BI 358 Lecture 5 🙌...Lab today! Yes, personal, lifetime data! + Outline update.

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** ...

   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, 10 walking + looked for other ways to be active

http://www.nwcr.ws/Research/published%20research.htm
UC Berkeley Wellness Engagement Calendar, September 2013
What about feedback for hunger-satiety?
Ghrelin (stomach fundus, pancreas, …)
Leptin (adipocytes)
Feedback Mechanisms for the Control of Food Intake

Sleep deprivation promotes the release of ghrelin & abdominal obesity!

http://www.plosmedicine.org/article/info%3Adoi%2F10.1371%2Fjournal.pmed.0010062

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.

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

Control of Energy Balance by Hypothalamic Neurons

1. Agouti-related Protein + Neuropeptide Y

2. Pro-opiomelanocortin + Cocaine & Amphetamine-regulated Transcript

- Energy Expenditure
- Food intake
- Times of Need!
- Times of Plenty!
Neurotransmitters & Hormones that Influence Hypothalamic Feeding & Satiety Centers

**↓ Feeding = Anorexigenic**
- 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 = Orexigenic**
- 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

<table>
<thead>
<tr>
<th>Secretion</th>
<th>Release Site</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Mucus</td>
<td>into GI Lumen</td>
</tr>
<tr>
<td>2. Enzymes</td>
<td>into GI Lumen</td>
</tr>
<tr>
<td>3. H$_2$O, acids, bases+</td>
<td>into GI Lumen</td>
</tr>
<tr>
<td>4. Hormones</td>
<td>into Blood</td>
</tr>
<tr>
<td>Secretion Type</td>
<td>Daily Volume (ml)</td>
</tr>
<tr>
<td>--------------------------------------</td>
<td>-------------------</td>
</tr>
<tr>
<td>Saliva</td>
<td>1000</td>
</tr>
<tr>
<td>Gastric secretion</td>
<td>1500</td>
</tr>
<tr>
<td>Pancreatic secretion</td>
<td>1000</td>
</tr>
<tr>
<td>Bile</td>
<td>1000</td>
</tr>
<tr>
<td>Small intestine secretion</td>
<td>1800</td>
</tr>
<tr>
<td>Brunner’s gland secretion</td>
<td>200</td>
</tr>
<tr>
<td>Large intestinal secretion</td>
<td>200</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>6700</strong></td>
</tr>
</tbody>
</table>
Hi gang!!
You need me for digestion!!

H₂O + Enzyme

Hydrolysis of Energy Nutrients

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

Carbohydrate
- Glucose

Protein + Fat
- Amino Acids
- Fatty Acids + Glycerol

…Central-linking theme, again!!
Disaccharide

Maltose + Water → Glucose + Glucose

Monosaccharides

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

Triglyceride

Fat + Water → Fatty acids + Glycerol
Carbohydrates in foods

Sizer & Whitney 2011 p 136
Carbohydrate Digestion = $1^0$ Energy Nutrient

- Ptyalin (saliva) - 20–40%
- Pancreatic amylase - 50–80%

Starches

Maltose and 3 to 9 glucose polymers

- Maltase and $\alpha$-dextrinase (intestine)

Glucose

Lactose

- Lactase (intestine)

Galactose

Sucrose

- Sucrase (intestine)

Fructose
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 (Bile + Agitation) → Emulsified fat

Emulsified fat → Fatty acids and 2-monoglycerides

Pancreatic lipase

G&H 2011 fig 65-4 p 792
HIGH PROTEIN (FAT?) FOODS?
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

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

Dietary Choline & L-Carnitine → Gut Flora → Hepatic FMOs → TMAO → Choline → Heart Failure, Kidney Disease, Atherosclerosis

TMA = Trimethyl Amine
Pondering Paleo?

Evolutionary Biologist
Behavioral Ecologist
U Minnesota

http://www.nutritionaction.com/daily/how-to-diet/pondering-paleo/
Dietary Protein, Shakes, Supplements &…?

Dietary Protein and EARLY Cancer

Weeks

# of ‘cancer’ clusters

http://www.aicr.org/about/advocacy/the-china-study.html
http://www.nutritionfacts.org/
American Institute for Cancer Research

10 CANCER PREVENTION RECOMMENDATIONS

- Maintain a healthy weight
- Move more
- Eat well
- Enjoy a plant-based diet
- Reduce red meat, avoid processed meat
- Cut down on alcohol
- Eat less salt
- After treatment, cancer survivors should follow the cancer prevention recommendations
- If you can, breastfeed your baby
- For cancer prevention don’t use supplements
- And always remember – do not smoke or chew tobacco.

http://www.aicr.org/reduce-your-cancer-risk/recommendations-for-cancer-prevention/
Where does enzymatic digestion of protein begin?
Zymogen = inactive precursor
Protein Digestion = \(3^0\) Energy Nutrient

Proteins → *Pepsin* → Proteoses, Peptones, Polypeptides

Trypsin, chymotrypsin, carboxypolypeptidase, proelastase

<table>
<thead>
<tr>
<th>Polypeptides</th>
<th>Peptidases</th>
<th>Amino acids</th>
</tr>
</thead>
<tbody>
<tr>
<td>+ Amino acids</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
What is the major function of the small intestine?

Absorption!!
Why is the pancreas so unique?
Enzymes specific for all 3 energy nutrients!
Poor motility causes greater absorption, and hard feces in transverse colon causes constipation.

Excess motility causes less absorption and diarrhea or loose feces.
Genetics & Environmental Disease Continuum

Genetics

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

More nutrition-related

Less nutrition-related

Diet & exercise impact

Sizer & Whitney 2011 fig 1-1 p 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!
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!

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

NB: Minimize not Eliminate!
Moderation not Abstinence!!
US Dietary Recommended Intakes (DRI) Committee Acceptable Macronutrient Distribution Ranges (AMDR)!

<table>
<thead>
<tr>
<th>Energy Nutrient</th>
<th>% Total Calories</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carbohydrate</td>
<td>45-65%</td>
</tr>
<tr>
<td>Fat</td>
<td>20-35%</td>
</tr>
<tr>
<td>Protein</td>
<td>10-35%</td>
</tr>
</tbody>
</table>
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!

1. Vary your veggies. Fill ½ your plate with fruits & vegetables!

2. Focus on fruits. Whole fruit preferable to juice, but any fruit counts! Fill ½ your plate with fruits & vegetables!

3. Make at least ½ of your grains whole grains!

4. Go lean with protein. Keep protein to < ¼ plate! Nuts, beans, peas, seeds, poultry, lean meat, seafood,…

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

Why Lower Sodium?
Sodium (Na) Intakes of U.S. Adults

Daily Averages (milligrams)

< 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 90% of Americans will develop high blood pressure or hypertension over their lifetime.

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

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

4. Reducing sodium intake 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.

③May directly impair kidney function & ↑risk of kidney stones.

④GI 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

http://www.nhlbi.nih.gov/health/health-topics/topics/dash
Why Fish & Healthy Oils?
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

Cardiovascular Deaths per 100,000 Population

- Ireland: 0.09%
- USA: 0.13%
- France: 0.14%
- Japan: 0.37%

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

- Wine: In moderation
- Drink Water
- Meats and Sweets: Less often
- Poultry and Eggs: Moderate portions, every two days or weekly
- Cheese and Yogurt: Daily to weekly
- Fish and Seafood: Often, at least two times per week
- 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
NB: Minimize trans fats!
Healthy Oils to Minimize Atherosclerosis

HAPOC?
Essential Fatty Acids: $\Omega$-6 Linoleic & $\Omega$-3 Linolenic Acids

Linoleic $\rightarrow$ Arachadonic Acid $\rightarrow$ Inflammatory Cascade

Linolenic $\rightarrow$ EPA, DHA $\rightarrow$ Anti-inflammatory
Emphasize good fats from plant sources like avocados!
**US Carbohydrate Intake Recommendations**

1. 45-65% of total calories, so for 2000 kcal diet \( \sim \frac{1}{2} \) 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 after all nutrient recommendations are met! (USDA)

5. Not more than \( \frac{1}{2} \) of discretionary calories should come from sugars. For women \( \leq 100 \) kcal, for men \( \leq 150 \) kcal.

6. Increase intakes of whole fruits & vegetables & make \( \geq \frac{1}{2} \) grain choices whole grain. Legumes several times/wk.

7. \( \leq 50 \) yr, women 25 g fiber/d, men 38 g fiber/d.
Why Lower Simple Sugars?
Each person in the US ingests $\sim \frac{3}{4} \text{ cup}$ or 31 tsp of refined sugars added to foods & beverages each day $\equiv > 140 \text{ lb per year}$!
Sugar in processed foods?

- ½ cup canned corn = 1 tsp sugar
- 1 Tbs ketchup = 1 tsp sugar
- 1 Tbs creamer = 2 tsp sugar
- 12 oz cola ≥ 10 tsp sugar
- 8 oz sweetened yogurt = 8 tsp sugar
- 2 oz chocolate = 8 tsp sugar

Sizer & Whitney 2011 fig 4-17 p 139
Added Sugars: Average US Supply per Person

Daily teaspoons of sugars

1890  1970  1980  1990  Today

39 g  41 g ≡ ~ 10 tsp!

USDA
Suggested upper limit (men)¹
Suggested upper limit (women)¹

AHA suggested upper limits!

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

S&W 2011 fig C4-4 p 145
"Number 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.”
1994 Diabetes Prevalence in the US by State

Key:
- <4.5%
- 4.5%-5.9%
- 6.0%-7.4%
- 7.5%-8.9%
- ≥9%

Source: Centers for Disease Control, Division of Diabetes Translation, [http://www.cdc.gov/diabetes/statistics](http://www.cdc.gov/diabetes/statistics), S&W 2014 fig 4-15 p139A.
2010 Diabetes Prevalence in the US by State

Key:
- Yellow: <4.5%
- Light Blue: 4.5%-5.9%
- Light Purple: 6.0%-7.4%
- Purple: 7.5%-8.9%
- Green: ≥9%

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.
1. Be as lean as possible without becoming underweight.
2. Be physically active for at least 30 minutes every day.
3. Avoid sugary drinks. Limit the consumption of energy-dense foods particularly processed foods high in added sugar, or low in fiber, or high in fat.
4. Eat more of a variety of vegetables, fruits, whole grains & legumes such as beans.
5. Limit consumption of red meats (such as beef, pork & lamb) & avoid processed meats.
6. If consumed at all, limit alcoholic drinks to 2 for men & 1 for women a day.
7. Limit consumption of salty foods & foods processed 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

- 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 is included.

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

Vegetarian Food Pyramid? Yes, but be a scientist!

- **Oils**: 2–3 teaspoons
- **Nuts and Seeds**: 1–2 servings
- **Dairy**: Vegan: fortified non-dairy substitutes
  - 3 servings
- **Beans and Protein Foods**: 2–3 servings
- **Fruits**: 1–2 servings
- **Vegetables**: 2–4 servings
- **Green Leafy Vegetables**: 2–3 servings
- **Bread, Pasta, Rice, Fortified Cereals**: 6–10 servings

Vegans need these supplements:
- **Vitamin B₁₂**: 2.4 μg/d
- **Vitamin D**: 200 IU/d
- **Calcium**: 600 mg/d

**VEGETARIAN FOOD PYRAMID**

- **Water**: 8 cups daily - Needs increase with activity

Why More Fruits, Vegetables Whole Grains & Beans?
Phytochemicals ≡ Plant chemicals

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

Potential regulators of health!

10s of thousands!

*aroma, color, taste*
Broccoli sprouts may contain ~ 10,000 unique phytochemicals!
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
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), $\alpha$-linolenic acid (an $\Omega$-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, lycopene with anti-oxidant activity is also in guava, papaya, pink grapefruit & watermelon!
**Table C2-3**

**Common Foods Ranked by Antioxidant Content**

<table>
<thead>
<tr>
<th>Position</th>
<th>Food Item</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Blackberries</td>
</tr>
<tr>
<td>2.</td>
<td>Walnuts</td>
</tr>
<tr>
<td>3.</td>
<td>Strawberries</td>
</tr>
<tr>
<td>4.</td>
<td>Spinach</td>
</tr>
<tr>
<td>5.</td>
<td>Artichokes, prepared</td>
</tr>
<tr>
<td>6.</td>
<td>Cranberries</td>
</tr>
<tr>
<td>7.</td>
<td>Coffee</td>
</tr>
<tr>
<td>8.</td>
<td>Raspberries</td>
</tr>
<tr>
<td>9.</td>
<td>Pecans</td>
</tr>
<tr>
<td>10.</td>
<td>Blueberries</td>
</tr>
<tr>
<td>11.</td>
<td>Cloves, ground</td>
</tr>
<tr>
<td>12.</td>
<td>Grape juice, cranberry juice, pomegranate juice</td>
</tr>
<tr>
<td>13.</td>
<td>Chocolate, dark, unsweetened</td>
</tr>
<tr>
<td>14.</td>
<td>Cherries, sour</td>
</tr>
<tr>
<td>15.</td>
<td>Wine, red</td>
</tr>
</tbody>
</table>

Sizer & Whitney 2011 Table C2-3 p 64
Antioxidant Capacity Depends Upon Seasons, Storage, Testing Methods, Variety...

| 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         |

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

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.

*NB:* ...but typical serving amounts may be too small to benefit human health!...Alcoholism?
High doses of soy phytoestrogens may lower blood cholesterol

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

*Life is all about balance: too much? too little?*
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.
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).
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
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.
Why exercise?
THE REWARD OF FITNESS: LONGEVITY

DEATH RATES
10,000 person yr

FITNESS LEVEL
Low 1 2 3 4 5
High

WOMEN (3120)

39.5 20.5 12.2 6.5 8.5

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

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

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

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