

Basic Biology Concepts

Today's lecture

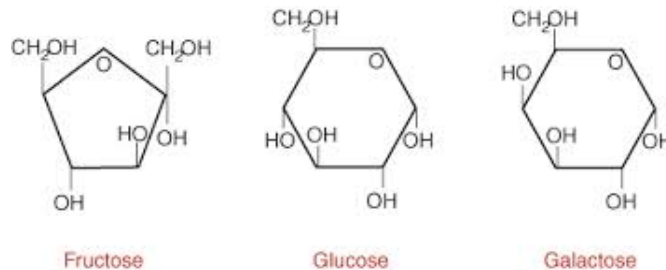
- Chemical composition of life
- Cell, cell contents, and cellular functions
- Energy and metabolism
- Application of biology for environmental engineering

Chemical composition of life

- Major elements: C, H, O, N, S, P
- Major classes of [macro]molecules:
 - carbohydrates
 - nucleic acids
 - protein
 - lipids

Carbohydrates

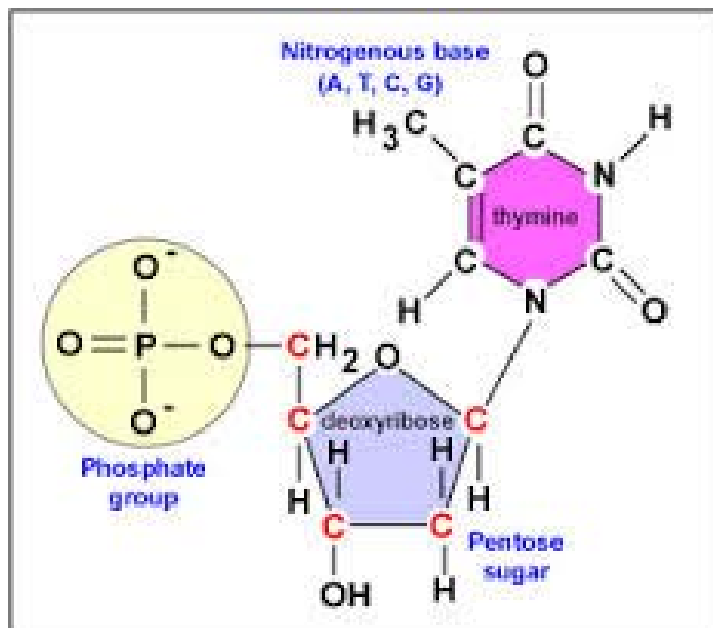
- Energy source, building materials for cells
- Monomers, dimers, polymers
 - Monosaccharides: building blocks



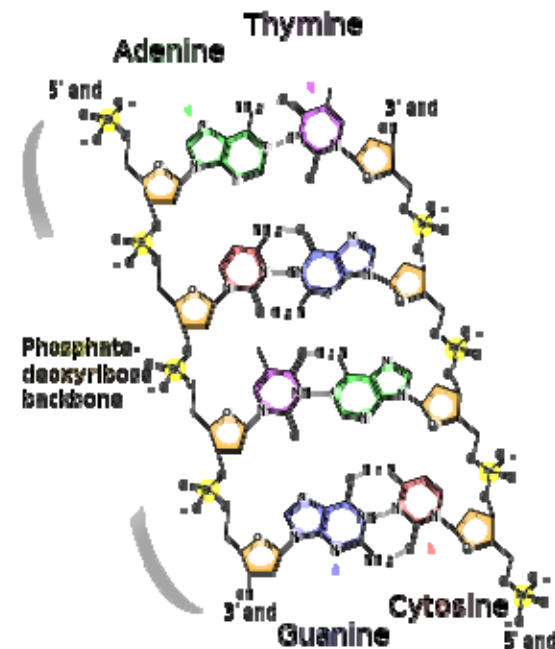
- Disaccharides: sucrose, lactose, maltose
- Polysaccharides: 100s – 1000s of monosaccharides

Nucleic acids

- Store and transmit hereditary information
- Monomers: nucleotides / polymers: DNA & RNA



Nucleotide for DNA



Structure of a DNA

DNA vs. RNA

	DNA (deoxyribonucleic acid)	RNA (ribonucleic acid)
Sugar	deoxyribose	ribose
Strand	double-stranded	single-stranded
Base	adenine (A), thymine (T), guanine (G), cytosine (C)	adenine (A), uracil (U), guanine (G), cytosine (C)
Function	long-term storage of genetic information; transfer genetic information to other cells and new organisms	transfer the genetic code from the DNA to ribosomes to make proteins

Proteins

- Affect almost all cellular functions (enzymes, immunoglobulins, hemoglobins, etc.)
- Structural support of organisms
- Monomers: amino acids (20) / polymers: polypeptides
- Structure of protein
[Fig 3-7]

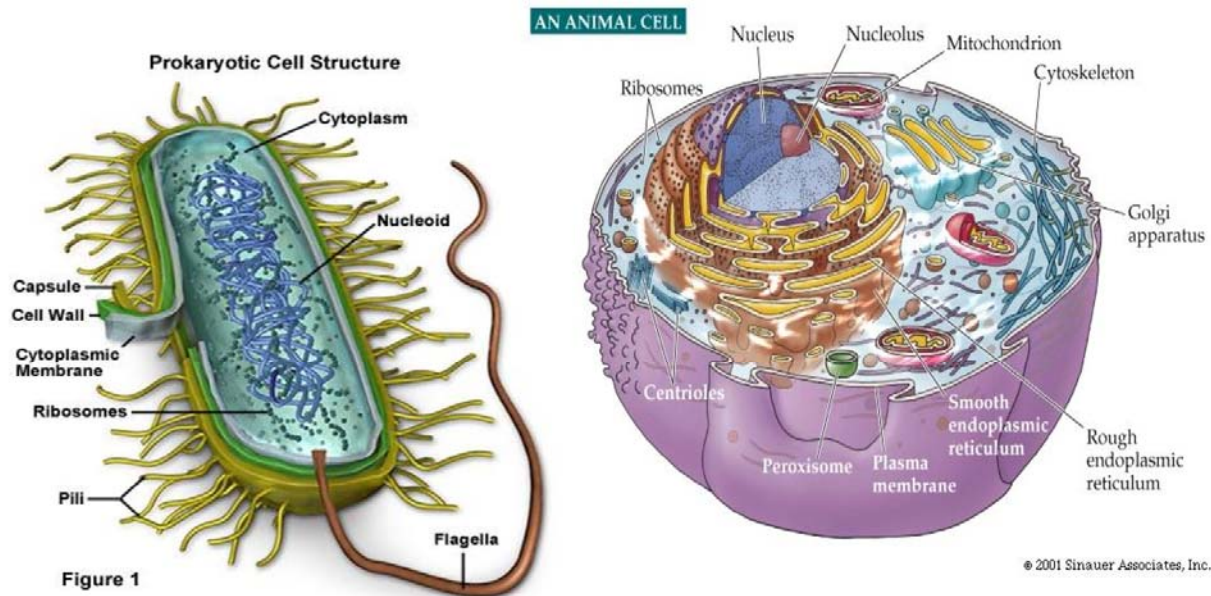


Lipids

- Not polymeric (no monomers, dimers, polymers)
- Various structures
- Common characteristic: hydrophobic (repulsion of water)
- Fats, phospholipids, and steroids
 - fats: store energy
 - phospholipids: major component of cell membranes
 - steroids: signaling (ex: steroid hormones)

The cells

- Prokaryotes vs. Eukaryotes: absence/presence of a nucleus

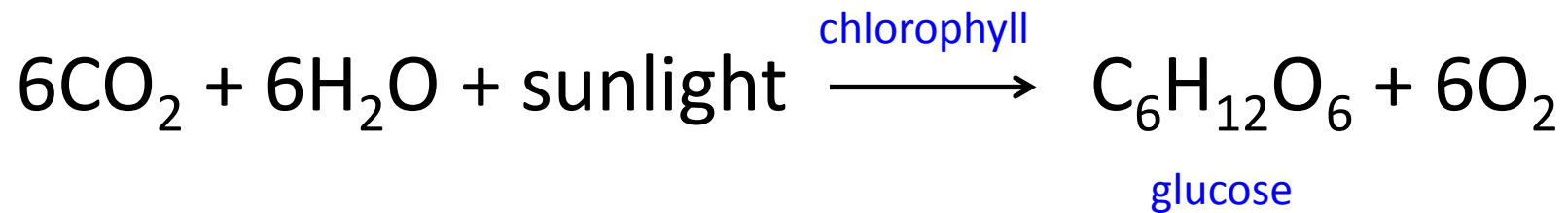


Composition of a cell

- Cell membrane
 - separates the interior of the cells from outside
 - exhibit selective permeability to control material movement in & out of a cell
- Nucleus: contains chromosomes (eukaryotic cells)
- Ribosomes: synthesize proteins
- Mitochondria: produce ATP
- Cell wall: give rigidity to a cell (prokaryotes/plant cells)

Energy and metabolism

- Photosynthesis: convert energy from sunlight into chemical energy



Energy and metabolism

- Metabolism: life-sustaining chemical transformations within cells of living organisms
 - catabolism: process to break down molecules into smaller units to generate energy (ATP)
 - anabolism: process to construct macromolecules from smaller molecules (consumes ATP)

Biology for environmental engineering

- Water quality (rivers, lakes, oceans..)
 - self-purification of natural water environments: contaminants are degraded by microorganisms
 - oxygen depletion: if excessive amount of organic contaminants are present, microorganisms consume most of dissolved oxygen in water → fish kills!
 - algae problems (algal bloom – excessive algal growth)

Biology for environmental engineering

- Wastewater treatment
 - biological wastewater treatment: use abilities of microorganisms to degrade/transform organic substances
 - main player: bacteria



Biology for environmental engineering

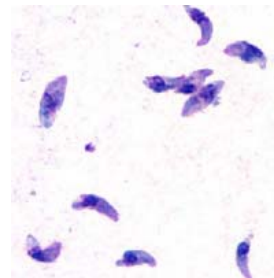
- Drinking water treatment
 - prevent waterborne diseases
 - types of disease-causing organisms: bacteria, protozoa, viruses, helminths
 - removal process: filtration & disinfection



Norovirus



Vibrio cholerae



Toxoplasma gondii



Biology for environmental engineering

- Detoxification of hazardous chemicals
 - use microorganisms (mostly bacteria) to detoxify hazardous chemicals in soils, sediments, and groundwater
 - ability to deal with newly generated chemicals

Reading assignment

- Textbook 89-117, 133-136