BI 358 Lecture 5

I. *Announcements* **Today** *Diet Controller* **+** *SuperTracker Nutritional Analyses* **112 HUE. Save 8** *.pdfs* **and e-mail!**

II. *Nutritional Physiology News Successful Dieting: US Weight Control Registry, UC Berkeley Wellness,* **January 2016**

III. *GI Physiology Connections* **G&H ch 62, 71, 63, 64, 65 + LS2**
   A. **Energy regulation + neural centers fig 71-1, 71-2, tab 71-2**
   B. **Secretions tab 64-1, fig 64-1, 64-2, pp 775-87**
   C. *Hydrolysis*: **Central theme of digestion ch 65 p 789-93 Carbohydrate fig 65-1 p 790; Fat fig 65-3 p 791, fig 65-4 p 792; Protein fig 65-2 p 791**
   D. **Overview: Stomach, small intestine, accessory organs, large intestine fig 63-2, 65-6, 65-7, 64-10, 64-11, 63-5...**

IV. *Nutrition & Disease Prevention* **...+ G&H ch 71**
   A. **Dietary & exercise guidelines to prevent disease: Eat the Rainbow! USDA, AHA, AICR, DASH, Mayo Clinic, ACSM Guidelines**
   B. **Rationale for guidelines**

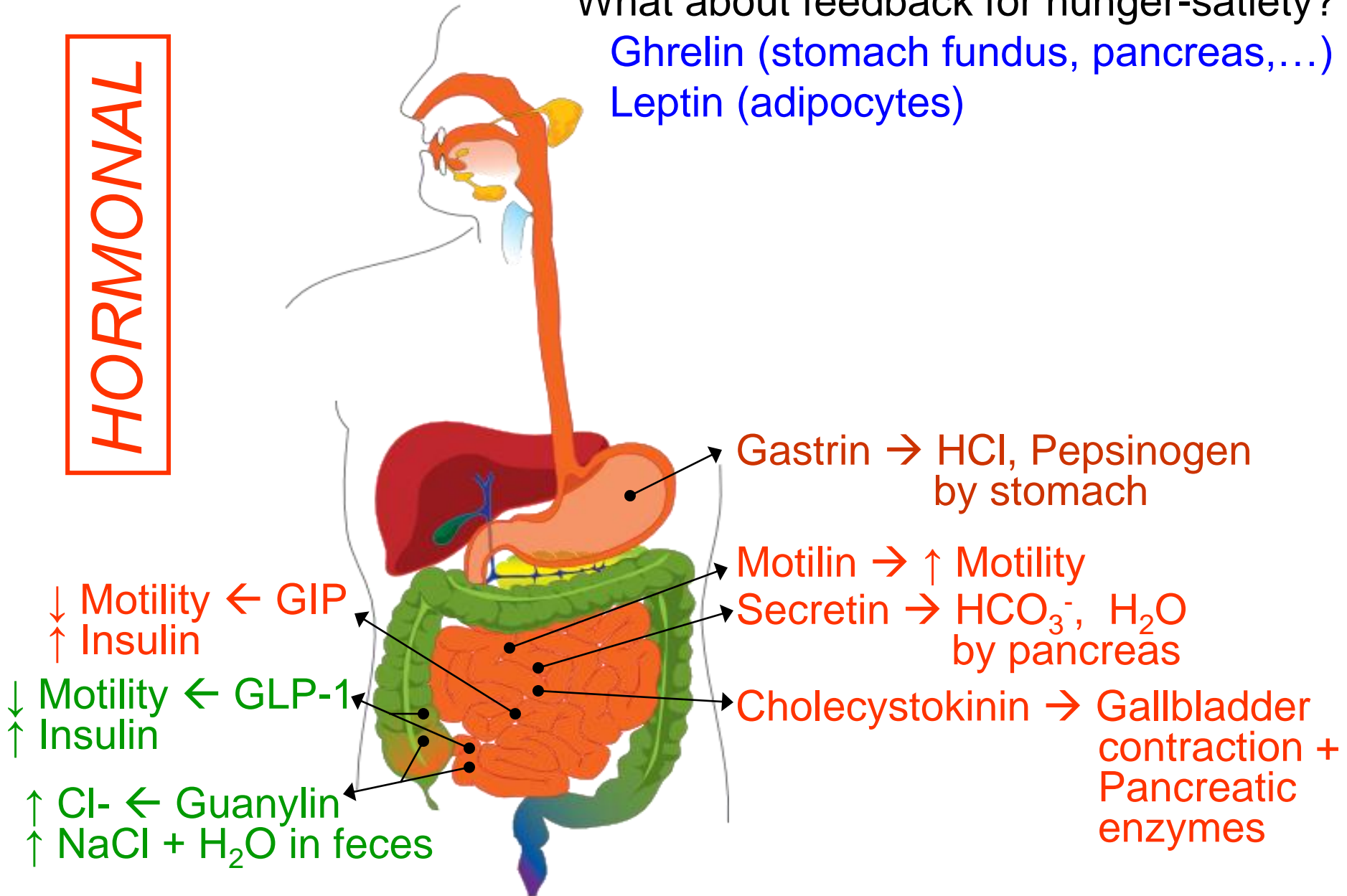# *Successful Dieting – National Weight Control Registry*

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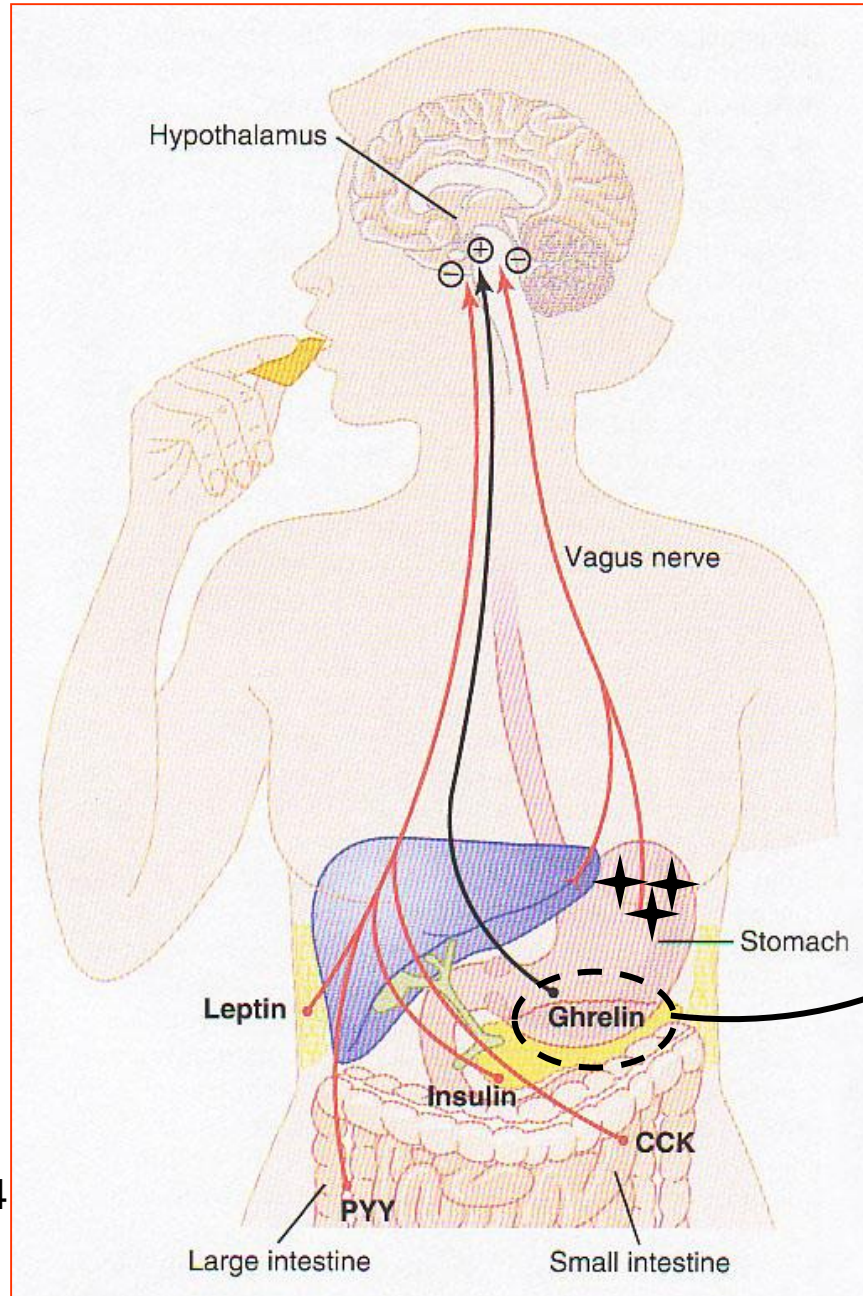- Much planned physical activity, 60-90 min/d, 1^0 walking + looked for other ways to be active

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

UC Berkeley Wellness Engagement Calendar, September 2013
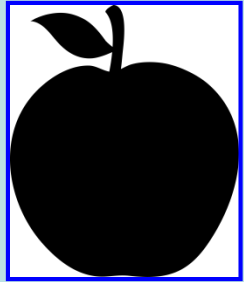
HORMONAL

What about feedback for hunger-satiety?
Ghrelin (stomach fundus, pancreas,…)
Leptin (adipocytes)

Gastrin → HCl, Pepsinogen
by stomach

Motilin → ↑ Motility
Secretin → HCO_3^-, H_2O
by pancreas

Cholecystokinin → Gallbladder
contraction +
Pancreatic
enzymes

↓ Motility ← GIP
↑ Insulin

↓ Motility ← GLP-1
↑ Insulin

↑ Cl- ← Guanylin
↑ NaCl + H_2O in feces

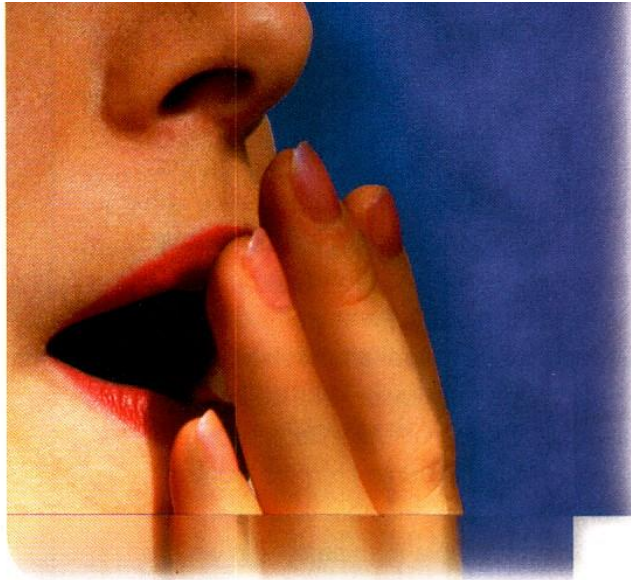# *Feedback Mechanisms for the Control of Food Intake*

Sleep deprivation promotes the release of ghrelin & abdominal obesity!

S Taheri & associates, *PLoS Medicine* Dec 2004

Sleep More, Eat Less

Wondering why you're so hungry? Maybe it's because you're not getting enough sleep.
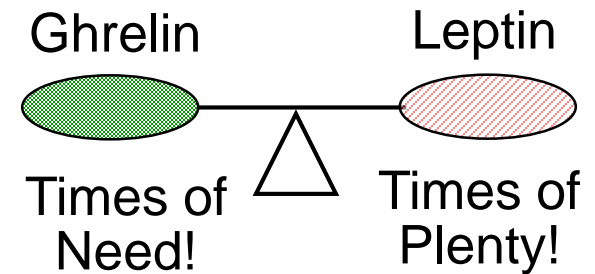
Researchers allowed 12 healthy young lean men to sleep for either four or eight hours in a laboratory. After one night of four hours of sleep, the men ate 22 percent more calories the next day than they did after eight hours. They also reported being more hungry before breakfast and dinner.

In a separate study, scientists found that a single night with only four hours of sleep led to insulin resistance in nine healthy lean men and women in their 40s. After the night of restricted sleep, the participants were less able to move blood sugar into their cells, which suggests that their bodies were at least temporarily resistant to insulin. Insulin resistance can lead to heart disease, diabetes, and possibly breast cancer.

What to do: Get enough sleep. Most adults need 7 to 8 hours a night. (School-aged children need at least 9 hours.) Other studies that limit adults' sleep find higher levels of ghrelin (which makes people hungry) and lower levels of leptin (which makes people feel full) in their blood. Changes in ghrelin, leptin, and insulin resistance may explain why studies find a higher risk of obesity, heart disease, diabetes, and high blood pressure in people who get too little sleep.
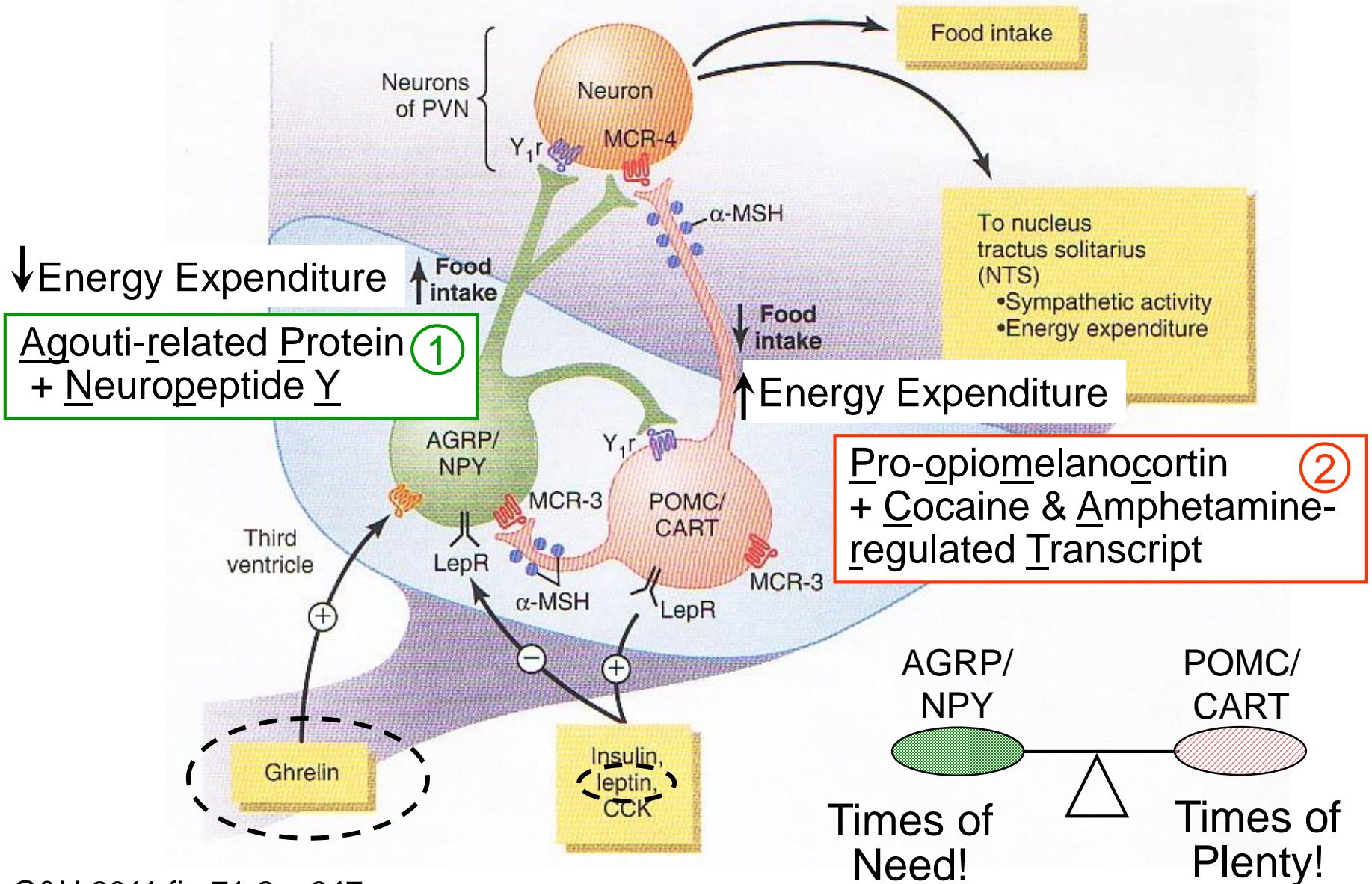
Am. J. Clin. Nutr. 91: 1550, 2010 and J. Clin. Endocrinol. Metab. 95: 2963, 2010.

promotes Leptin release!

Ghrelin   Leptin

Times of Need!   Times of Plenty!

http://www.vivo.colostate.edu/hbooks/pathphys/endocrine/gi/ghrelin.html

NAHL CSPI, 07/08/2010

Control of Energy Balance by <u>Hypothalamic</u> Neurons

↓Energy Expenditure

↑**Food intake**

<u>A</u>gouti-<u>r</u>elated <u>P</u>rotein ①
 + <u>N</u>euro<u>p</u>eptide <u>Y</u>

↑Energy Expenditure

<u>P</u>ro-<u>o</u>pio<u>m</u>elano<u>c</u>ortin ②
+ <u>C</u>ocaine & <u>A</u>mphetamine-
regulated <u>T</u>ranscript

AGRP/
NPY — Times of Need!

POMC/
CART — Times of Plenty!

G&H 2011 fig 71-2 p 847

Neurotransmitters & Hormones that Influence Hypothalamic Feeding & Satiety Centers

↓ Feeding = <u>Anorexigenic</u>

Cocaine- & amphet-regulated tr (CART)

α-Melanocyte stimulating h…(α-MSH)

Leptin

Serotonin

Norepinephrine

Corticotropin releasing h…(CRH)

Insulin

Cholecystokinin (CCK)

Glucagon-like peptide (GLP)

Peptide YY (PYY)

↑ Feeding = <u>Orexigenic</u>

Agouti-related protein (AGRP)

Neuropeptide Y (NPY)

Melanin-concentrated h…(MCH)

Orexins A & B

Endorphins

Galanin (GAL)

Amino Acids (Glutamate & GABA)

Cortisol

Ghrelin

Endocannabinoids/Anandamide

G&H 2011 tab 71-2 p 847

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**

Table 64-1 Daily Secretion of Intestinal Juices

	Daily Volume (ml)	pH
Saliva	1000	6.0-7.0
Gastric secretion	1500	1.0-3.5
Pancreatic secretion	1000	8.0-8.3
Bile	1000	7.8
Small intestine secretion	1800	7.5-8.0
Brunner's gland secretion	200	8.0-8.9
Large intestinal secretion	200	7.5-8.0
Total	6700	

Hydrolysis of Energy Nutrients

…Central-linking theme!!

Hi gang!!
You need me
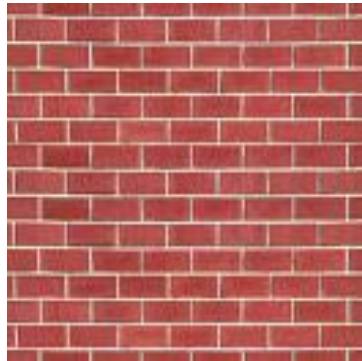for digestion!!

+

Help!
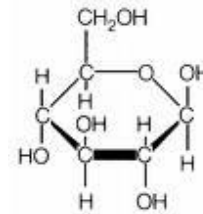Me too!
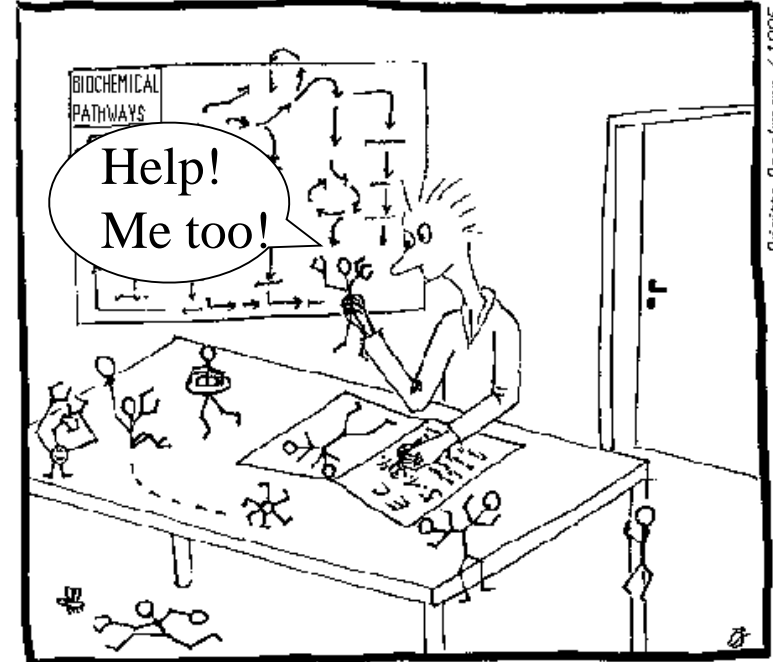
H_2O + Enzyme

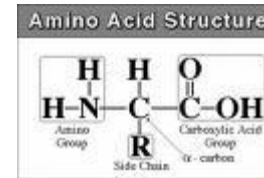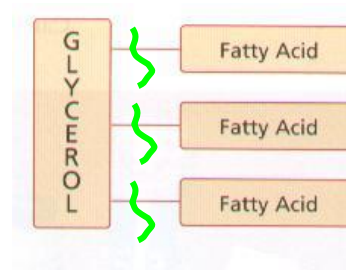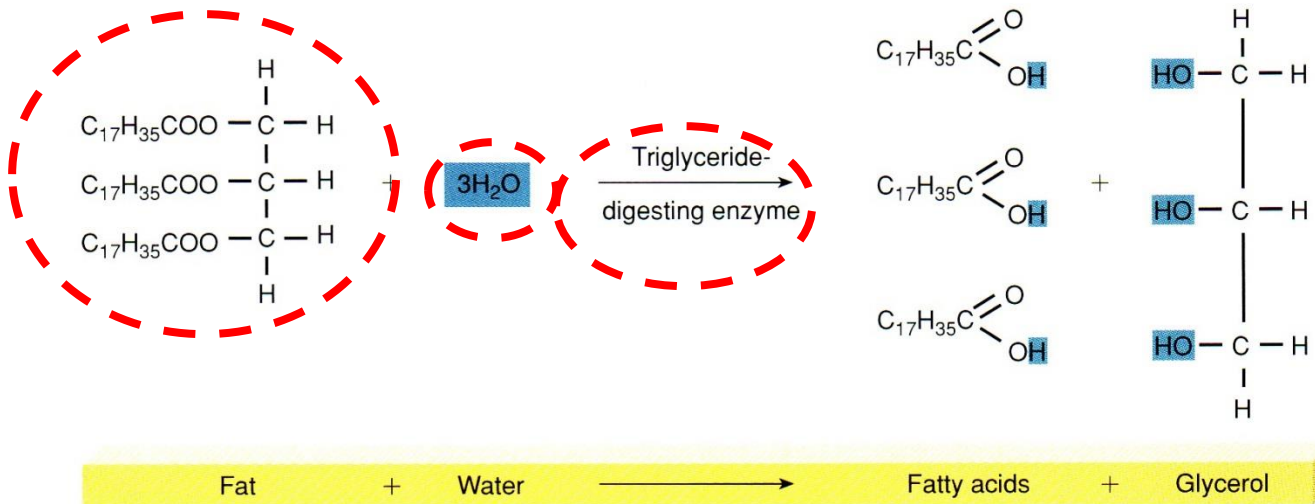# Polymer to Monomer (Many to One)
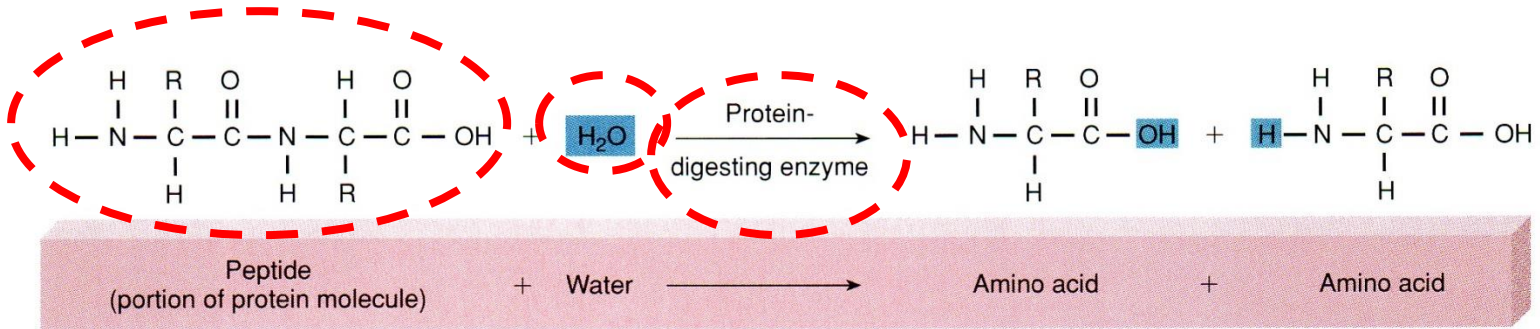
...Central-linking theme, again!!

Carbohydrate → Glucose

Protein + Fat → Amino Acids

Fatty Acids + Glycerol

| Maltose | + | H_2O | Carbohydrate-digesting enzymes | → | Glucose | + | Glucose |

Disaccharide → **Monosaccharides**

Maltose + Water ⟶ Glucose + Glucose

Peptide (portion of protein molecule) + H_2O — Protein-digesting enzyme → Amino acid + Amino acid

Peptide (portion of protein molecule) + Water ⟶ Amino acid + Amino acid

Fat + $3H_2O$ — Triglyceride-digesting enzyme → Fatty acids + Glycerol

$C_{17}H_{35}COO$, $C_{17}H_{35}C$, OH, HO

Fat + Water ⟶ Fatty acids + Glycerol

Carbohydrates in foods

Sizer & Whitney 2011 p 136
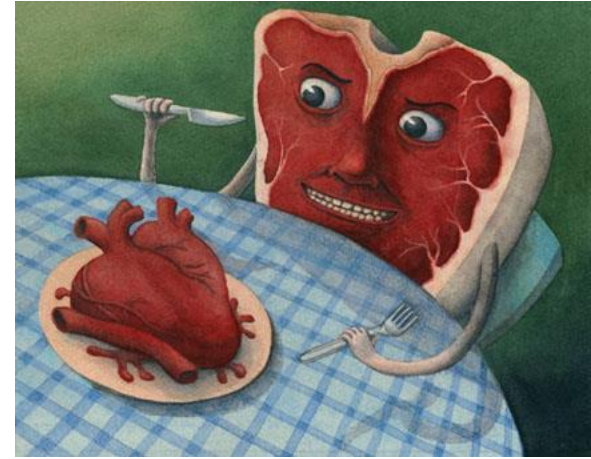
Carbohydrate Digestion = 1^0 Energy Nutrient
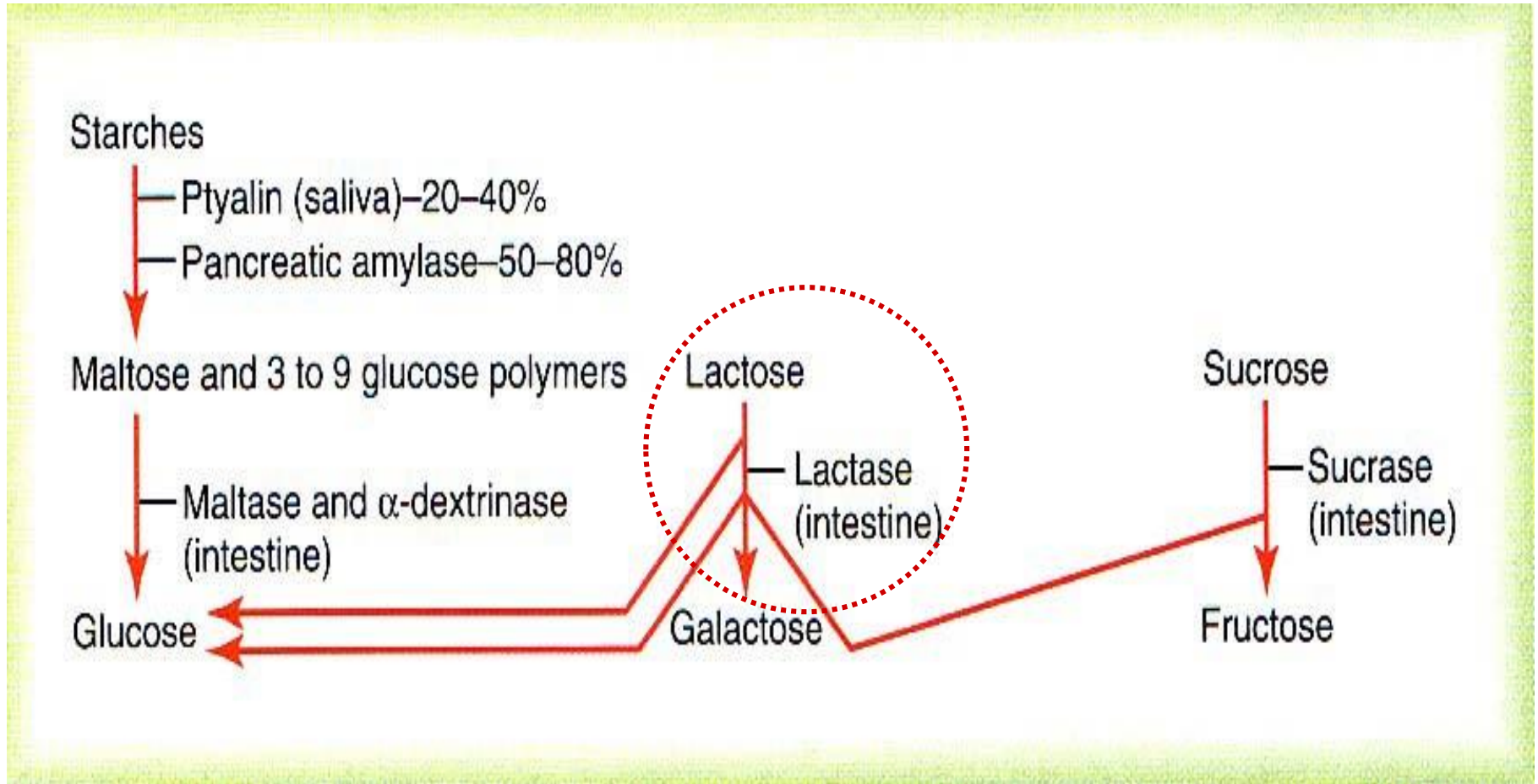
Why Do Some People Have Trouble Digesting Milk?

- Ability to digest milk carbohydrates varies
  - Lactase
    - Made by small intestine
- Symptoms of intolerance
  - Gas, diarrhea, pain, nausea?
- Milk allergy?
- Nutritional consequences
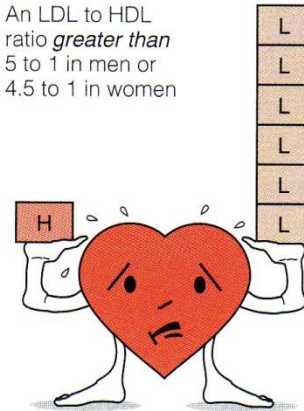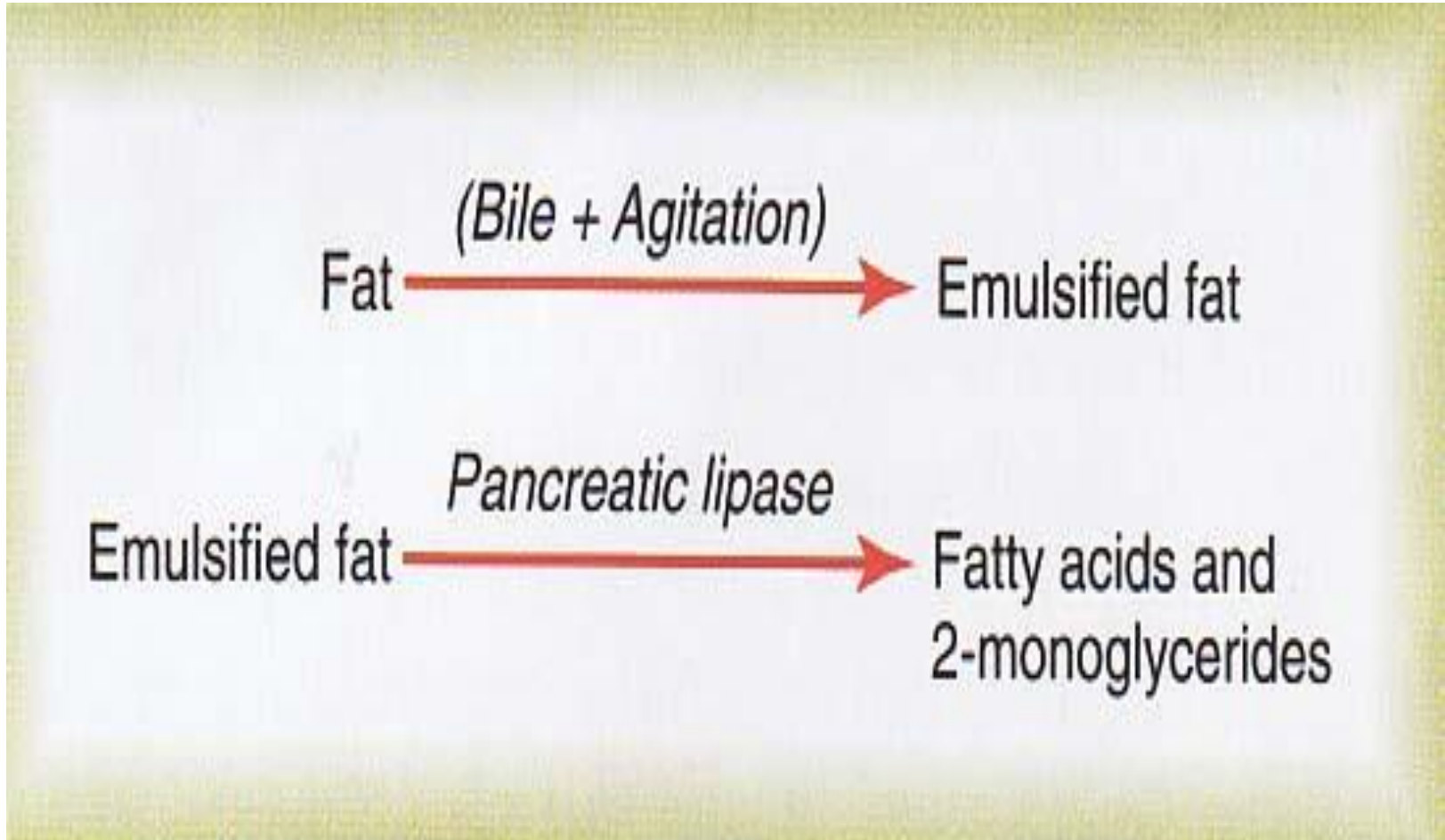- Milk tolerance and strategies

HIGH FAT FOODS

An LDL to HDL
ratio *greater than*
5 to 1 in men or
4.5 to 1 in women

Increased risk of
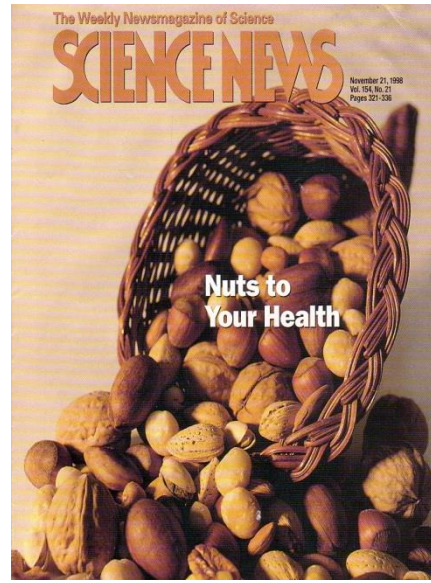heart disease

Fat Digestion = 2^0 Energy Nutrient
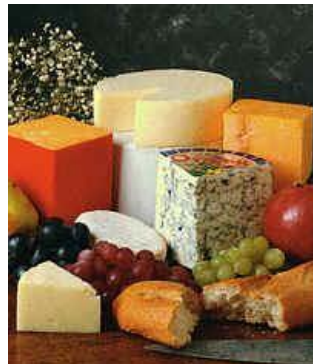

Fat $\xrightarrow{\text{(Bile + Agitation)}}$ Emulsified fat

Emulsified fat $\xrightarrow{\text{Pancreatic lipase}}$ Fatty acids and 2-monoglycerides

HIGH PROTEIN (FAT?) FOODS?

Speaking of Wellness
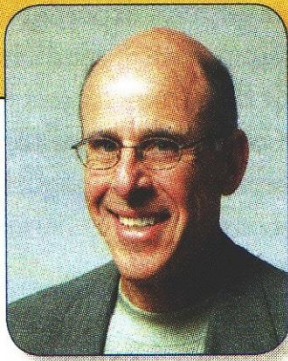
John Swartzberg, M.D.
Chair, Editorial Board

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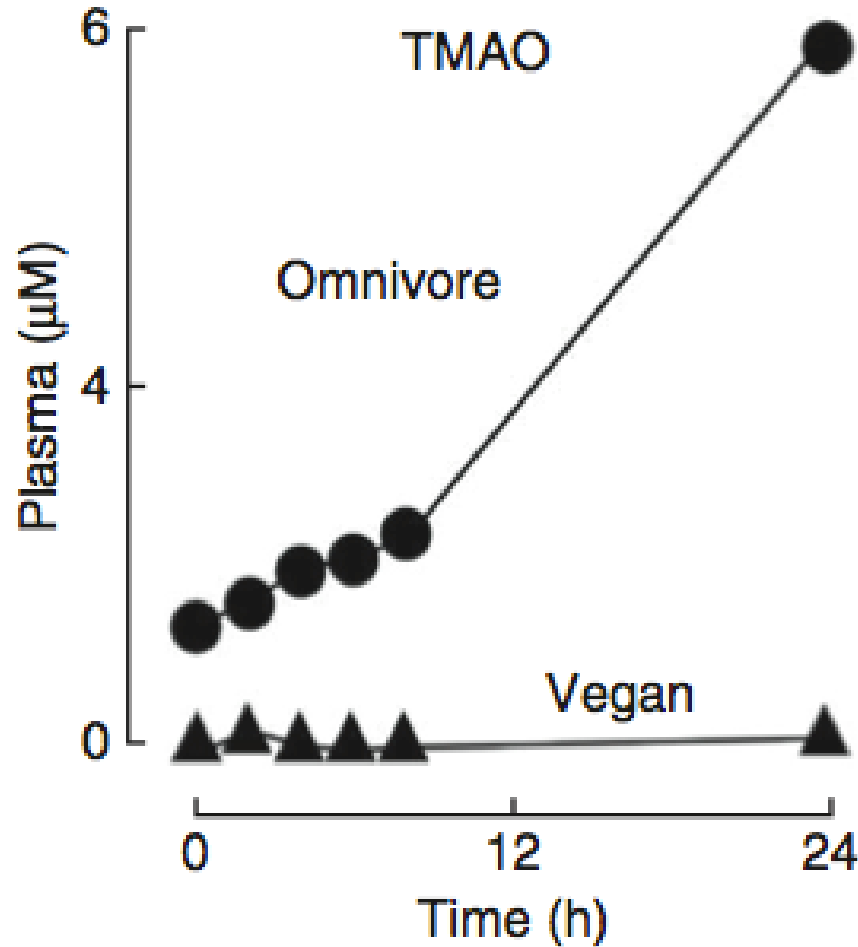
Meat & Eggs → L-Carnitine & Choline → Trimethyl Amine (TMA) → TMAO → *Inflammation & Atherosclerosis*

Dietary Choline & L-Carnitine

Gut Flora

TMA = Trimethyl Amine

The pathway linking diet, gut microbes and TMAO to a growing collection of disease states

Hepatic FMOs

TMAO

Choline

Heart Failure

Kidney Disease

Atherosclerosis
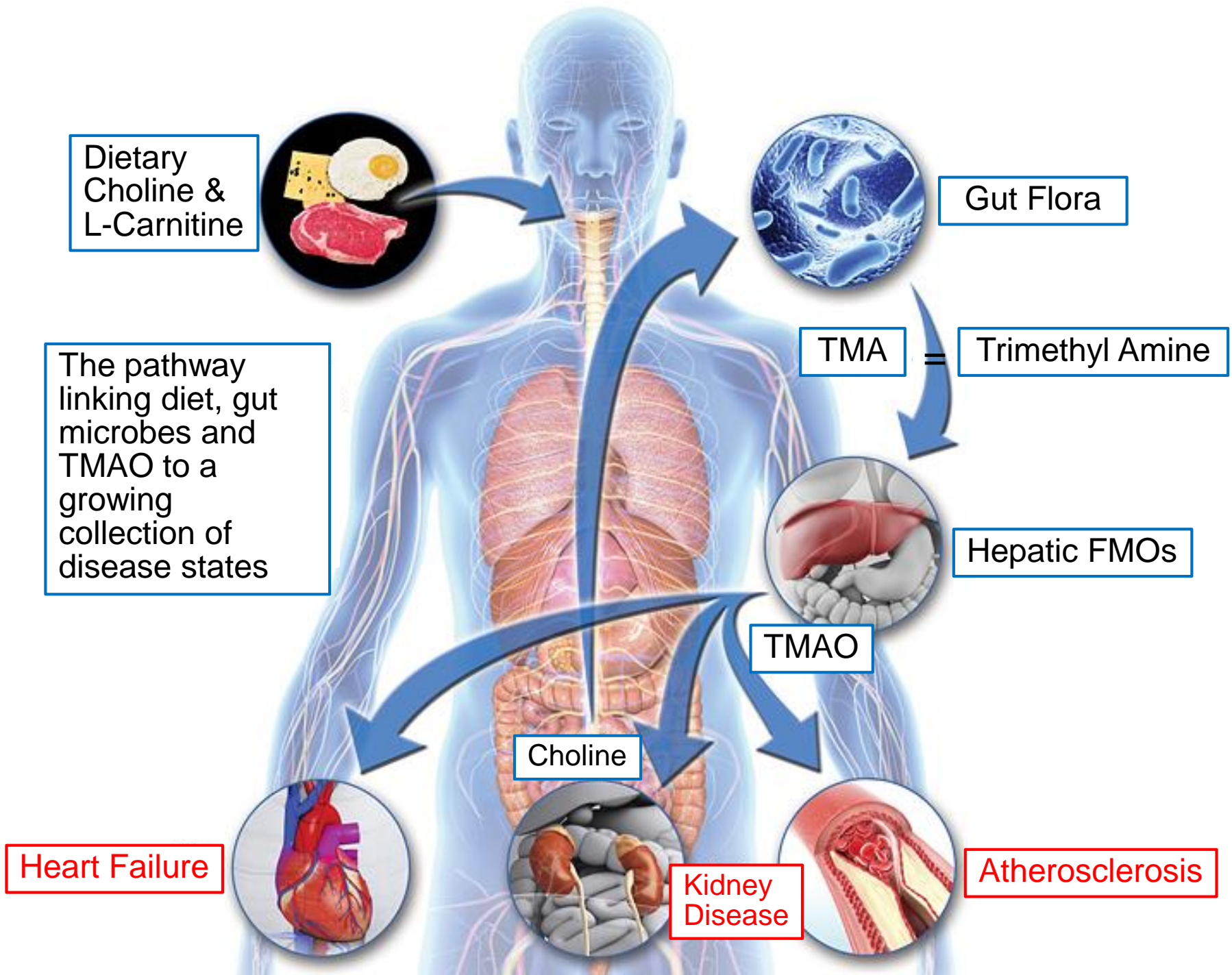
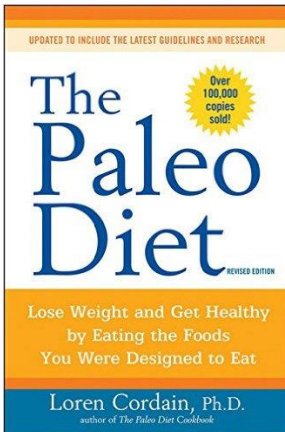# *Pondering Paleo?*
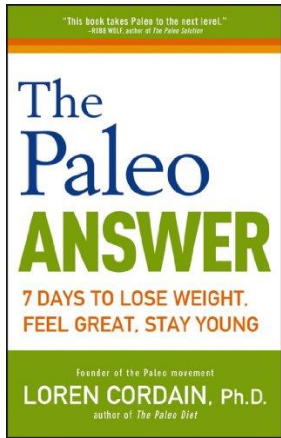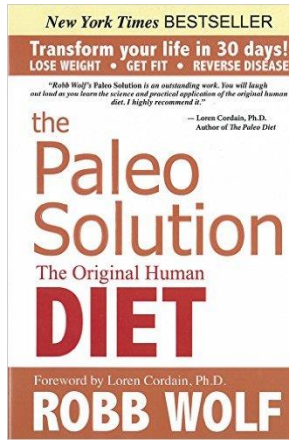
Evolutionary Biologist
Behavioral Ecologist
U Minnesota
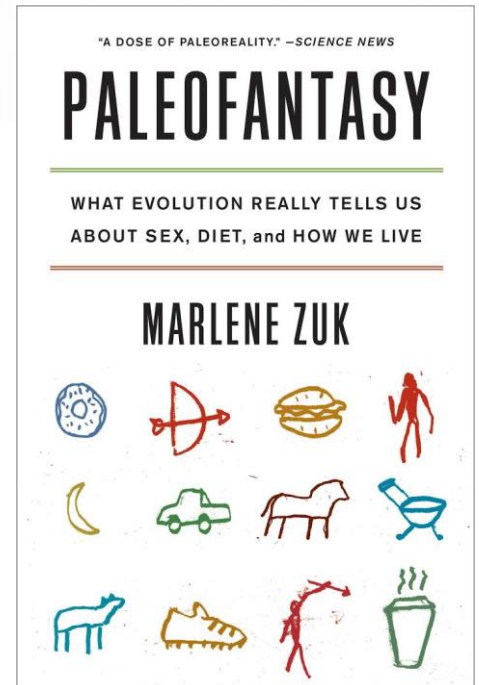
Dietary Protein, Shakes, Supplements &…?

Dietary Protein and EARLY Cancer
(Youngman and Campbell, J. Nutr., 1991, Nutr. Cancer, 1992)

ON 20%
OFF 5%
ON 20%
OFF 5%

\# of 'cancer' clusters

3   6   9   12
Weeks
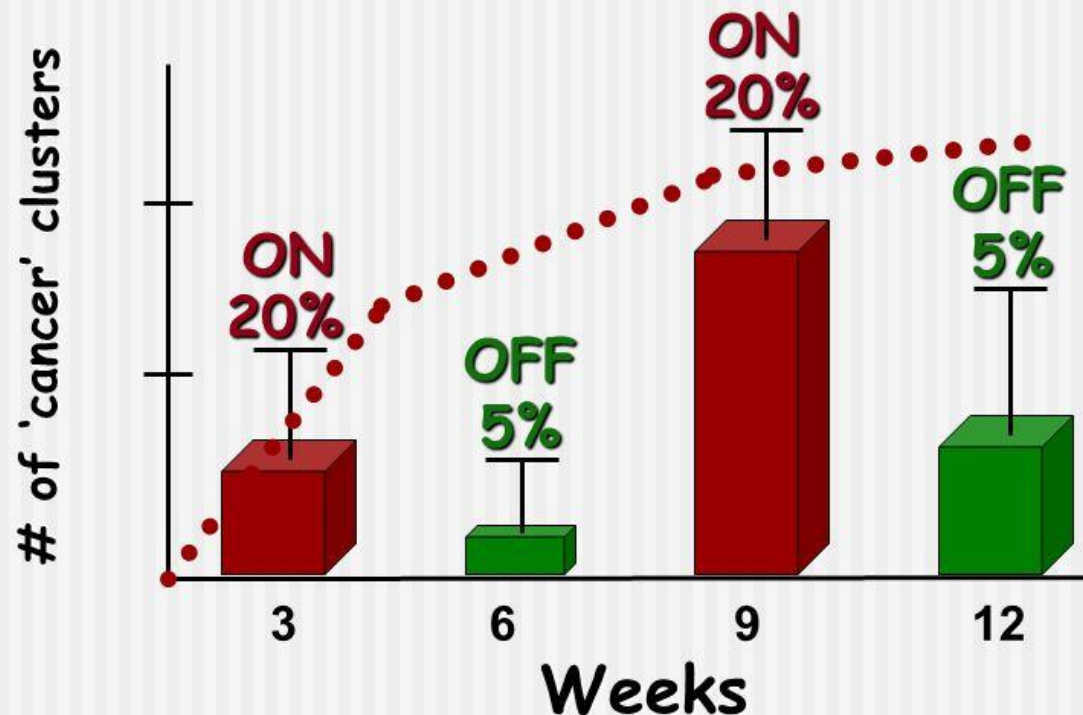
copyright T. Colin Campbell 2010   9

American Institute for Cancer Research

http://www.aicr.org/reduce-your-cancer-risk/recommendations-for-cancer-prevention/

Where does *enzymatic* digestion of *protein* begin?
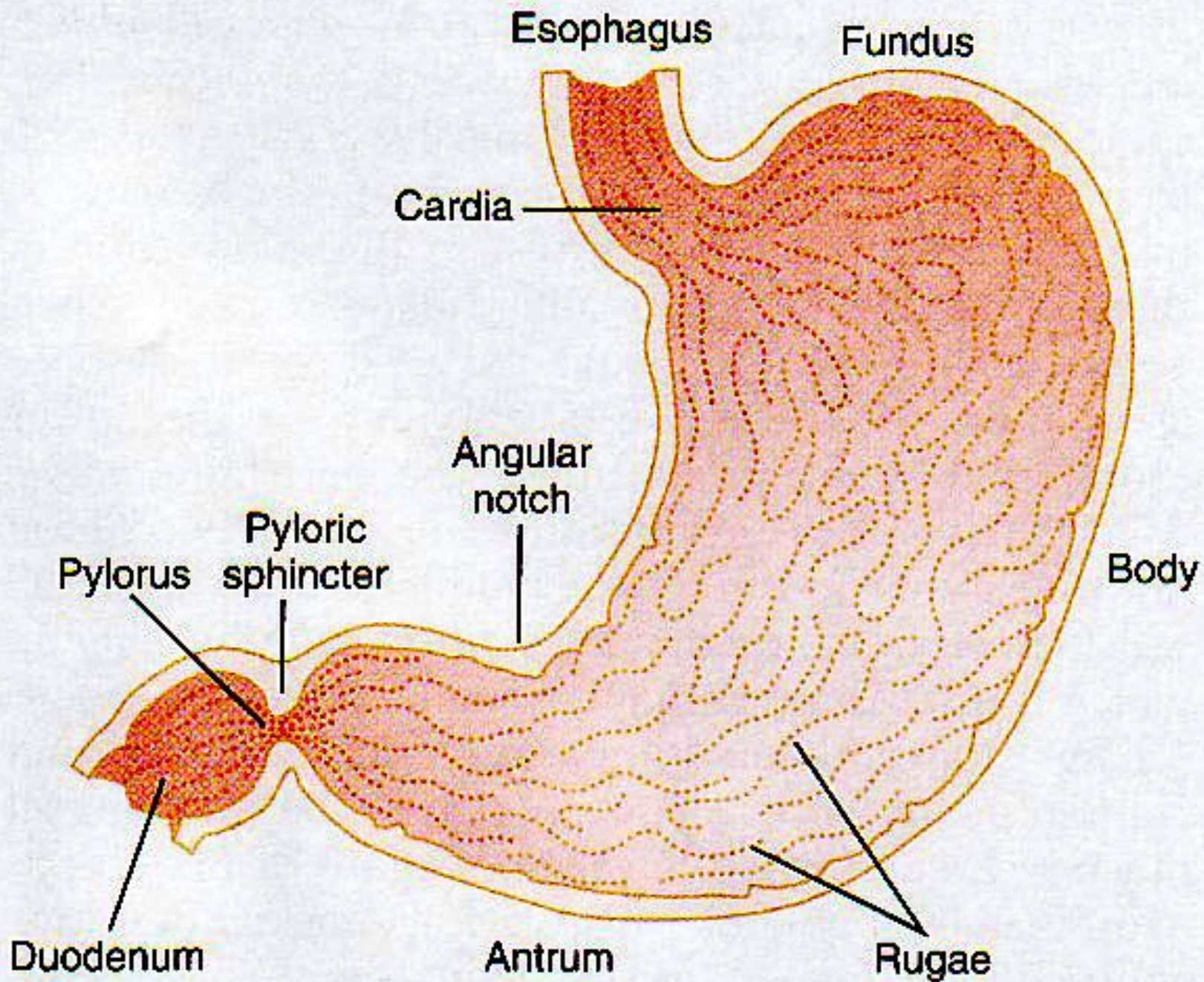
Zymogen = inactive precursor

Autocatalysis

Pepsinogen → Pepsin → Digestion

Protein

Gastric lumen

HCl

Peptide fragments
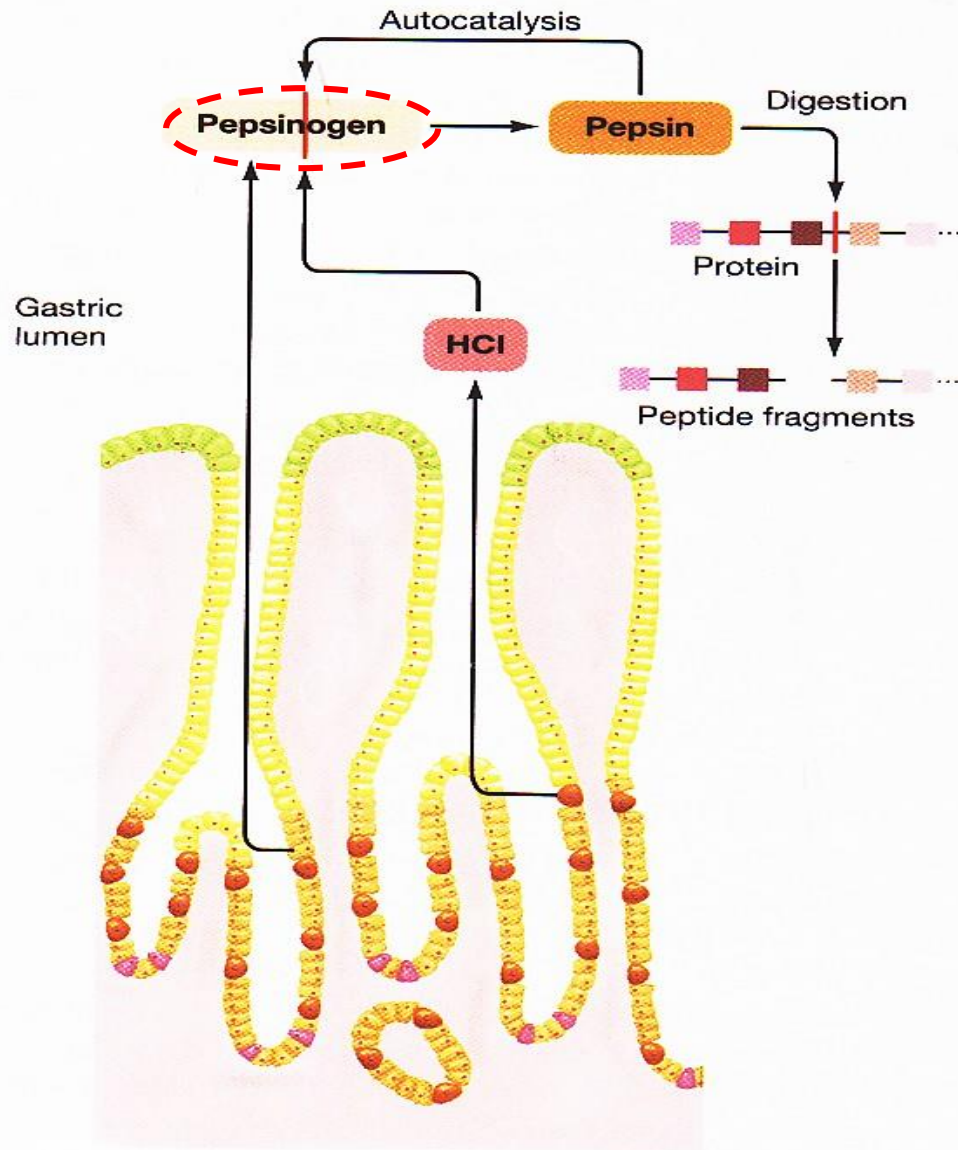
= Various amino acids

| = Enzymatic splitting of a chemical bond

LS2 2006

Protein Digestion = 3^0 Energy Nutrient
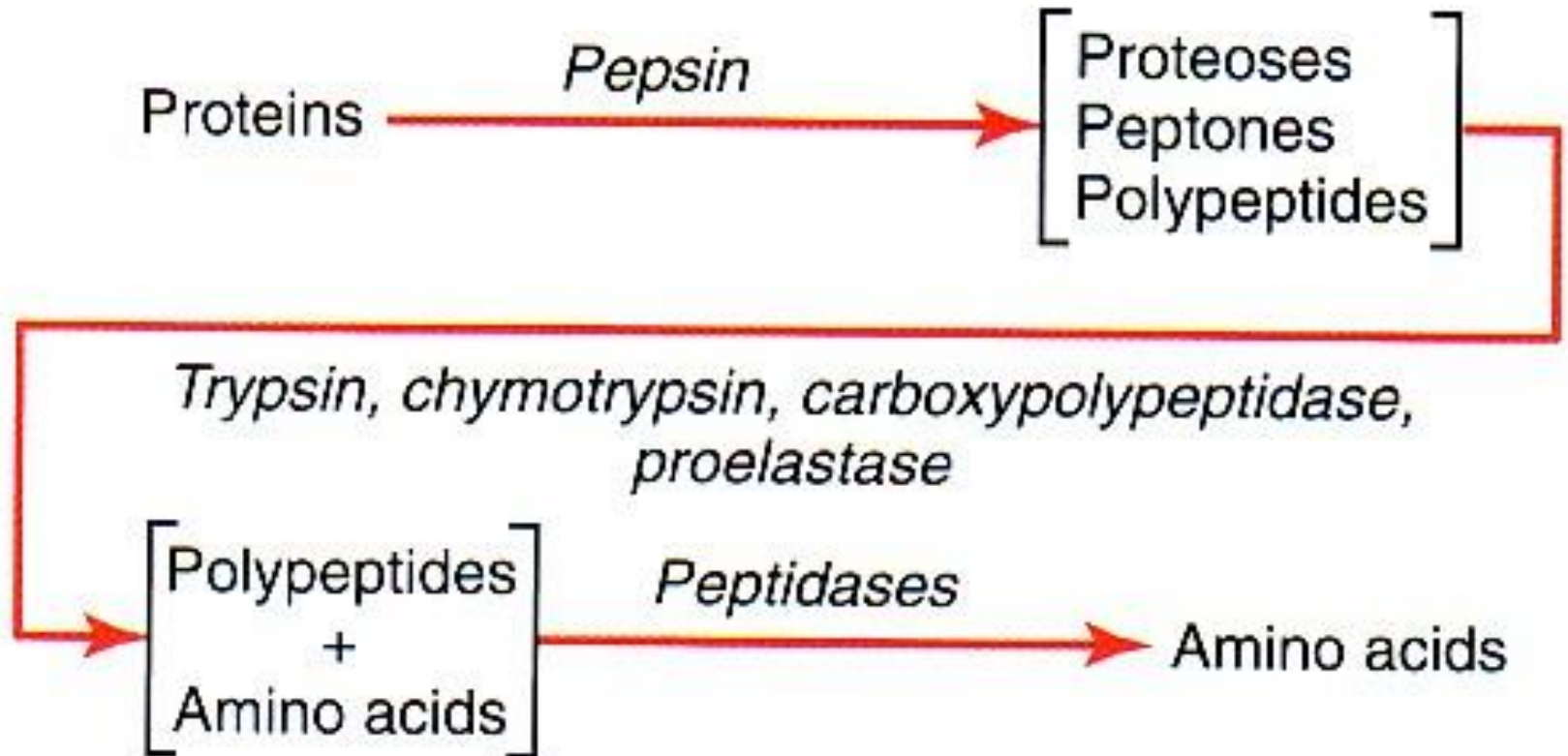
G&H 2011 fig 65-2 p 791

What is the major function of the small intestine?

Absorption!!

Brush border

Pinocytic vesicles

Endoplasmic reticulum

Mitochondria

G&H 2011 fig 65-7

Central lacteal

Blood capillaries

Vein

Artery

A

Brush border

Basement membrane

Arteriole

Capillaries

Venules

Central lacteal

B
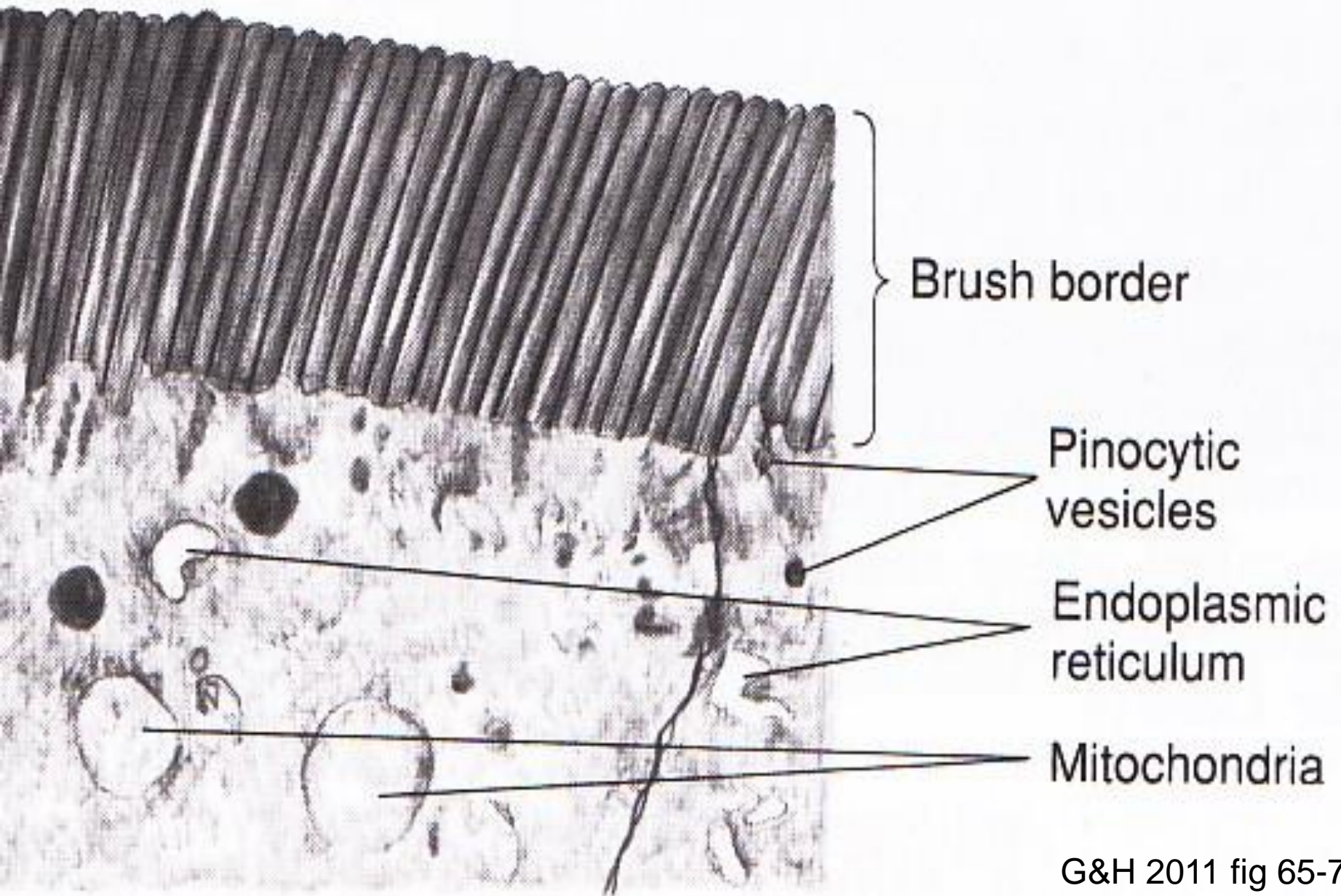
G&H 2011 fig 65-6
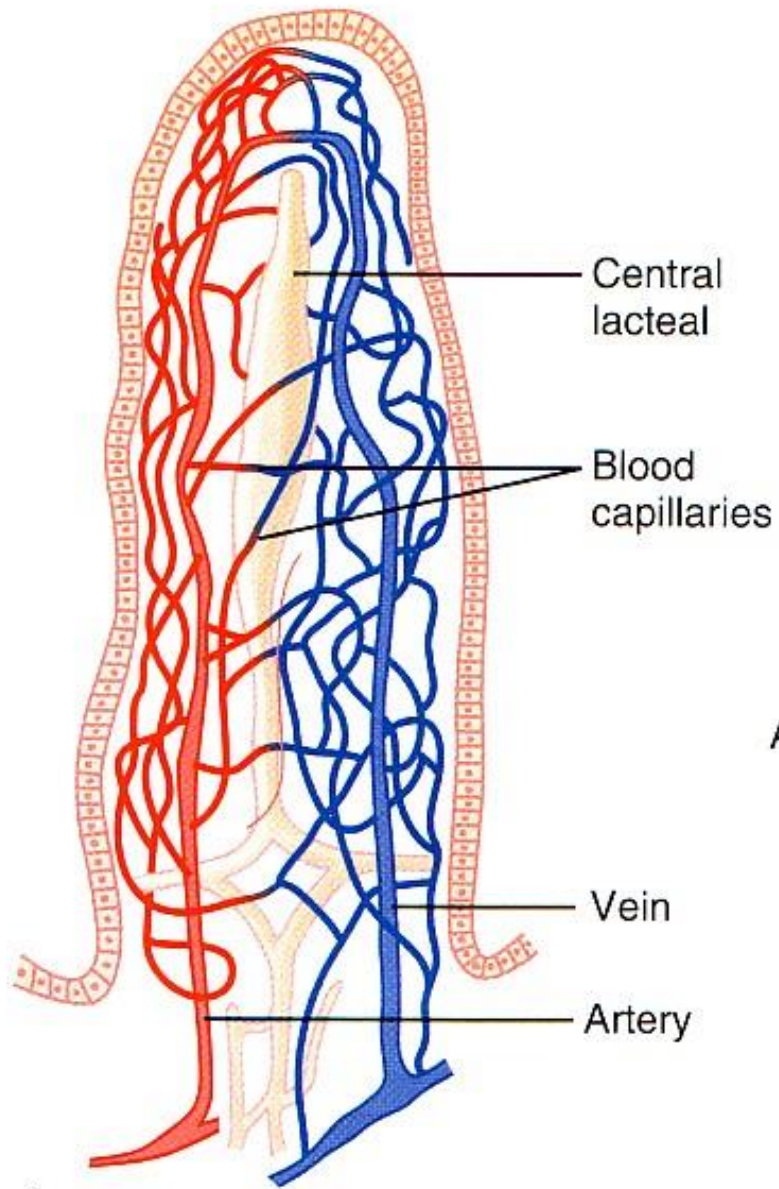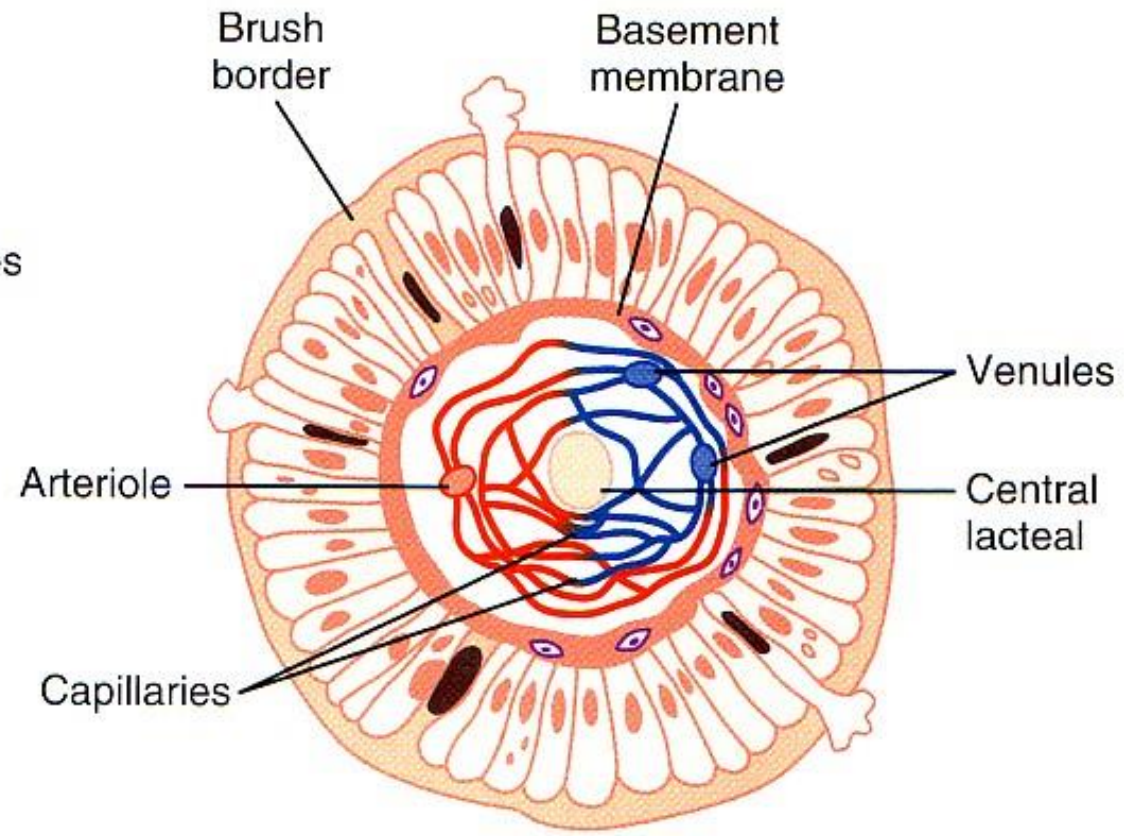
Why is the *pancreas* so unique?

Bile duct from liver

Duodenum

Stomach

Hormones (insulin, glucagon)

Blood

Duct cells secrete aqueous NaHCO₃ solution

Acinar cells secrete digestive enzymes

Endocrine portion of pancreas (Islets of Langerhans)

Exocrine portion of pancreas (Acinar and duct cells)

The glandular portions of the pancreas are grossly exaggerated.
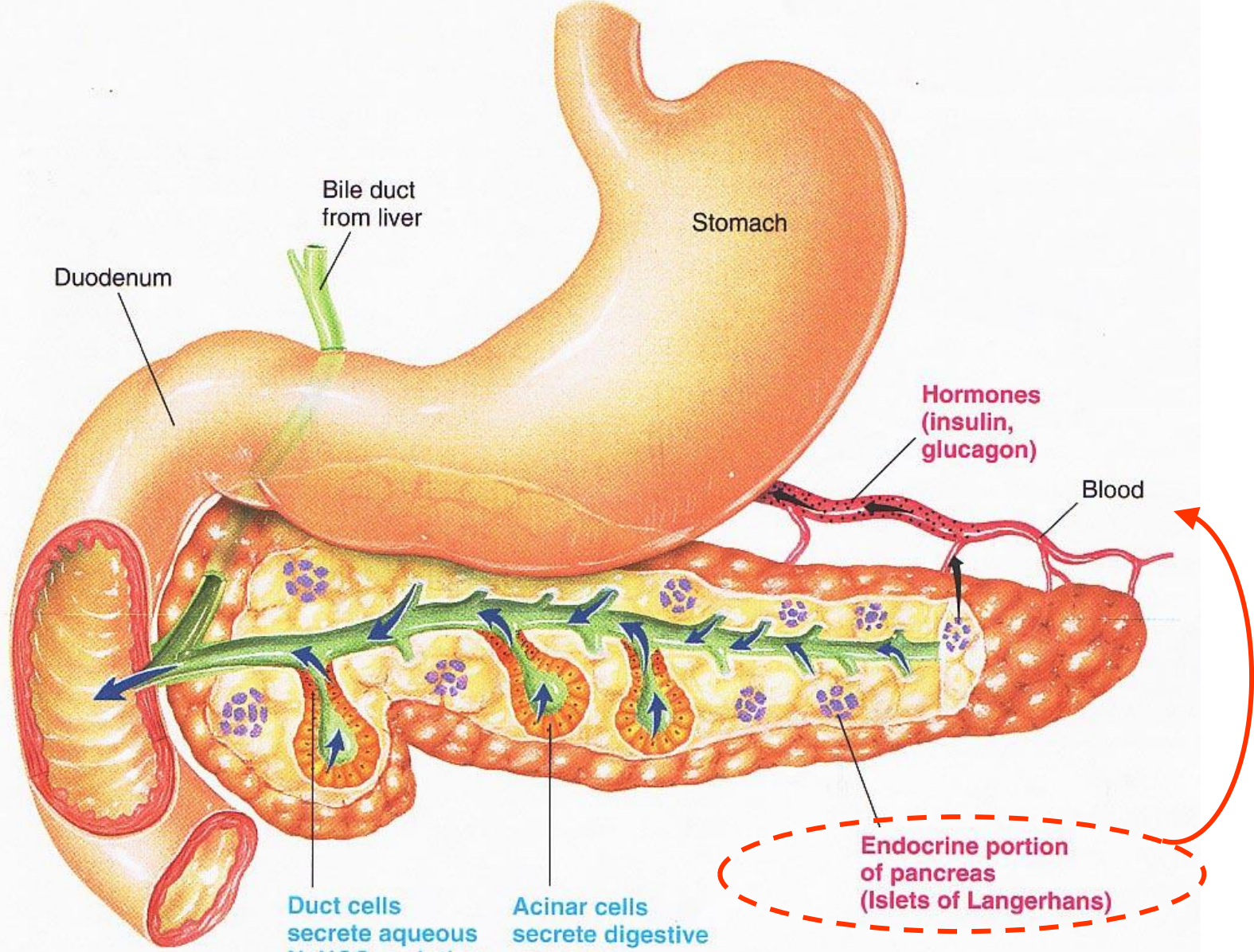
Enzymes specific for all 3 energy nutrients!

LS2 2006

Semi-mush

Mush

Semifluid

Fluid

Poor motility causes greater absorption, and hard feces in transverse colon causes constipation

Ileocecal valve

Semi-solid

Solid

Excess motility causes less absorption and diarrhea or loose feces

G&H 2011 fig 63-5
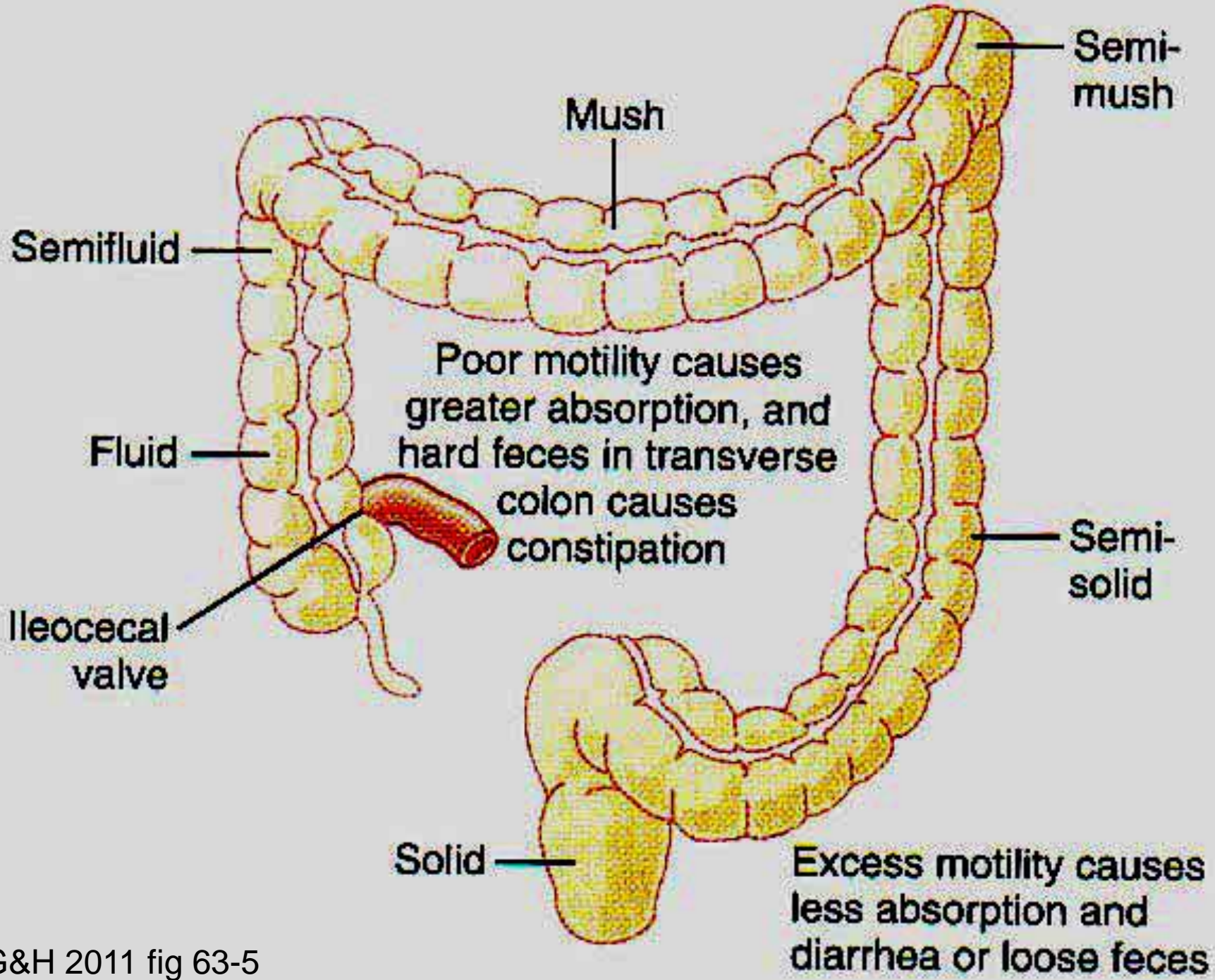
Genetics & Environmental Disease Continuum
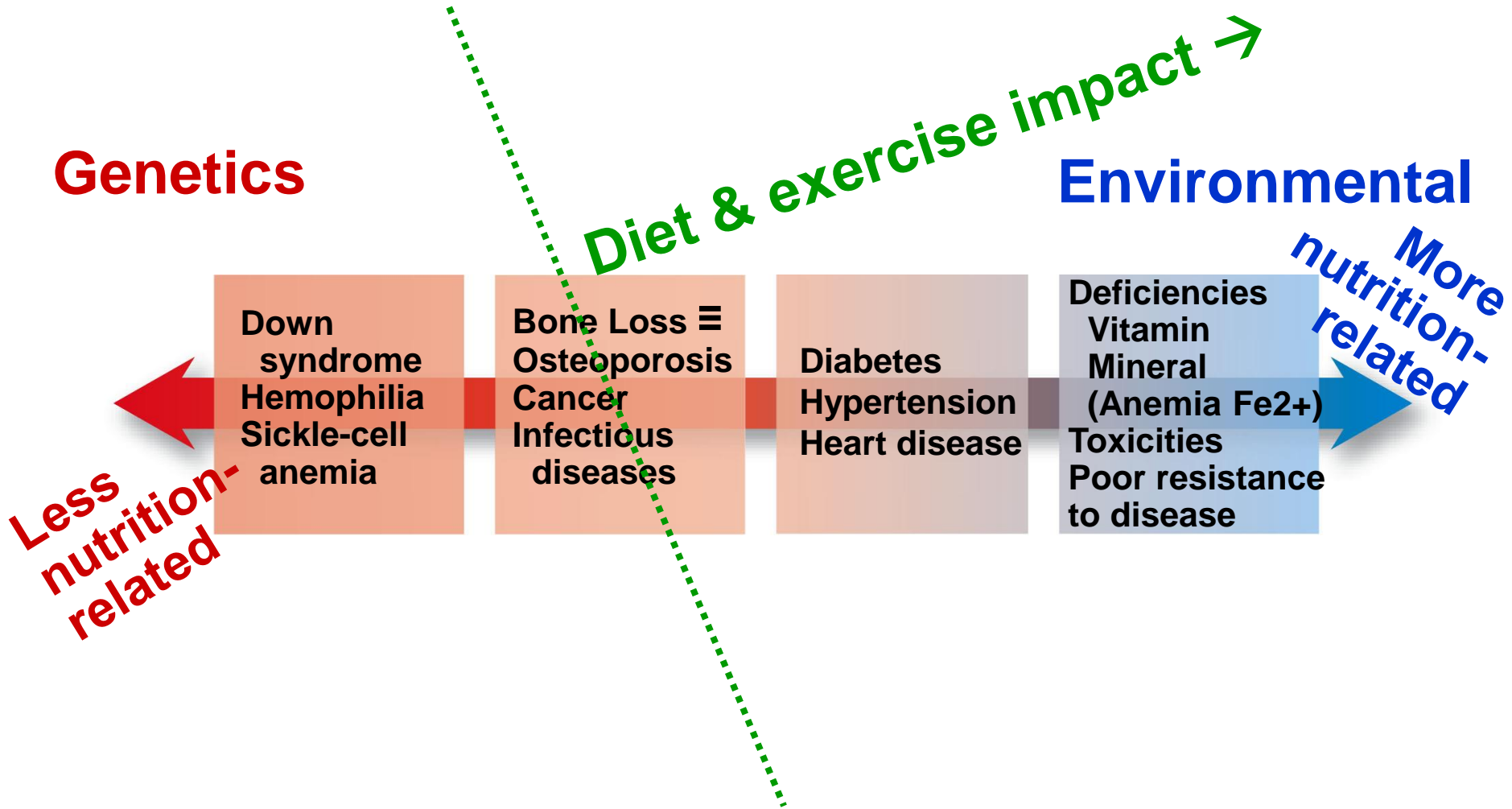
Genetics

Diet & exercise impact →

Environmental

Less nutrition-related

More nutrition-related

Down syndrome
Hemophilia
Sickle-cell anemia

Bone Loss ≡ Osteoporosis
Cancer
Infectious diseases

Diabetes
Hypertension
Heart disease

Deficiencies
Vitamin
Mineral
(Anemia Fe2+)
Toxicities
Poor resistance to disease

Sizer & Whitney 2011 fig 1-1 p 3

Eat Real, America!

"With the right food choices, physical activity, and not smoking, we could prevent about 80 percent of heart disease, about 90 percent of diabetes, and 70 percent of stroke," says Walter Willett, chair of the nutrition department at the Harvard School of Public Health in Boston. "Those are the three pillars. They really do make a difference."

The right food choices are simple: Eat less red meat, sweets, refined grains, and salt, and drink fewer sugary beverages. Replace unhealthy foods with vegetables, fruit, beans, and whole grains, and with smaller amounts of fish, poultry, and low-fat dairy. Those foods aren't just good for our health. They can also help protect the Earth.

Here's why—and how—to eat real.

With the right food choices, physical activity, and not smoking, we could prevent about 90% of diabetes, 80% of heart disease, about & 70% of stroke!
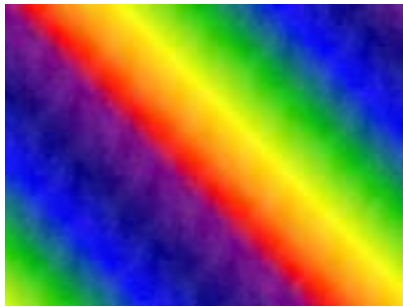
Eating the Rainbow Hawaiian Style!!

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*, September 11, 2008 citing D. Chong & N. Kerr.

All of these factors help to build a nutritious diet.
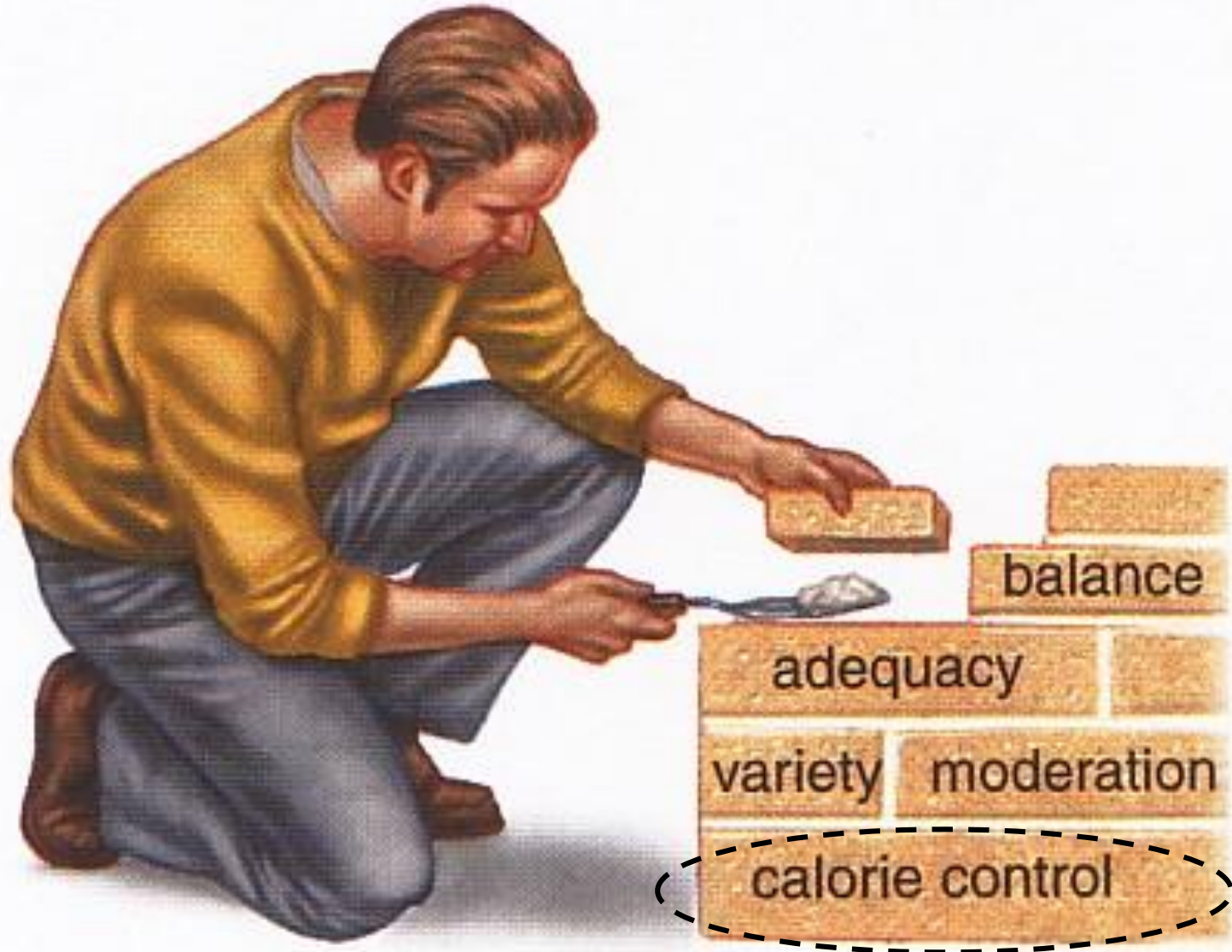
**To Help Lower Body Wt & %Fat
EXERCISE!! +*Minimize* These!!**

FAT	**9 Kcal/g**
ETOH	**7 Kcal/g**
CARB	**4 Kcal/g**
PRO	**4 Kcal/g**

**<u>NB</u>: *<u>Minimize</u>* not *Eliminate*!
Moderation not *Abstinence!!***

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

Energy Nutrient	% Total Calories
Carbohydrate	45-65%
Fat	20-35%
Protein	10-35%

Low in kcal, **High** in vitamins, minerals & fiber!
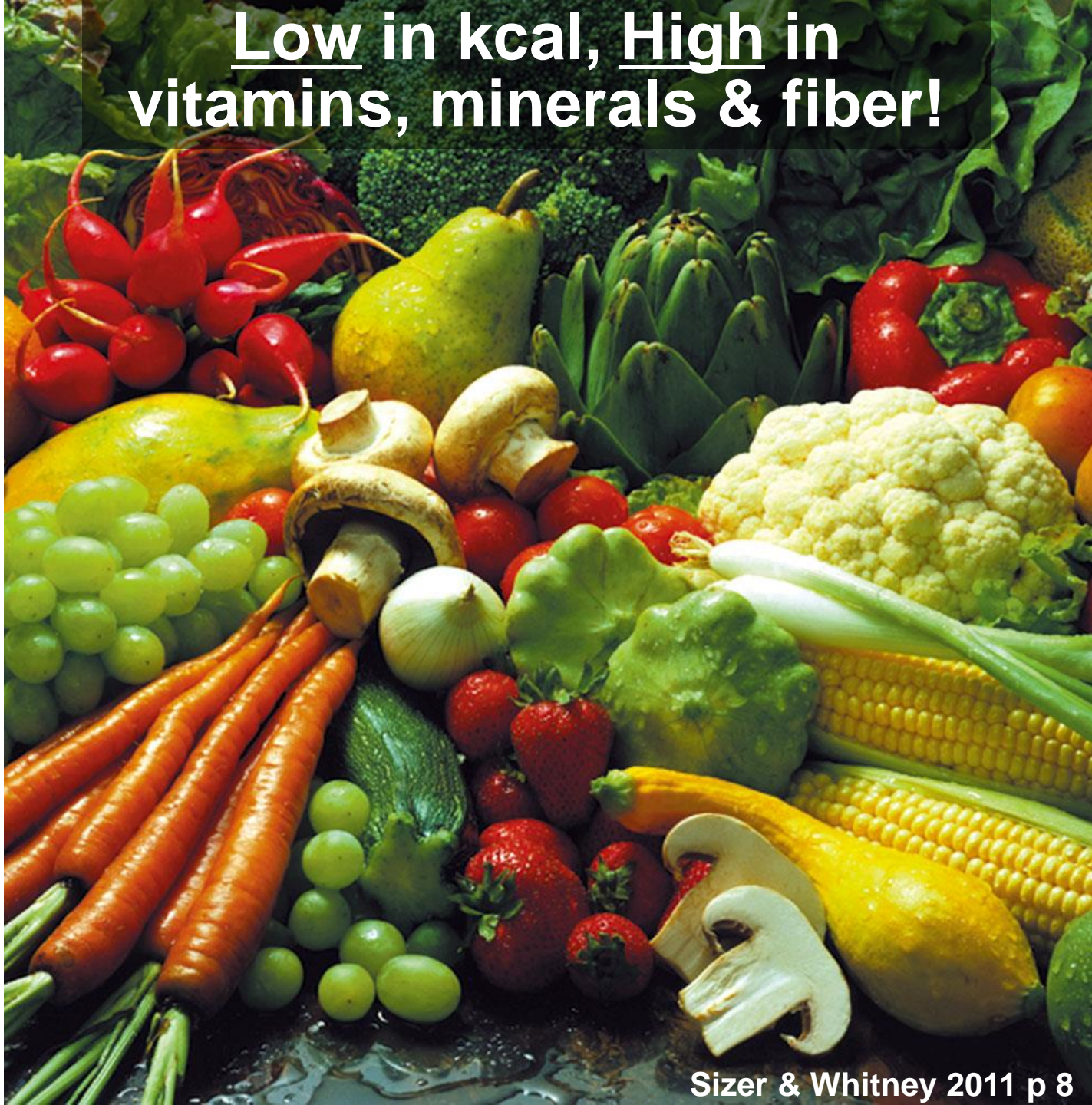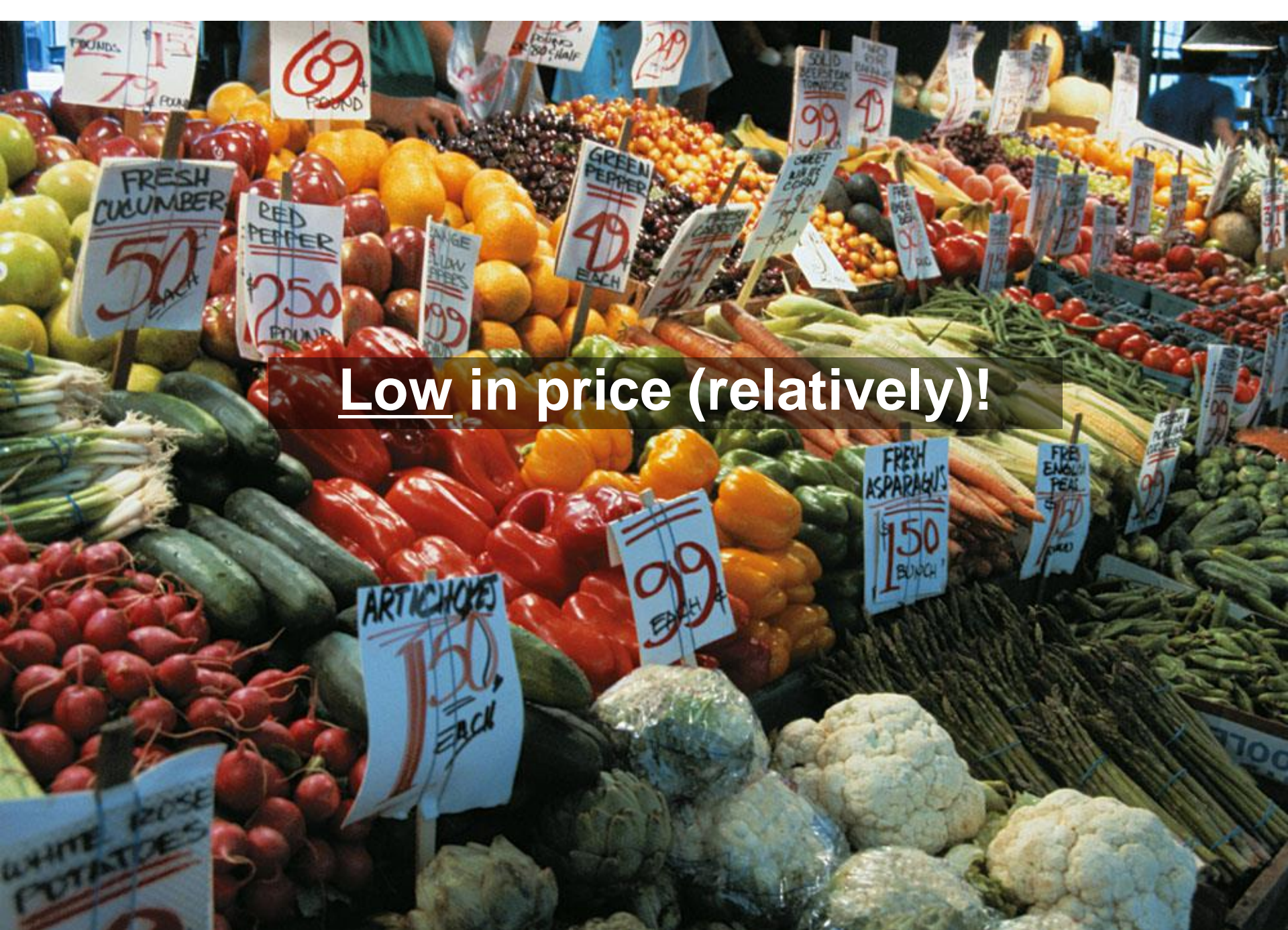
Low in price (relatively)!

High in kcal, low in vitamins, minerals & fiber!

MyPlate launched June 2, 2011!

2. <u>Focus on fruits</u>. Whole fruit preferable to juice, but any fruit counts! Fill ½ your plate with fruits & vegetables!
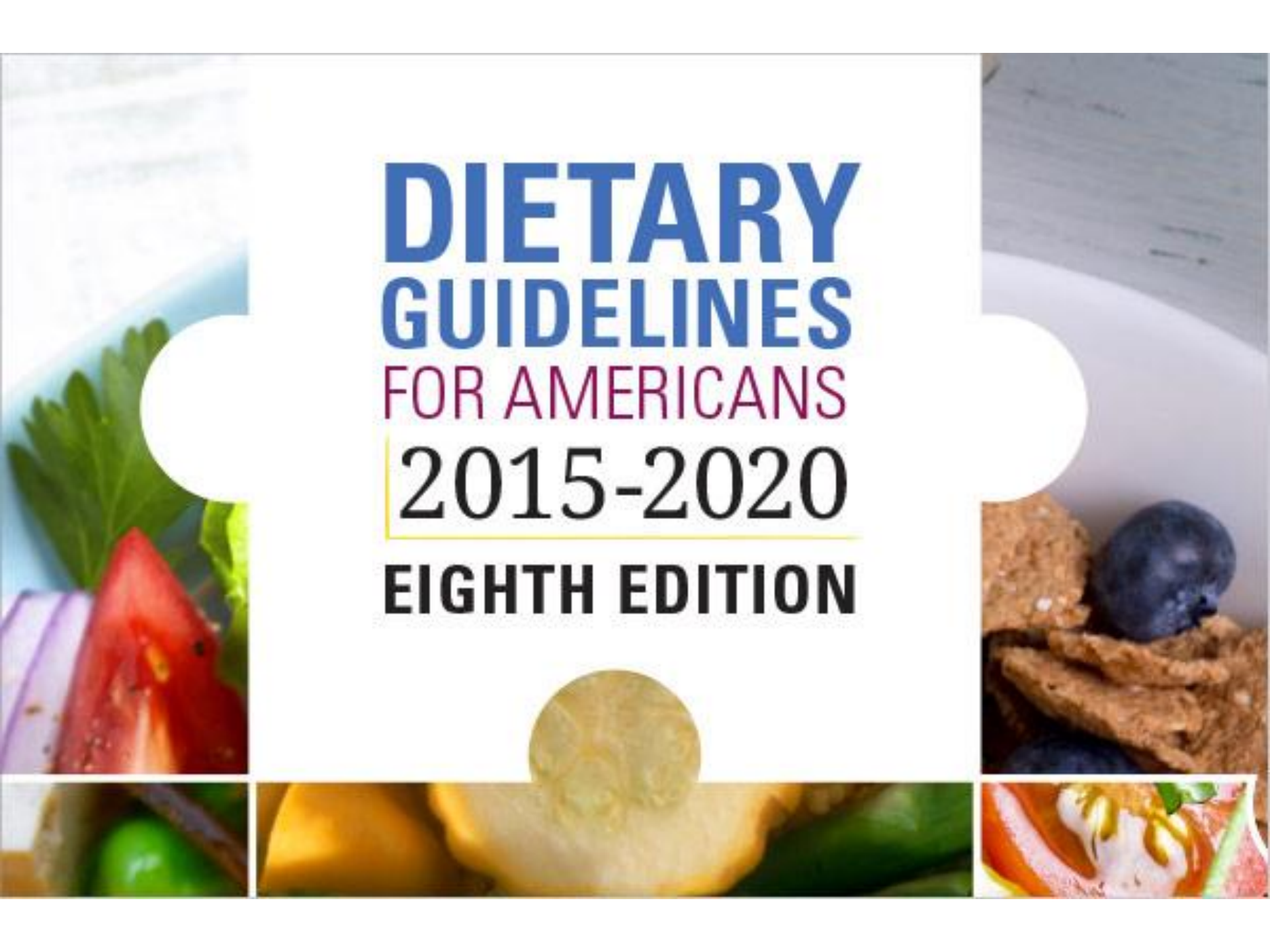
3. <u>Make at least ½ of your grains whole</u> grains!

5. <u>Get your calcium-rich foods</u>. Buy skim or 1% milk. Go easy on cheese!

1. <u>Vary your veggies</u>. Fill ½ your plate with fruits & vegetables!

4. <u>Go lean with protein</u>. Keep protein to < ¼ 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 <u>includes</u>:

- <u>**Variety of vegetables**</u> from all subgroups: dark green, red & orange, legumes, starchy & other
- **<u>Fruits</u>**, especially whole fruits
- <u>**Grains**</u>, at least half of which are whole grains
- **<u>Fat-free or low-fat dairy</u>**, including milk, yogurt, cheese &/or fortified soy beverages
- <u>**Variety of protein foods**</u> including seafood, lean meats & poultry, eggs, legumes & nuts, seeds & soy products
- **<u>Oils</u>** (healthy)

A healthy eating pattern <u>limits</u>:

- **<u>Saturated fats</u>** & **<u>trans fats</u>**, added **<u>sugars</u>** & **<u>sodium</u>**
- <u>**Balance calories with physical activity**</u> to manage weight.

http://health.gov/dietaryguidelines/2015/

Sodium (Na) Intakes of U.S. Adults

Daily Averages (milligrams)

3,500
3,000
2,500
2,400[a]
2,000
1,500
1,000
500
0

Blacks   Whites   Other[b]

< 2400 mg ↓ BP = 1 tsp of Salt (NaCl ≅ 40% Na)

< 1500 mg ↓ BP

< 500 mg/d = ¼ tsp Salt/d!

Body requirement
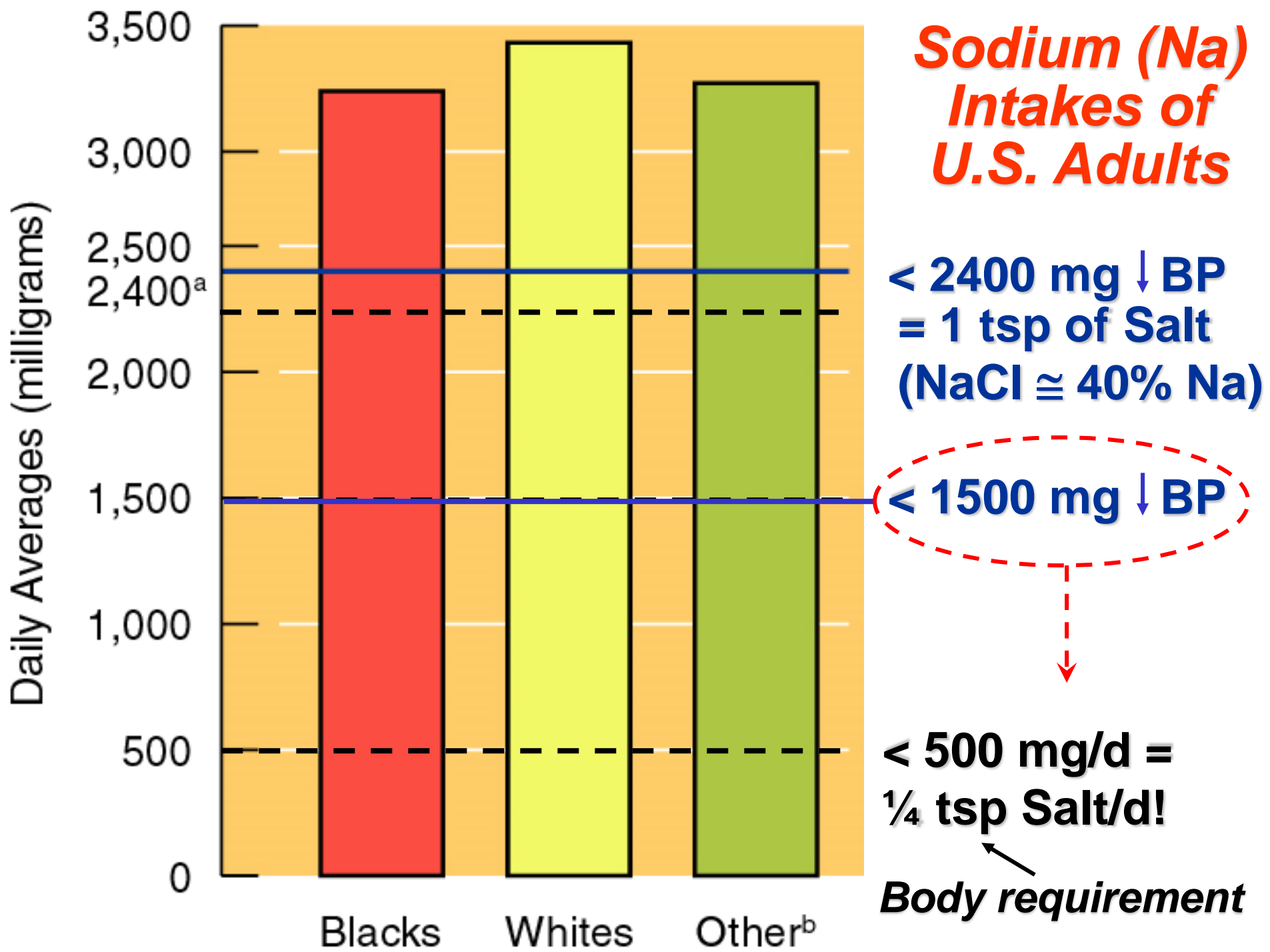
Sodium Reduction as a Means to Prevent Cardiovascular Disease and Stroke

1. Approximately <u>90% of Americans</u> will develop high blood pressure or <u>hypertension</u> over their lifetime.

2. BP-related diseases: stroke, CHD, heart failure & kidney disease are <u>leading causes of morbidity & mortality</u> in the US & throughout the world.

3. <u>Independent</u> of its effects on BP, excess sodium intake <u>adversely affects the heart, kidneys & blood vessels</u>.

4. <u>Reducing sodium intake</u> to < 1500 mg/d should reduce American deaths from CVD & stroke by 20%.

http://www.heart.org/HEARTORG/GettingHealthy/NutritionCenter/HealthyDietGoals/Sodium-Salt-or-Sodium-Chloride_UCM_303290_Article.jsp

More Reasons to Shake the Salt Habit
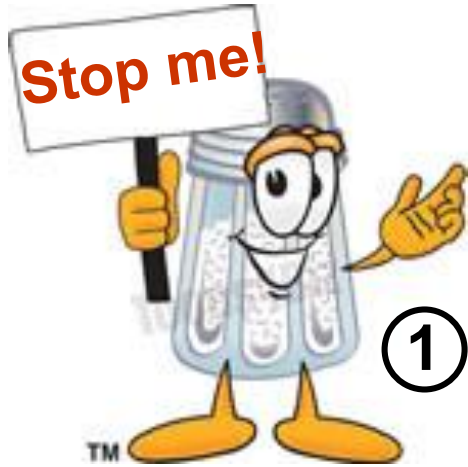
① ↓blood vessel vasodilation w/in 30 min by ingesting 1500 mg Na+!

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 WellnessLetter Jun 2011, Jan 2012

Mayo Clinic How to tame your salt habit!

Dietary Approaches to Stop Hypertension (DASH)

Fruits & vegetables + low-fat dairy products
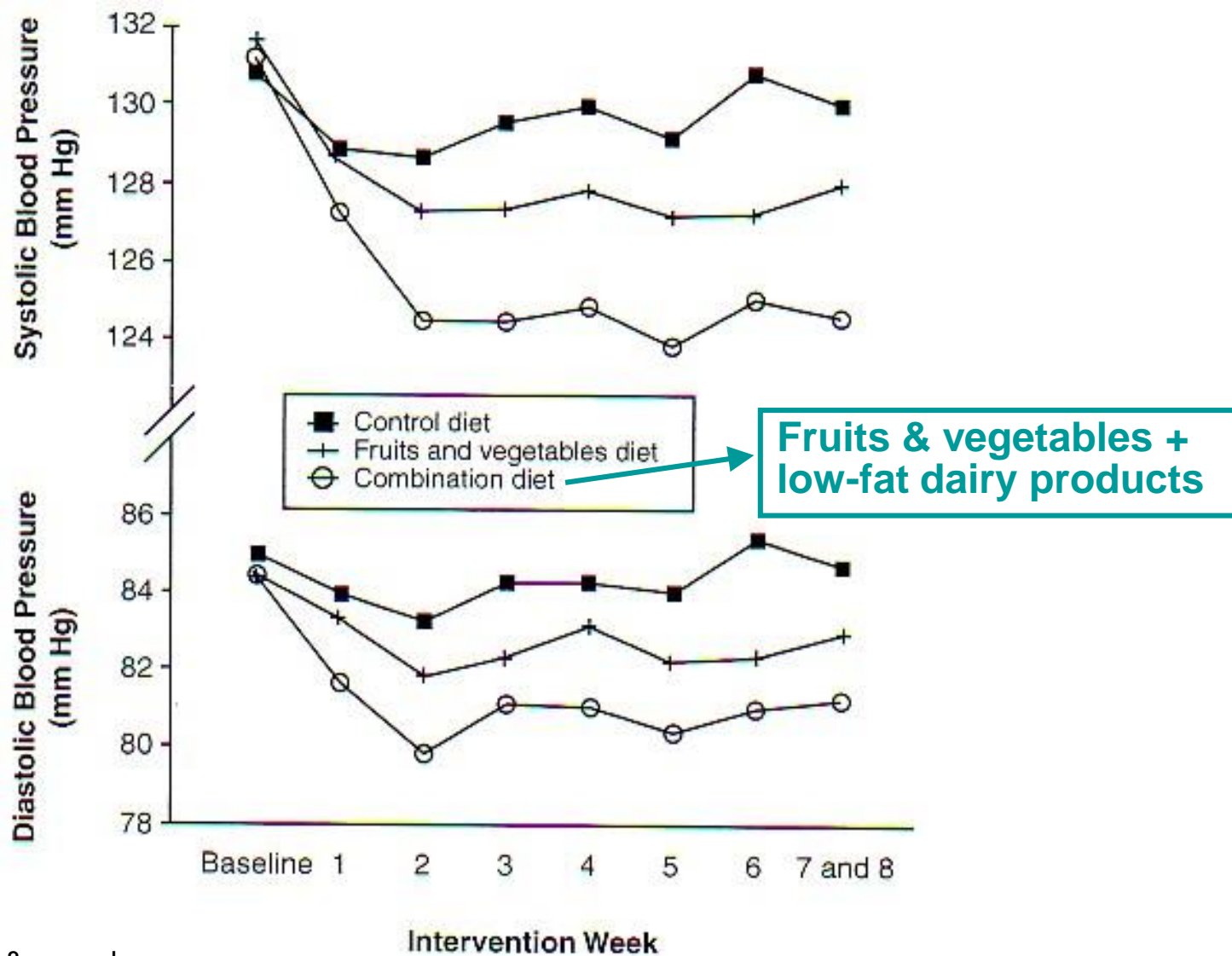
SOURCE: LJ Appel & coworkers, *NEJM* 1997,336:1117-24

http://www.nhlbi.nih.gov/health/health-topics/topics/dash

AHA Statistical Fact Sheet 2013 Update
What do Americans* eat per day?

Whole grains: 0.5-0.8 servings/d
   Only 3-5% consume ≥ 3 servings/d

Vegetables: 1.3-2.2 servings/d
   Only 3-7% consume ≥ 5 servings/d

Fruits: 1.1-1.8 servings/d
   Only 6-11% consume ≥ 4 servings/d

Fish & Shellfish   1.2-1.7 servings/wk
   75%-80% or more consume < 2 servings/wk

Fish Oil Intakes & Cardiovascular Death Rates

Sizer & Whitney 2011
fig 5-12 p 167
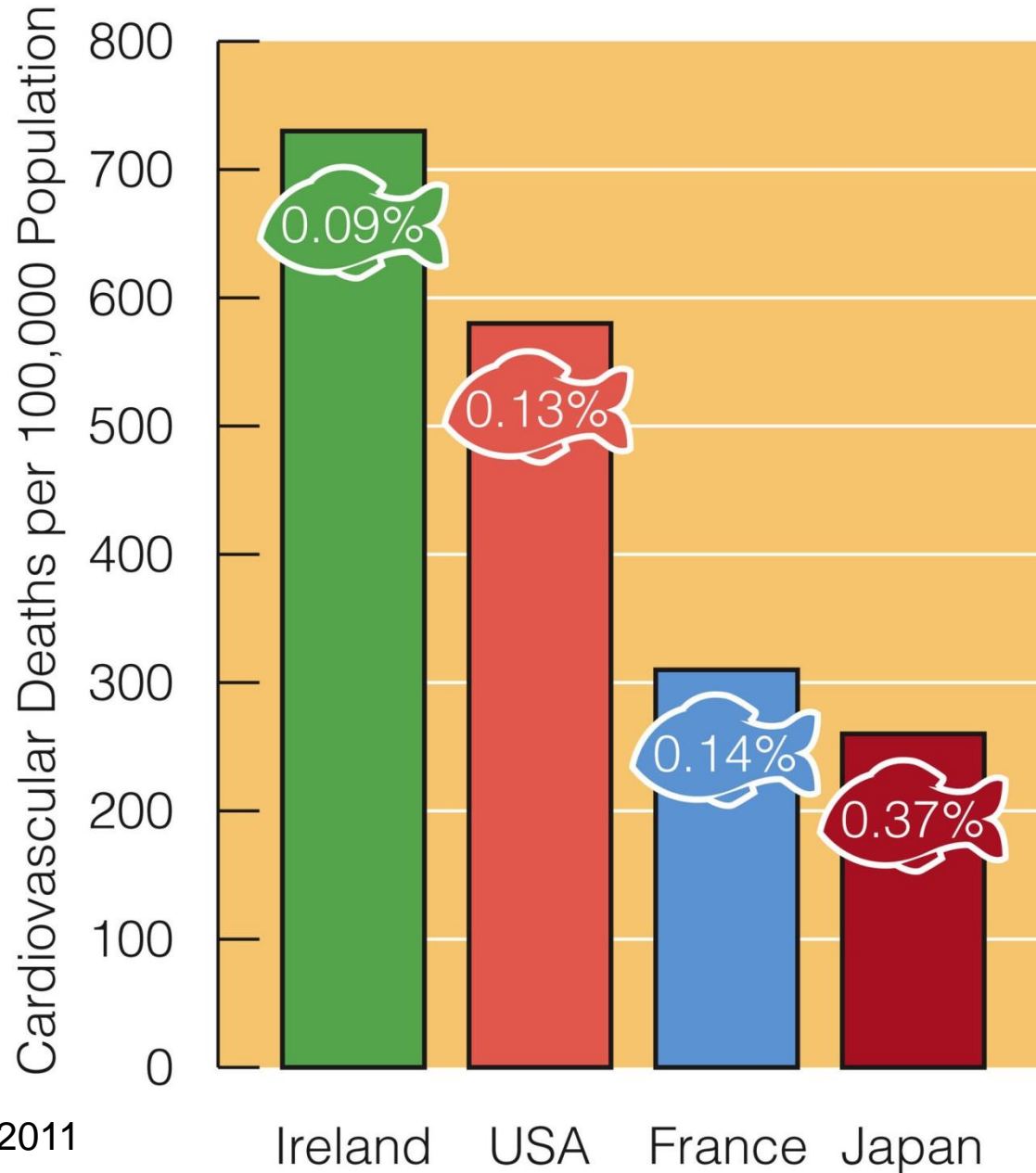
Deep cold water fish are fabulous sources of Ω-3 fatty acids!

Mediterranean Diet Pyramid
A contemporary approach to delicious, healthy eating

Meats and Sweets
Less often

Wine
In moderation

Poultry and Eggs
Moderate portions, every two days or weekly

Cheese and Yogurt
Moderate portions, daily to weekly

Fish and Seafood
Often, at least two times per week

Drink Water

Fruits, Vegetables, Grains (mostly whole), Olive oil, Beans, Nuts, Legumes and Seeds, Herbs and Spices
Base every meal on these foods

Be Physically Active; Enjoy Meals with Others

Illustration by George Middleton   ©2009 Oldways Preservation and Exchange Trust   www.oldwayspt.org

saturated   monounsaturated   polyunsaturated
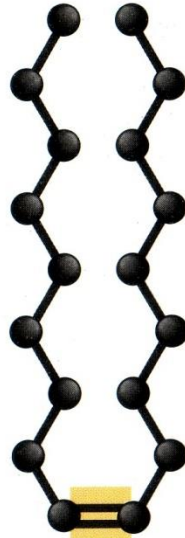
point of unsaturation
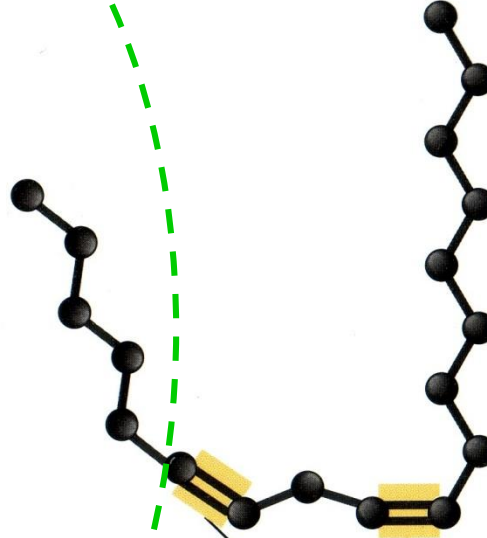
points of unsaturation

NB: Minimize trans fats!

♥ *Healthy Oils to Minimize Atherosclerosis HAPOC?*

H A P O C
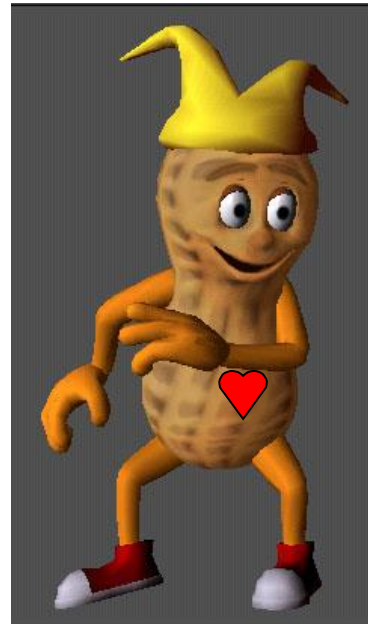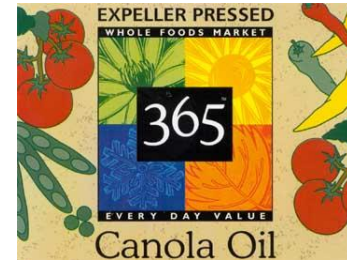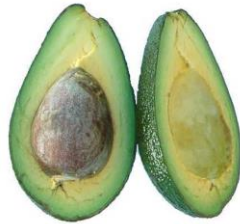
Essential Fatty Acids: Ω-6 Linoleic & Ω-3 Linolenic Acids

Linoleic → Arachadonic Acid → Inflammatory Cascade

Linolenic → EPA, DHA → Anti-inflammatory

Emphasize good fats from plant sources like avocados!

Sizer & Whitney 2011 p 155

US Carbohydrate Intake Recommendations

1. **45-65% of total calories, so for 2000 kcal diet ~½ or 1000 kcal, for 2500 kcal, 1250 kcal from carbohydrates.**

2. **Absolute minimum of 130 g/d (DRI) for CNS!**

3. **Choose & prepare foods & beverages with little added sugars. Insufficient evidence exists to set UL, but DRI says a high maximum of 25% or less of total kcal.**

4. **Added sugars may provide discretionary calories <u>after all nutrient recommendations are met!</u> (USDA)**

5. **Not more than ½ of discretionary calories should come from sugars. For women ≤ 100 kcal, for men ≤ 150 kcal.**

6. **Increase intakes of whole fruits & vegetables & make ≥ ½ grain choices whole grain. Legumes several times/wk.**

7. **≤ 50 yr, women 25 g fiber/d, men 38 g fiber/d.**

Why Lower Simple Sugars?

Each person in the US ingests ~ ¾ cup or 31 tsp of refined sugars added to foods & beverages each day ≡ > 140 lb per year!

Sizer & Whitney 2011 p 145

Sugar in processed foods?

1 Tbs creamer = 2 tsp sugar

12 oz cola ≥ 10 tsp sugar

1 Tbs ketchup = 1 tsp sugar

8 oz sweetened yogurt = 8 tsp sugar

½ cup canned corn = 1 tsp sugar

2 oz chocolate = 8 tsp sugar

Sizer & Whitney 2011 fig 4-17 p 139

Added Sugars: Average US Supply per Person

39 g   41 g
≡ ~ 10 tsp!

USDA
← Suggested upper limit (men)[a]
← Suggested upper limit (women)[a]

♂
♀

AHA suggested upper limits!   S&W 2011 fig C4-4 p 145

http://www.dailymail.co.uk/health/article-3255034/Coca-Cola-Pepsi-brands-differ-sugar-world.html
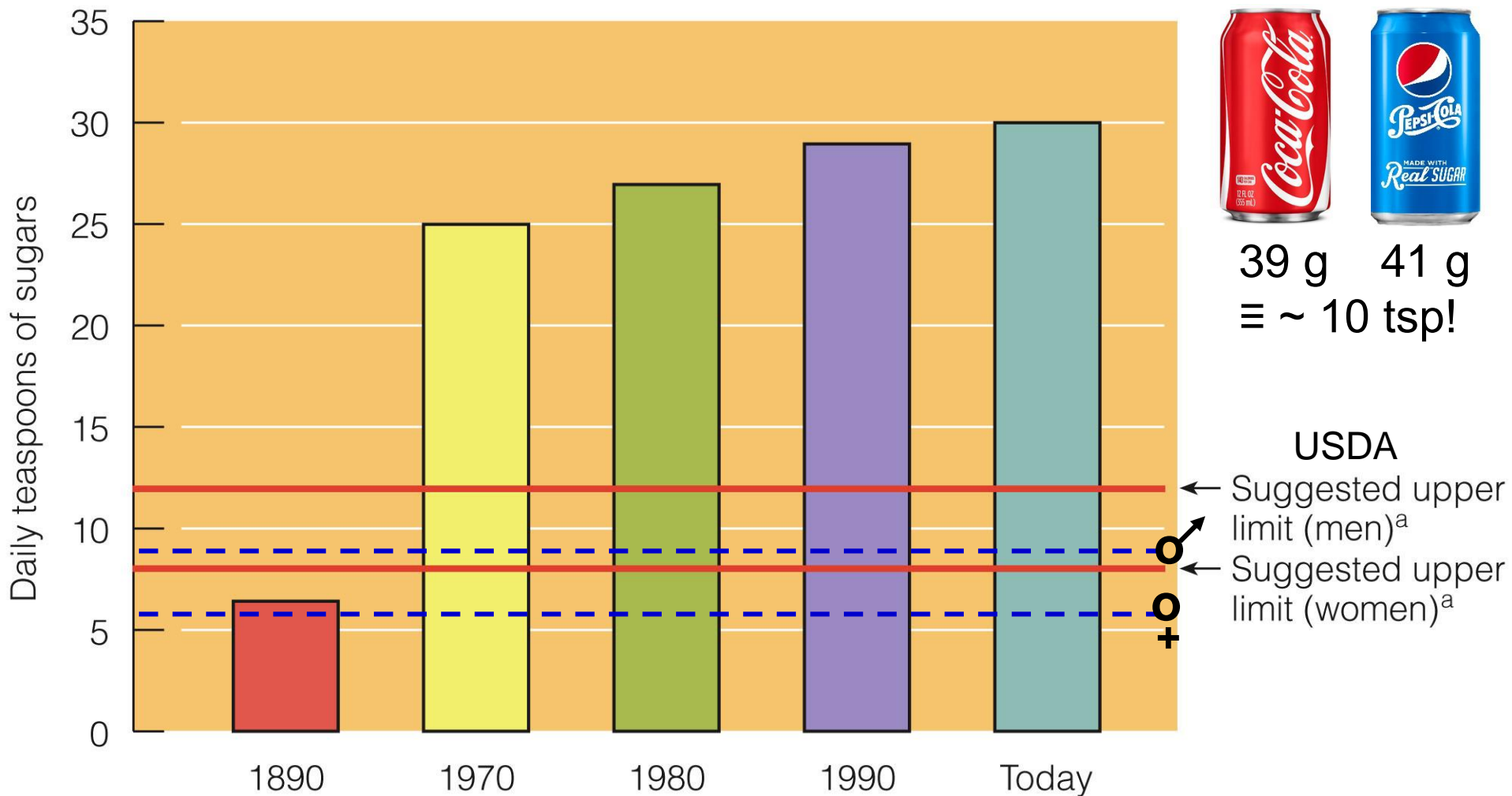
DIABETES

How to Play Defense

BY BONNIE LIEBMAN

"**N**umber of people with diabetes increases to 24 million," announced the Centers for Disease Control and Prevention in June.

One out of four Americans aged 60 or older now has the disease. Another 57 million people—40 percent of those aged 40 to 70—have pre-diabetes. Diabetes has even started to show up in teenagers.

"We've seen strong and sustained increases in the incidence of diabetes since 1990, and they show no signs of slowing down," notes Linda Geiss, chief of diabetes surveillance at the CDC. "It's like a runaway train."

Is there any good news about an epidemic that's out of control?

"Diabetes is an almost totally avoidable disease," says Walter Willett of the Harvard School of Public Health in Boston. "We estimate that more than 92 percent of the cases could be avoided by diet and lifestyle."

PRODUCE AISLE

DIABETES AISLE

1994 Diabetes Prevalence
in the US by State

Key:

(yellow)	<4.5%
(light blue)	4.5%–5.9%
(magenta)	6.0%–7.4%
(purple)	7.5%–8.9%
(green)	≥9%

2010 Diabetes Prevalence
in the US by State

Key:

<4.5%	7.5%–8.9%
4.5%–5.9%	≥9%
6.0%–7.4%	

INSULIN RESISTANCE

When insulin docks in the receptors on cell membranes, that should signal glucose transporters to let glucose (blood sugar) into the cell. But if you are insulin resistant, some glucose transporters never get the message. (Others don't need insulin to let glucose in.) That leaves excess glucose in the blood, so the pancreas has to pump out more insulin. If it can't keep up, blood sugar rises and you have diabetes.

WHERE'S THE FAT?

Muscle Fat

Liver Fat

Visceral Fat
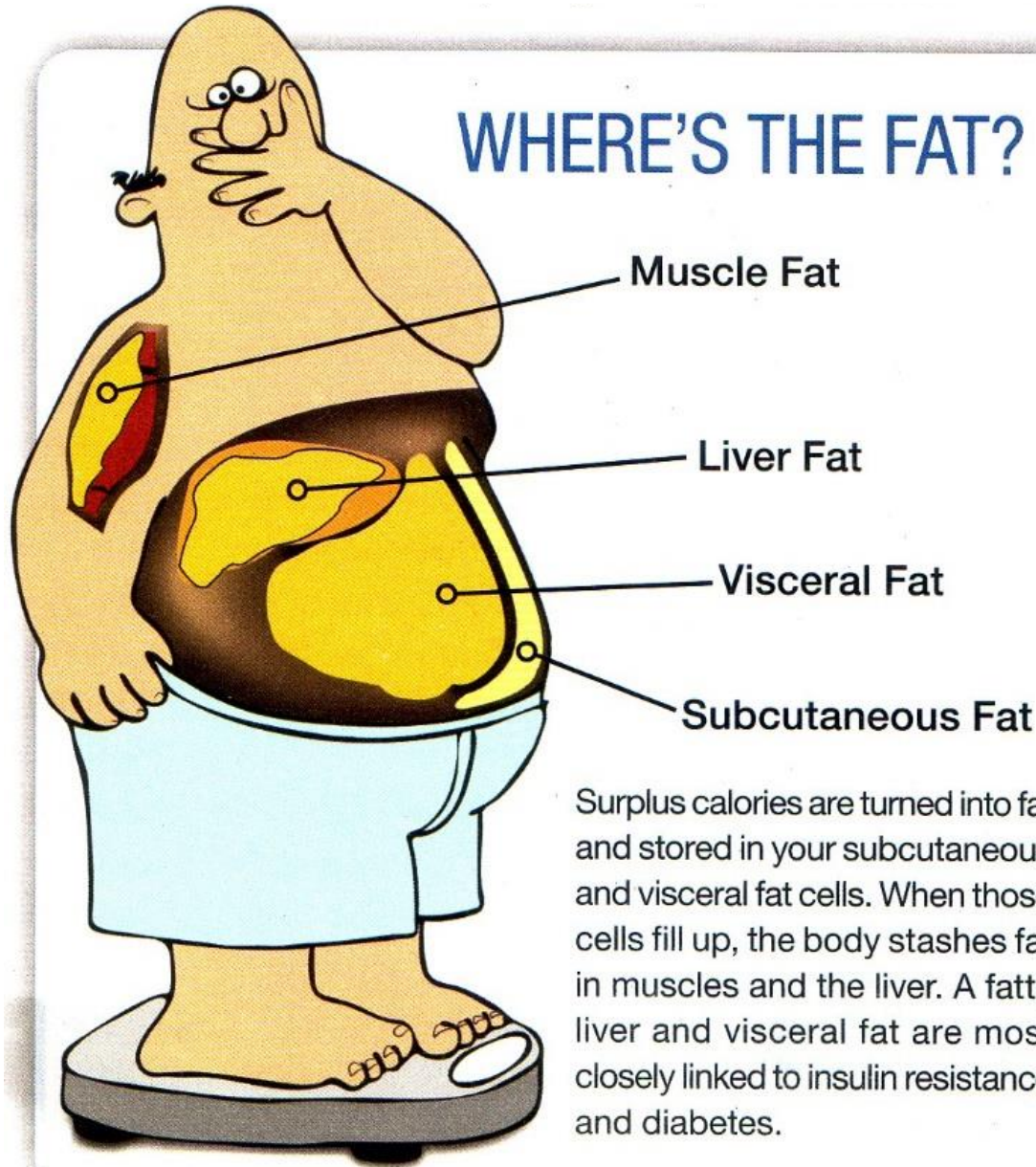
Subcutaneous Fat

Surplus calories are turned into fat and stored in your subcutaneous and visceral fat cells. When those cells fill up, the body stashes fat in muscles and the liver. A fatty liver and visceral fat are most closely linked to insulin resistance and diabetes.

The Bottom Line

- The best way to dodge diabetes is to lose (or not gain) extra pounds.

- Limit sweets, especially sugar-sweetened drinks. Even the naturally occurring sugars in 100% fruit juice may raise your risk.

- Eat leafy greens, whole grains, beans, and nuts to boost your magnesium.

- Get the RDA for vitamin D (600 IU a day up to age 70 and 800 IU over 70) from supplements or foods fortified with vitamin D.

- Do *at least* 30 minutes of brisk walking or other aerobic exercise every day.

- Shoot for 2 or 3 strength training sessions a week. Each should include 8 to 12 repetitions of 8 to 10 exercises.

Nutrition Action HealthLetter, Center for Science in the Public Interest, June 2011.

**Recommendations for
CANCER PREVENTION**

1. Be as <u>lean</u> as possible <u>without</u> becoming <u>underweight</u>.
2. Be <u>physically active</u> for <u>at least 30 minutes</u> <u>every day</u>.
3. <u>Avoid sugary drinks</u>. <u>Limit</u> the consumption of energy-dense foods particularly <u>processed foods</u> high in added sugar, or low <u>in fiber</u>, or <u>high in fat</u>.
4. <u>Eat</u> more of a <u>variety</u> of <u>vegetables, fruits, whole grains</u> & <u>legumes</u> such as <u>beans</u>.
5. <u>Limit</u> consumption of <u>red meats</u> (such as beef, pork & lamb) & avoid <u>processed meats</u>.
6. If consumed at all, <u>limit alcoholic drinks</u> to 2 for men & 1 for women a day.
7. <u>Limit</u> consumption of <u>salty foods</u> & foods <u>processed</u> with salt (sodium).
8. Don't use supplements to protect against cancer.

The Mayo Clinic Diet Emphasizes Vegetables, Fruits & Whole Grains, Too!

Mayo Clinic Healthy Weight Pyramid

Category	Recommendation
SWEETS	Up to 75 calories daily
FATS	3 to 5 daily servings
PROTEIN/DAIRY	3 to 7 daily servings
CARBOHYDRATES	4 to 8 daily servings
FRUITS	Unlimited (minimum 3)
VEGETABLES	Unlimited (minimum 4)

Daily Physical Activity

© Mayo Foundation for Medical Education and Research. See your doctor before you begin any healthy weight plan.

http://www.mayoclinic.org/healthy-living/weight-loss/in-depth/mayo-clinic-diet/art-20045460

Vegetarian Food Pyramid? Yes, but be a scientist!

Oils — 2–3 teaspoons

Nuts and Seeds — 1–2 servings

Vegans need these supplements:
Vitamin B$_{12}$: 2.4 µg/d
Vitamin D: 200 IU/d
Calcium: 600 mg/d

Dairy
Vegan: fortified non-dairy substitutes
3 servings

Beans and Protein Foods — 2–3 servings

Vegetables — 2–4 servings

Green Leafy Vegetables — 2–3 servings

Fruits — 1–2 servings

Dried Fruit — 1–2 servings

Bread, Pasta, Rice, Fortified Cereals — 6–10 servings

VEGETARIAN FOOD PYRAMID

Water: 8 cups daily - Needs increase with activity

Be Physically Active!

© 2006 Wadsworth - Thomson

SOURCES: **Sizer & Whitney 2006** *Nutrition: Concepts & Controversies*;
Venti & Johnston 2002 *Journal of Nutrition* **132:1050-4.**

Potential regulators of health!

10s of thousands!

① **Anti-oxidants**
protect DNA from oxidative damage

② **Protein synthesis**
regulation/control

③ **Hormone-like action**
endocrine mimicry

④ **Blood effects**
modify blood chemistry

Phytochemicals ≡ Plant chemicals

aroma, color, taste

Broccoli sprouts may contain ~ 10,000 unique phytochemicals!

Sizer & Whitney 2011 p 66

A Wealth of Phytochemicals

All cruciferous vegetables contain powerful cancer-fighting phytochemicals, including:

diindolylmethane (DIM), one of many *indoles* found in these vegetables, has been shown to inhibit proteins associated with breast and ovarian cancers.

crambene, plentiful in Brussels sprouts, may offer the most preventive benefits when combined with *indole-3-carbinol* (I3C).

glucosinolates, which turn into powerful protective agents called *isothiocyanates* when a cruciferous vegetable is chewed or chopped. May reduce inflammation, a factor in cancer development.

American Institute for Cancer Research

American Institute for Cancer Research Foods that Fight Cancer

Beans   fiber, saponins, protease inhibitors, phytic acid.

Berries   fiber, vitamin C, ellagic acid, flavonoids

Cruciferous Vegetables glucosinolates: glucoraphin →
        sulphoraphane, crambene, indole-3-carbinol & isothiocyanates

Dark Green Leafy Vegetables fiber, folate, carotenoids: 1^0 lutein &
        zeaxanthin; saponins, flavonoids

Flaxseed lignans (a phyto-E), α-linolenic acid (an Ω-3)

Garlic   organosulfurs: allicin, alliin, allyl sulfides; quercetin,...

Grapes and Grape Juice resveratrol (a polyphenol)

Green Tea catechins (class of flavonoids), polyphenols

Soy   isoflavones, saponins, phenolic acids, phytic acid, phytosterols,
        protein kinase inhibitors

Tomatoes lycopene

Whole Grain fiber, vitamins, minerals, 100s of phytochemicals:
        antioxidants, phenols, lignans (a phyto-E), saponins

http://www.aicr.org/site/PageServer?pagename=foodsthatfightcancer_home

≥ 5 tomato-containing meals per week may protect from cancers of the esophagus, stomach & prostate !

...but, the phytochemical candidate, <u>lycopene</u> with anti-oxidant activity is also in guava, papaya, pink grapefruit & watermelon!
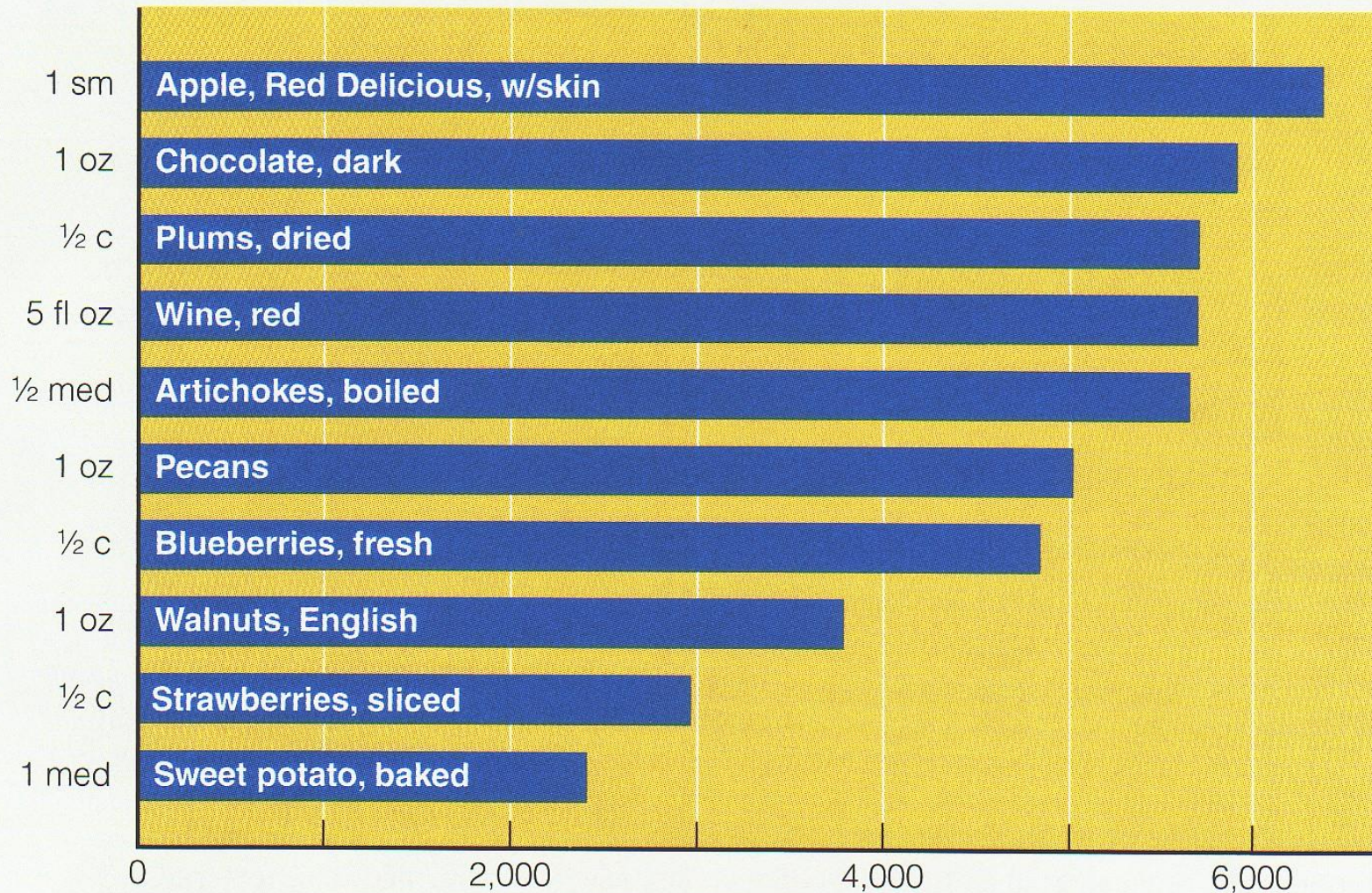
Common Foods Ranked by Antioxidant Content

TABLE C2-3

1. Blackberries
2. Walnuts
3. Strawberries
4. Spinach
5. Artichokes, prepared
6. Cranberries
7. Coffee
8. Raspberries
9. Pecans
10. Blueberries
11. Cloves, ground
12. Grape juice, cranberry juice, pomegranate juice
13. Chocolate, dark, unsweetened
14. Cherries, sour
15. Wine, red

Sizer & Whitney 2011 Table C2-3 p 64

Antioxidant Capacity Depends Upon Seasons, Storage, Testing Methods, Variety…

Serving	Food
1 sm	Apple, Red Delicious, w/skin
1 oz	Chocolate, dark
½ c	Plums, dried
5 fl oz	Wine, red
½ med	Artichokes, boiled
1 oz	Pecans
½ c	Blueberries, fresh
1 oz	Walnuts, English
½ c	Strawberries, sliced
1 med	Sweet potato, baked

0   2,000   4,000   6,000

[a]Measured in micromole TE (Trolox equivalents), a laboratory-derived value used to measure the antioxidant activity of foods. Other laboratory methods yield other results.

Source: R. M. Bliss, Data on Food Antioxidants Aid Research, November 2007, available at http://www.ars.usda.gov/is/pr/2007/071106.htm.

Environmental Working Group Suggestions

Dirty Dozen!

Buy These Organic
- **Apples**
- **Bell Peppers**
- **Celery**
- **Cherries**
- **Imported Grapes**
- **Nectarines**
- **Peaches**
- **Pears**
- **Potatoes**
- **Red Raspberries**
- **Spinach**
- **Strawberries**

Clean 16!!

Not as Much Concern
- **Asparagus**
- **Avocados**
- **Bananas**
- **Broccoli**
- **Cabbage**
- **Cantaloupe**
- **Cauliflower**
- **Corn (sweet)**
- **Eggplant**
- **Honeydew**
- **Kiwi**
- **Mangos**
- **Onions**
- **Papaya**
- **Pineapples**
- **Peas (sweet)**
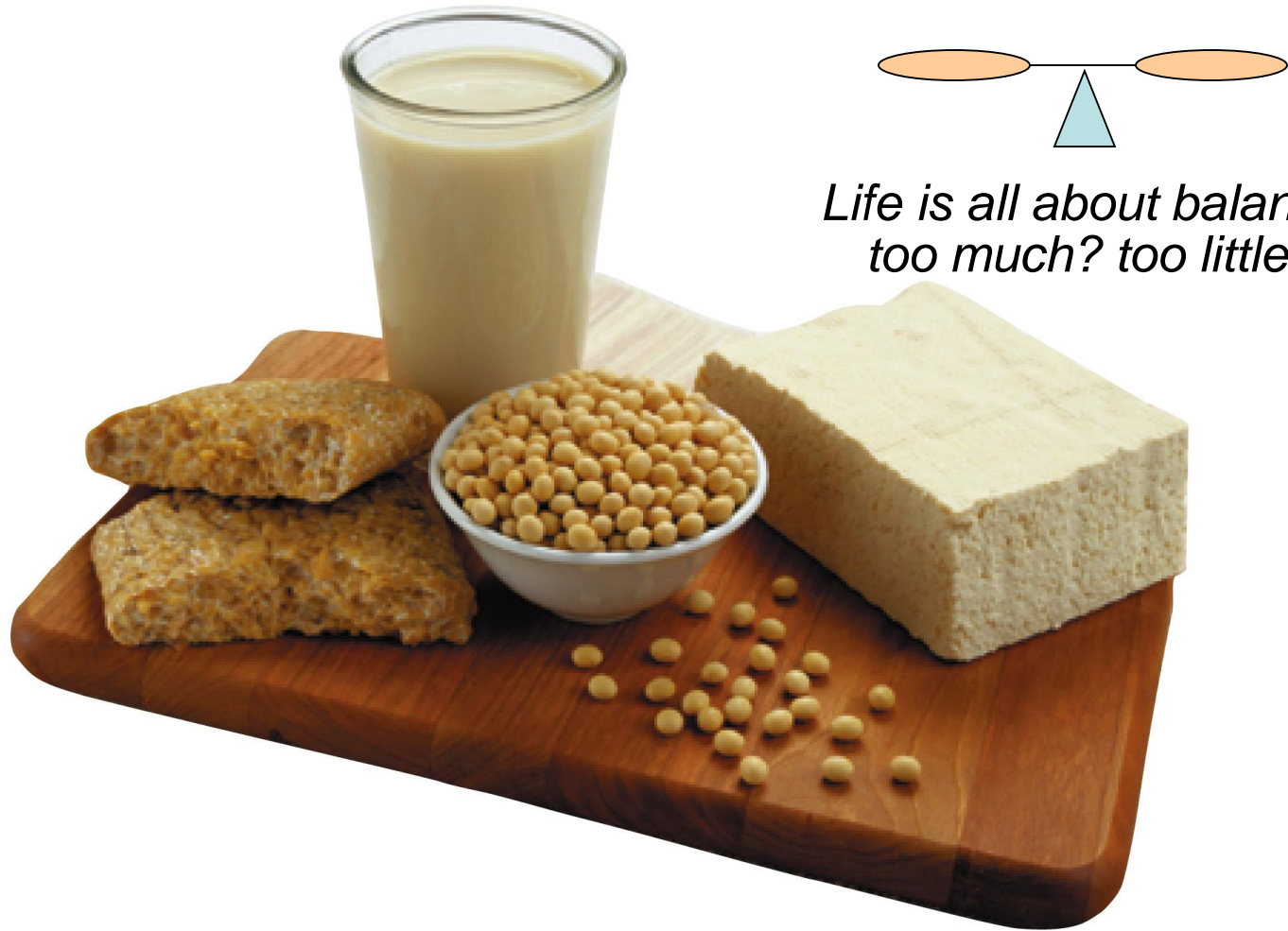
https://www.ewg.org/foodnews/dirty_dozen_list.php
https://www.ewg.org/foodnews/clean_fifteen_list.php

Resveratrol, a flavonoid in purple grape juice & red wine may lower incidence of cardiovascular diseases.

<u>NB</u>: ...but typical serving amounts may be too small to benefit human health!...Alcoholism?

High doses of soy phytoestrogens may lower blood cholesterol

Life is all about balance: too much? too little?

<u>NB</u>: ...but low doses of the phytoestrogen, *genistein* promotes breast cancer cell division (in lab cultures & mice).

Preventing Cancer: Strategies That Can Reduce Your Risk
UC Berkeley Wellness Reports, 2012

1. Don't smoke or use any tobacco product.

2. Keep the weight off.

3. Get off the couch.

4. Eat a healthy diet.

5. Drink less alcohol.

6. Limit high-heat cooking.

7. Limit sun exposure.

8. Limit radiation from medical imaging tests.

9. Test your home for radon.

10. Test your water for arsenic.

11. Decrease workplace exposure to carcinogens.

12. Limit your exposure to air pollution (outdoors & indoors).

University of California, Berkeley
Wellness Letter

American Heart Association®

Learn and Live SM

Diet & Lifestyle Recommendations

1. **Use up at least as many calories as you take in!**

2. **Eat a variety of nutritious foods from all food groups.**

3. **Eat less of the nutrient-poor foods.**

4. **Don't smoke tobacco — and stay away from tobacco smoke.**

http://www.heart.org/HEARTORG/GettingHealthy/NutritionCenter/HealthyDietGoals/Dictionary-of-Nutrition_UCM_305855_Article.jsp

![American Heart Association - Learn and Live]

Daily Food Choice Recommendations

1. *Choose lean meats & poultry without skin & prepare them without added saturated & trans fat.*
2. *Select fat-free,1 percent fat & low-fat dairy products.*
3. *Cut back on foods containing partially hydrogenated vegetable oils to reduce trans fat.*
4. *Cut back on foods high in dietary cholesterol. Aim to eat less than 300 milligrams of cholesterol each day.*
5. *Cut back on beverages and foods with added sugars.*
6. *Choose and prepare foods with little or no salt. Aim to eat less than 1,500 milligrams of sodium per day.*
7. *If you drink alcohol, drink in moderation. 1 drink/day if you're a woman & 2 drinks/day if you're a man.*
8. *Follow AHA recommendations when you eat out & keep an eye on portion sizes.*

THE REWARD OF FITNESS: LONGEVITY
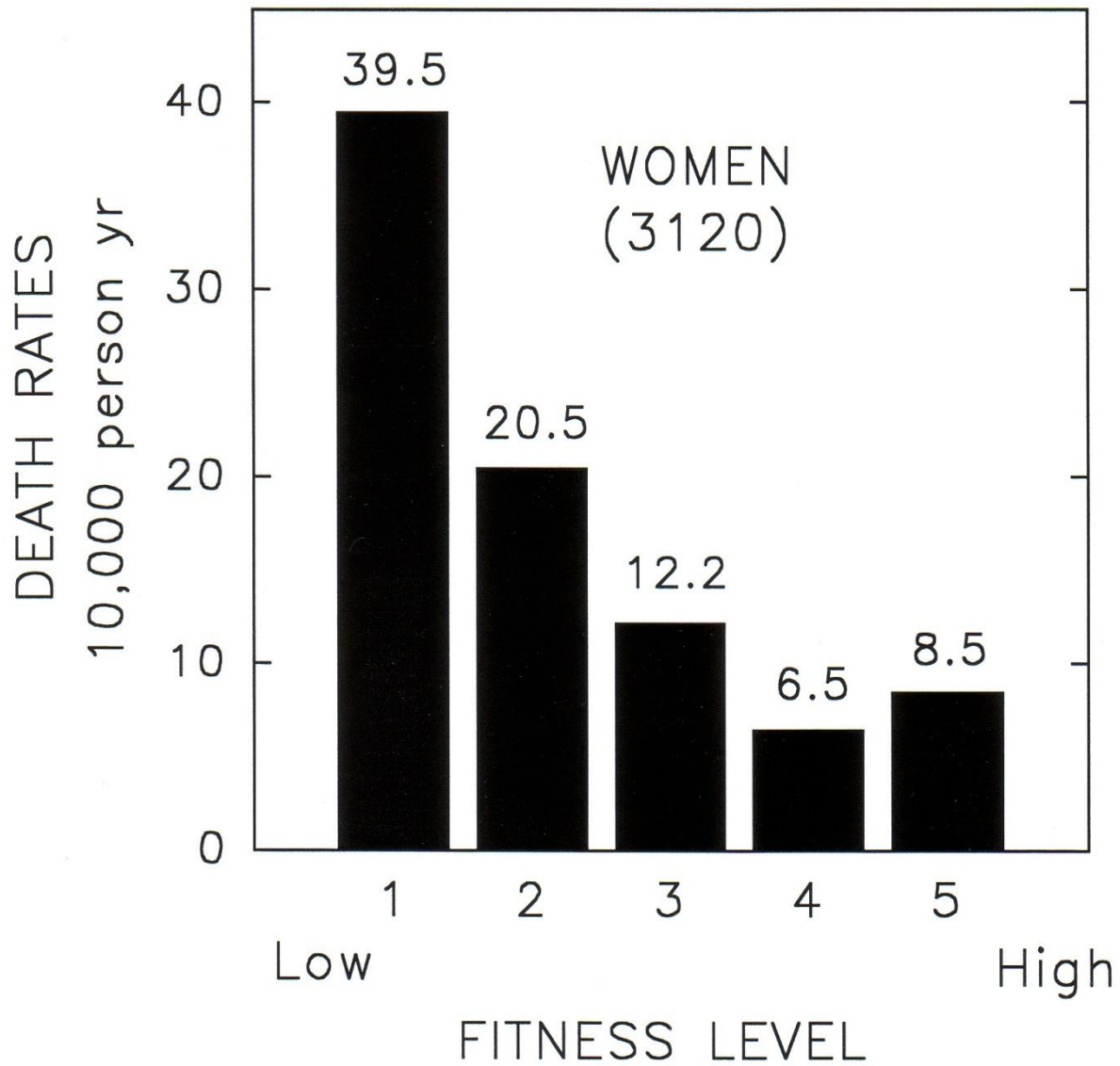
Exercise is a must based on its insulin-like effect!

100s of other reasons! Exercise –

↑ lean body mass, ↑ cardiac output,
↑ myocardial contractility, ↑ central &
peripheral blood flow, ↑ fibrinolytic activity,
↑ HDL cholesterol, ↑ work capacity,
↑ sleep quality, ↓ % body fat,
↓ TOT & LDL cholesterol,↓ triglycerides, ↓
platelet aggregation, ↓ blood pressure,
↓ CVD risk,...

Guidelines: Healthy Adults < 65 yr

**Do moderately intense aerobic exercise
30 min/d, 5 d/wk**

OR
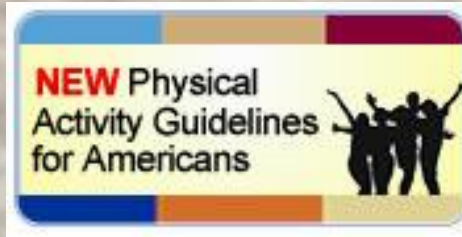
**Do vigorously intense aerobic exercise
20 min/d, 3 d/wk**

AND

**Do 8-10 strength-training exercises
8-12 repetitions/each exercise, 2 d/wk**

http://www.acsm.org/access-public-information/position-stands
http://www.acsm.org/public-information/brochures

Federal exercise guidelines include strength training for all

http://www.cdc.gov/physicalactivity/everyone/guidelines/index.html
http://www.health.gov/paguidelines/

NEW Physical Activity Guidelines for Americans

Adults: Moderate to Vigorous Exercise ≥ 30 min, 5 d/wk

Children: Moderate to Vigorous Exercise ≥ 60 min, 5 d/wk