

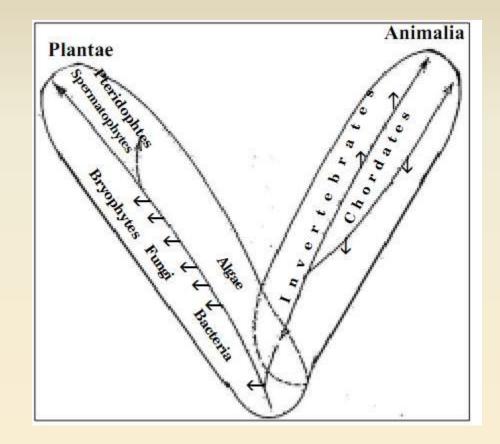
Basic Plant Biology A Review





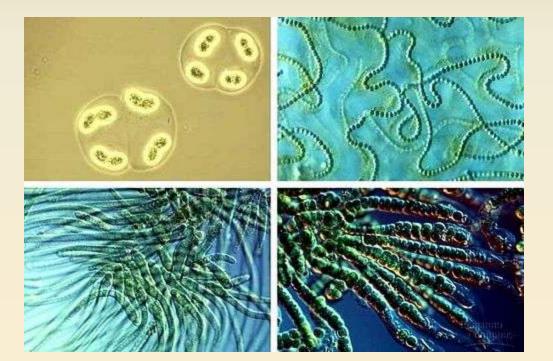


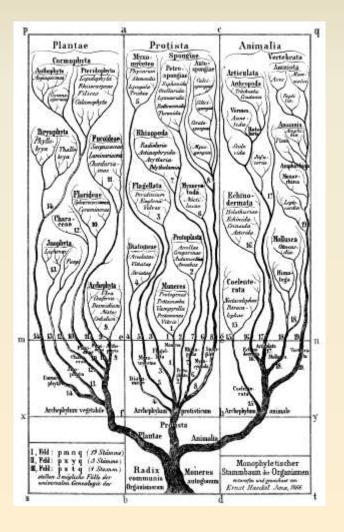
Traditional View of Biology: Animals and Plants



Traditional View of Biology: Animals and Plants

Problem: Microscopic Organisms (Bacteria, Fungi, Algae)





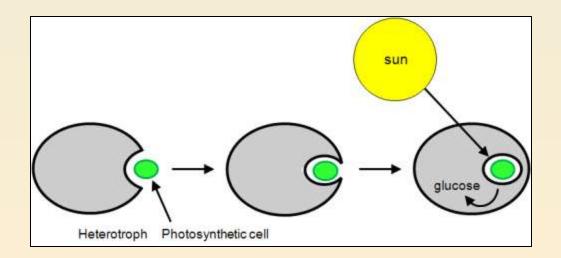
Traditional View of Biology: Animals and Plants

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Complication:

Endosymbiotic origin of organelles (Lynn Margulis)

Membrane-bound structures in eukaryotic cells are derived from formerly free-living organisms that have become intimately symbiotic



Traditional View of Biology: Animals and Plants

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Further Information: DNA molecular phylogenetic information

1. Confirming evidence for endosymbiotic theory

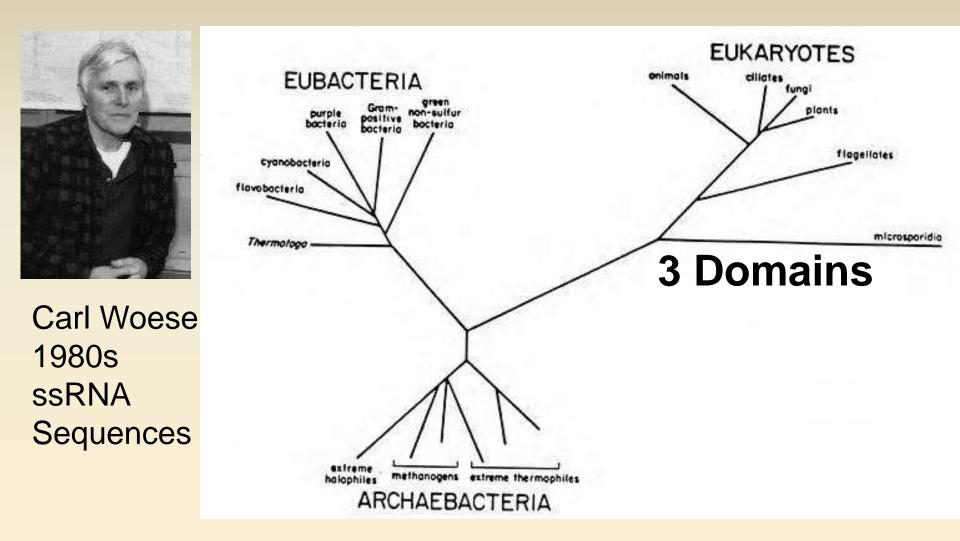
Traditional View of Biology: Animals and Plants

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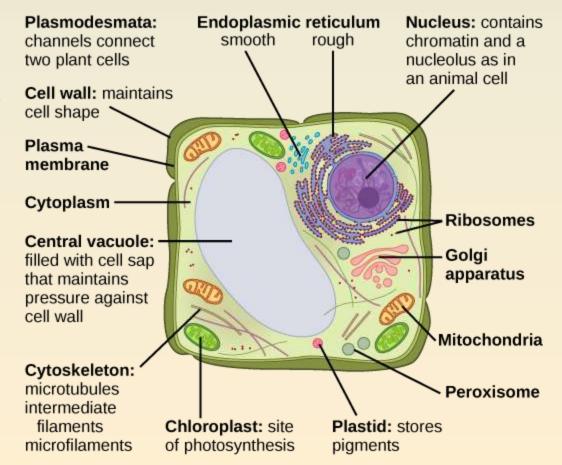
Further Information: molecular phylogenetic information

- 1. Confirming evidence for endosymbiotic theory
- 2. Suggestion that life split early into at least 3 major lineages

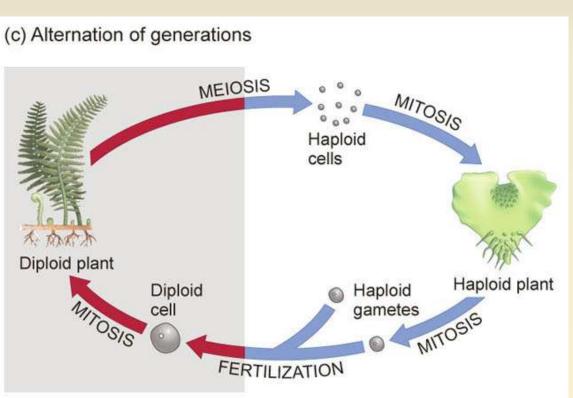
Carl Woese and the rRNA Tree of Life



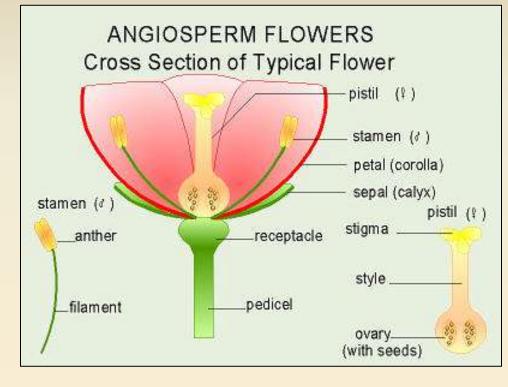
- 1. Eukaryotic nucleus
- 2. Chloroplasts present
- Cell wall with cellulose
- 4. Autotrophic make own food

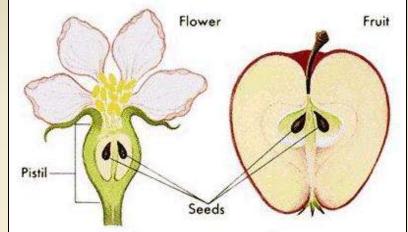


- 1. Eukaryotic
- 2. Chloroplasts present
- 3. Cell wall with cellulose
- 4. Autotrophic
- Complex Life Cycle (alternation of generations)



Angiosperms - Flowering Plants Flowers developed, Seeds enclosed by pistil, "fruit"



















Monocots



Gyymnosperms – "naked seed" plants Have no flowers or fruit, seeds borne naked







Ferns and Fern Allies Vascular plants, but no flowers, no seeds Reproduce by spores





Mosses and Liverworts - Bryophytes

Lack true roots, stems and leaves

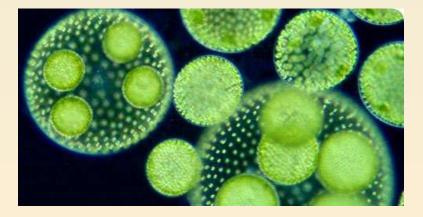
- Require moisture for fertilization
- Without vascular tissue; rely on diffusion of water Dispersal by spores



Algae - Diverse, single-celled to complex seaweeds Photosynthetic eukaryotes, green plants







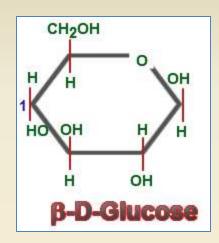


Fungi – not plants Non-photosynthetic eukaryotes, saprophytic, Reproduce by spores, chitin cell walls (not cellulose)

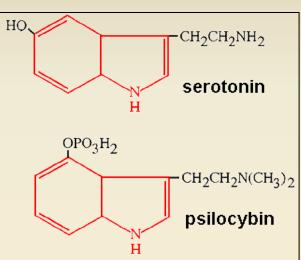


Includes yeast

Basic Chemistry Review

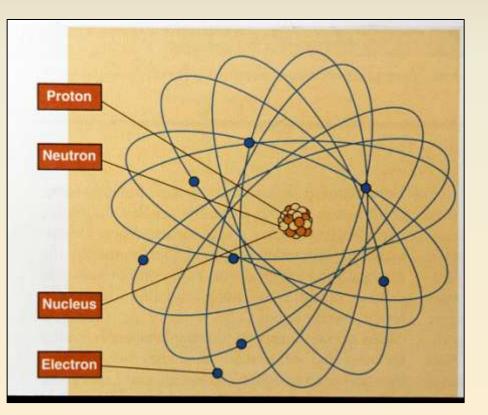






Atoms

Atoms are the basic unit of chemistry. They consist of 3 smaller things



- **Protons** these are positively charged (+)
- Electrons these are negatively charged (-)
- Neutrons these have no charge

Elements Pure substances, can't be broken down further



e.g. Silver, Copper, Magnesium, Iron

The universe is composed of approximately 100 types of atoms. Each type of atom is referred to as an **element**.

Periodic Table of the Elements

| | Group | | | | | | | | | | | | | | | | | | |
|--------|---|--------------------------|--------------------|------------------------|-------------------|------------------------|-----------------------|---------------------|---------------------|----------------------|----------------------|----------------------|----------------------|--------------------|----------------------|---------------------|----------------------|--------------------|--|
| | 1 | | | | | | | | | | | | | | | | | 18 | |
| | 1A | | | | | | Alkalai met | tals | | Post-transitio | on metals | | | | | | 8A | | |
| | 1 | | 11 — Atomic number | | | | - | Alkaline ea | rth metals | | Metalloids 2 | | | | | | | | |
| - 8 | | | | | | Lanthanides | | | | | | | | | | He | | | |
| | Hydrogen 2 Na Element symbol 1.0078 2A Sodium – Element name | | | | Lanuidnices | | | Other nonmetals | | 13 3A | 14 4A | 15 5A | 16 6A | 17 7A | Helium 4.0026 | | | | |
| | | 3 4 22.990 Atomic weight | | | | Actinides | | | Halogens | | 5 | 6 | 7 | 8 | 9 | 10 | | | |
| 8 | 1.1 | Be | | | Atomic weight | | 1 | Transition metals | | | Noble gases | | B | ċ | Ň | Ŏ | Ê | Ne | |
| 3 | Lithium | thium Beryllium | | | | Unknown p | roportion | | | | Boron | Carbon | Nitrogen | Oxygen | Fluorine | Neon | | | |
| | 6.938 | 9.0122 | | | | Unknown p | roperties | | | | 10.806 | 12.009 | 14.006 | 15.999 | 18.998 | 20.180 | | | |
| | 11 | 12 | | | | | | | | | | | 13 | 14 | 15 | 16 | 17 | 18 | |
| | | Mg | a | 12 A | 120 | | . | 2 | | 10 | | | AL | Si | P | S | CL | Ar | |
| | Sodium 22.990 | Magnesium 24.305 | 3 3B | 4 48 | 5 5B | 6 6B | 7 7B | 8 | 9 8B | 10 | 11 1B | 12 2B | Aluminum 26.982 | Silicon 28.084 | Phosphorus 30.974 | Sulfur 32.059 | Chlorine 35.446 | Argon 39,948 | |
| | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | |
| 8 | ĸ | Ča | Sc | Ťi | v | Cr | Mn | Fe | Co | Ni | Ču | Zn | Ga | Ge | As | Se | Br | Kr | |
| Period | Potassium | Calcium | Scandium | Titanium | Vanadium | Chromium | Manganese | Iron | Cobalt | Nickel | Copper | Zinc | | Germanium | Arsenic | Selenium | Bromine | Krypton | |
| | 39.098 | 40.078 | 44.956 | 47.867 | 50.942 | 51.996 | 54.938 | 55.845 | 58.933 | 58.693 | 63.546 | 65.38 | 69.723 | 72.63 | 74.922 | 78.96 | 79.904 | 83.798 | |
| | 37 | 38 | 39 | 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 50 | 51 | 52 | 53 | 54 | |
| | | Sr | Y | Zr | Nb | Mo | Tc | Ru | Rh | Pd | Ag | Cd | ļņ | Sn | Sb | Те | | Xe | |
| | Rubidium 85.468 | Strontium 87.62 | Yttrium 88.906 | Zirconium 91.224 | Niobium 92.906 | Molybdenum 95.96 | Technetium 98.9062 | Ruthenium 101.07 | Rhodium 102.91 | Palladium 106.42 | Silver 107.87 | Cadmium 112.41 | Indium 114.82 | Tin 118.71 | Antimony 121.76 | Tellurium 127.60 | lodine 126.90 | Xenon 131.29 | |
| | 55 | 56 | 00.700 | 72 | 73 | 74 | 75 | 76 | 77 | 78 | 79 | 80 | 81 | 82 | 83 | 84 | 85 | 86 | |
| | 6- | Ba | | Hf | Та | Ŵ | Re | Os | İr | Pt | Au | Hg | Τl | Pb | Bi | Po | At | Rn | |
| | Cesium | Barium | | Hafnium | Tantalum | Tungsten | Rhenium | Osmium | Iridium | Platinum | Gold | Mercury | Thallium | Lead | Bismuth | Polonium | Astatine | Radon | |
| | 132.91 | 137.33 | 1 | 178.49 | 180.95 | 183.84 | 186.21 | 190.23 | 192.22 | 195.08 | 196.97 | 200.59 | 204.38 | 207.2 | 208.98 | (209) | (210) | (222) | |
| | 87 | 88 | | 104 | 105 | 106 | 107 | 108 | 109 | 110 | 111 | 112 | 113 | 114 | 115 | 116 | 117 | 118 | |
| | | Ra | | Rf | Db | Sg | Bh | Hs | Mt | Ds | Rg | Cn | Uut | FL | Uup | Lv | Uus | Uuo | |
| | Francium (223) | Radium (226) | | Rutherfordium (261) | Dubnium (262) | Seaborgium (266) | Bohrium (264) | Hassium (269) | Meitnerium (268) | Damstadtium (268) | Roentgenium (268) | Copernicium (268) | Ununtrium (268) | Flerovium (268) | Ununpentium (268) | (268) | Ununseptium (268) | (268) | |
| | (223) | (220) | | (201) | (202) | (200) | (204) | (203) | (200) | (200) | (200) | (200) | (200) | (200) | (200) | (200) | (200) | (200) | |
| | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | |
| | | | des | 57 | 58 | 59 | 60 | 61 | 62 | 63 | 64 | 65 | 66 | 67 | 68 | 69 | 70 | 71 | |
| | | | iani | La | Ce | Pr | Nd | Pm | Sm | Eu | Gd | Tb | Dy | Ho | Er | Tm | Yb | Lu | |
| | | | Lanthanides | Lanthanum 138.91 | Cerium 140.12 | Praseodymium 140.91 | Neodymium 144.24 | Promethium (145) | Samarium 150.36 | Europium 151.96 | Gadolinium 157.25 | Terbium 158.93 | Dysprosium 162.50 | Holmium 164.93 | Erbium 167.26 | Thulium 168.93 | Ytterbium 173.04 | Lutetium 174.97 | |
| | | | | 89 | 90 | 91 | 92 | 93 | 94 | 95 | 96 | 97 | 98 | 99 | 100 | 101 | 102 | 103 | |
| | | | des | Ac | Th | Pa | Ű | Np | Pu | Am | Cm | Bk | Cf | Es | Fm | Md | No | Lr | |
| | | | Actinides | Actinium | Thorium | Protactinium | Uranium | Neptunium | Plutonium | Americium | Curium | Berkelium | | Einsteinium | Fermium | Mendelevium | Nobelium | Lawrencium | |
| | | | | | | | | | | | | | | | | | | | |

SOURCES: National Institute of Standards and Technology, International Union of Pure and Applied Chemistry

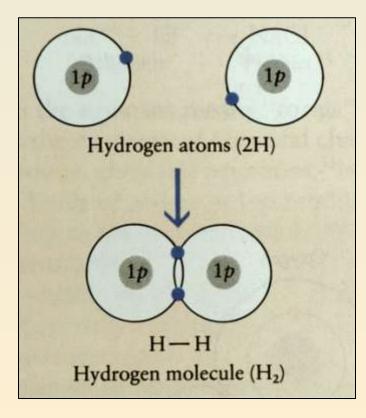
Organic vs. Inorganic

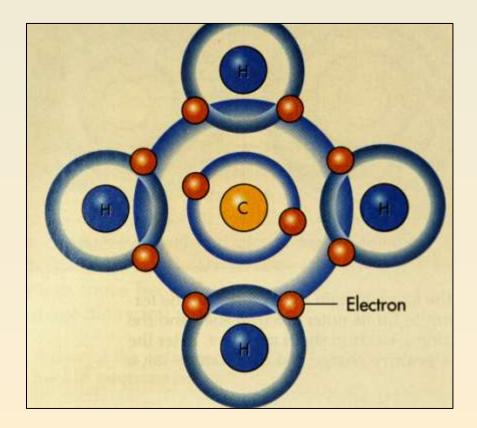
Organic molecules contain Carbon, inorganic molecules do not.

- CH4 is the formula for methane, it is organic.
- NaCl is the formula for common table salt, it is inorganic.

Chemical Bonding

Covalent These *strong* bonds form when two atoms *share electrons*.



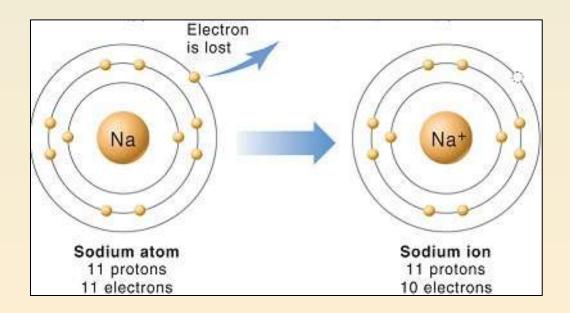


Chemical Bonding

lons

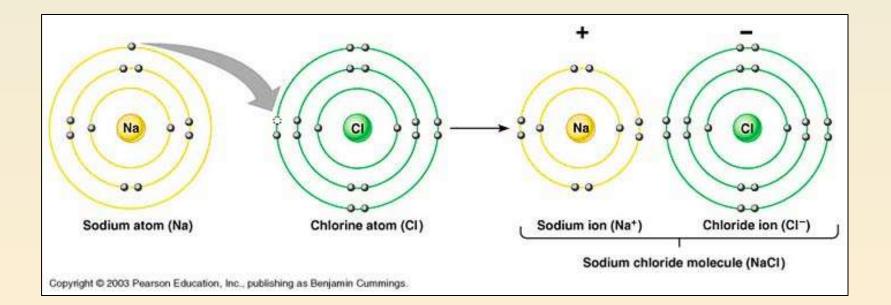
Sometimes atoms gain or lose electrons. These atoms are then called ions.

- **Positive Ion** Occurs when an atom *loses an electron* (negative charge) it has more protons than electrons.
- **Negative Ion** Occurs when an atom *gains an electron* (negative charge) it will have more electrons than protons.



The following image shows Na *losing* an electron and Cl *gaining* an electron

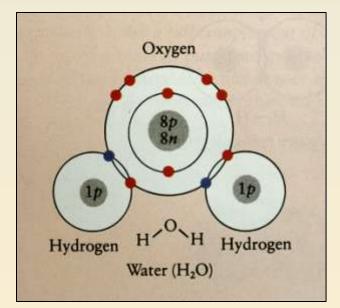
Thus the Na becomes Na+ The Cl becomes Cl-



Hydrogen Bond

Weakest bond between atoms. When the electrons are not equally shared; one atom of the molecule becomes partly negative and the other then becomes partly positive. Positive and negative are attracted to each other.

This is especially common between water molecules.





Polar and Nonpolar Substances

Since the water has opposite charges on different parts of the same molecule we call it Polar.

- A **Polar substance** has charges that can interact with the charges in water. Therefore Polar molecules are said to be Hydrophilic too (water loving).
- A Nonpolar substance then lacks any charges and will not be able to interact with water. Nonpolar molecules are said to be Hydrophobic (water hating).

Macromolecules

- Carbohydrates
- Lipids
- Proteins
- Nucleic Acids







Carbohydrates

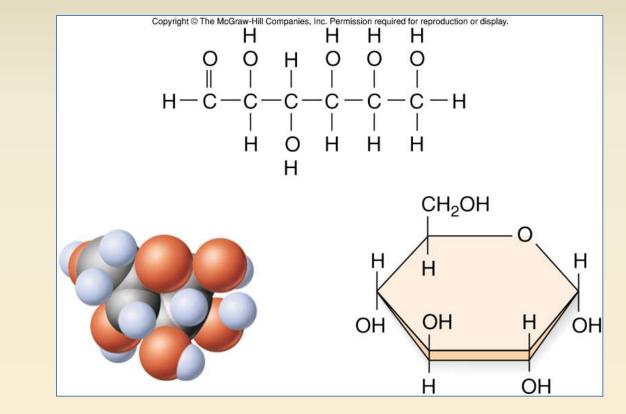


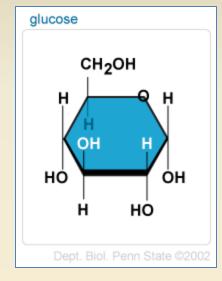
Carbohydrates

- **Carbohydrates** are composed primarily of carbon, hydrogen and oxygen and used primarily by living things as a source of energy and for structure.
- The simplest carbohydrates are sugars called **monosaccharides**. An example of a monosaccharide is the sugar glucose, formula C6H12O6.
- Monosaccharides can bond together to form larger carbohydrates called **polysaccharides**. An example of a polysaccharide is starch as is found in potatoes or pasta.

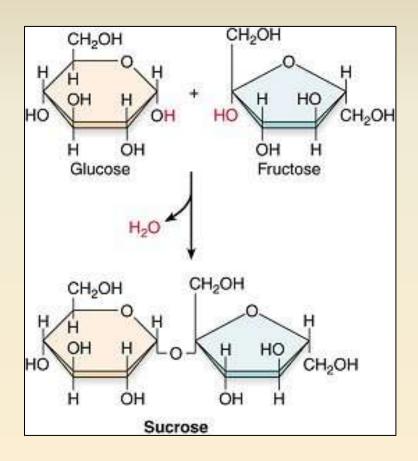
Monosaccharides - Glucose

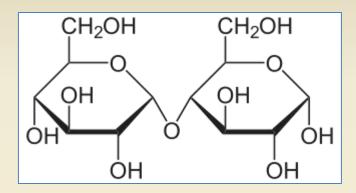
formula C6H12O6





Disaccharides - two carbohydrates linked together; ie. sucrose, maltose



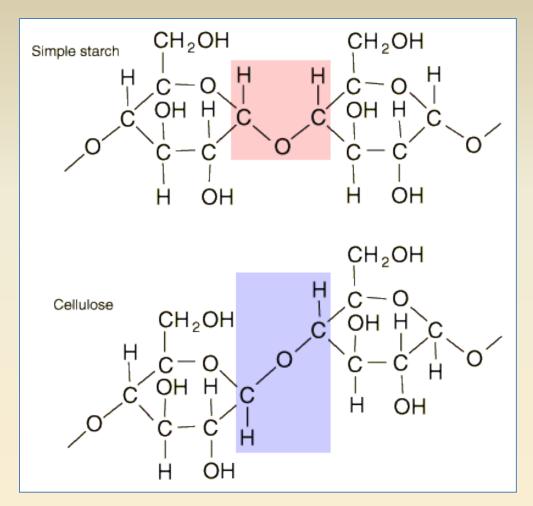


Maltose



Beer is brewed from malted barley

Starch and Cellulose

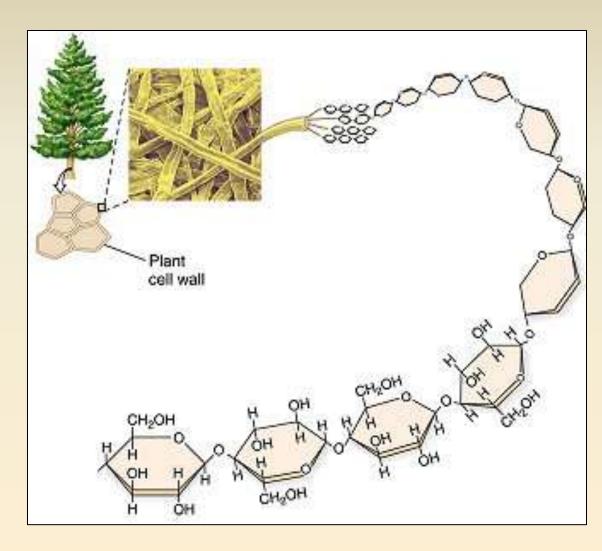


- differ in how the carbohydrates are linked together, two slightly different types of bonds are used.
- makes them different enough that one you can easily digest while the other is not digested at all by humans.

Polysaccharides

Cellulose

- the most common organic compound on Earth
- Wood, paper
- Food additive



Lipids

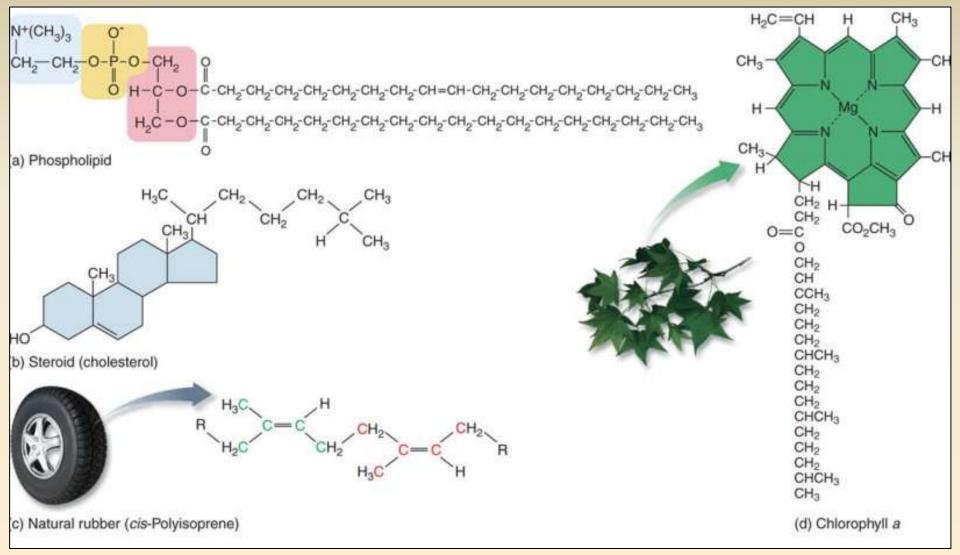
- store extra energy and insulate the body.
- cell membranes, myelin sheaths, and certain hormones.
- from animal fat and vegetable oils.





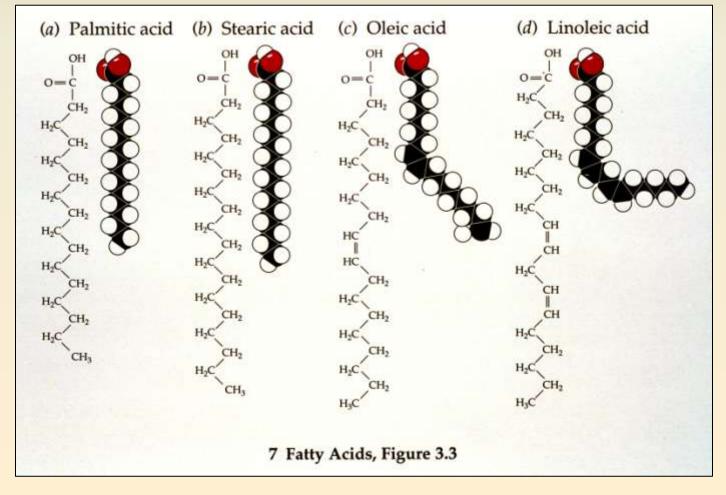


Lipids

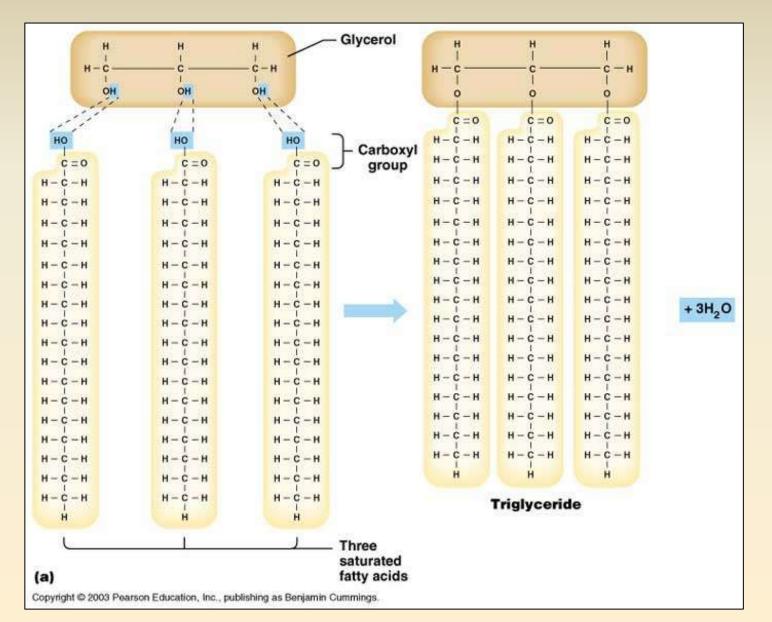


Fatty acids

- Long neutral carbon chains (C-C-C-C-C-C-C-C-C-C) with carboxyl group at one end.
- They come in many different lengths, get many different fatty acids.
- They are non-polar, so they clump together in water (oil and water don't mix.)

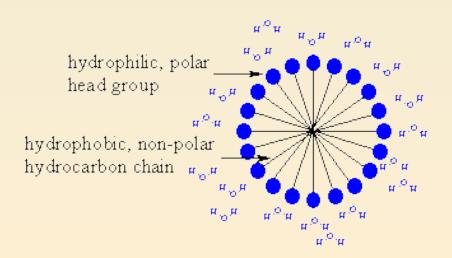


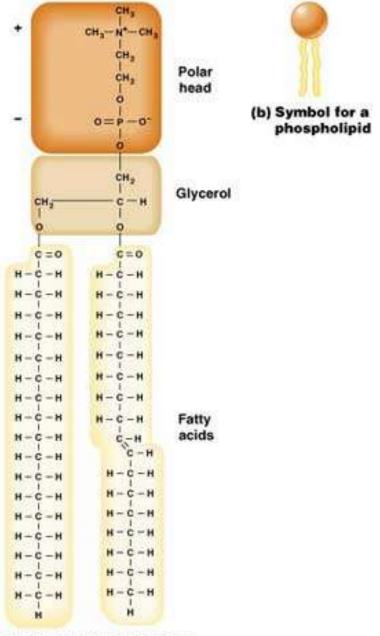
Triglycerides Three fatty acids linked by **glycerol**.



Phospholipids - remove one fatty acid from a Triglyceride and add a Phosphorous instead.

- organize themselves in water in unique ways.
- partly non-polar (long tails) and partly polar (the phosphorous end.)

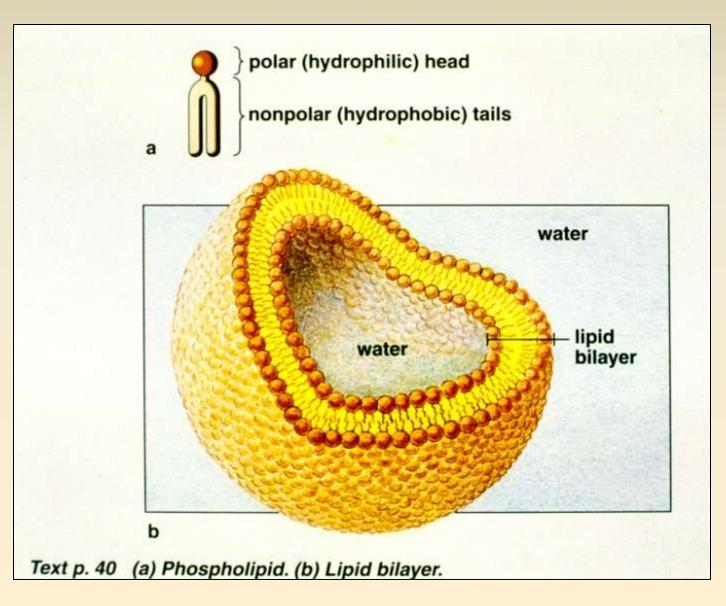




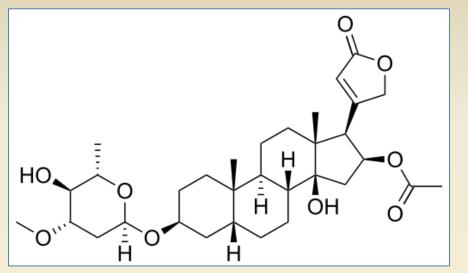
(a) Phospholipid structure

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Phospholipids form a **Bilayer** or a **Micelle** (round ball) in water Phospholipids are used to construct cell membranes

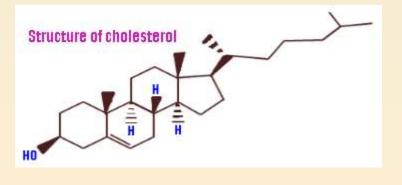


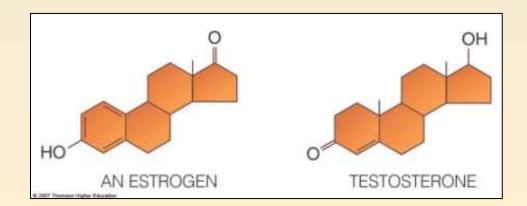
Steroids – lipids



Oleandrin

a toxic cardiac glycoside from *Nerium oleander*





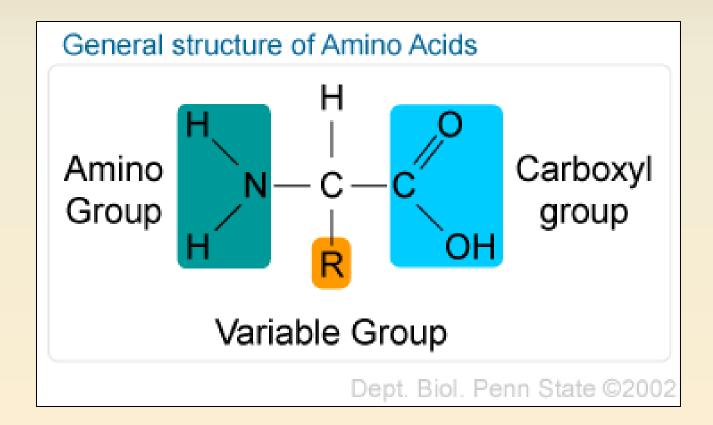
Proteins



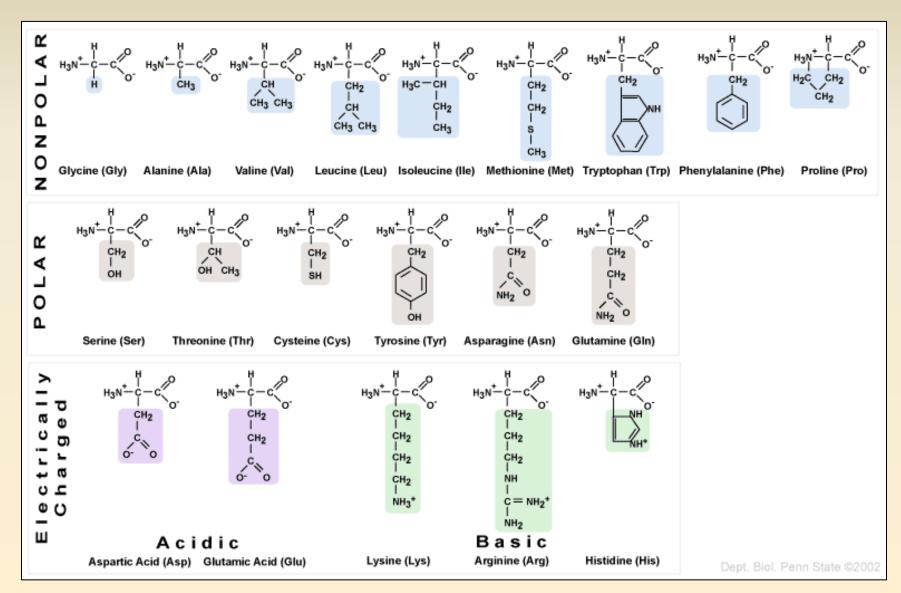


Proteins

Proteins are made by building long chains of **amino acids**. The Amino acid structure looks like this:

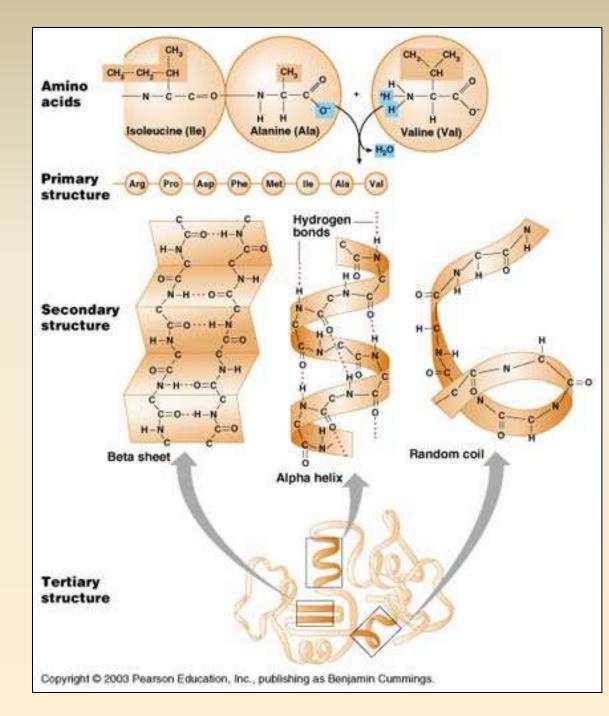


The R side chain is attached to central Carbon. Each R side chain has a different structure to it Twenty different types of side chains (20 amino acids)

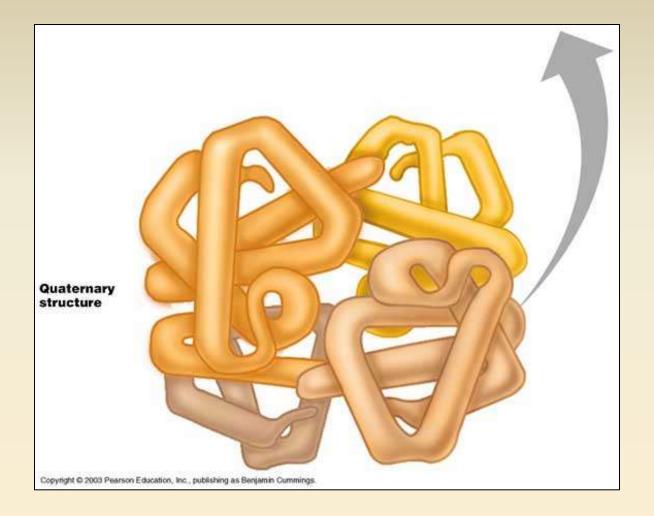


Four Levels of protein structure

Primary - exact sequence of amino acids before folding. Secondary - simple folding create simple structures. **Tertiary** - folding results in complex **3D** structures



Quaternary - multiple 3D subunits organized into a bigger structure

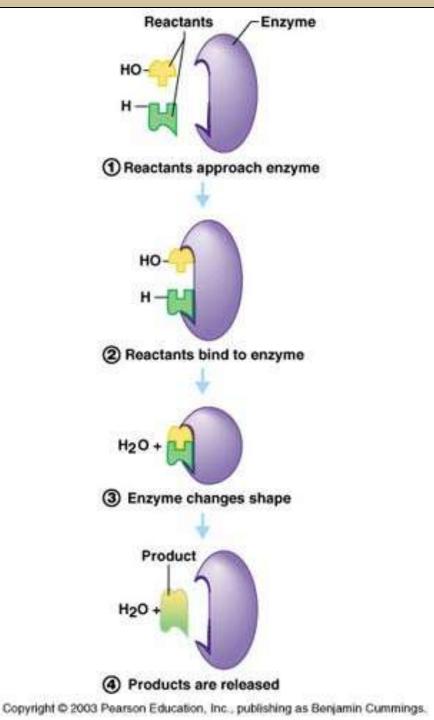


- Proper protein function depends on correct 3D structure.
- Any change in the specific primary structure can cause the protein to fold differently.
- A different shape can lead to a different function (or lack of proper function).

Enzymes

Proteins specifically shaped to carry out special functions in cells:

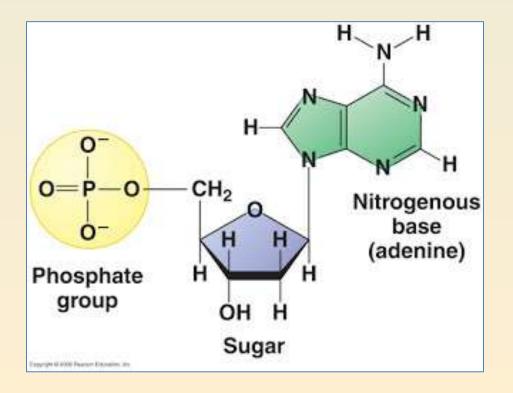
- They accelerate the rate of chemical reactions necessary for life.
- Enzymes take a **Substrate** and convert it into a new Product
- Each specific reaction needs a specific enzyme.
- Any changes in their shape will effectively stop chemical reactions.

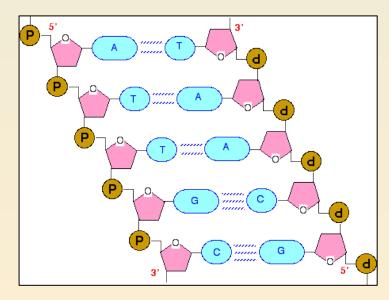


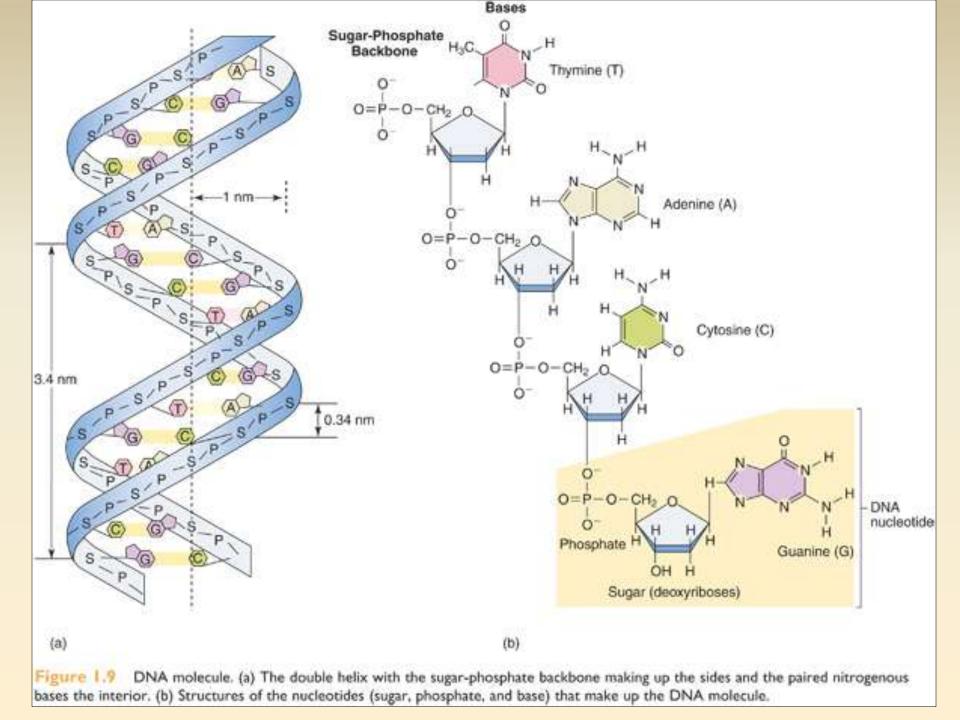
Nucleic Acids

One nucleotide has 3 parts:

- Sugar (pentose, a 5 carbon sugar)
- Base (A, G, C, T, U)
- Phosphorous

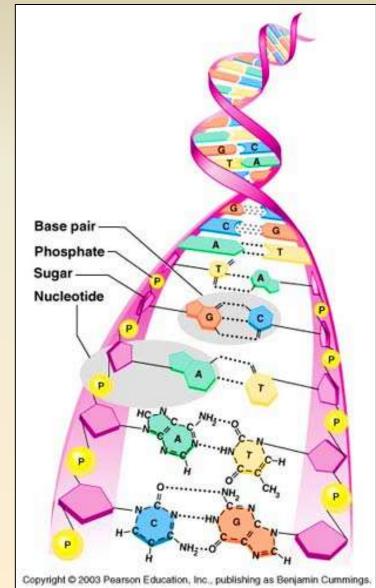




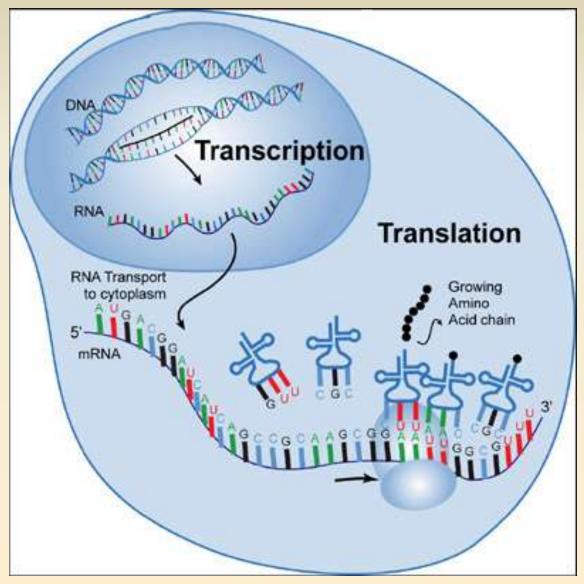


DNA Structure

- Double helix
- Paired strands are linked by bases
 - Adenine ("A")
 - Cytosine ("C")
 - Guanine ("G")
 - Thymine ("T")
 - A must bond with T
 - G must bond with C

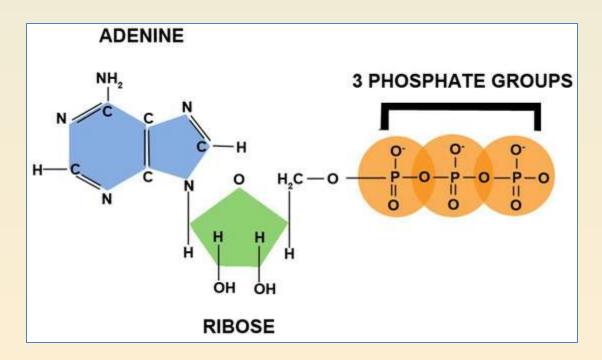


Transcription: DNA => RNA Translation: RNA => Protein (enzymes)



ATP – adenosine triphosphate

- Needed when cells require energy.
- Energy from sunlight is stored in ATP molecules and is used just like a rechargeable battery .
- Once energy is released, ATP is converted to an ADP (adenosine di-phosphate).

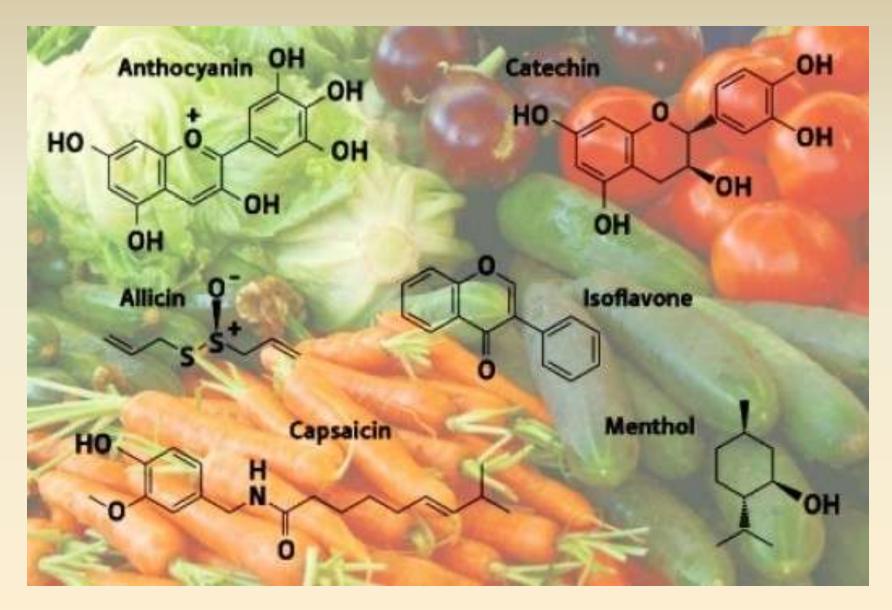


Energy currency of metabolism

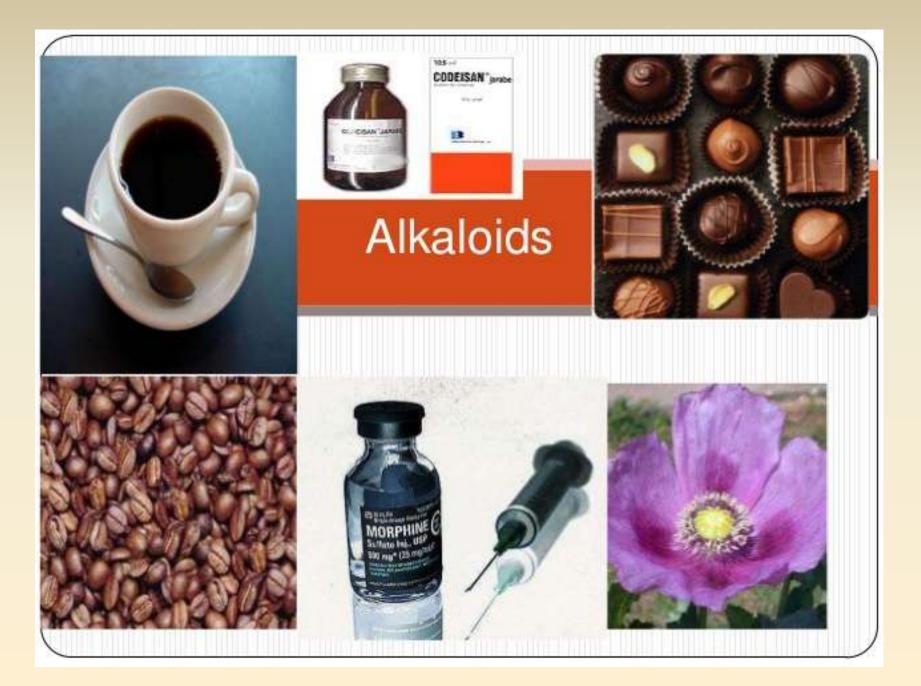
Secondary Compounds

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|------------------------|-----------------------------------|---|----------------------|
| | | Table 39.1 Secondary Metabolites | |
| Compound | Source | Structure | Effect on humans |
| Morphine (alkaloid) | Opium poppy Papaver somniferum | HO N-CH ₂ | Narcotic pain killer |
| Quinine (alkaloid) | Quinine bark | CH ₃ O CH ₃ O CH ₂ CH ₂ CH ₂ CH ₂ CH ₂ CH ₂ CH ₂ CH ₂ CH ₂ | Antimalarial drug |
| Taxol (terpenoid) | Cinchona officinalis | OOCCH ₃ O OH OH OOCCH ₃ O OH OOCCH ₃ O OOCCH ₃ OOCCH ₃ O OOCCH ₃ | Anticancer drug |

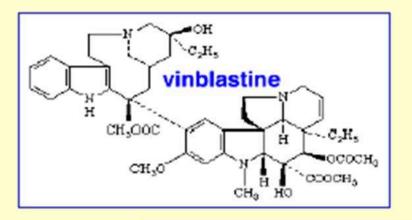
Secondary Compounds

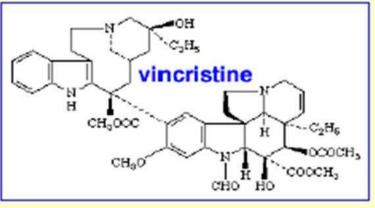


| Class of Compound | Examples | Use by Humans | Chapter |
|-------------------|-------------------------------|-----------------------------------|------------|
| Terpenes | Essential oils | Herbs and spices/flavor | Chapter 17 |
| | Essential oils | Perfumes and incense | Chapter 5 |
| | Taxol | Chemotherapy | Chapter 19 |
| Phenolics | THC | Hallucinogen/glaucoma treatment | Chapter 20 |
| | Urushiol | Allergen | Chapter 21 |
| Glycosides | Cassava—cyanogenic glycosides | Starchy staple | Chapter 14 |
| | Yam—saponin | Starchy staple/source of steroids | Chapter 14 |
| | Digitoxin | Heart medication | Chapter 19 |
| Alkaloids | Caffeine | Stimulant | Chapter 16 |
| | Ephederine | Stimulant/decongestant | Chapter 19 |
| | Quinine | Treatment for malaria | Chapter 19 |
| | Morphine | Pain relief, psychoactive | Chapter 20 |
| | Cocaine | Anesthetic/psychoactive | Chapter 20 |
| | Mescaline | Hallucinogen | Chapter 20 |



Vinblastine & Vincristine are Alkaloids







C. Roseus↑ ↓Vinca minor



End