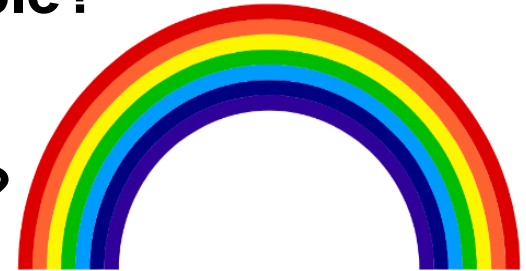


Nutrition Lab 3 tomorrow!  
Exam I this Wednesday, July 3rd!!...



## BI 121 Lecture 5

- I. Announcements** Data + Flashdrive for Nutrition Lab! Q?
- II. Sample Exam Q + Q about Exam?**
- III. Nutrition Primer** DC Module 2,Sizer & Whitney (S&W) Sci Lib
  - A. Essential Nutrients: H<sub>2</sub>O, 1<sup>o</sup> Carbohydrates, 2<sup>o</sup> Fats, 3<sup>o</sup> Proteins, Vitamins, Minerals; Macro- vs Micro-?
  - B. Dietary Guidelines: HHS-USDA, AICR, Eat the **Rainbow!**
  - C. **Blue Zones?** Habits of longest lived people?
  - D. Okinawan Longevity Diet?
  - E. Pondering Paleo? Marlene Zuk, U Minn
  - F. Animals vs. Plants? Protein, WHO, Meat?
  - G. TMAO, Neu5GC and Inflammation?
  - H. Carbohydrate Confusion. Why Plants & Whole Grains?
  - I. Exercise, Carbohydrates & Fats
  - J. How Optimal % Body Fat US Wt Registry, Zuti & Golding
- IV. GI (Gut) Structure & Function** DC Module 3, LS 2012 ch 15
  - A. Gut Doughnut Analogy + Secretions L Brilla WWU
  - B. Digestion Steps Dr. Evonuk + LS pp 437- 439; DC p 23
  - C. Hydrolysis + Polymer → Monomer: Central Themes!  
LS p 438, SI Fox 2009 + ...



# Macronutrients & Micronutrients Essential for Life

## Macronutrients

H<sub>2</sub>O/Water

✓ 1<sup>o</sup> Carbohydrates

✓ 2<sup>o</sup> Fats/Triglycerides/Lipids

✓ 3<sup>o</sup> Proteins

## Micronutrients

Vitamins (A, D, E, K; C + B)

Minerals (K<sup>+</sup>, Na<sup>+</sup>, Ca<sup>2+</sup>, Mg<sup>2+</sup>,  
Fe<sup>2+</sup>, Zn<sup>2+</sup>,...)

## Sample Food Sources

Water, other drinks, fruits  
& vegetables

Grains, vegetables, fruits,  
dairy products

Meats, full-fat dairy  
products, oils

Meats, legumes, dairy  
vegetables

**NB: Need only minute quantities!**

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

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

✓ **Energy nutrients = yield ATP**



# *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!

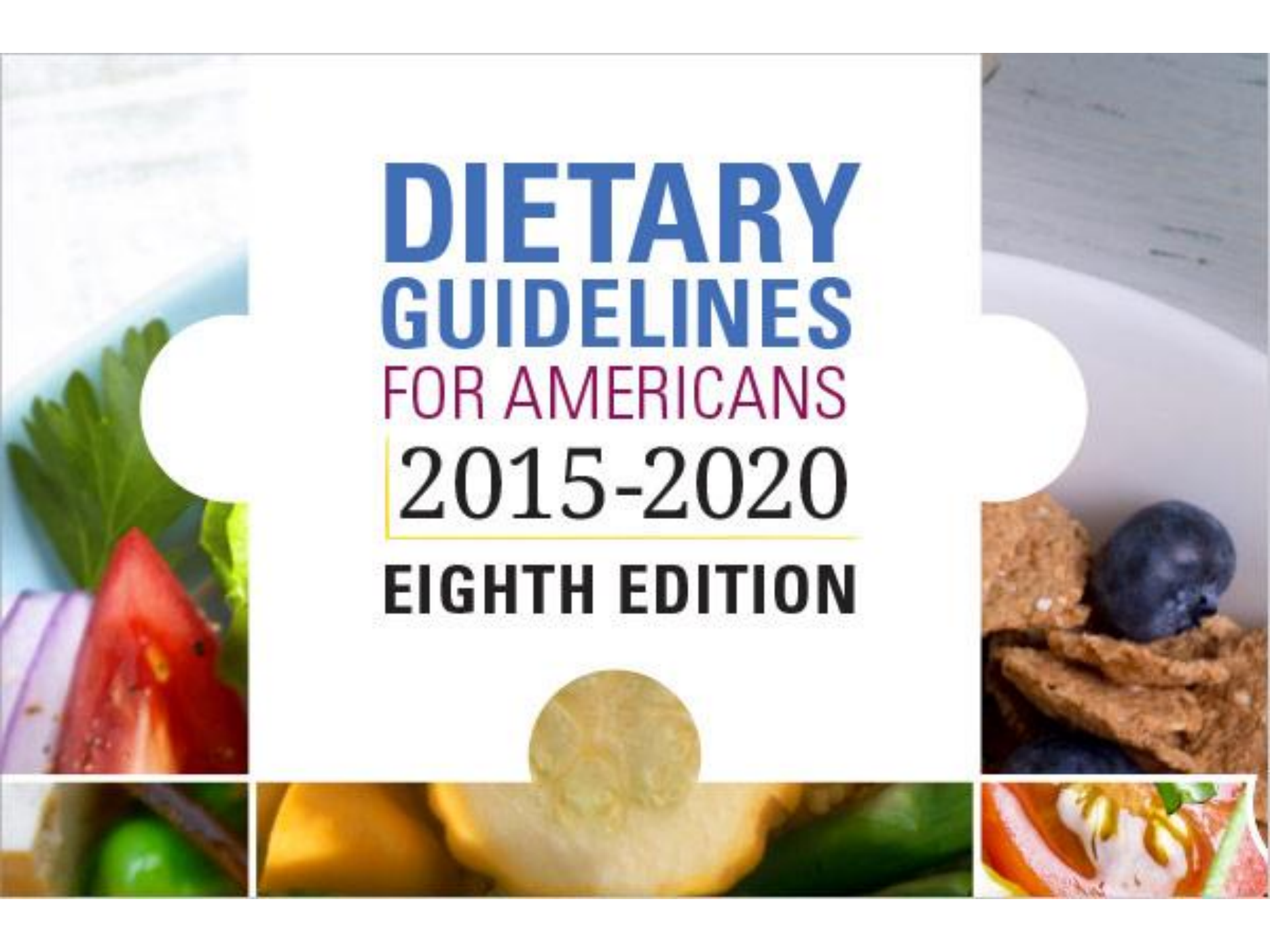


3. Make at least  $\frac{1}{2}$  of your grains whole grains!

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***

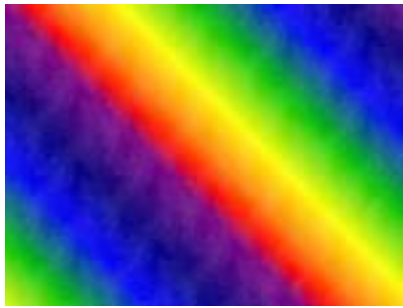
- 1. Choose a diet rich in variety of plant-based foods.**
- 2. Eat plenty of vegetables & fruits.**
- 3. Maintain a healthy weight & be physically active.**
- 4. Drink alcohol only in moderation, if at all.**
- 5. Select foods low in fat & salt.**
- 6. Prepare & store food safely.**

**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!



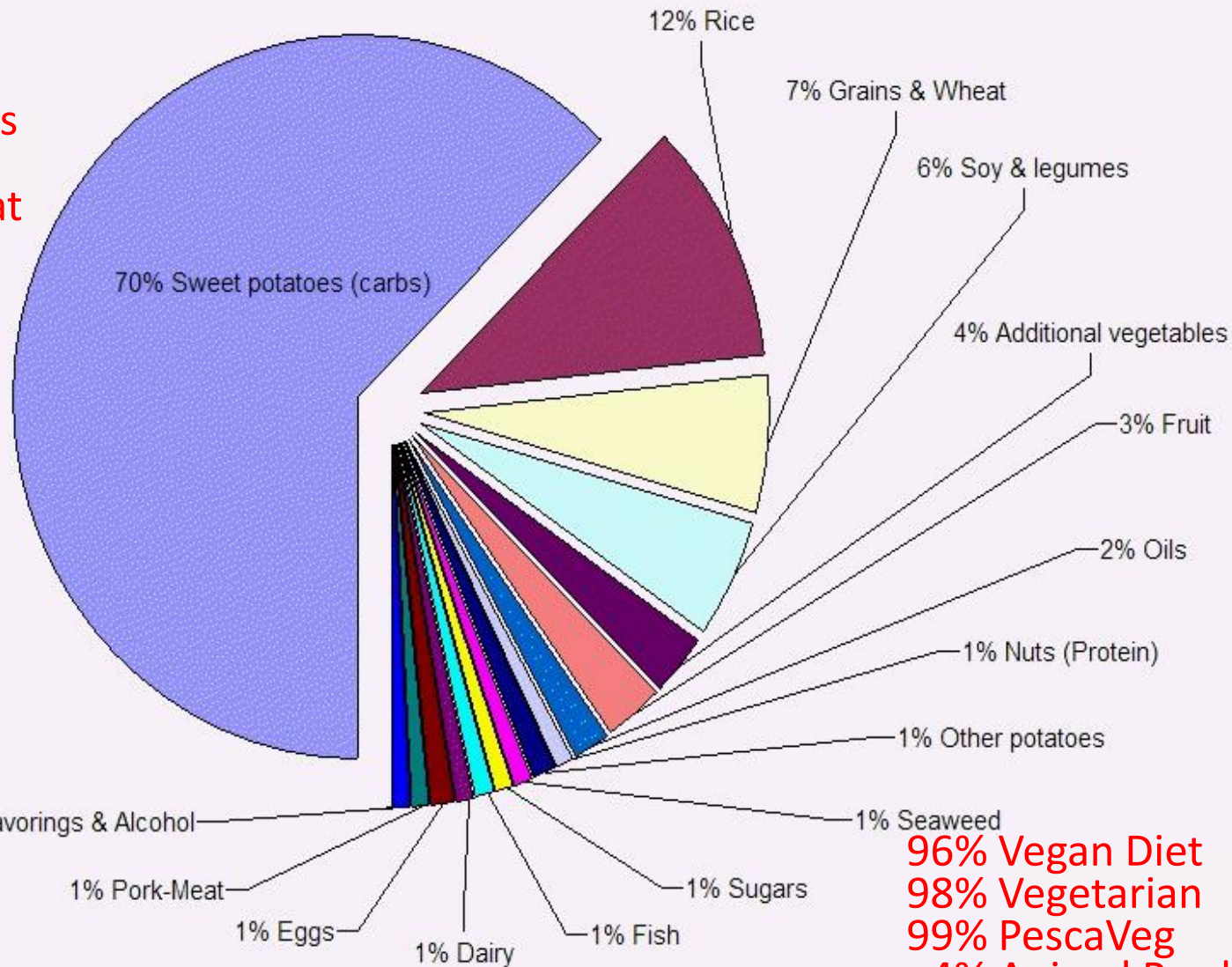
[https://en.wikipedia.org/wiki/Blue\\_Zone](https://en.wikipedia.org/wiki/Blue_Zone)

<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



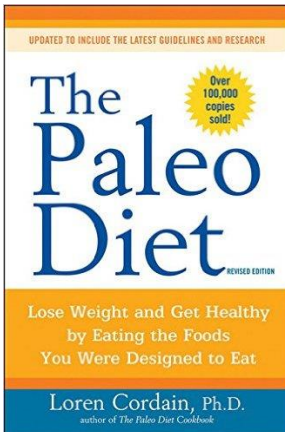
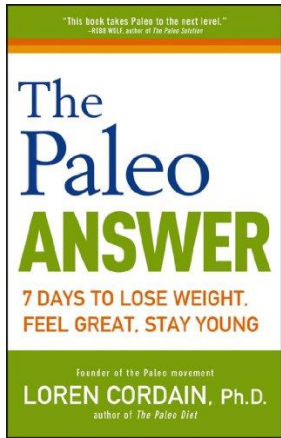
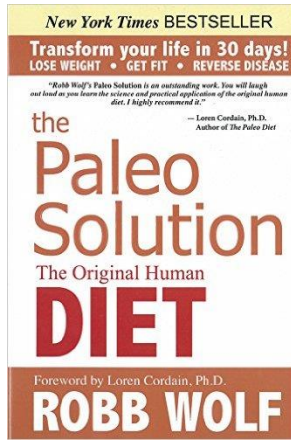
85% Carbohydrates  
 9% Protein  
 6% Fat  
 85-10-5  
 1785 Calories

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

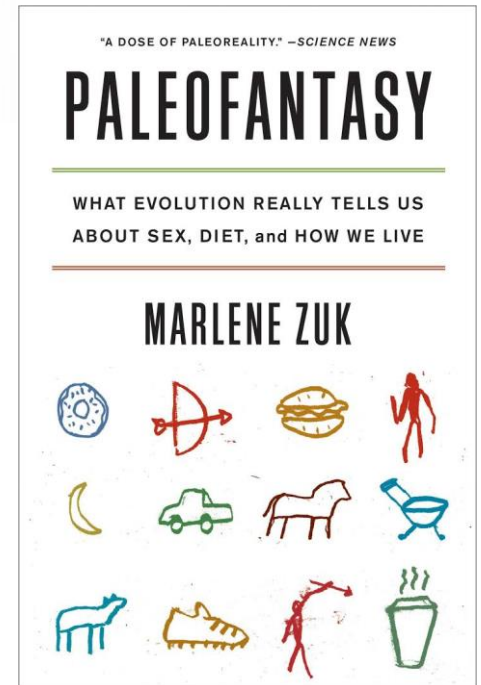
SCIENTIFIC STUDY: "The Diet of the World's Longest-Lived People and Its Potential Impact on Morbidity and Life Span"  
 JOURNAL: Annals of the Academy of Sciences - Volume 1114: 434-455 (2007).

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**



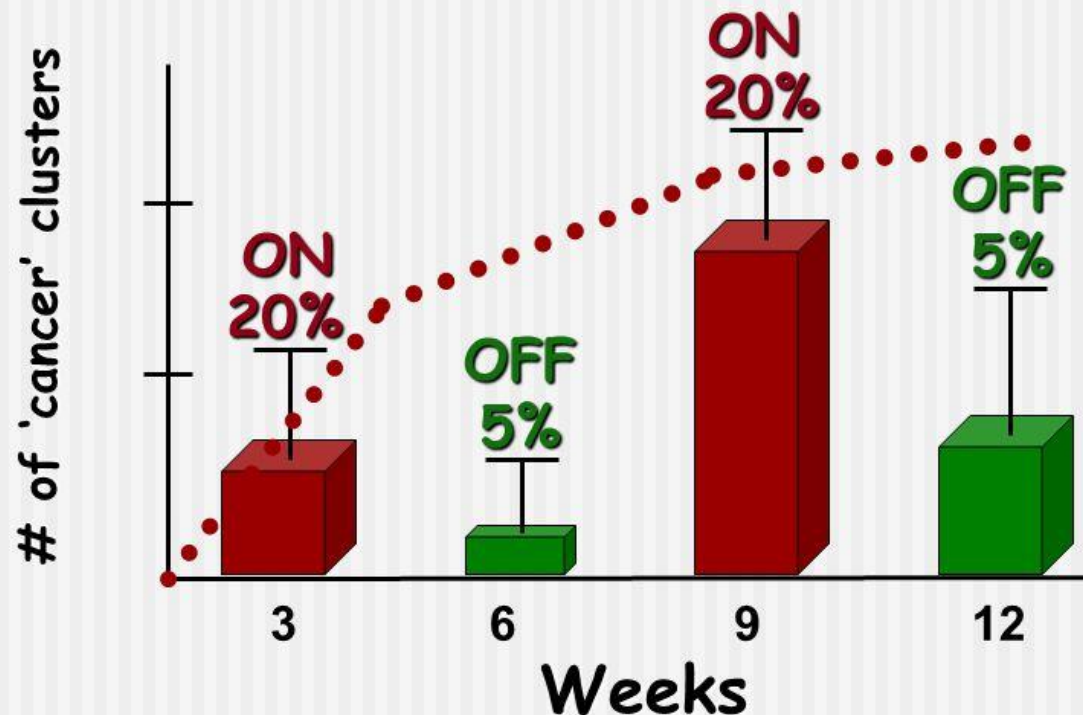
**Boneless,  
skinless,  
cooked  
chicken  
breast 6-8 oz,  
53 -70 g of  
protein!**

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

# Dietary Protein, Shakes, Supplements &...?

## Dietary Protein and EARLY Cancer

(Youngman and Campbell, *J. Nutr.*, 1991, *Nutr. Cancer*, 1992)



copyright T. Colin Campbell 2010

9

<http://www.aicr.org/about/advocacy/the-china-study.html>

<http://www.nutritionfacts.org/>

# Red Meat, Processed Meat & Cancer Incidence

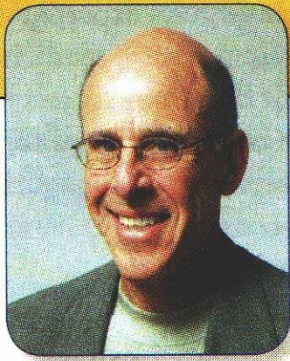


Total cancer mortality & cancers of:

Colon & rectum  
Esophagus  
Liver  
Pancreas  
Kidney  
Prostate  
Lung  
Breast



**SOURCES:** Rodriguez Hernandez 2015, Abid 2014, Larsson 2014, Pericleous 2014, Zhu 2014, Aune 2013, Ferlay 2013, Kim 2013, Freedman 2010, Alexander 2010, Alexander 2009



**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  $5\% + (18\% \text{ of } 5\%) = 6\%$ . 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.

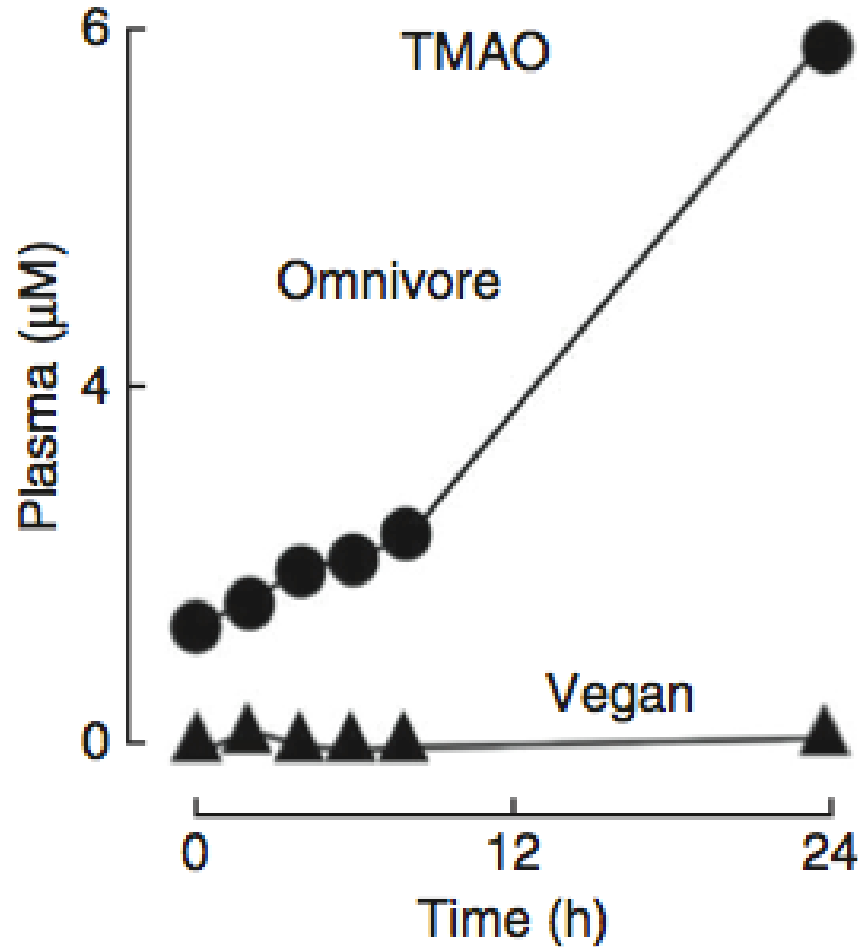
In fact, IARC cited estimates that 34,000 cancer deaths per year worldwide can be attributed to diets high in processed meat. In contrast, tobacco causes nearly 2 million cancer deaths per year.

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.

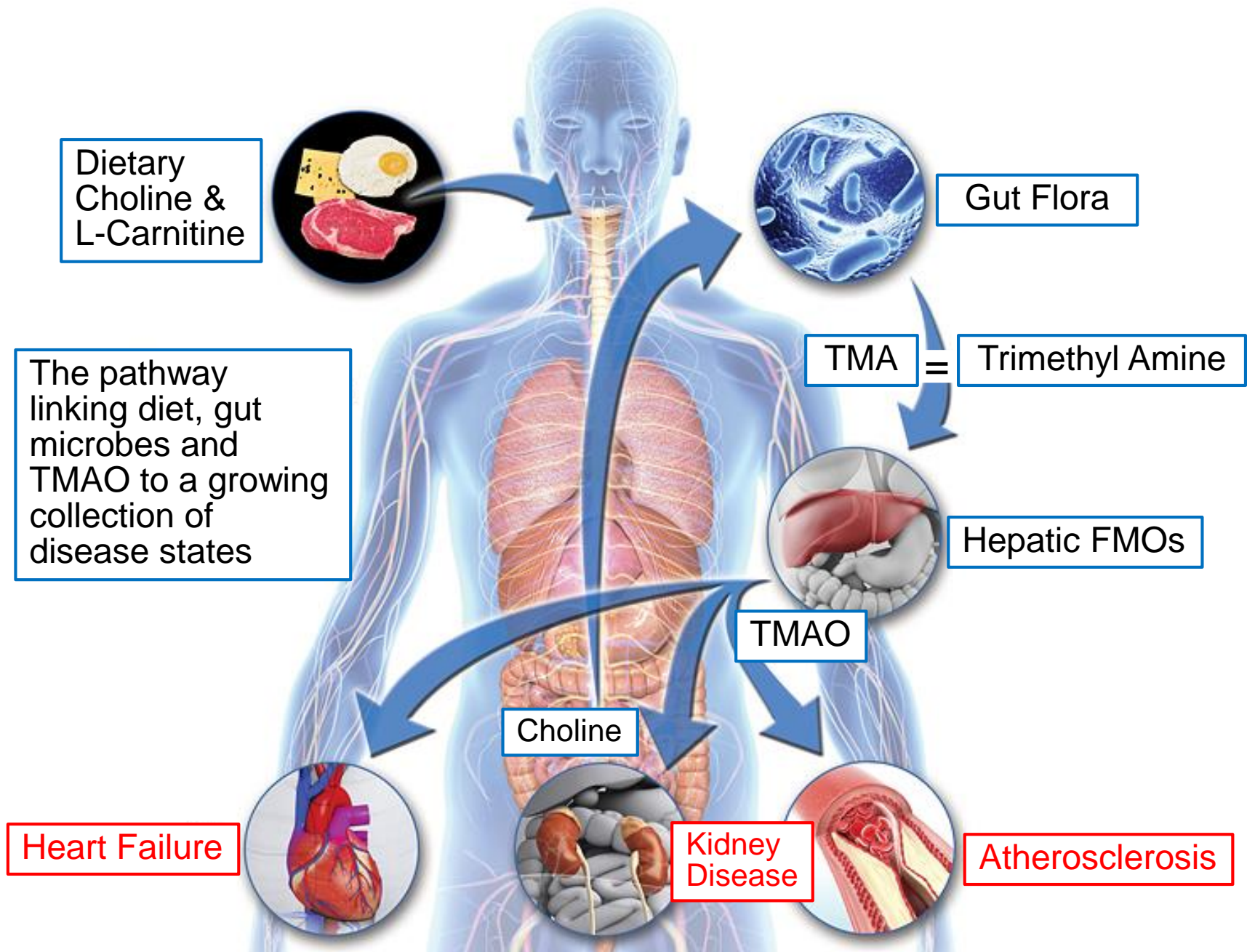
# Gut Bacteria Involved in **Inflammation & Atherosclerosis**?



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

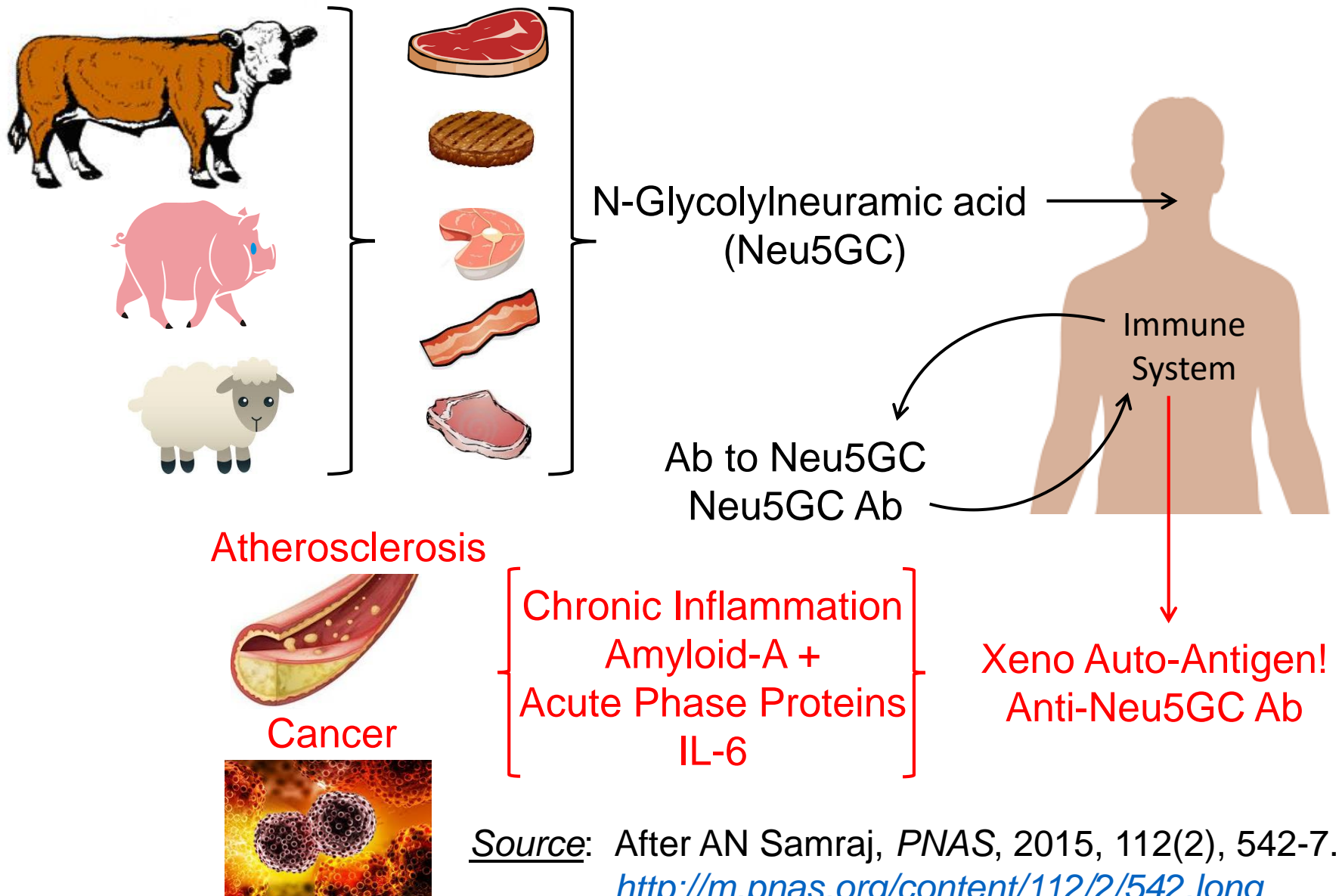
<https://consultqd.clevelandclinic.org/2015/02/gut-flora-dependent-tmao-new-studies-extend-its-reach-beyond-the-arteries-to-the-heart-and-kidneys/>





<http://www.nejm.org/doi/full/10.1056/NEJMoa1109400#t=article>

# 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>

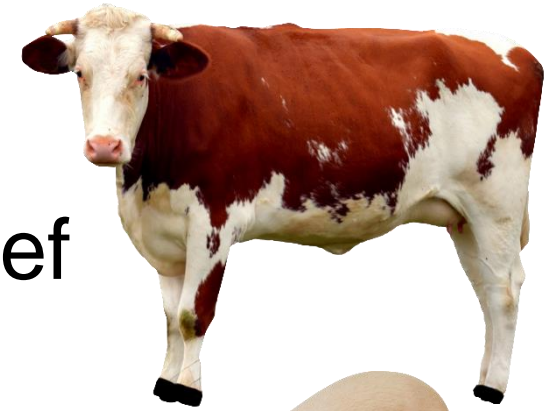
# Environmental Impact

Grain required for:



~61 kg

1 kg of Beef



~38 kg

1 kg of Pork



~13 kg

1 kg of Fish



~33% of H<sub>2</sub>O farm animal footprint  
due to beef production

SOURCE: SM Downs & J Fanzo. Curr Nutr Rep, 2015, 4:313-22

# 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*

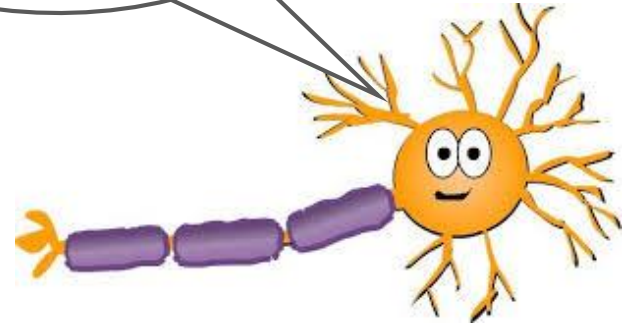
**3** Veggie  
Dips

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

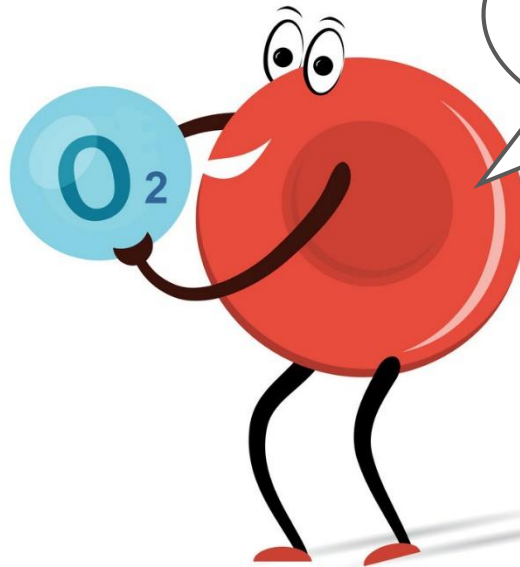
I prefer  
glucose!



Me three!



Me too!



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!*



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





***...but, the phytochemical candidate, lycopene with anti-oxidant activity is also in guava, papaya, pink grapefruit & watermelon!***



# Why Eat Whole Grains?



**Based on existing evidence, eating whole grains is definitely good for our health.**

*Shengmin Sang, Professor of Food Science & Human Health North Carolina A&T*

**Fiber** ↑ fullness, motility, beneficial bacteria, wt control  
↓ cholesterol, insulin response, inflammation, diabetes and CVD risk...



**B-vitamins** thiamin, niacin, riboflavin ↑ energy metabolism

**Folate** ↑ red blood cells, ↓ neural tube defects

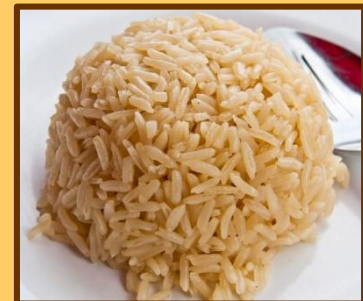
**Iron** ↑ O<sub>2</sub> carrying, ↓ iron-deficiency anemia in women

**Magnesium** ↑ bone building & muscle energy release

**Selenium** an anti-oxidant, protects body cells & ensures a healthy immune system...



**[https://www.choosemyplate.gov/  
grains-nutrients-health](https://www.choosemyplate.gov/grains-nutrients-health)**



# Nutrition Action

OCTOBER 2011 \$2.50

**HEALTH LETTER®**  
 CENTER FOR SCIENCE IN THE PUBLIC INTEREST

## Eat Real, America!

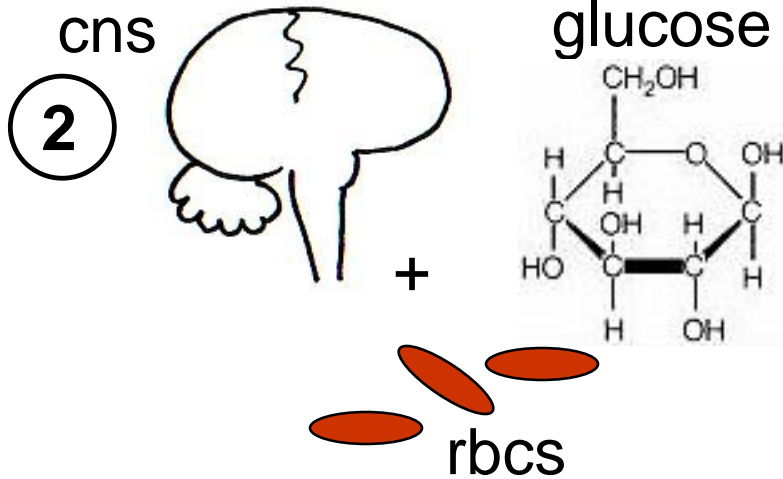
"With the right food choices, physical activity, and not smoking, we could prevent about 80 percent of heart disease, about 90 percent of diabetes, and 70 percent of stroke," says Walter Willett, chair of the nutrition department at the Harvard School of Public Health in Boston. "Those are the three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

*Continued on page 3.*

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!



# Negative Effects of Low Carbohydrate

1



- ① ↑ fatigue/exhaustion central & peripheral!
- ② ↓ glucose – brain+spinal cord, rbc's thrive upon.
- ③ ↓ variety which reduces intake of phytochemicals, vitamins, minerals & fiber.
- ④ ↑ risk of respiratory infections.

4



+ gall stones,  
↓ thermoregulation...

# Dietary Composition & Physical Endurance

eg, Atkins!

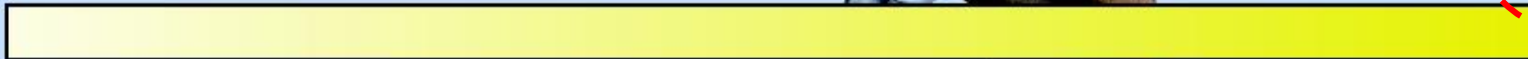
High-fat diet



Normal mixed diet



High-carbohydrate diet



**~ 1/3 endurance!**

Maximum endurance time:

57 min

114 min

167 min





# ***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.**

# Successful Dieting – National Weight Control Registry

- 5000 people,  $\geq 30$  lb weight loss,  $\geq 5$  yr
- High-carbohydrate (55-60%), low-fat (24%) diet with the rest ( $\sim 16$ -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

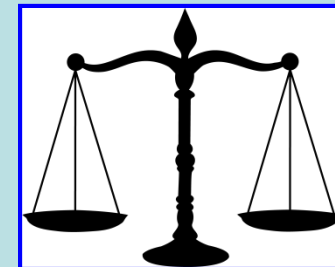
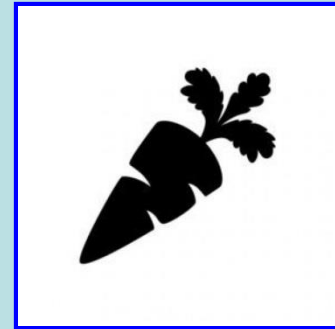
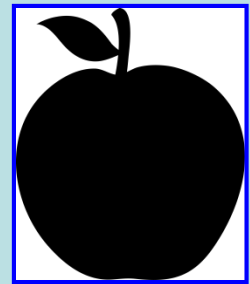
- Eight of 10 ate breakfast daily which may help better manage calories during the day

- Self-monitor, weigh themselves  $\geq 1$ x/wk & many still keep food dairies

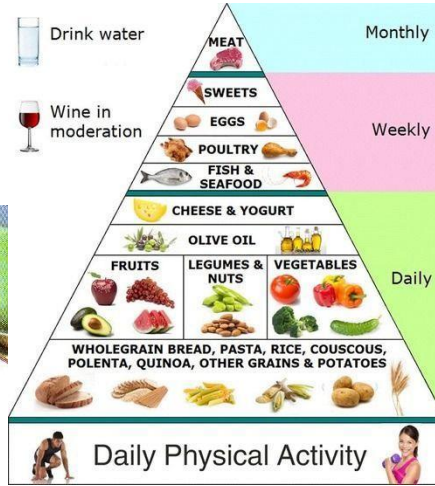
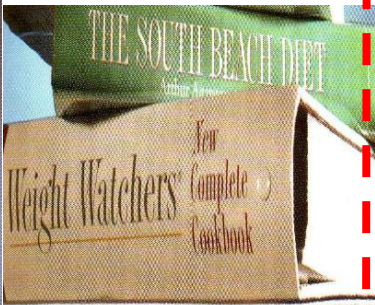
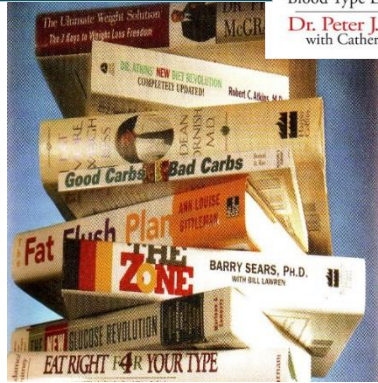
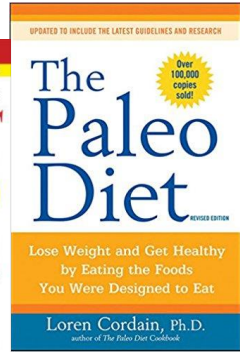
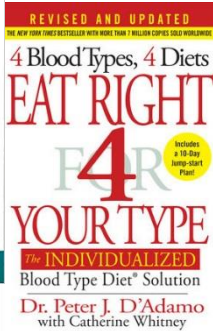
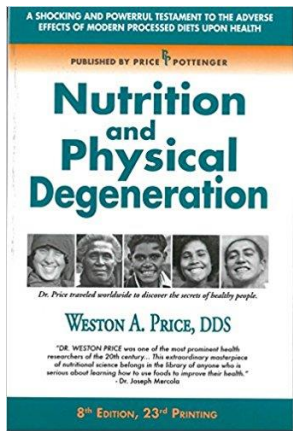
- Much planned physical activity, 60-90 min/d, 1<sup>0</sup> walking + looked for other ways to be active

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

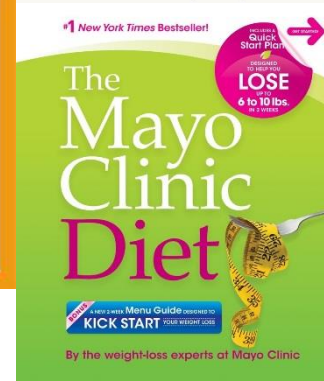
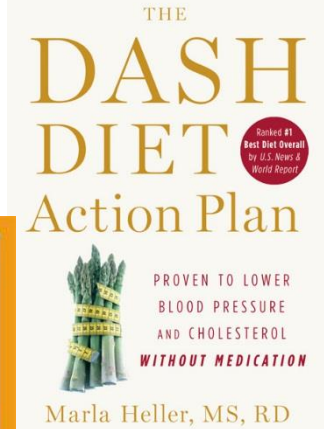
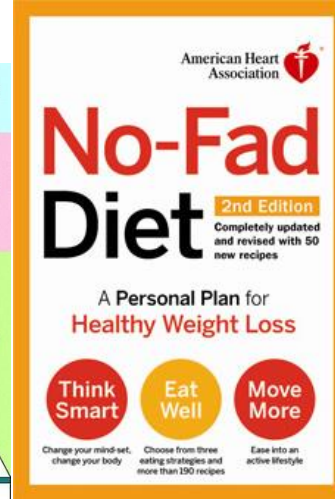
UC Berkeley Wellness Engagement Calendar, September 2013



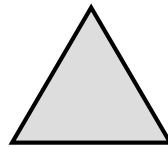
# Which Diets are Best?



Mediterranean Diet



**Not Plant-based**  
**Lower Carbohydrate**



**Plant-based**  
**Lower Fat**

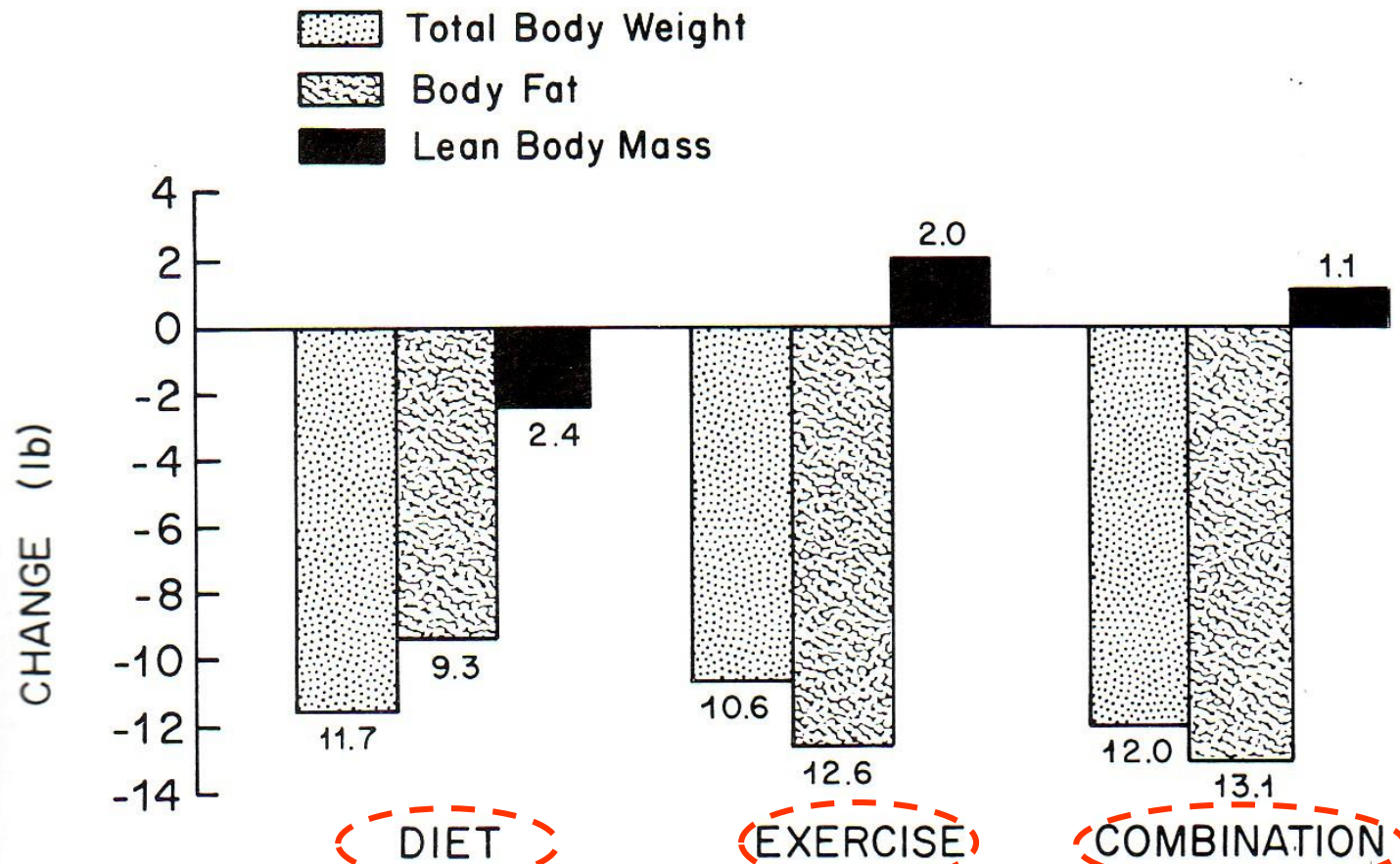


**Not Peer-Reviewed = Trade Book**  
**→ Opinion**



**Peer-Reviewed = Text Books**  
**→ Research**





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

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



***Exercise is better than dieting in lowering body fat & preserving muscles!***



# Questions + Discussion

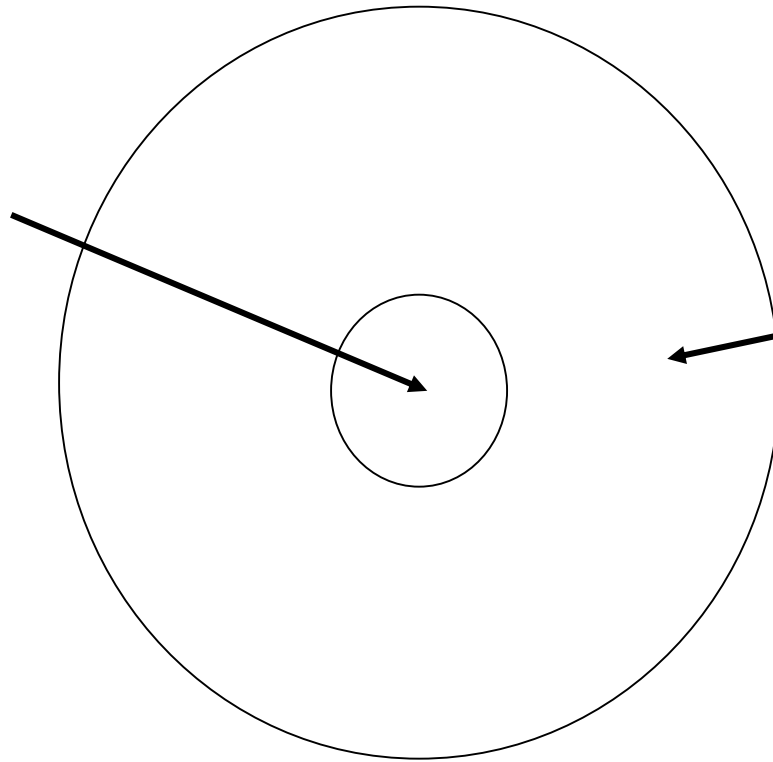




# GI-Doughnut Analogy



**GI Lumen**



**Body**



Me?



# ***Gut Secretions***

## ***Secretion***

## ***Release Site***

**1. Mucus**

**into GI Lumen**

**2. Enzymes**

**into GI Lumen**

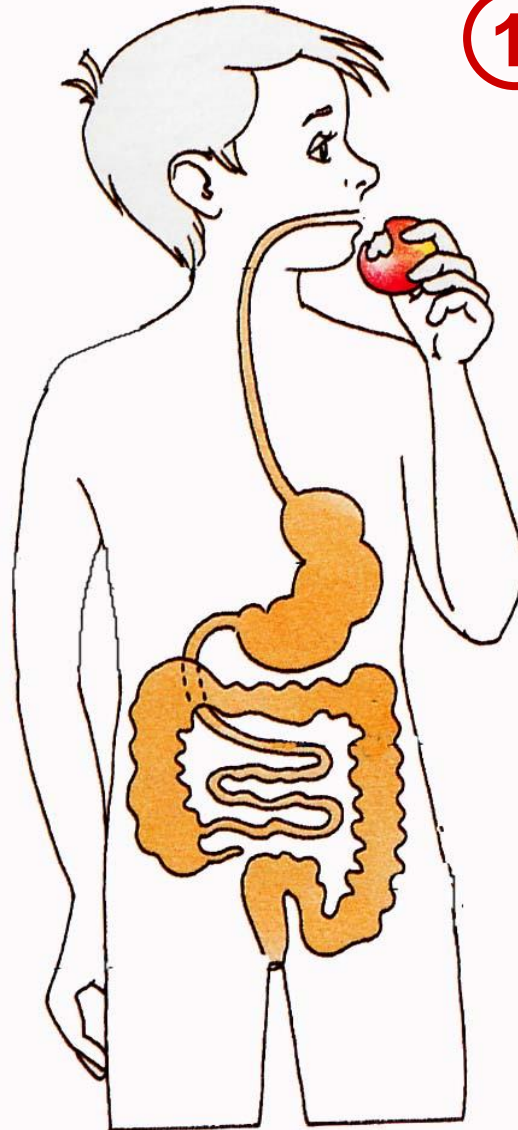
**3. H<sub>2</sub>O, acids, bases+**

**into GI Lumen**

**4. Hormones**

**into Blood**

# Digestion Steps



① Ingestion

② Mechanical Digestion

③ Chemical Digestion

④ Peristalsis

⑤ Absorption

⑥ Storage

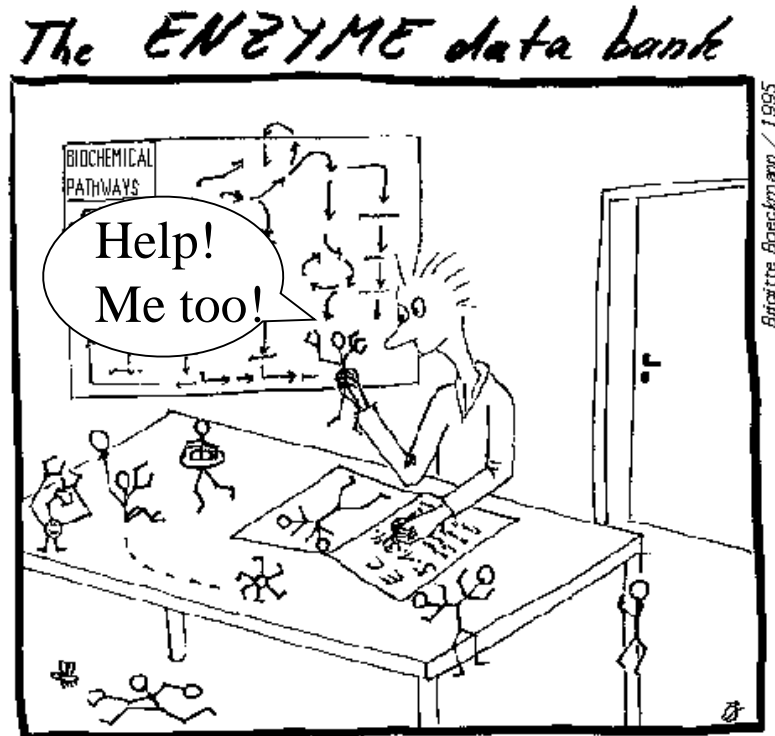
⑦ Defecation

# Hydrolysis of Energy Nutrients

Hi gang!!  
You need me  
for digestion!!



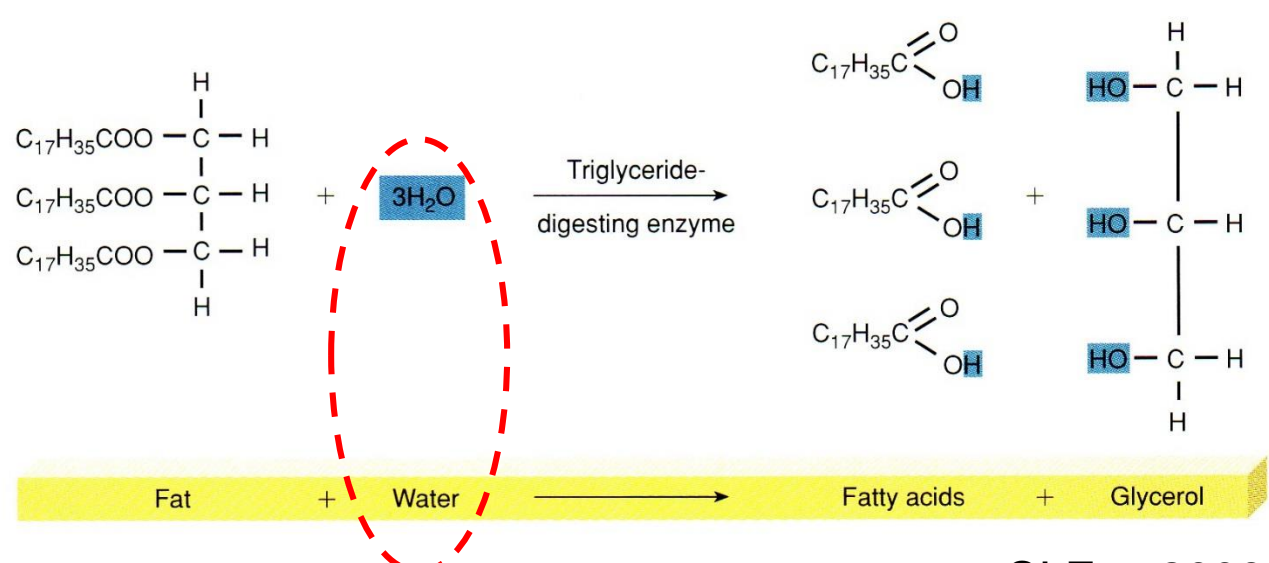
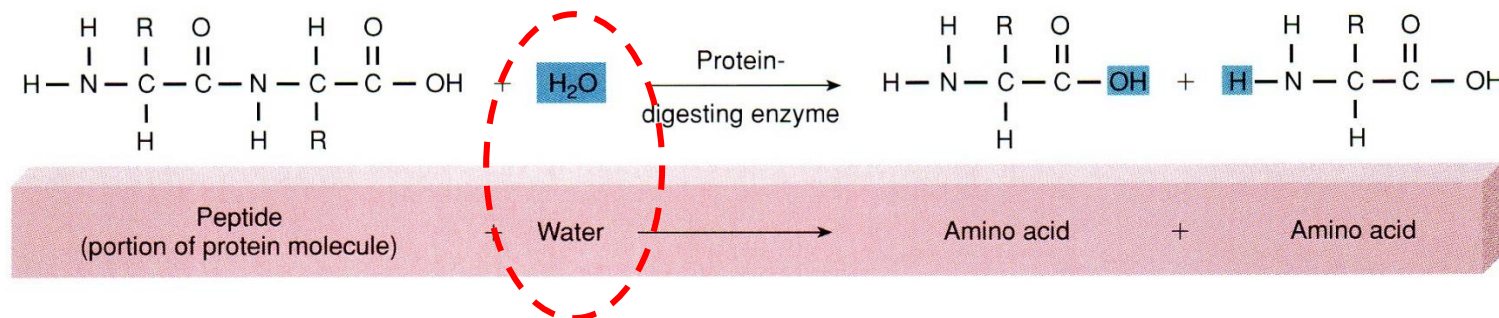
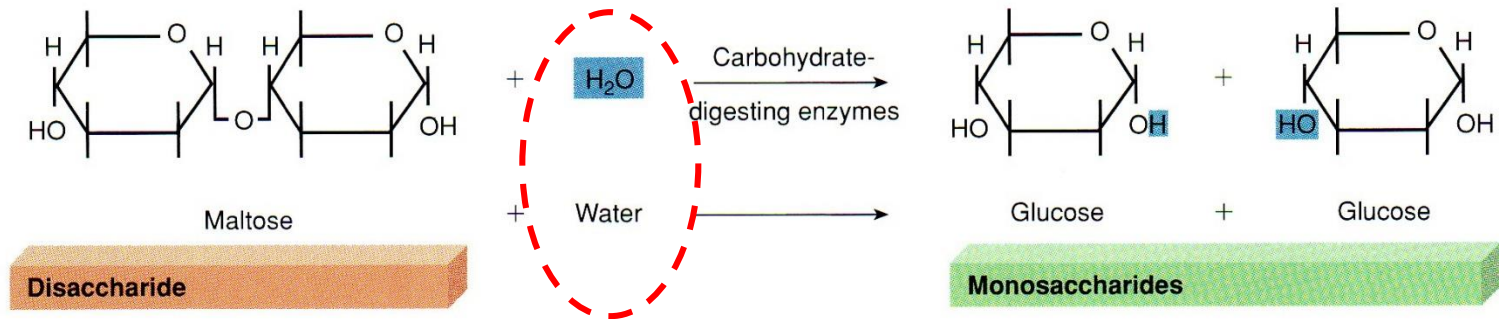
+



H<sub>2</sub>O

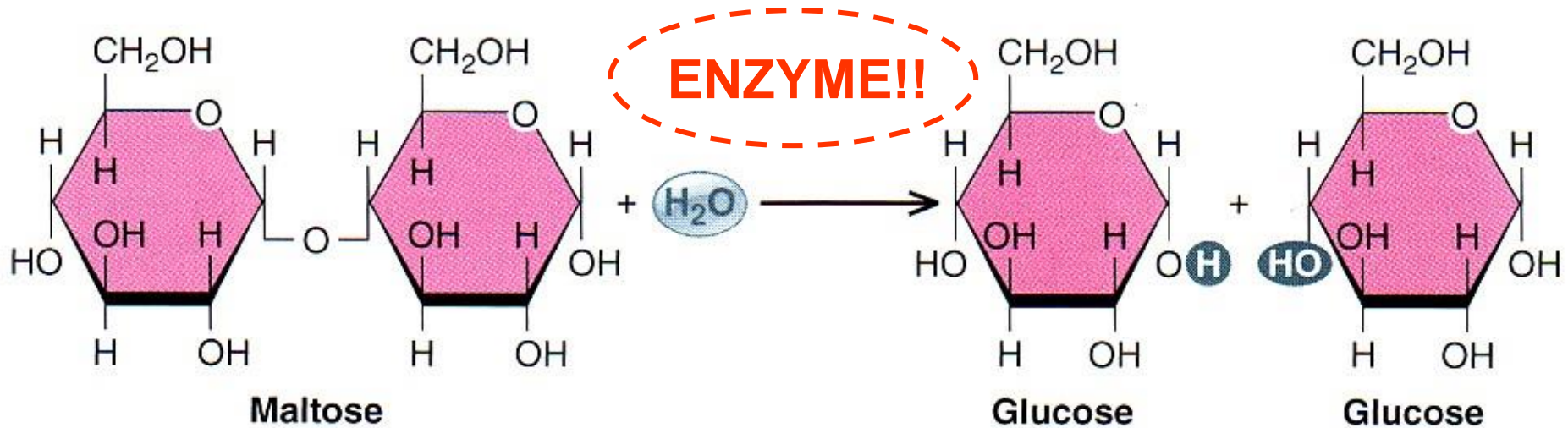
+

Enzyme





# What's missing?

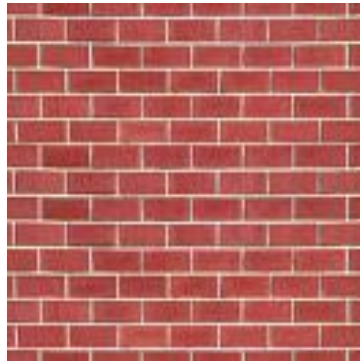


● **FIGURE 15-1** An example of hydrolysis. In this example, the disaccharide maltose (the intermediate breakdown product of polysaccharides) is broken down into two glucose molecules by the addition of H<sub>2</sub>O at the bond site.

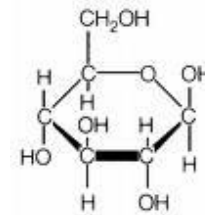
# Polymer to Monomer (Many to One)



...Central-linking theme!!

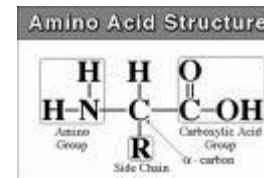


Carbohydrate

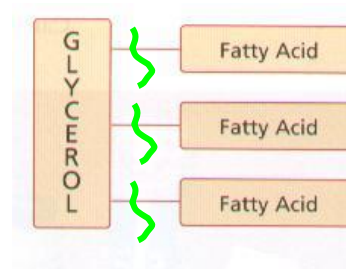
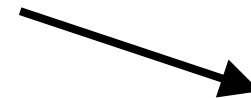


Glucose

Protein  
+  
Fat



Amino Acids



Fatty Acids  
+  
Glycerol

# 1. Mouth

Ingestion entry way  
salivary gland secretion  
mucus + enzymes  
enzymatic digestion: carbohydrate  
mastication = chewing  
deglutition = swallowing



# 2. Esophagus

Rapid transit  
peristalsis  
secretion mucus

Esophagus

# 3. Stomach

Mixing peristalsis  
secretion mucus + HCl  
+ enzymes  
enzymatic digestion:  
protein + butter fat!

Stomach

# 5. Pancreas

Secretion mucus +  
 $\text{NaHCO}_3$  + enzymes  
enzymatic digestion:  
carbohydrate, fat, protein

Pancreas

Liver

Gallbladder

Duodenum

Large intestine

Small intestine

Anal canal

Rectum

# 4. Liver-Gall Bladder

Emulsification =  
detergent action of bile  
+ secretion

# 6. Small Intestine

Absorption  
Secretion mucus  
+ enzymes  
enzymatic digestion:  
carbohydrate, fat, protein  
Peristalsis

Liver

Gallbladder

Duodenum

Large intestine

Small intestine

Anal canal

Rectum

# 7. Large Intestine

Dehydration  
secretion + absorption  
storage + peristalsis