30% of US adults are overweight. Our diet has been linked to five of the ten leading causes of death in the US.

1. Carbohydrates,
   A) sugars, sucrose is table sugar, from sugar cane or sugar beets. Fructose is sweeter and use it to provide less calories but with the same sweetness. High fructose corn syrup is glucose treated with enzymes to give fructose. In US 1968 to now sugar intake went from 11 kg/year to over 70 kg/year.

   \[
   \text{Sucrose} + H_2O \rightarrow \text{glucose} + \text{fructose} \\
   \text{Lactose} + H_2O \rightarrow \text{glucose} + \text{galactose}
   \]

   b) complex carbohydrates - bread, flour, cereals, pasta should be 65-80% of diet intake
   carbohydrates can be stored as glycogen, excess is converted to fat.

   c) artificial sweeteners. Want something sweet without calories. In 1977 saccharin was shown to cause bladder cancer in animals. However Congress went ahead with it. 1981 the FDA approved aspartame. 160 times sweeter than saccharin. difficult to predict taste.
2. Fats, high energy foods no more than 30% of caloric intake from fat. Fats come from triglycerides. Used to coat vital organs so they do not become damaged. Stored under skin to help insulate against temp. changes.

Dietary fat and cholesterol have been linked to arteriosclerosis –hardening of the arteries. Give heart attack or stroke. Artery clogging plaque is high in cholesterol. Water insoluble, so measure LDL and HDL. HDL are the only ones that transport cholesterol to the liver for processing and excretion. Found by studying Greenlanders. Fish oils also might help prevent heart disease. Effect caused by poly unsaturated fatty acids.

3. Proteins,

   essential amino acids- the eight amino acids the body cannot synthesize.
   Each dietary food is usually lacking in a few specific amino acids. Corn lacks tryptophan and lysine. Most animal sources have plenty of amino acids, milk, fish, eggs, cheese.

4. Minerals- inorganic components represent 4% of the bodies weight.
   iodine is important to for the thyroid and to stop goiter. KI is added to table salt.
   Iron for hemoglobin.
   Calcium and phosphorus for bones and teeth. Also P for to store energy.

5. Vitamins specific organic compounds that are required in the diet to prevent specific diseases.
Two classes-
  a) Water soluble- B, C contains more nitrogen and oxygen. excrete excess. need to be replenished. Go down the drain while cooking.
  b) Fat soluble- can be stored in fat. can store several years worth of vitamin A. excess for some can cause problems, D can cause pain in bones, nausea, diarrhea.

6. Dietary fiber- may be soluble or insoluble. Insoluble is cellulose. Supposed to help lower the risk of colon cancer but has not been verified.

7. Starvation- derive your body of food.

8. Processed food- Whole wheat is rich in vitamin B1 and others. White flour the wheat germ and bran are removed resulting in no vitamins. Use the starch and bran for animal food. Polished rice was introduced to the South East Asia and people got beriberi. When fruits and vegetable are peeled they lose their vitamins. Heat also destroys some vitamins and water absorbs water soluble vitamins and minerals. In US over half the diet consists of processed foods.

9. Additives- used to preserve, enhance flavoring, prevent disease, add nutritional value.

   Most common
   1. Sugar, salt, corn syrup major
   2. citric acid, baking soda, vegetable colors, mustard, pepper.
   a) Improve nutrition-
      1. First was KI to table salt to prevent goiter.
      2. vitamin B1 to polished rice to prevent beriberi.
      3. enriched flour- B complex vitamins and iron still lacks vitamin B6, pantothenic acid, zinc, fiber and …
      4. vitamin C added to fruit juices.
      5. fortified milk -vitamin D to avoid rickets
      6. vitamin A to margarine, already in butter
b) Flavor additives- can be synthetic or natural, nutmeg, ginger

1. Flavor enhancers- no flavor themselves but enhance the taste.
   a. table salt.
   b. monosodium glutamate- MSG- sodium salt of glutamic acid. Large doses can be bad, teratogen and in mice cause parts of the brain to go numb.

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c) Preservatives-

1. NaNO₂ is put on meats, gives pink coloring kills botulism poisoning might cause stomach cancer. Might form nitroso compounds, supper potent carcinogen. R₂N₂O
2. Sulfur dioxides- preserves dried fruit, bleaches and prevents browning of wines, jelly, ….
3. bacteria and fungus ruin food, Major ones are propionic acid added to read and cheese.
4. EDTA- (ethylenediamine tetraacetic acid) removes metal cofactors necessary for bacteria and fungus.

d) Antioxidants BHA, BHT prevents fats and oils from forming rancid products.

Fats form free radicals. Fat + O₂ \[\rightarrow\] free radical leads to a chain reaction and the formation of lots of radicals. Stabilizes radical without polymerization because of bulky groups.
d) Food colors. Some are natural like B-Carotene, beet juice, saffron.

Lots of synthetic dyes- some have been banned, all have lots of double bonds.

E) Poisons in Food-
   Carcinogens- cancer causing agents. Appear in our food naturally.
   Barbaques cause lots of them. It is estimated that our consumption of
   natural carcinogens is 10,000 times greater than synthetic ones.
   Bacterium C, botulinum 1g can kill more than a million people, can grow
   anaerobic.

   Aflatoxins are the most potent- produced by mold on stored peanut and
   grains, Aflotoxin B₁ is 10 million times more potent than saccharin

F) Two types of additives-
   a) Intentional- put into a product to perform a specific function-

   b) incidental- get in accidentally. Pesticide residual, insect parts,
   antibiotics.
EX. 1989- discovery of residue daminozide (alar) used to riped apples at the same time and have better appearance. Breaks down to dimethyl hydrazine a suspected carcinogen. To get the same dose of a lab animal you would eat 13,000 kg of apples a day for 70 years. consumers freaked and it was banned.

Antibiotics- %0% of the sales in the US go to animal feeds. May lead to allergies and resistant bacteria.

Diethylstilbestrol- added to animal feed to promote weight gain, caused cancer in offspring of woman who took the additive during pregnancy.

Difficult to find and ban. Took 15 years.

E) Future 9000 deaths and 6 million illness due to food from food poisoning caused by bacteria toxins. Few have been related to intentional food additives. Should stay alert.

10. Fertilizers-

a) Nitrogen-only bacteria can take N₂ from the air. Grow on the roots of plants. (clover) Can rotate crops between cloves and something else. Plants take up nitrogen as NO₃⁻ or NH₄⁺. Lightening makes nitric acid.

Right before WWI Haber.

\[ 3\text{H}_2 + \text{N}_2 \xrightarrow{\text{Haber}} 2\text{NH}_3 \]

\[ \text{NH}_3 + 2\text{O}_2 \xrightarrow{\text{Lightening}} \text{HNO}_3 + \text{H}_2\text{O} \]
\[ \text{HNO}_3 + \text{NH}_3 \rightarrow \text{NH}_4\text{NO}_3 \] wanted it as an explosive but made a good fertilizer.

b) Phosphorus- need P for DNA and RNA and other. used bird droppings guano, fish meal…figured out in 1800 and the bones of battlefields were dug up and shipped. In bones P is tightly bound. 1843

\[
\text{Ca(PO}_4\text{)}_2 + 2\text{H}_2\text{SO}_4 \rightarrow \text{Ca(H}_2\text{PO}_4\text{)}_2 + 2\text{CaSO}_4
\]

phosphate rock or bone more soluble

more common today is to add N and P in \((\text{NH}_4\text{)}_2\text{HPO}_4\)

Most phosphates come from reserves of ancient sea creature bones. 2/3 in Morocco. High grade phosphate reserves might be depleted in 30-40 years.

c) Potassium. comes as K⁺ good solubility. from KCl.

d) other nutrients, farmers get a mixed bag. which contains three main components, N, P \((\text{P}_2\text{O}_5\text{, not true form}), \text{potassium (K}_2\text{O, not true form})\) Thus a bag that says 5-10-5 is 5% 10% and 5% the rest is inert material.

Get table 16.10

11. pesticides- needed to kill pests, black plague, malaria. Problem is that pesticides kill indiscriminate.

a) DDT an insecticide. Found right before WWII. First used against grapevine pests and potato beetles. Used on Allied soldiers to get rid of lice. Was found not be harmful to people. Easily made. According to World Health Organization approx. 25 million lives have been saved and hundred of millions of illnesses prevented by DDT type pesticides.
Problems:

a) resistant strains of flies and insects
b) made bird shells too thin by interfering with calcium metabolism.
c) interferes with the growth of plankton and crustaceans
d) does not readily break down, is harmful to cold blooded animals. Is stored in fat
e) fat soluble so they go into the food chain.

Other pesticides-
1. organic phosphorus-break down more readily.
2. Carbamates- most are narrow insecticides break down readily but are harmful to honey bees.

12. Other controls-
1. 
   a) Use of other insects- praying mantis and ladybugs are sold to eat garden pests.
b) use of bacteria and fungus- the gene for the toxins they produce has also been added to cotton, corn, potato. However, insects develop resistance.
c) can breed insect and fungus resistant plants.

2.
a) sterilization- send out sterilized males by radiation, chemicals, or cross-breeding. Infertile males in greater population. Very expensive and time consuming.
b) juvenile hormones- keeps insects in the pre-adult stage. No reproduction. Is difficult and expensive and only good for some insects. Don’t want a caterpillar

12. Alternative agriculture-
   a) ag uses 13% of our energy use. Pesticides, tilling, machines…
   b) organic farmers rotate crops with legumes to regenerate nitrogen, use animals for fertilizer, control pests by planting variety of crops, alternating use of fields, use less energy but less productivity but less costs. Use labor which is a renewable source.

13. Growth is exponential while food supply is additive.