A NEW HYPOTHESIS OF OBESITY

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LOW-CARB Breckenridge 2018

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Breckenridge, Colorado

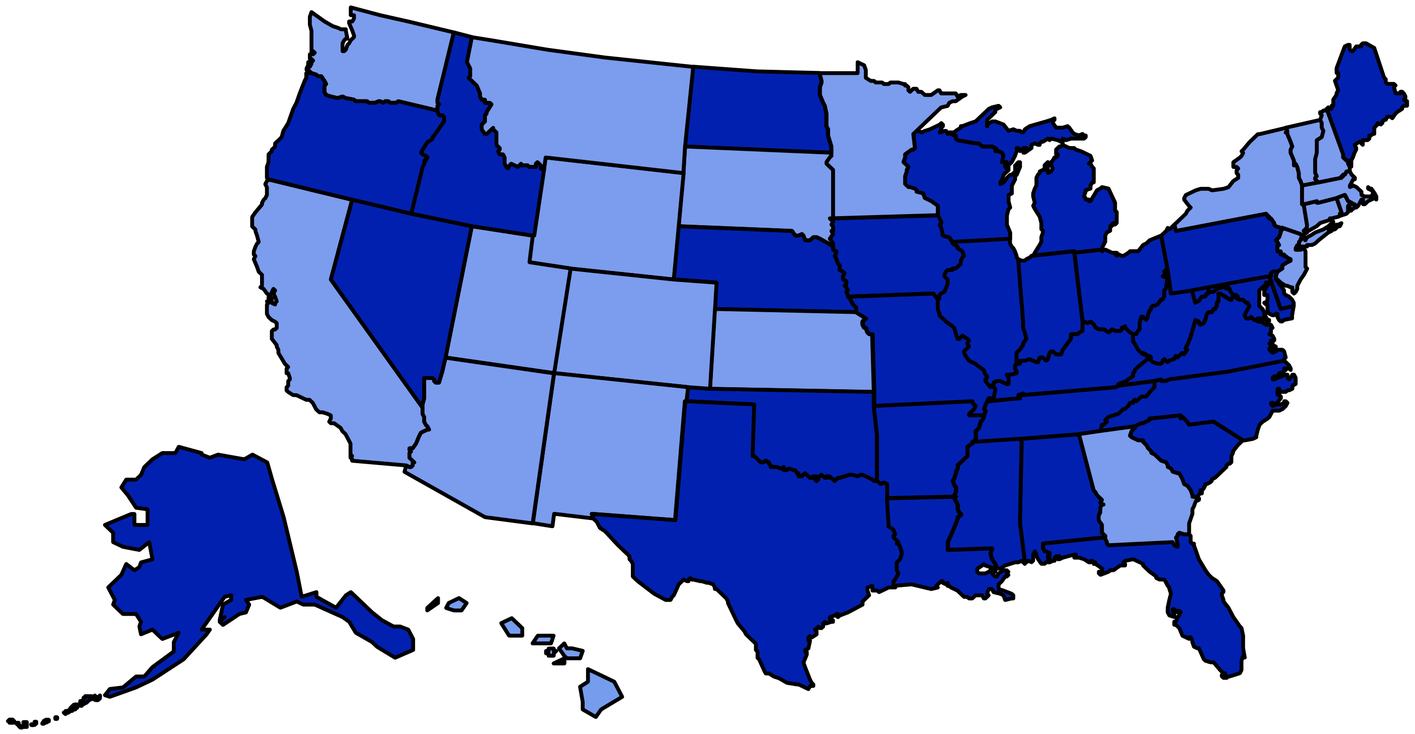
Disclosures

I have no financial interest or affiliation concerning material discussed in this presentation

Obesity Trends* Among U.S. Adults

BRFSS, 1996

(*BMI ≥30, or ~ 30 lbs. overweight for 5’ 4” person)



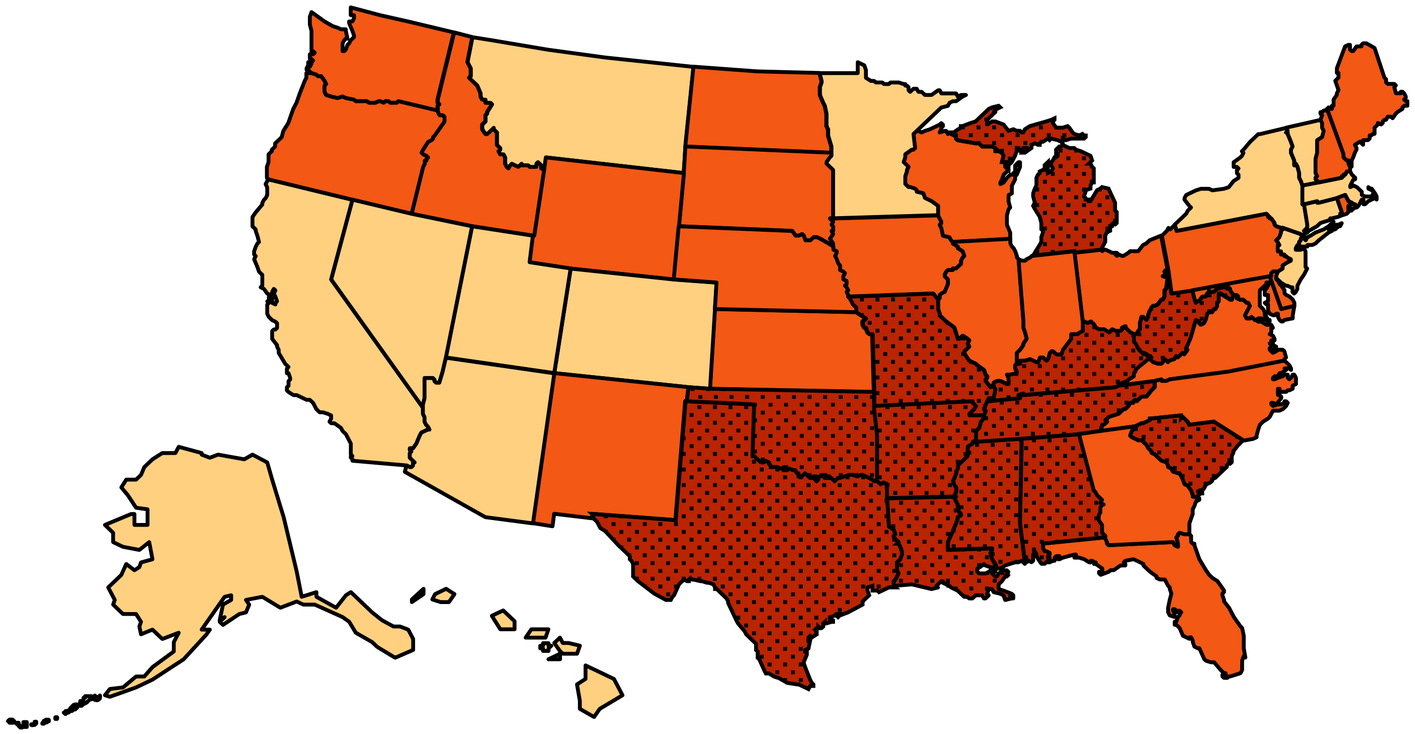
No Data | <10% | 10%–14% | 15%–19%

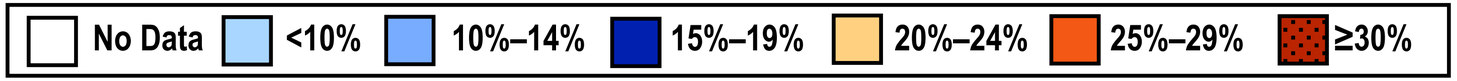
Source: Behavioral Risk Factor Surveillance System, CDC.

Obesity Trends* Among U.S. Adults

BRFSS, 2010

(*BMI ≥30, or ~ 30 lbs. overweight for 5’ 4” person)

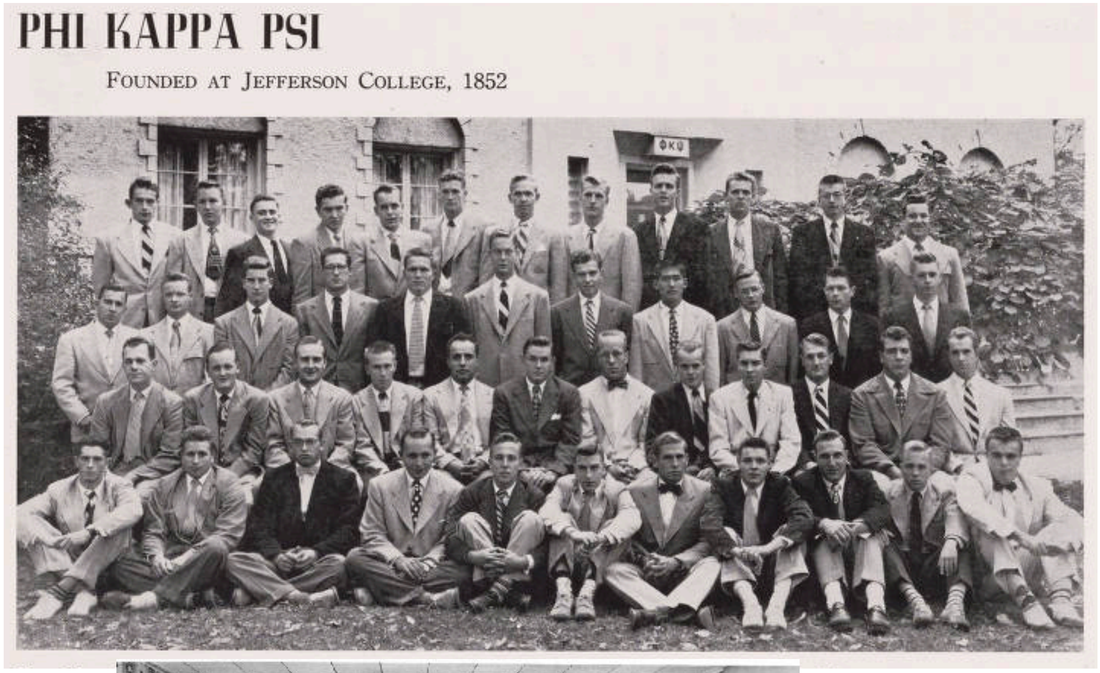


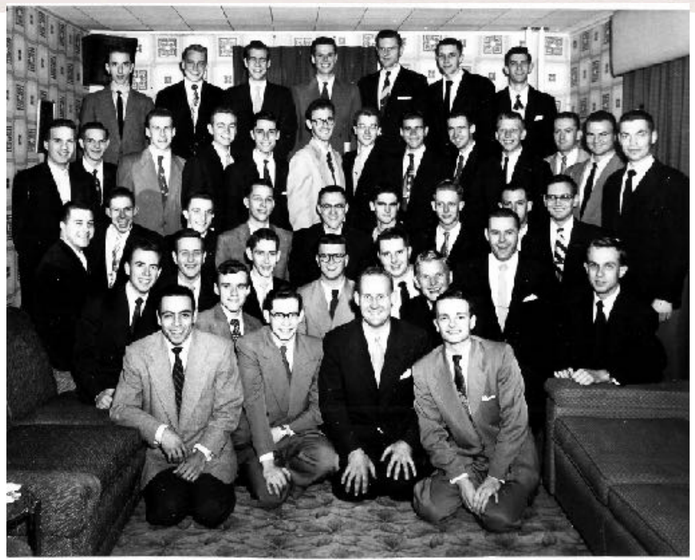


Source: Behavioral Risk Factor Surveillance System, CDC.

Sorority 1950s

Fraternity 1950s





Kids in the 1950s

Sorority 2015

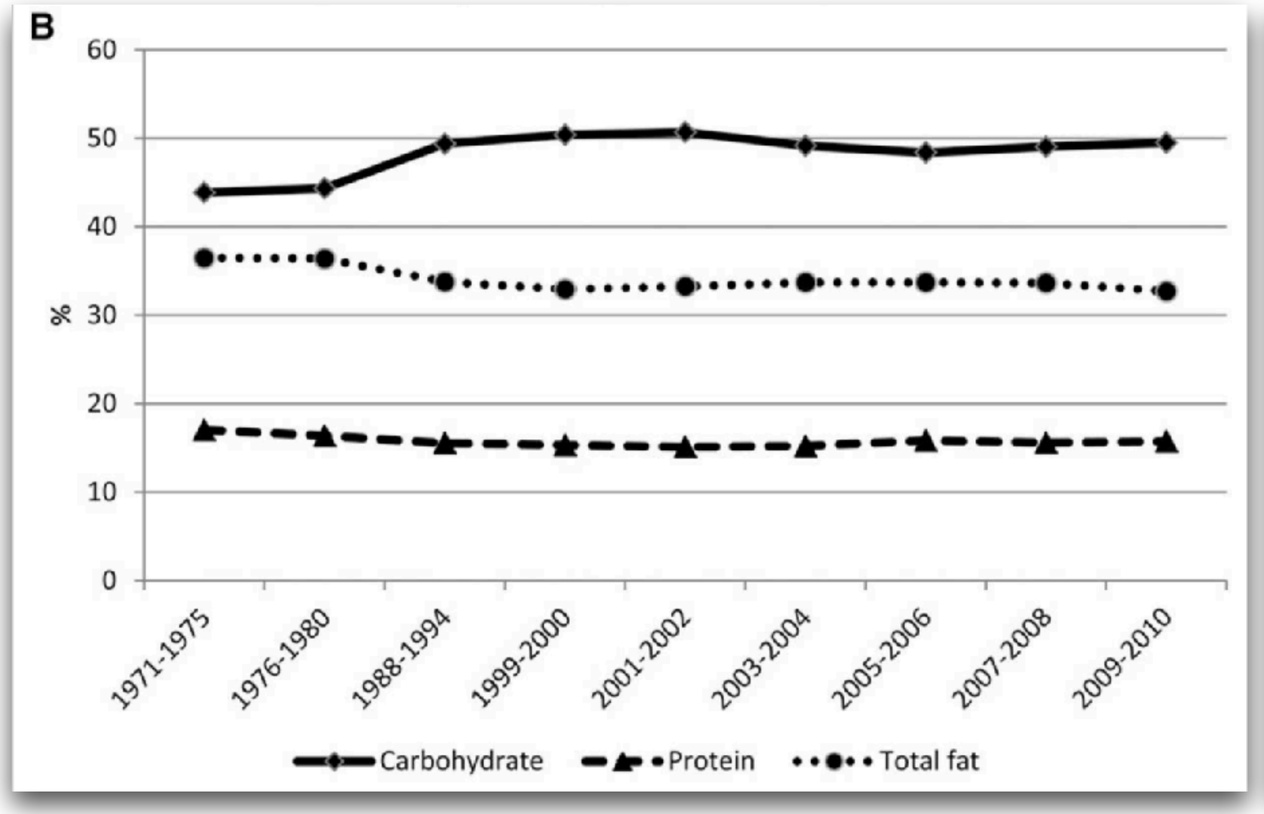
Fraternity 2015

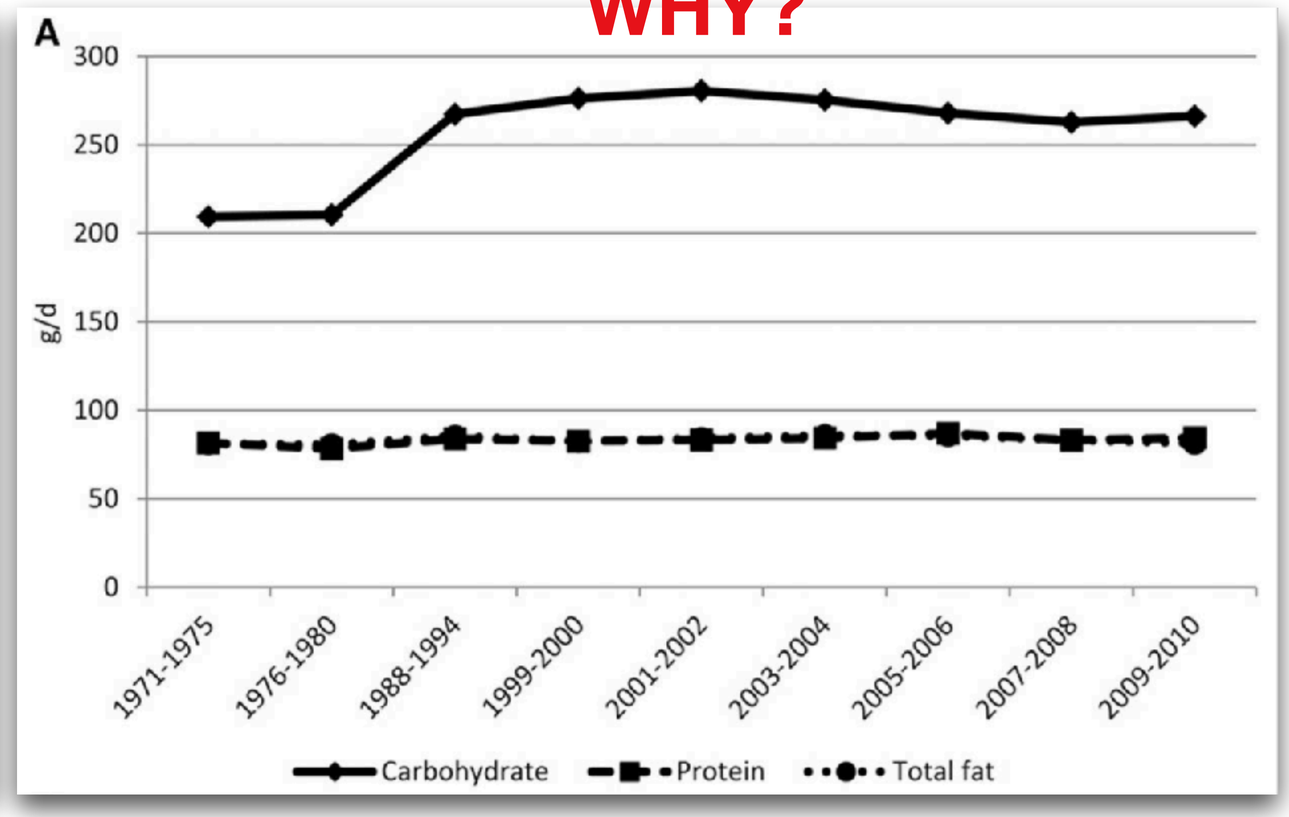
WHAT HAPPENED?

WHAT CHANGED?

Macronutrient intake

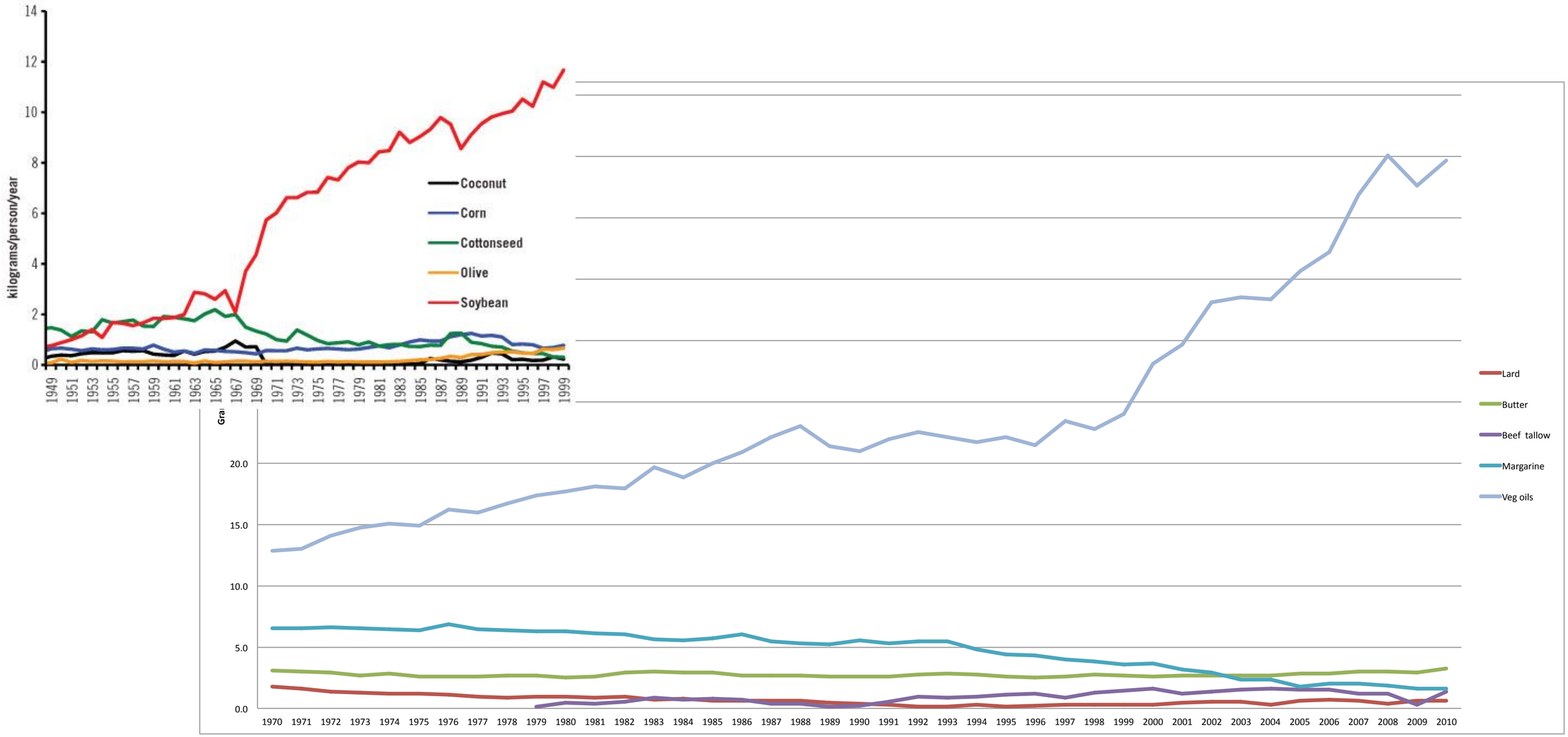
WHY?





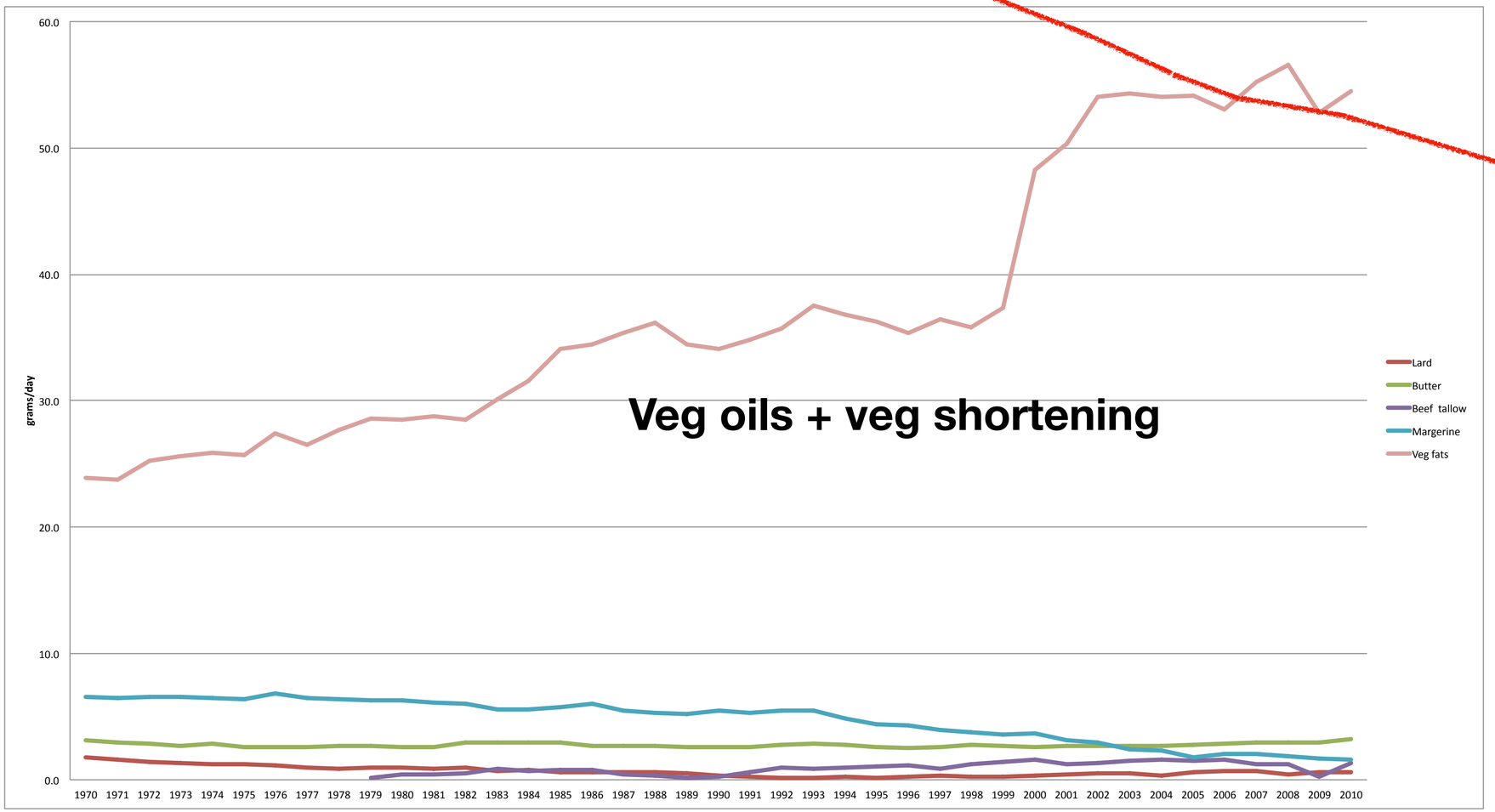
Ford ES & Dietz WH ***AJCN*** 97(4) (2013) 848-853

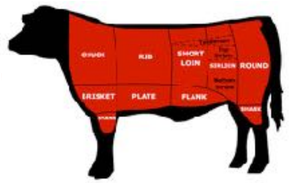
Added fats & oils



Data from Economic Research Service 7/26/2017

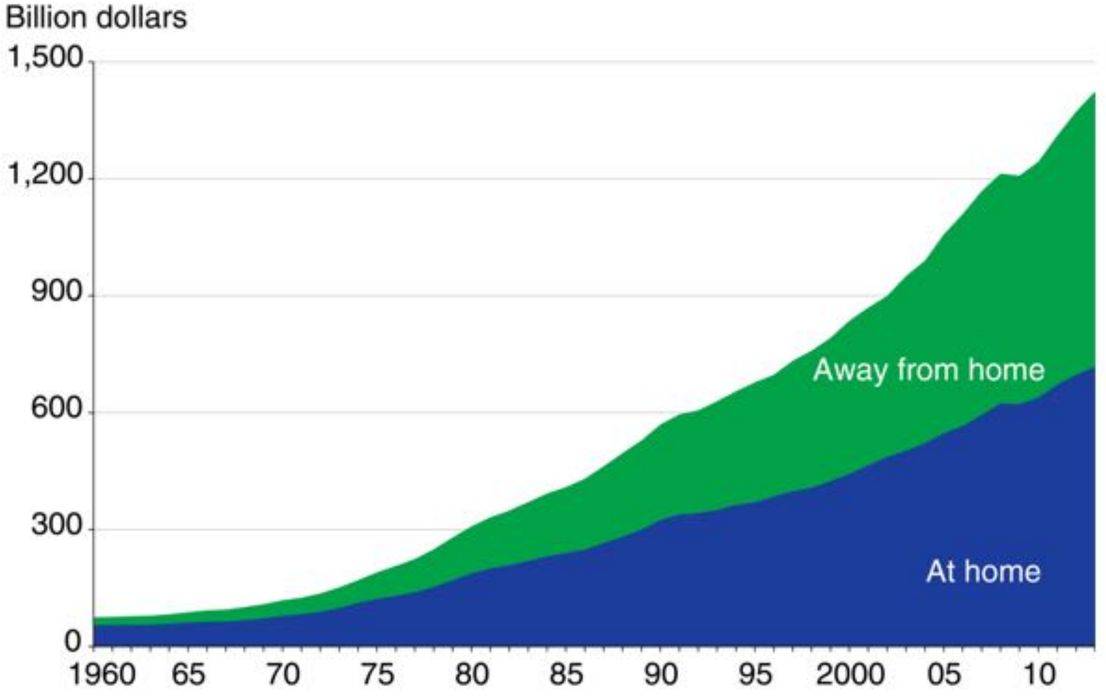
Added fats, oils & shortening





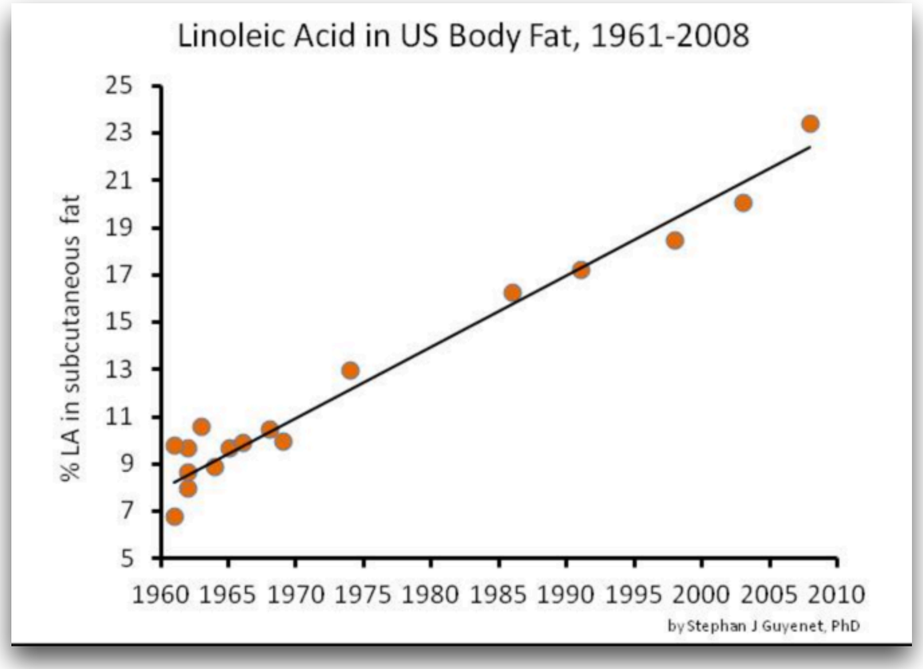
Data from Economic Research Service 7/26/2017

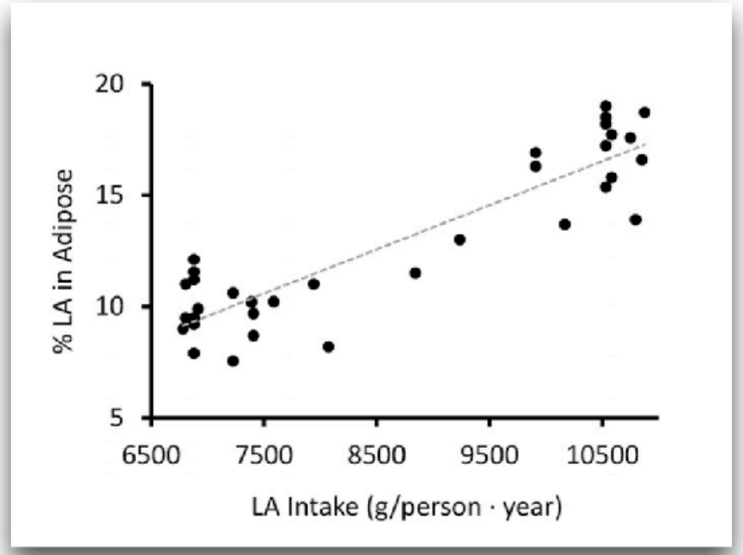
Food-at-home and away-from-home expenditures in the United States 1960-2013



Source: USDA, Economic Research Service, Food Expenditure Series.

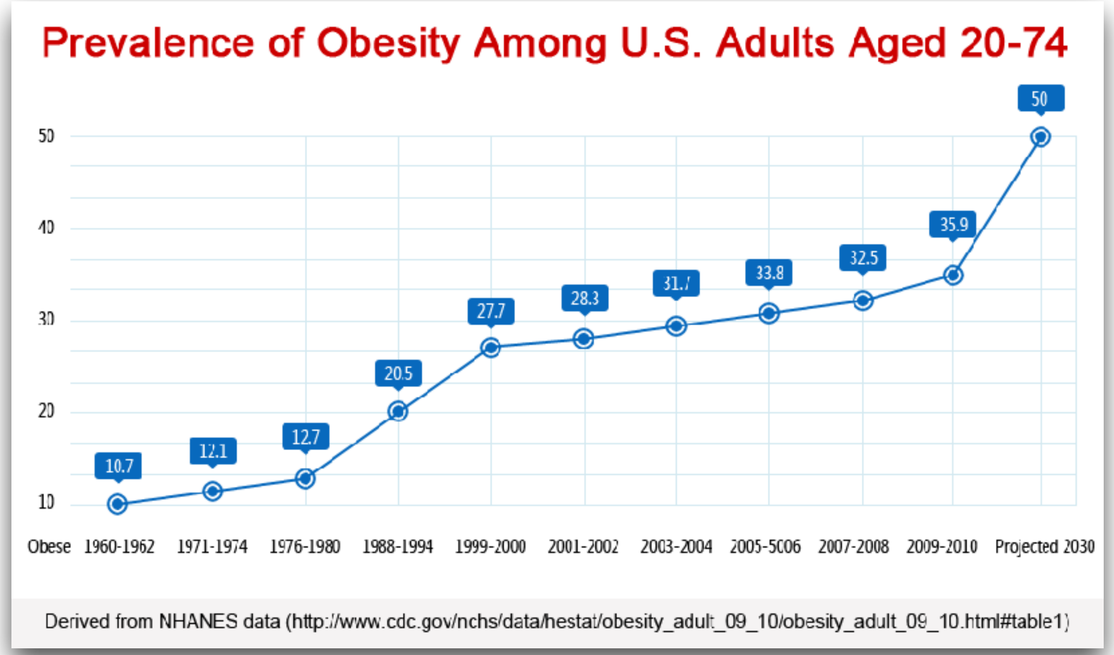
DIETARY FAT	FATTY ACID CONTENT NORMALIZED TO 100%		
MY ORGANIC SUNFLOWER OIL	85%	4%	11%
OLIVE OIL	72%	11%	17%
CANOLA OIL	62%	32%	6%
PEANUT OIL	49%	33%	18%
LARD	47%	12%	41%
BEEF FAT	44%	4%	52%
PALM OIL	39%	10%	51%
BUTTER FAT	34%	2%	64%
CORN OIL	25%	62%	13%
SOYBEAN OIL	24%	61%	15%
LINOLEIC SUNFLOWER	20%	69%	11%
COTTONSEED OIL	18%	55%	27%
SAFFLOWER OIL	13%	77%	10%
	MONOUNSATURATED	POLYUNSATURATED	SATURATED

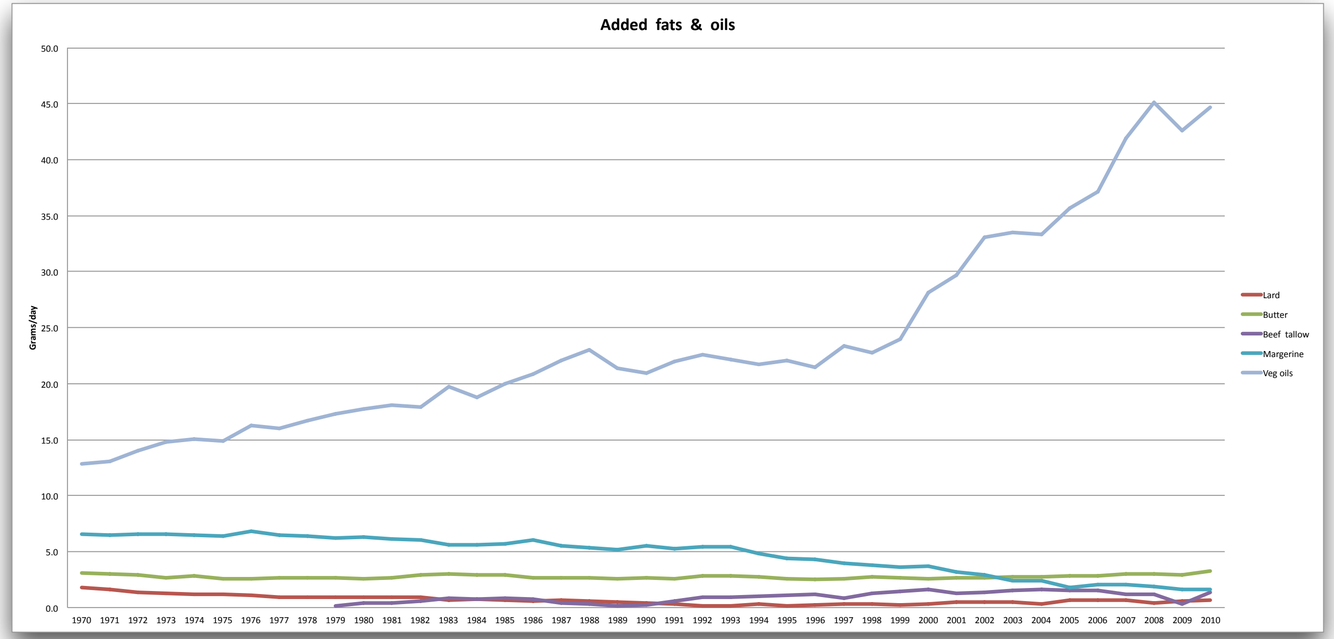




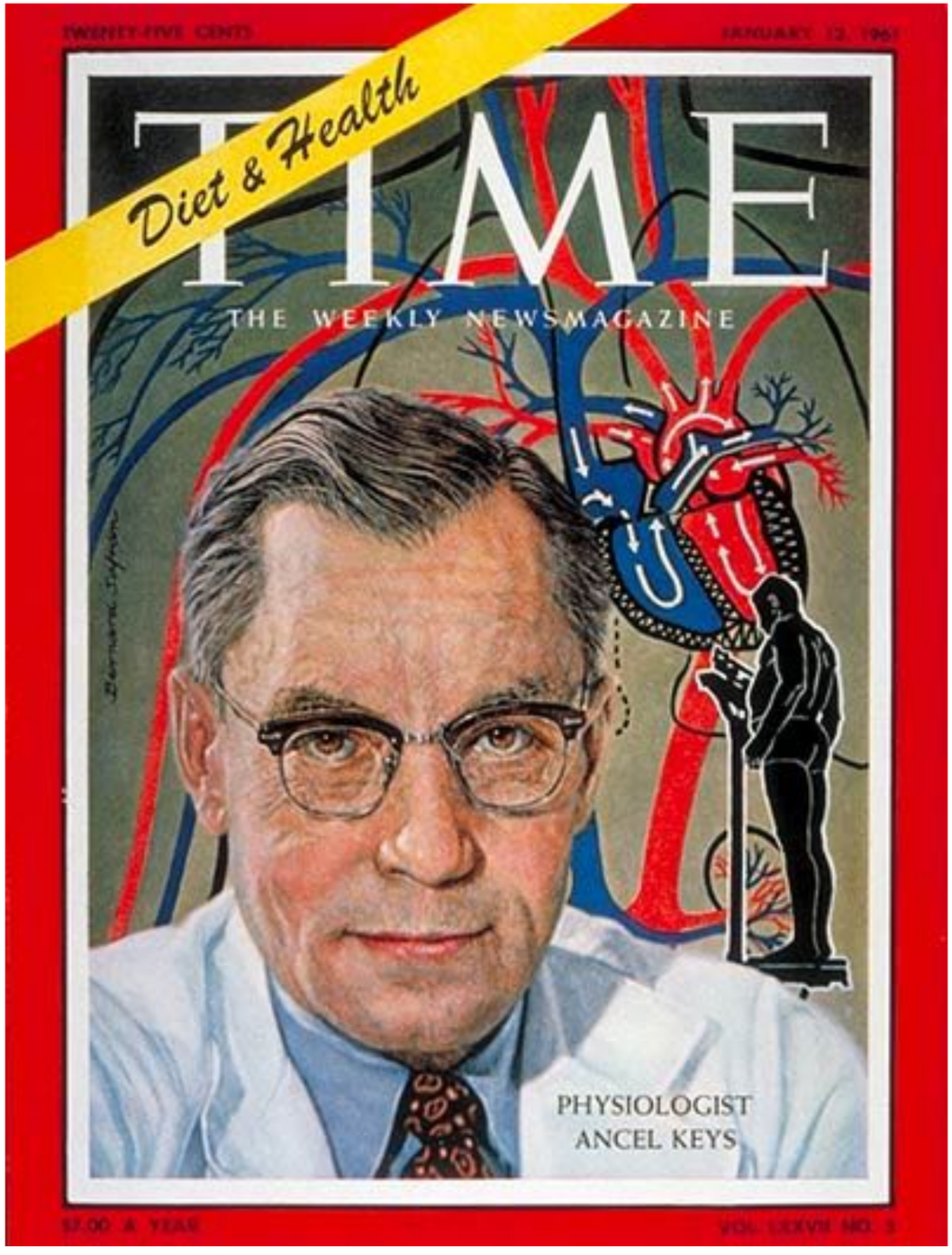
Guyenet & Carlson *Adv Nutr* (2015) 6:660-4

Trends in obesity vs trends in vegetable oil intake





Clearly vegetable fats are correlative. Are they causative? And if so, how?

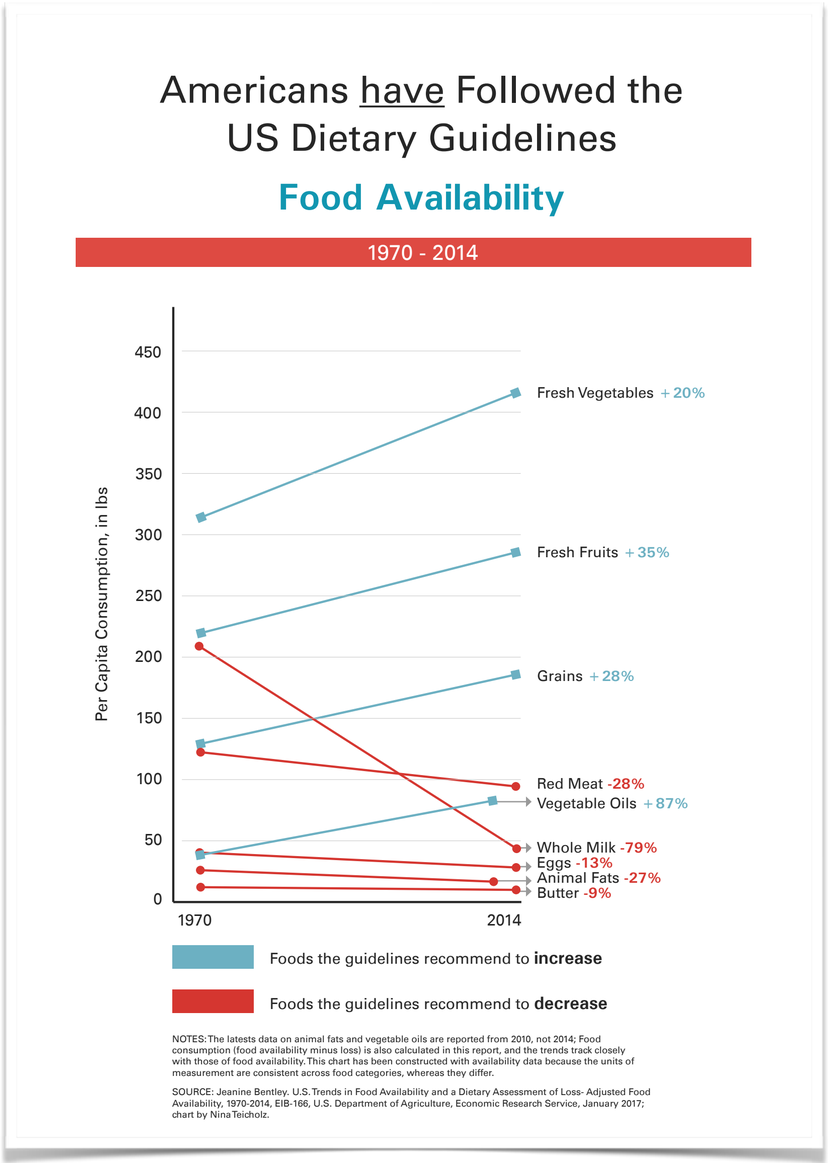

TWENTY-FIVE CENTS
JANUARY 12, 1961
Diet & Health
TIME
THE WEEKLY NEWSMAGAZINE
PHYSIOLOGIST
ANCEL KEYS
$7.00 A YEAR
VOL. LXXVII NO. 2

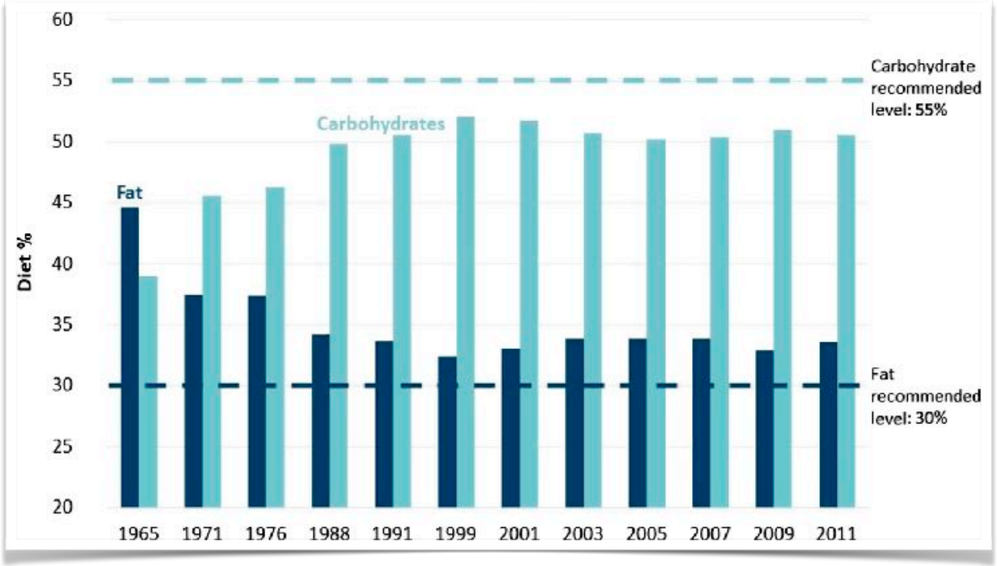
Attitude toward saturated fat prior to ~1980

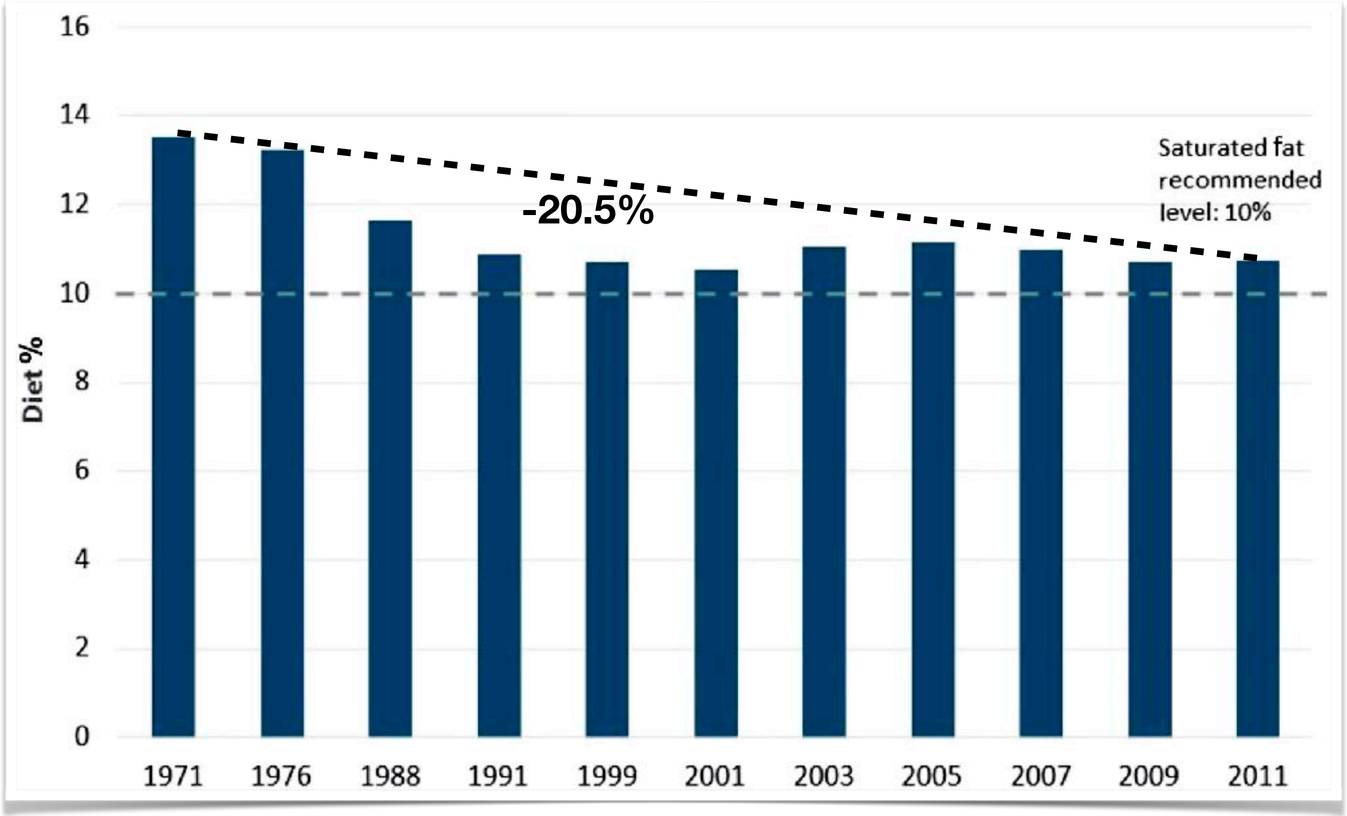
WHAT, ME WORRY?

Attitude toward saturated fat after ~1980

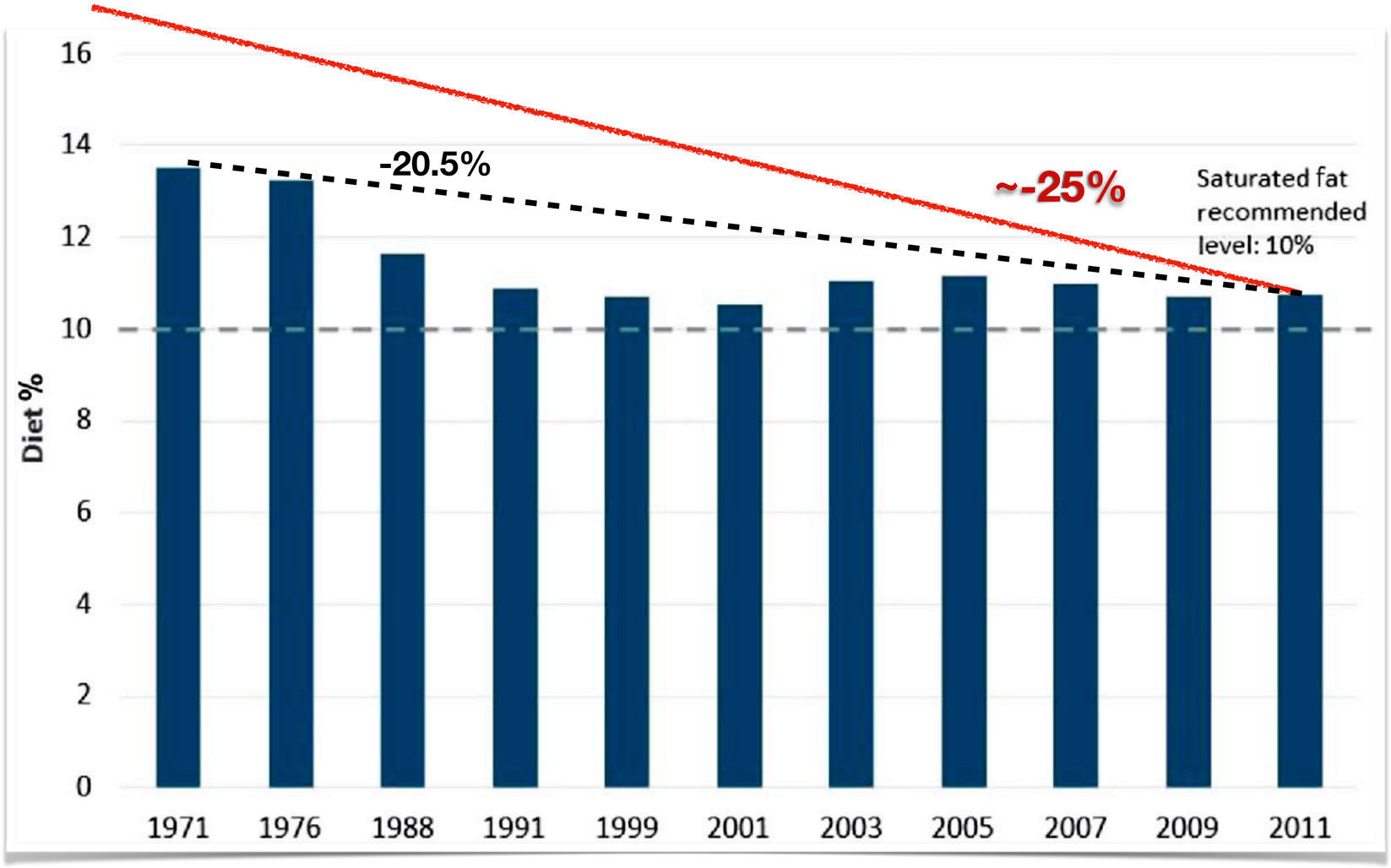
WE'VE BEEN PLUCKY LITTLE SOLDIERS







Saturated fat intake



Cohen et al ***Nutrition*** 31 (2015) 727-732

Change since ~1980

Linoleic acid ↑↑↑↑↑

Saturated fat ↓↓

Kcal ↑↑

The Perfect Storm

Wholesale adoption of vegetable oils

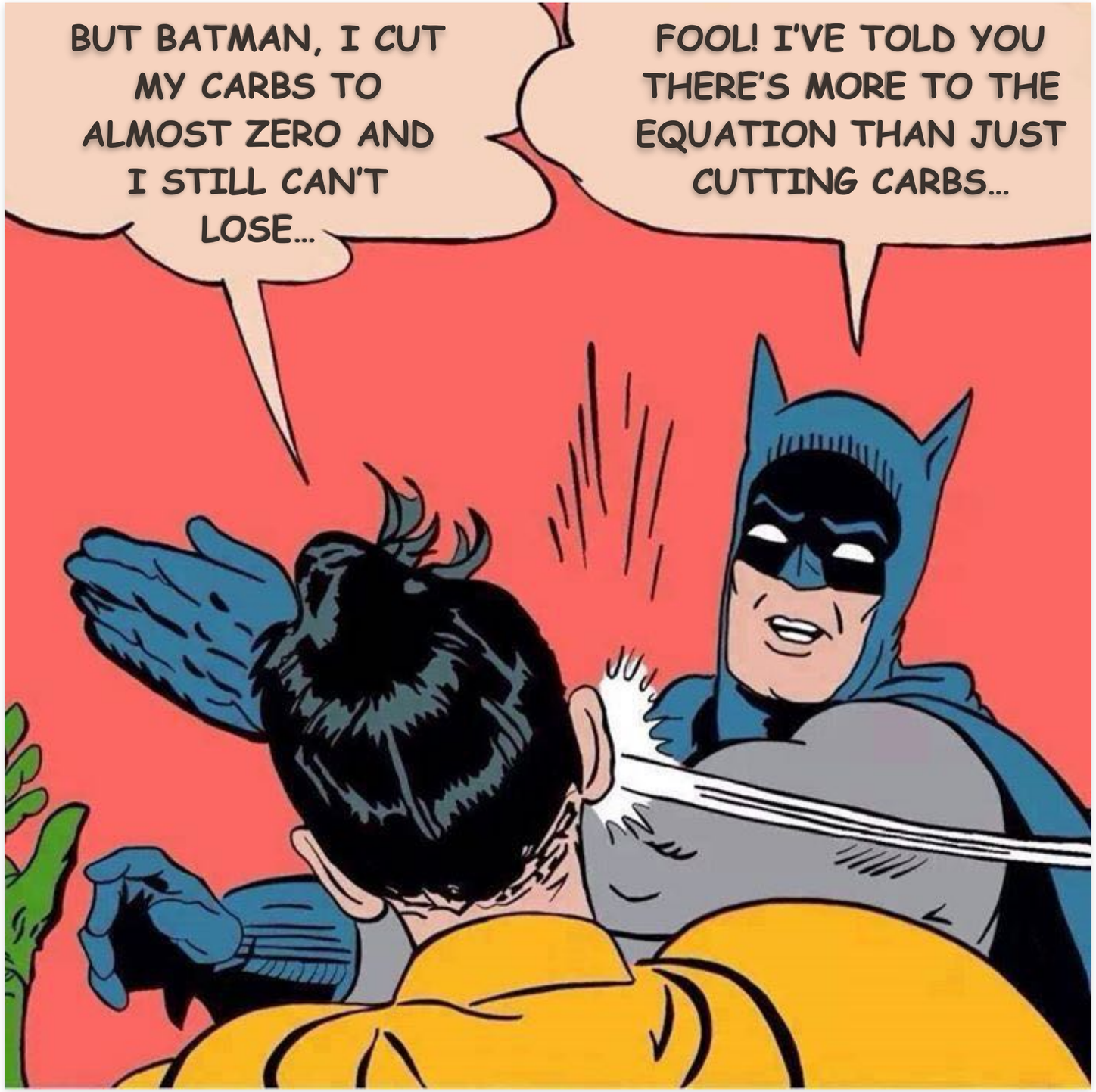
Increased consumption of refined carbs

The demonization of saturated fat

Hypothesis

1. Linoleic acid promotes obesity

2. Saturated fats protect against obesity


BUT BATMAN, I CUT MY CARBS TO ALMOST ZERO AND I STILL CAN'T LOSE...
FOOL! I'VE TOLD YOU THERE'S MORE TO THE EQUATION THAN JUST CUTTING CARBS...

Hypothesis

(In addition to the C-I hypothesis)

1. Linoleic acid promotes obesity

2. Saturated fats protect against obesity

Mechanism????

HYPERLIPID

YOU NEED TO GET CALORIES FROM SOMEWHERE, SHOULD IT BE FROM CARBOHYDRATE OR FAT?

WEDNESDAY, FEBRUARY 28, 2018

More on drinking varnish

This paper is a gem.

Reducing the Dietary Omega-6:Omega-3 Utilizing α-Linolenic Acid; Not a Sufficient Therapy for Attenuating High-Fat-Diet-Induced Obesity Development Nor Related Detrimental Metabolic and Adipose Tissue Inflammatory Outcomes

What did they do? They fed rats chow or they fed them on one of four

ABOUT ME

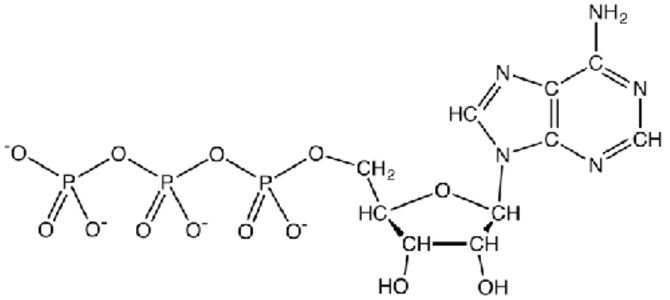
PETER

I am Petro Dobromylskyj, always known as Peter. I'm a vet, trained at the RVC, London University. I was fortunate enough to intercalate a BSc degree in physiology in to my veterinary degree. I was even more fortunate to study

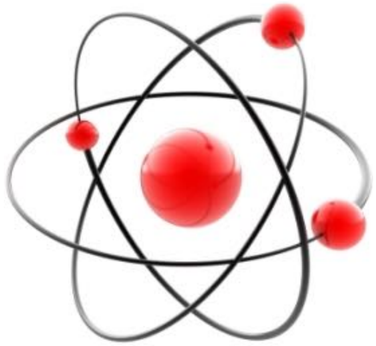
http://high-fat-nutrition.blogspot.com/


What we know
for pretty sure
What we know
for pretty sure

LIFE SIMPLIFIED



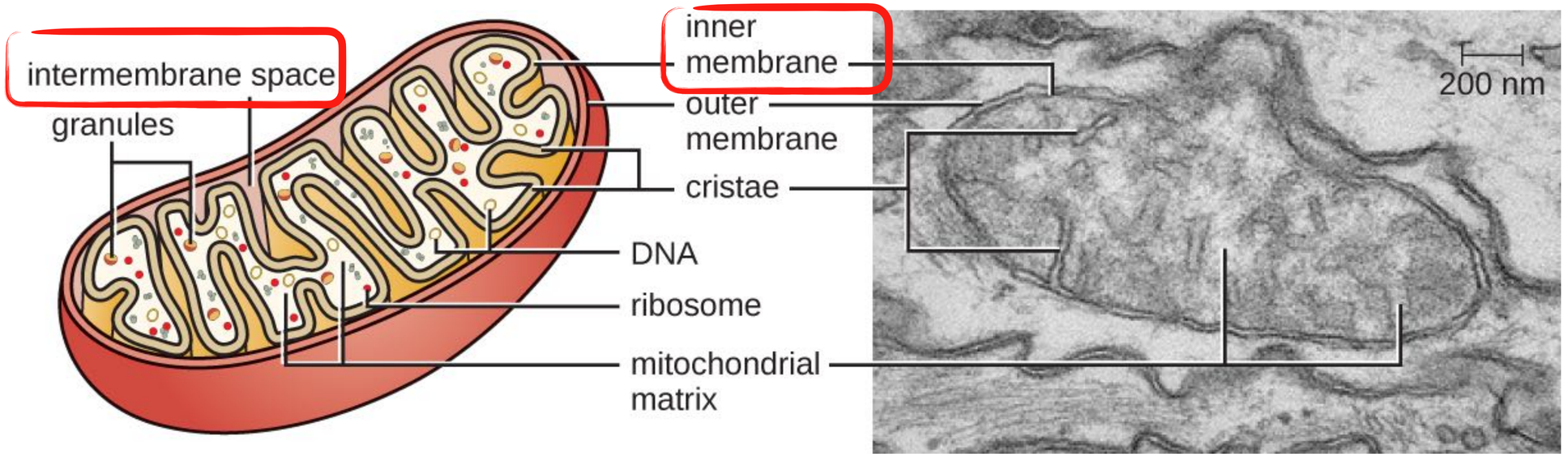
FOOD → ATP → LIFE

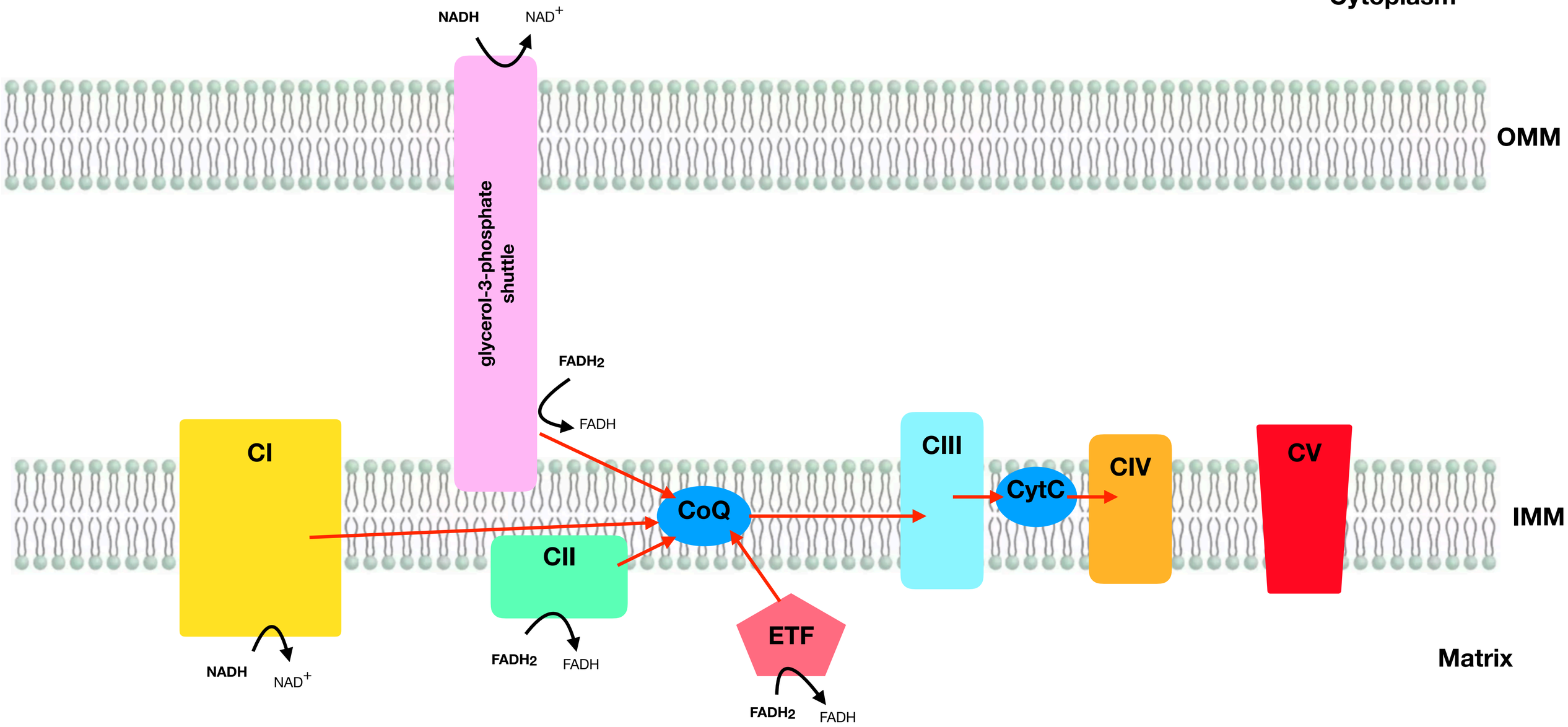


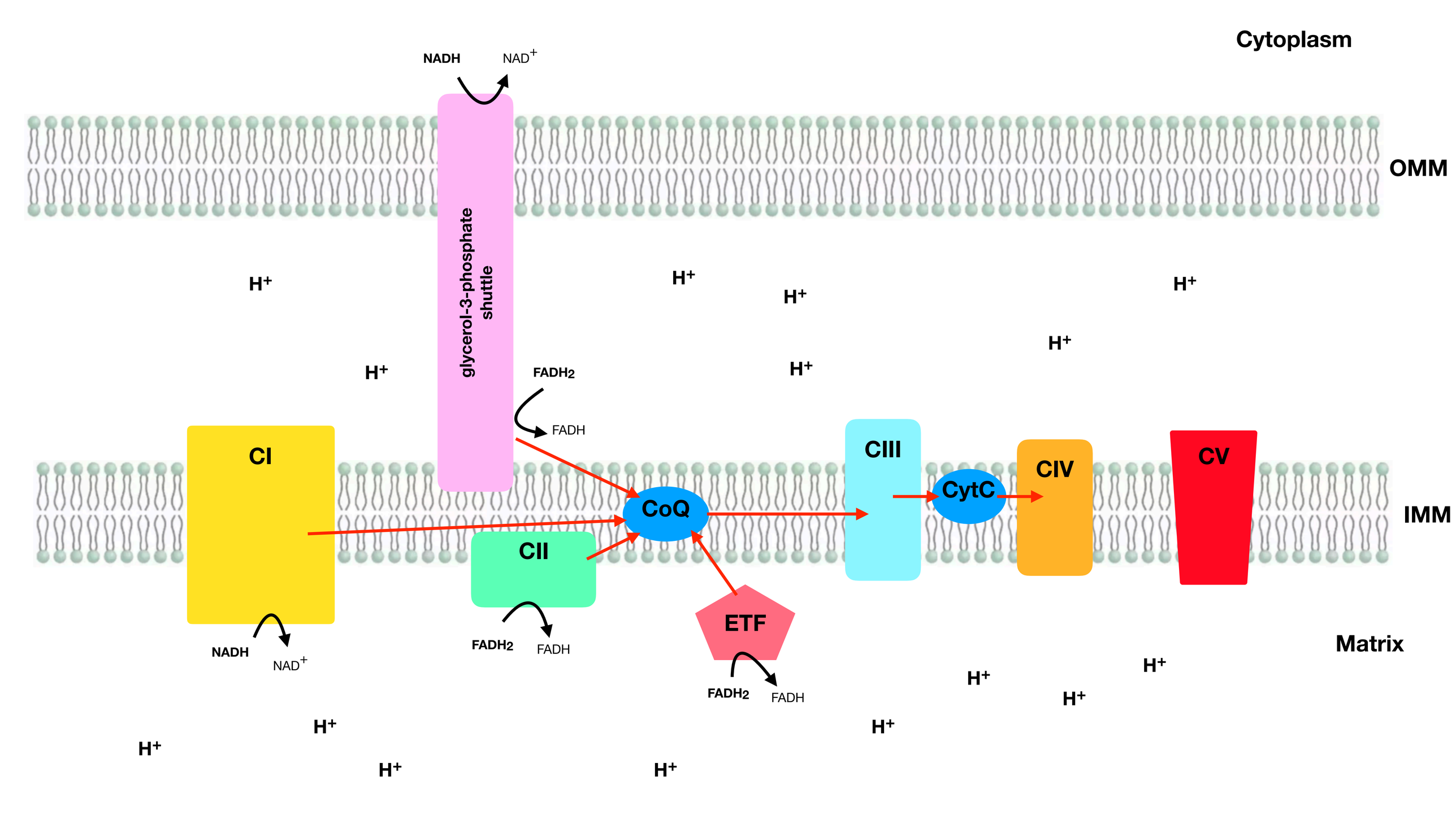
FOOD

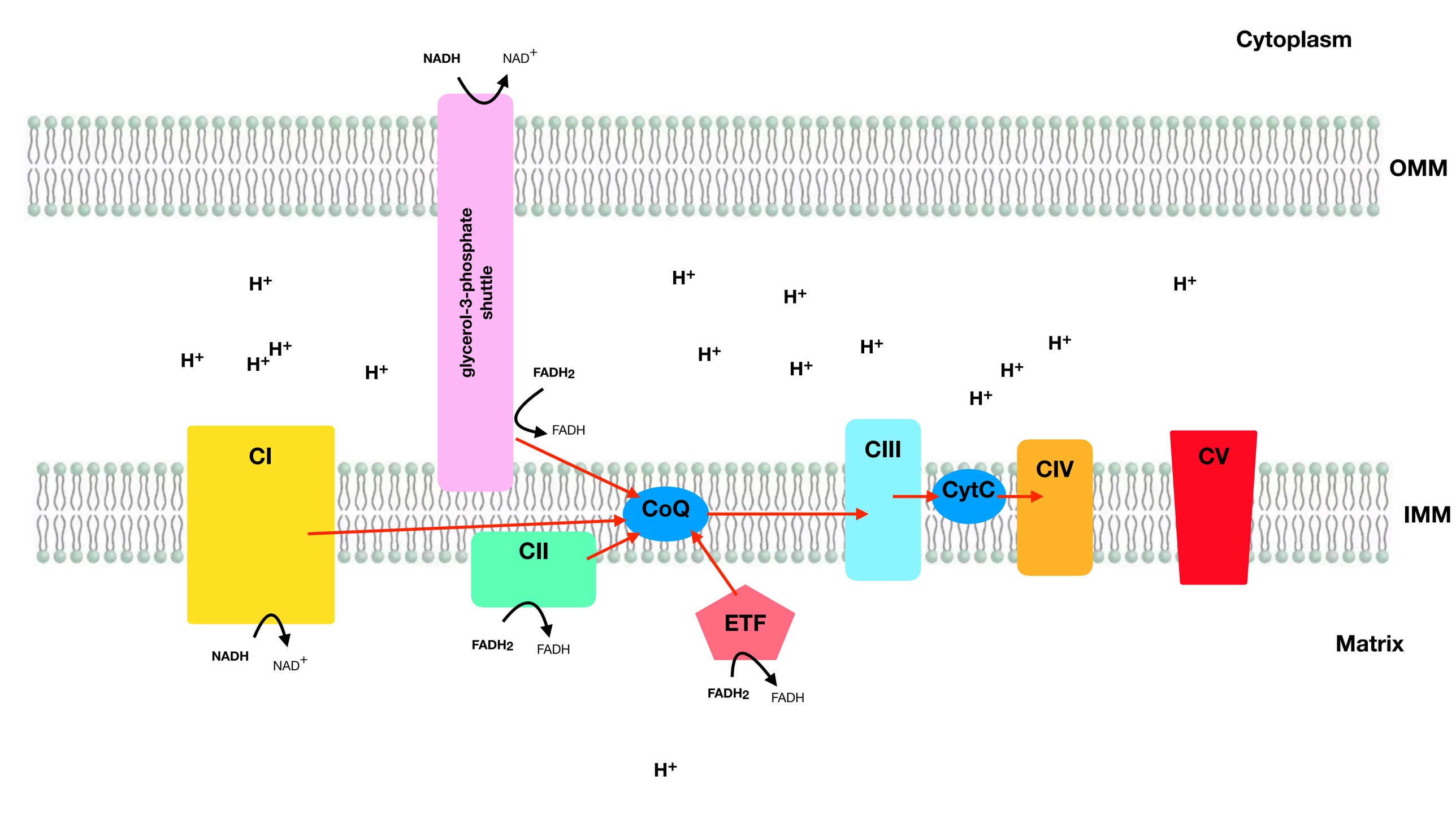
ATP

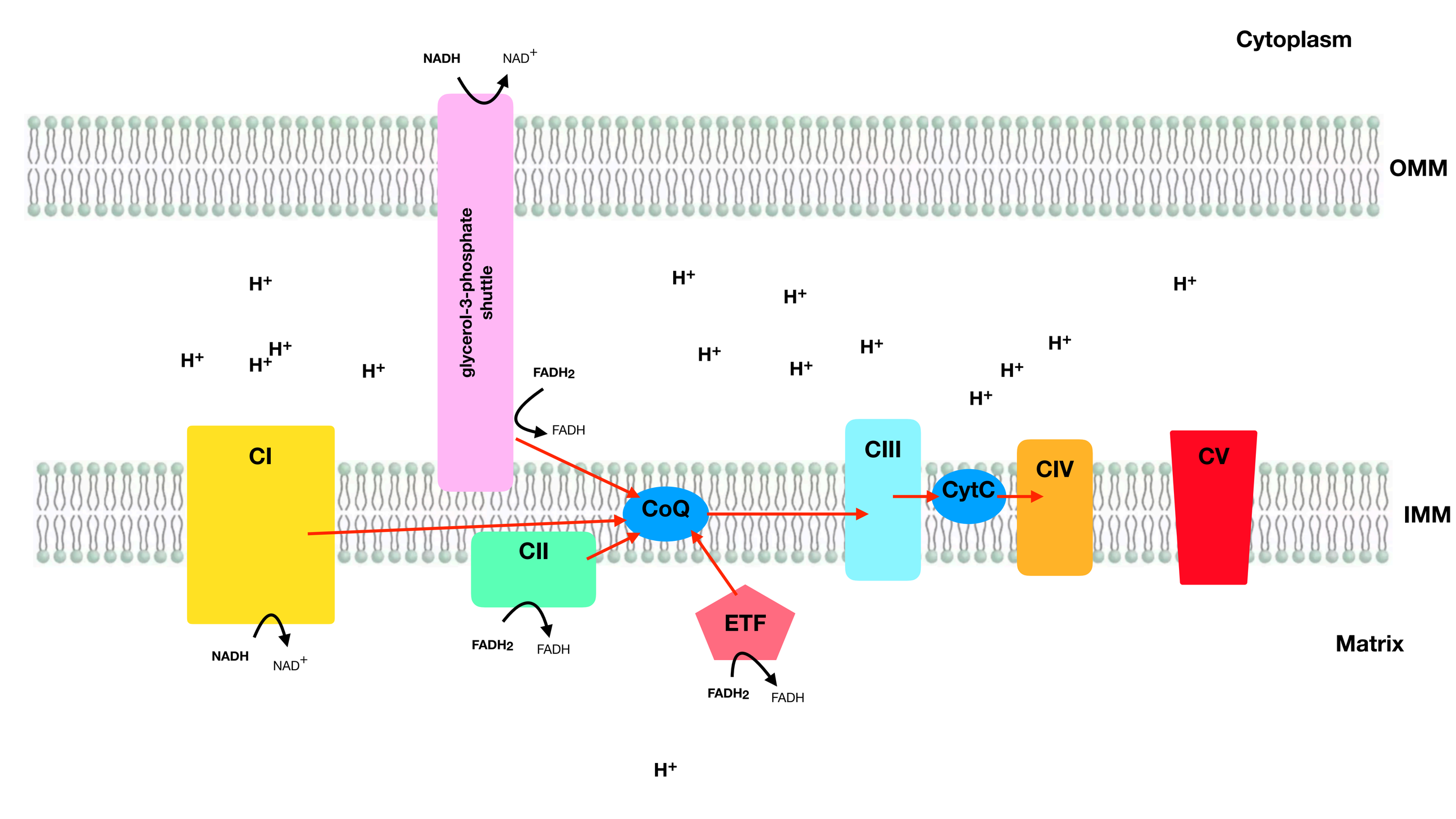
MITOCHONDRION




Cytoplasm
NADH
NAD+
OMM
glycerol-3-phosphate shuttle
FADH2
FADH
CI
CII
CoQ
CIII
CytC
CIV
CV
ETF
IMM
NADH
NAD+
FADH2
FADH
FADH2
FADH
Matrix


Cytoplasm
NADH
NAD+
OMM
glycerol-3-phosphate shuttle
H+
FADH2
FADH
CI
CII
CoQ
CIII
CytC
CIV
CV
IMM
ETF
NADH
NAD+
FADH2
FADH
Matrix


Cytoplasm
NADH
NAD+
OMM
glycerol-3-phosphate shuttle
H+
FADH2
FADH
CI
CII
CoQ
CIII
CytC
CIV
CV
ETF
IMM
NADH
NAD+
FADH2
FADH
FADH2
FADH
Matrix
H+


Cytoplasm
NADH
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FADH2
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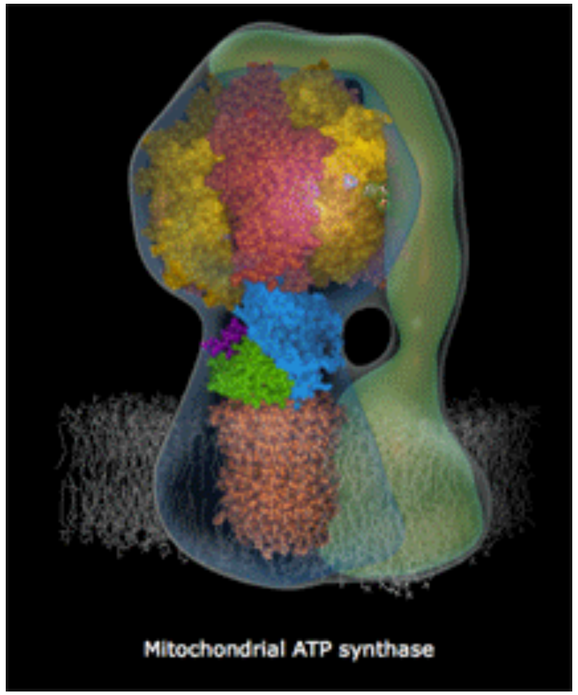
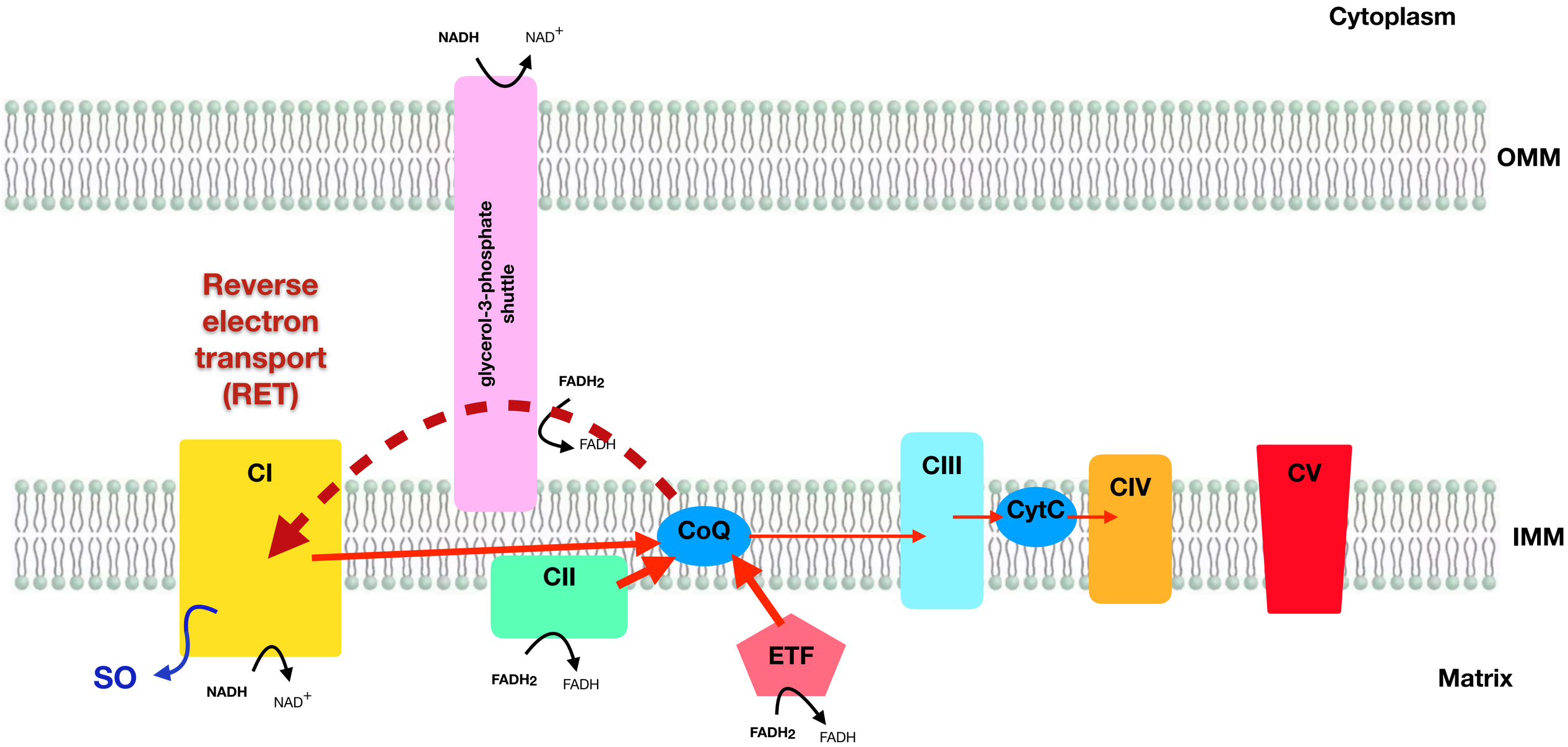
CII
CoQ
CIII
CytC
CIV
CV
ETF
IMM
NADH
NAD+
FADH2
FADH
FADH2
FADH
Matrix
H+

COMPLEX V
ATP SYNTHASE

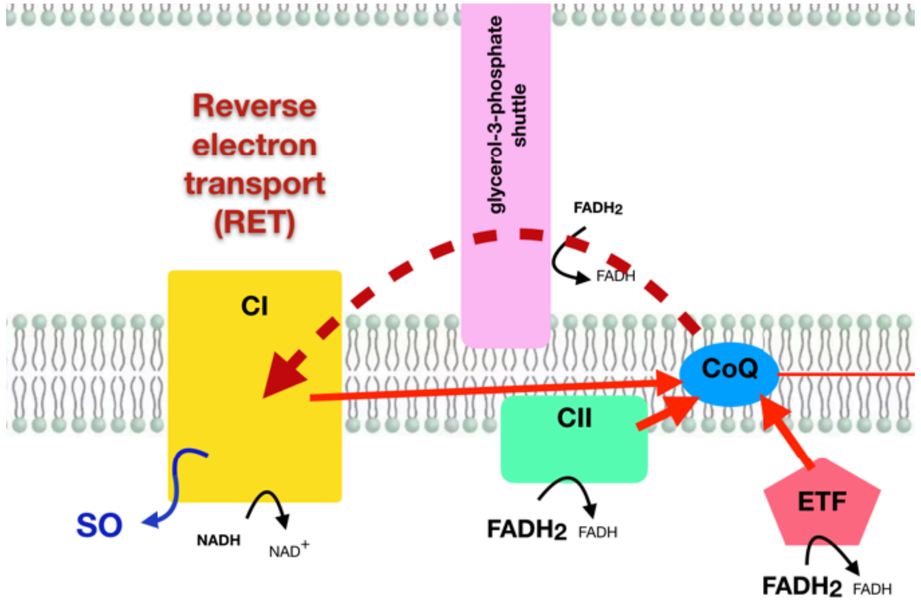
150 revolutions per second



Churns out your body weight in ATP daily


Cytoplasm
NADH
NAD+
OMM
glycerol-3-phosphate shuttle
Reverse electron transport (RET)
FADH2
FADH
CI
CII
CIII
CIV
CV
CoQ
CytC
ETF
IMM
SO
NADH
NAD+
FADH2
FADH
FADH2
FADH
Matrix

ROS as signaling molecules



Increased mitochondrial biosynthesis

Antioxidants lower ROS leak, mtDNA, and ATP synthesis

Cause localized insulin resistance

Local insulin resistance

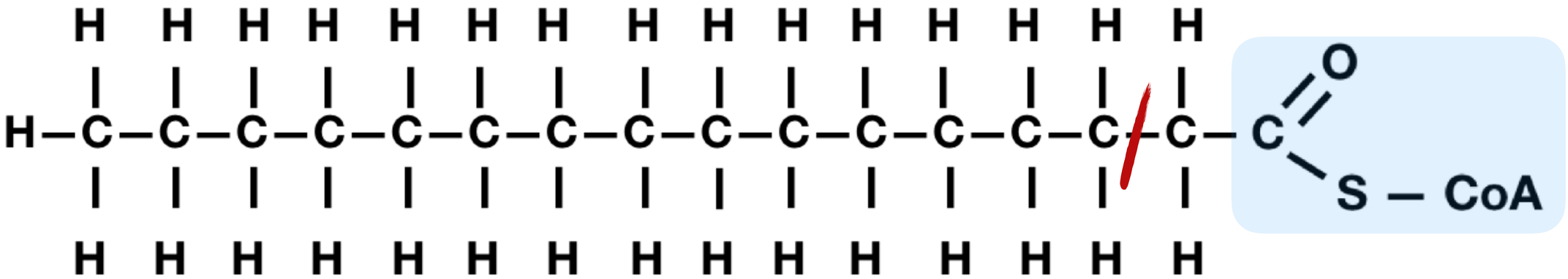
Physiological insulin resistance

H_2O_2 → **Inhibits autophosphorylation of the insulin receptor**

Starvation or fasting

Low-carb dieting

How do we generate $FADH_2$ & NADH?

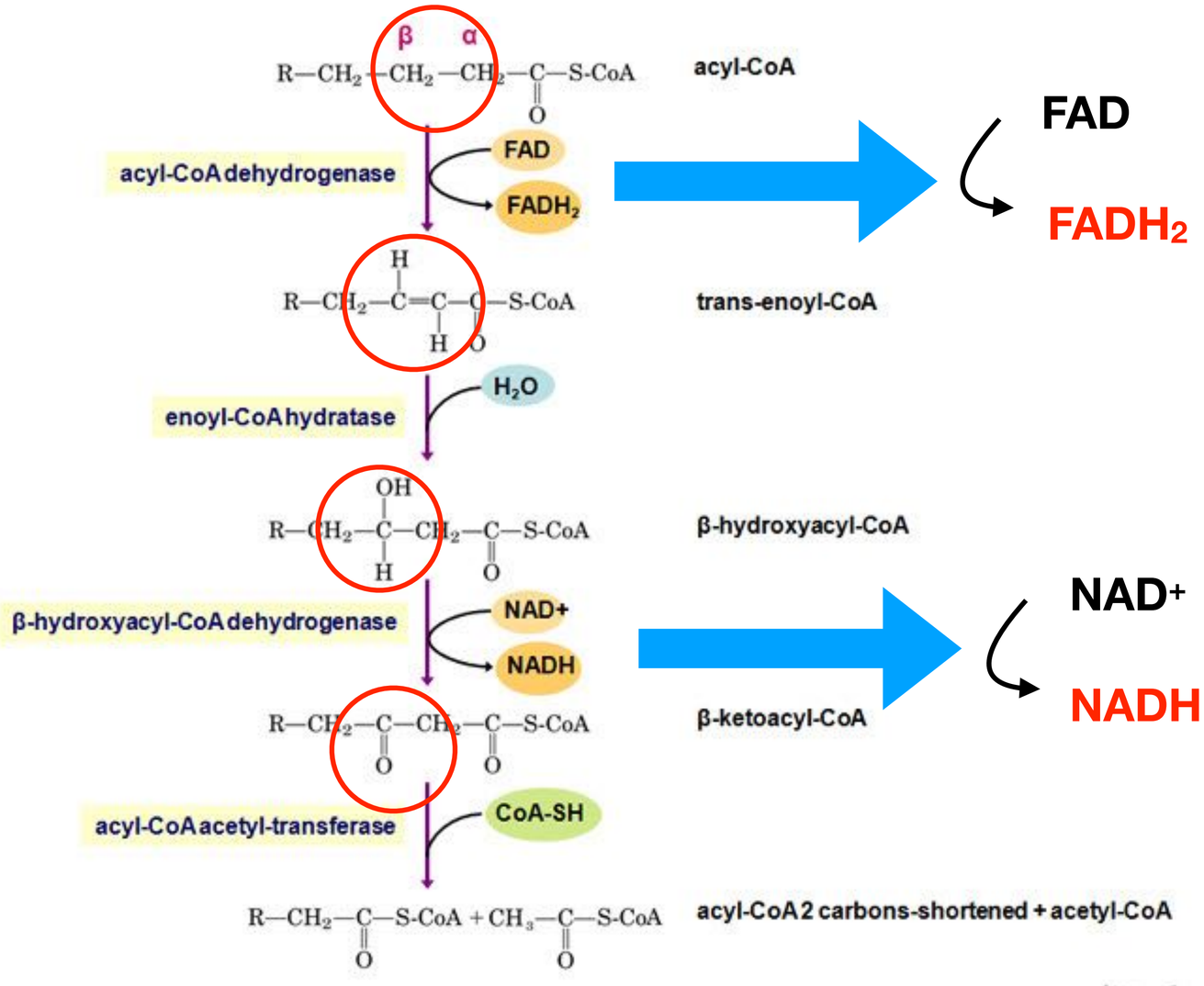


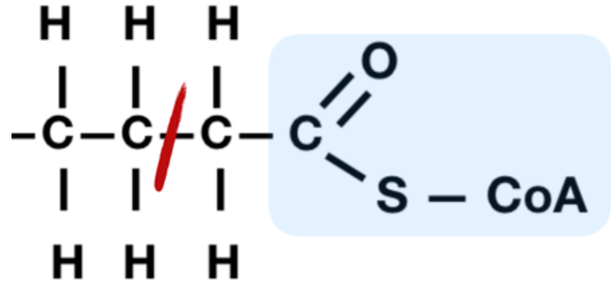
Palmitic Acid (C16)

Beta-oxidation

Chops off two carbons at a time until the fatty acid is completely oxidized

Beta-oxidation





16 C saturated fat completes 7 cycles of beta-oxidation, each creating an acetyl CoA

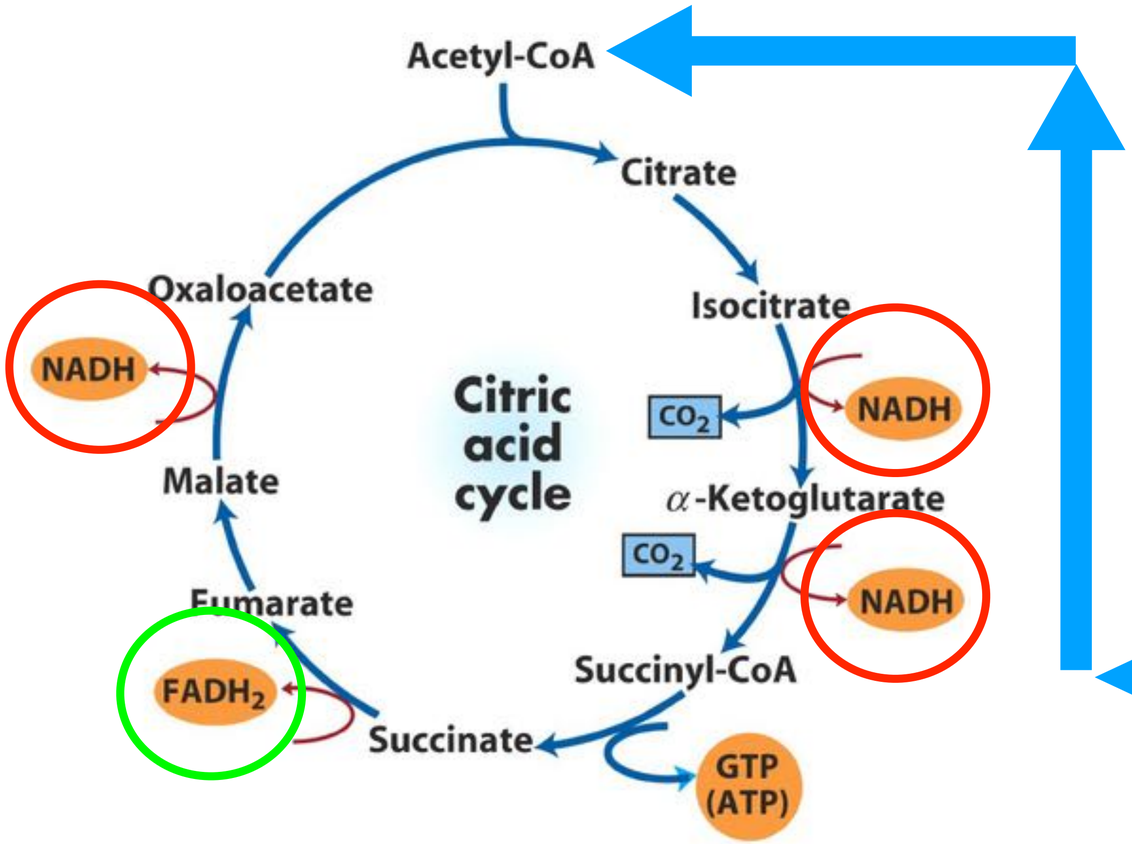
7 FADH2

7 NADH

8 ACETYL COA

Krebs Cycle

$FADH_2$/NADH (F/N Ratio) = 0.48

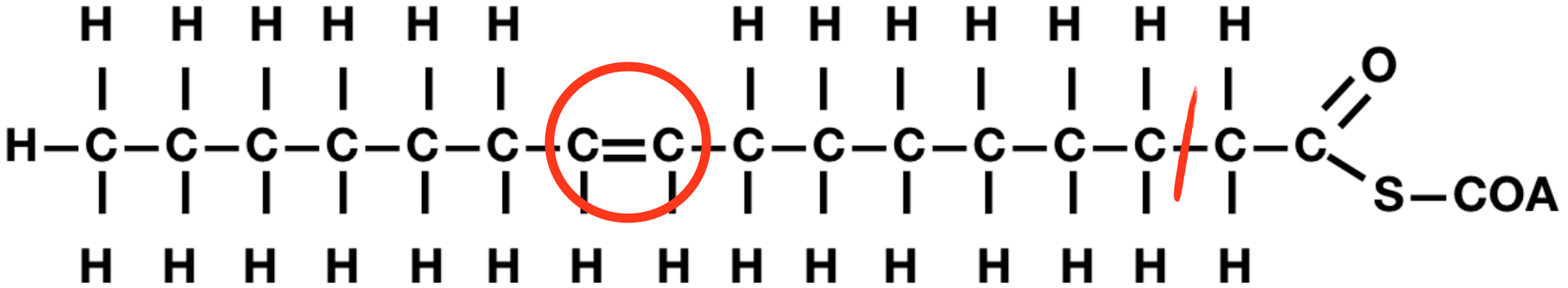


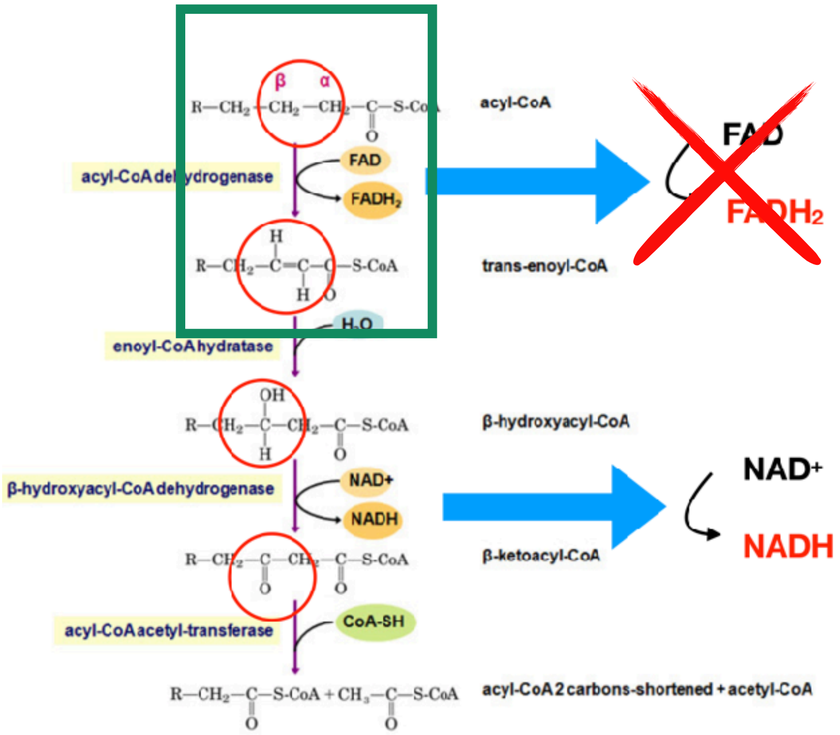
8 $FADH_2$ + 7 $FADH_2$ = 15 $FADH_2$

24 NADH + 7 NADH = 31 NADH

8 ACETYL COA

Beta-oxidation





Palmitoleic Acid (16 C fat)

6 $FADH_2$

7 NADH

8 Acetyl CoA

After running all 8 acetyl CoA thru Krebs Cycle:

6 $FADH_2$ + 8 $FADH_2$ = 14 $FADH_2$

7 NADH + 24 NADH = 31 NADH

F/N ratio = 13/28 = 0.45

Beta-oxidation

Oleic acid (18 C fat with one double bond)

8 cycles of beta oxidation provides:

8 NADH + 7 $FADH_2$ + 9 acetyl CoA

9 acetyl CoA $\xrightarrow{\text{Krebs}}$ 27 NADH + 9 $FADH_2$

35 NADH + 16 $FADH_2$

F/N ratio = 16/35 = 0.46

Linoleic acid (18 C fat with two double bonds)

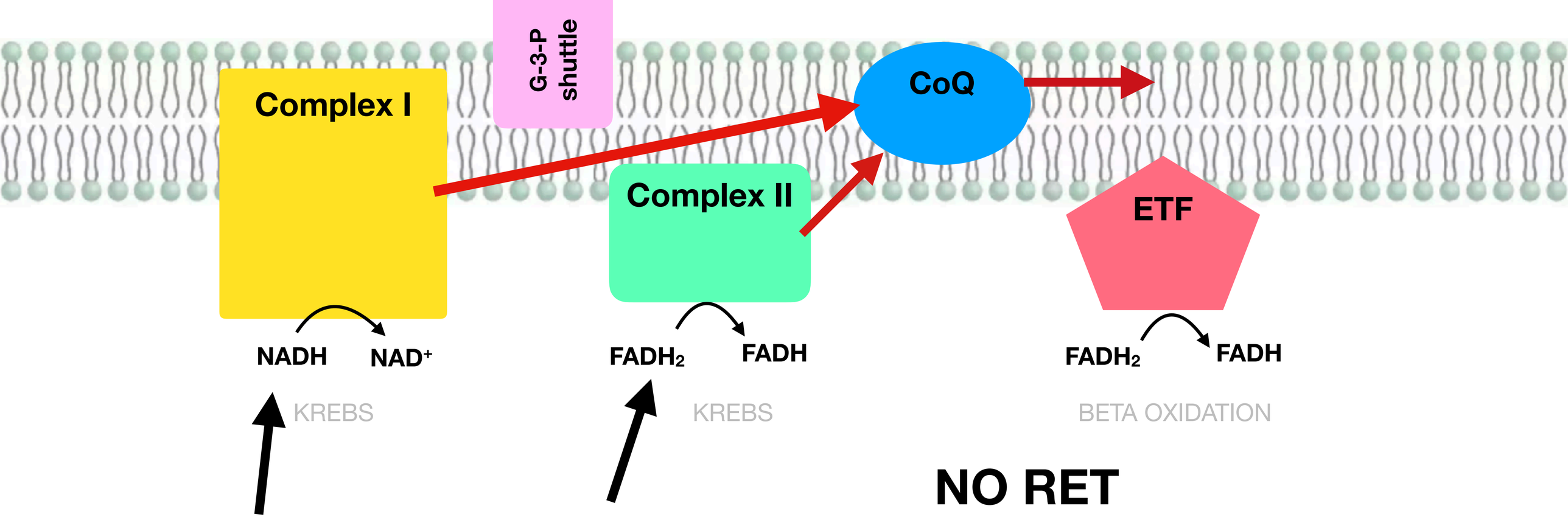
8 NADH + 6 $FADH_2$ + 9 acetyl CoA

35 NADH + 15 $FADH_2$

F/N ratio = 15/35 = 0.43

F/N Ratio

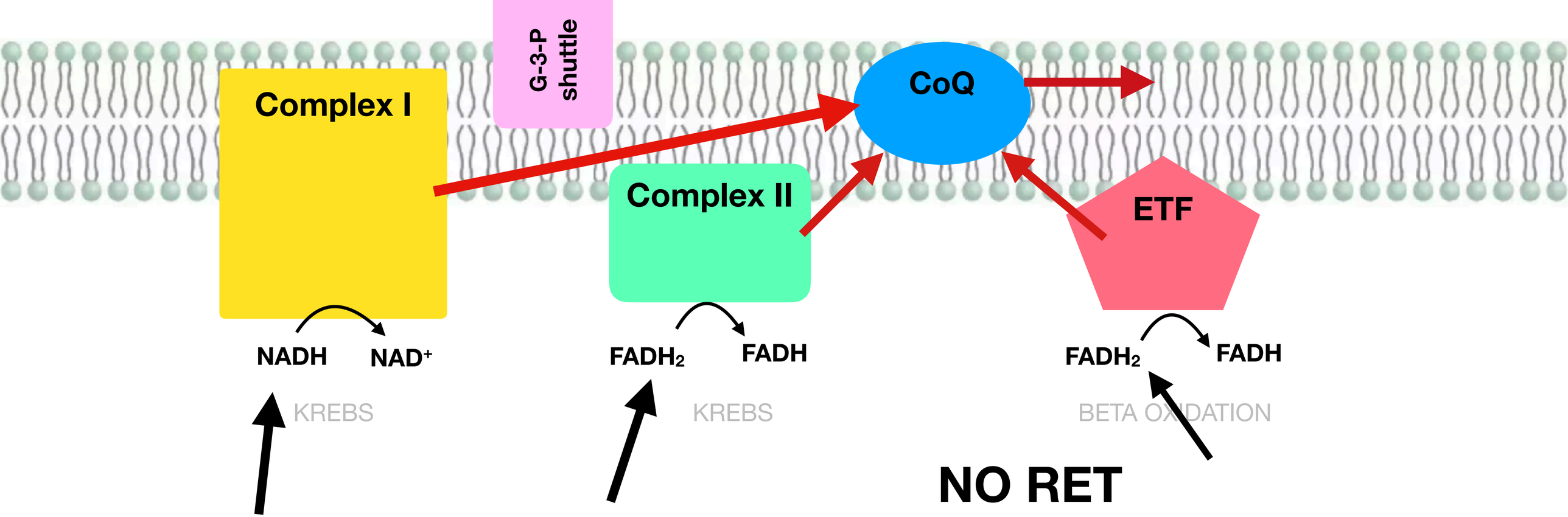
		Drives RET?
Palmitic acid	0.48	++
Oleic acid	0.46	+
Palmitoleic acid	0.45	–
Linoleic acid	0.43	–
Glucose	0.20	–



NO RET

NO LOCAL INSULIN RESISTANCE

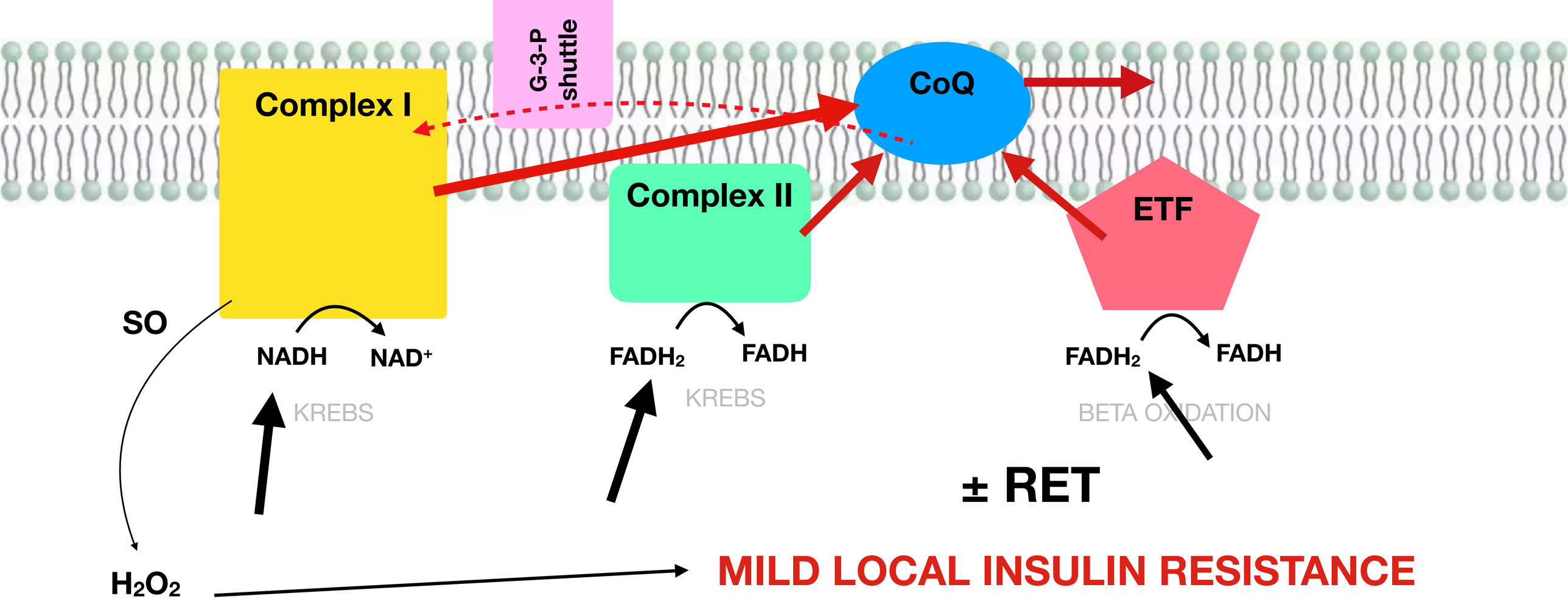
GLUCOSE (0.20)



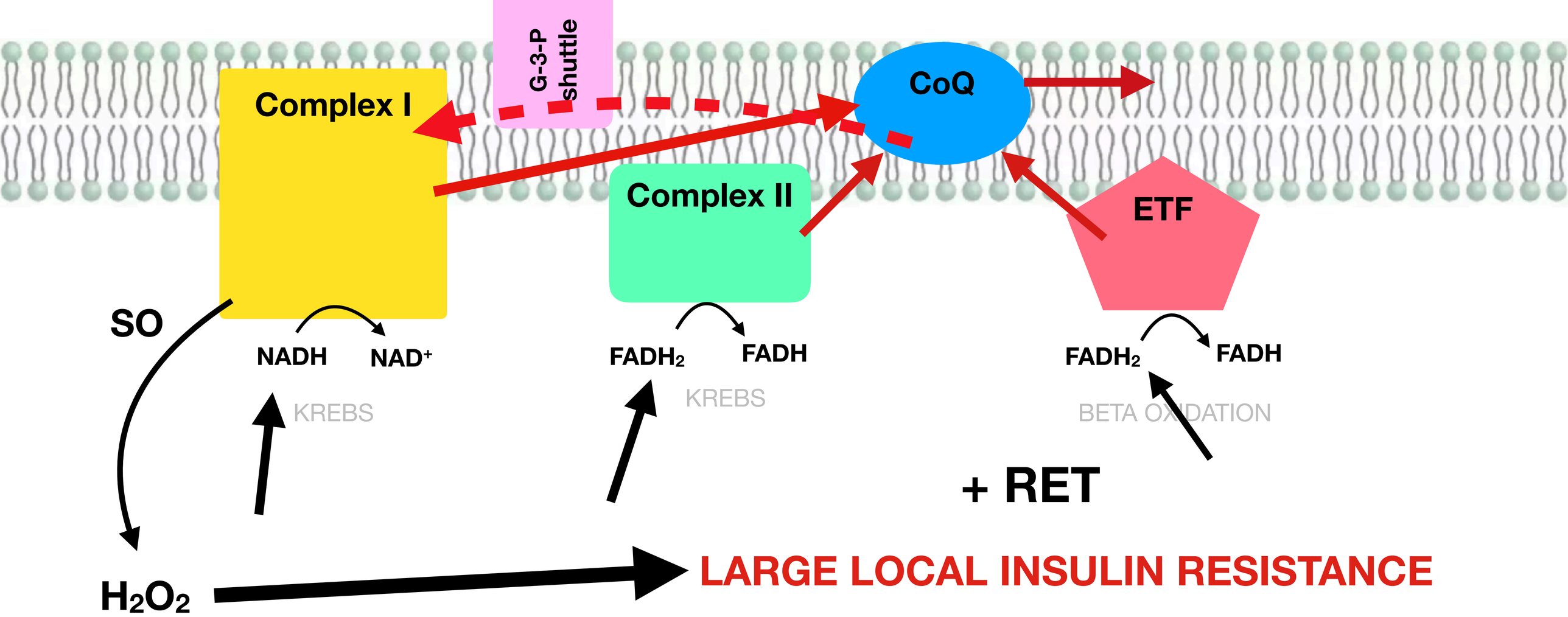
NO RET

NO LOCAL INSULIN RESISTANCE

LINOLEIC ACID (0.43)



OLEIC ACID (0.46)



PALMITIC ACID (0.48)

ADIPOSE CELL

McDonald's fries
cooked in <u>beef tallow</u>

STEARIC ACID
+
GLUCOSE

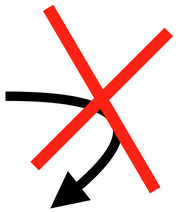
Back to circulation

Increases EE
Reduces hunger

ADIPOSE CELL

McDonald's fries
cooked in <u>vegetable oil</u>

LINOLEIC ACID
+
GLUCOSE



No Local IR
Adipose cell expands

OPEN

Citation: Nutrition & Diabetes (2016) **6**, e195; doi:10.1038/nutd.2016.1

www.nature.com/nutd

ORIGINAL ARTICLE

The effects of potatoes and other carbohydrate side dishes consumed with meat on food intake, glycemia and satiety response in children

R Akilen, N Deljoomanesh, S Hunschede, CE Smith, MU Arshad, R Kubant and GH Anderson

Exp 1 **Exp 2**

	CHO calories	*Meat calories*	*Cumulative calories*	*CHO calories*	*Meat calories*	*Cumulative calories*
Rice	848.8 ± 155.8 a	185.3 ± 1.5	1034.2 ± 156.6 a	847.1 ± 66.7 b	194.8 ± 2.5	1041.9 ± 67.1 a
Pasta	880.3 ± 113.9 a	187.9 ± 1.9	1068.3 ± 114.7 a	892.9 ± 61.1 ab	195.2 ± 2.2	1088.1 ± 60.4 a
BMP	507.9 ± 99.1 b	193.1 ± 1.9	700.8 ± 98.6 b	517.9 ± 49.3 c	190.1 ± 1.9	707.9 ± 49.6 b
BFF	1070.7 ± 99.4 a	187.9 ± 2.5	1258.6 ± 99.5 a	1021.8 ± 69.9 a	190.3 ± 2.5	1212.1 ± 69.4 a
FFF	912.2 ± 92.4 a	188.2 ± 3.2	1100.4 ± 92.7 a	940.8 ± 62.6 ab	195.2 ± 2.3	1136.1 ± 62.5 a
	$P < 0.0001$	$P = 0.2836$	$P < 0.0001$	$P < 0.0001$	$P = 0.2836$	$P < 0.0001$

ADIPOSE CELL

Low-carb diet

STEARIC ACID

+

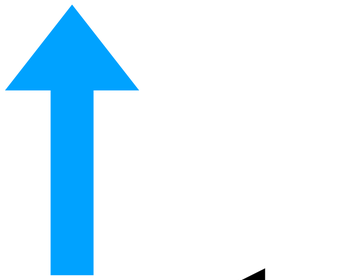
GLUCOSE

Back to circulation

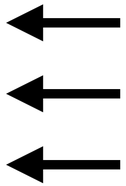
Increases EE
Reduces hunger
Spares glucose

ADIPOSE CELL

Viscera



NEFA

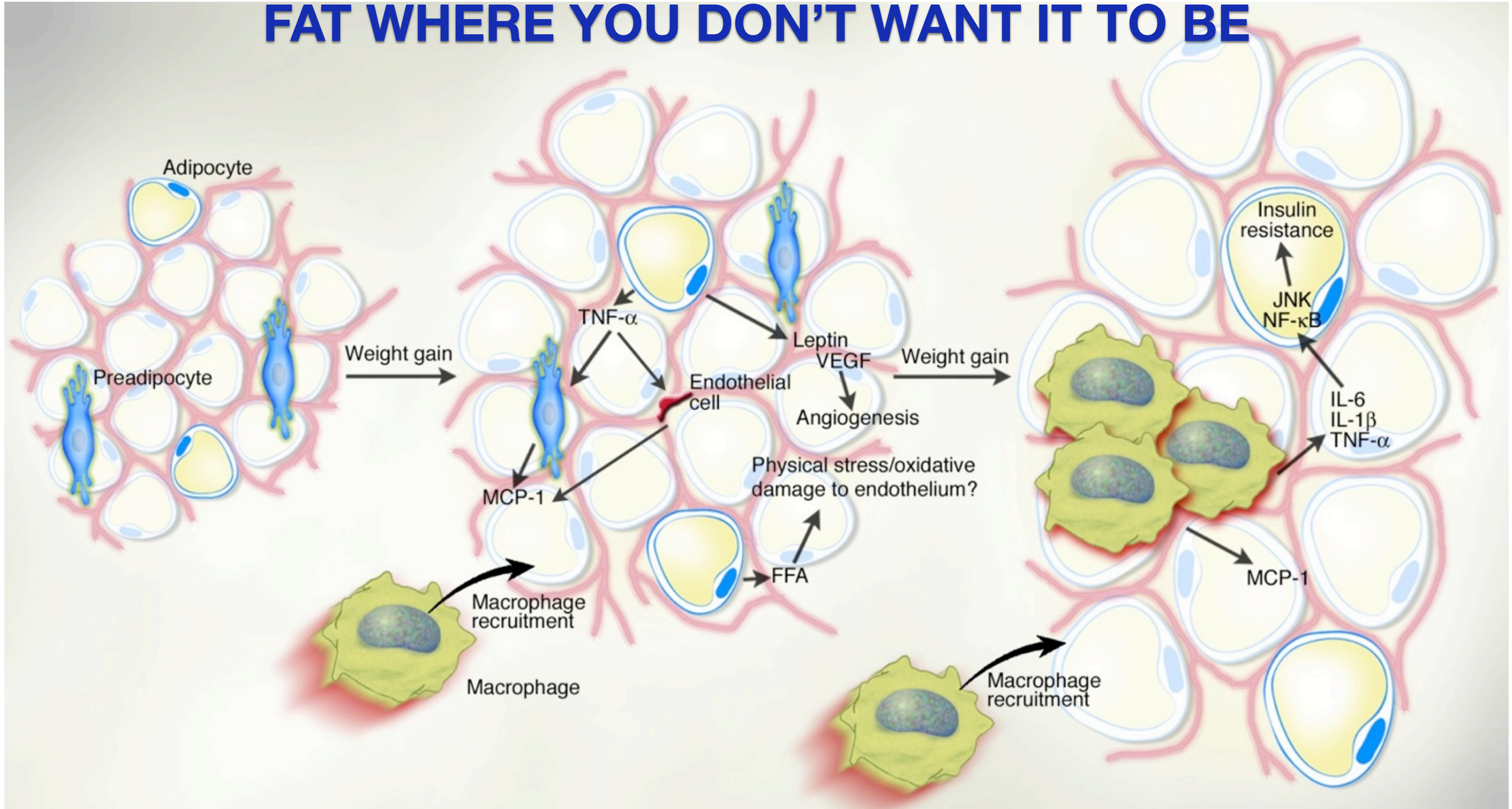


Back to circulation

Critical size
ATGL
Perilipin A

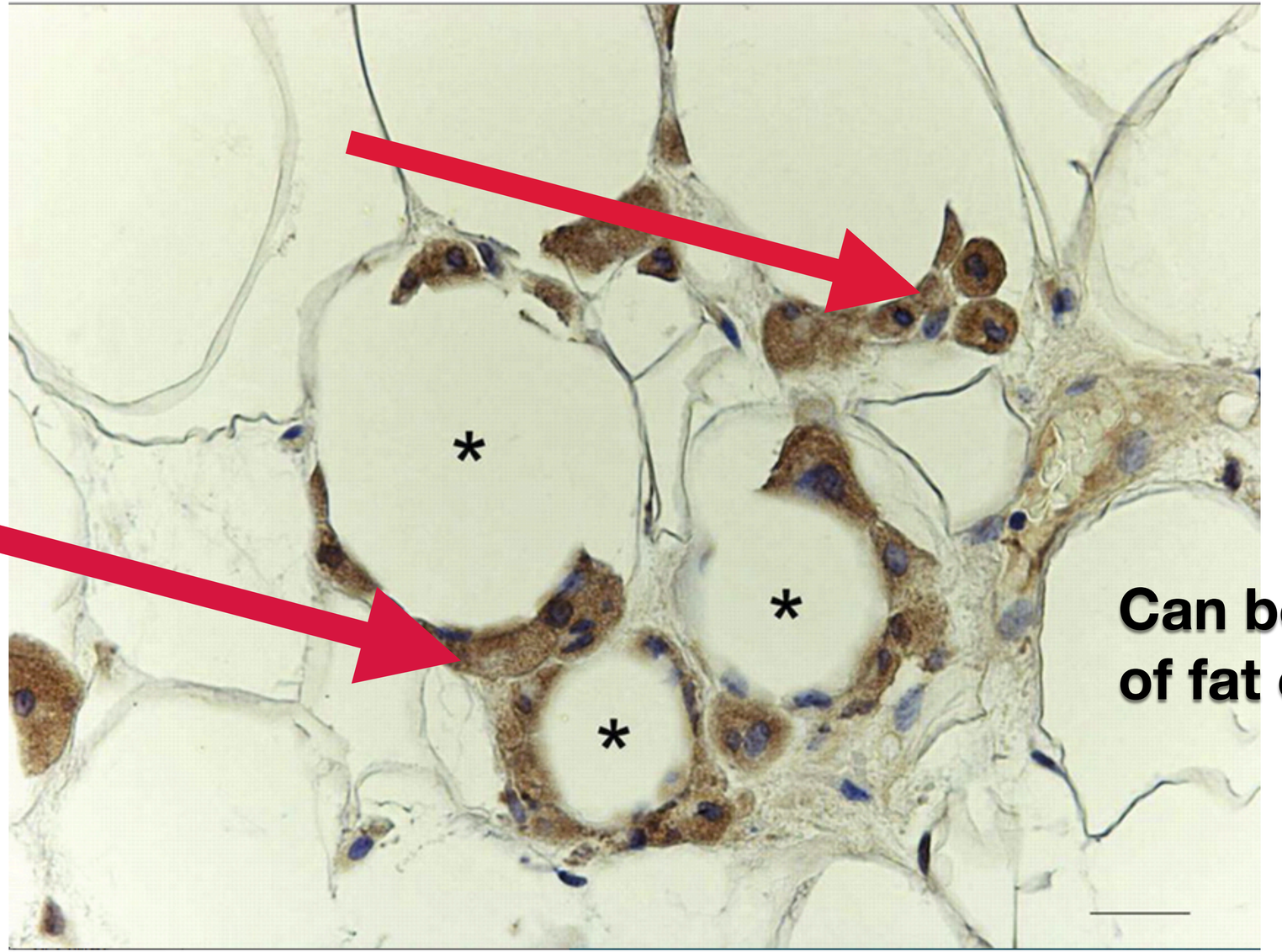
ECTOPIC FAT

FAT WHERE YOU DON'T WANT IT TO BE



ECTOPIC FAT

MACROPHAGE INFILTRATION OF FAT CELLS



Can be 50 - 60%
of fat cell mass

Reverse electron transport protects the fat cells (and others) from over nutrition

Saturated fat drives reverse electron transport

Saturated fat is a beneficial macronutrient

Linoleic acid prevents reverse electron transport and fills the cells with fat. It acts like a supercharged carb.

Linoleic acid should be avoided

RECOMMENDATIONS

1.CUT THE CARBS

2. METICULOUSLY AVOID LINOLEIC ACID

3. EAT MORE AT HOME

4. EAT MORE SATURATED FAT