BIOLOGY REVIEW

ELEMENTS

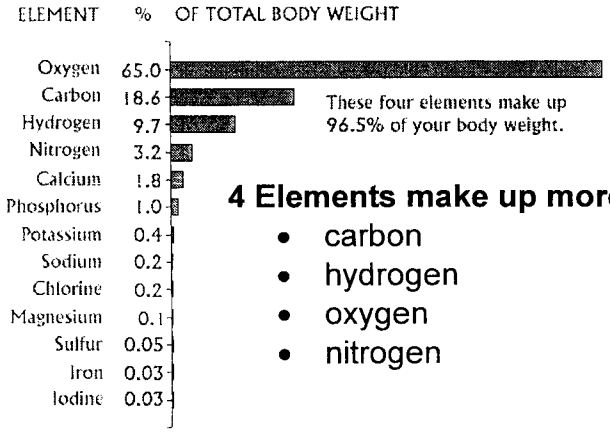
- EVERYTHING is made up of elements (living and non-living)
- One of the simplest chemical substances
- Can NOT be broken down into simpler substances
- 90 elements occur naturally on Earth

Each element is abbreviated by a one or two letter symbol

C represents the element carbon

Cl represents the element chlorine

Ca represents the element calcium



4 Elements make up more than 96 percent of the mass of a human

- carbon
- hydrogen
- oxygen
- nitrogen

TRACE ELEMENTS

- Present in living things in very small amounts
- Play a vital role in maintaining healthy cells in ALL organisms
- Example: deficiency in iodine = goiters in thyroid

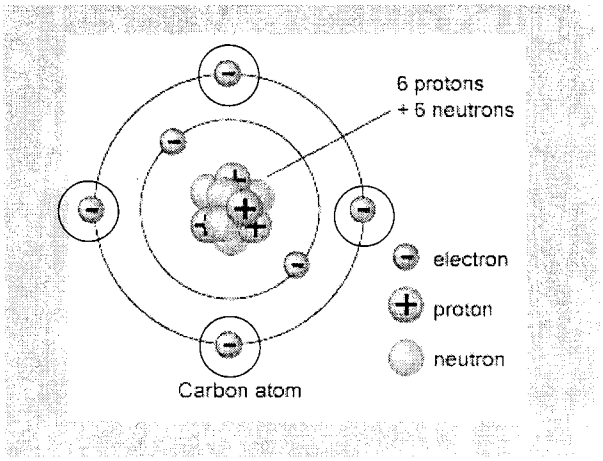
ATOMS

- Elements are made up of atoms
- An atom is the smallest particle of an element that has the characteristics of that element
- Characteristics / properties of elements are determined by the **structure of their atoms**

An introduction to organic chemistry . . .

A carbon atom

- 6 protons
- 6 electrons
- 4 electrons available for bonding in the outer energy level
- Can bond with other carbon atoms, as well as many other elements
- Forms 4 covalent bonds in order to become stable



Carbon has the ability to combine with other elements, and form a vast array of chemical structures

Carbon atoms can bond with other carbon atoms to form:

- single bonds
- double bonds
- triple bonds
- straight chains
- branched chains
- rings

A carbon chain can contain up to 1000s of carbon atoms.
These large molecules are called macromolecules (an example being proteins)

ISOMERS

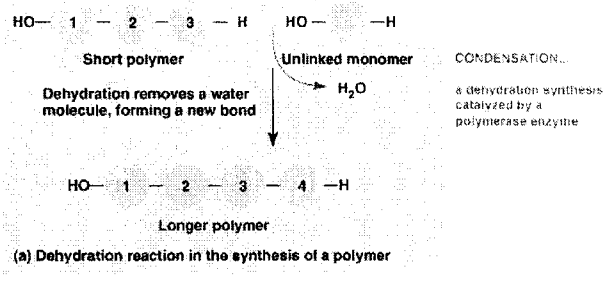
Compounds that have the same simple formula but differ in three-dimensional structure (ex: glucose and fructose)

POLYMER

- a large molecule formed when many smaller molecules bond together, usually in long chains

CONDENSATION

- Small molecules with a –H and an –OH bond together, The –H and –OH group are removed (form H20).
- The subunits are bonded by covalent bonds



HYDROLYSIS

A polymer is broken apart by the addition of water molecules. The –H and –OH ions attach to the bonds between subunits that make up the polymer (Ex: digestion of food)

CARBOHYDRATES

- are used by the cell to store and release energy
- are organic compounds composed of carbon, hydrogen, and oxygen

MONOSACCHARIDE

- a simple sugar, the simplest type of carbohydrate
- Common examples are the isomers glucose and fructose

DISACCHARIDE

- a two-sugar carbohydrate
- formed when two monosaccharide molecules link together
- EXAMPLE: Sucrose = glucose + fructose (combine by a condensation reaction)

POLYSACCHARIDES

- composed of many monosaccharide subunits
- EXAMPLES . . . (the three are polymers of glucose!)
  - STARCH: Consists of highly branched chains of glucose units and is used as food storage by plants
  - GLYCOGEN: Another glucose polymer similar to starch but more highly branched
  - CELLULOSE: Forms the cell walls of plants and gives plants structural support

LIPIDS

- Organic compounds with a large proportion of C-H bonds
- An example of a lipid found in beef fat has the formula $C_{57}H_{110}O_6$ (much less oxygen than carbohydrates)
- Commonly called fats and oils
- Insoluble in water (molecules are nonpolar and therefore not attracted to water molecules)
- Used by cells for long-term energy storage, insulation, and protective coatings
- The major components of the membranes that surround all living cells

SATURATED FATS

- Contain fatty acid chains of carbon with only single bonds
- Generally solid at room temperature
- Example: butter

UN-SATURATED FATS

- Contain fatty acid chains of carbon with double bonds
- Usually liquid at room temperature
- Example: olive oil

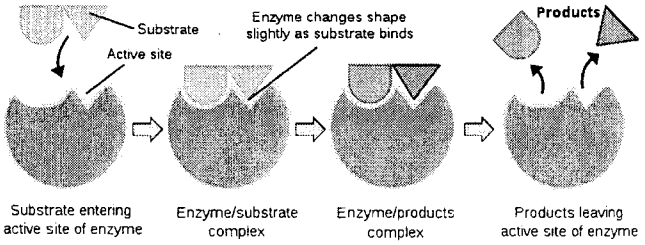
PROTEINS

- large complex polymers composed of carbon, hydrogen, nitrogen, and sometimes sulfur
- essential to all life
- build structures and carry out cell metabolism
- building blocks of many structural components (hooves, hair, nails)

Proteins are important in . . .

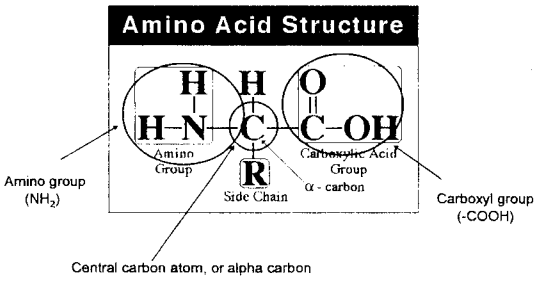
- Muscle contraction
- Transporting oxygen in the bloodstream
- Providing immunity
- Carrying out chemical reactions

ENZYME - a <u>protein</u> that speeds up a chemical reaction → → →

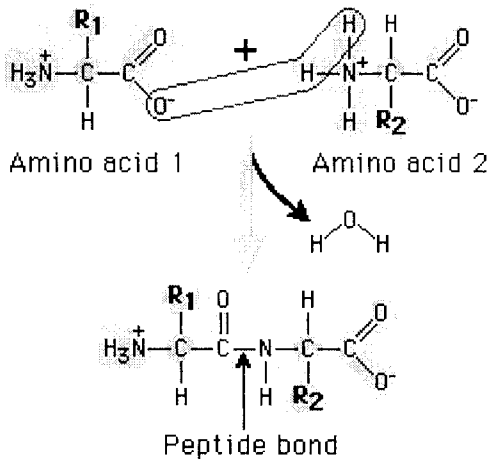


AMINO ACIDS

- The basic building blocks of proteins
- There are 20 different kinds
- They link together by condensation, to form a **peptide** bond
- The order of amino acids determine the kind of protein



There are 20 different R side chains

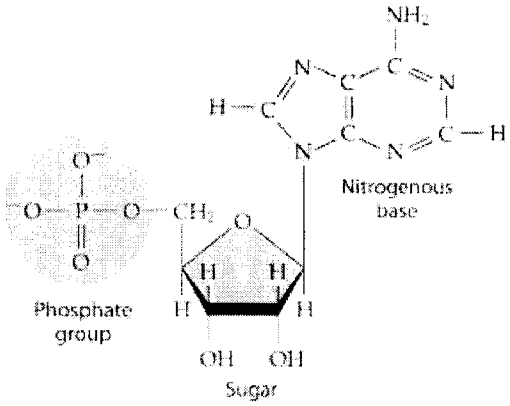


NUCLEIC ACIDS

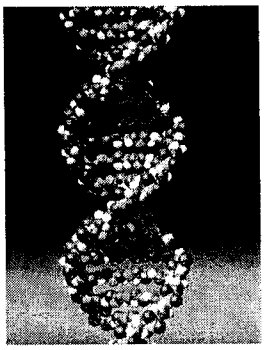
- Store information in cells in the form of a code
- Made up of subunits called nucleotides

NUCLEOTIDES

- Consist of carbon, hydrogen, oxygen, nitrogen, and phosphorus
- Basic building block of nucleic acids → → →
- Made up of a sugar molecule bonded to a phosphate group and a nitrogen base



DNA



- is a nucleic acid, made up of 4 different types of nucleotides.
- deoxyribonucleic acid → → →
- master copy of an organism's information code (instructions)
- DNA's instructions are passed on every time a cell divides
- forms the genetic code

RNA

- ribonucleic acid
- another important nucleic acid
- works with DNA to produce proteins

THE CELL - **Eukaryotic cell structure**

Plasma membrane

- boundary between cell and external environment
- controls movement of material entering and exiting the cell (oxygen, nutrients, etc. enter ~ waste products and excess water leave)
- flexible and allows cell to vary its shape if needed

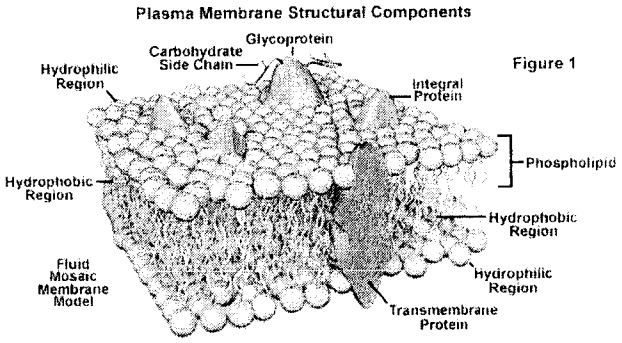


Figure 1

How do things cross a cell membrane?

- some materials enter and leave through protein passageways (passive or active)
- Other materials pass directly through the membrane (passive – diffusion)

*** Diffusion is the movement of molecules from a region in which they are highly concentrated to a region in which they are less concentrated

Cell wall

- an additional external boundary outside the plasma membrane in some cells
- relatively inflexible
- much thicker than the
- plasma membrane
- found in the cells of plants, fungi, almost all bacteria, and some protists
- not found in animal cells
- made of different substances in different organisms

Cellulose in plants (forms fibers . . . The fiber in our diet)

Plant Cell Wall

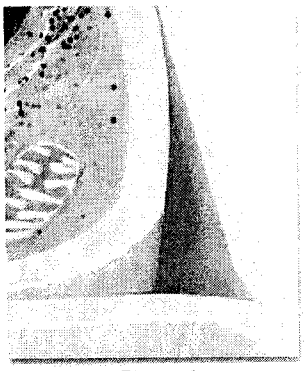


Figure 1

Nucleus

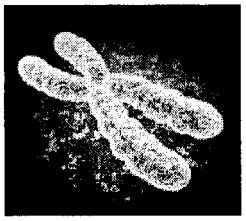
- the organelle that manages cell functions in a eukaryotic cell
- contains our DNA

Nuclear envelope

- surrounds the nucleus
- is four layers thick (2 double layers)
- has large pores (materials can pass between nucleus and the rest of the cell)

Chromatin

- Long strands of DNA
- Packs into identifiable chromosomes when cells are dividing (reproducing) → → →



Nucleolus

- A region in the nucleus
- Produces tiny cell particles (called ribosomes) that are involved in protein synthesis

Ribosomes

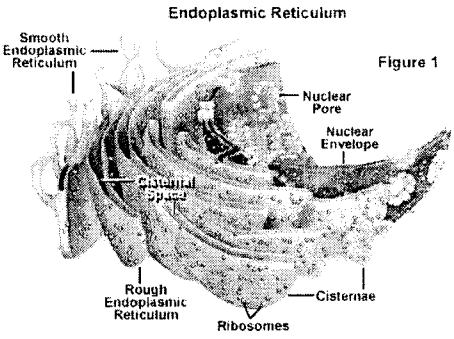
- The site where the cell assembles enzymes and other proteins according to the directions of the DNA
- Are cell organelles
- Are NOT bounded by a membrane.

Cytoplasm

- Material that lies outside the nucleus and surrounds the organelles
- A clear fluid
- Usually constitutes a little more than half the volume of an animal cell
- Most important chemical reactions take place here

E.R.

- Endoplasmic reticulum
- A folded membrane, surrounded by cytoplasm →
- Has a large surface area on which chemical reactions can take place. (A large surface area can be packed into a small area by folding the surfaces (think tissue box))
- The site of lipid synthesis in the cell
- There are 2 types of endoplasmic reticulum . . .



Rough E.R.

- Coated with ribosomes

Smooth E.R.

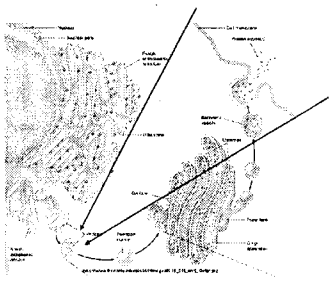
- Area of the endoplasmic reticulum without ribosomes

Storage in the cell

Golgi apparatus

Golgi apparatus

New proteins and lipids travel from the E.R to the Gogli body.



They travel in small membrane-bound transport packages (or vesicles)

- series of closely-packed, flattened membrane sacks (looks like a stack of pancakes)
- is a sort of sorting center
- receives new proteins and lipids from the E.R.
- distributes proteins and lipids to the plasma membrane and other cell organelles
- chemically modifies the proteins it receives
- repackages proteins and sends them to their final destination in the cell

Vacuole

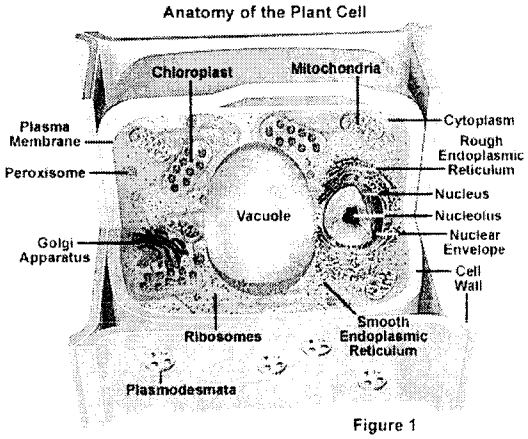


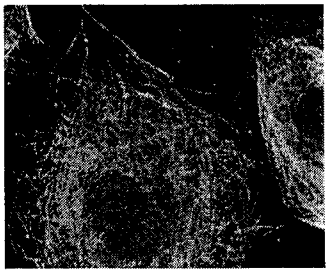
Figure 1

- space for temporary storage of materials
- sac of fluid surrounded by a membrane
- often store food, enzymes, and other materials needed by the cell
- Some store waste products
- A plant cell has a single large vacuole that stores ter and other substances

Lysosomes

- Disassemble things
- Contain digestive enzymes
- Digest excess or worn-out cell parts, food particles, and invading virus and bacteria

Cytoskeleton



- network of thin, fibrous elements
- provides support for organelles
- dynamic and constantly changing structure
- helps maintain cell shape (like poles in a tent)
- usually composed of microtubules and microfilaments

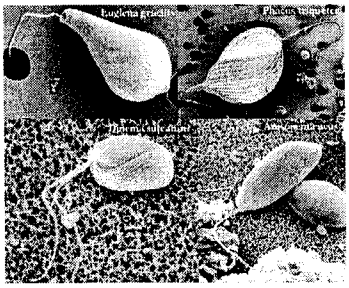
Microtubules

- thin, hollow cylinders made of protein
- act as tracks on which organelles move from place to place

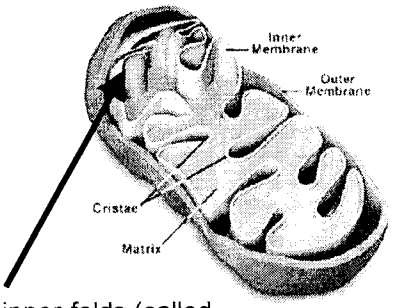
Microfilaments
- thin, solid protein fibers
- important in muscle cell contraction and in cell locomotion – the movement of whole cells from place to place

Cilia
- short, numerous hair-like projections out of the plasma membrane → → →
- tend to occur in a large number on a cell's surface
- have a coordinated beating activity
- organisms that contain many cells have cilia that move fluids over a cell's surface, rather than moving the cell itself

Cilia can be found in windpipe. They beat and propel particles of dirt and mucus towards the mouth and nose, where they are expelled



Flagella
- longer projections that move with a whip-like motion
- cells that have flagella have only one or two per cell
- in single-celled organisms, cilia AND flagella are the major means of locomotion

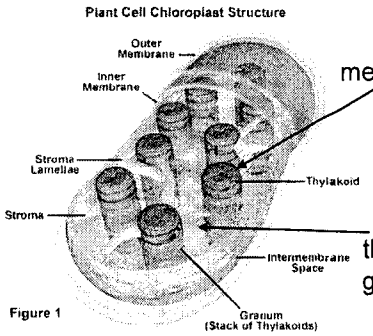


Mitochondria
- organelles in which food molecules are broken down to release energy
- have an outer membrane and a highly-folded inner membrane (large surface area in a small space)
- found in every cell except prokaryotes

Energy-storing molecules are produced on the inner-folds (called cristae)

Chloroplasts
- found in plant cells
- the site where light energy is converted into useable chemical energy
- store the chemical energy in food molecules (sugars and starches)
- contain the molecule chlorophyll (traps energy from sunlight and gives plants their green color)
- belong to a group of plant organelles called plastids, which are used for storage

Chloroplasts



Thylakoid membranes – where light energy is trapped

Stroma: the fluid that surrounds the grana membranes

Chapter 9 – Homeostasis and the plasma membrane

ALL organisms are subject to constant changes in their environment
Failure to adjust to changes in the environment can mean death for an organism

iving cells

must maintain a balance
control materials that enter and leave
must keep their internal concentrations of substances such as water, glucose, and other nutrients
must eliminate wastes as they are produced

lasma membrane

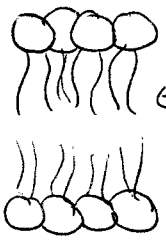
maintains the proper concentrations of materials inside a cell
maintains homeostasis
controls the passage of materials into and out of the cell
allows only certain particles to pass through

Selective permeability

- "the property of a membrane that allows some materials to pass through while keeping others out"
  - Allows different cells to carry on different activities within the same organism

EXAMPLE : Only nerve cells in your body may respond to a certain chemical. The chemical is in your bloodstream, so all cells are exposed to it. Only the membranes of the nerve cells admit the chemical.

Plasma membrane



MEMBRANE PROTEINS
- determine which particles can pass
- enzymes
- markers (recognized by chemical inside & outside the cell)

How things cross the membrane
- diffusion (requires no energy)
  small, non-polar molecules or H_2O, CO_2, O_2, N_2
- passive transport by proteins (no energy)
- active transport by proteins (requires energy)
  - forces substances against their concentration gradient (ex: nutrients into the cell from an environment where they are scarce)

Osmosis → water moves from area of higher water concentration to lower water concentration.
- more dissolved particles = lower water concentration

hypotonic solution
water enters cell, high turgor pressure, cell may burst (lyse)
(cell wall offers protection in plant cells)

hypertonic
water flows out, cell shrivels

isotonic
same concentration in & out
no osmosis