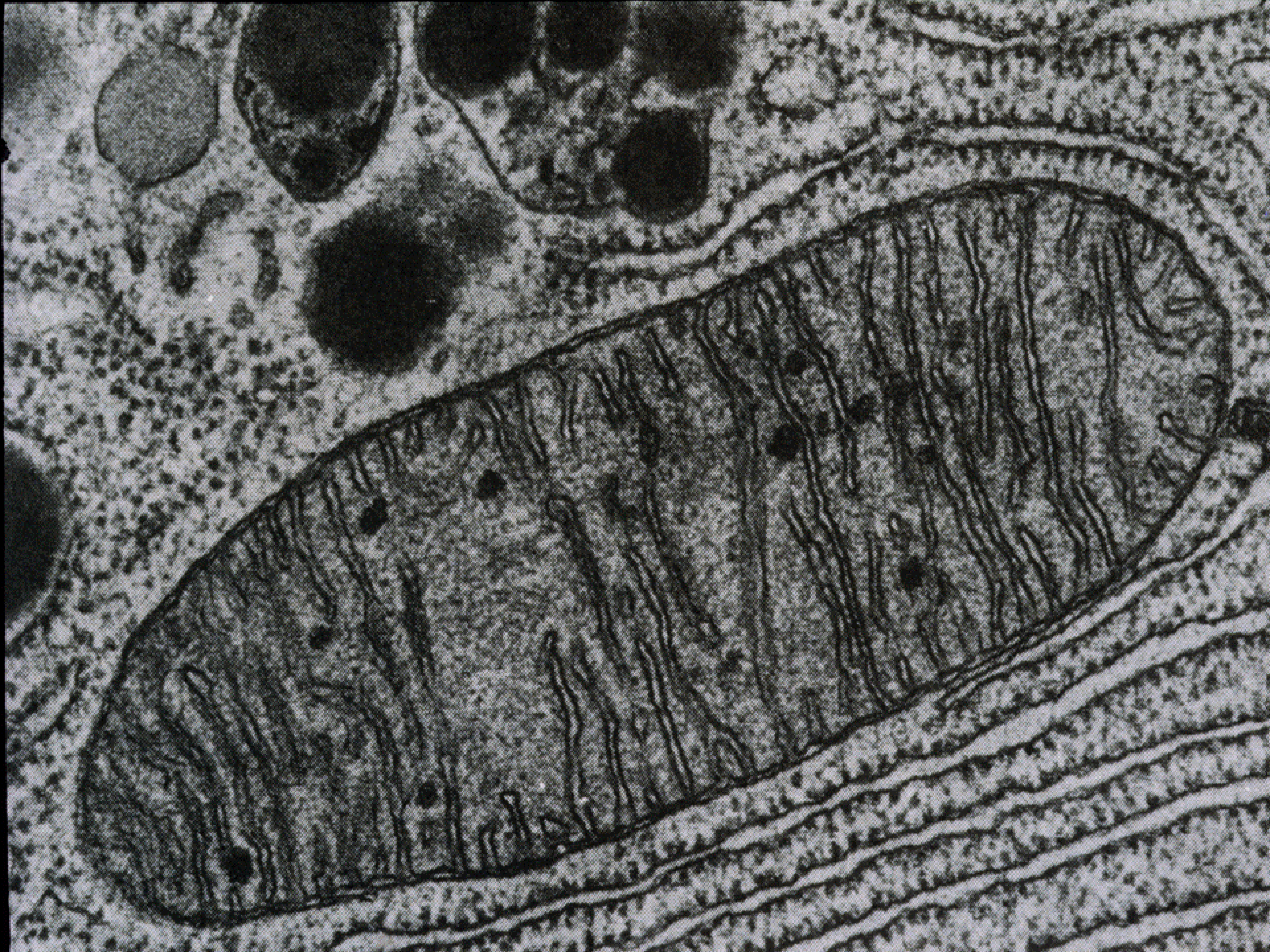
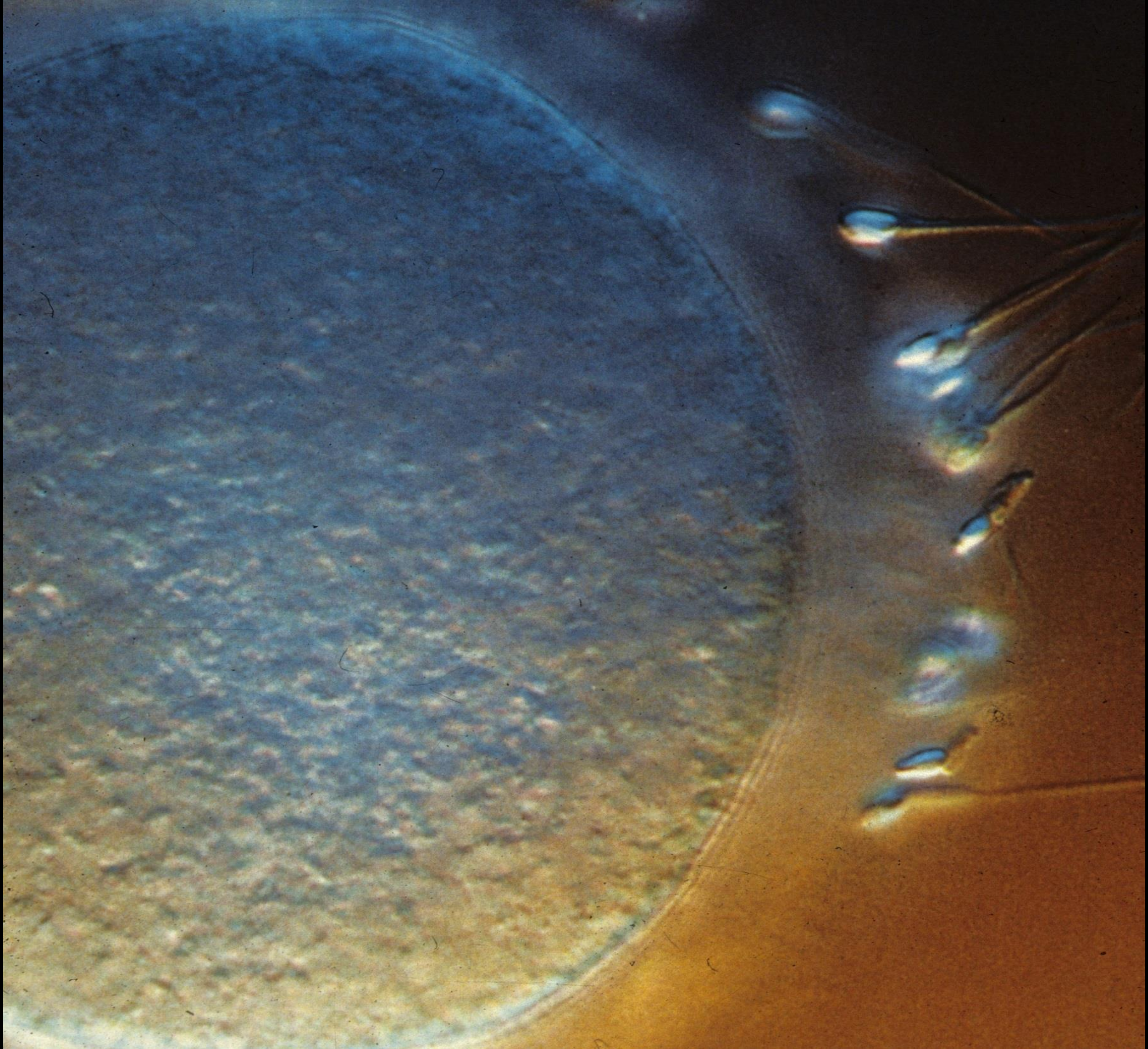


fig 2-8 LS 2012





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.**

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.**


The Weekly Newsmagazine of Science
SCIENCE NEWS
July 27, 1996
Vol. 150, No. 4
Pages 49-64
Vaults Hold
Cell Mystery
An organelle?

What's in the Vault?

An ignored cell component may often account for why chemotherapy fails

By JOHN TRAVIS

Can you imagine exploring the anatomy of the human body and missing the heart, the organ that sends life-giving blood coursing through the body? Of course not. Or not noticing the brain, the custodian of memories and creator of thoughts? Don't be ridiculous.

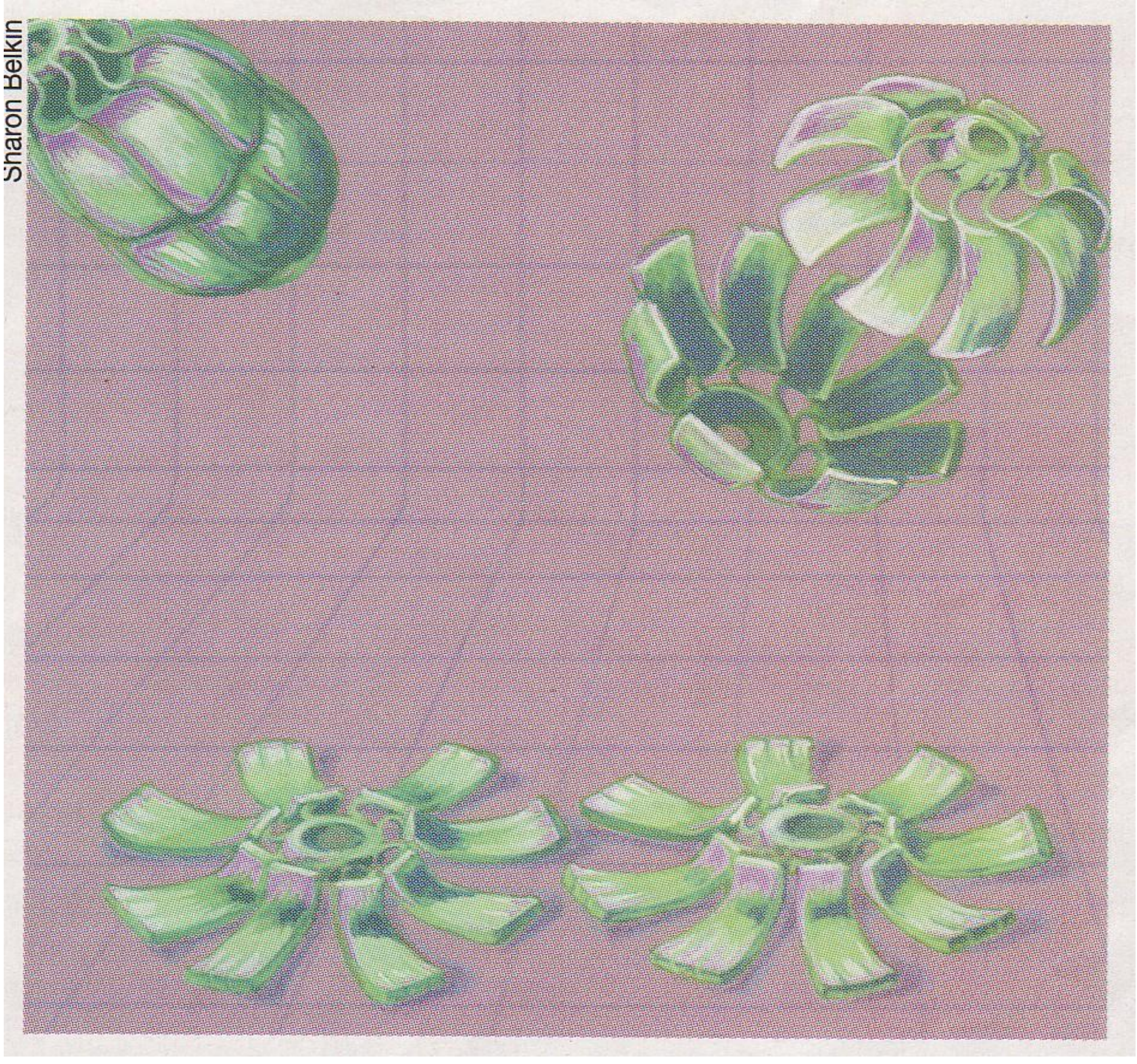
Yet cell biologists may soon have to acknowledge an equally unimaginable oversight in their field. For decades, their powerful microscopes have failed to spot a basic cell component of animals and perhaps any organism with a nucleus. Known as vaults, the barrel-shaped particles are three times the size of ribosomes, the eas-

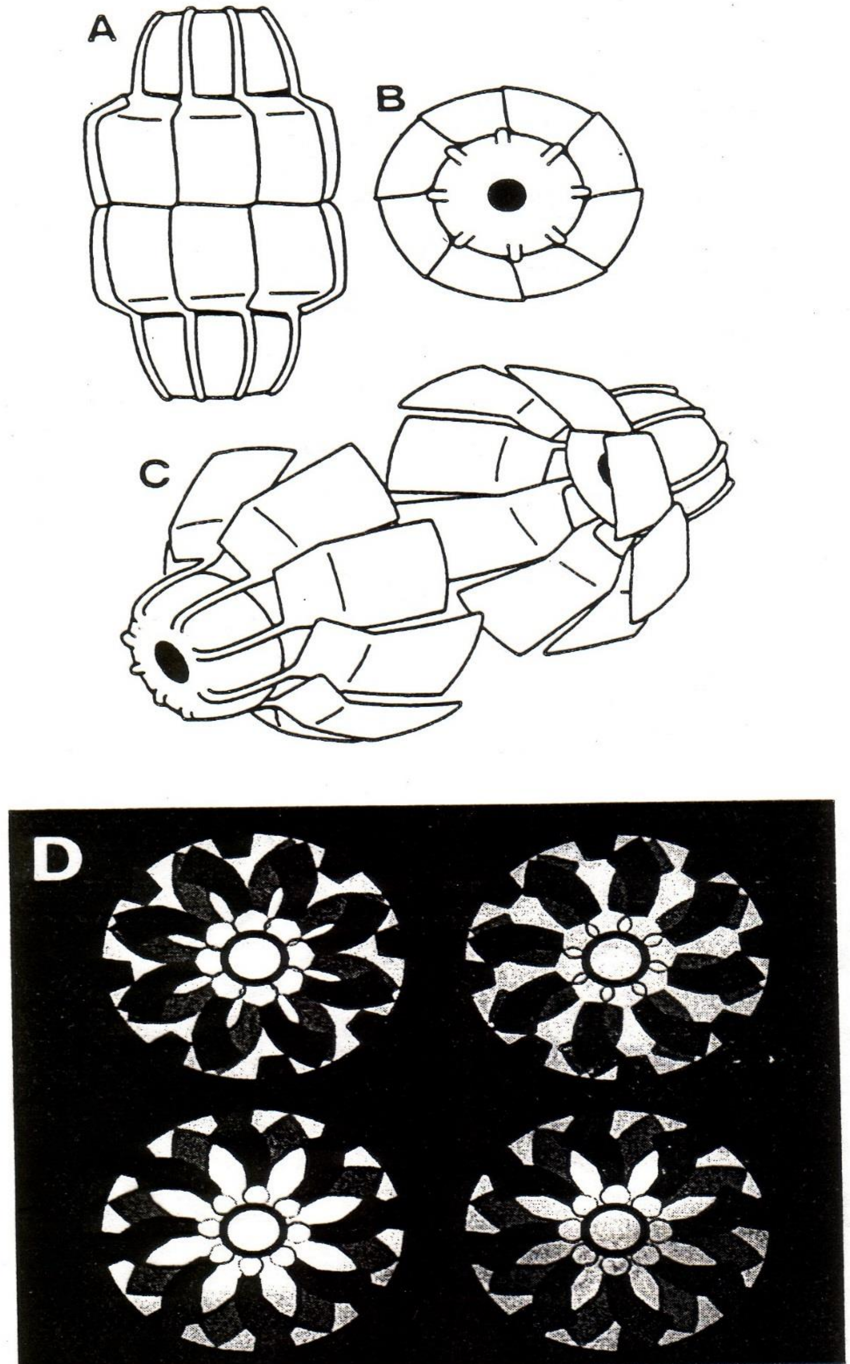
through a microscope. But if it were contaminated with objects that shrug off the stain, that sea would be dotted with white islands. Rome likens the strategy to finding an invisible person by looking for an unexplained shadow in the beam of a spotlight.

To Kedersha's surprise, unstained ovoid objects appeared among her coated vesicles. Since some of the stain settled into furrows on top of the unexpected shapes, the negative staining revealed fine details of the exterior of these mysterious interlopers, including arches that reminded Rome and Kedersha of the ceil-

us something by this incredible structure. And the one thing we might surmise from the structure [of vaults] is that they might contain something," says Rome.

That shape also hints that vaults may pick up their unknown cargo at the nuclear membrane, the barrier that separates the cell's cytoplasm from its nucleus. The nucleus is a fluid-filled sac containing DNA and the machinery required to translate the instructions encoded by that DNA into molecules called messenger RNA. These mRNA strands, as well as other molecules,


Sharon Belkin


A
B
C
D

AEROBIC = MITOCHONDRION

w/O_2

ANAEROBIC = CYTOSOL

without O_2

1. Immediate/ATP-PC
2. Glycolysis


CREATINE


FREE
4 Extra Servings!
ISS RESEARCH
COMPLETE
Creatine
EFFERVESCENT
ADVANTAGE
24 (17 gram) Servings
individually packaged

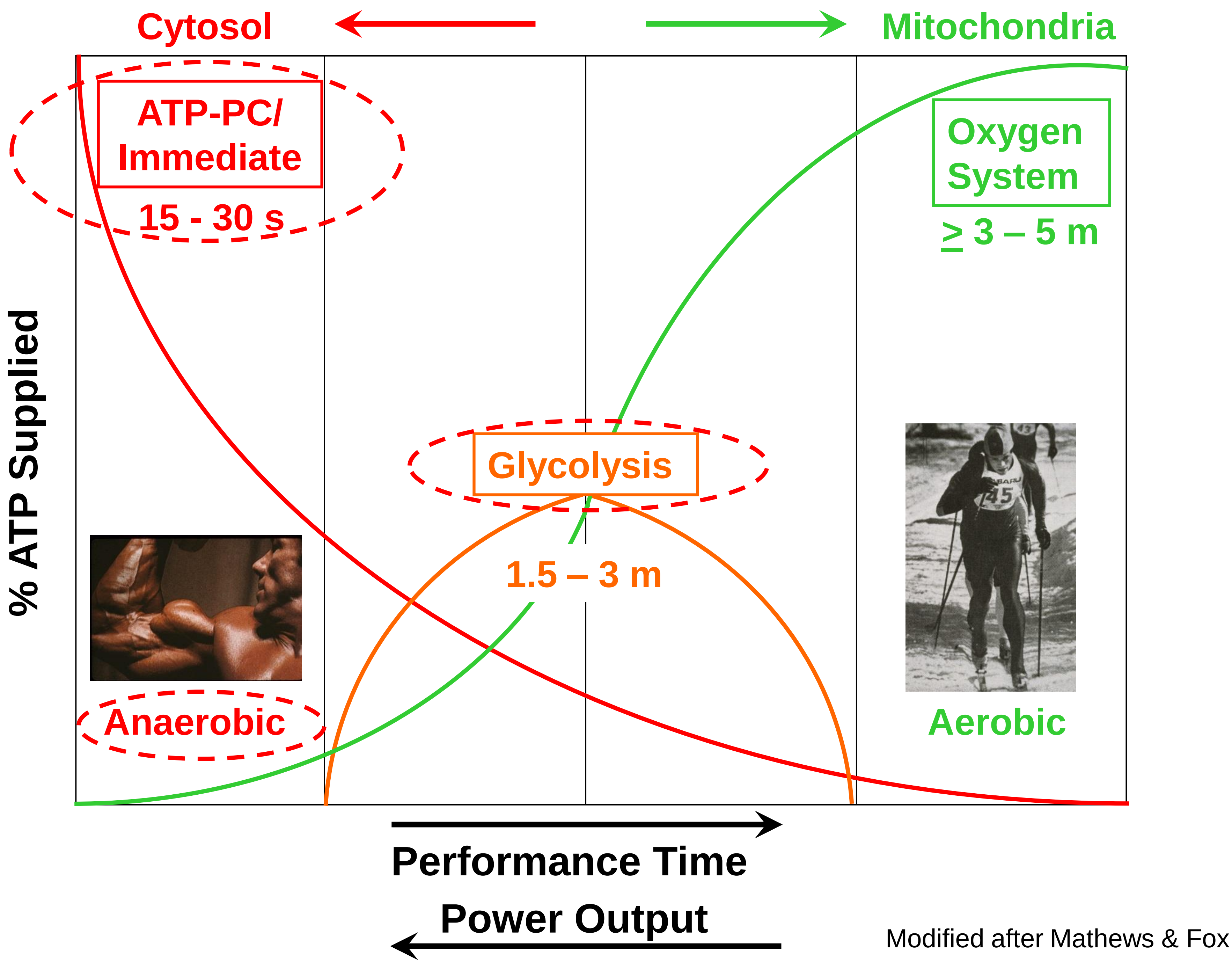

ULTIMATE NUTRITION
crea
pure
BIOVOLUMIZING
1000g (1kg)


BALANCE
PURE
CREATINE
MONOHYDRATE

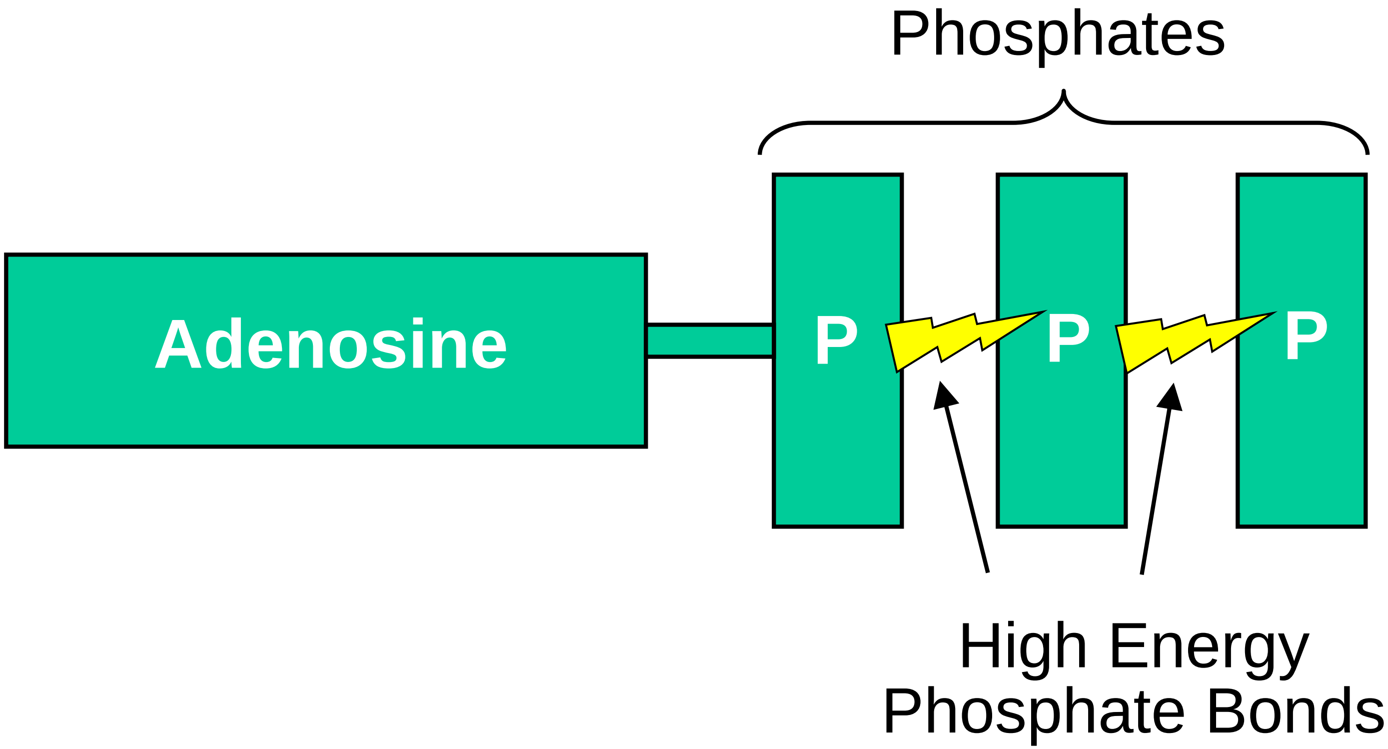
I'M CHAMP!

WOW!

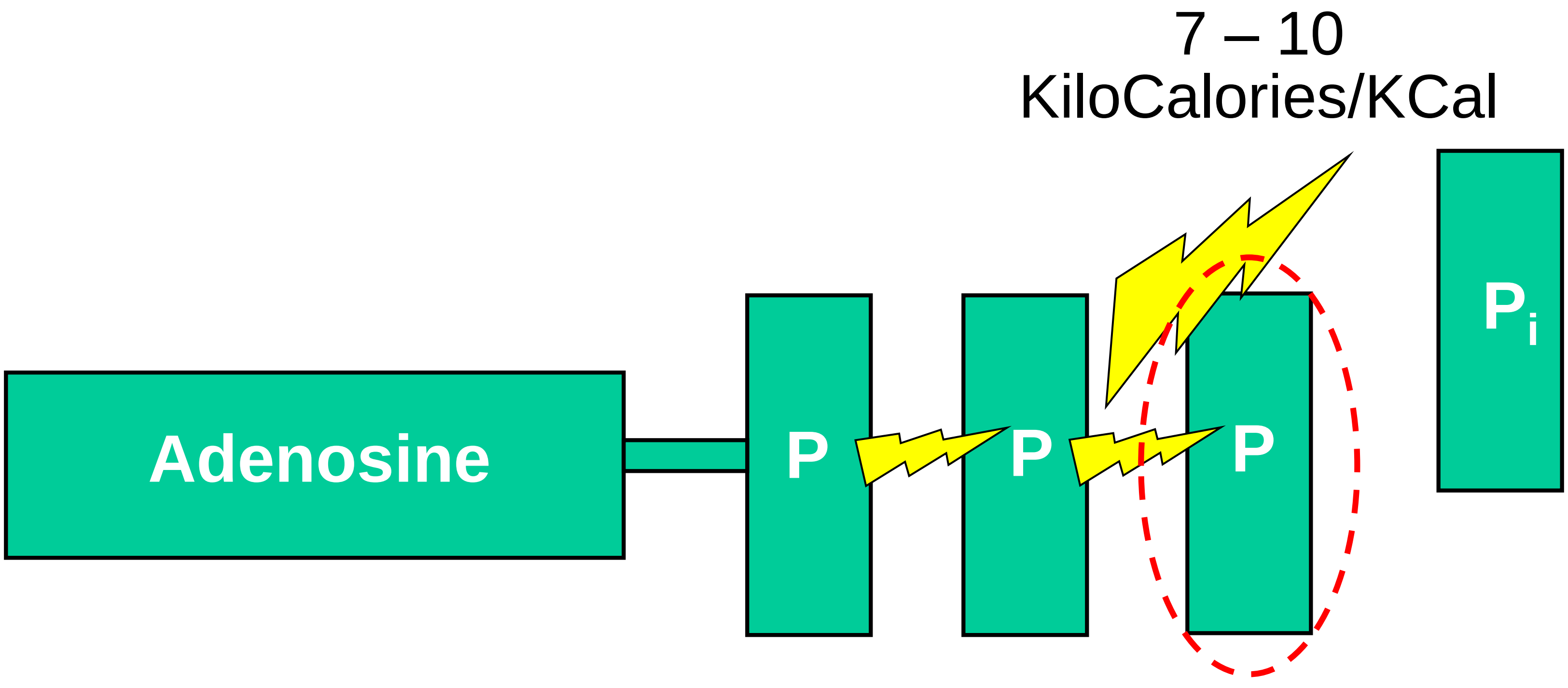

PUMP


Cytosol
Mitochondria
ATP-PC/
Immediate
15 - 30 s
Oxygen
System
≥ 3 – 5 m
Glycolysis
1.5 – 3 m
% ATP Supplied
Anaerobic
Aerobic
Performance Time
Power Output
Modified after Mathews & Fox

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



Cleave One High Energy Phosphate Bond To Do Work!!

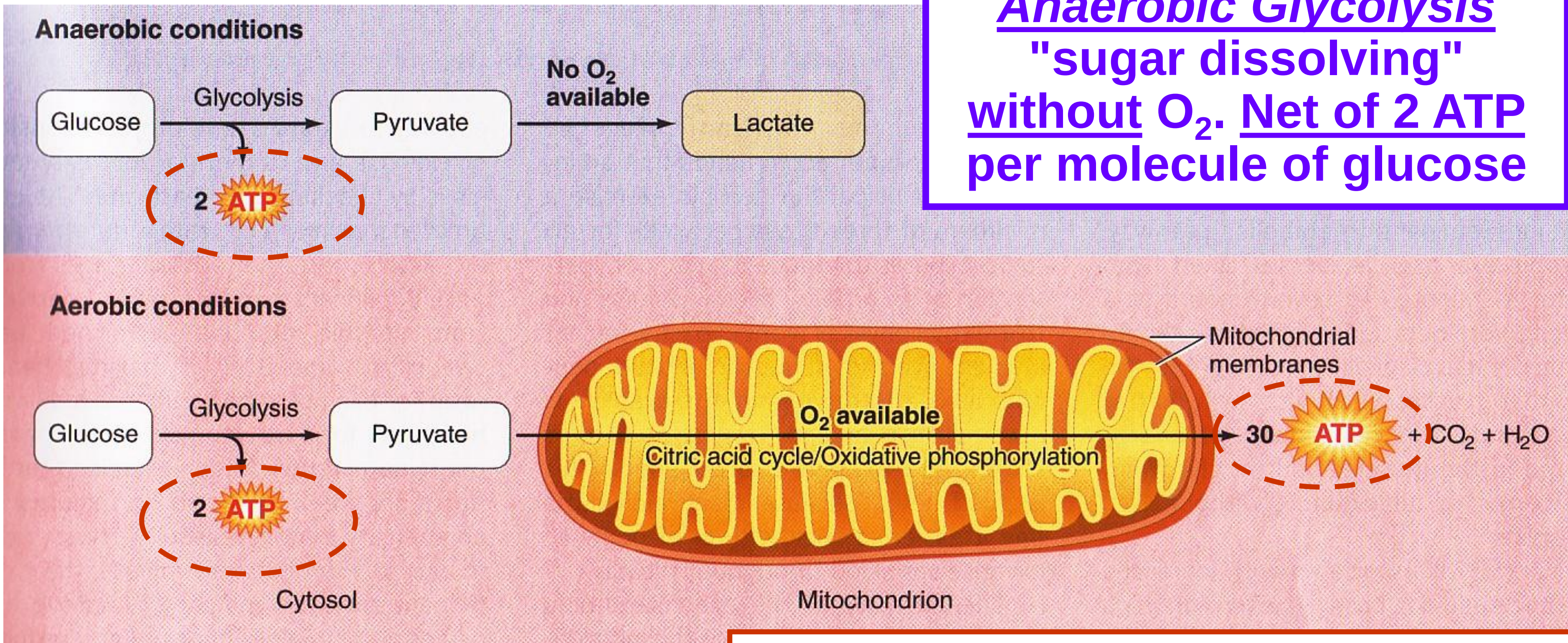


1. *Synthesis of Macromolecules*
2. *Membrane Transport*
3. *Mechanical Work*

Make big things from little things!

Move things! Microscopic! ↔ Move things! Macroscopic!

Anaerobic vs. Aerobic Metabolism

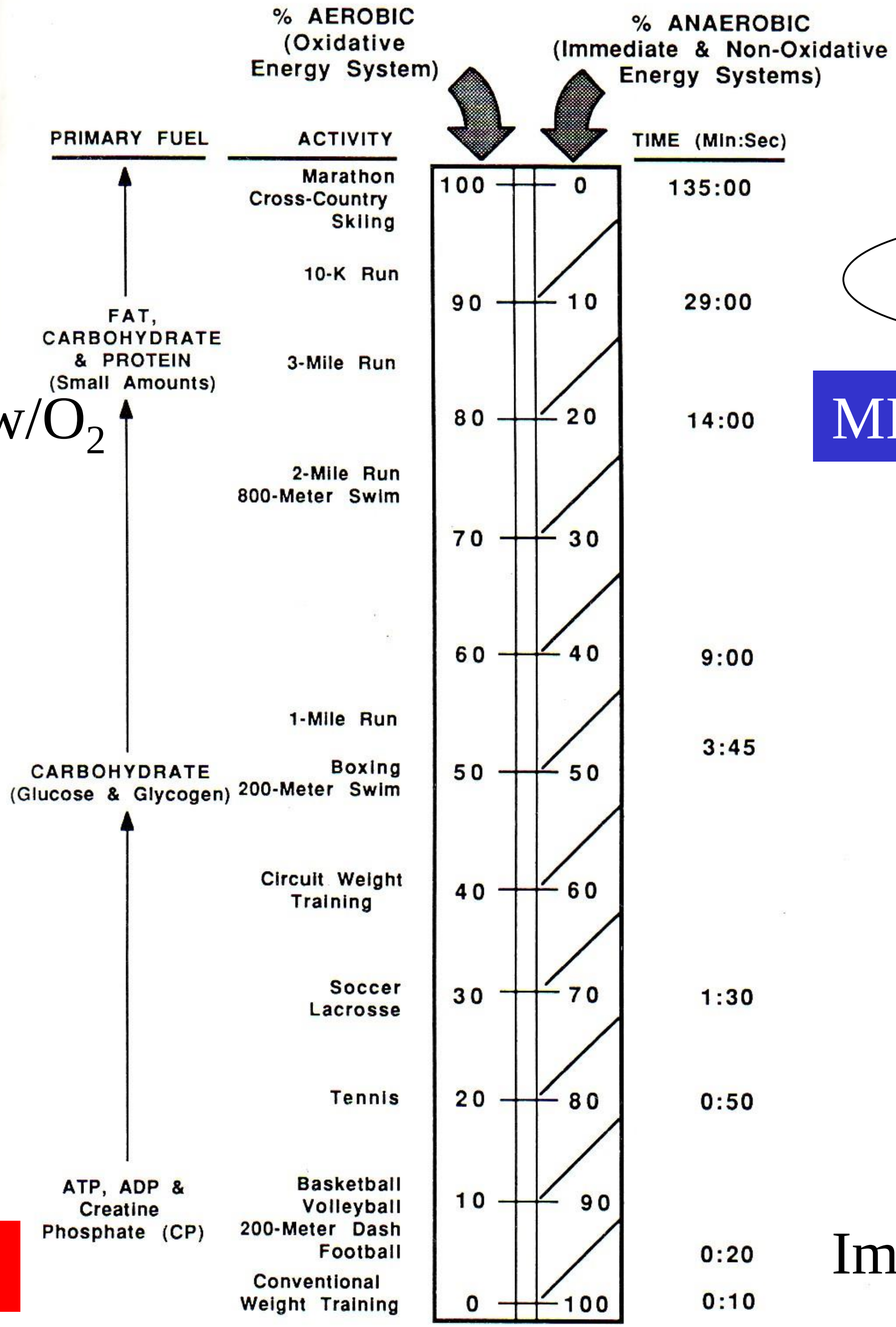


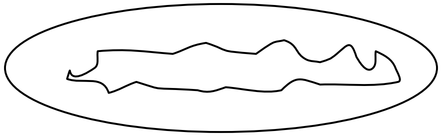
Anaerobic Glycolysis
"sugar dissolving" without O_2. Net of 2 ATP per molecule of glucose

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





MITOCHONDRIA

CYTOSOL

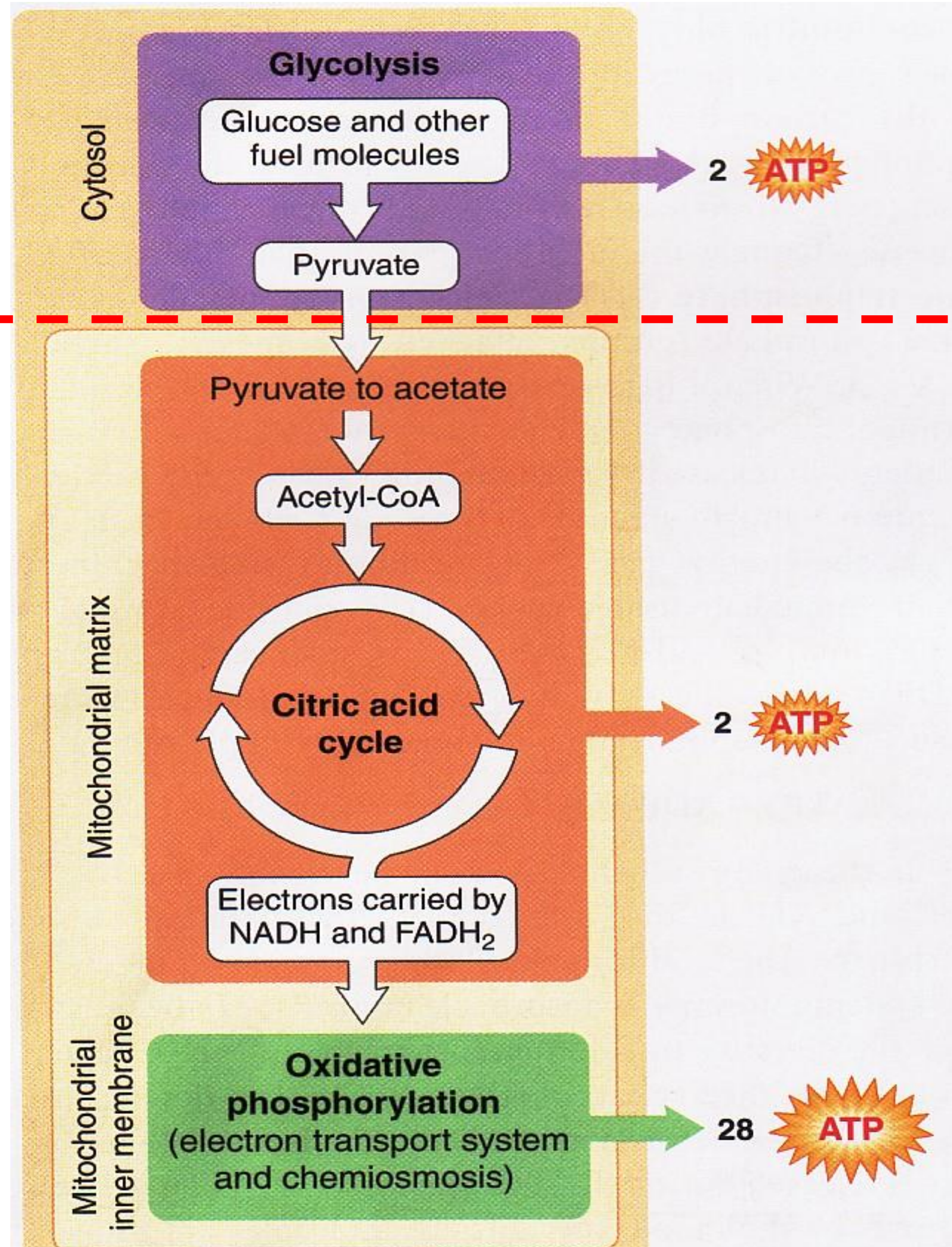
Glycolysis

Immediate/ATP-PC

ANAEROBIC

Stages of Cellular Metabolism/Respiration

<u>Anaerobic</u>
Glycolysis
Cytosol



<u>Aerobic</u>
Metabolism
Mitochondria

Matrix

Inner Membrane

fig 2-9 LS 2012

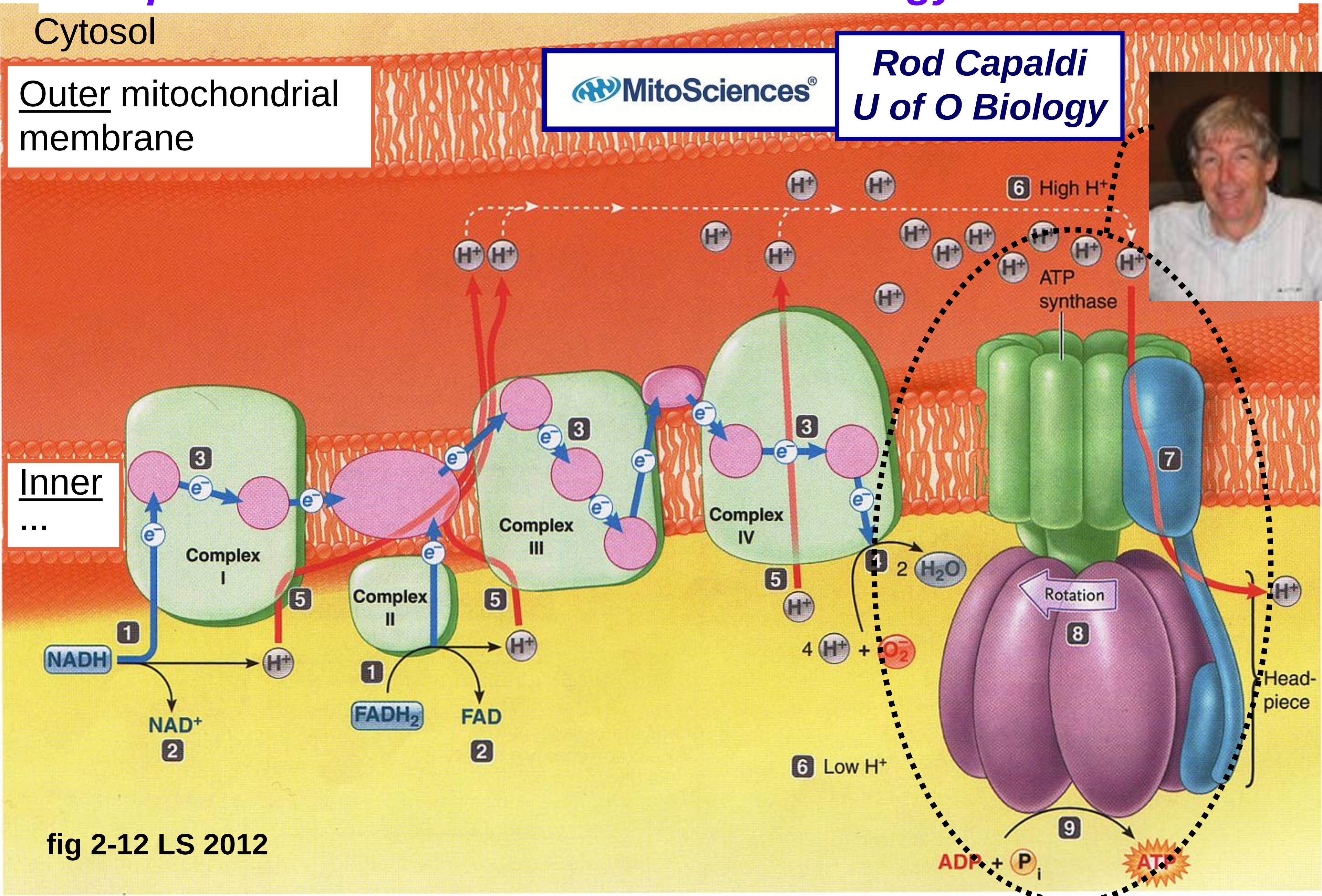
Cashing in electrons at the Electron Transport Chain (ETC) produces an abundance of ATP energy molecules!

Cytosol

Outer mitochondrial membrane

MitoSciences®

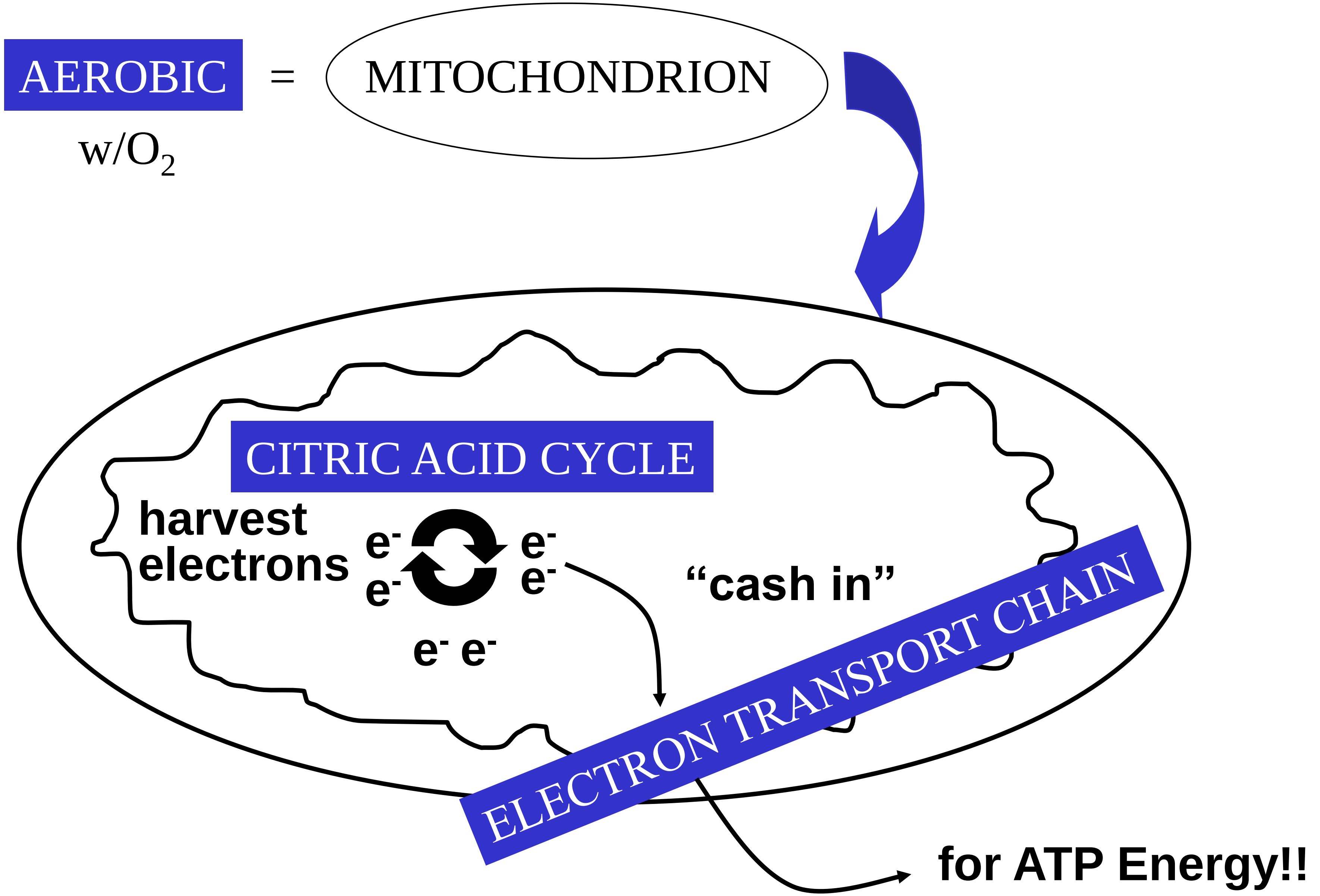
Rod Capaldi
U of O Biology



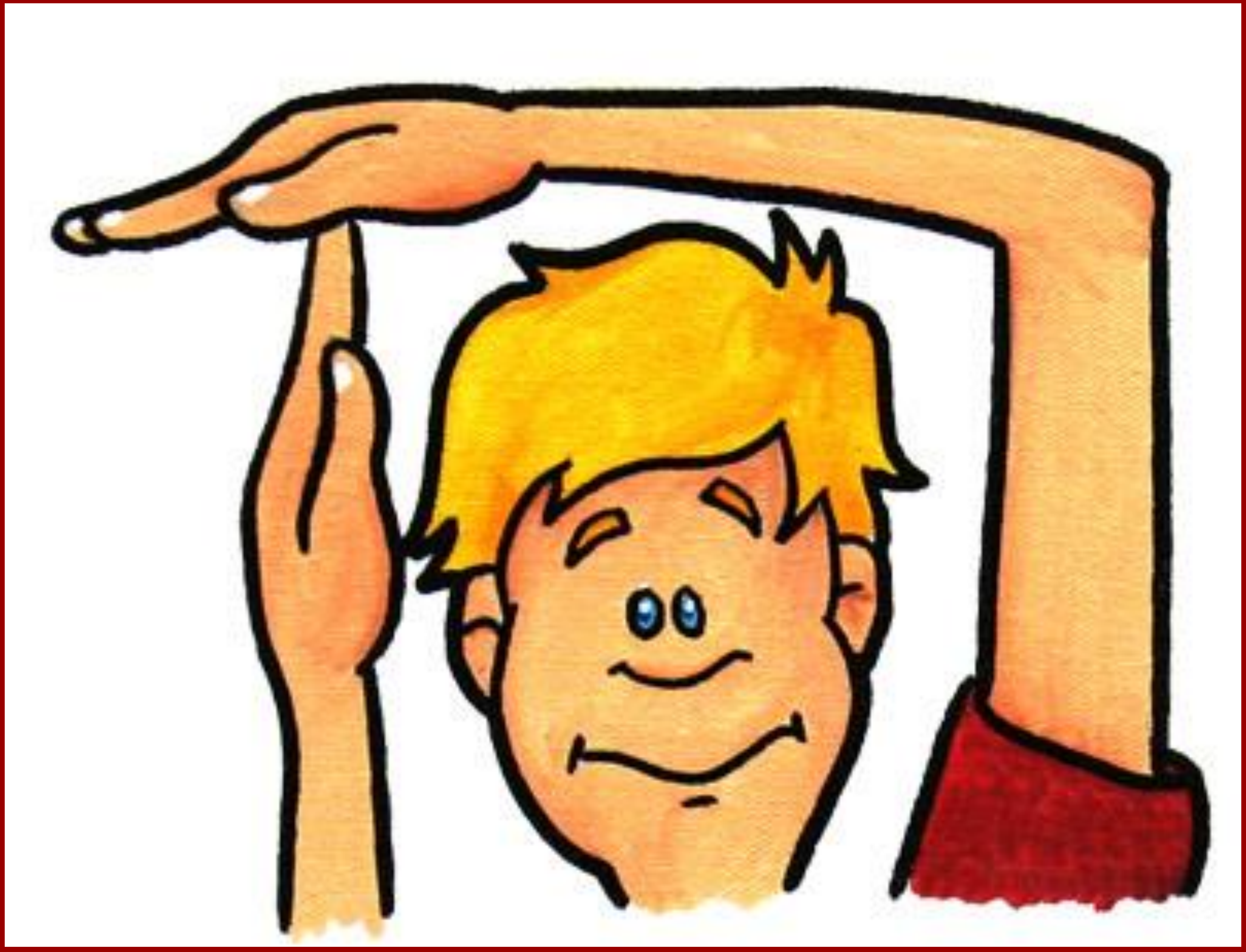
Inner
...

fig 2-12 LS 2012

Goals of Aerobic Metabolism

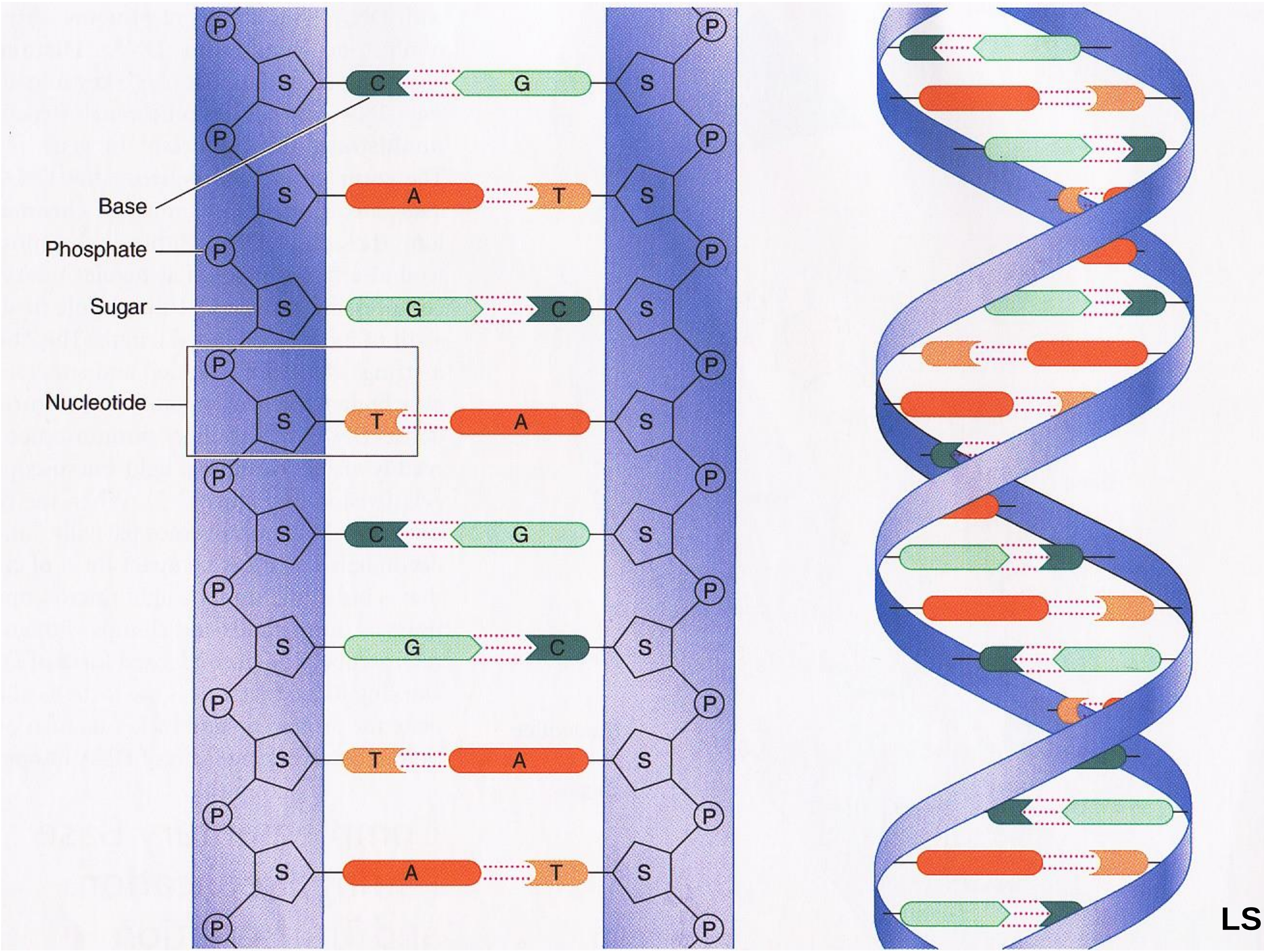


Time-out for questions!



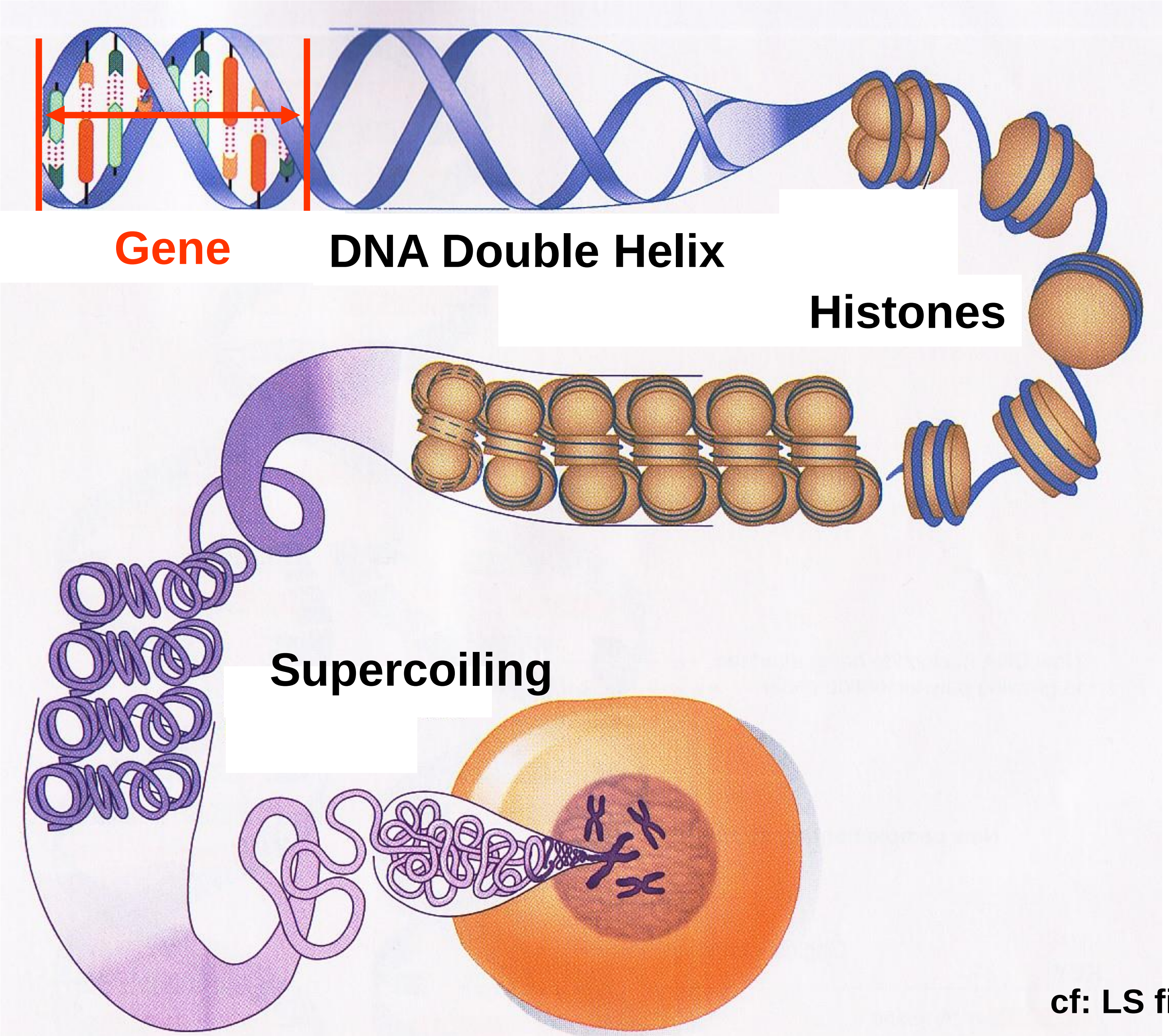
What are DNA's major functions? Heredity + Day-to-Day Cell Function

What does DNA look like? Double-helix!!



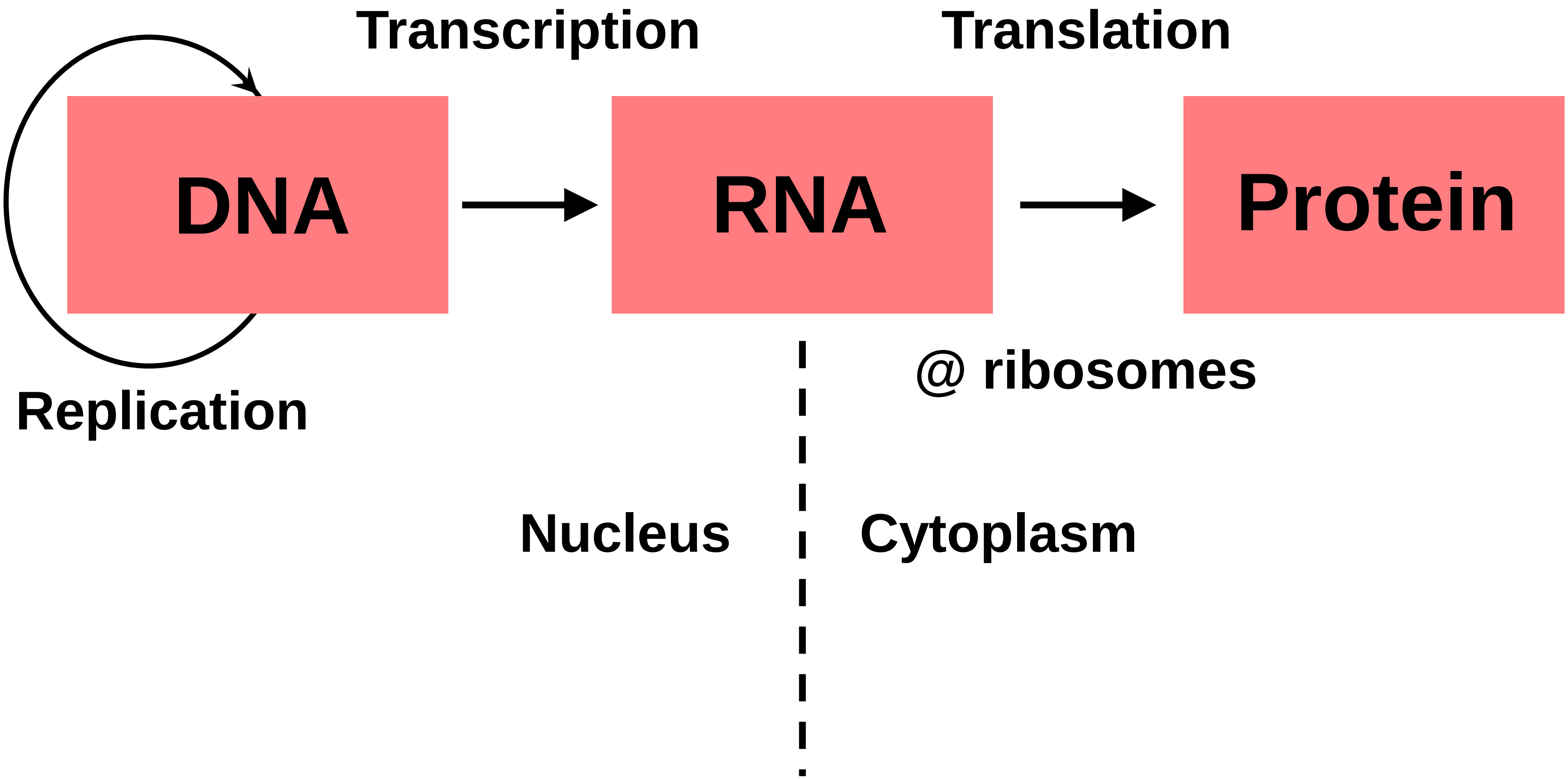
LS fig C-2

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



cf: LS fig C-3

What does DNA do, day-to-day?



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

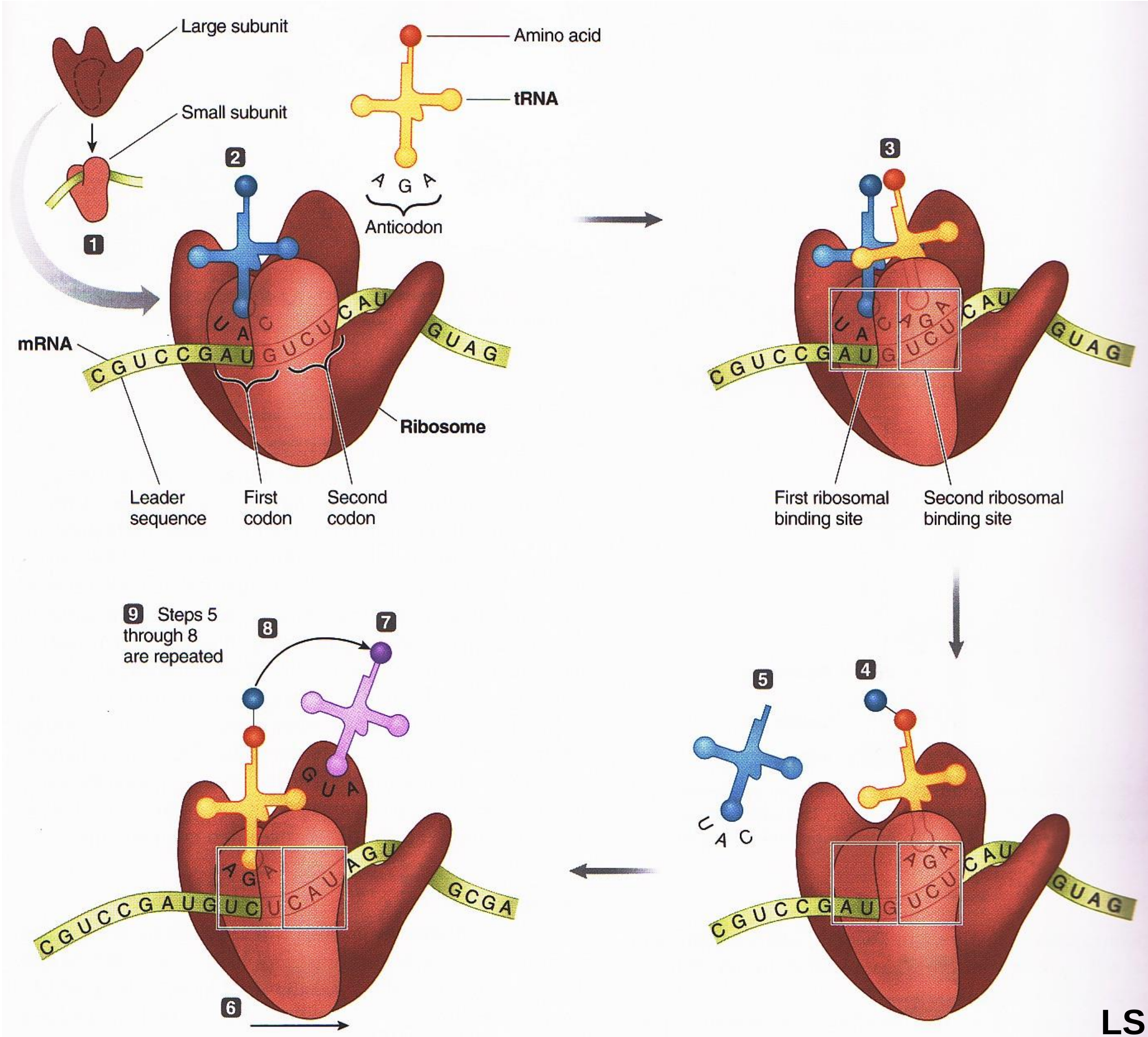
DNA	mRNA	tRNA
code word	codon	anti-codon
TAT	AUA	UAU
ACG	UGC	ACG
TTT	AAA	UUU
TAC	AUG	UAC

Second base of codon

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

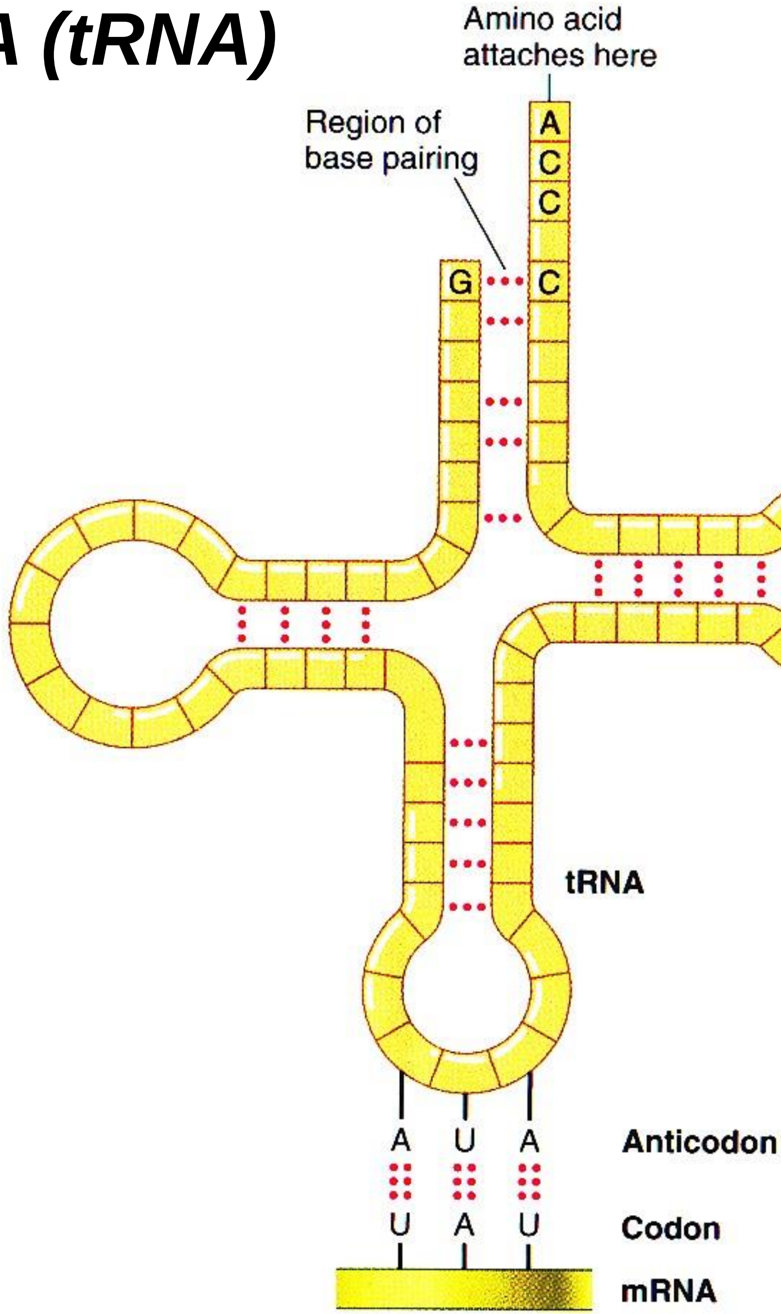
D. Silverthorn, *Physiology: An Integrated Approach.* San Francisco: Pearson Education, 2010.

Translation? Ribosomes Make Proteins



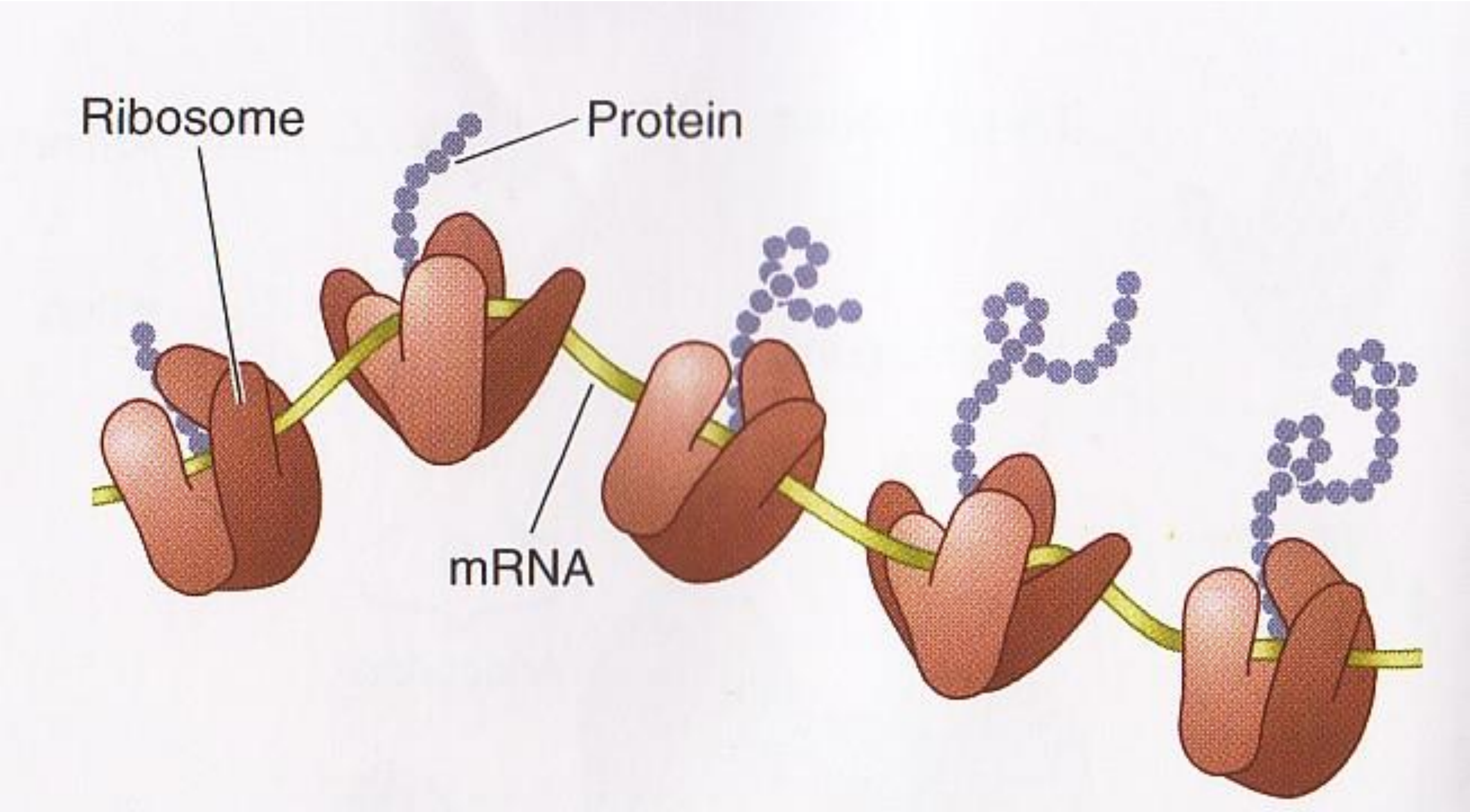
LS 2012 fig C-7

Transfer RNA (tRNA)



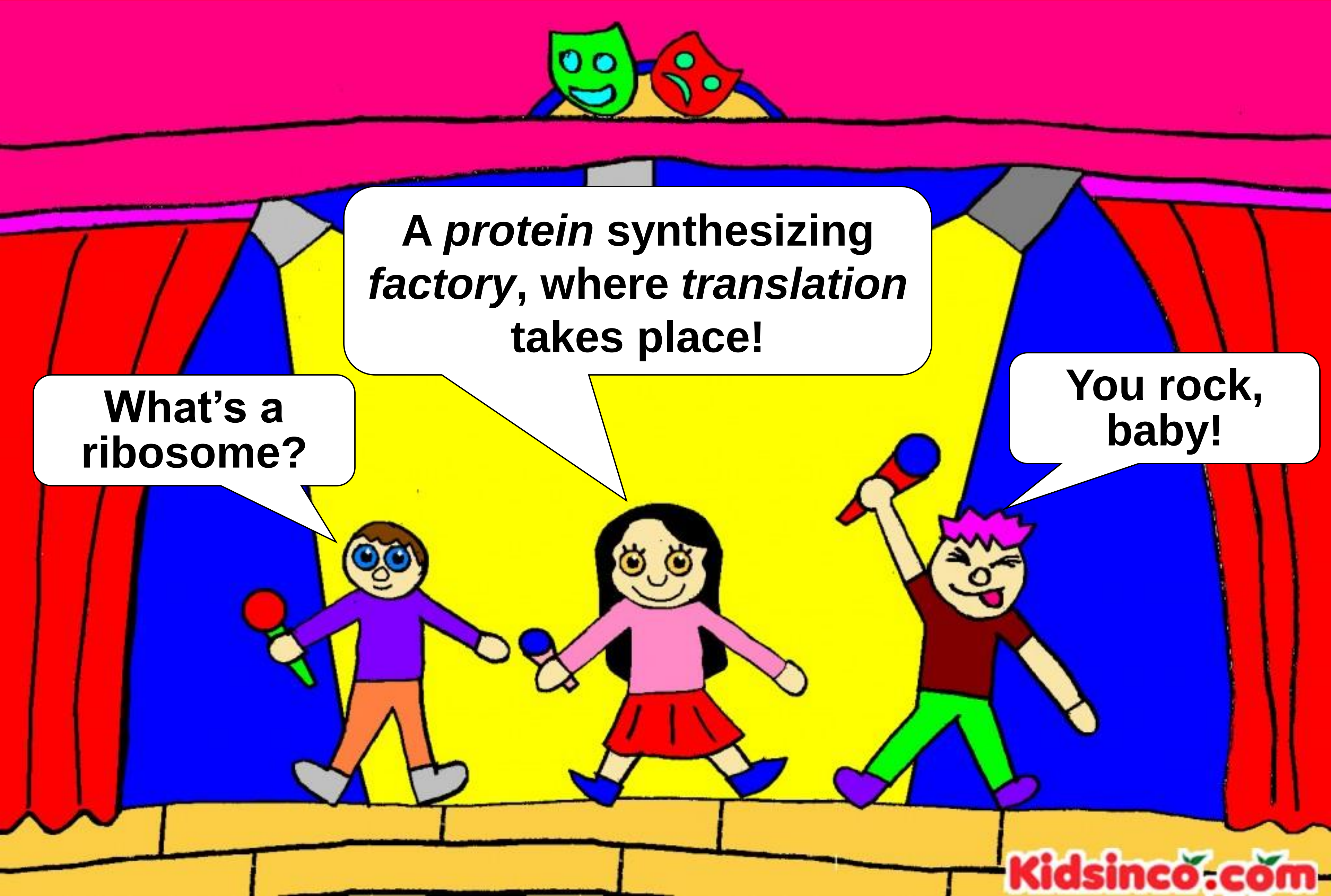
LS fig C-8

A Polyribosome. Which Way is Synthesis?



LS fig C-9

Class Skit on Translation!



Questions + Discussion