The Cell

Living Organisms

- All organisms except *Viruses* are cellular
- There is and enormous diversity
- Only *Two* fundamental types

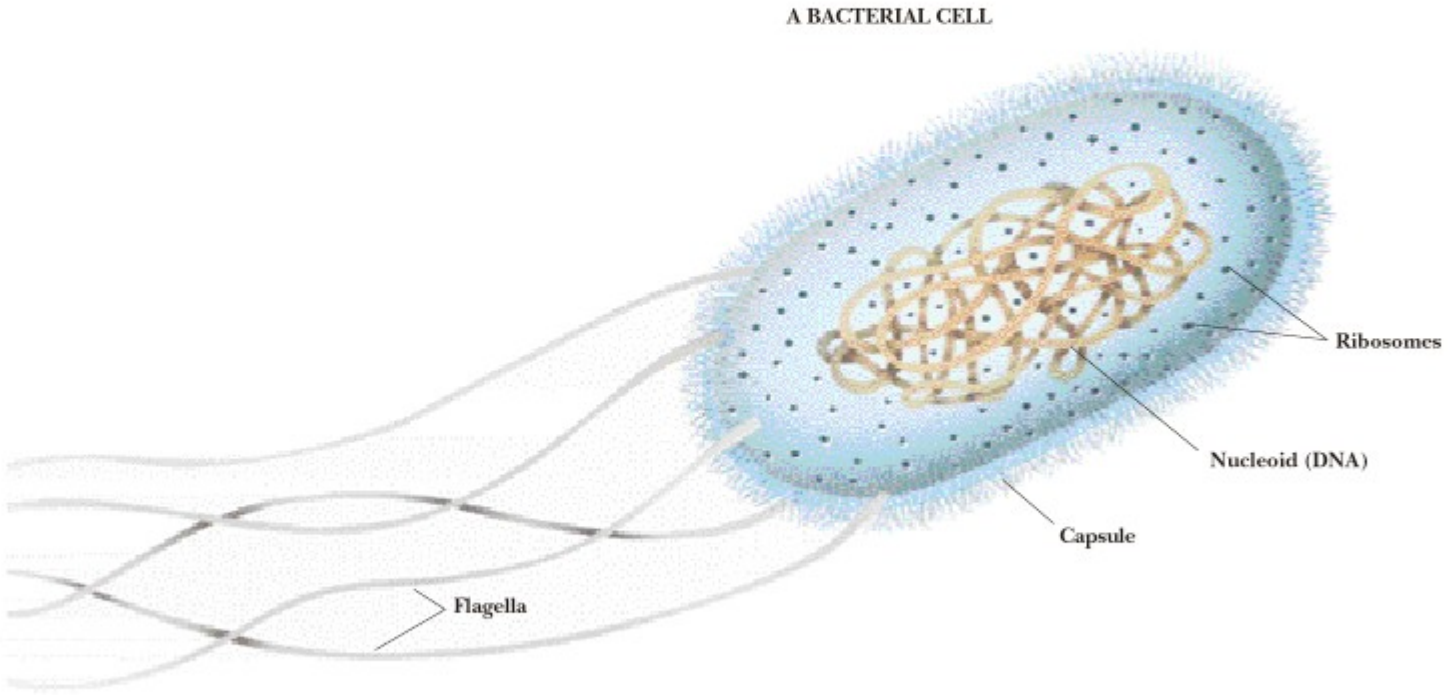
Fundamental Cell Types

- **Prokaryotic** – Domains *Bacteria* & *Archaea*
- **Eukaryotic** Animals, plants, protozoa, fungi & algae
- Differences important from the scientific & human health standpoint

Structural Difference

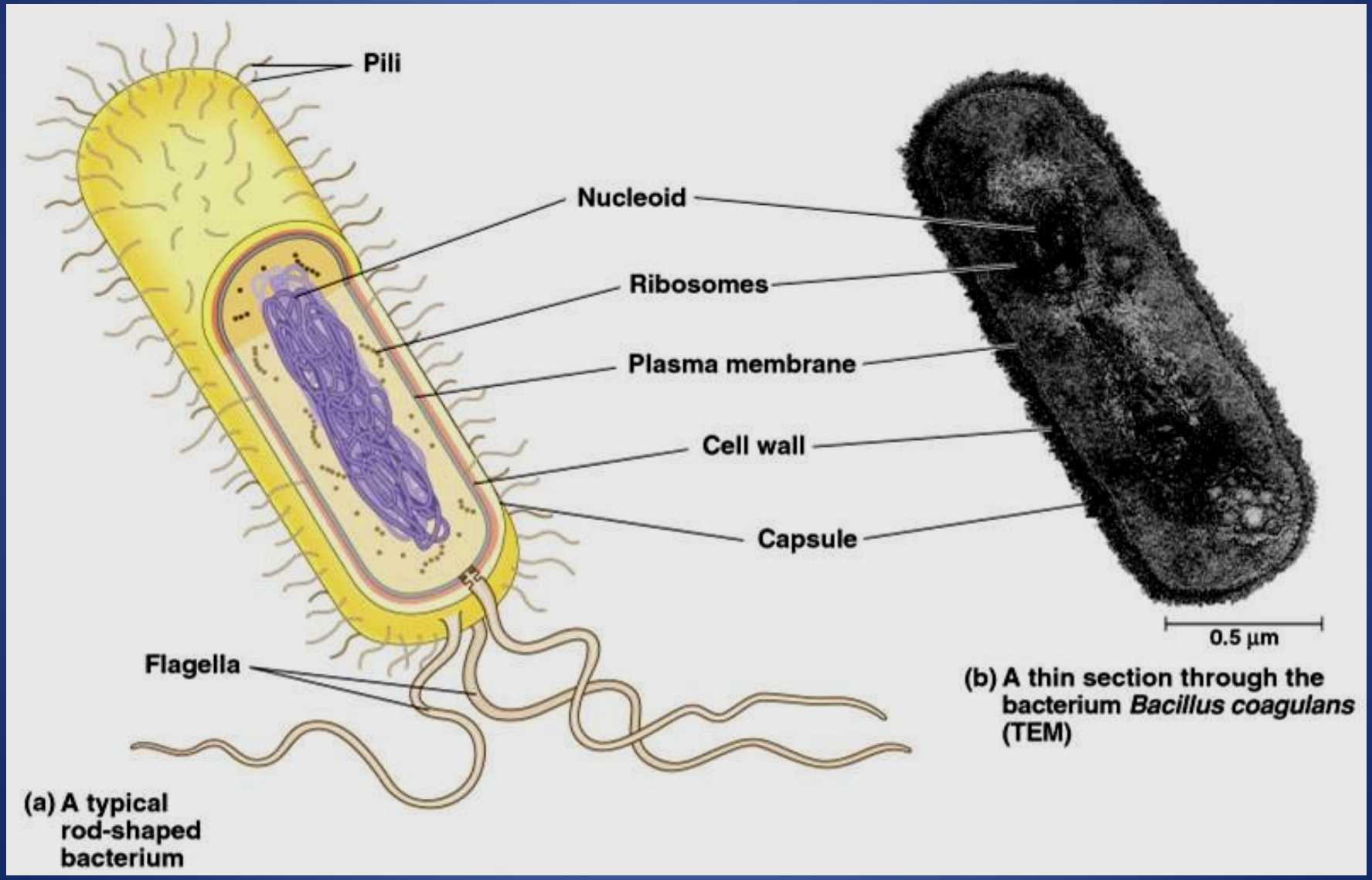
- Prokaryotes
  - Have organelles but are not membrane bound
  - Have irregular area containing DNA
- Eukaryotes
  - Membrane bound organelles
  - Defined nucleus

Garrett & Grisham: Biochemistry, 2/e
Figure 1.21



Saunders College Publishing

Prokaryote Cell Structure



The Bacterial Cell Structure

- The Envelope & Capsule
- Pili & Flagella
- Cytoplasm & Inclusions

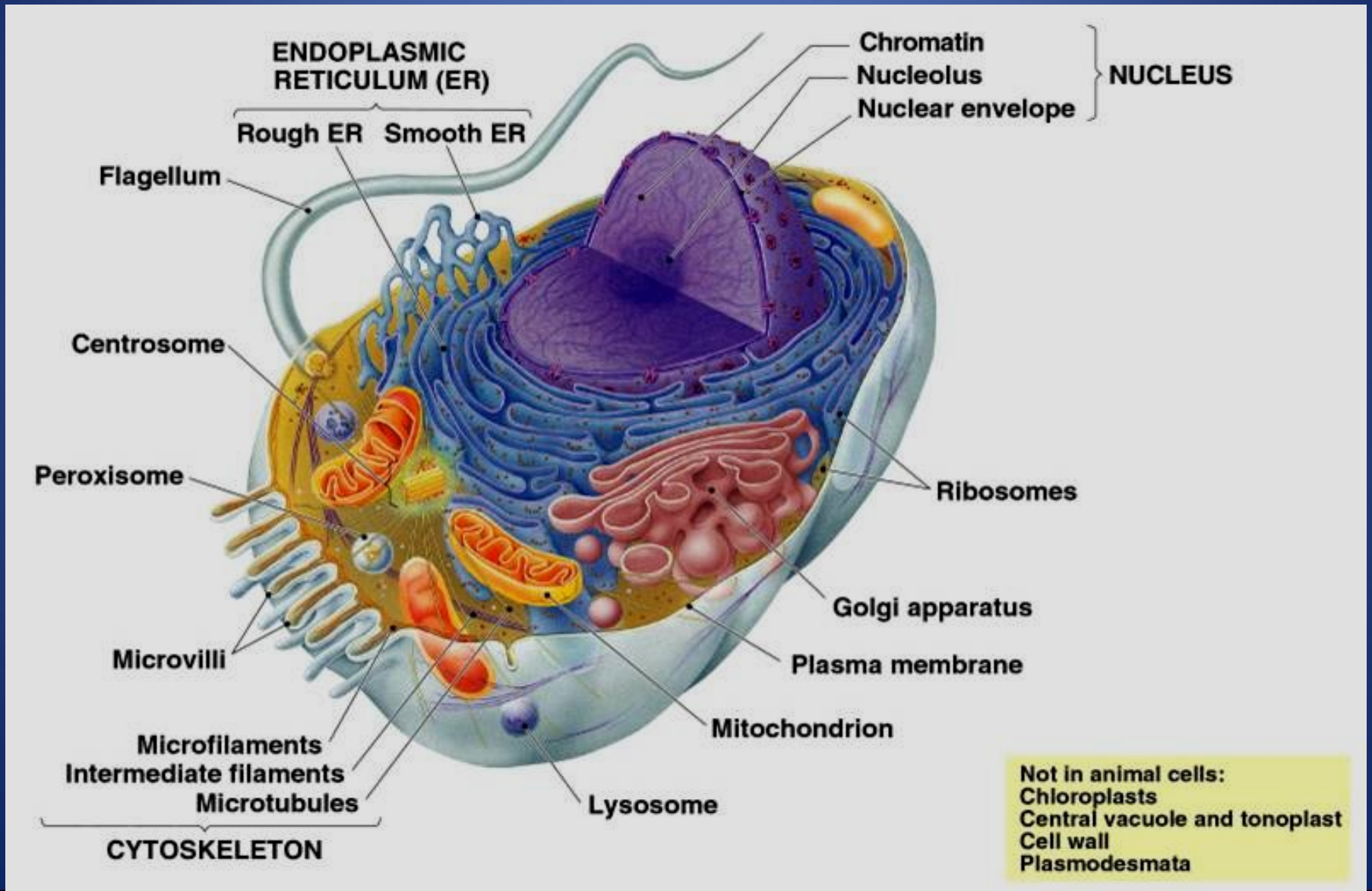
The Envelope & Capsule

- The bacterial envelope can be a three layered structure
  - –Outer Membrane
  - –Cell Wall
  - –Cytoplasmic Membrane
- A capsule may or may not surround the envelope

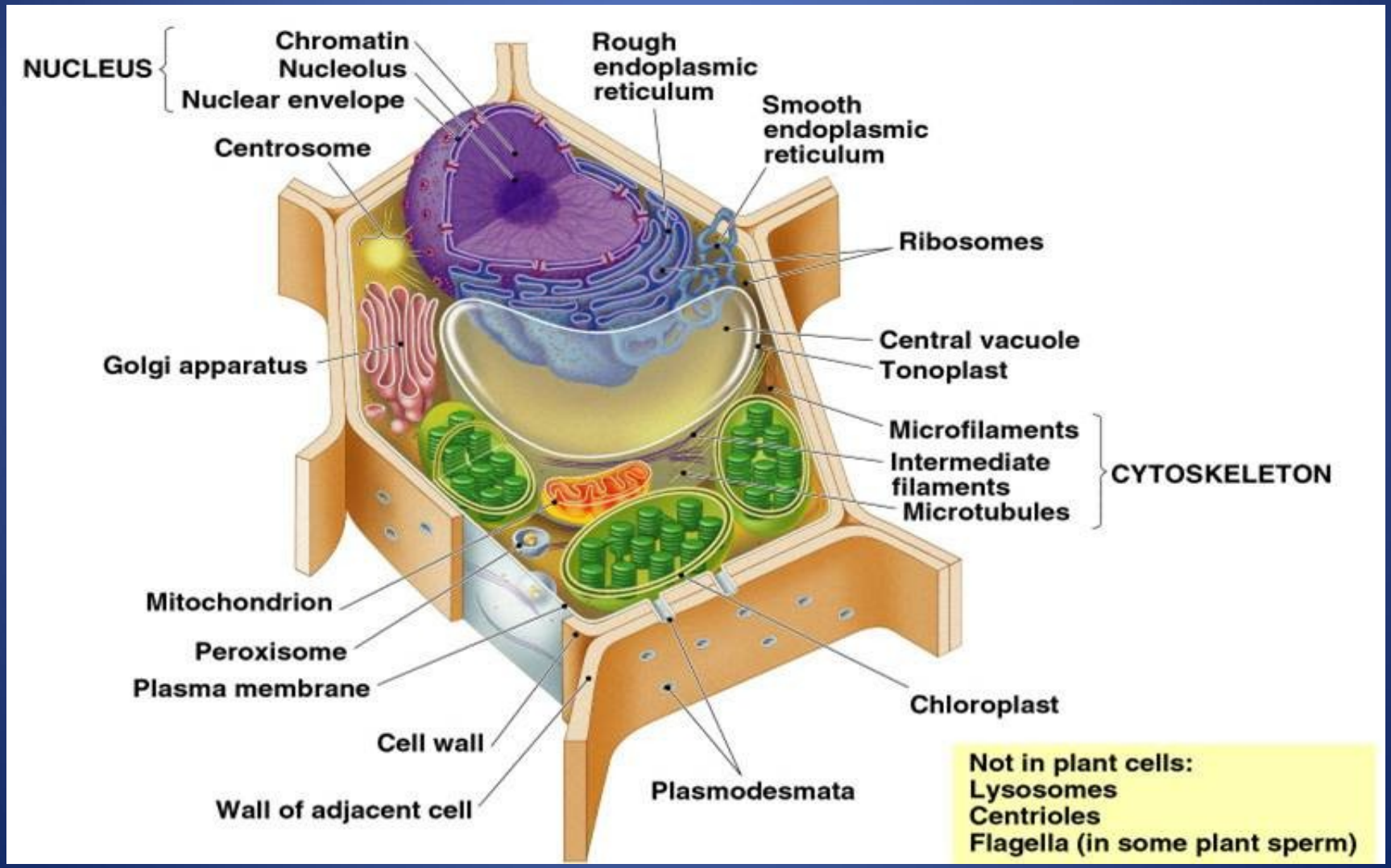
Pili

- Straight hair like projections made of protein pilins
- May be short or several cell lengths long

The Eukaryotic Animal Cell



The Eukaryotic Plant Cell



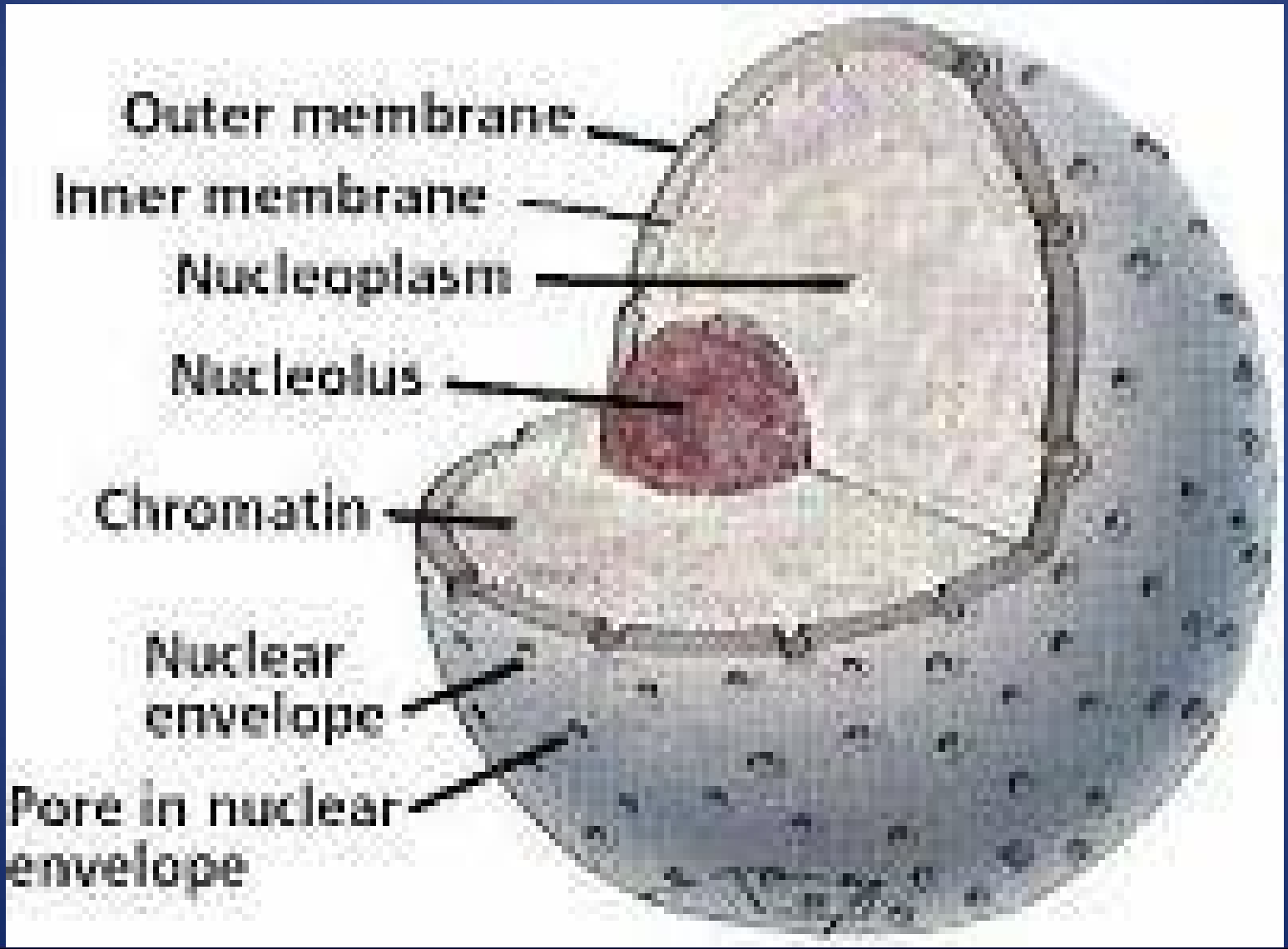
Eukaryotic Structures

- External structures→ cilia, flagella
- Cell walls, Cell membranes
- Cytoplasmic inclusions
  - –Ribosomes
  - –Cytoskeleton
  - –Centrioles & Centrosomes

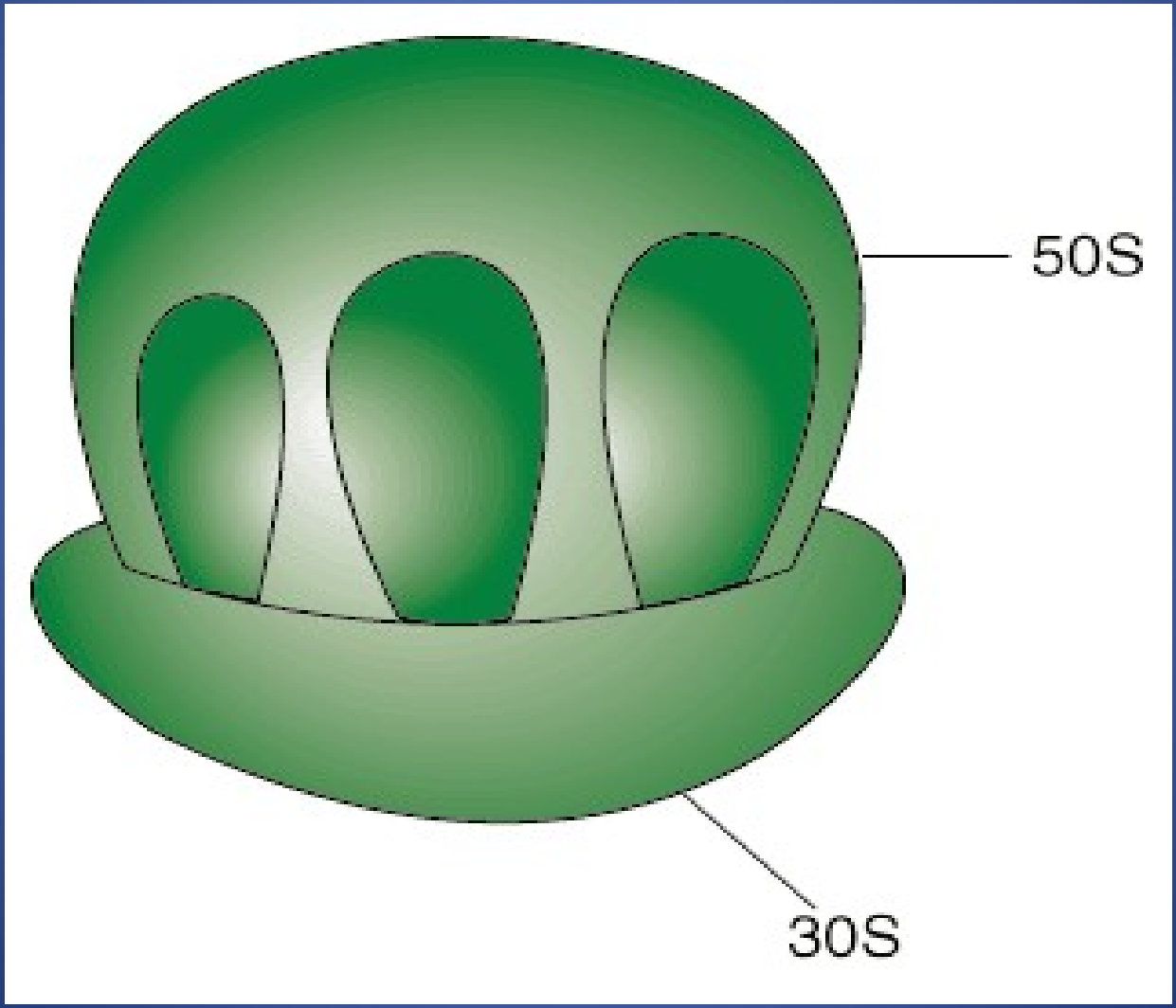
Eukaryotic Structures

- Nucleus & contents
- Endoplasmic Reticulum (rough & smooth)
- Golgi Body
- Lysosomes
- Mitochondria & Chloroplasts

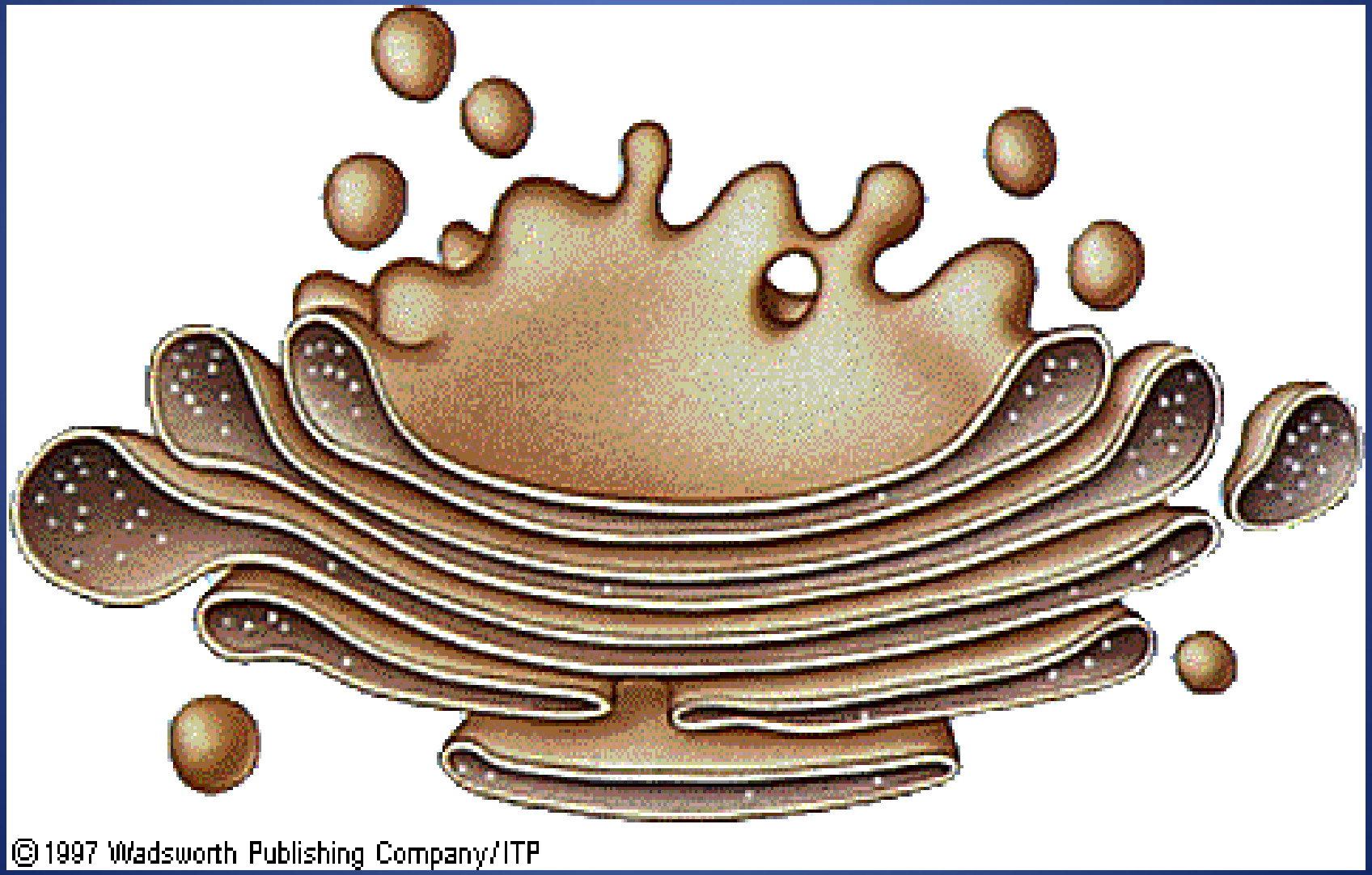
Nucleus & contents



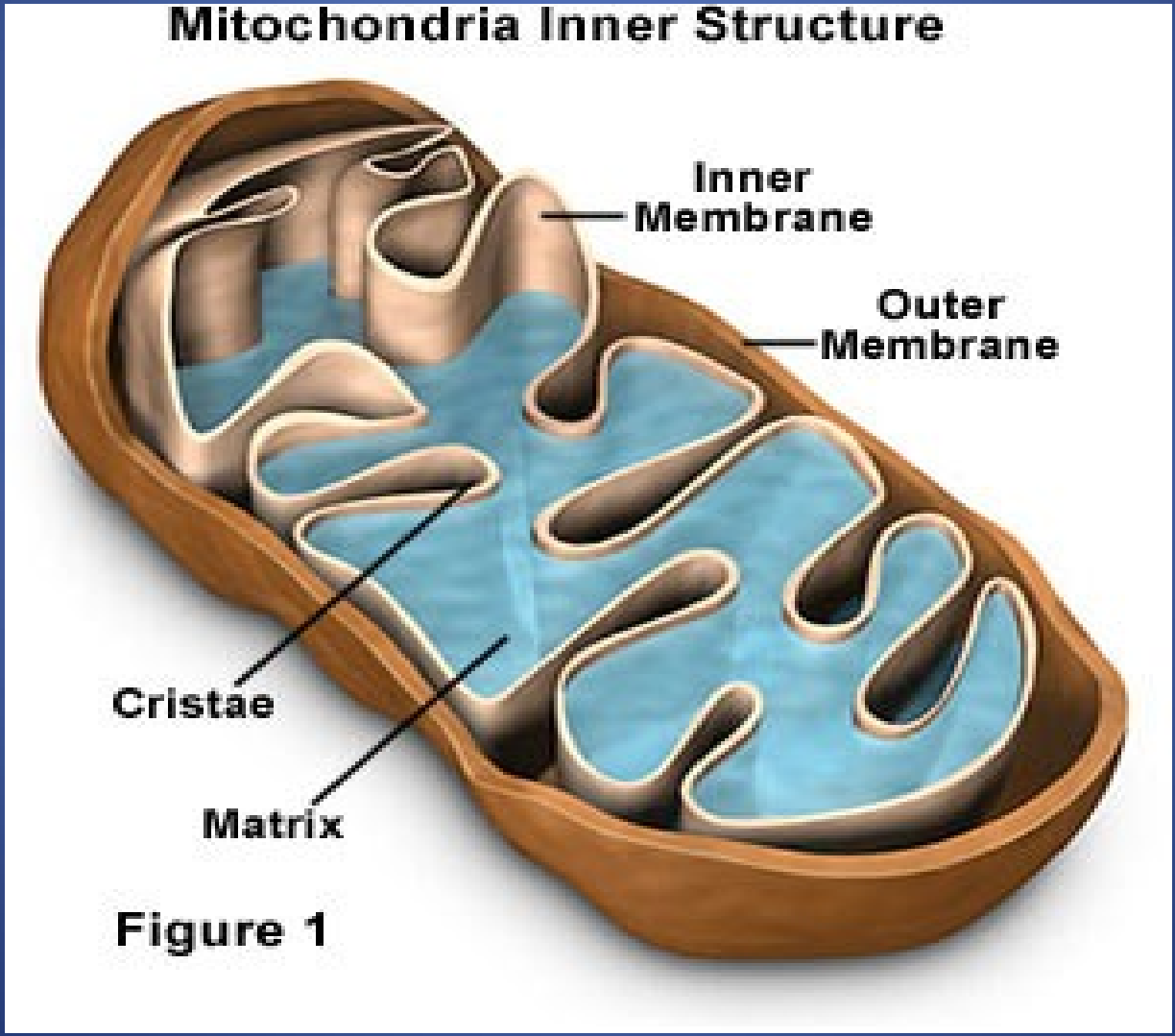
Ribosome



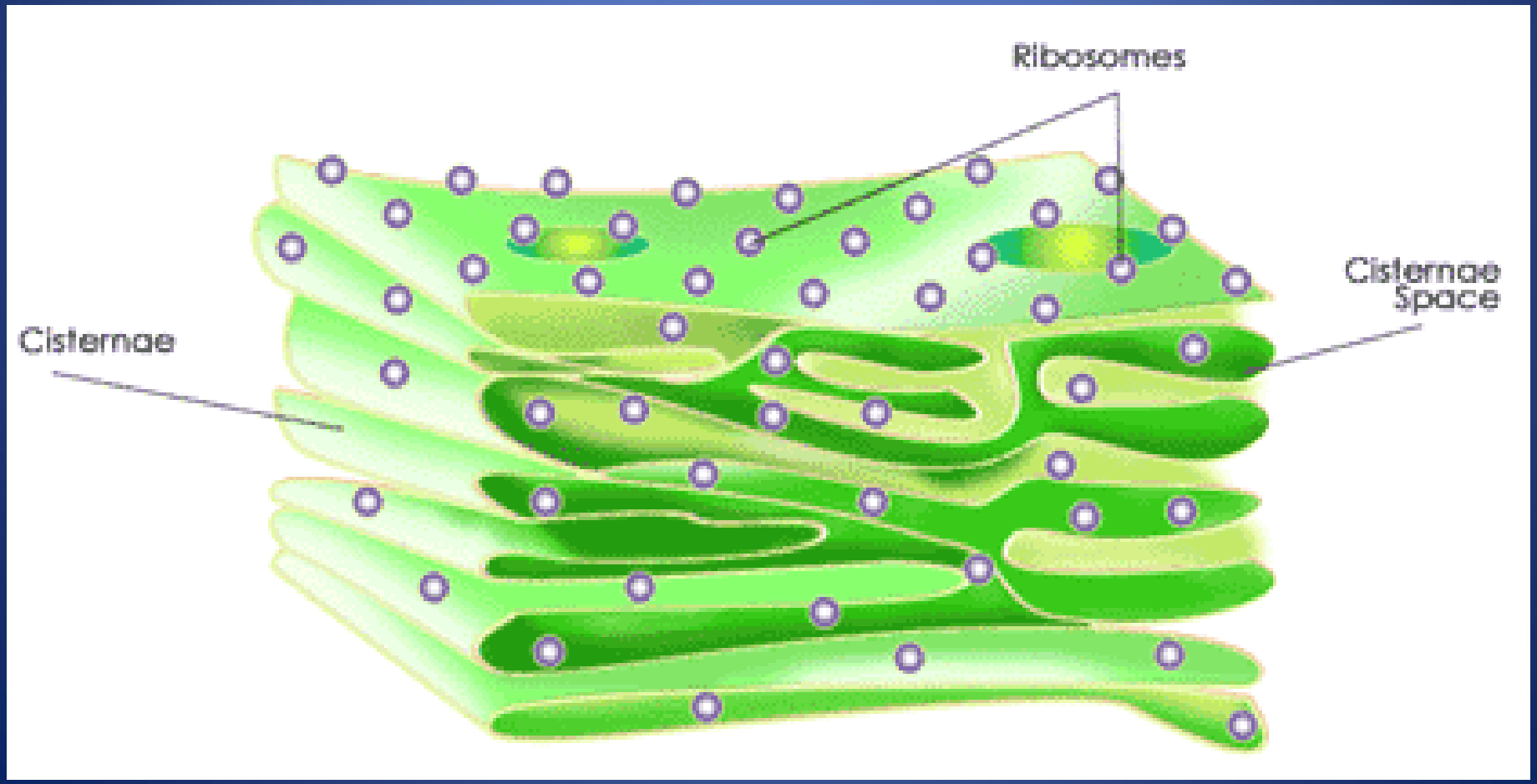
Golgi Body



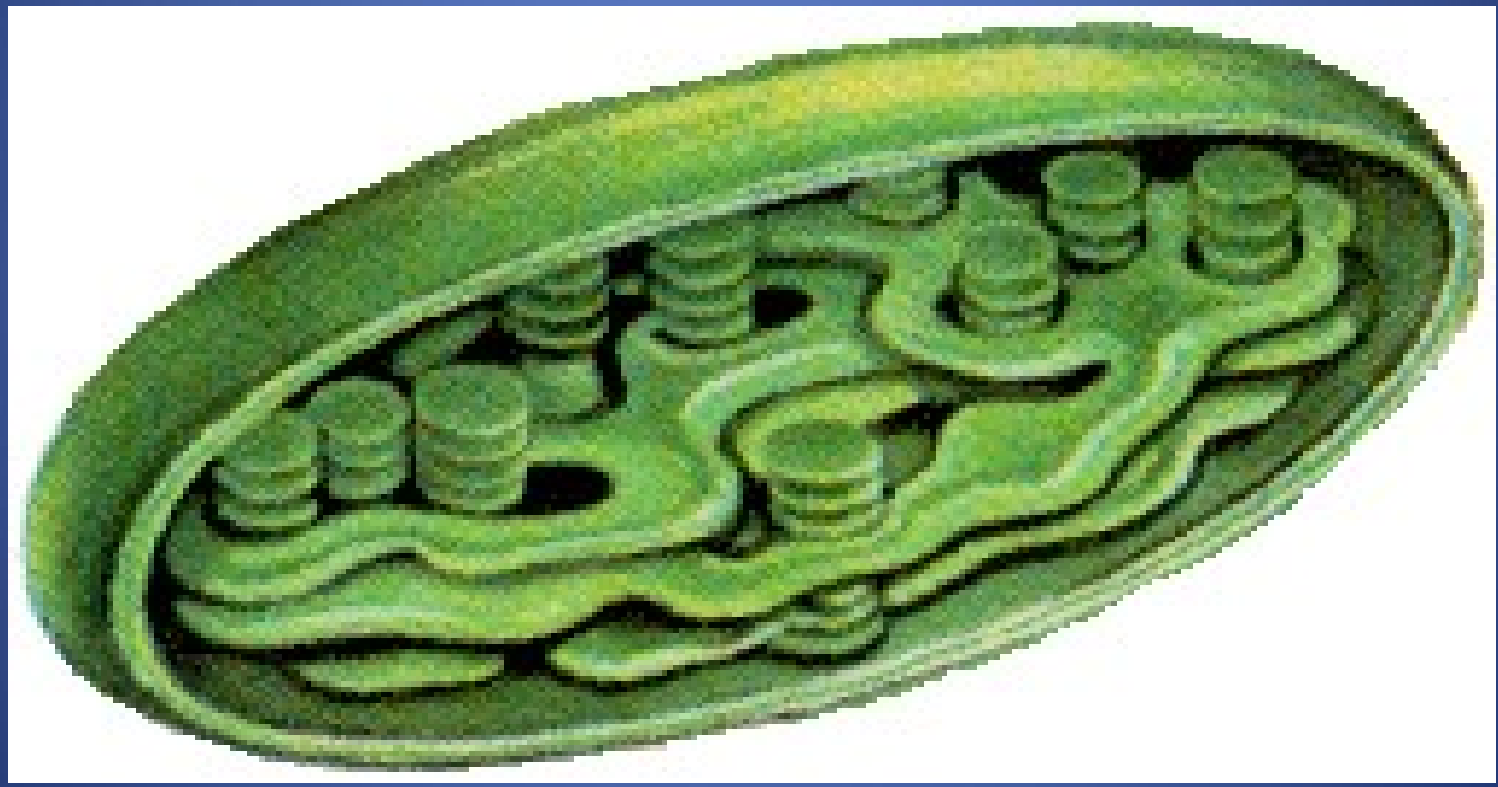
Mitochondria



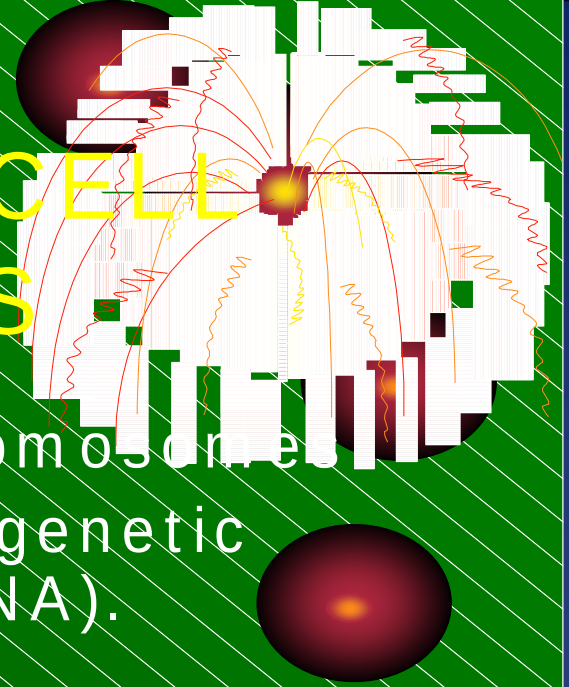
Endoplasmic Reticulum (rough &)smooth



Chloroplasts



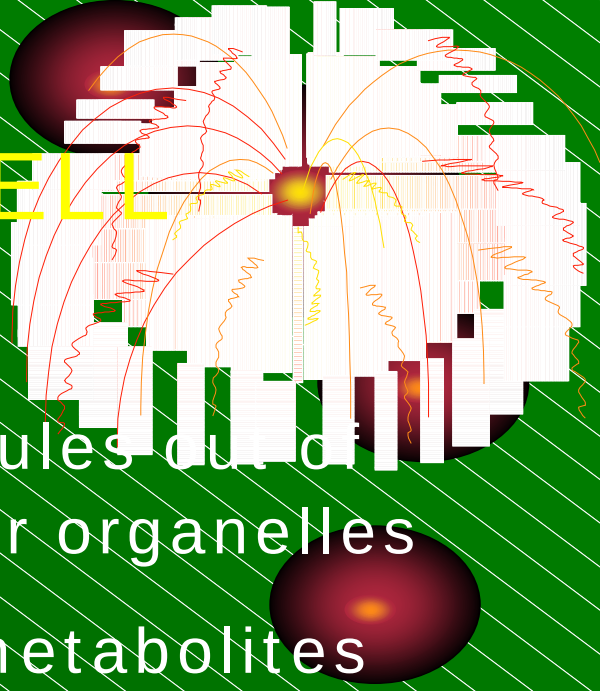
FUNCTIONS OF CELL ORGANELLES



- Nucleus: Contains the chromosomes which may carry genetic information(on DNA).
- Mitochondria: Power house of cells generates ATP.
- Ribosomes Sites of protein synthesis.
- Endoplasmic reticulum: Synthesis ofsecretory proteins and carbohydrates.

Contd.....

FUNCTIONS OF CELL ORGANELLES



…..Contd

- Golgi apparatus — Transport molecules out of cells and to other organelles
- Lysosomes: — Degradation of metabolites and cellular components after cell death.
- Peroxisomes — Removal of H_2O_2 and other oxidising radicals.
- Chloroplasts (in plants) — Photosynthesis.
- Vacuoles (in plants) — Degradation and storage.

Cells

All living things are made up of one or many tiny units called cells. Algae, mushrooms, yeasts, plants and animals, all are made of cells. Each has a nucleus containing DNA, a living fluid called cytoplasm and covered by a living membrane, cell membrane.

- Prokaryotic
- No nucleus
- DNA in cytoplasm.
- All organelles like mitochondria are not membrane bound
- Hair like flagella are simple tubes.
- Ribosomes, the organelles for synthesizing proteins are smaller in size = 70 S

- Eukaryotic
- Has a nucleus
- DNA in nucleus.
- All organelles like mitochondria are membrane bound
- Flagella are complex supported by 9+2 tubes.
- Ribosomes are larger in size = 80 S

The relative amounts of the major classes of biomolecules in living organisms

- Example E.Coli

Major molecular component

Component	Percent total weigh	Approxmate No of Molecular species
Water	70	1
Proteins	15	3000
Nucleic acids		
DNA	1	1
RNA	6	1000
Carbohydrates	3	50
Lipids	2	40
Building-block molecules&intermediates	2	500
Inorganic ions	1	12

- The proteins are the most prominent biomolecules in the cell, making up over 50% of the dry weight .
- There is 3000 different kinds of protein molecules (20 a.a can be arranged in different sequence to give a huge number of different proteins)
- The second most abundant biomolecules are nucleic acids .
- These are followed by carbohydrates & lipids .
- All living cells contain approximately the same proportion of the major classes of biomolecules as in E.Coli .(in human there is about 100.000 different kinds of proteins)

Functional Groups

Functional Groups

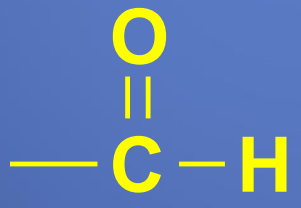
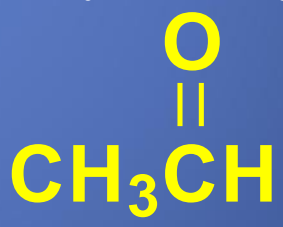
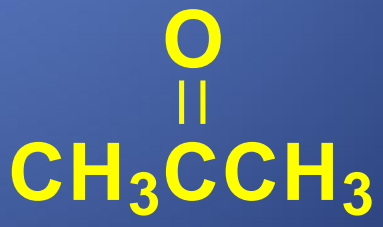
Functional group - a specific arrangement of atoms in an organic compound, that is capable of characteristic chemical reactions.

- What is the best way to classify organic compounds? **By their functional groups.**

Functional Groups

- Part of an organic molecule where chemical reactions take place
- Composed of an atom or group of atoms
- Replace a H in the corresponding alkane
- Provide a way to classify organic compounds

Some Types of Functional Groups

Haloalkane	-F, -Cl, -Br	CH_3Cl
Alcohol	-OH	CH_3OH
Ether	-O-	$CH_3\text{-}O\text{-}CH_3$
Aldehyde		
Ketone		

Carboxylic acid	-COOH	CH_3COOH
Ester	-COO-	CH_3COOCH_3
Amine	$-NH_2$	CH_3NH_2
Amide	$-CONH_2$	CH_3CONH_2
Thiol	- S-H	

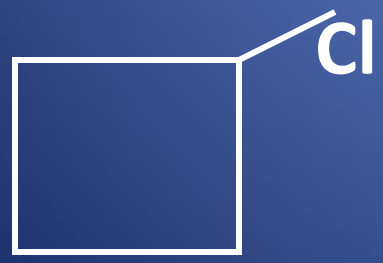
Haloalkanes

An alkane in which one or more H atoms is replaced with a halogen (F, Cl, Br, or I)

CH_3Br 1-bromomethane

(methyl bromide)

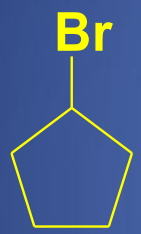
$CH_3CH_2CHCH_3$ 2-bromobutane



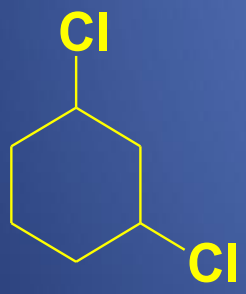
chlorocyclobutane

Solution HA1

Name the following:



bromocyclopentane



1,3-dichlorocyclohexane

Substituents

List other attached atoms or group in alphabetical order

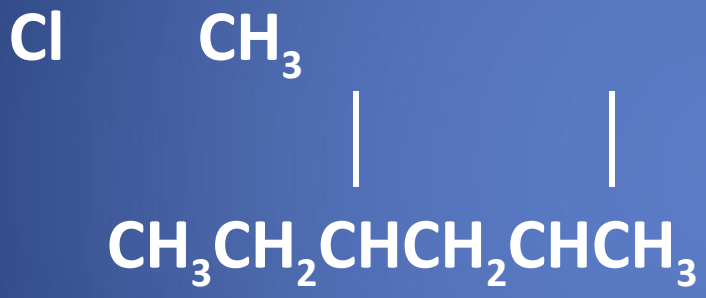
Br = bromo, Cl = chloro

Cl Br

4-bromo-2-chloroheptane

Solution HA2

The name of this compound is:



3) 4-chloro-2-methylhexane

Functional Groups

- Nearly all organic biomolecules are a derivatives of hydrocarbons i.e compound of carbon and hydrogen in which the backbone consists of carbon atoms joined by covalent bonds and the other bonds of the carbons are shared with hydrogen atoms .
- One or more hydrogen atoms of hydrocarbons may replaced by different kinds of functional groups to yield different families of organic compounds .

- Typical families of organic compounds and theire characteristic functional groups are :

The alcohols : have one or more hydroxyl group - OH

The amines : have amino group - NH2

The ketones : have carbonyl group

- Many other functional groups are also important in biomolecules .

- The functional groups in biomolecules make it possible to analyze and predict their chemical characteristics and reactions :

  e.g. enzymes function by recognizing a specific functional group in a biomolecule and catalyzing a characteristic chemical change in its structure .

- Most of biomolecules are polyfunctional, containing two or more different kinds of functional groups , each type of functional group has its own chemical characteristics and reactions

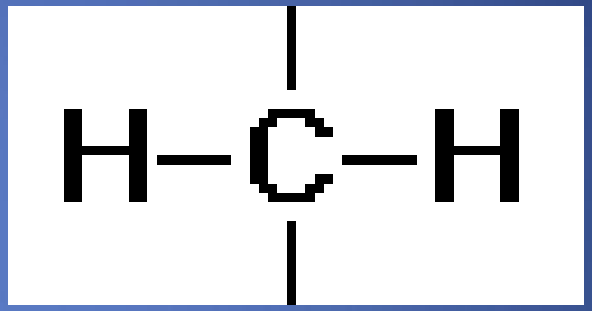
  e.g. amino acids : all contain at least two different functional groups , amino and carboxyl groups .

  Glucose : has two kinds of functional groups , a hydroxyl and aldehyde group .

Summary of Functional Groups

- Certain combinations of atoms (e.g., OH) have characteristic properties different from their individual atoms. Recognizing a handful of these **functional groups** is very useful for chemists and biologists.

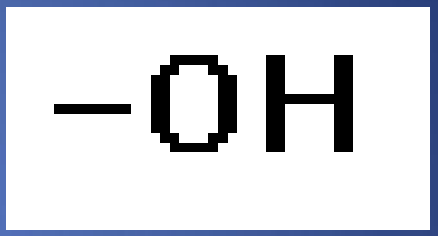
Hydrocarbon



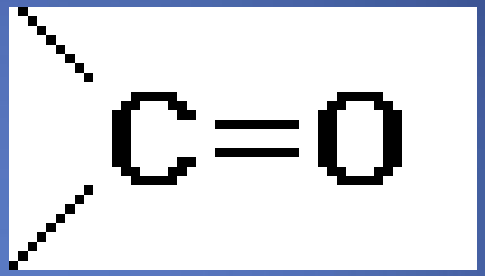
- insoluble in water
- nonpolar
- does not form H bonds
- electrons equally shared between H and C

)Hydroxyl (-OH

- water soluble; forms H bonds
- found in alcohols and sugars



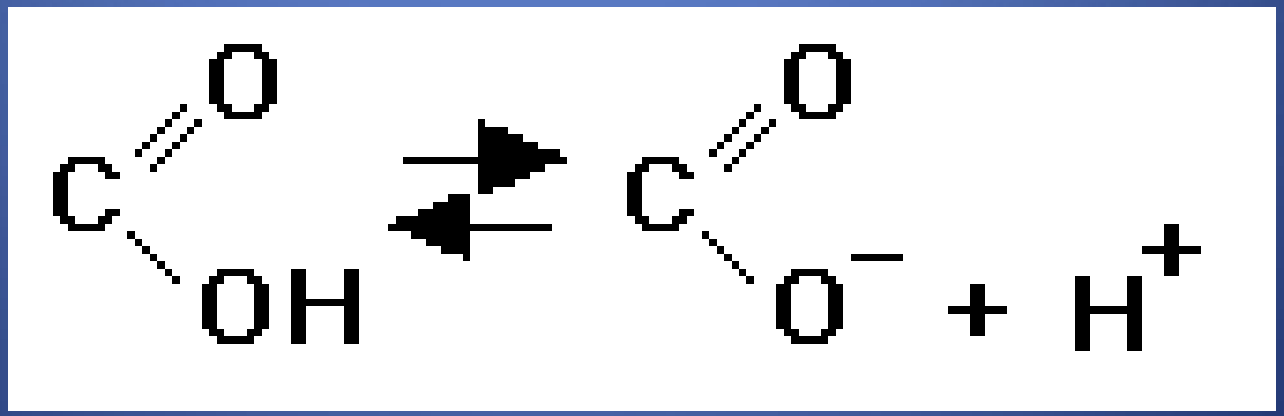
)Carbonyl (-C=O



- forms H bonds
- found once in all sugars
- If bonded to Hydrogen atom = **aldehyde group (H-C=O)**
- If not bonded to H atom = **keto group (-C=O)**

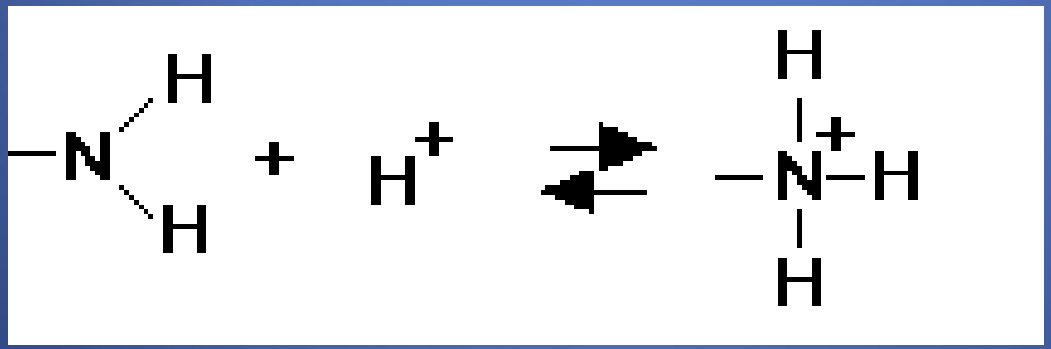
)Carboxyl (-COOH

- good acceptor of H bonds
- acid; often ionized to COO-



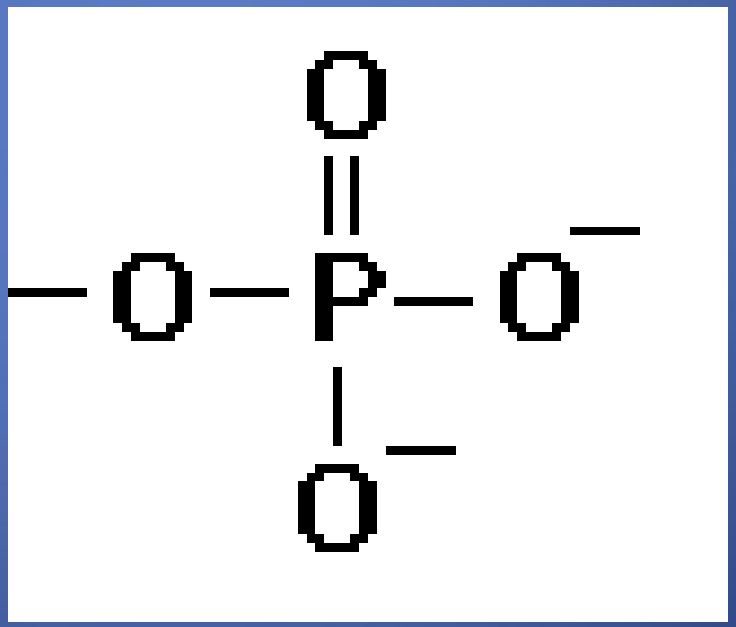
)Amino (-NH2

- forms H bonds
- base; often ionized to NH3+



=)Phosphate (-PO4

- forms H bonds; very soluble
- always ionized



)Sulfhydryl (-SH

- forms weak H bonds
- two -HS groups can react to form S-S (disulfide) bonds
- used to crosslink polypeptides