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The AP Biology Study Platform That Guarantees Success

AP Bio Semester 1 Review (deck 1)

Glenn Wolkenfeld (Mr. W)
Creator, Learn-Biology.com

AGENDA

1. Methods and resources for Semester 1 review
2. Your Questions
3. Practice FRQs

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1. STUDY METHODS and RESOURCES

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Goals of (AP Bio) Exam Review

1. Identifying gaps in knowledge and filling them
2. Doing as much authentic practice as possible
3. Becoming confident, skilled, and fluent

Biggest Review Mistake (mostly by students)

1. Passive activities that lead to overconfidence
   a. Reading through an outline (and highlighting)
   b. Rereading your textbook
   c. Rereading your notes (and highlighting)
   d. Passively watching a lot of YouTube videos
2. The problem: Familiarity/ease of experience leads to overconfidence

Discuss with a partner

What’s the best way to review?

Retrieval practice + Spacing + Interleaving

1. Retrieval Practice/testing effect
    a. WHAT: Actively recalling information from memory
    b. WHY: Strengthens memory and recall
    c. HOW: Flashcards, interactive outlines, practice (or real) tests
2. Spacing effect
    a. WHAT: Spread out study sessions over time
    b. WHY: Improves long term retention by making the brain work harder
    c. HOW: scheduling
3. Interleaving
    a. WHAT: Mix different topics and types of problems into a study session (as opposed to topic by topic studying)
    b. WHY: Builds connections between topics and leads to more flexible thinking and better problem-solving
    c. HOW: next slide

Discuss with a partner

[Interleaving on Learn-Biology.com]

Your plan for AP Bio Semester 1 Final Success

1. Self assess to find your gaps
    a. Use the checklist
    b. Use the outline
    c. Take a test on Learn-Biology.com
2. Fill the gaps with
    a. Flashcards
    b. Tutorials
    c. Consulting your textbook.
    d. Chat GPT
3. Practice writing FRQs

To help you study study for your semester final and the AP Bio exam…

Download this checklist at

apbiosuccess.com/checklist

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Topics 2.4 – 2.9: Membrane Structure and Function; Osmosis

- ☐ Describe the fluid mosaic model of the cell membrane. Include
  - ☐ The overall function of the membrane
  - ☐ The role of phospholipids
  - ☐ The role of embedded proteins (how they fit into the bilayer, and their var
  - ☐ The functions of cholesterol, glycolipids, and glycoproteins.
- ☐ Define selective permeability.
- ☐ Explain how selective permeability arises from the fluid mosaic structure of the memb
  - ☐ How small, nonpolar molecules like N_2, CO_2, and O_2 can pass across the
  - ☐ How ions and large polar molecules move across the membrane
  - ☐ How small polar molecules (like water) pass through the membrane
- ☐ Compare and contrast passive transport, active transport, and facilitated diffusion. Co process to membrane structure.
- ☐ Compare and contrast endocytosis and exocytosis.
- ☐ Explain membrane potential
- ☐ Connect membrane potential to processes such as ATP synthesis.
- ☐ Define the term osmosis, and be able to predict and explain the flow of water into or hypotonic, hypertonic, and isotonic environments.
- ☐ Explain the movement of water into or out of cells (and entire organisms) in relation

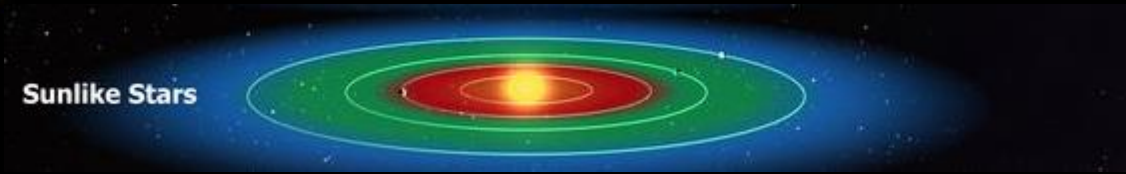
What are your ?s

1. Properties of water/hydrogen bonds
2. Monomers/Polymers/ Functional groups
3. Carbohydrates and lipids
4. Proteins
5. Nucleic Acids
6. Lactose intolerance
7. Sickle cell anemia
8. Prokaryotes v. eukaryotes

8. Cell size (surface area/volume)
9. Cellular compartmentalization/ endosymbiosis
10. Cell parts/organelle function
11. Cell Membrane Structure
12. Membrane transport
13. Osmosis
14. Water Potential

Properties of Water and Hydrogen Bonding

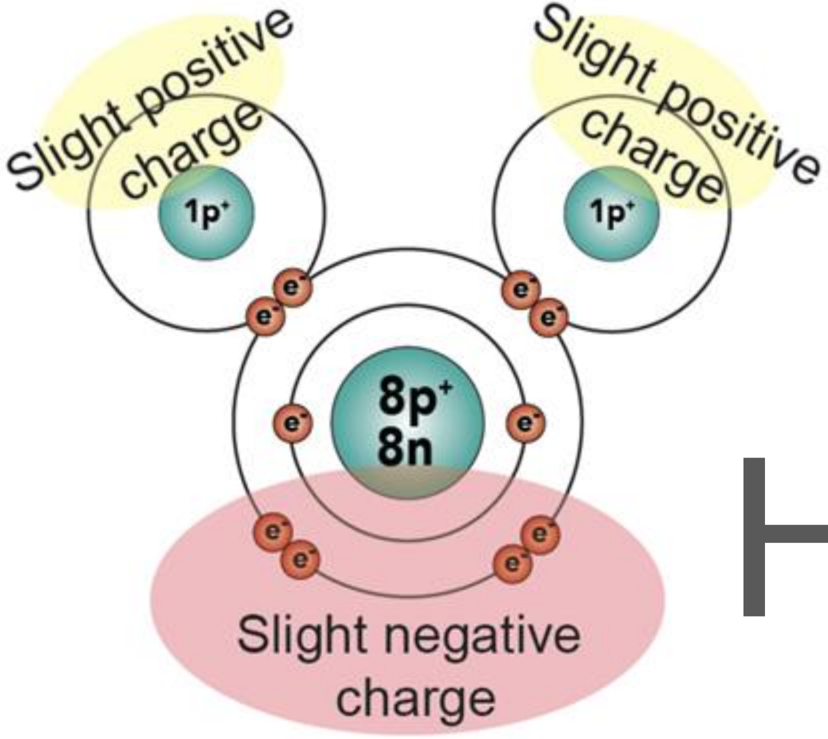
Life is based on Water



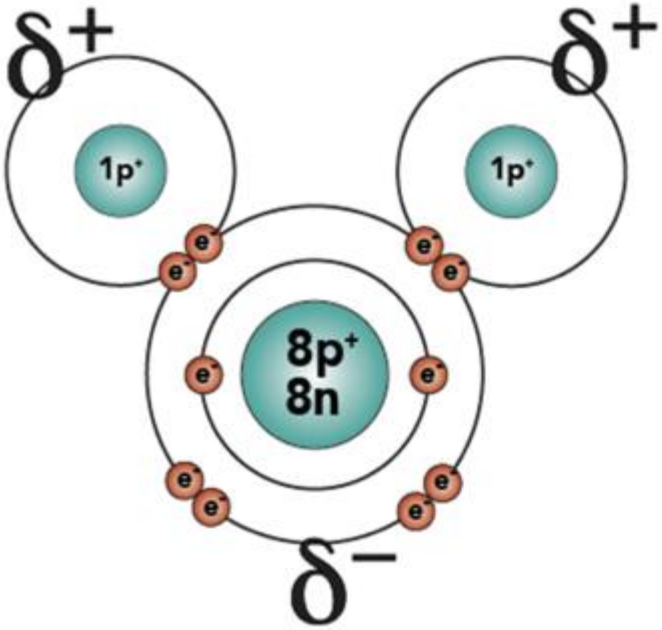
Living things are mostly made of water

- Animals: 60 - 70%
- Plants: 80-90%
- Microorganisms (bacteria): 70 - 80%

Water is a polar molecule

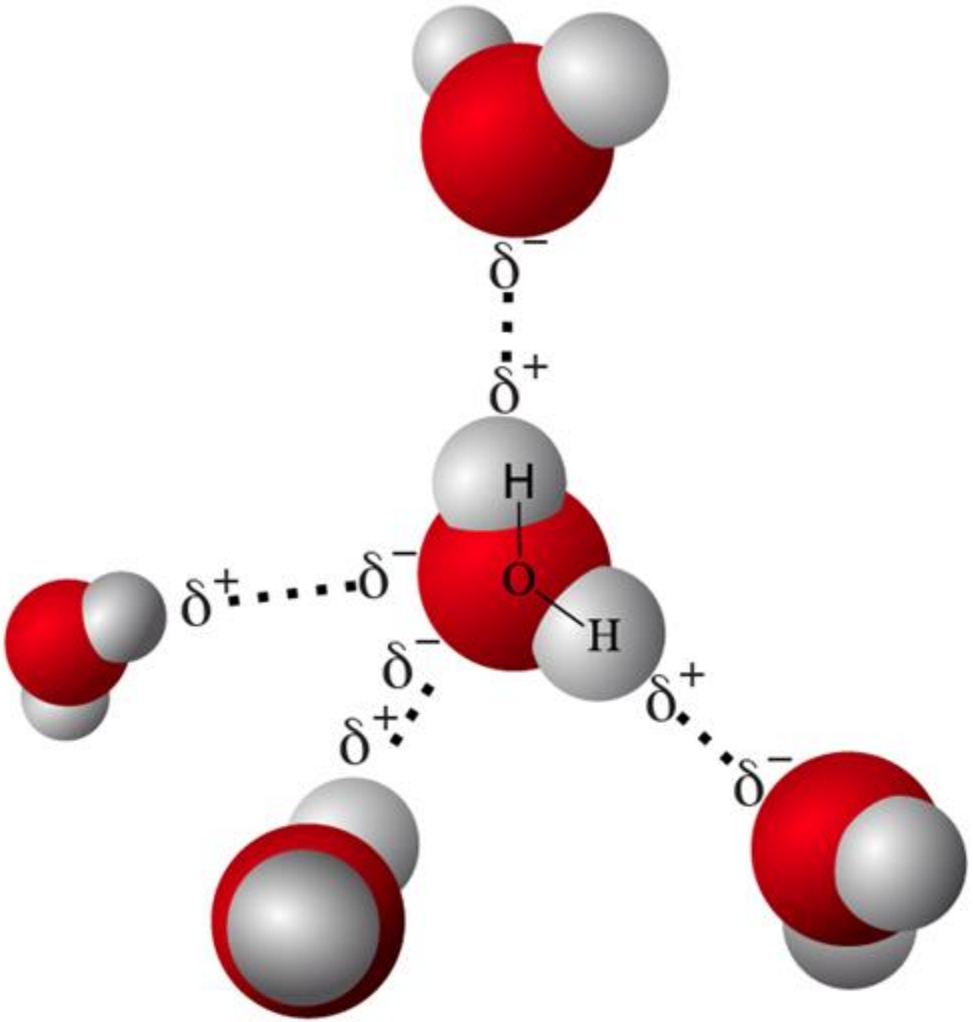


H_2O

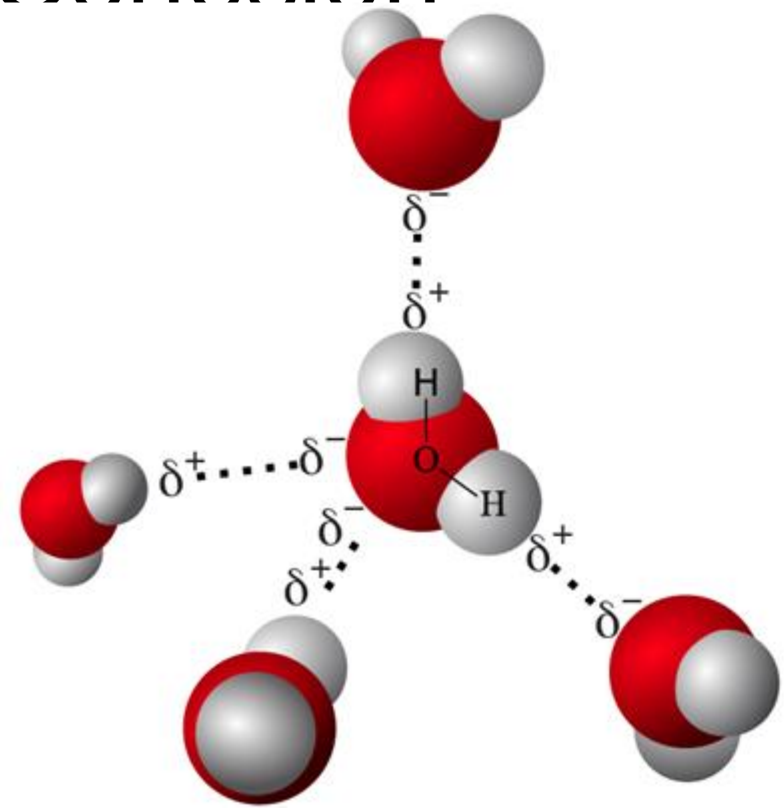


Hydrogen bonds are *intermolecular* bonds

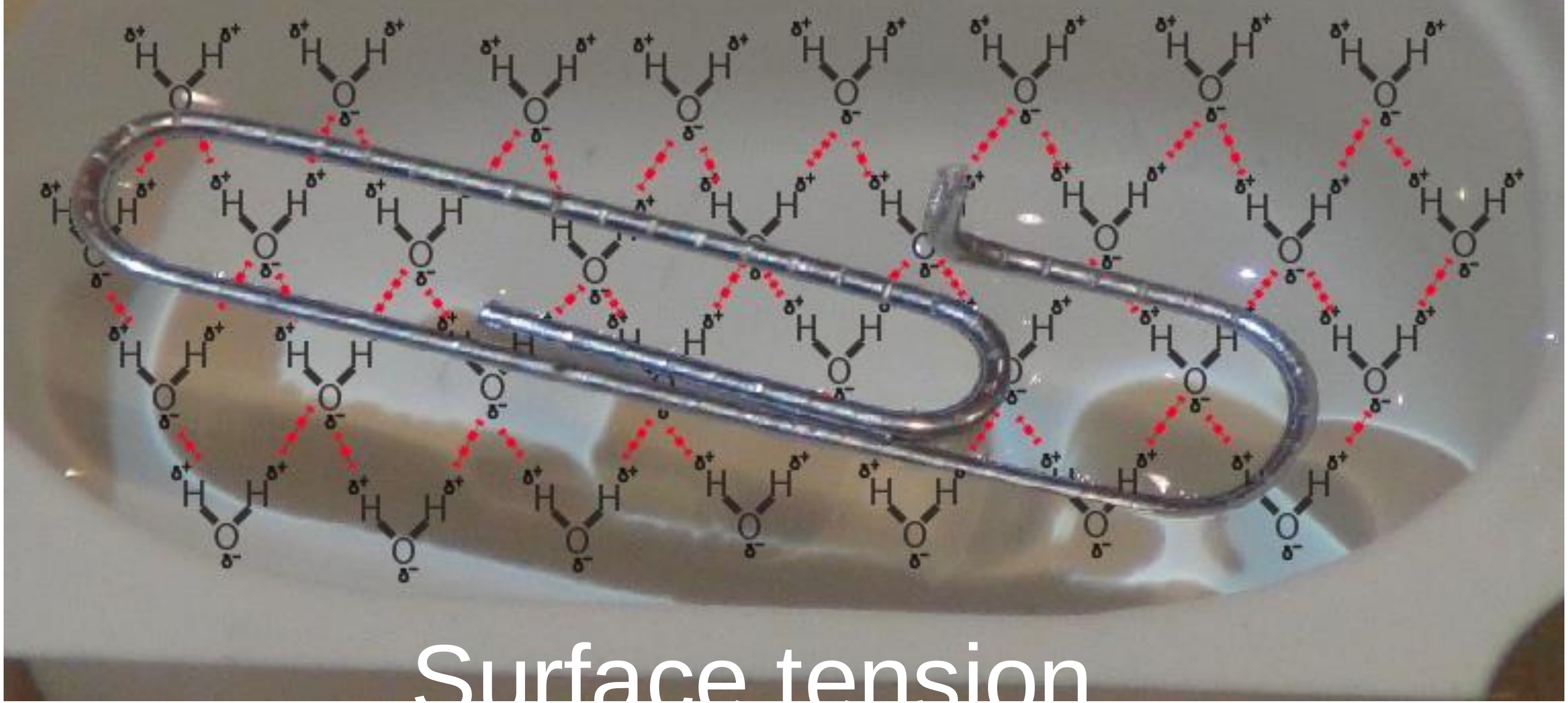
- Between the δ⁺ (hydrogen) side of one water molecule and the δ⁻ (oxygen) side of another water molecule.
- MUCH weaker than covalent or ionic bonds.



Cohesion



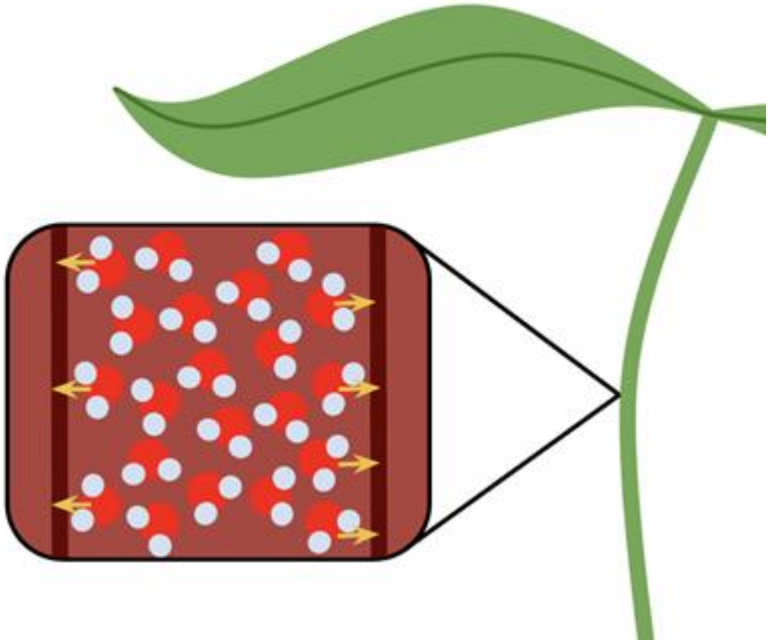
- Hydrogen bonds between water molecules.
- Responsible for
    - Water's high heat of vaporization,
    - High specific heat, and
    - Ice being lighter than liquid water.
    - High surface tension.

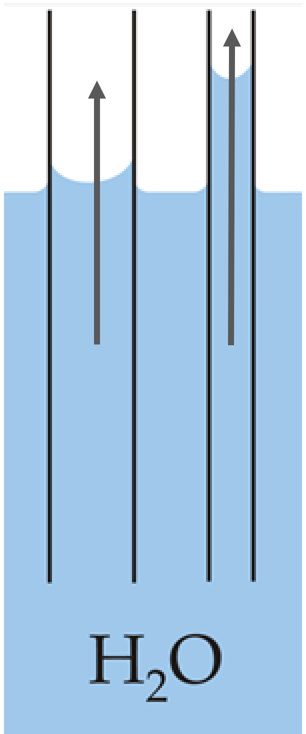


Surface tension

- Force exerted by the water molecules on the surface of a body of water.
- Creates a kind of web or net upon the surface (water striders, resisting evaporation, etc.)

Adhesion

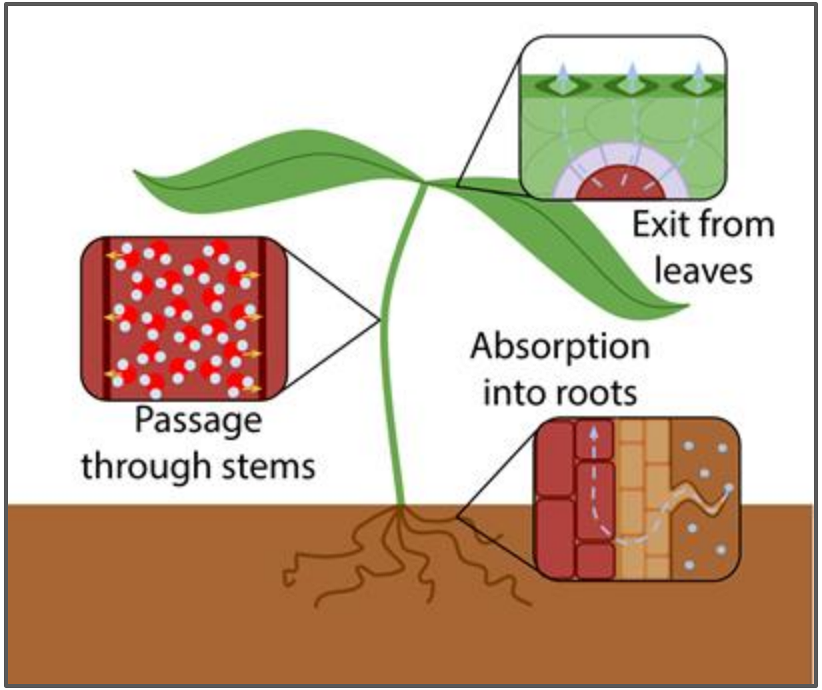




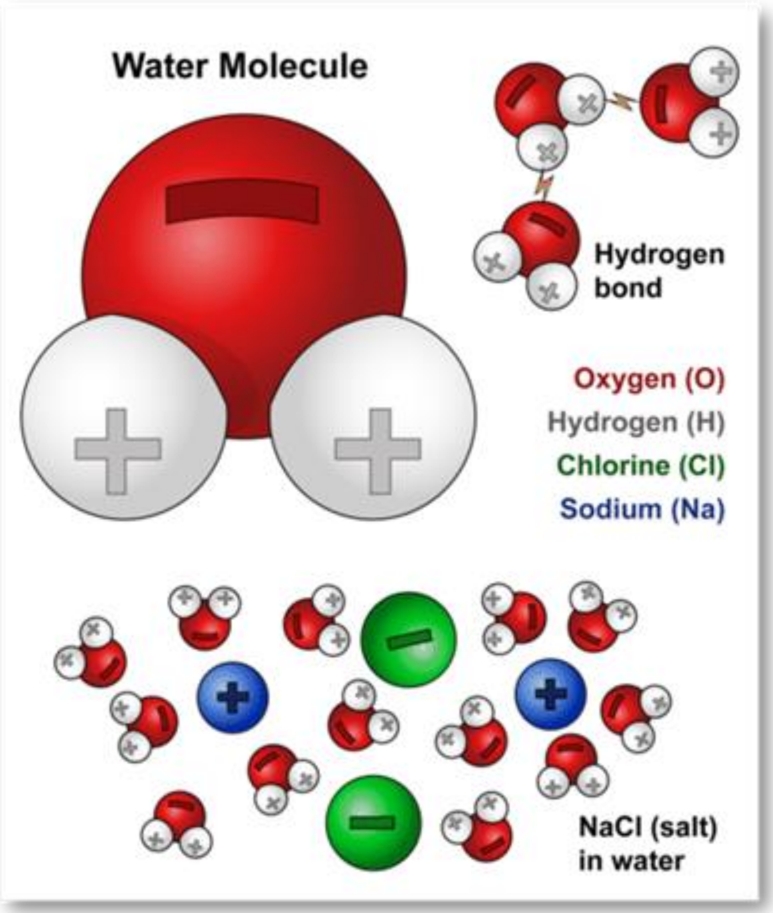
- H-bonds between water molecules and other polar substances (e.g.: cellulose walls making up the xylem of plants).
- Responsible for capillary action.

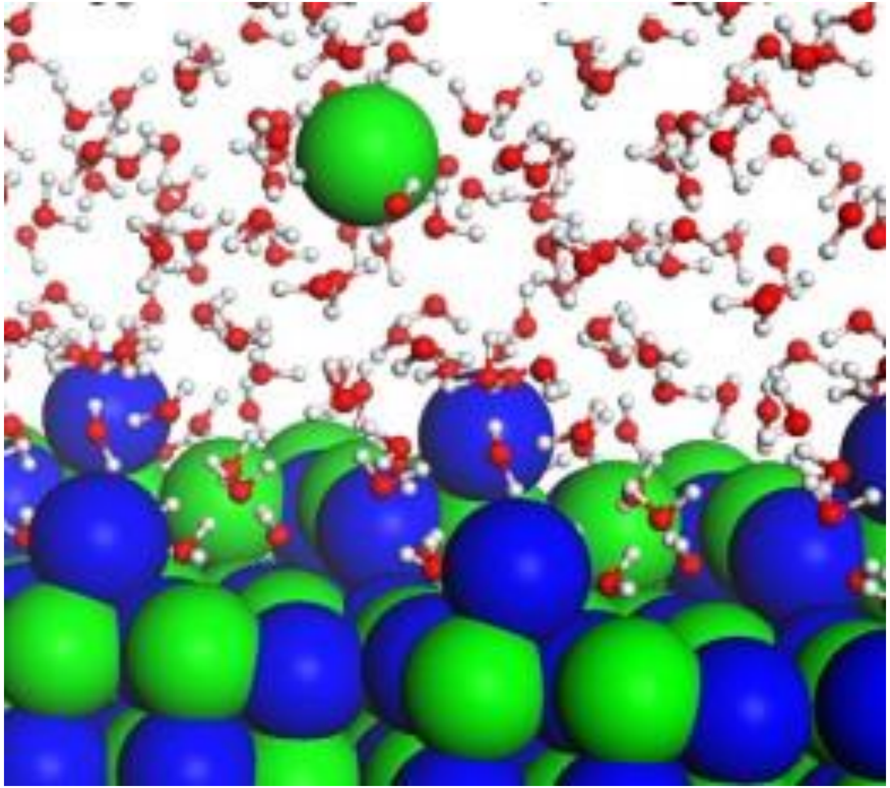
Transpiration

- Evaporation + cohesion + adhesion pull water up plants



Why water is a great solvent

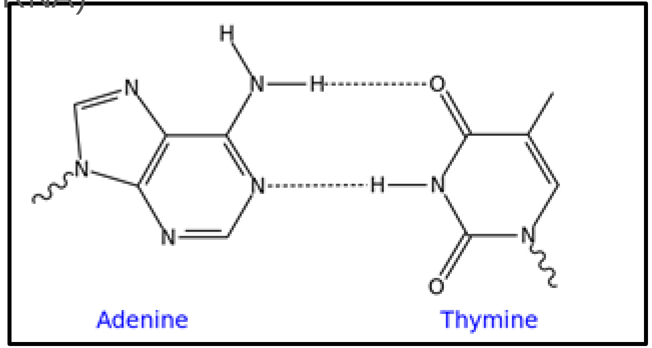


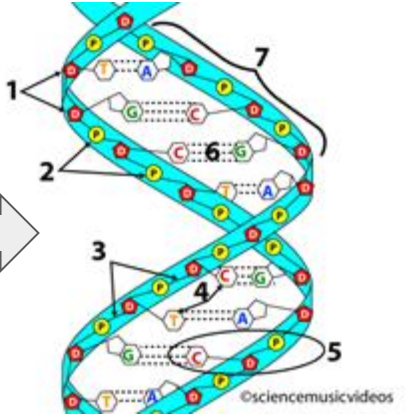


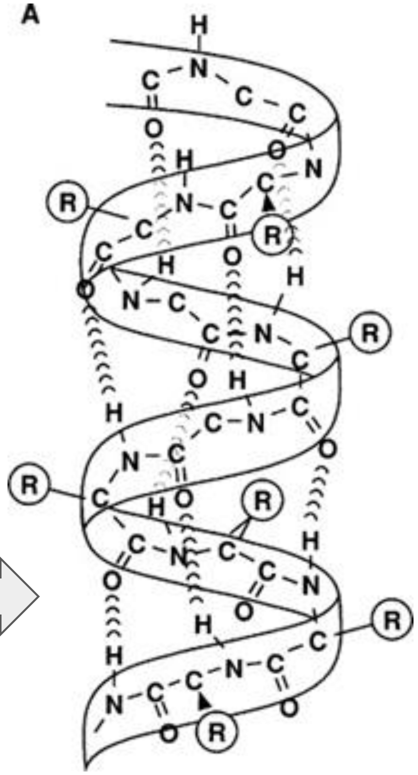
Model of water interacting with salt

Hydrogen bonds are key to biological structure

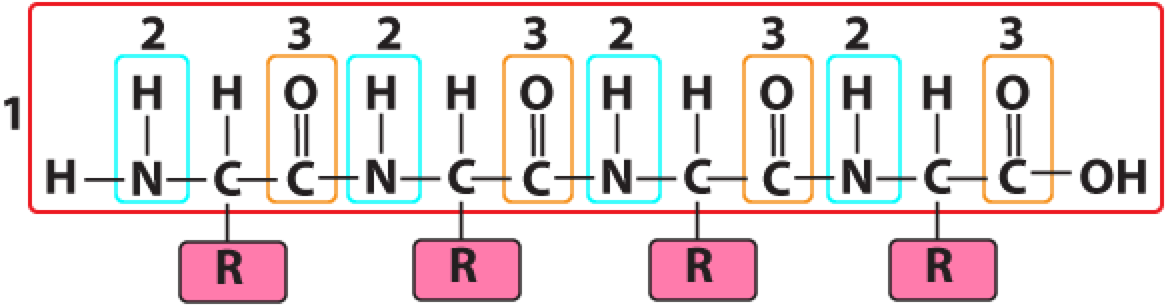
Between complementary base pairs in DNA (and RNA)





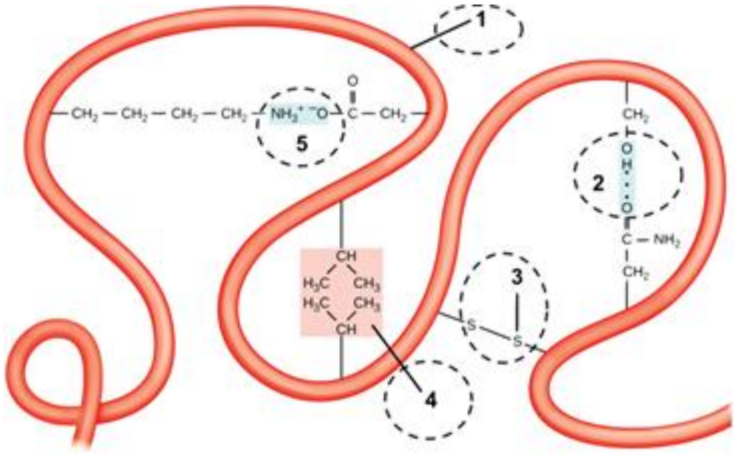


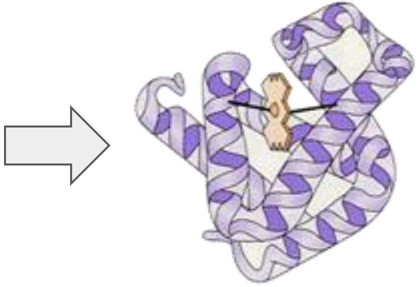
In protein secondary structure



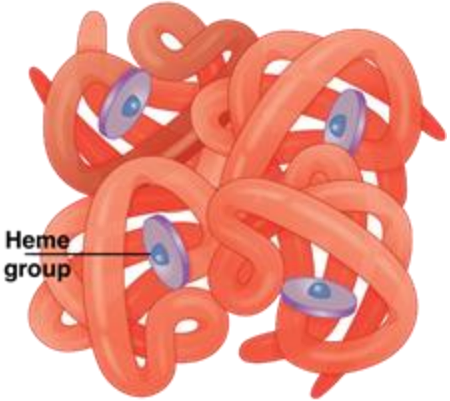
Hydrogen bonds are key to biological structure

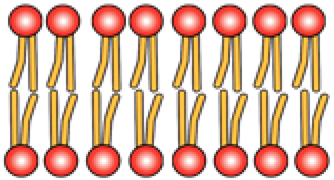
In protein tertiary structure

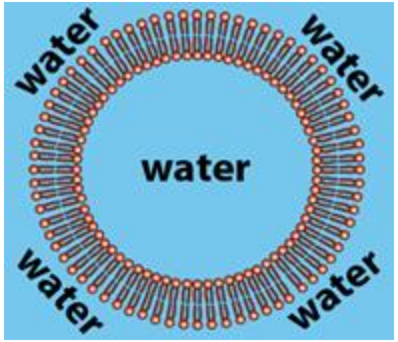




Quaternary structure

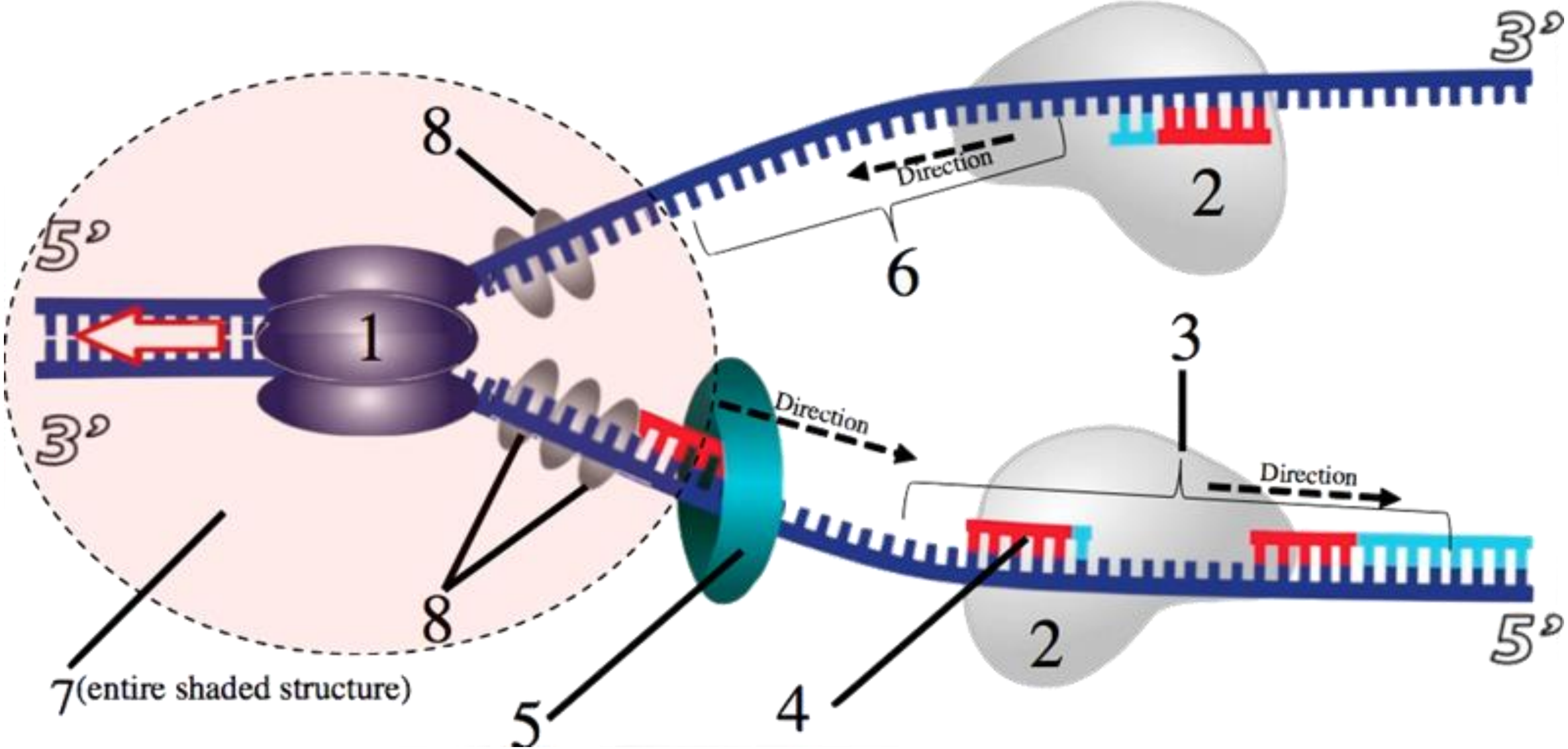




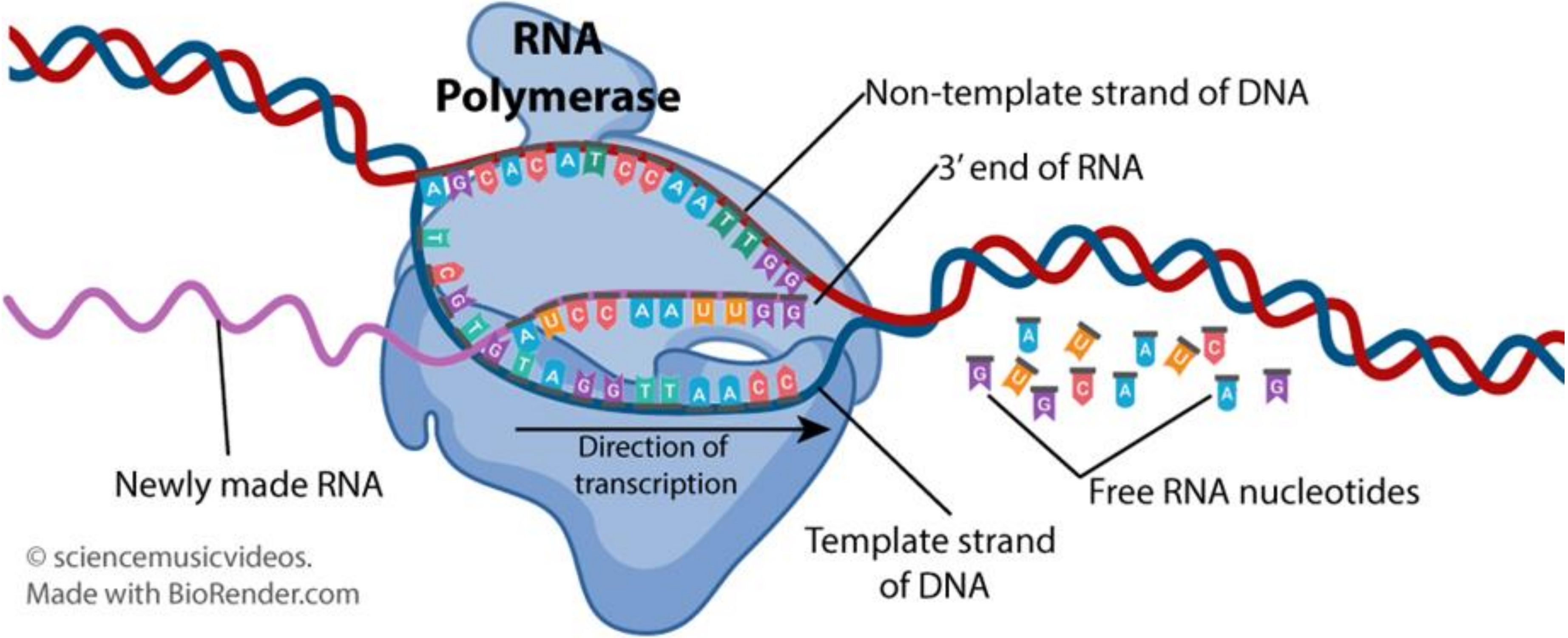


In cell membrane formation

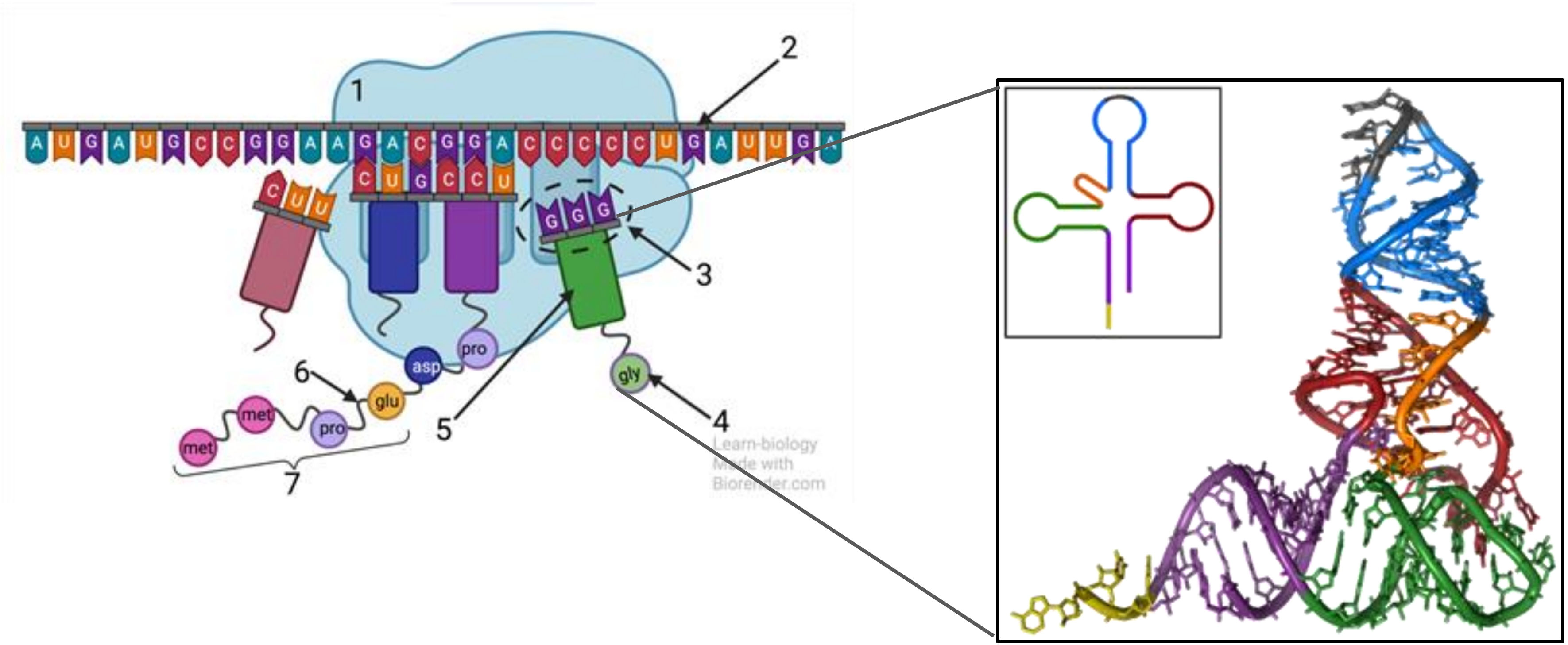
HYDROGEN BONDS ARE ESSENTIAL in DNA replication



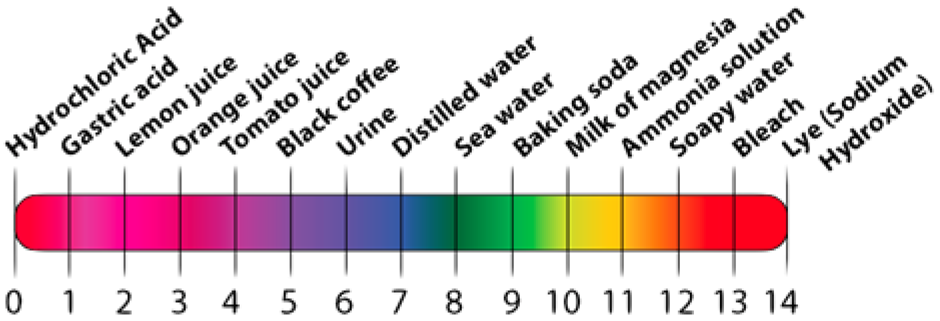
HYDROGEN BONDS ARE ESSENTIAL during transcription



HYDROGEN BONDS ARE ESSENTIAL during protein synthesis



Acidity and Alkalinity



Acidic

Basic

$HCl \rightarrow H^+ + Cl^-$

$NaOH \rightarrow Na^+ + OH^-$

- Acidic solutions:
  - More hydrogen ions (protons or H^+) than hydroxide ions (represented by OH^-)
  - pH is below 7.
- Bases:
  - Have more hydroxide ions than hydrogen ions
  - pH is above 7.

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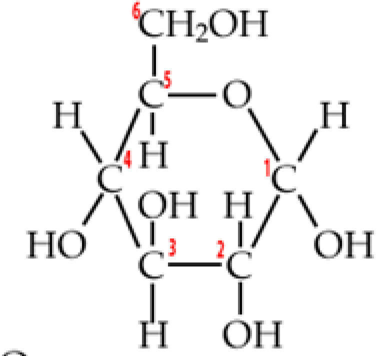
Structural Formulas, Monomers and Polymers, Functional Groups

Structural Formulas

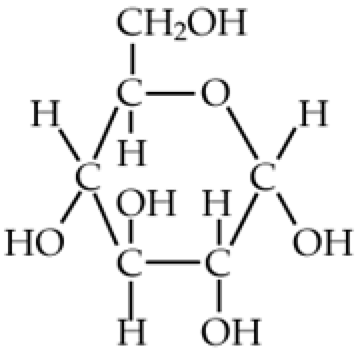
Carbon numbering



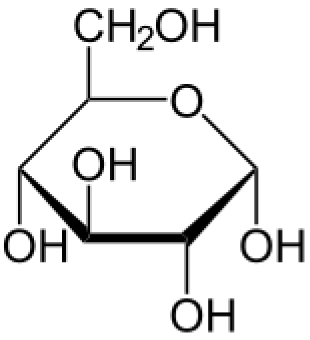
Glucose

$C_6H_{12}O_6$

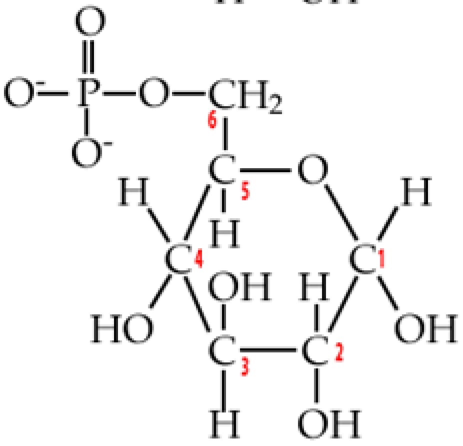
Molecular formula



Full structural formula, showing all atoms and all bonds

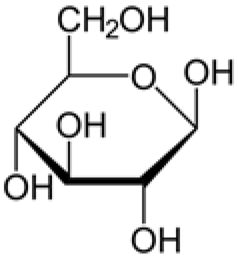


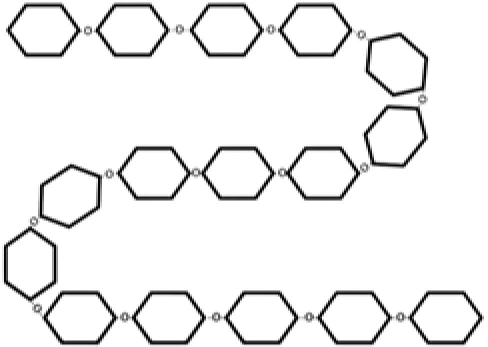
An abbreviated structural formula.



Glucose-6-Phosphate

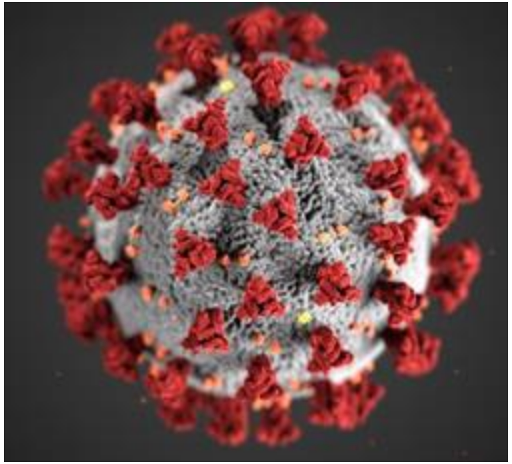
What are monomers? Polymers?

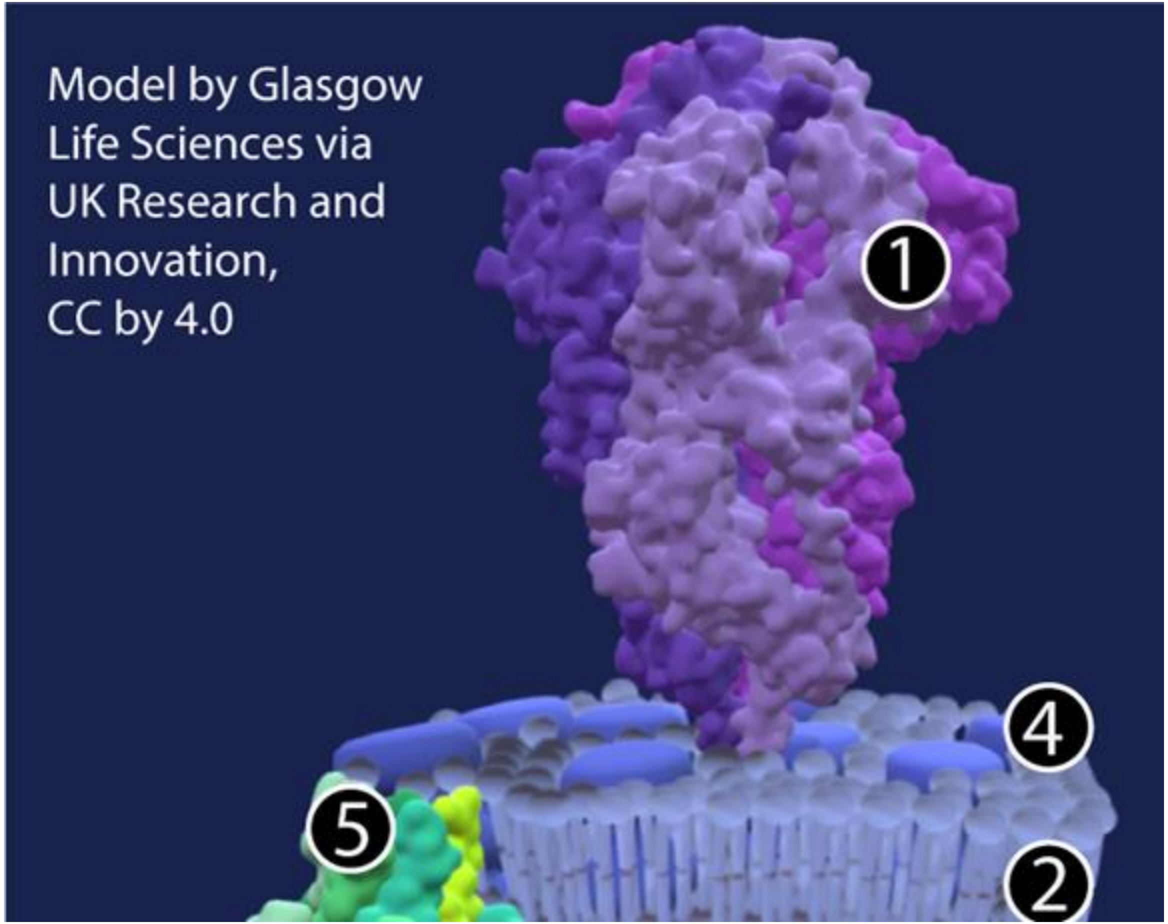




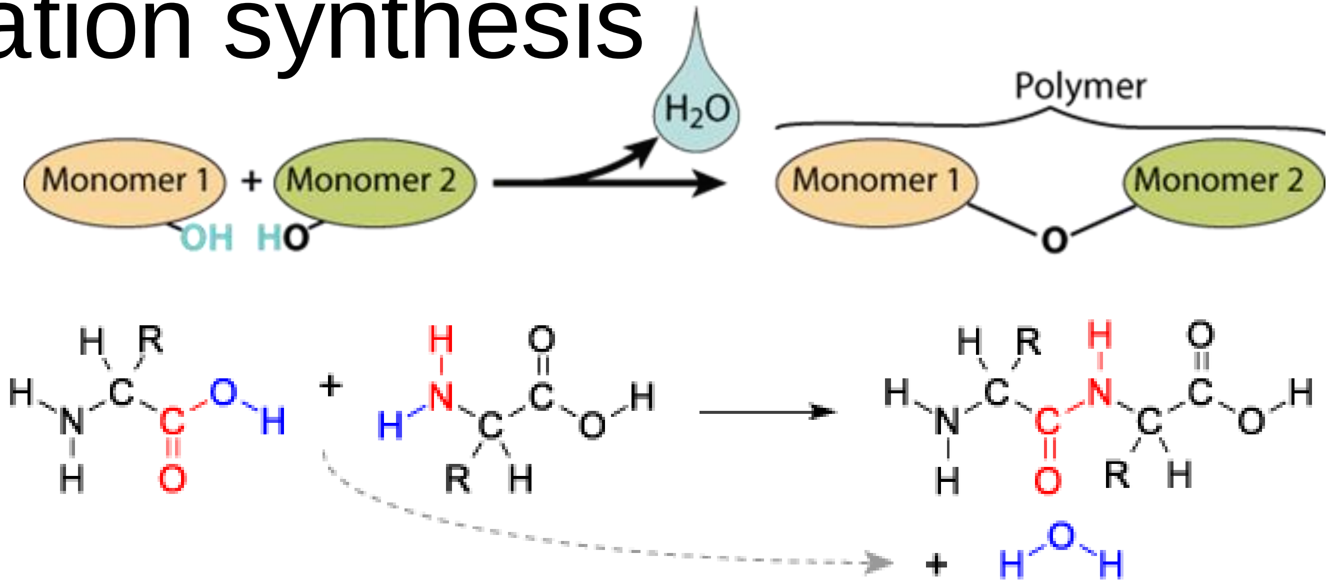
- **Monomers:** small building blocks.
- Enzymes combine monomers to form polymers.
- **Polymers**: AKA macromolecules, with specific shapes and properties
- Enzymes can also break polymers down to monomers

A macromolecule (and a polymer): SARS-CoV-2 Spike Protein



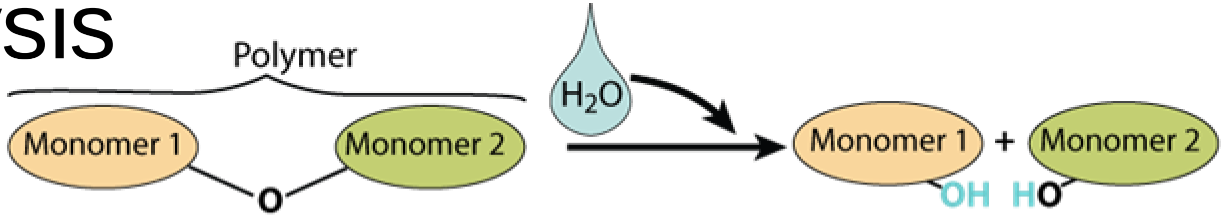


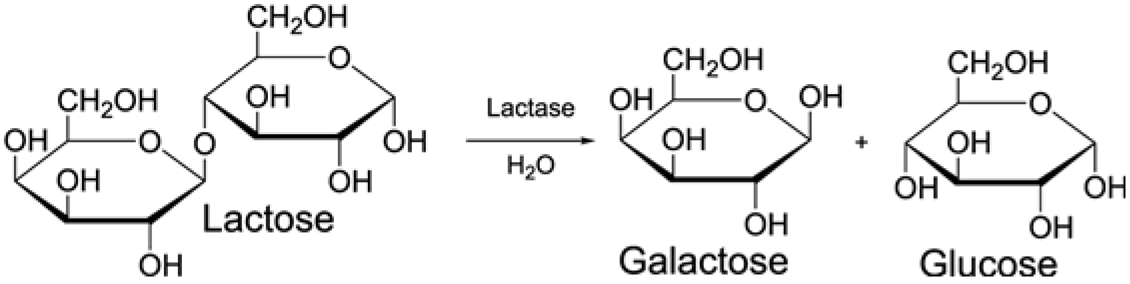
Dehydration synthesis



- Enzymes pull a hydroxyl group (an —OH) off of one monomer (or a group of already connected monomers),
- A hydrogen atom is pulled off the other.
- The —H and —OH combine to form water (hence, *dehydration* synthesis).

Hydrolysis



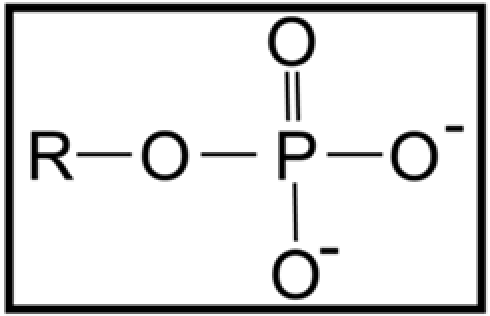


- Enzymes insert a water molecule between the monomers making up the polymer.
- This breaks the bond that held the two monomers together.
- IMPORTANT VERB: to hydrolyze

Functional groups

- **YOU *DON'T* NEED TO KNOW THESE BY NAME.**
- **YOU SHOULD KNOW HOW THEY AFFECT MOLECULES.**

1



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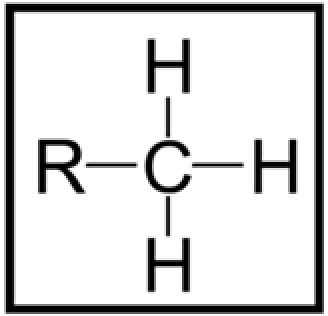

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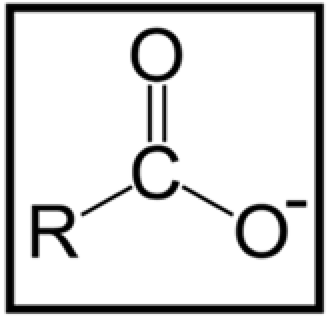

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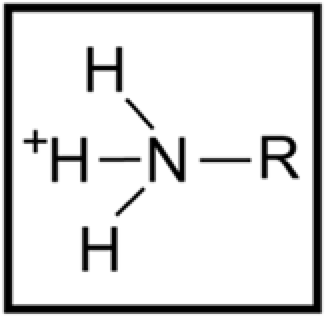

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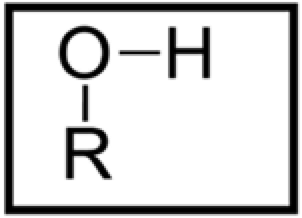

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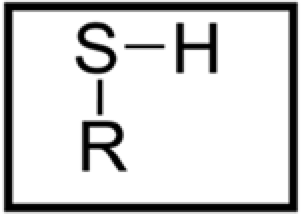

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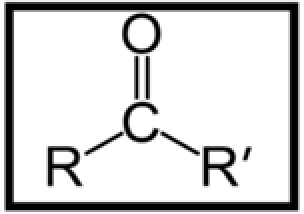

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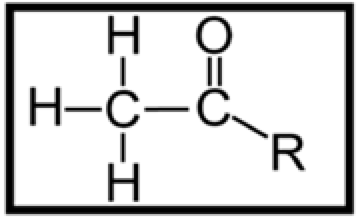
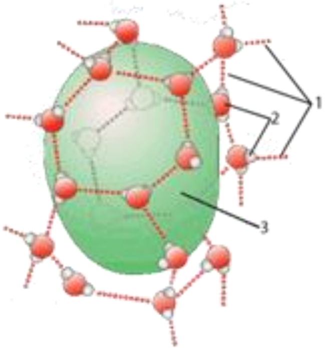
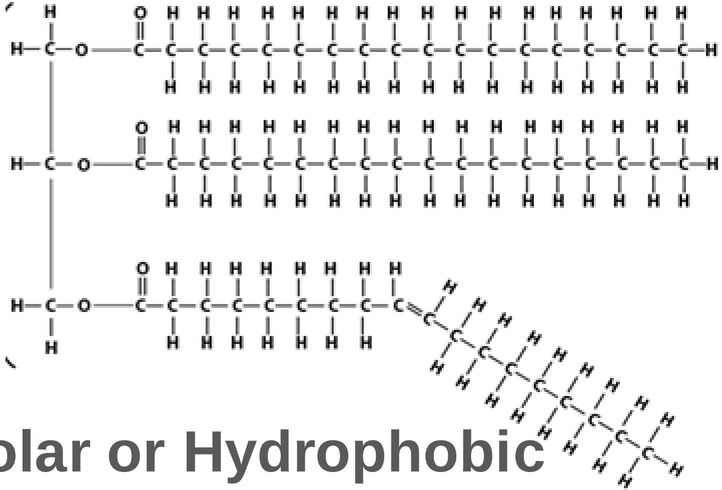


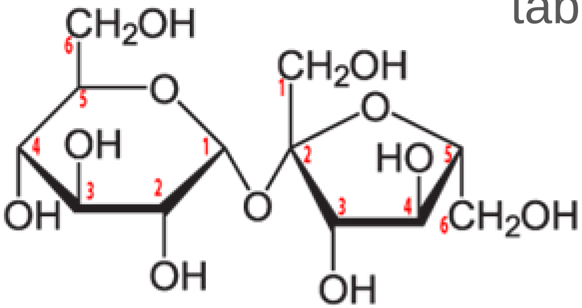
Functional groups determine how molecules interact with water





Non-polar or Hydrophobic

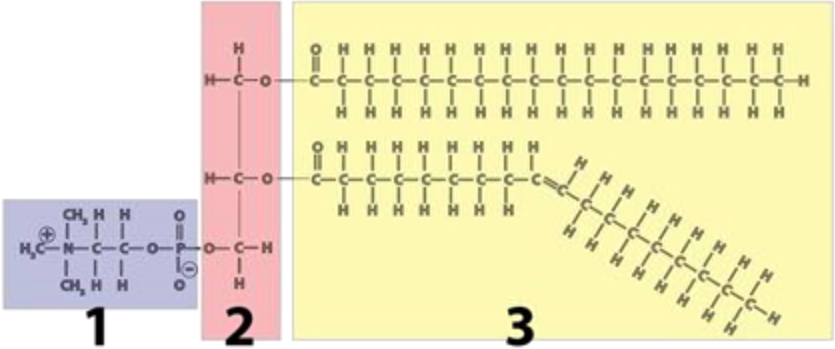
Sucrose: table sugar

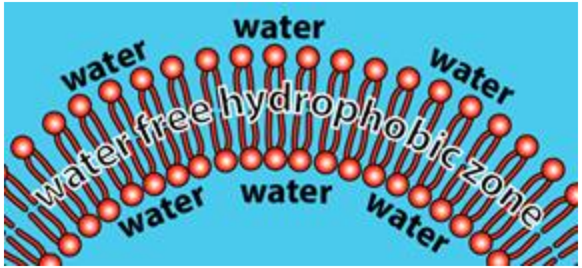


Polar or Hydrophilic

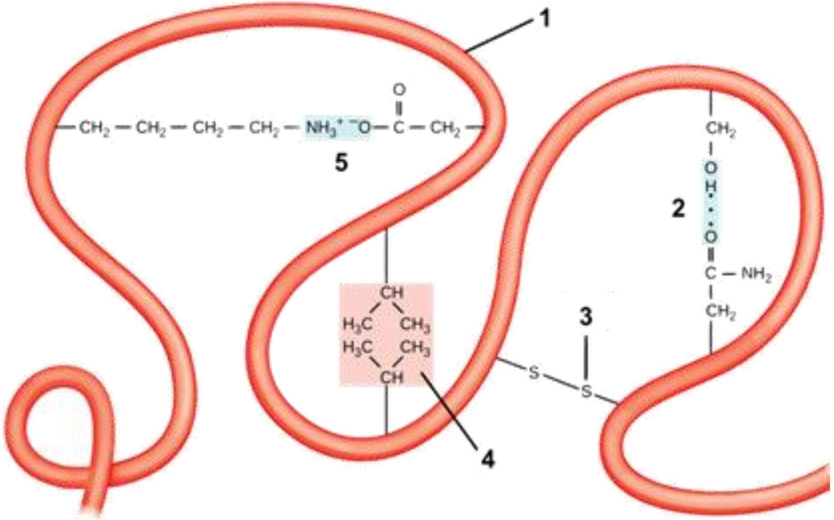
Functional Groups in context

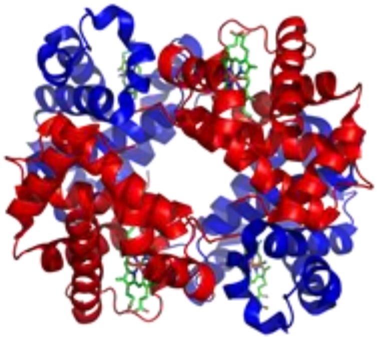
Phospholipid





Phospholipid bilayer

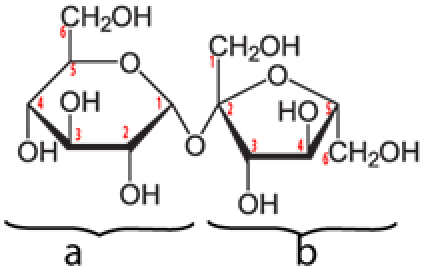




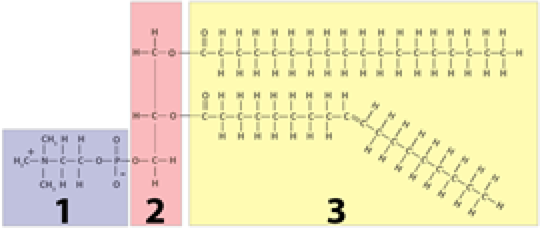
Hemoglobin (a protein)

Biomolecules

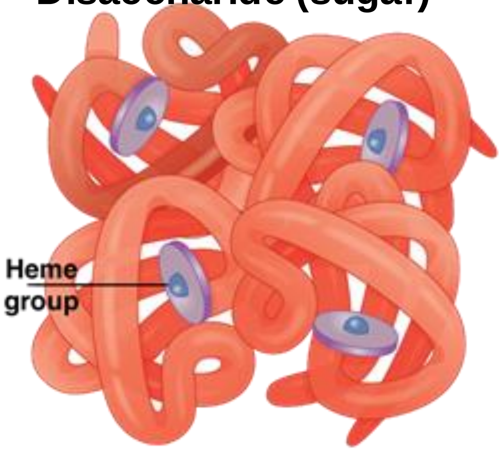
The four biomolecule families



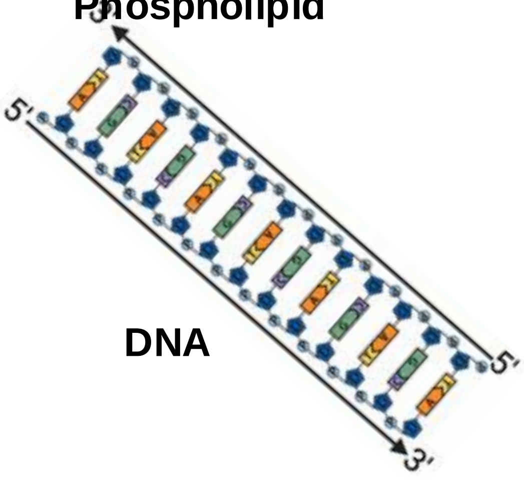
Disaccharide (sugar)



Phospholipid



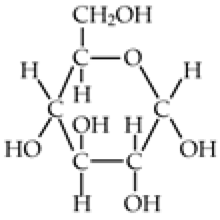
Hemoglobin



DNA

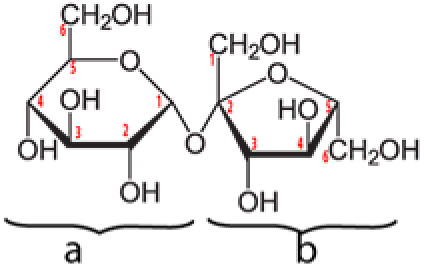
- Carbohydrates
- Lipids
- Proteins
- Nucleic Acids

Carbohydrates



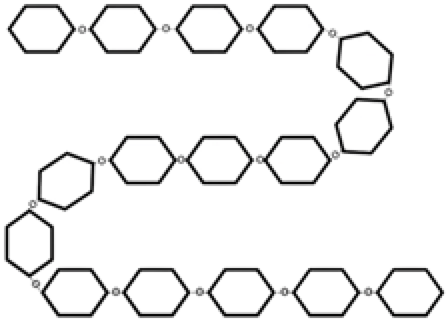
Glucose

Monosaccharides (simple sugars)



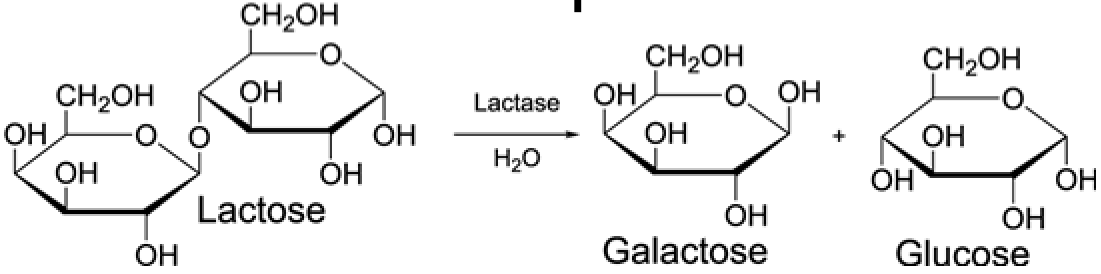
Disaccharides (two linked monosaccharides)

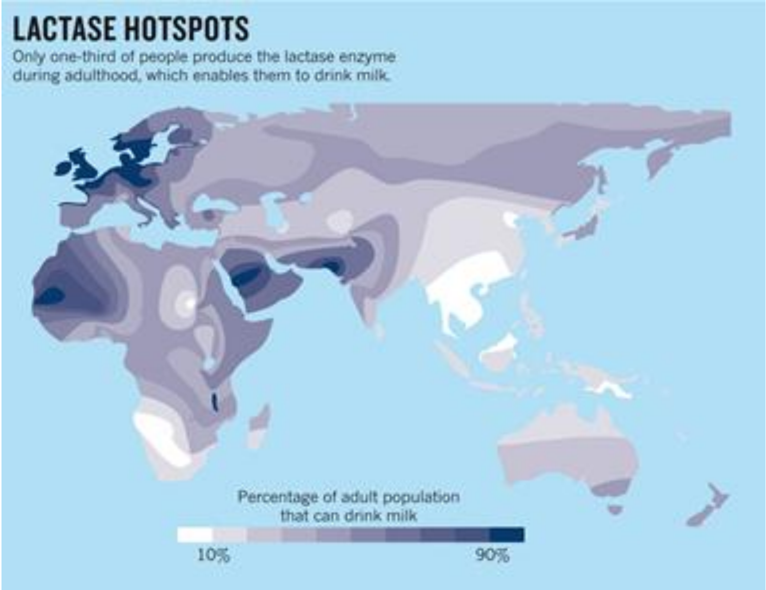
Polysaccharides (starch, cellulose)



- Monosaccharides: energy sources and building blocks
- Disaccharides: energy transfer (sucrose, lactose)
- Polysaccharides
  - Energy storage (starch/glycogen)
  - Structures (cellulose: cell walls)

Illustrative example: lactose tolerance/intolerance.

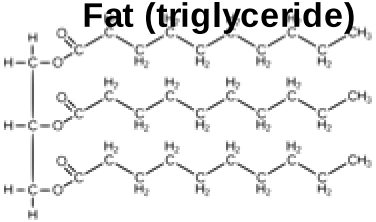


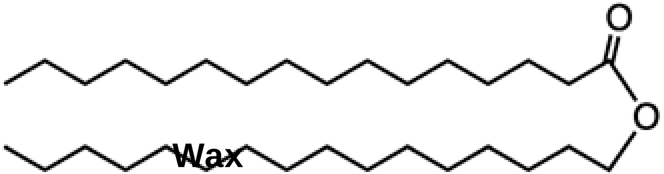


- Lactose: sugar in milk.
- Lactase: hydrolyzes lactose into monosaccharides
- Most mammals only produce lactase during infancy (while suckling).
- Most adult mammals don’t produce lactase (adaptation: why produce an enzyme for something you don’t eat)
- Some human groups (pastoralists/herders) evolved *lactase persistence*
- Most humans (the majority) are lactose intolerant as adults

Lipids: An overview

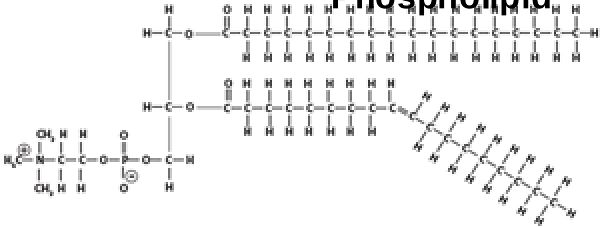
Fat (triglyceride)

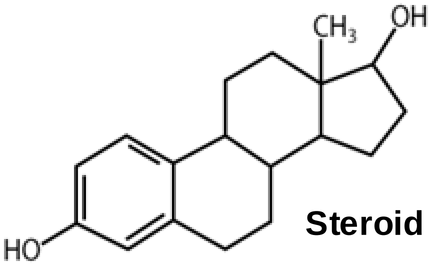




Wax

Phospholipid

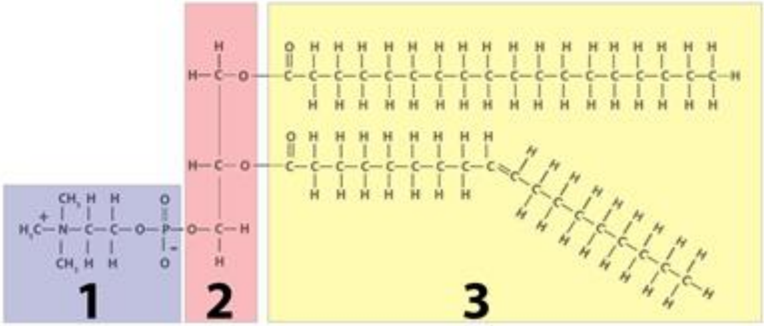


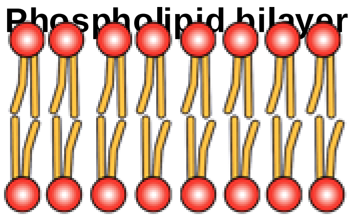


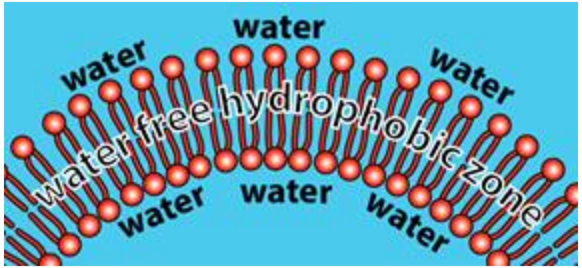
Steroid

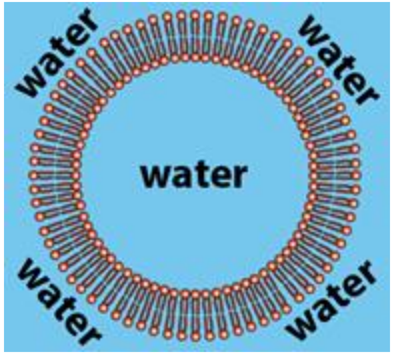
- Wholly or partly nonpolar.
- *Not* composed of repeating monomers.
- Functions
  - Energy storage and insulation (fats/oils)
  - Waterproofing (waxes)
  - Membrane formation (phospholipids)
  - Signaling (steroids)

Phospholipids, water, and membranes





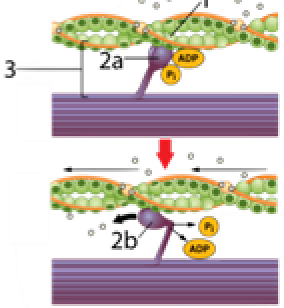




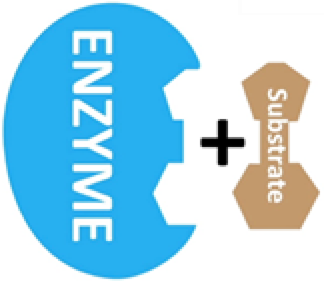
- When mixed with water, the heads form hydrogen bonds with water, while the tails form a water free zone
- This creates a phospholipid bilayer, the basis of membranes

Protein overview: key functions

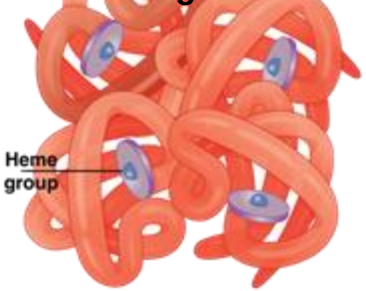
Muscle fiber



Enzymes



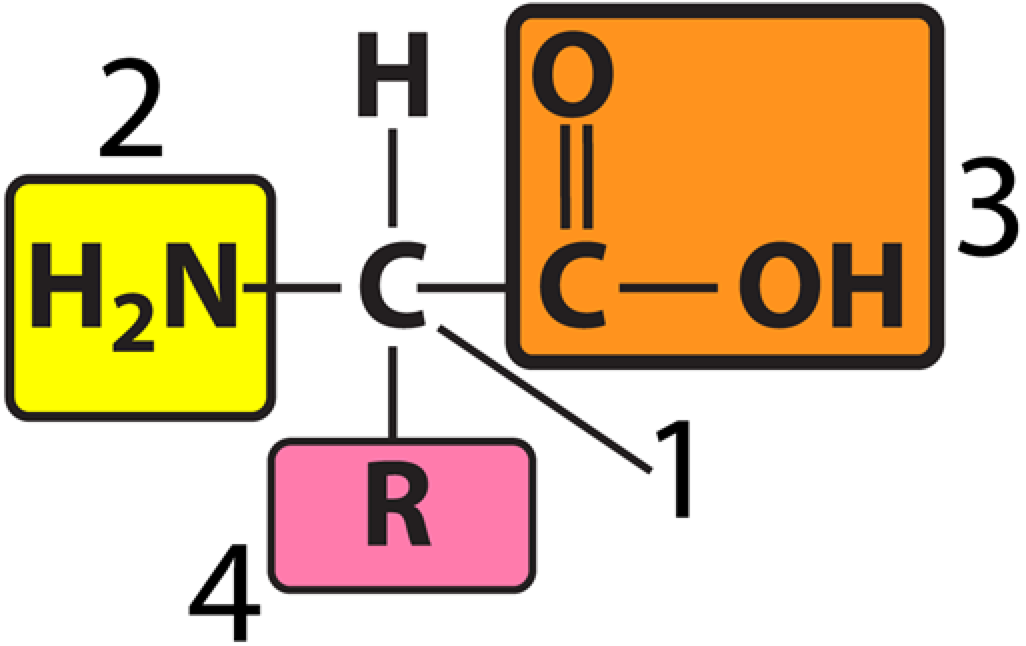
Hemoglobin



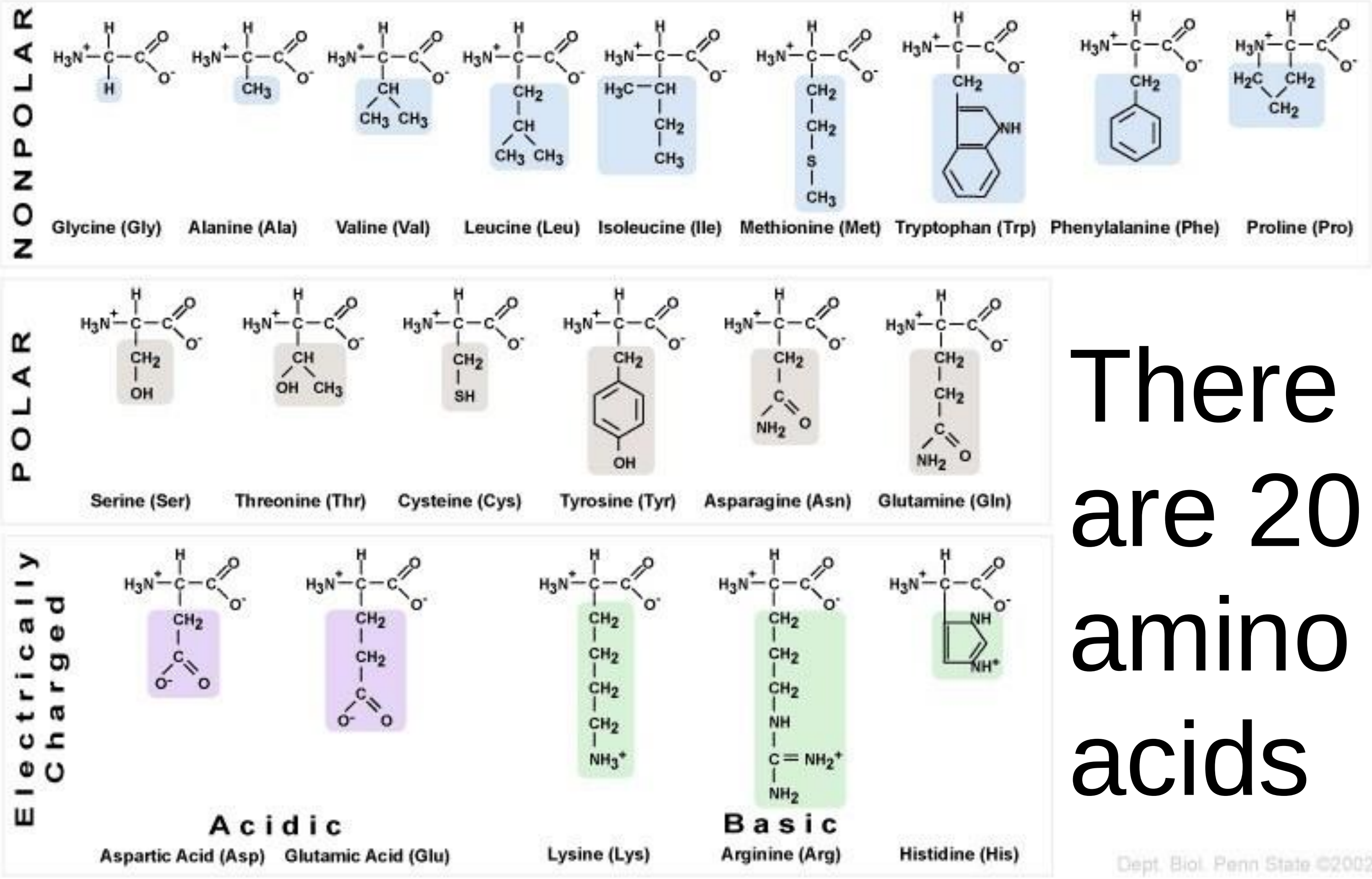
Insulin

- **Motion**: muscle tissue, also cilia and flagella
- **Enzymes**
- **Structure**: collagen or keratin (hair, feathers, and nails)
- **Transport** (hemoglobin, which carries oxygen)
- **Energy** storage (albumin)
- Transmitting **signals** (hormones like insulin or protein neurotransmitters)

Amino Acids are the monomers

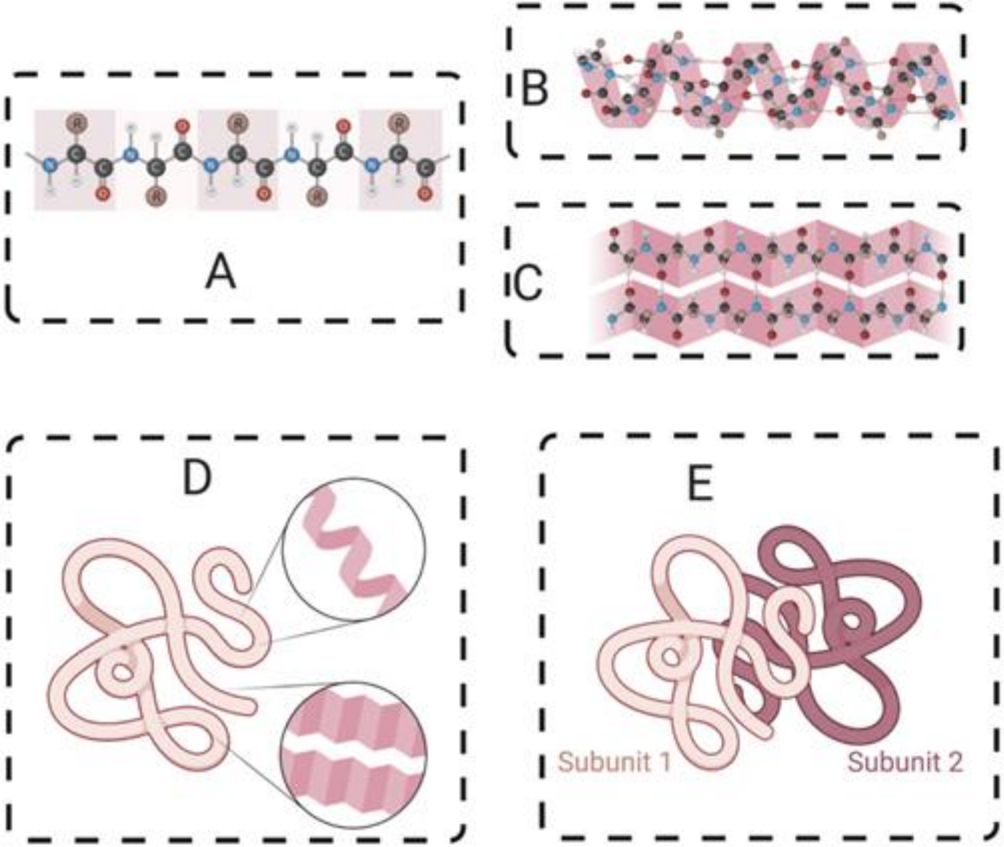


- Central carbon (1)
- Amine group (2)
- Carboxyl group (3)
- Hydrogen atom
- A variable R group (4)
  - Also called a "side chain"
  - Can be polar, non-polar, acidic, or basic



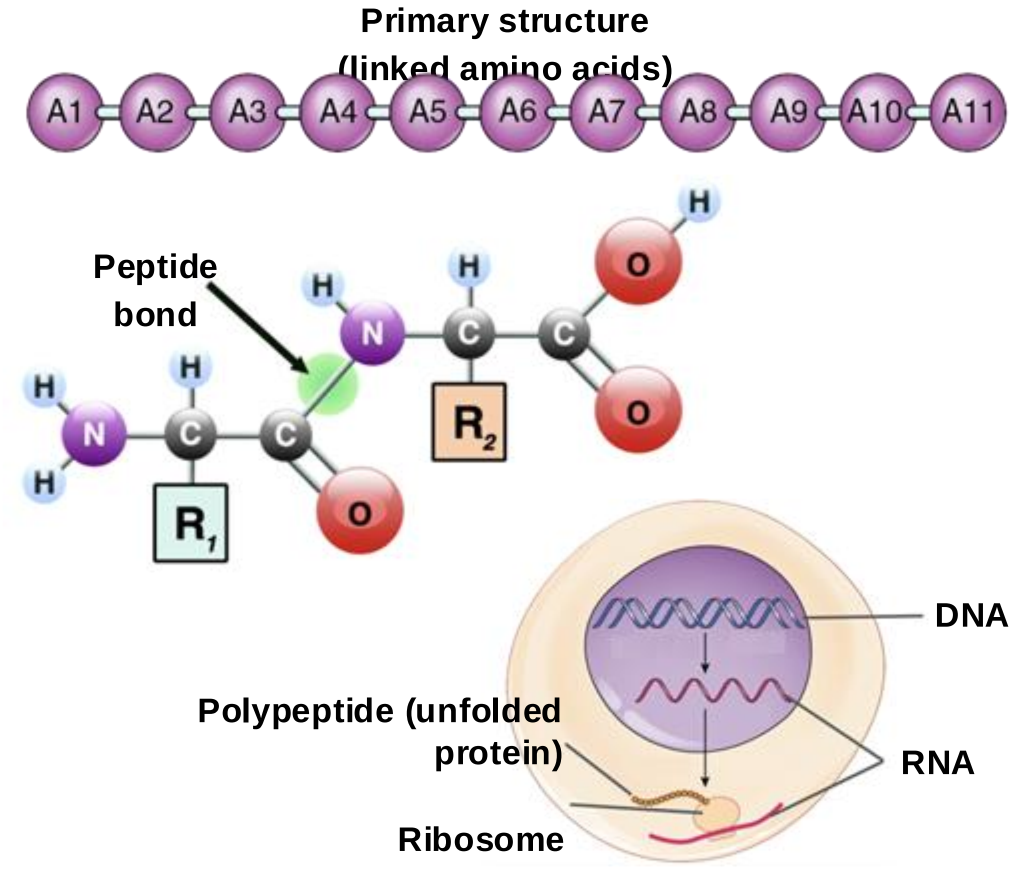
There are 20 amino acids

OVERVIEW: Protein structure emerges through 4 levels of interaction



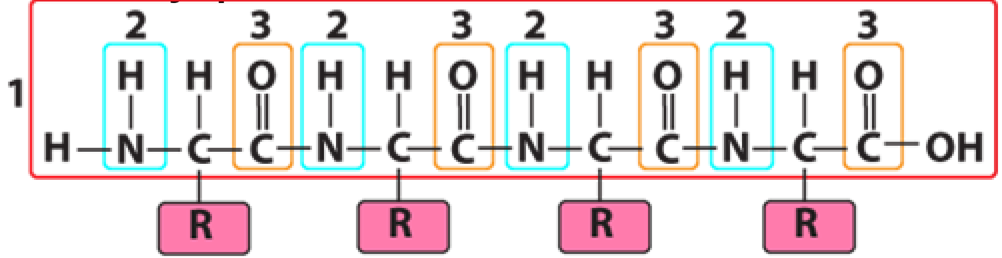
- 1° structure (A): linear sequence of amino acids (genetically determined)
- 2° Structure (B and C): interactions involving polypeptide backbone
- 3° Structure (D): interaction between R groups
- 4° (Quaternary) structure (E): interactions between multiple folded tertiary polypeptides.

Primary protein structure

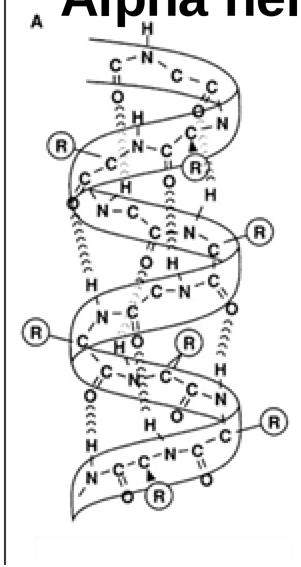


- Genetically determined sequence of amino acids in a polypeptide chain.
- Each amino acid is connected to the next by a **peptide bond**
- Peptide bonds are formed by ribosomes during *translation* or *protein synthesis*

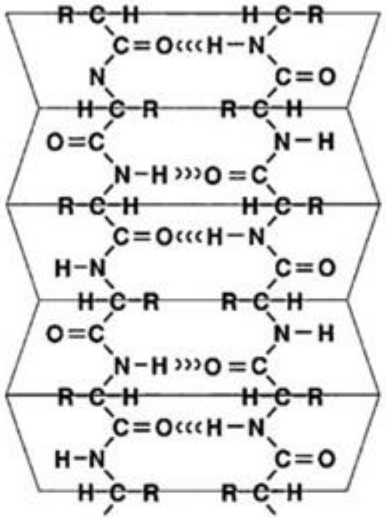
Secondary protein structure



Alpha helix

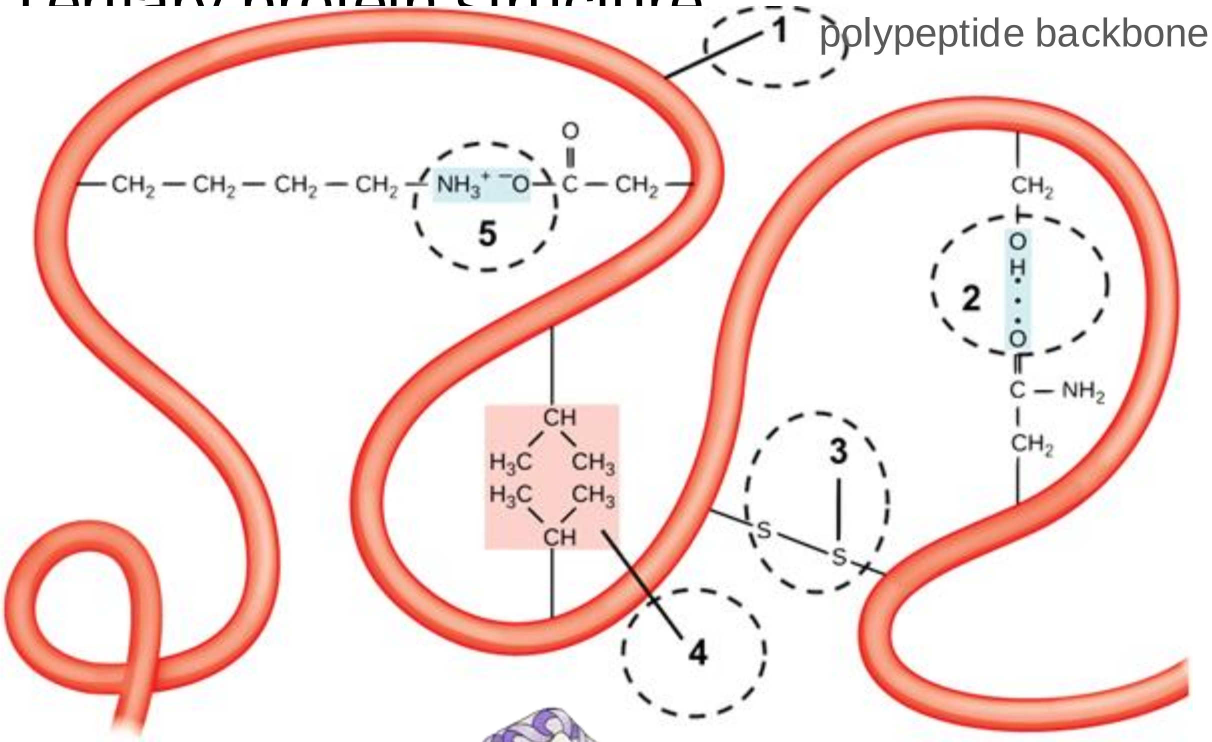


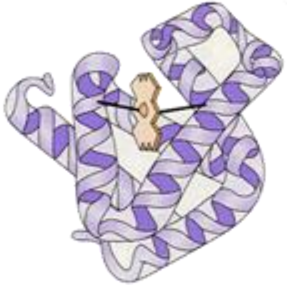
Beta Pleated Sheet



- Involves interactions between carbonyl (3) and amine residues (2) in the polypeptide backbone.
- Two forms

Tertiary protein structure

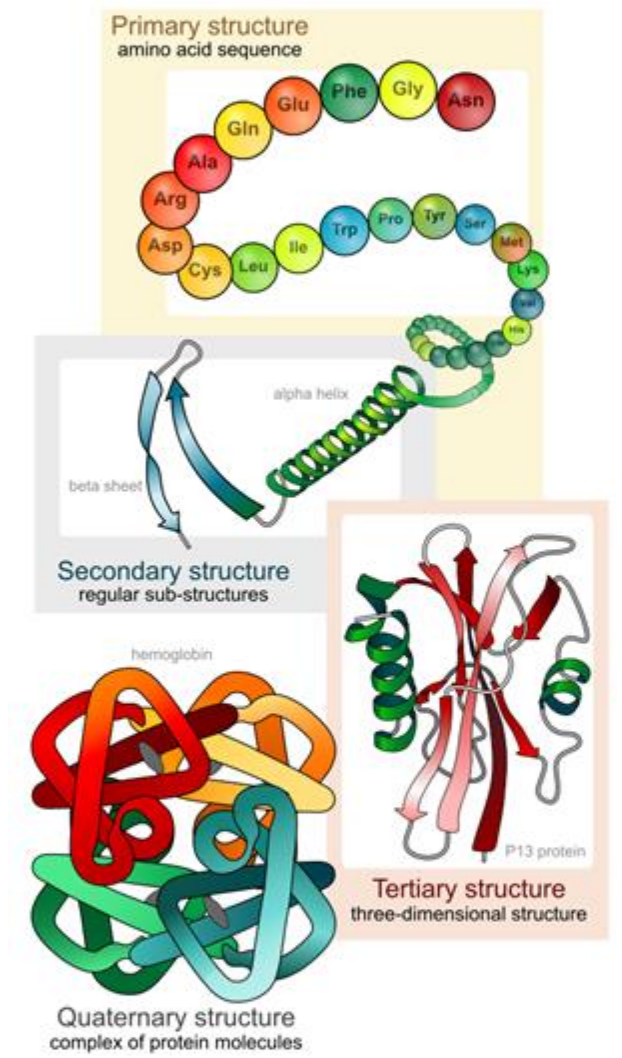




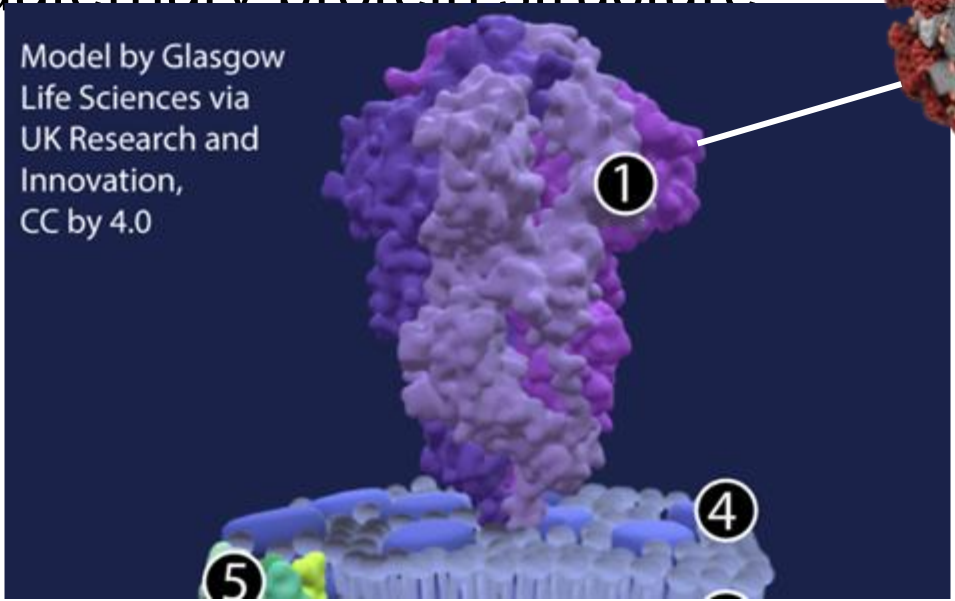
Myoglobin

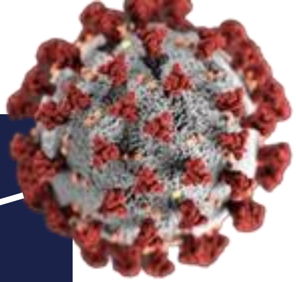
- Interactions between amino acid side chains (also called R-groups)
- Hydrogen bonds (2)
- Covalent bonds (3)
- Hydrophobic clustering (4)
- Ionic bonds (5)

The result is a complex, three-dimensional shape.



Quaternary protein structure

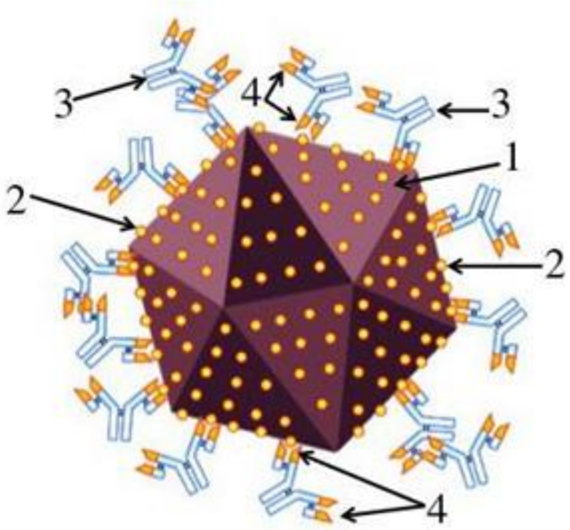


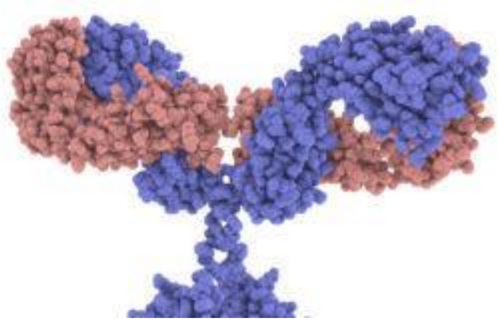


(1) SARS Spike Protein: 3 polypeptide chains

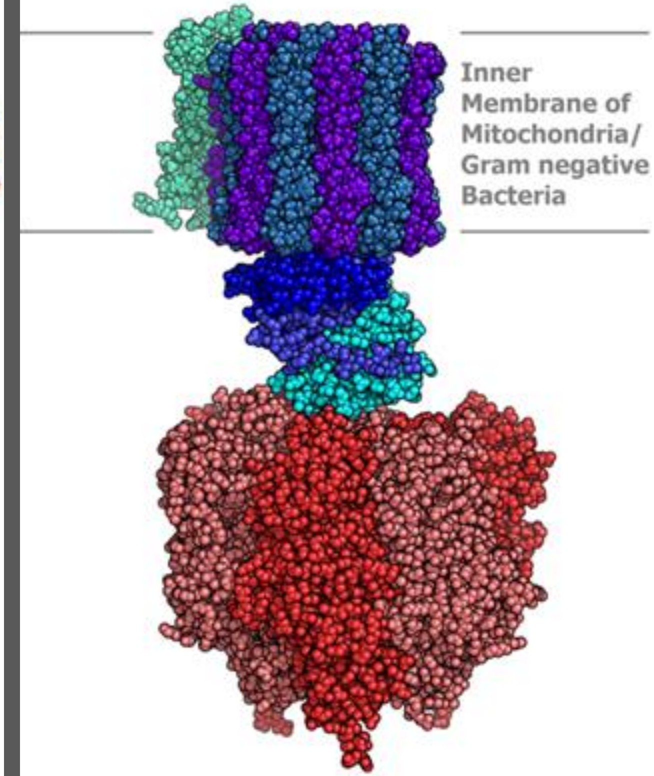
- Involves multiple polypeptides
- Can involve hydrogen bonds, ionic bonds, and hydrophobic interactions

Protein shape = structure and function = Adaptation



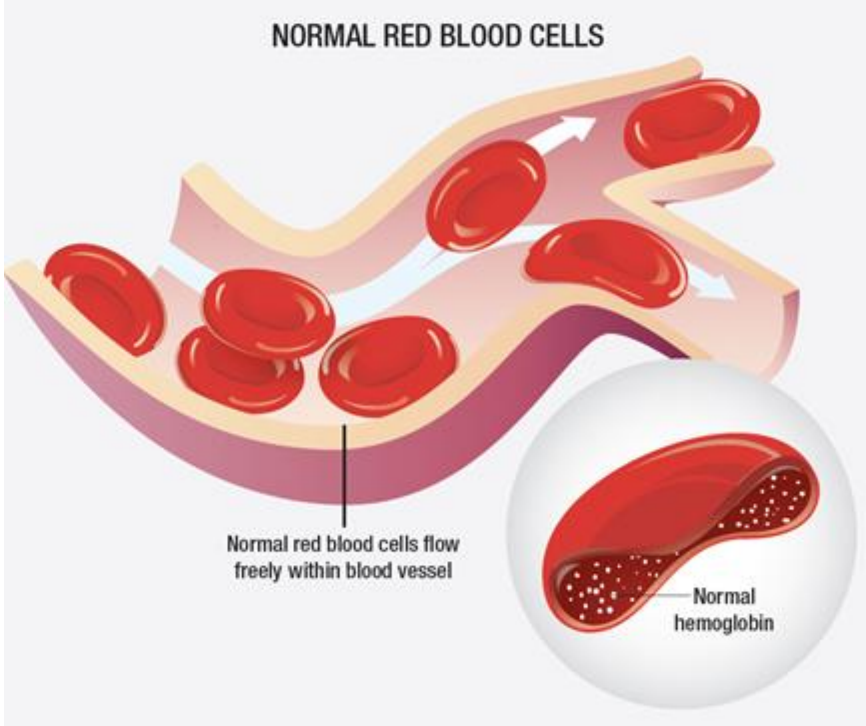


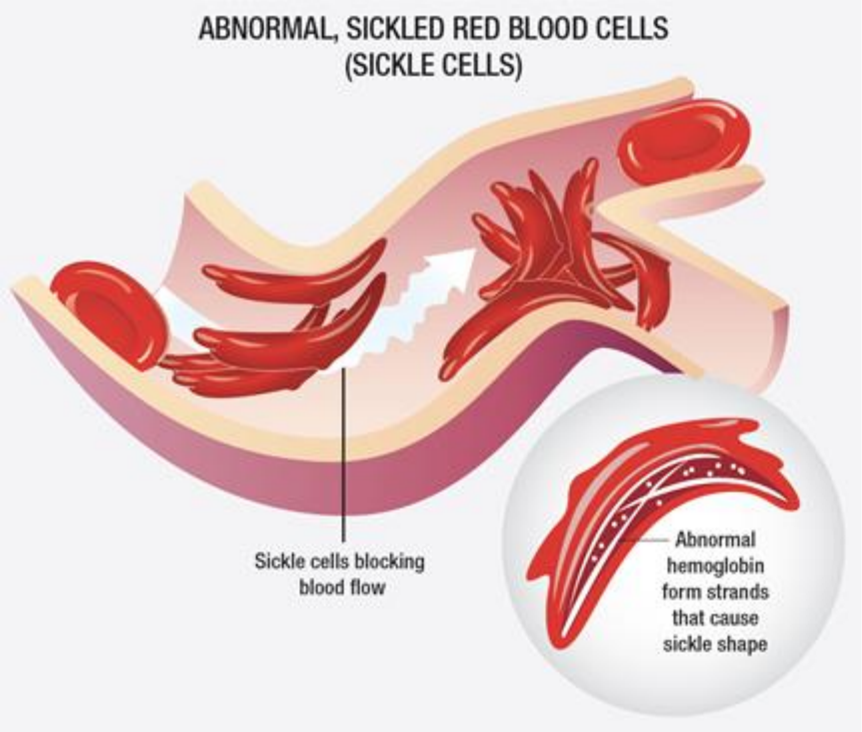
Immune system antibodies (proteins) interacting with viral proteins



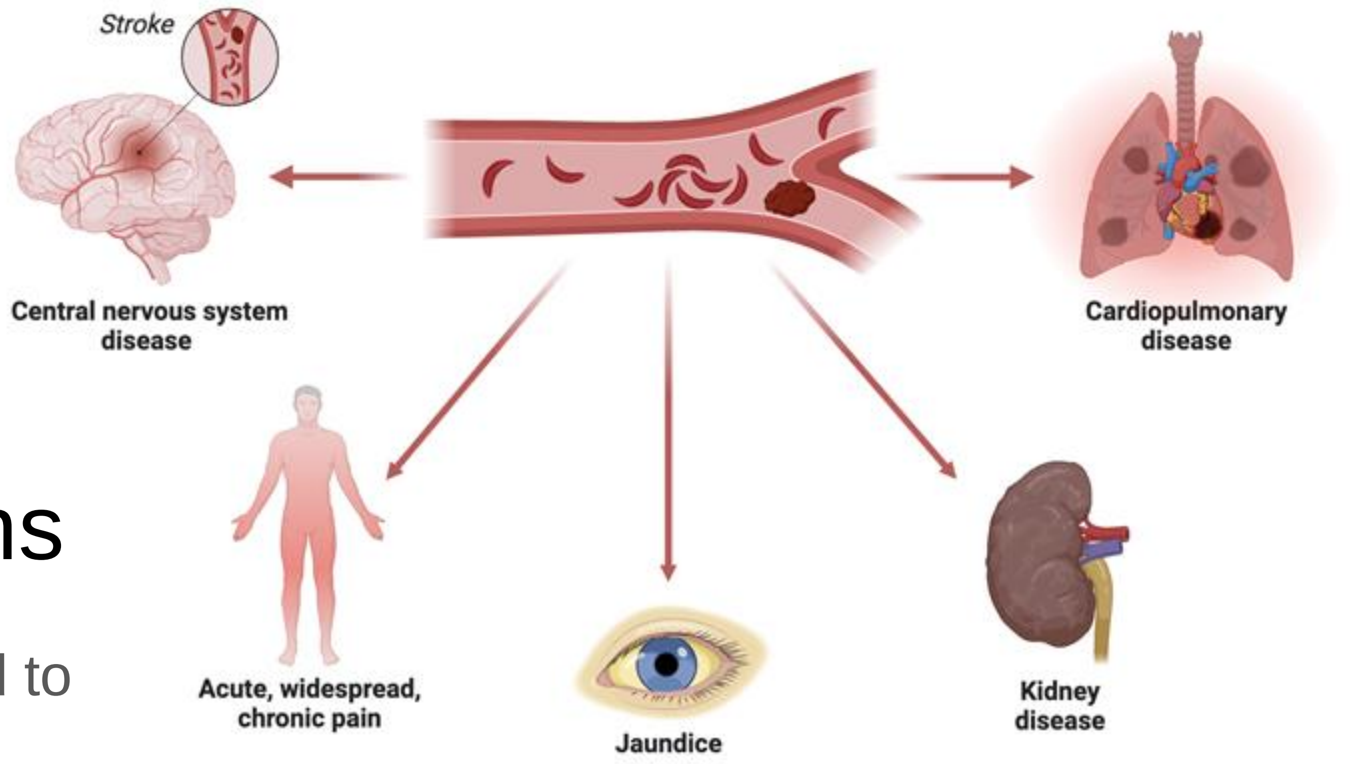
ATP Synthase

Sickle cell disease





- Inherited disease affecting hemoglobin in red blood cells.
- Affects about 100,000 U.S. citizens, mostly African Americans, and about 8,000,000 people worldwide



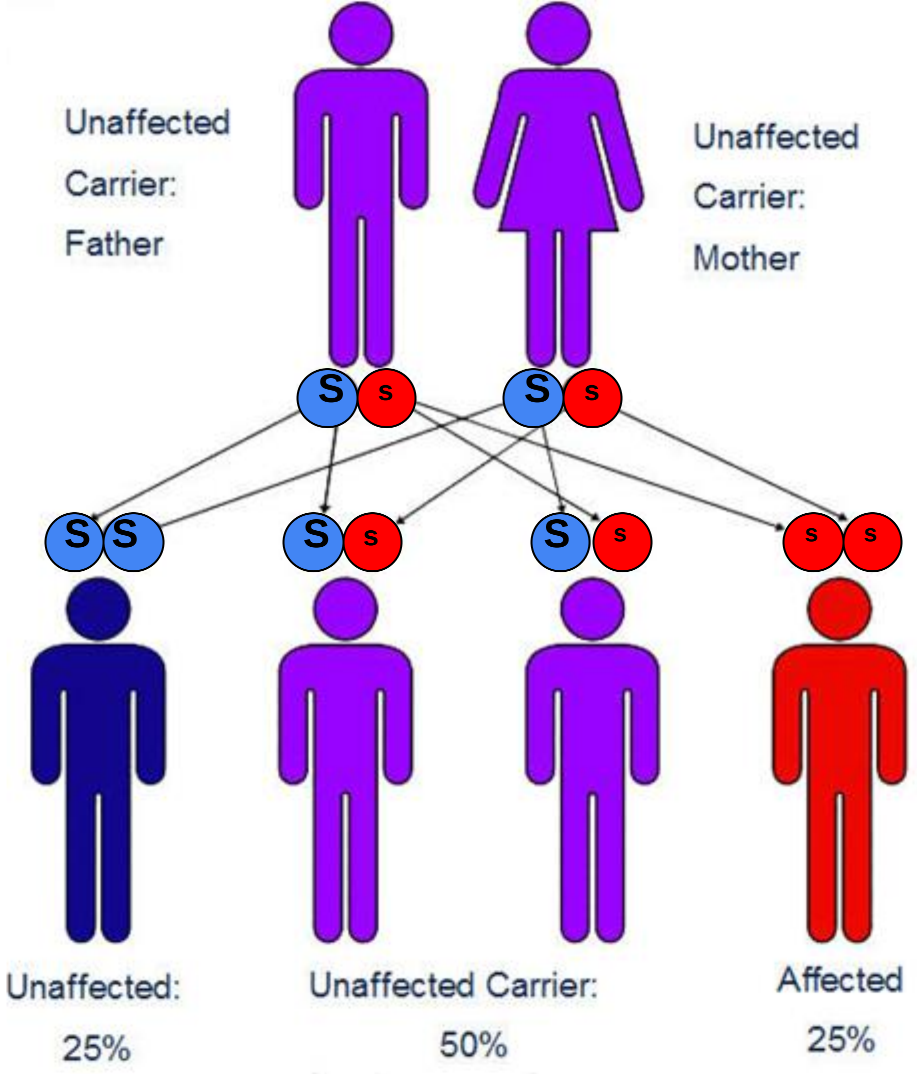
Symptoms/ complications

- Mostly related to clotting and inflammation
- Improved medical care has increased lifespan from early childhood mortality to 50 years (or longer).

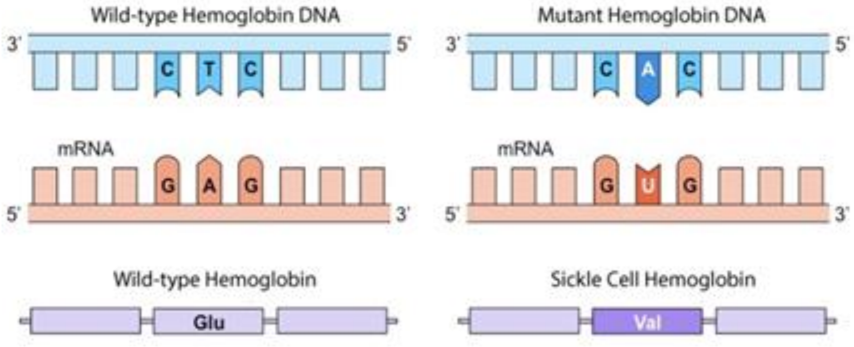
Inheritance is **autosomal** and **recessive**

- You have to inherit the gene from **both** parents
- SS: homozygous normal (no presence of allele)
- Ss: heterozygous (one allele, but no symptoms)
- ss: affected

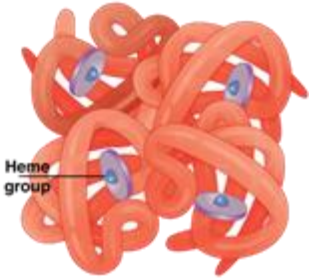
	S	s
S	SS	Ss
s	Ss	ss



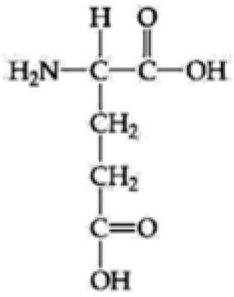
Caused by a point mutation in the gene for hemoglobin



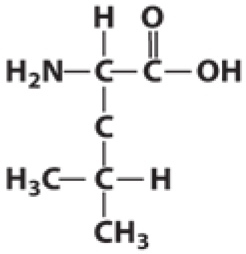
- Hemoglobin: quaternary protein
  - Two Alpha chains: 141 amino acids
  - Two Beta chains: 146 amino acids
- A point mutation in the beta chains substitutes “A” for “T”
- The resulting beta chains have valine (nonpolar) instead of glutamic acid.



Hemoglobin

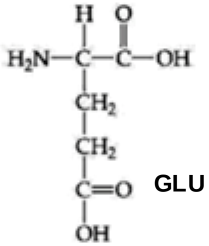


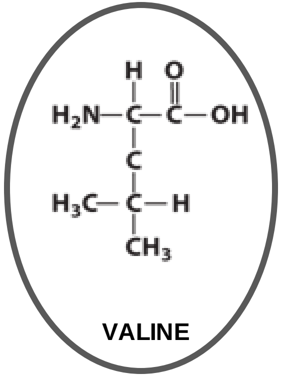
GLUTAMIC ACID

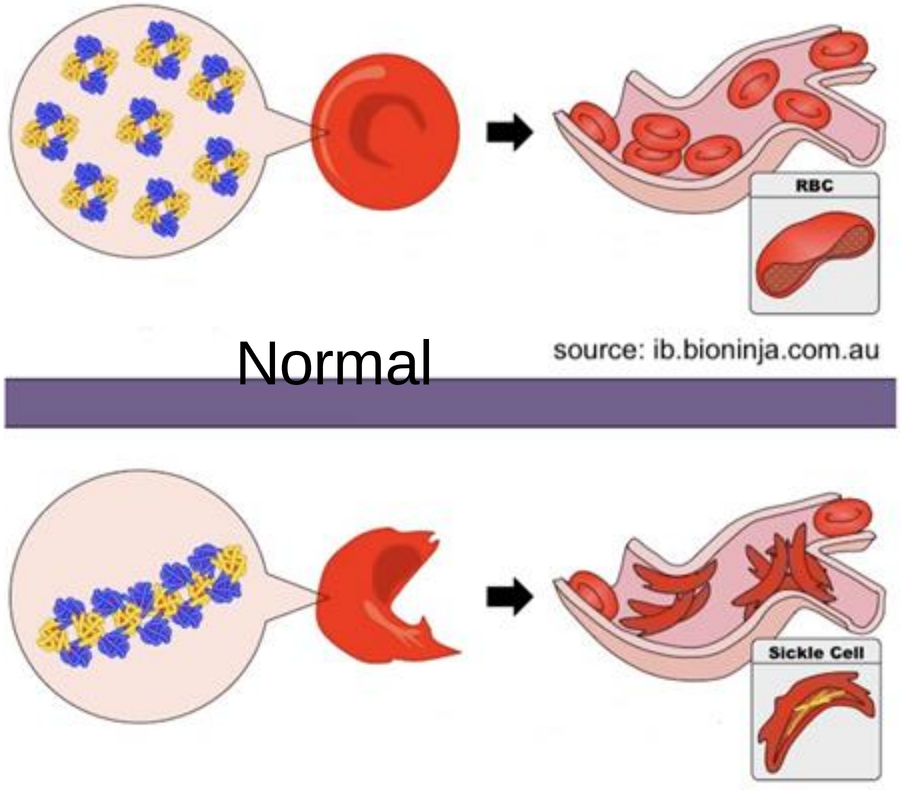


VALINE

How the substitution causes sickling





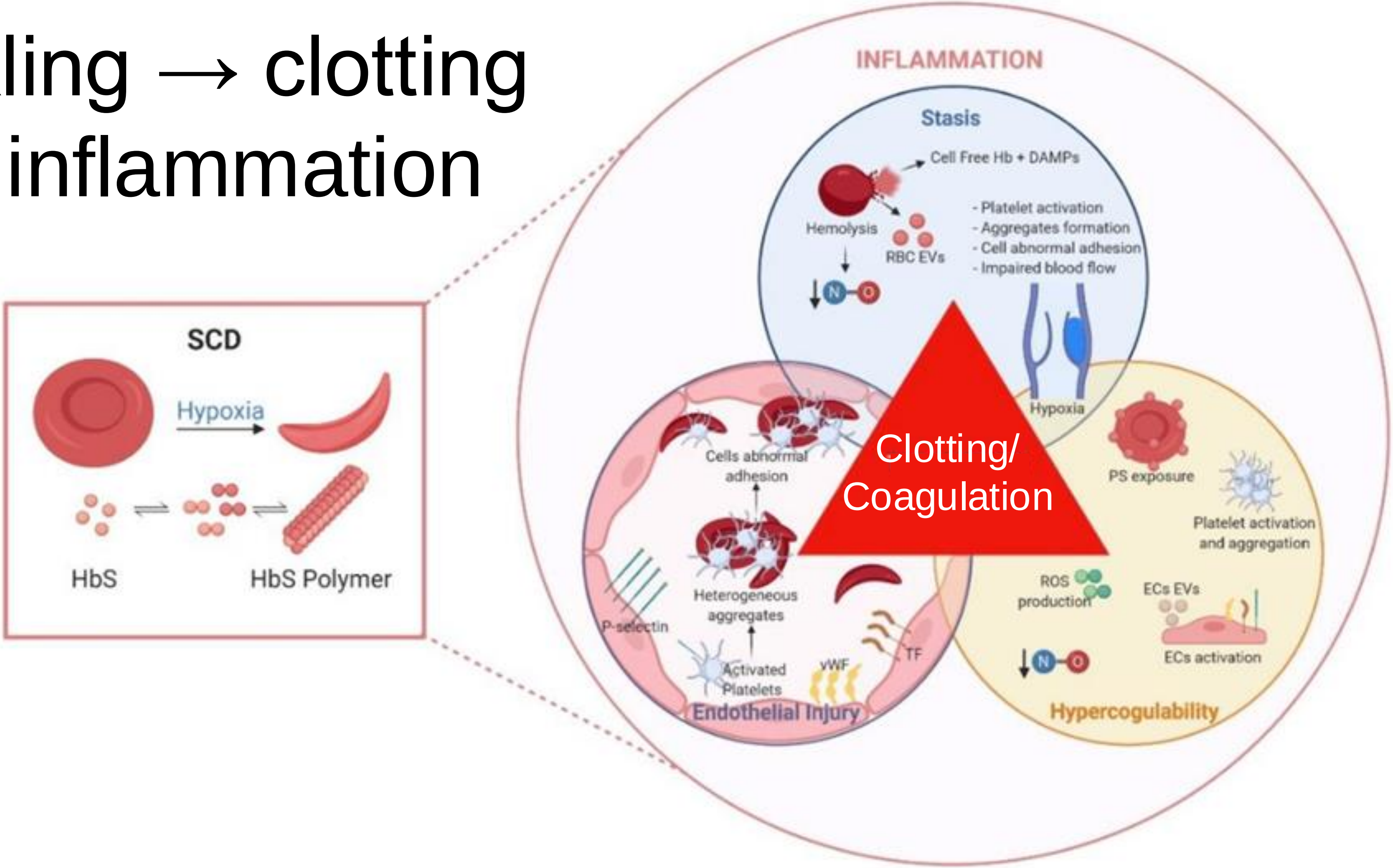


Normal

Mutant (sickled)

- Because of exterior-facing valines, the mutated hemoglobin molecules form hydrophobic bonds with one another.
- This creates fibers, causing cells to sickle.
- It’s like a 5th level structure (a polymer of polymers)

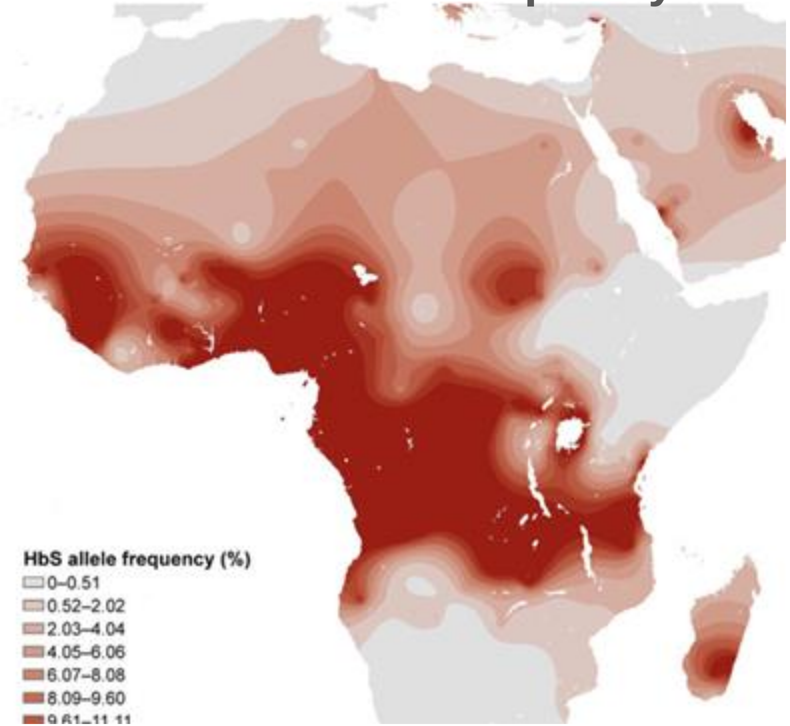
Sickling → clotting and inflammation



If sickle cell disease is so bad, why is the sickle cell allele so common?

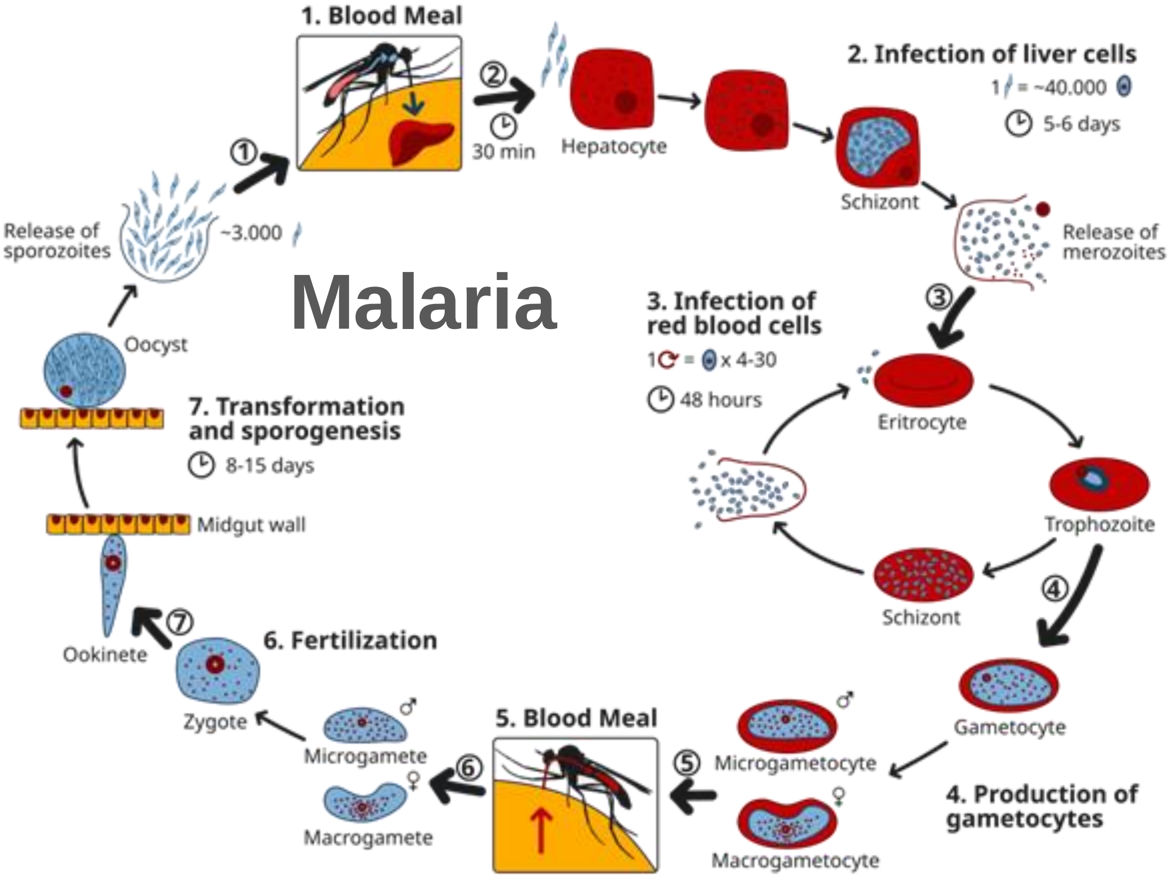
- *Allele*: gene variant
  - HbA: normal hemoglobin
  - HbS: sickle-cell hemoglobin
- In Nigeria (country with the highest level of sickle cell disease)
  - 2% of babies are born with the disease
  - Between 20% and 30% of the population are heterozygotes (Ss).
  - The frequency of the HbS allele is between 10% and 15%

HbS Allele Frequency



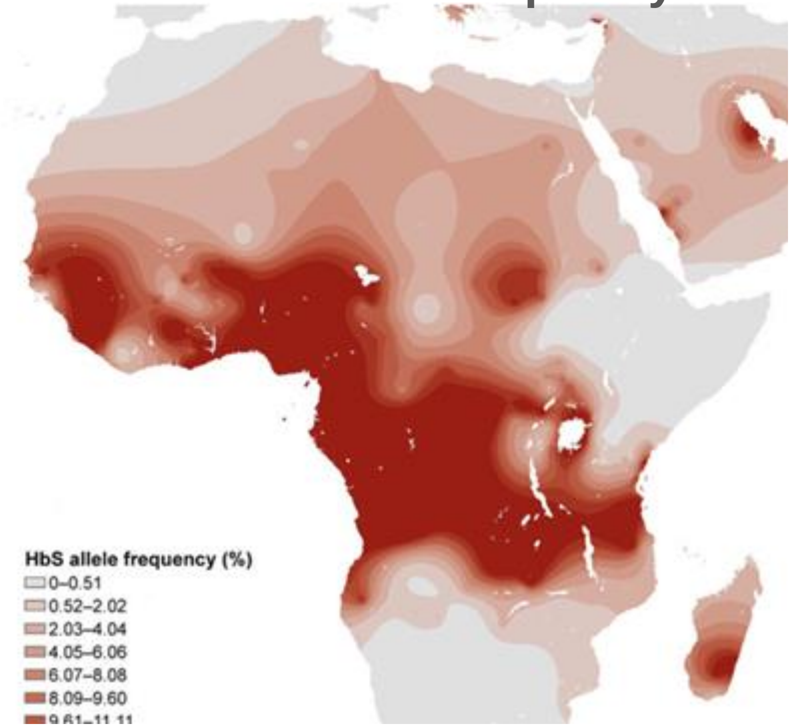
ANSWER: The sickle cell allele disrupts the life cycle of the parasite that causes malaria.

- Malaria: caused by a eukaryotic protist that infects red blood cells
- The parasite is spread by mosquitoes
- RBC rupture causes debilitating fever
- Affected 249 million people and caused over 600,000 deaths in 2022

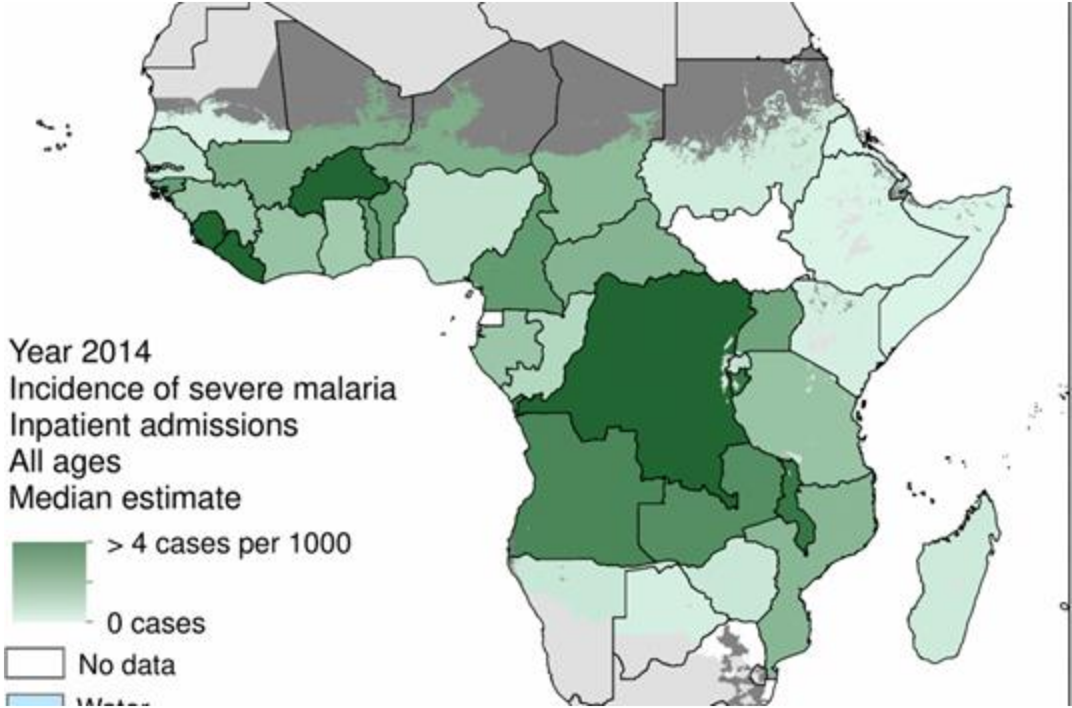


The sickle cell allele is common because of natural selection

HbS Allele Frequency

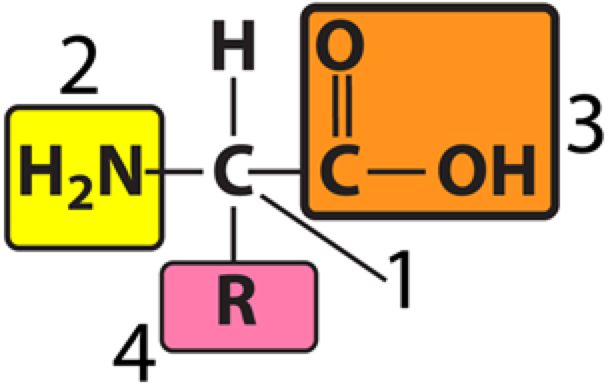


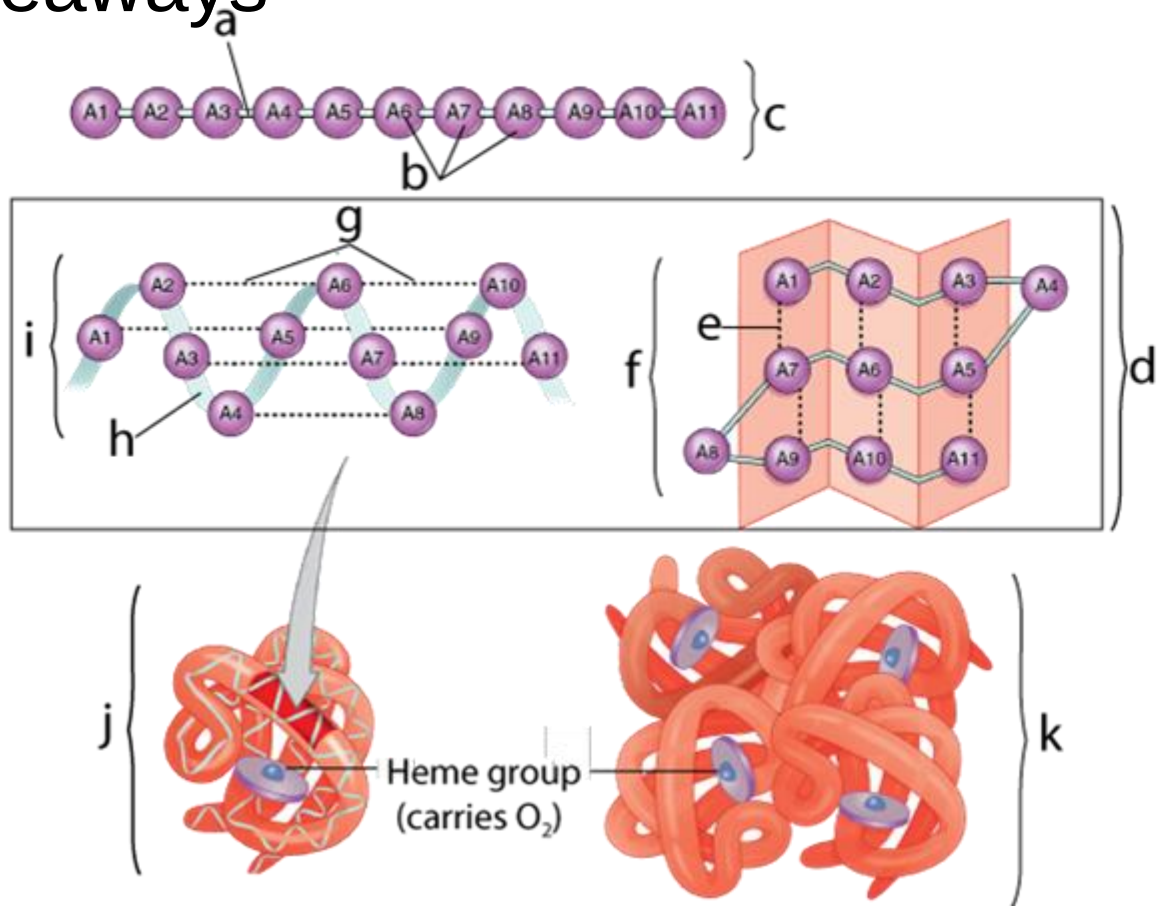
Malaria Incidence



Proteins: Key Takeaways

- Amino acid structure
- Four levels of protein structure





QUESTIONS (and comments)

?s

To help you study study for your semester final and the AP Bio exam…

Download this checklist at

apbiosuccess.com/checklist

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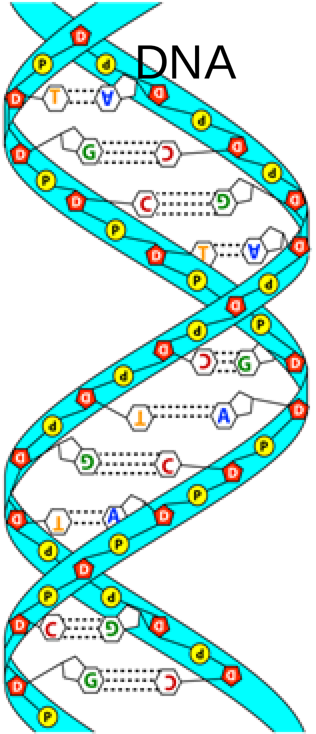
The AP Biology Study Platform That Guarantees Success

Topics 2.4 – 2.9: Membrane Structure and Function; Osmosis

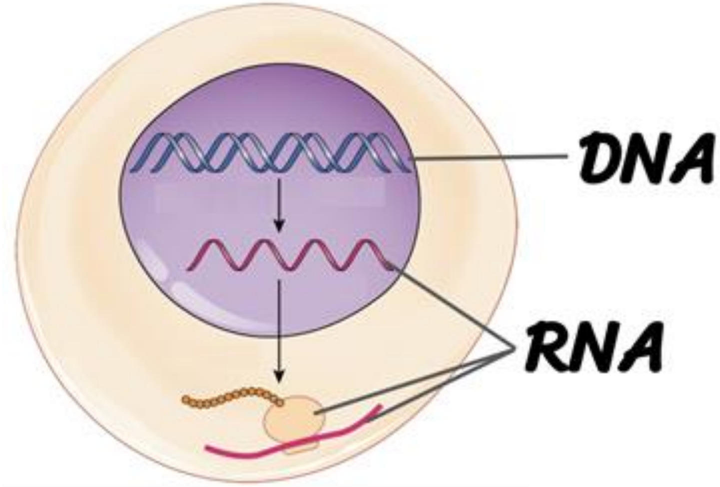
- ☐ Describe the fluid mosaic model of the cell membrane. Include
  - ☐ The overall function of the membrane
  - ☐ The role of phospholipids
  - ☐ The role of embedded proteins (how they fit into the bilayer, and their var
  - ☐ The functions of cholesterol, glycolipids, and glycoproteins.
- ☐ Define selective permeability.
- ☐ Explain how selective permeability arises from the fluid mosaic structure of the memb
  - ☐ How small, nonpolar molecules like N_2, CO_2, and O_2 can pass across the
  - ☐ How ions and large polar molecules move across the membrane
  - ☐ How small polar molecules (like water) pass through the membrane
- ☐ Compare and contrast passive transport, active transport, and facilitated diffusion. Co process to membrane structure.
- ☐ Compare and contrast endocytosis and exocytosis.
- ☐ Explain membrane potential
- ☐ Connect membrane potential to processes such as ATP synthesis.
- ☐ Define the term osmosis, and be able to predict and explain the flow of water into or hypotonic, hypertonic, and isotonic environments.
- ☐ Explain the movement of water into or out of cells (and entire organisms) in relation

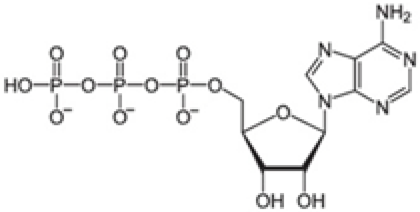
NUCLEIC ACIDS

The biological importance of nucleic acids



DNA

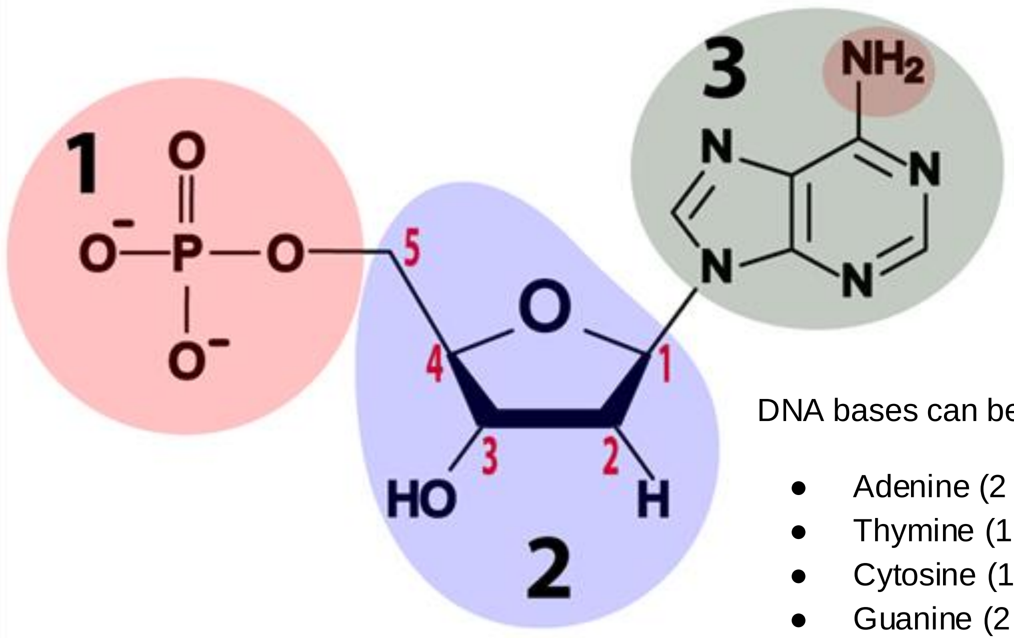




ATP

- DNA: molecule of heredity.
- RNA
  - Hereditary molecule in some viruses
  - Key role is information transfer, as in messenger RNA
  - Can also act as an enzyme, catalyzing reactions: this is seen in ribosomes and spliceosomes
  - Can regulate gene expression: microRNAs.
- ATP (an RNA monomer): Life's key energy transfer molecule, powering most cellular work.

Name the monomer of nucleic acids, and describe its structure.



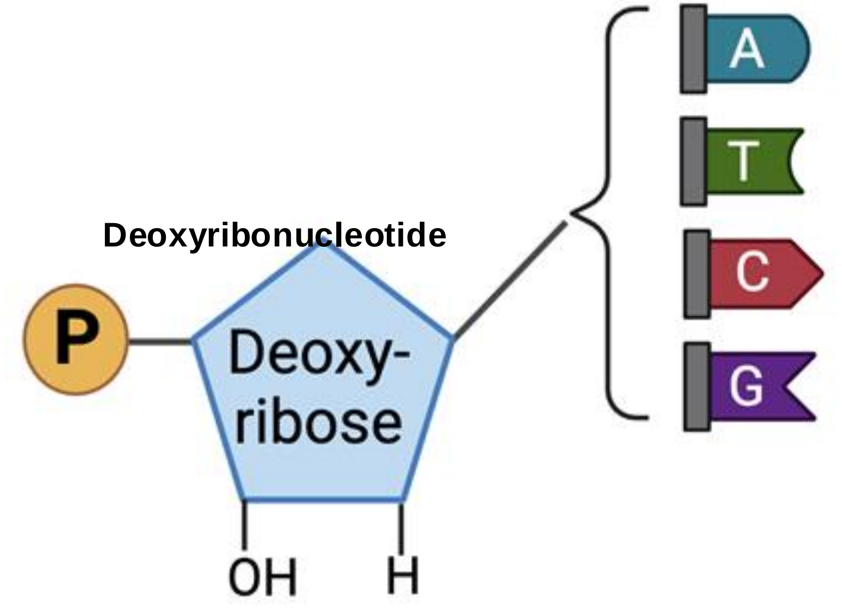
DNA bases can be

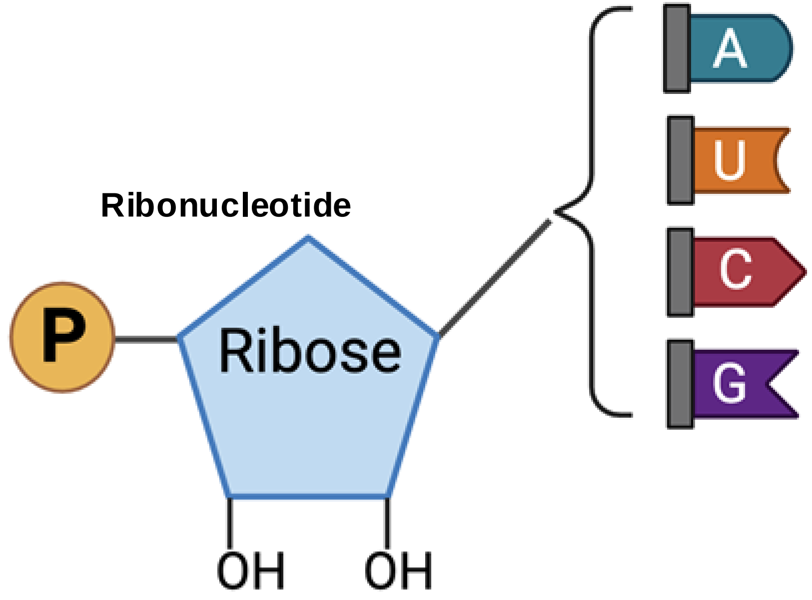
- Adenine (2 rings)
- Thymine (1 ring)
- Cytosine (1 ring)
- Guanine (2 rings)

DNA nucleotide

- Monomers:**nucleotides**
- 5-carbon sugar (at 2)
- A phosphate group (at 1)
- One of four nitrogenous bases (at 3).
- Phosphate group: connects to the 5' carbon in the sugar
- Nitrogenous base is connected to the 1' carbon.

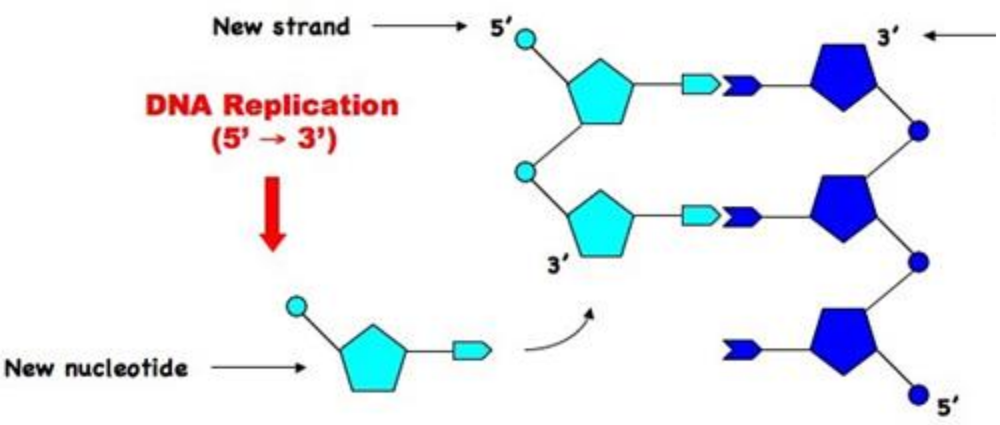
Different monomers in DNA and RNA

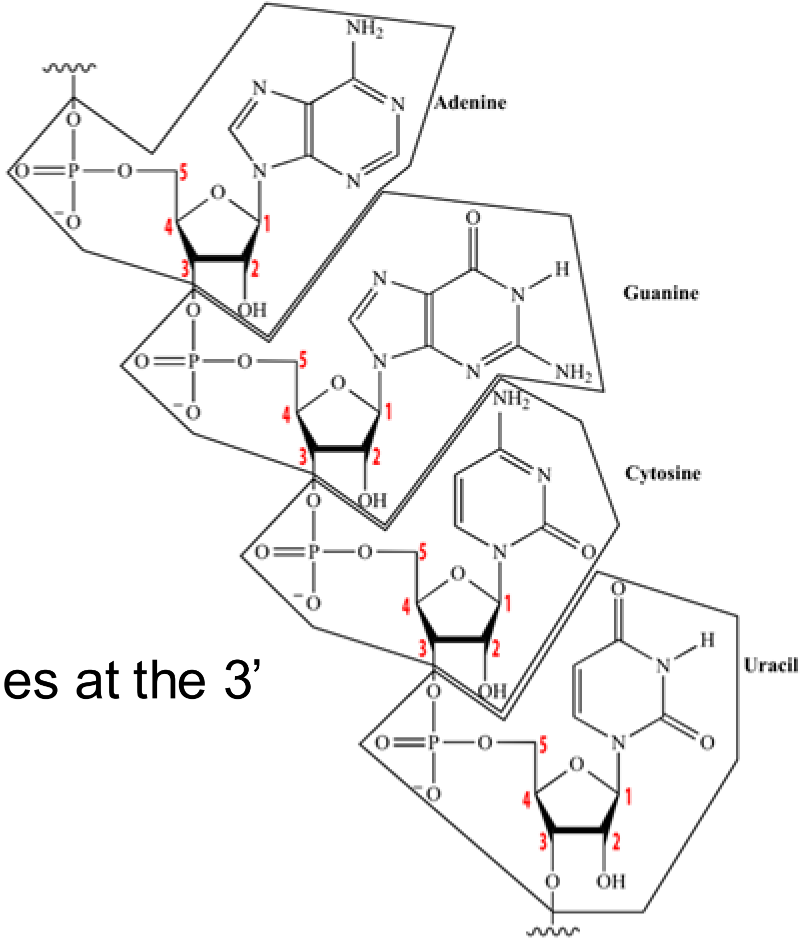




- DNA: the sugar is **deoxyribose**. The bases are **A, T, C, and G** (adenine, thymine, cytosine, and guanine).
- RNA: the sugar is **ribose**. The bases are **A, U, C, and G** (adenine, uracil, cytosine, and guanine).

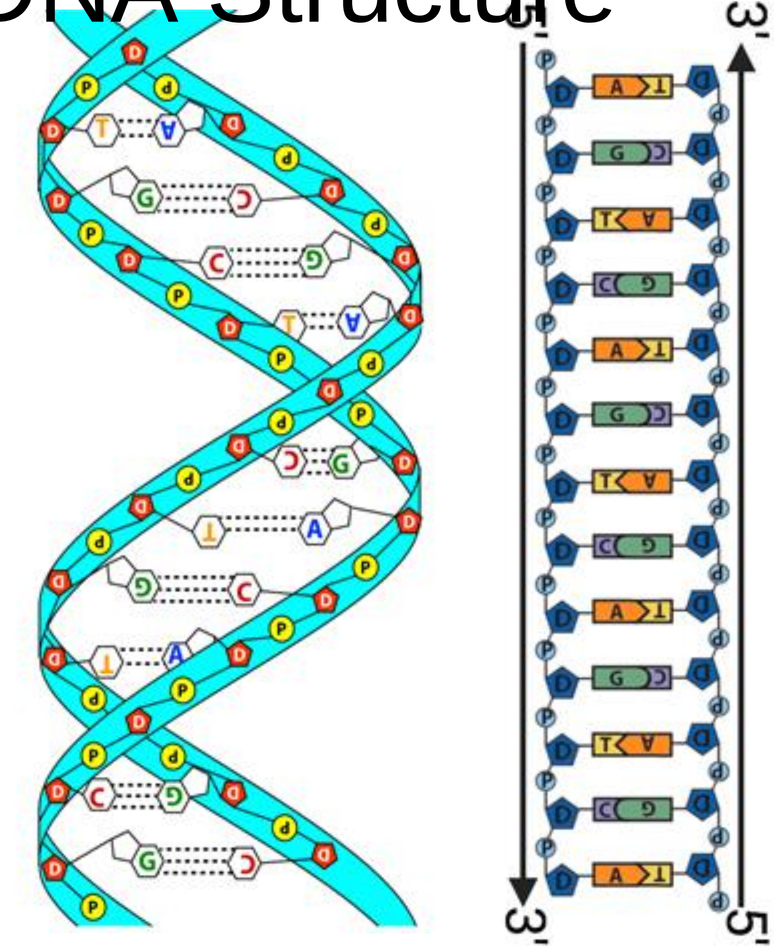
Nucleotides: From Monomers to Polymers





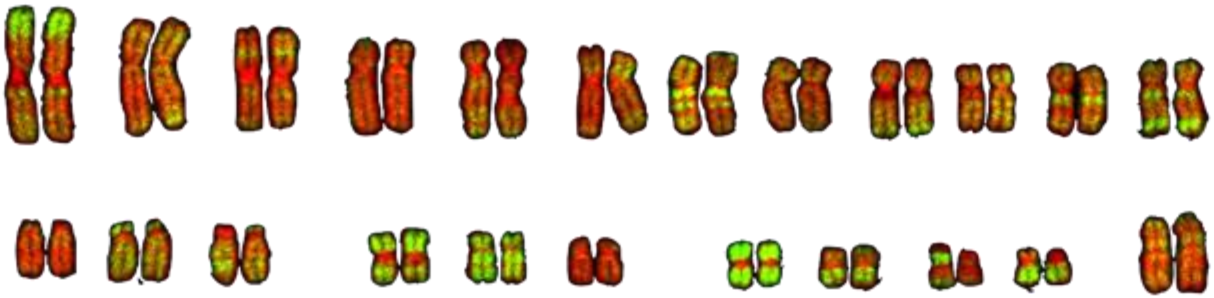
- Polymerase enzymes add new nucleotides at the 3' end of the growing strands
- Polymerases **always build 5' to 3'**
- Creates a **sugar-phosphate backbone**

DNA Structure

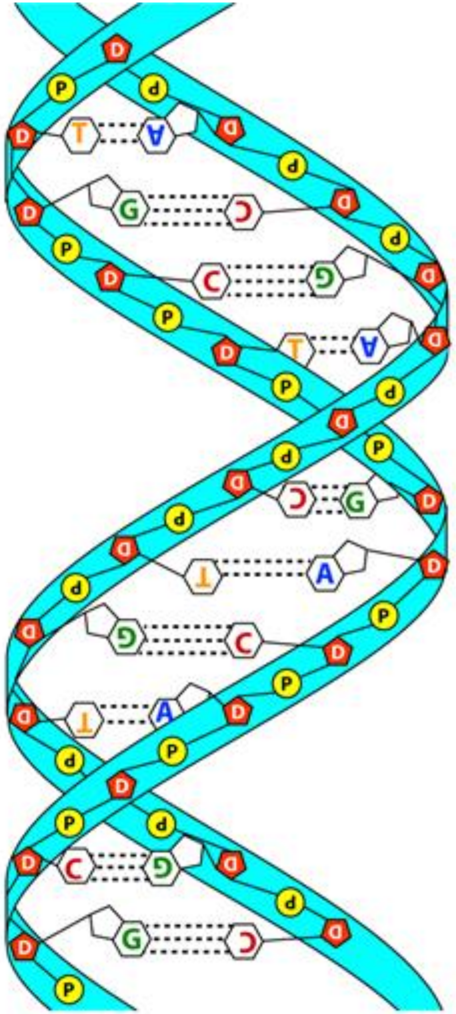


- Two nucleotide strands.
- *Within each strand*, the nucleotides connect to one another by **sugar-phosphate** bonds.
- The strands connect by **hydrogen bonds** between nitrogenous bases with complementary shapes:
  - A:T
  - C: G
- The two strands are *antiparallel*: Note the opposing 5’ to 3’ orientation in each strand.

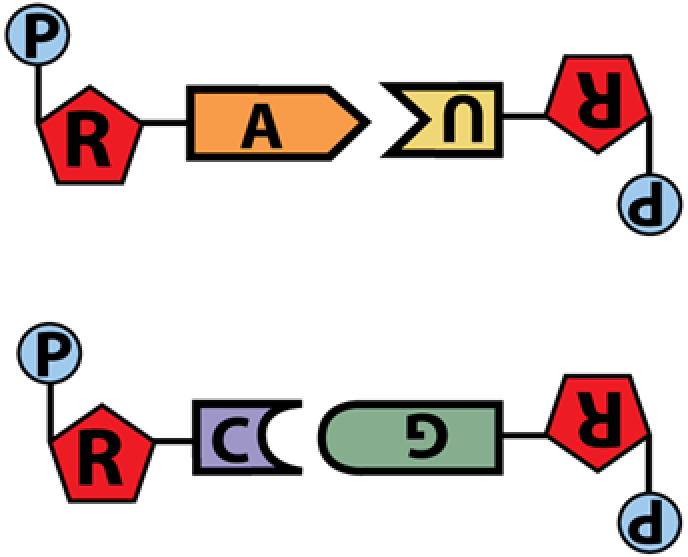
Hydrogen Bonds → Stability → Information Storage

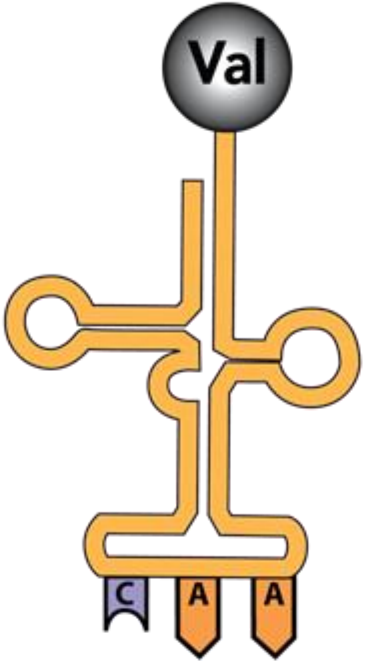


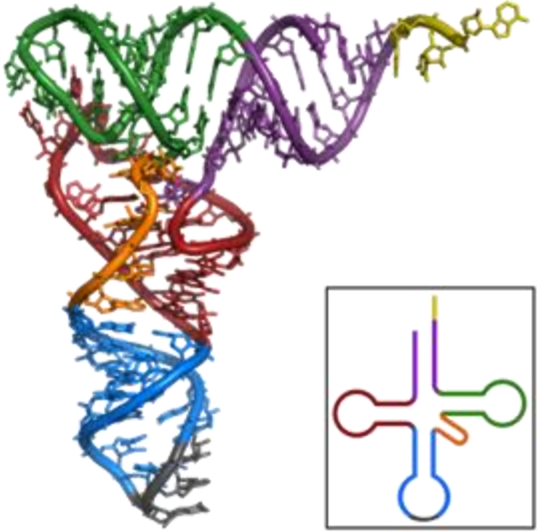
Each chromosome is a molecule of DNA
(with up to 250 *million* bases)



RNA Base Pairing → internal hydrogen bonding → specific shapes and functions

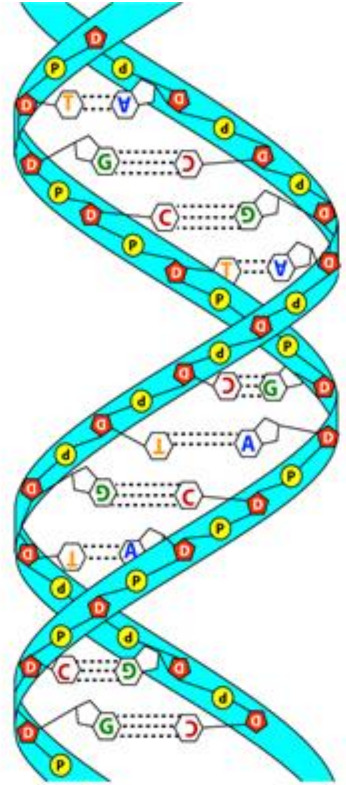


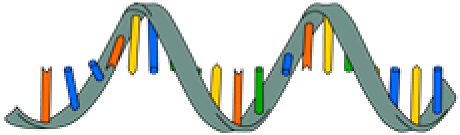


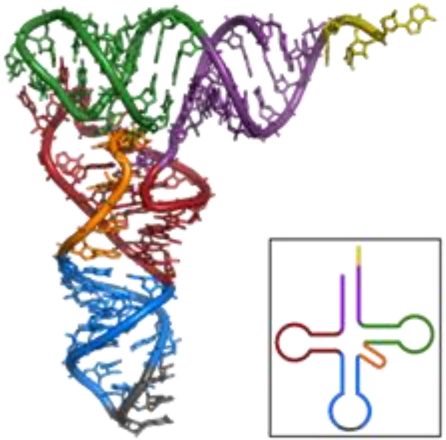


Nucleic Acids: Key takeaways

1. Include DNA and RNA
2. Monomers are nucleotides
3. DNA structure
    a. Sugar phosphate backbone
    b. Hydrogen bonds
4. RNA structure







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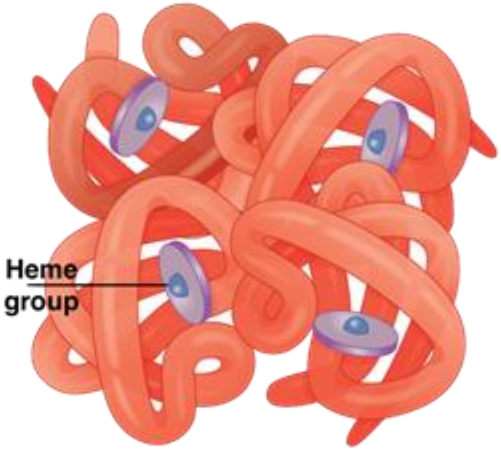
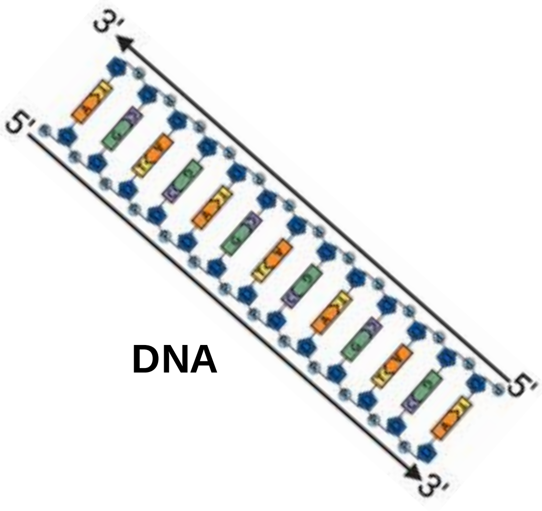


Hemoglobin



DNA

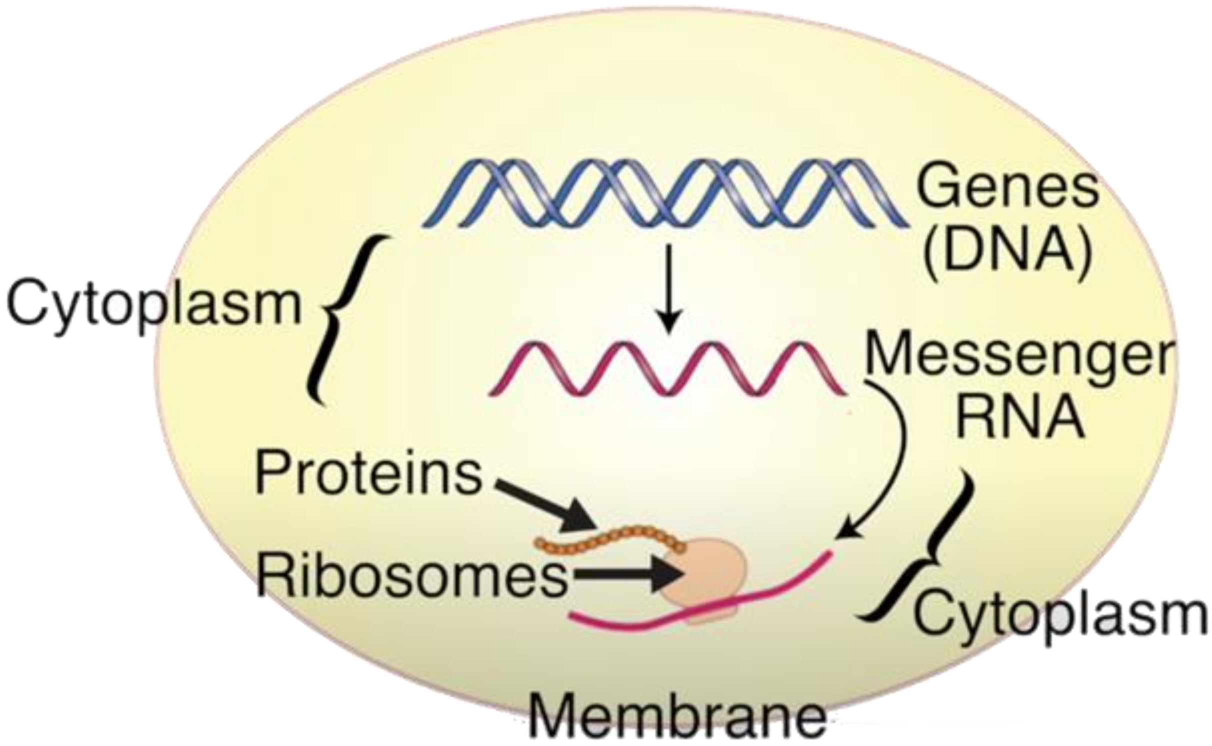
Complete the tutorials about Proteins and Nucleic Acids on Learn-Biology.com

QUESTIONS (and comments)

?s

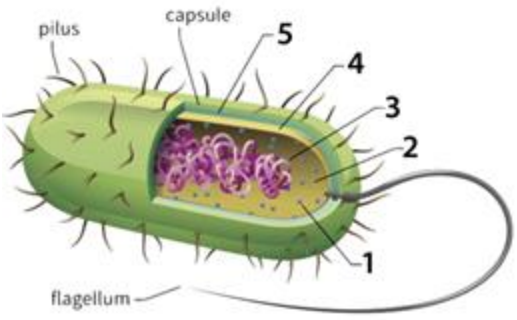
Cells: An Introduction

Describe the basic structure and fundamental parts of cells.

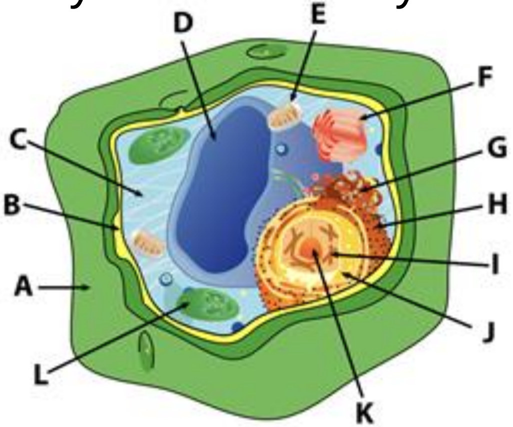


- Basic unit of life, of S & F
- Structure
  - Membrane
  - Genetic information (DNA)
  - Systems for maintenance and replication
    - mRNA + ribosomes make proteins
    - Enzymes (and other structures) in cytoplasm

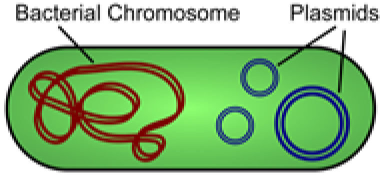
Compare/contrast prokaryotic and eukaryotic cells

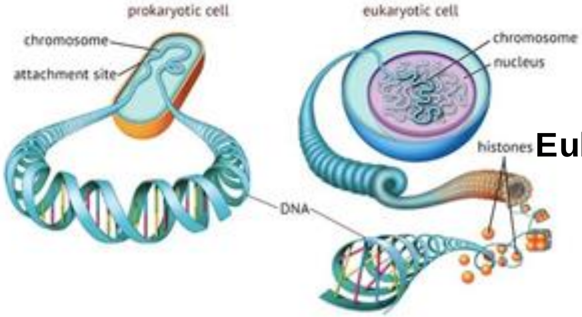


Prokaryotic cell



Eukaryotic cell (plant cell)



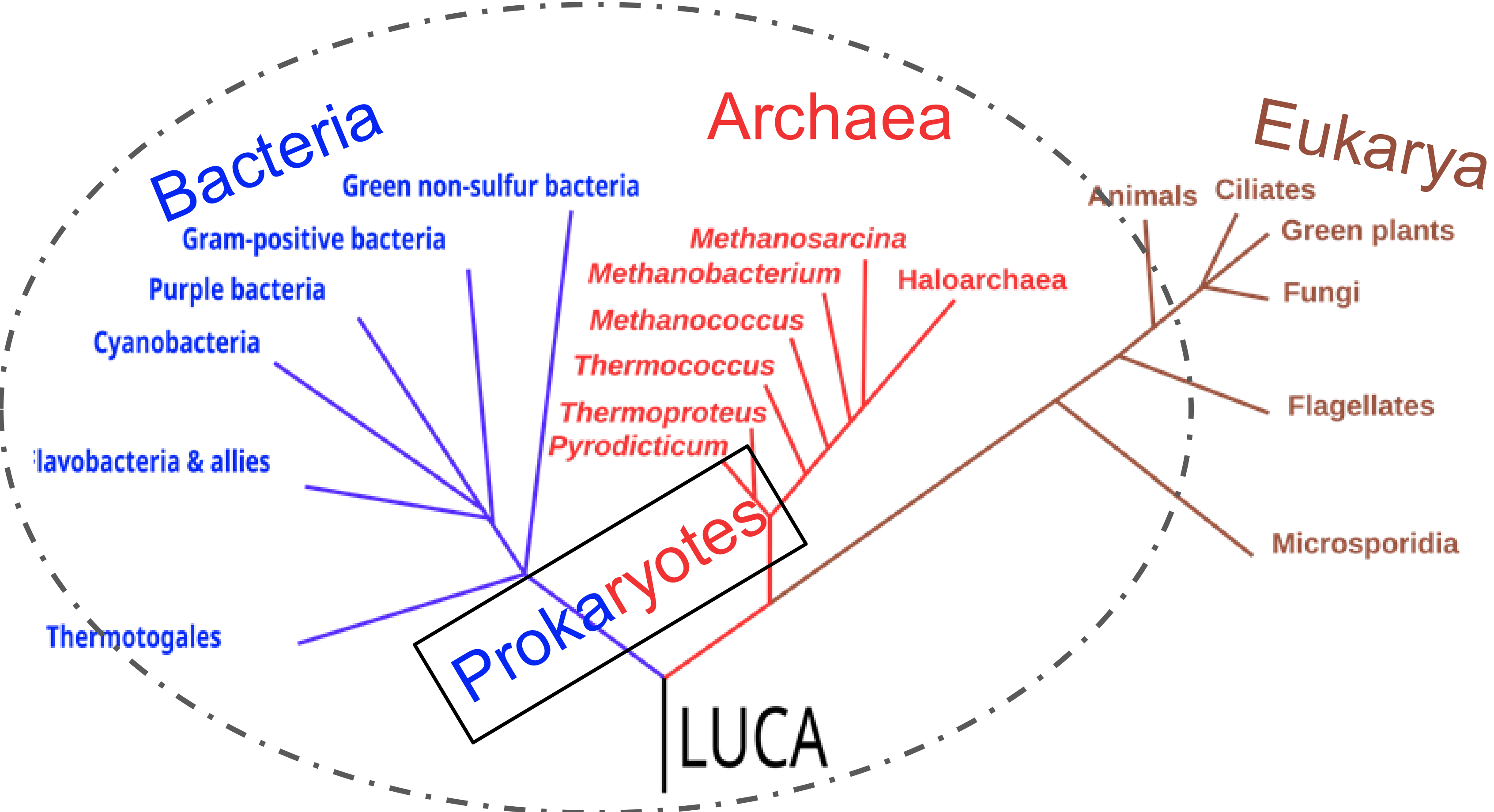


Prokaryotic DNA

Eukaryotic DNA

- Prokaryotic cells
  - Small, relatively simple
  - No nucleus
  - Chromosome is circularized (3)
  - Contain plasmids
  - Found in Archaea and Bacteria
- Eukaryotic cells
  - Larger, more complex
  - Nucleus
  - Multiple, linear chromosomes
  - DNA is associated with proteins
  - Mitochondria
  - Many membrane-bound organelles

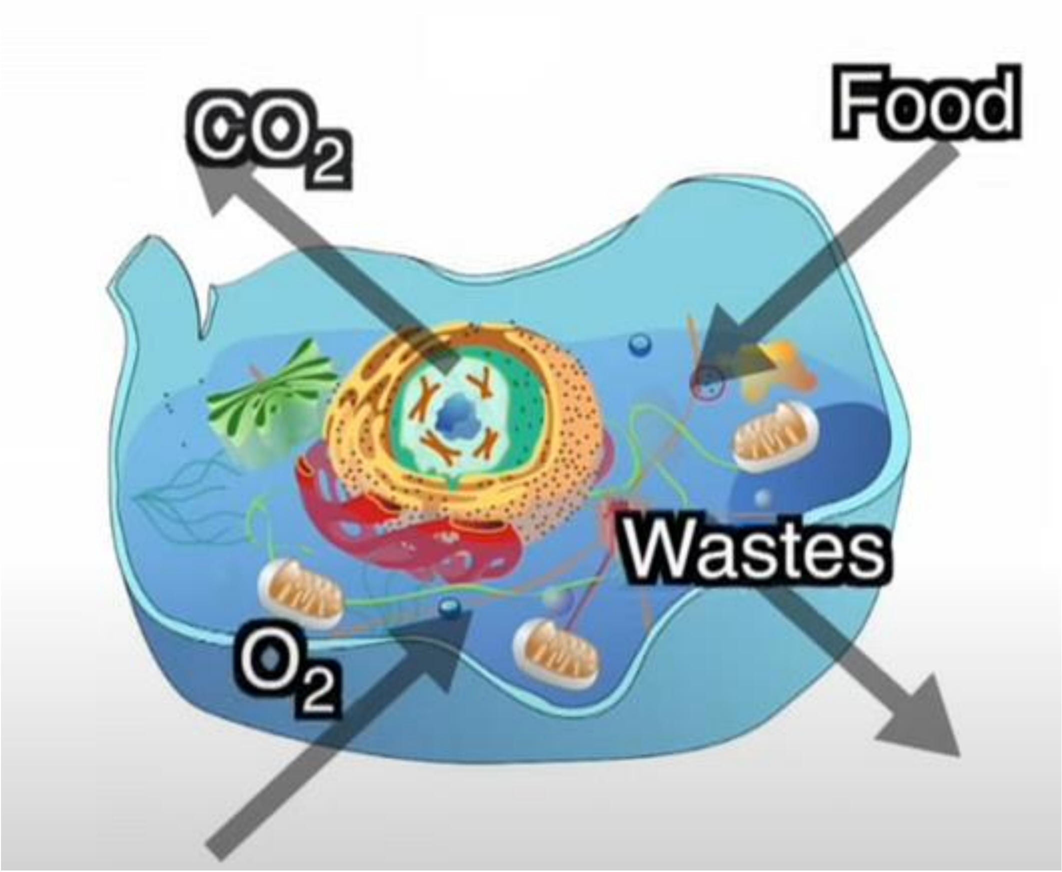
Expert tip: *Prokaryote* is bad evolutionary category.



TOPIC 2.3

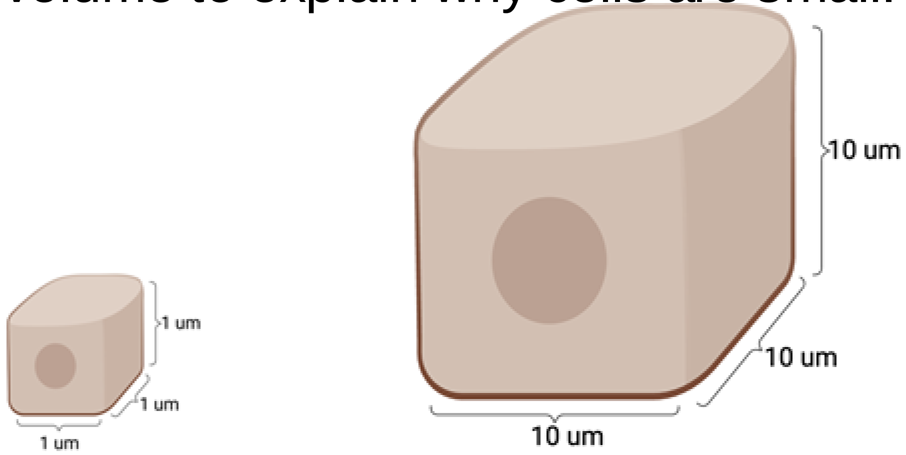
Cell Size

The small size of cells (0.1μm to 100 μm) comes down to diffusion.



- Cells need to have enough membrane surface area to allow for diffusion of substances in and out.

Use the relationship between surface area and volume to explain why cells are small.

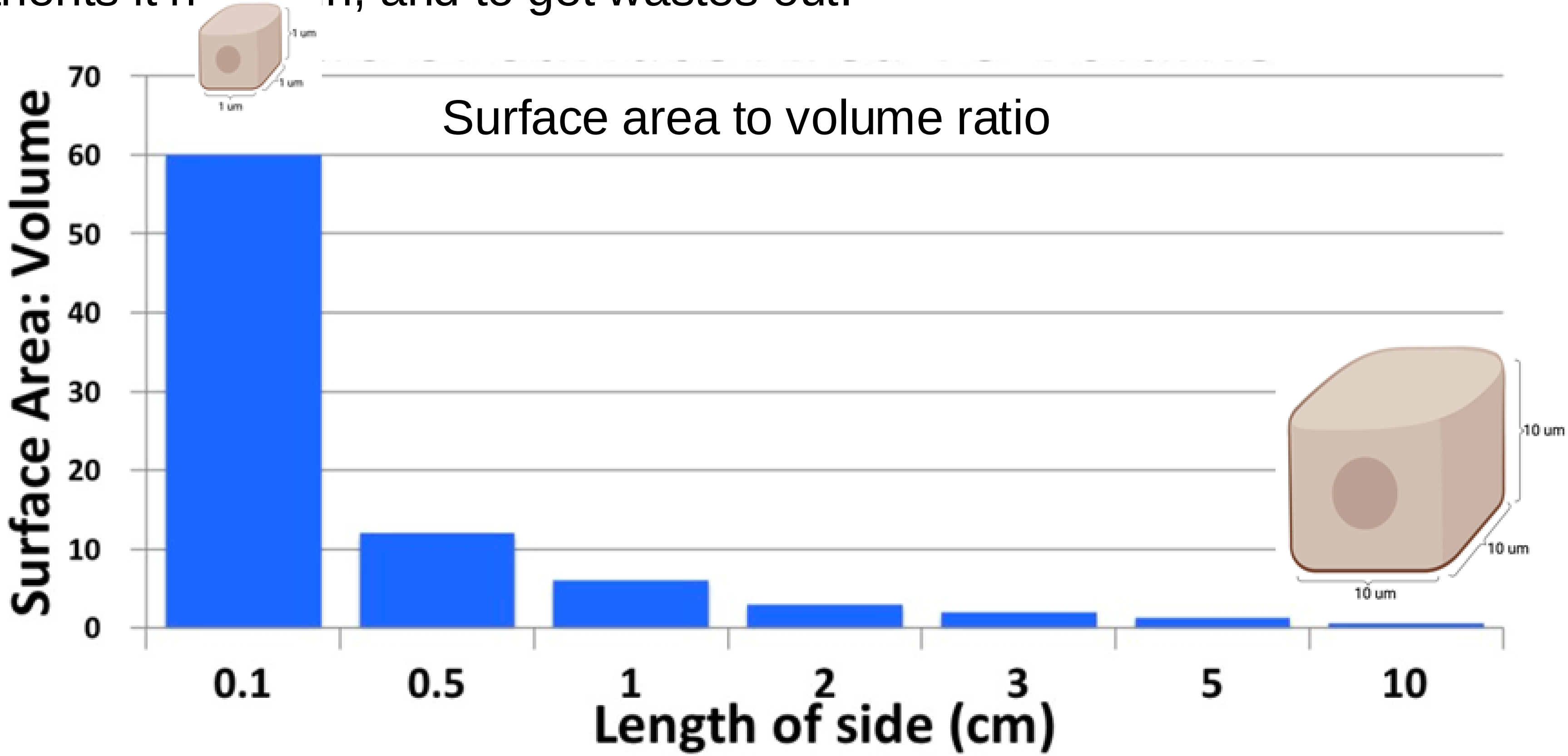


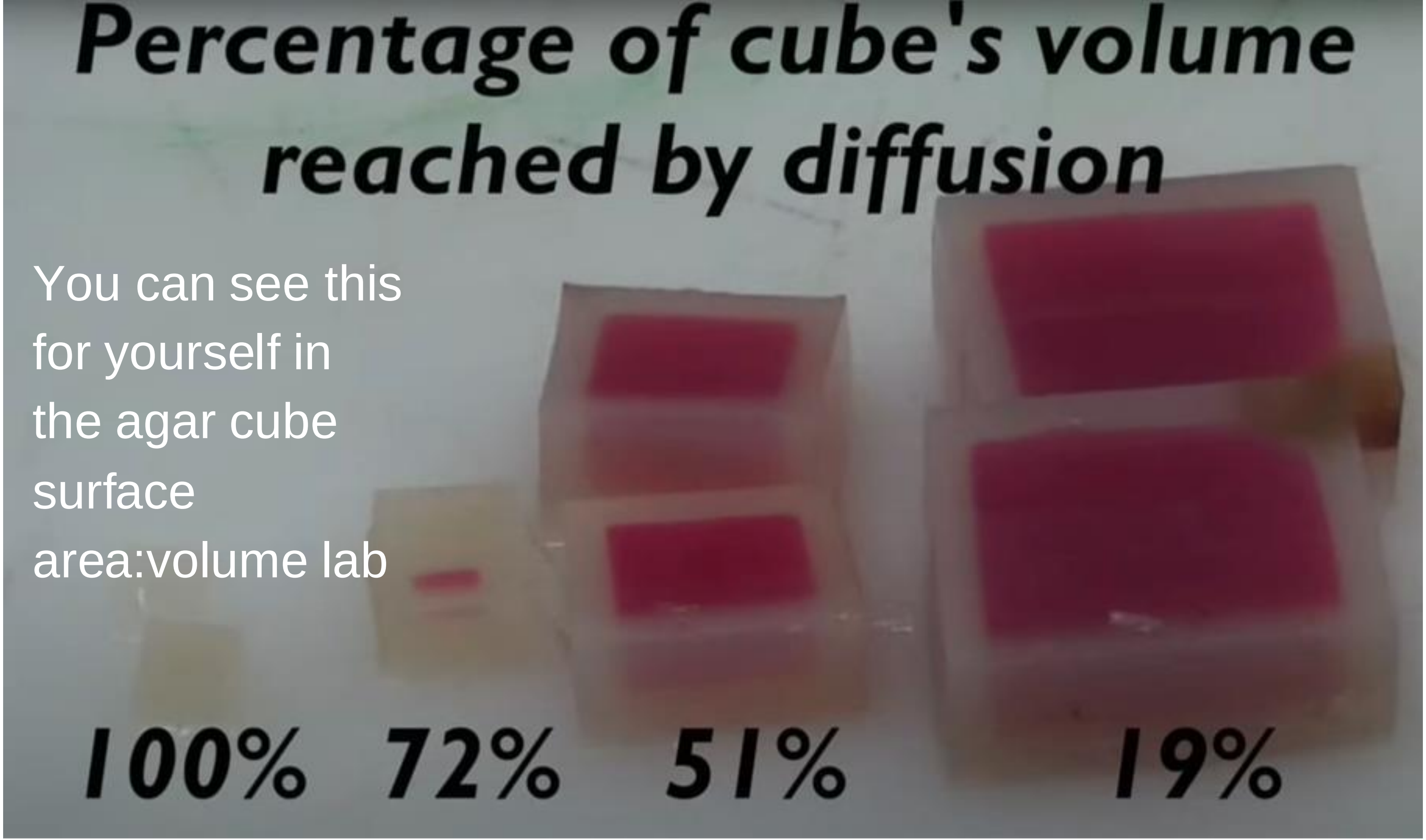
An example for two cuboidal cells.

Length	Surface area (units^2)	Volume (units^3)	surface area: volume
1	6	1	6:1
10	600	1000	0.6:1

- As an object gets larger, its amount of surface area relative to its volume *decreases*.
- Example:The larger cell's surface area to volume ratio is 1/10th that of the smaller cell.

CONSEQUENCE: A large cell can’t efficiently use diffusion to get the nutrients it needs in, and to get wastes out.

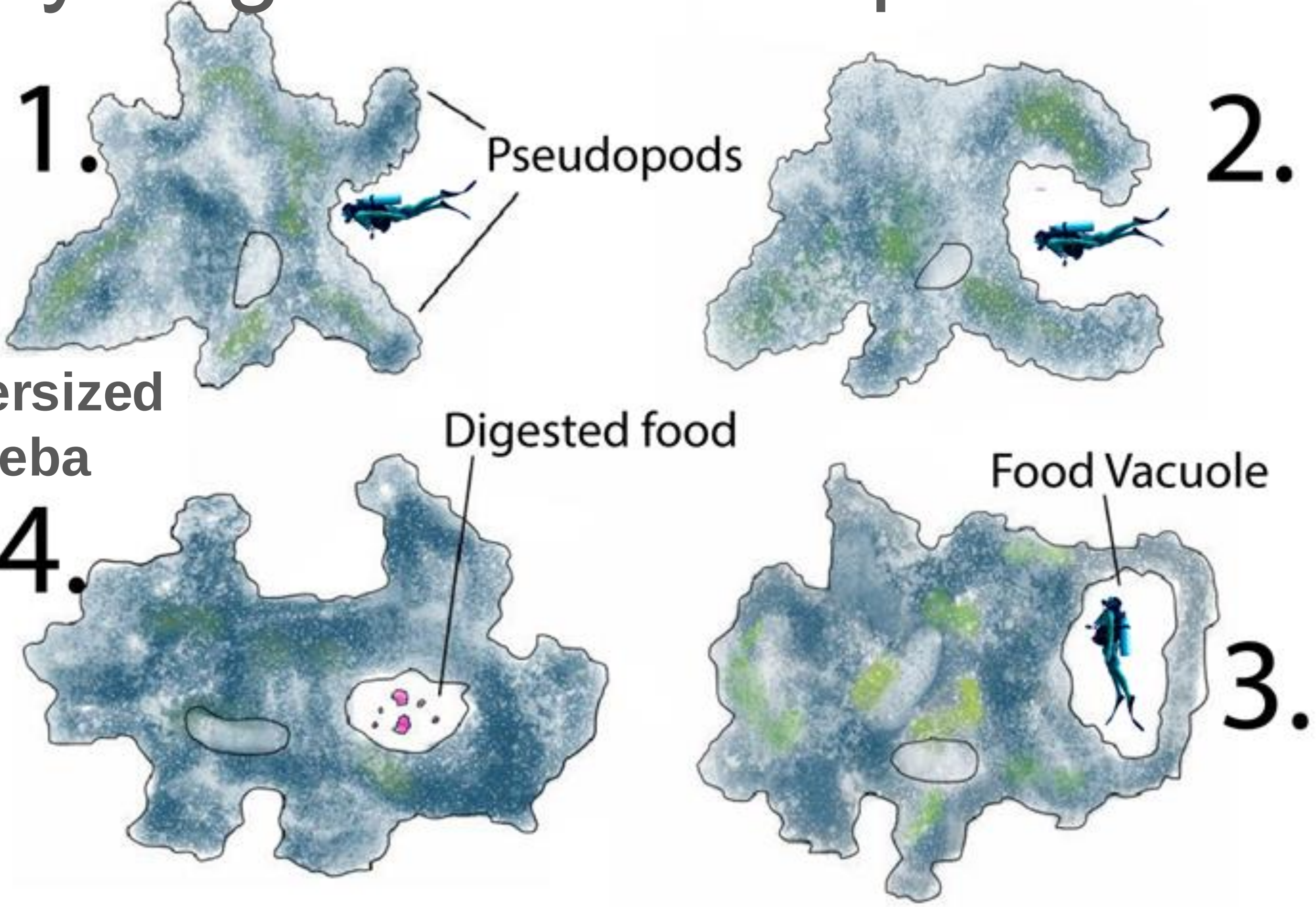



Percentage of cube's volume reached by diffusion
You can see this for yourself in the agar cube surface area:volume lab
100%
72%
51%
19%

That's why huge cells are impossible

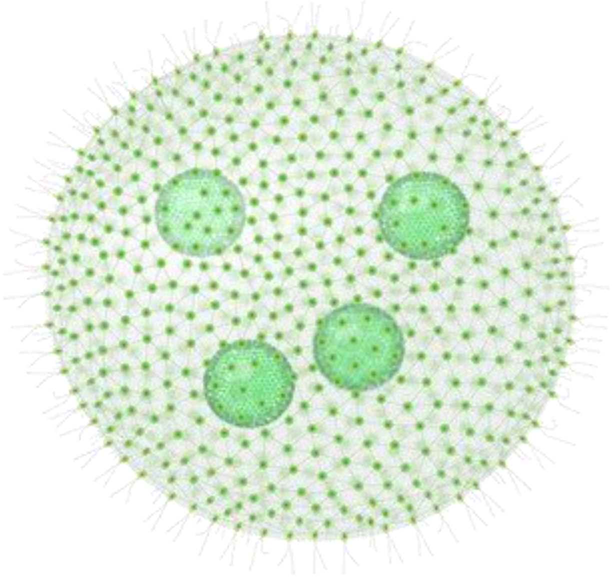
- Their insides would starve
- They'd choke on their wastes

Supersized Amoeba

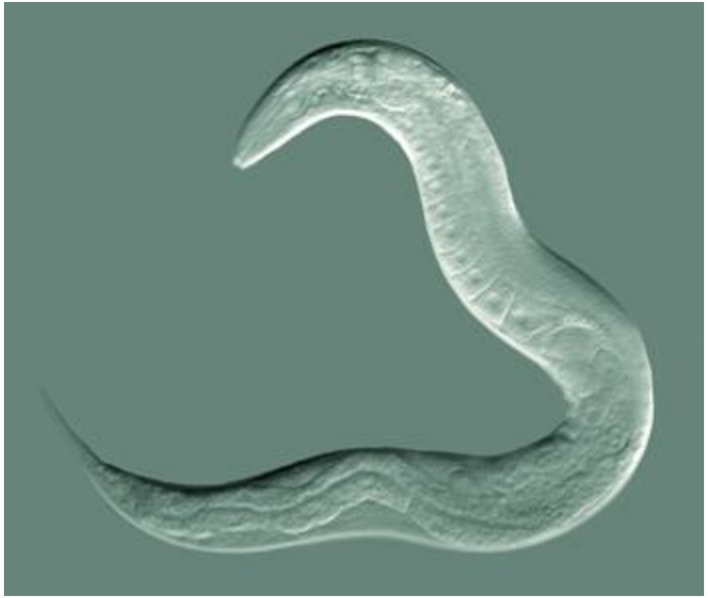


How life became large

1. Multicellularity
2. Adaptations that increased internal surface area to allow for diffusion of materials into and out of cells.

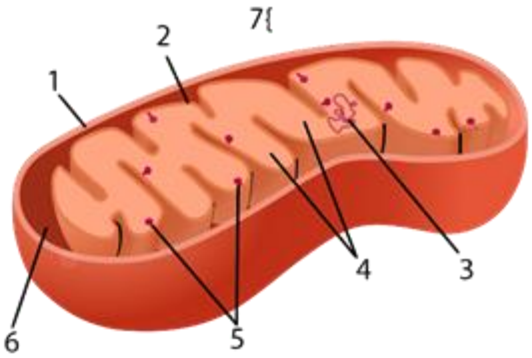


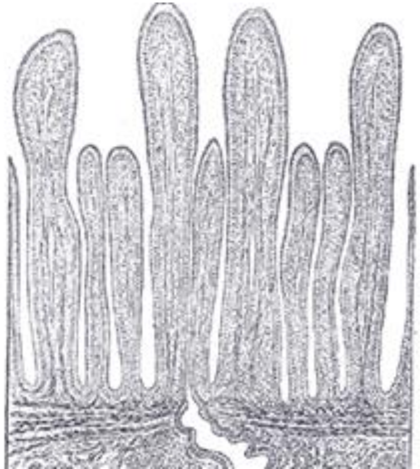
Volvox (an alga), 0.5 mm diameter



C. elegans nematode worm, 1mm x 5 um

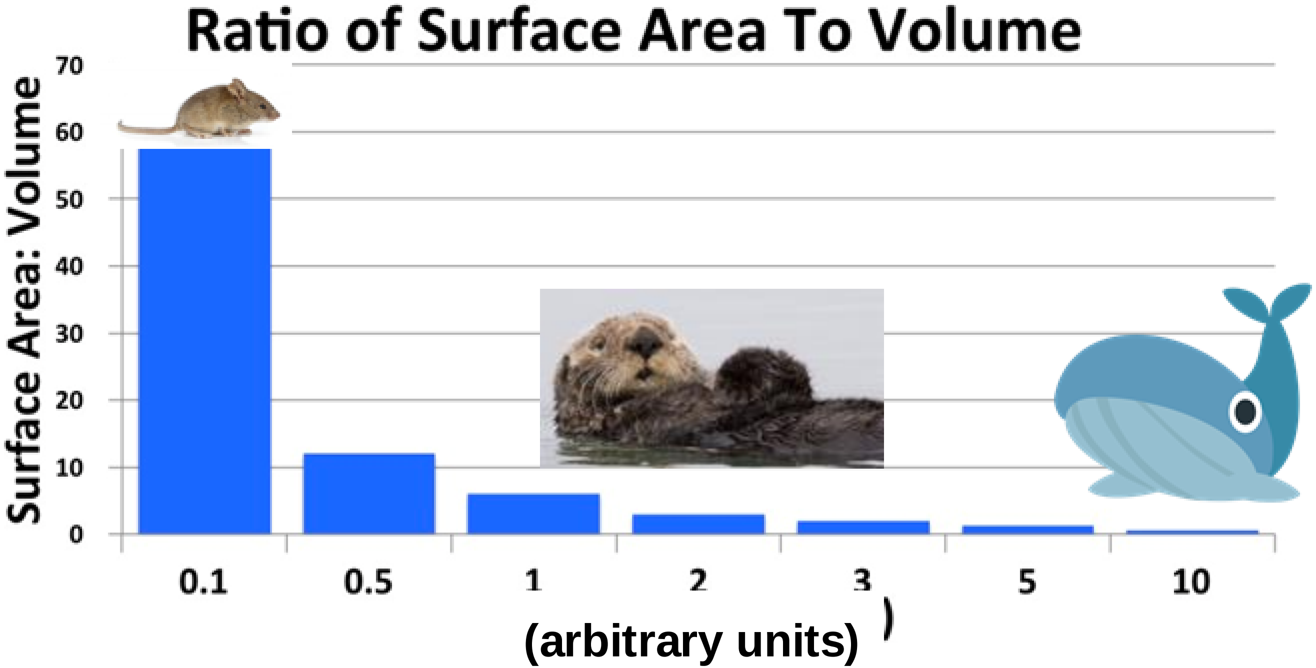
Adaptations for increasing surface area in organisms or parts of organisms





- Increases surface for diffusion of molecules or heat
- Increases working surface for membrane embedded enzymes
- HOW
  - Thin sheets of tissue (gills, elephant ears)
  - Highly folded surfaces

EXAMPLE: Explain, in terms of surface area, why there are no small (mouse-sized) marine mammals (and why some are really huge!)?



- Mammals are warm-blooded
- Ocean water is cold→hypothermia
- Increased size decreases surface area:volume ratio
- Less heat lost to environment

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Topics 2.4 – 2.9: Membrane Structure and Function; Osmosis

- ☐ Describe the fluid mosaic model of the cell membrane. Include
  - ☐ The overall function of the membrane
  - ☐ The role of phospholipids
  - ☐ The role of embedded proteins (how they fit into the bilayer, and their var
  - ☐ The functions of cholesterol, glycolipids, and glycoproteins.
- ☐ Define selective permeability.
- ☐ Explain how selective permeability arises from the fluid mosaic structure of the memb
  - ☐ How small, nonpolar molecules like N_2, CO_2, and O_2 can pass across the
  - ☐ How ions and large polar molecules move across the membrane
  - ☐ How small polar molecules (like water) pass through the membrane
- ☐ Compare and contrast passive transport, active transport, and facilitated diffusion. Co process to membrane structure.
- ☐ Compare and contrast endocytosis and exocytosis.
- ☐ Explain membrane potential
- ☐ Connect membrane potential to processes such as ATP synthesis.
- ☐ Define the term osmosis, and be able to predict and explain the flow of water into or hypotonic, hypertonic, and isotonic environments.
- ☐ Explain the movement of water into or out of cells (and entire organisms) in relation

QUESTIONS (and comments)

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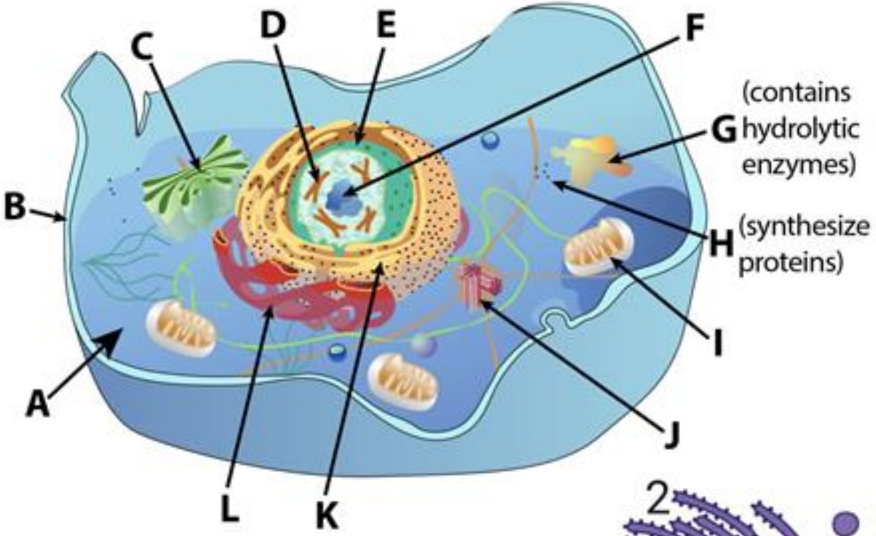
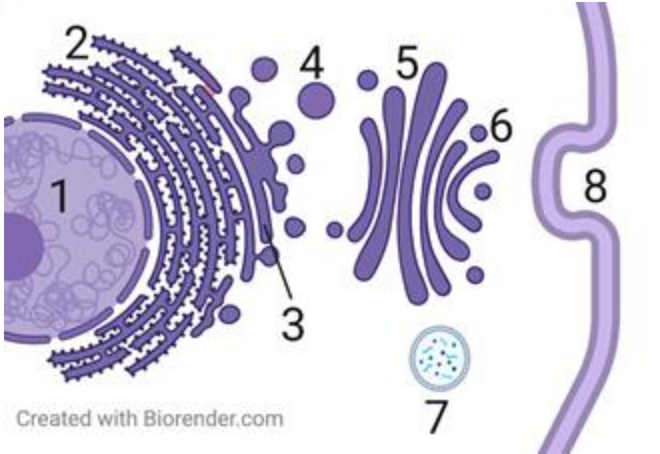
TOPICS 2.10-2.11

Cellular Compartmentalization and the Endomembrane System

How eukaryotic cells are organized

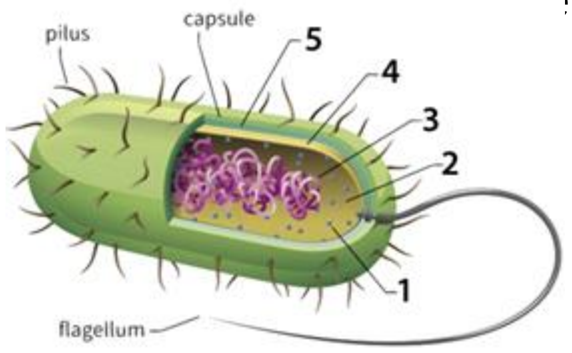
What is cell compartmentalization? What are its advantages?



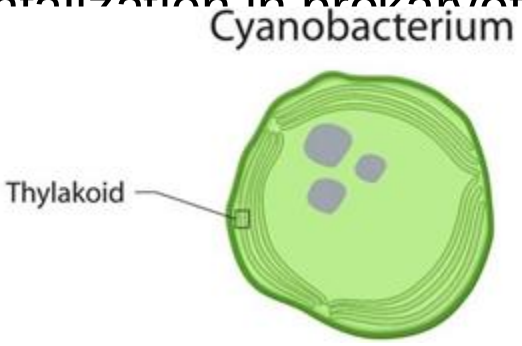


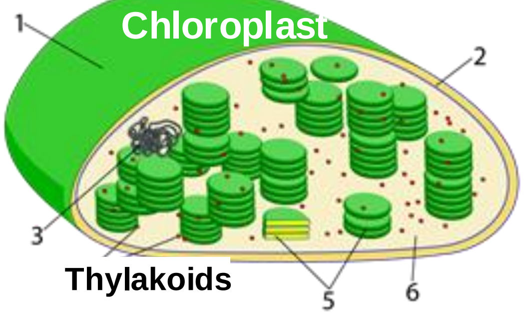
- COMPARTMENTALIZATION: Internal division into sections
- ADVANTAGES
  - Allows cell to have regions with internal chemistry distinct from cytoplasm (e.g., lysosomes)
  - Increases surface area for
    - membrane-bound enzymes (e.g., smooth ER, Golgi)
    - Ribosomes in the rough ER

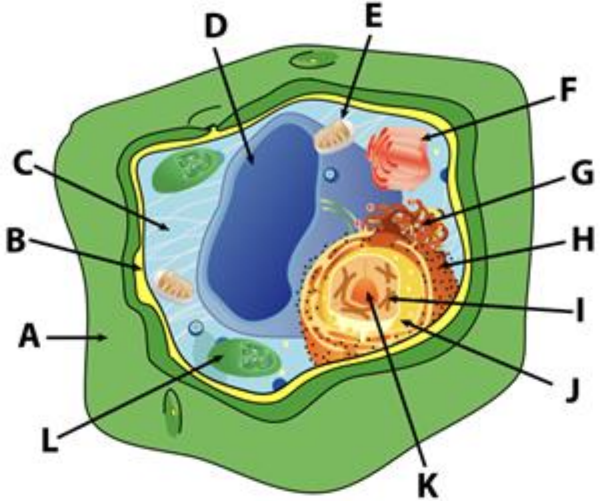
Compare compartmentalization in prokaryotic and eukaryotic cells.



Bacterial cell



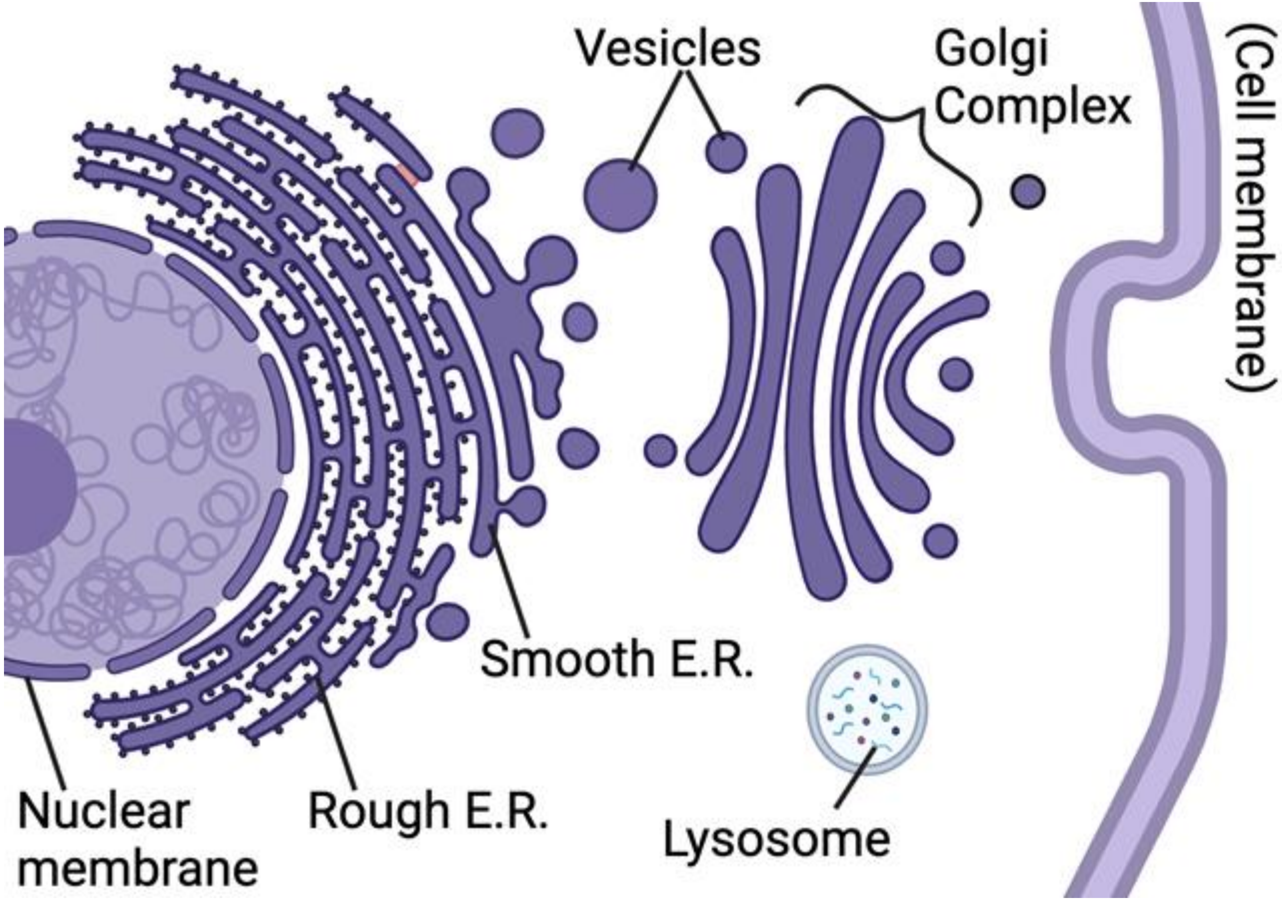




Eukaryotic cell
(plant cell)

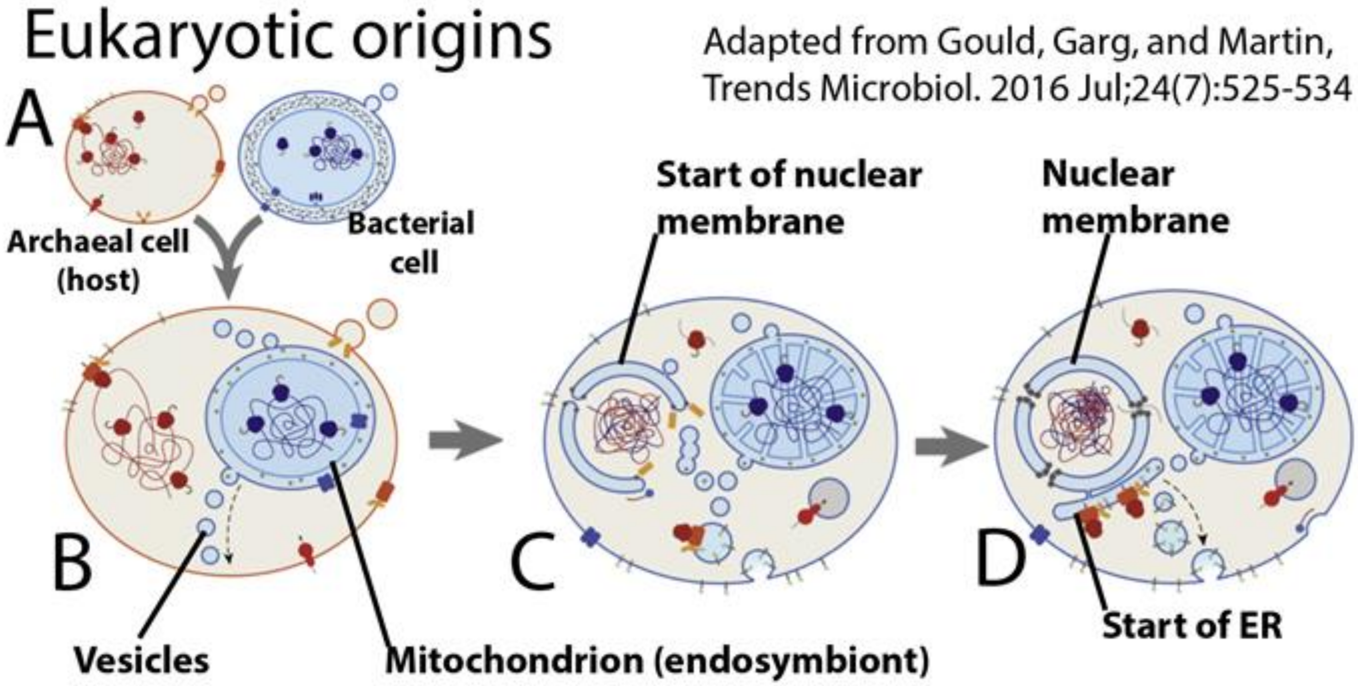
- Prokaryotic cells: few compartments (though there are internal regions with specialized structures and functions (thylakoids).
- Eukaryotic cells: highly compartmentalized,
  - Many internal membranes that divide the cell into regions with distinct structures, chemistry, and functions.
  - Examples: lysosomes, the E.R., the Golgi complex, and vacuoles.

Many eukaryotic compartments are part of the **endomembrane system**



- A dynamic, connected system of internal membranes and compartments
- Includes: nuclear membrane, the Rough ER, Smooth ER, Golgi, Lysosomes, and vesicles
- Membrane (and material) flow from one compartment to the next

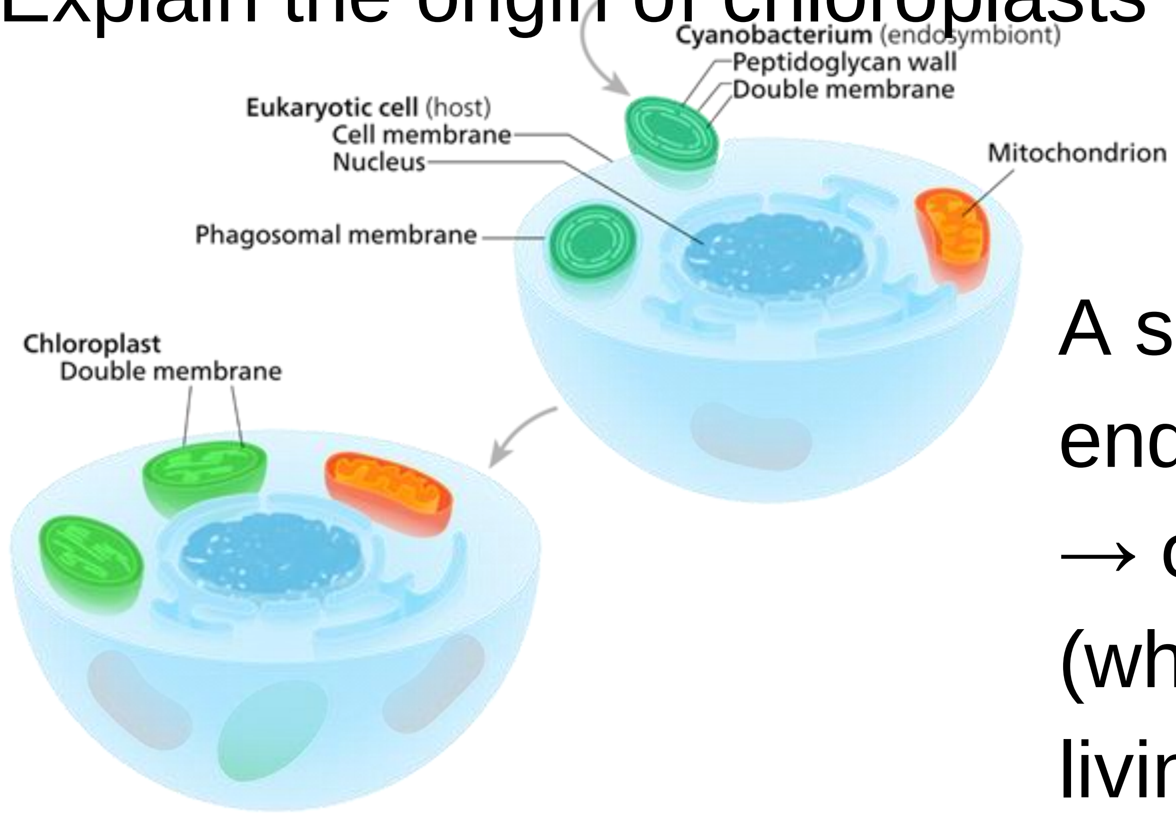
Explain the origin of mitochondria and cellular compartmentalization



- Archaeal cell and bacterial cell merged (B)
- Bacterial cell → mitochondrion
- Secretion of vesicles → nuclear membrane (C) and E.R. (D)

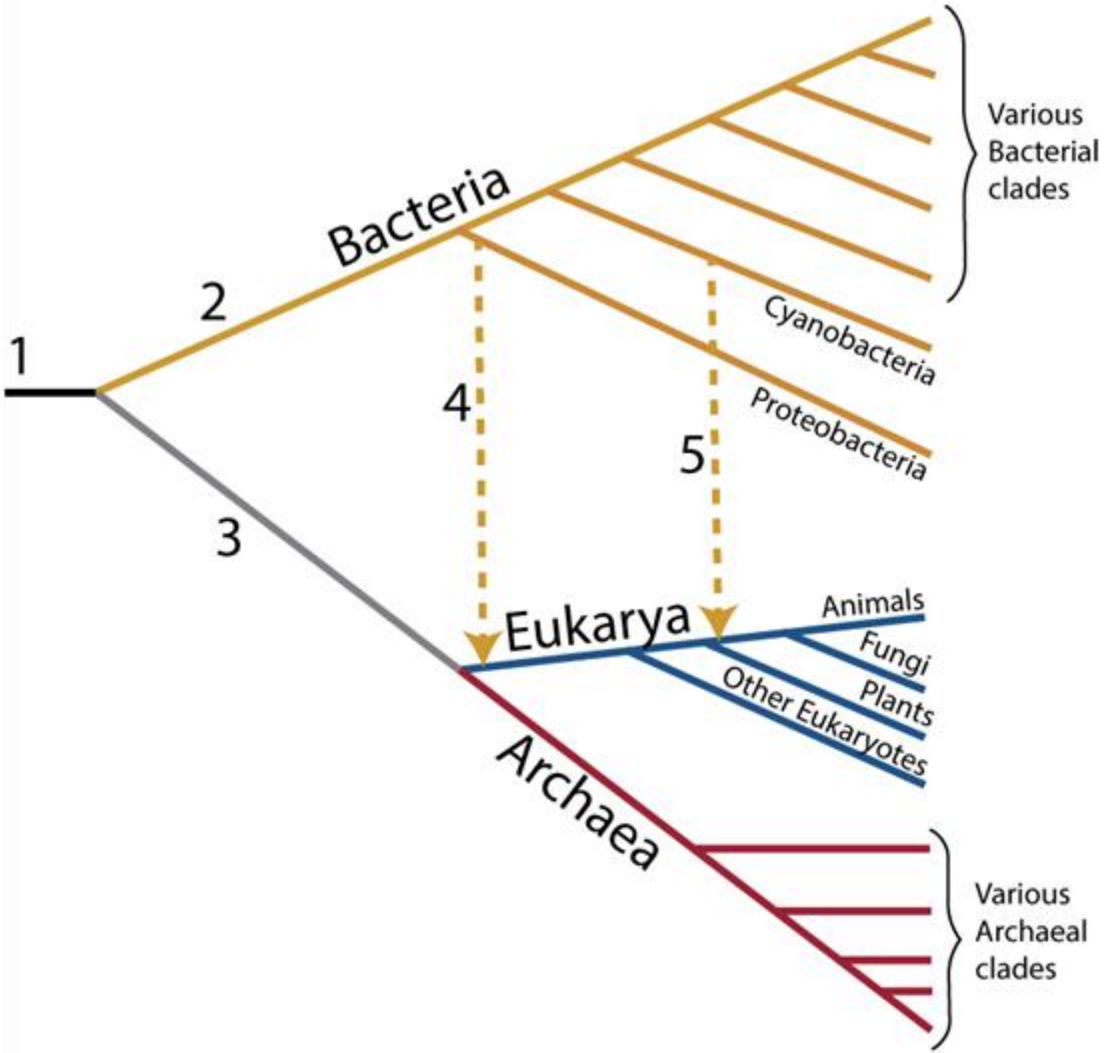
- Dates back ~1.8 bya
- Arose as mutualistic endosymbiosis

Explain the origin of chloroplasts

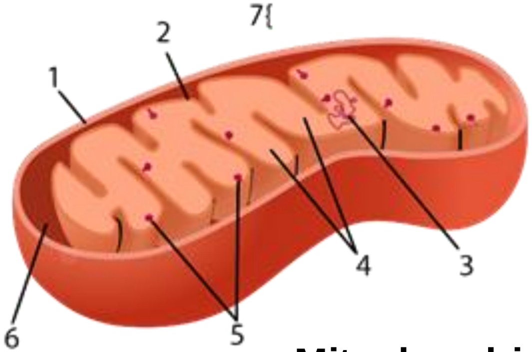


A second endosymbiotic event → chloroplasts (which were free-living cyanobacteria)

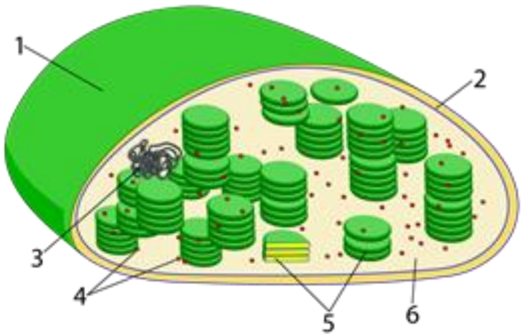
Another look at the three domains



What's the evidence that chloroplasts and mitochondria were once free-living bacterial cells that arose through endosymbiosis?



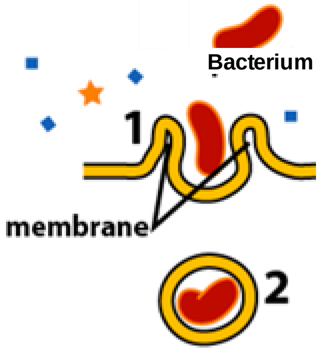
Mitochondria



Chloroplast

Like bacteria, both organelles

- Have their own circular DNA
- Replicate themselves through binary fission
- Use their own ribosomes to produce some of their own proteins.
    - Ribosomes resemble bacterial ribosomes in terms of their rRNA sequence and structure.
- Have (at least) two membranes (outer one is a vestige of an vesicle from endocytosis)



Bacterium surrounded by vesicle

QUESTIONS (and comments)

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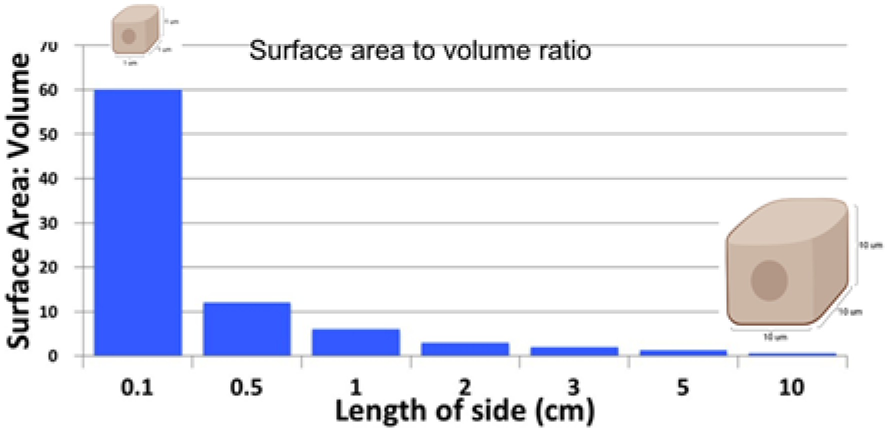

Complete the tutorials about Cell Size and Cellular Compartmentalization on Learn-Biology.com

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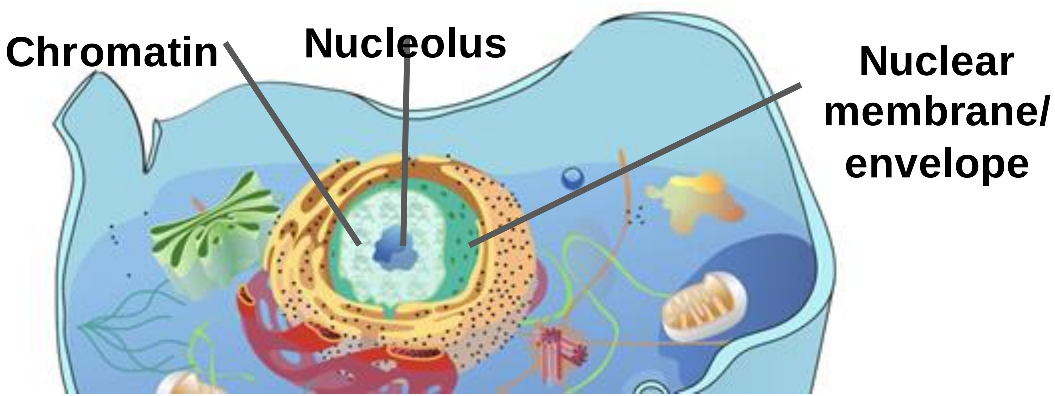
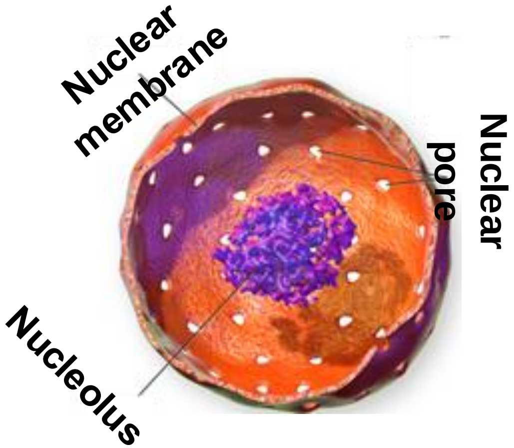
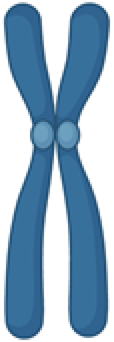
TOPICS 2.1 - 2.2

Eukaryotic Cell Parts and Functions

Describe the structure and function of the nucleus.



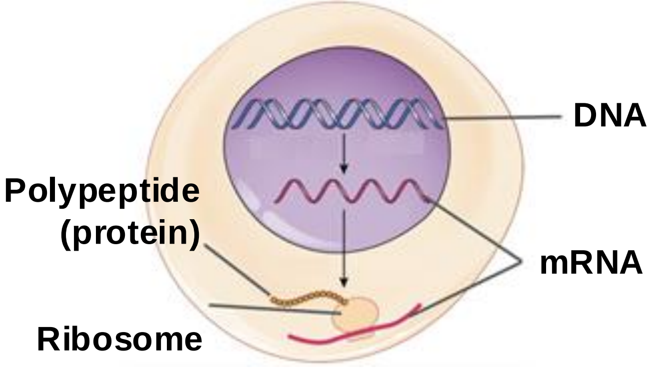


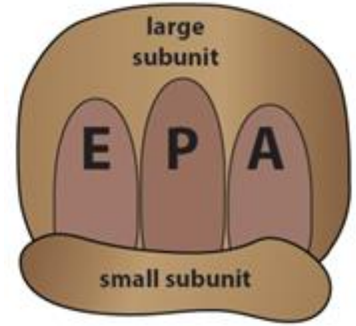


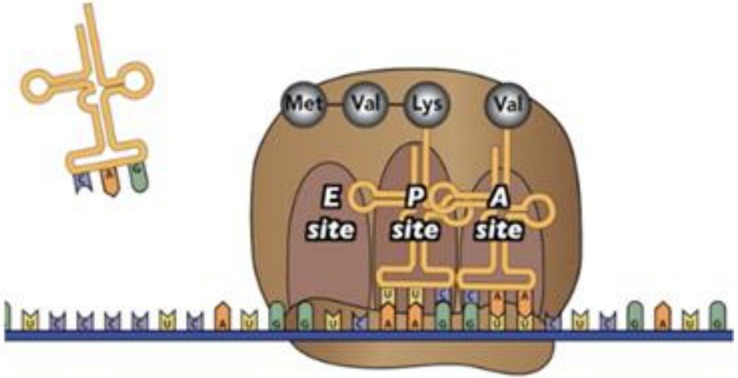
Replicated Chromosome

- FUNCTION: stores and protect genetic information/DNA
- DNA is wrapped around proteins to form chromosomes
- Chromatin (spread out DNA)
- Nucleolus: assembles ribosomes
- Nuclear membrane: separates chromosomes from cytoplasm.
- Nuclear pore: allows molecules to enter/leave nucleus

Describe the structure and function of ribosomes.



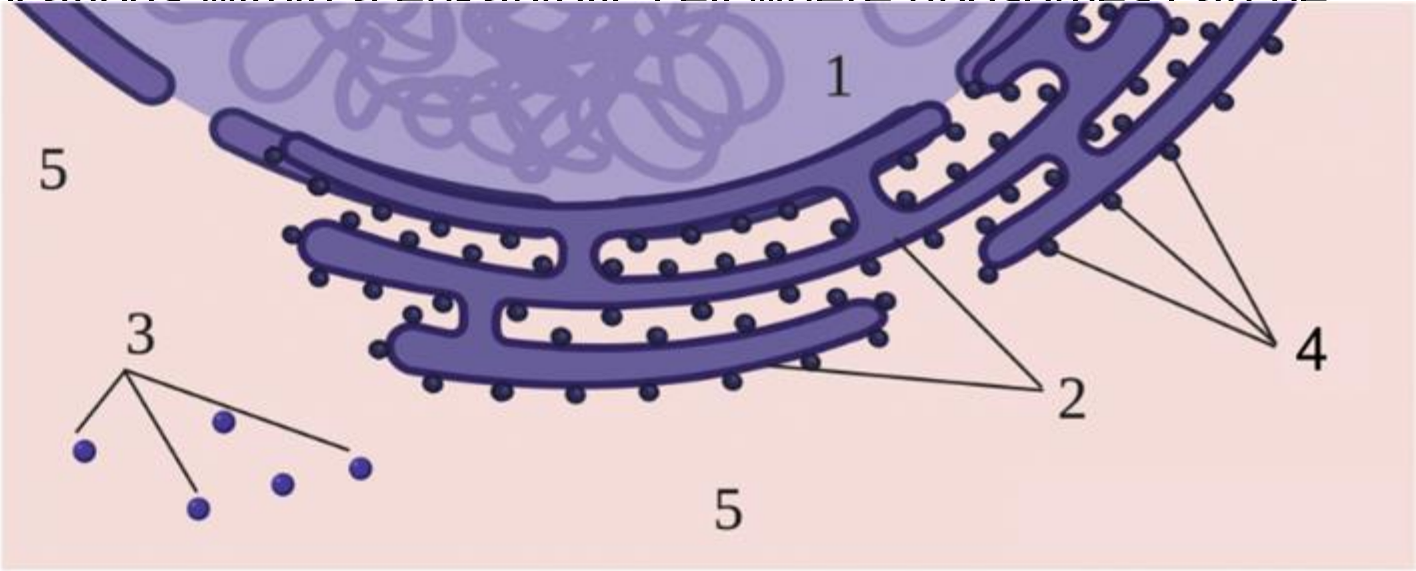




- Particles composed of ribosomal RNA and protein.
- Consist of large and small subunits
- Ribosome function:
    - Reads a genetic message encoded in a sequence of mRNA
    - Translates that message into a sequence of amino acids that make up the primary structure of a protein.

DETAILS OF TRANSLATION/PROTEIN SYNTHESIS IN UNIT 6

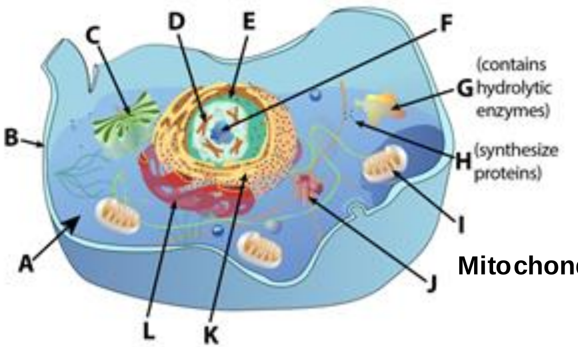
What are two locations within a eukaryotic cell where ribosomes can be found?



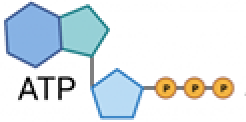
Ribosomes can be “free” or “bound”

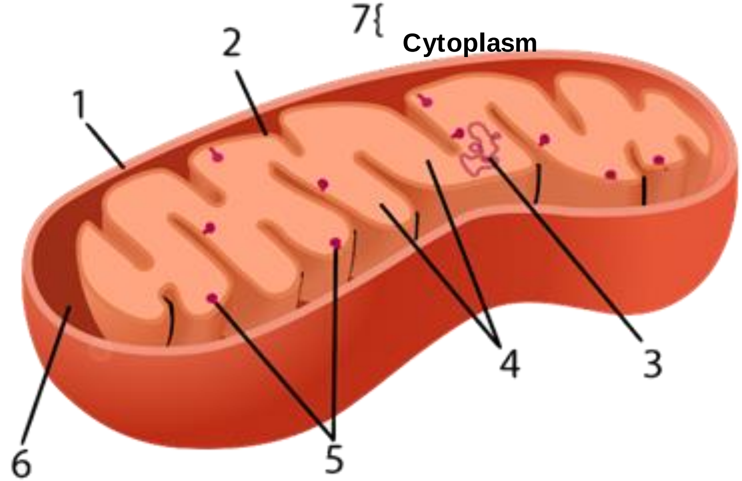
- Free ribosomes (3) float freely in the cytoplasm (5).
- Bound ribosomes (4) are connected to the membrane of the rough ER (endoplasmic reticulum).
- All ribosomes start out as free…through *protein targeting* they migrate to the ER to become bound (tutorial on Learn-Biology.com).

Describe the structure and function of mitochondria



Mitochondria



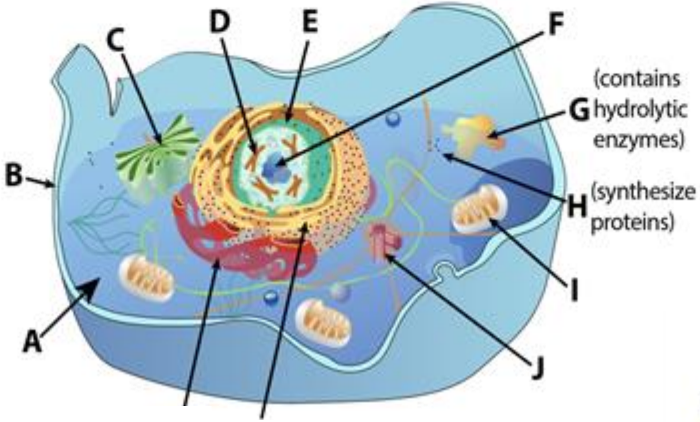


FUNCTION: converting food energy into ATP

Key Structures:

- Matrix (cytoplasm).
  - Enzymes for Krebs cycle
  - Chromosome/DNA (3);
  - also ribosomes (not shown)
- Inner membrane (2)
  - highly folded (↑ surface area).
  - Has membrane-embedded enzymes and proteins (5) that make ATP
- Intermembrane space (6)
- Outer membrane (1)

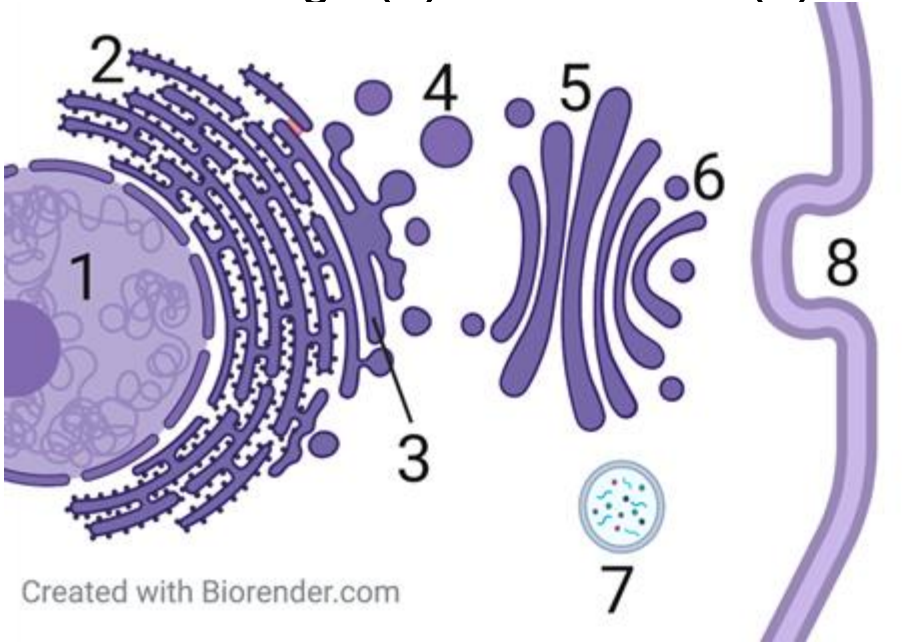
Describe the endoplasmic reticulum (E.R.), and list its two forms



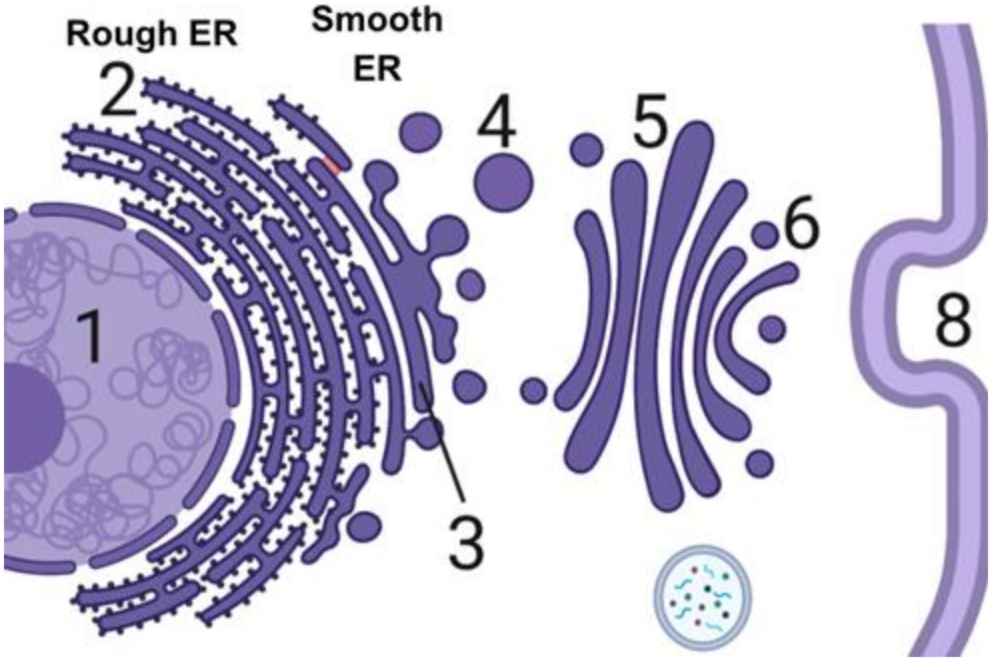
Smooth ER

Rough ER

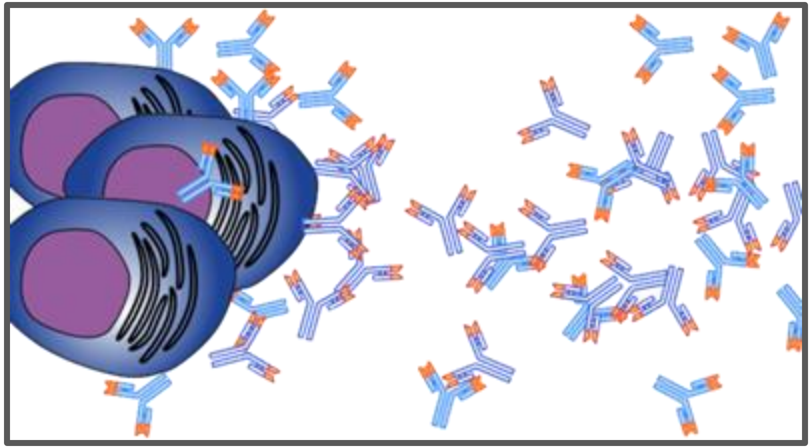
- An interconnected series of channels between the nuclear membrane and Golgi body
- Rough (2) and smooth (3)



Describe the structure and function of the rough E.R.

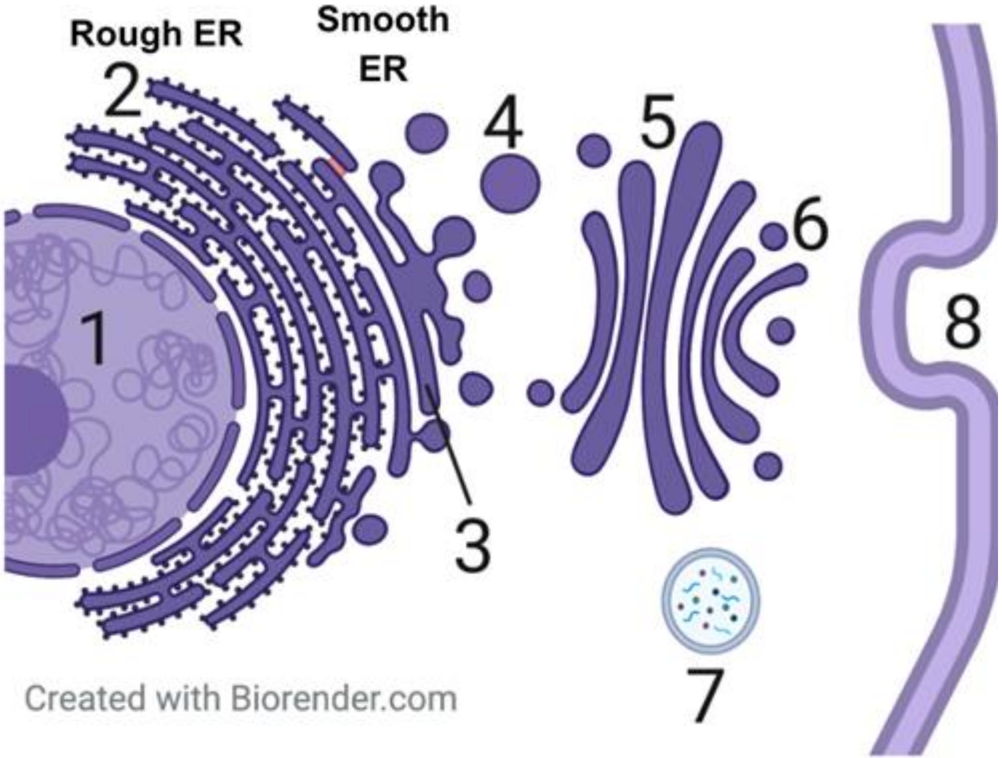


- Studded with ribosomes.
- Synthesizes proteins for inclusion in lysosomes, other organelles, in the membrane, or for export from the cell



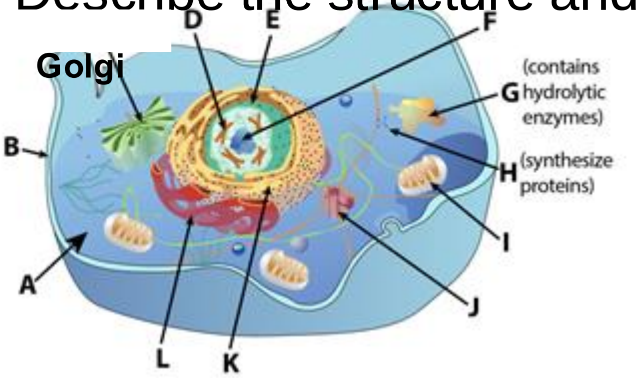
B cell secreting antibodies

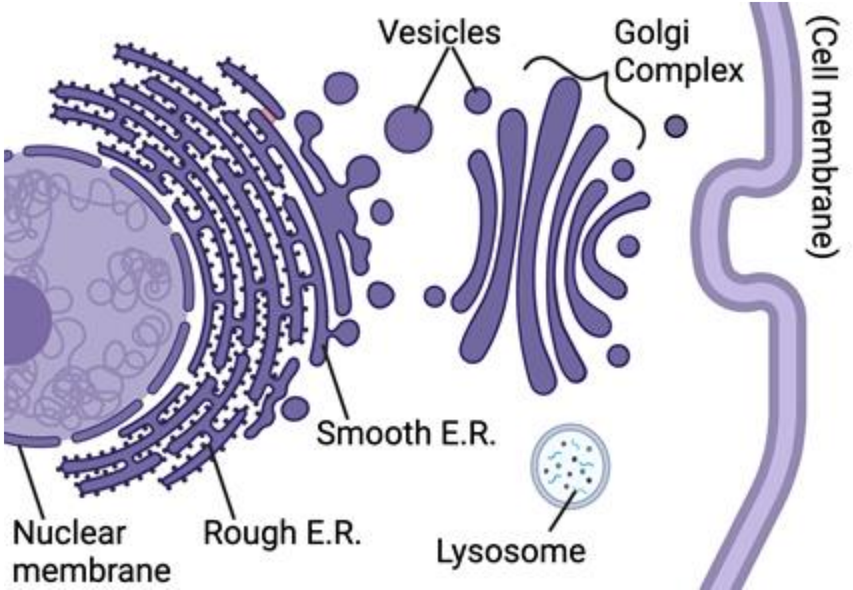
Describe the structure and function of the smooth E.R.



- On the outer side of the ER network.
- Lacks ribosomes but has many embedded enzymes.
- Functions (vary by tissue)
  - Synthesis of lipids,
  - Converting toxins into soluble forms that can be excreted from the body
  - Carbohydrate breakdown and synthesis.

Describe the structure and function of the Golgi complex.

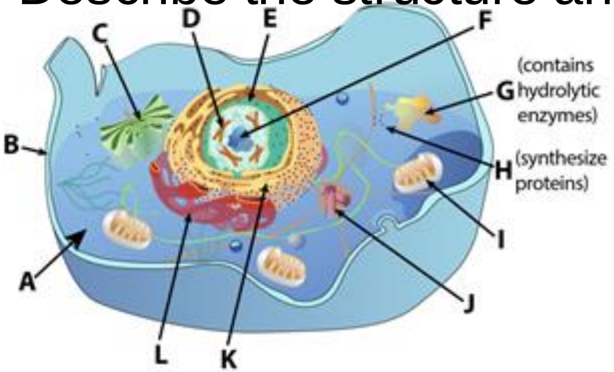




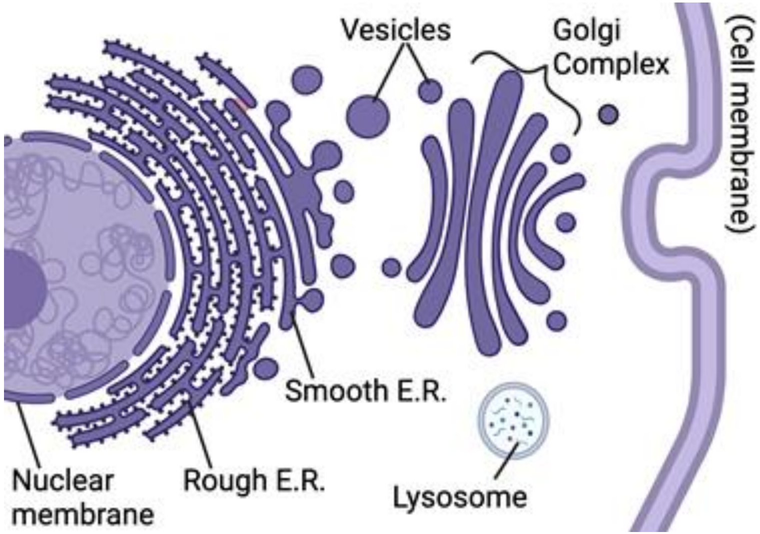
- A series of membrane-bound flattened sacs.
- Receives vesicles from the rough and smooth E.R., and chemically modifies the contents (usually proteins).
- Packages modified proteins into vesicles that are sent to organelles, to the cell membrane, or exported from the cell.

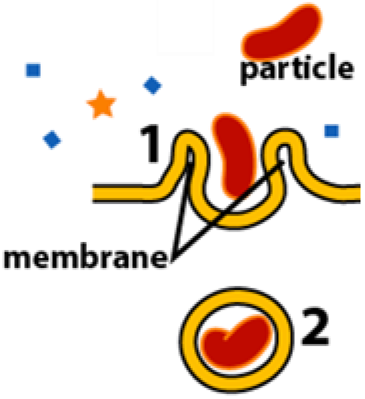
AKA: *Golgi body* or *Golgi apparatus*.

Describe the structure and function of lysosomes.



lysosome **(but could be other large vesicles, too)**



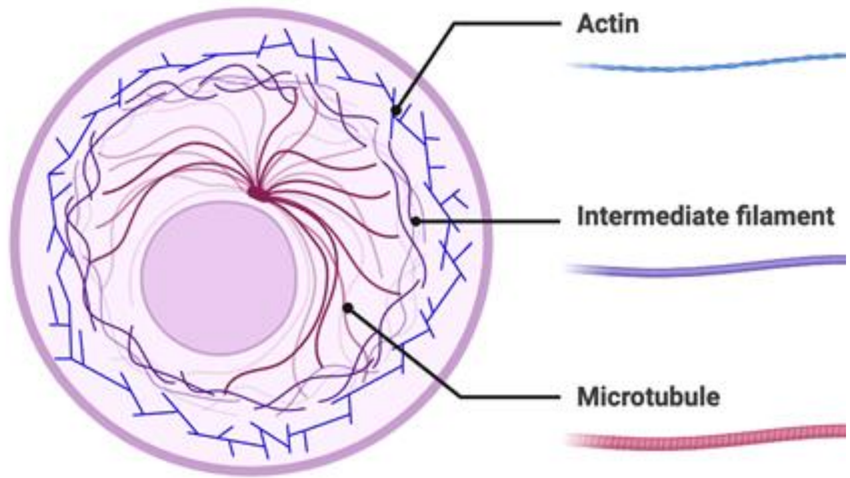


Vesicle with food to be sent to a lysosome

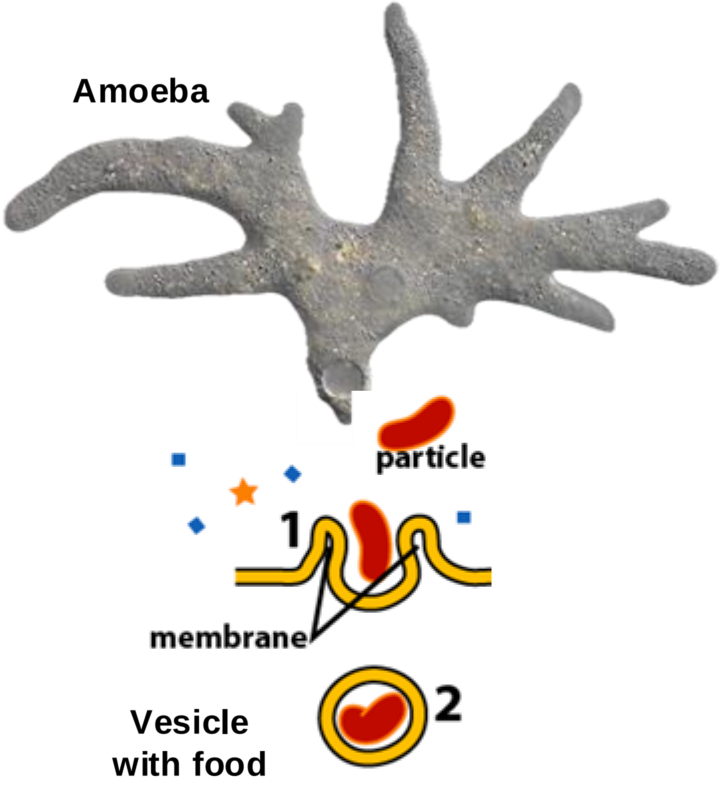
YOU WILL *NEVER* HAVE TO IDENTIFY A LYSOSOME ON A DIAGRAM ON THE AP EXAM!

- Membrane-bound organelles that contain hydrolytic enzymes.
- Only found only in animal cells
- Carry out intracellular digestion.
- Also recycle worn-out, damaged, or excess organelles and molecules.
- Play a key role in apoptosis (programmed cell death)

Describe the structure and function of the cytoskeleton

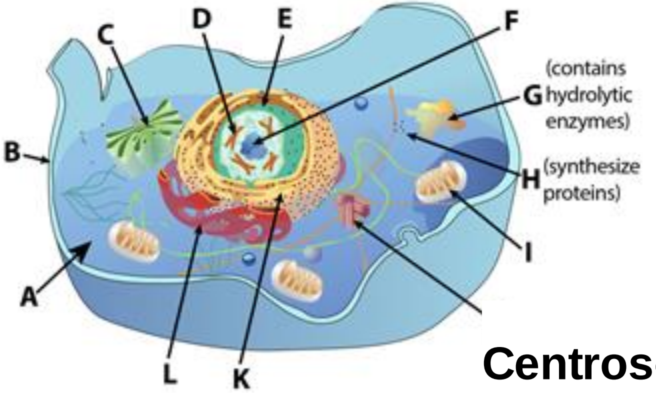


Fibers Making up the Cytoskeleton

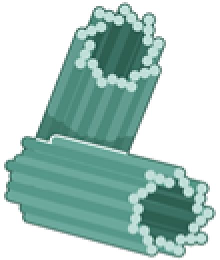


- A dynamic network of protein fibers
- Enables cells to move materials and organelles
- Enables cell to move their membranes (endocytosis, amoeboid movement)

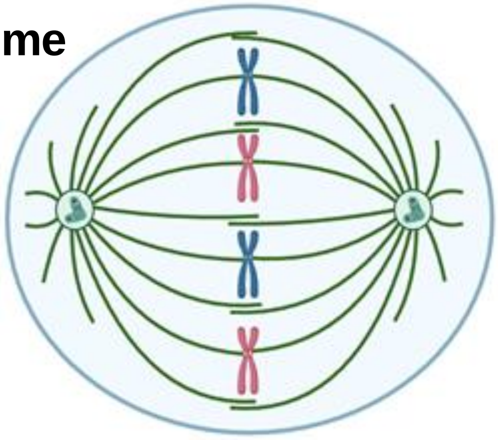
What are centrosomes/centrioles?



Centrosome



Centrioles

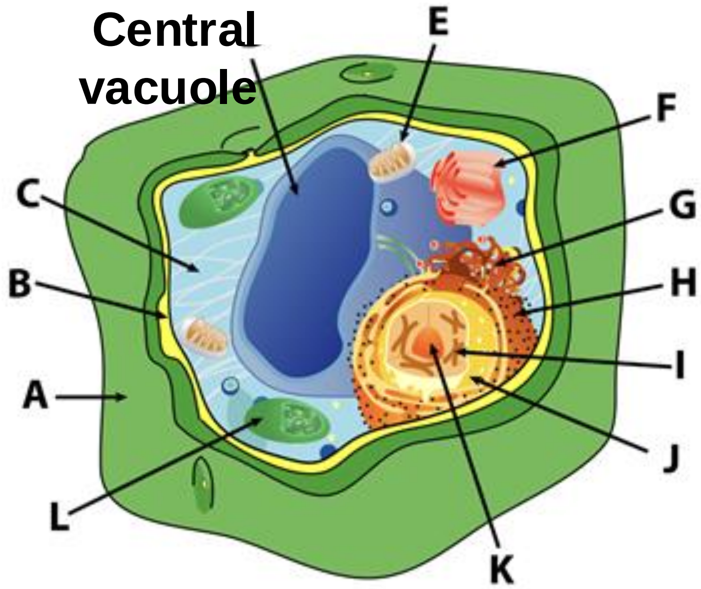


Spindle

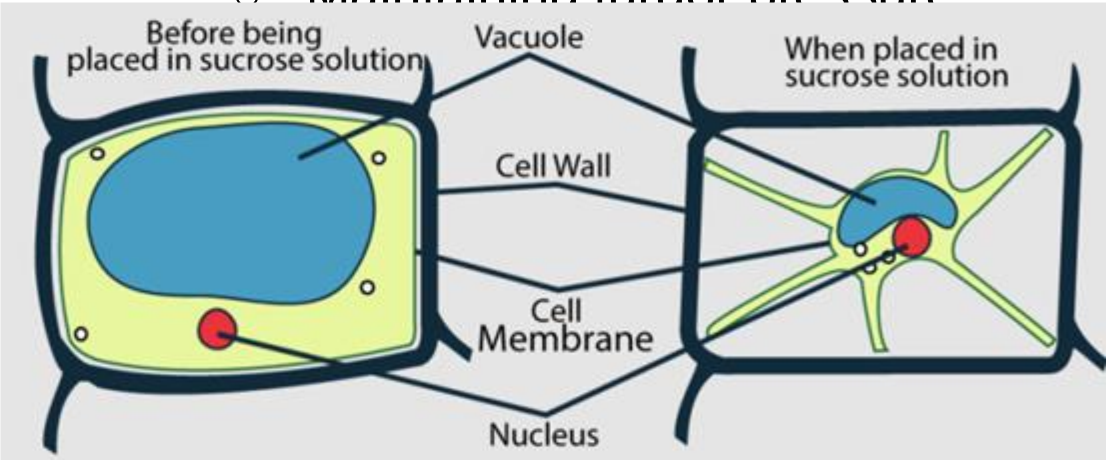
Centrosome: the organelle (with two centrioles)

- FUNCTION: creating spindle fibers for separating chromosomes during mitosis and meiosis

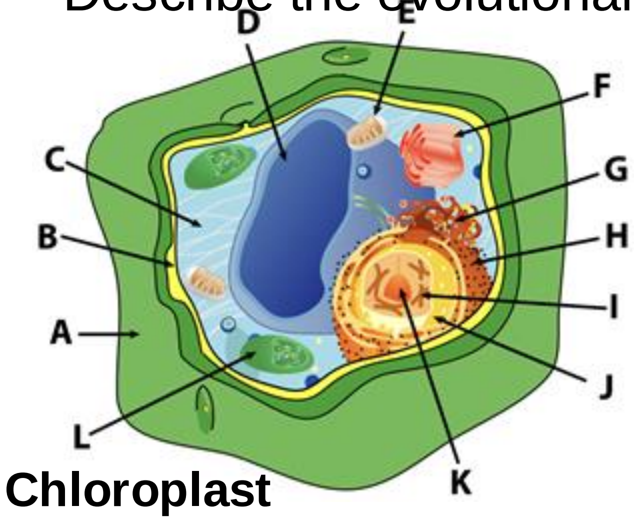
Describe the function of the central vacuole.

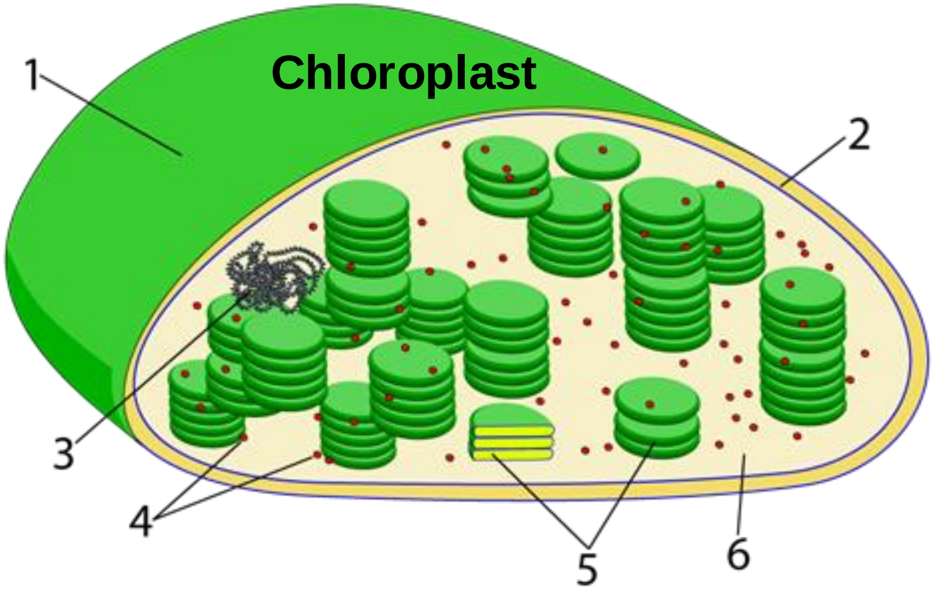


- ONLY IN PLANT CELLS
- Functions
  - Water storage.
  - Storing and releasing needed macromolecules,
  - Sequestering waste products
  - Maintaining turgor pressure



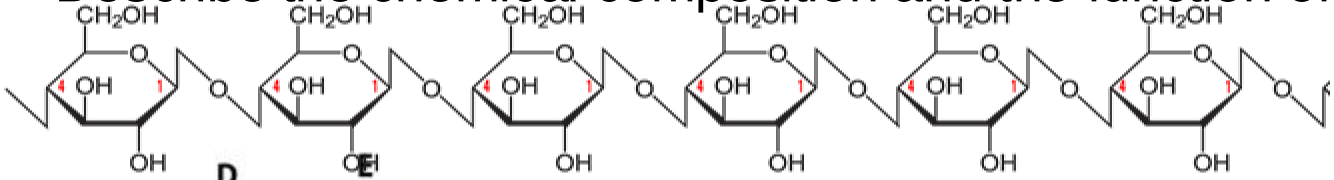
Describe the evolutionary origin and function of chloroplasts



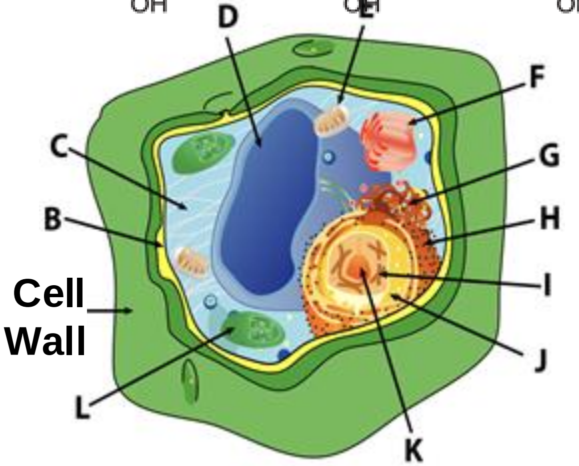


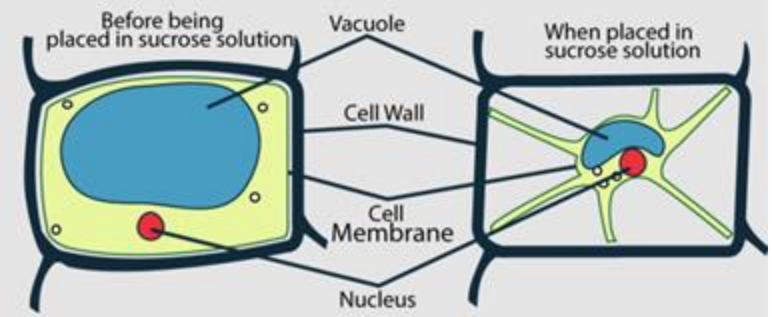
- Endosymbiotic descendants of free-living photosynthetic bacteria (w/ their own DNA, ribosomes, etc).
- FUNCTION: creating carbohydrates through photosynthesis.
- DETAILS IN UNIT 3

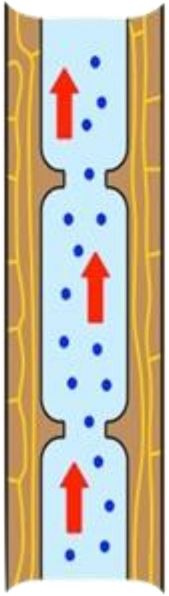
Describe the chemical composition and the function of the plant cell wall.



Cellulose







Xylem

- Composed primarily of cellulose, a polysaccharide.
- Major function: pressure vessel that prevents over-expansion in response to inward water flow (osmotic pressure)
- Primary component of wood and water-conducting tubes in plant stems

QUESTIONS (and comments)

?s

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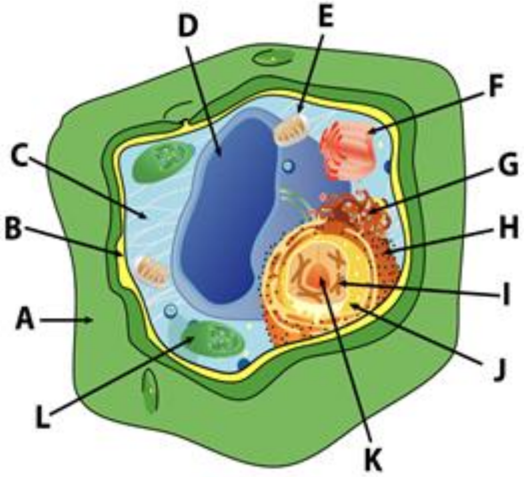

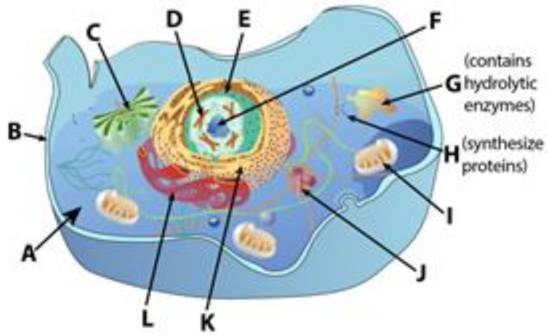

Complete the tutorials about Cell Parts and Functions on Learn-Biology.com.

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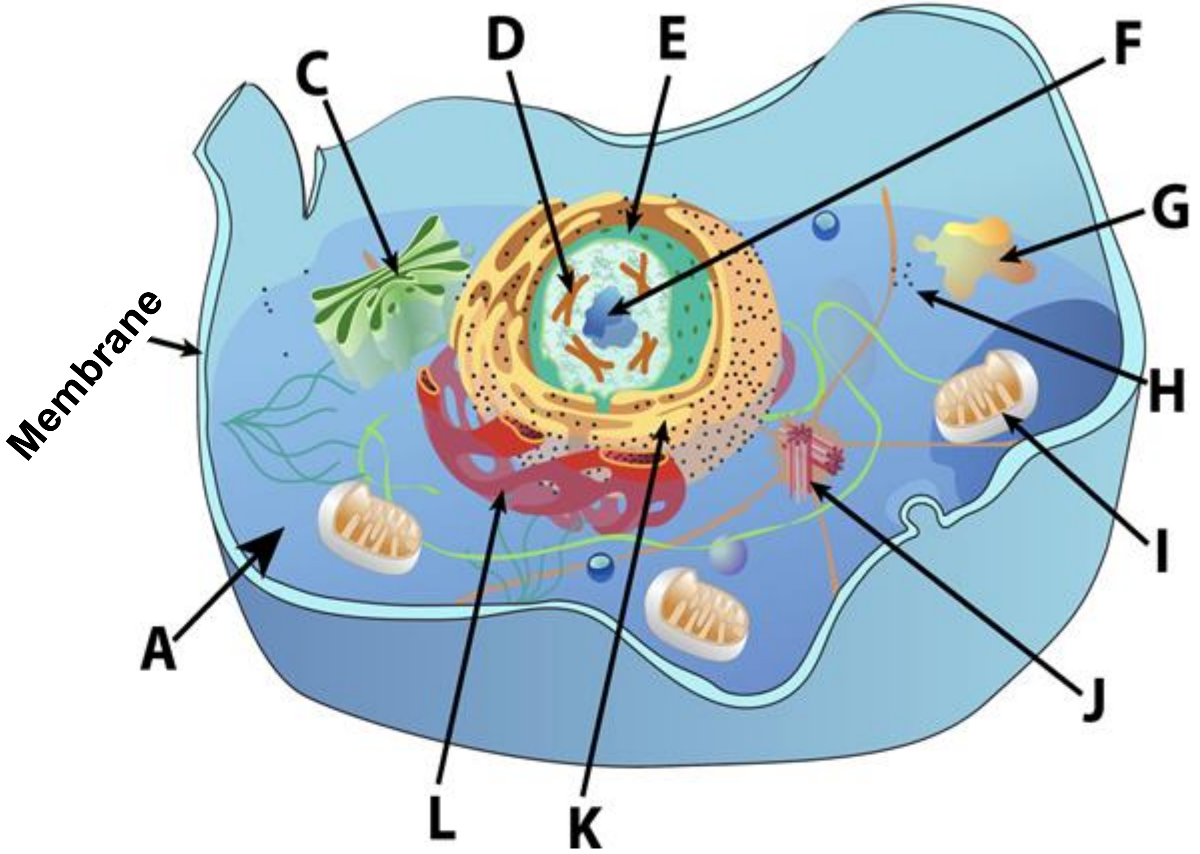
Topic 2.4

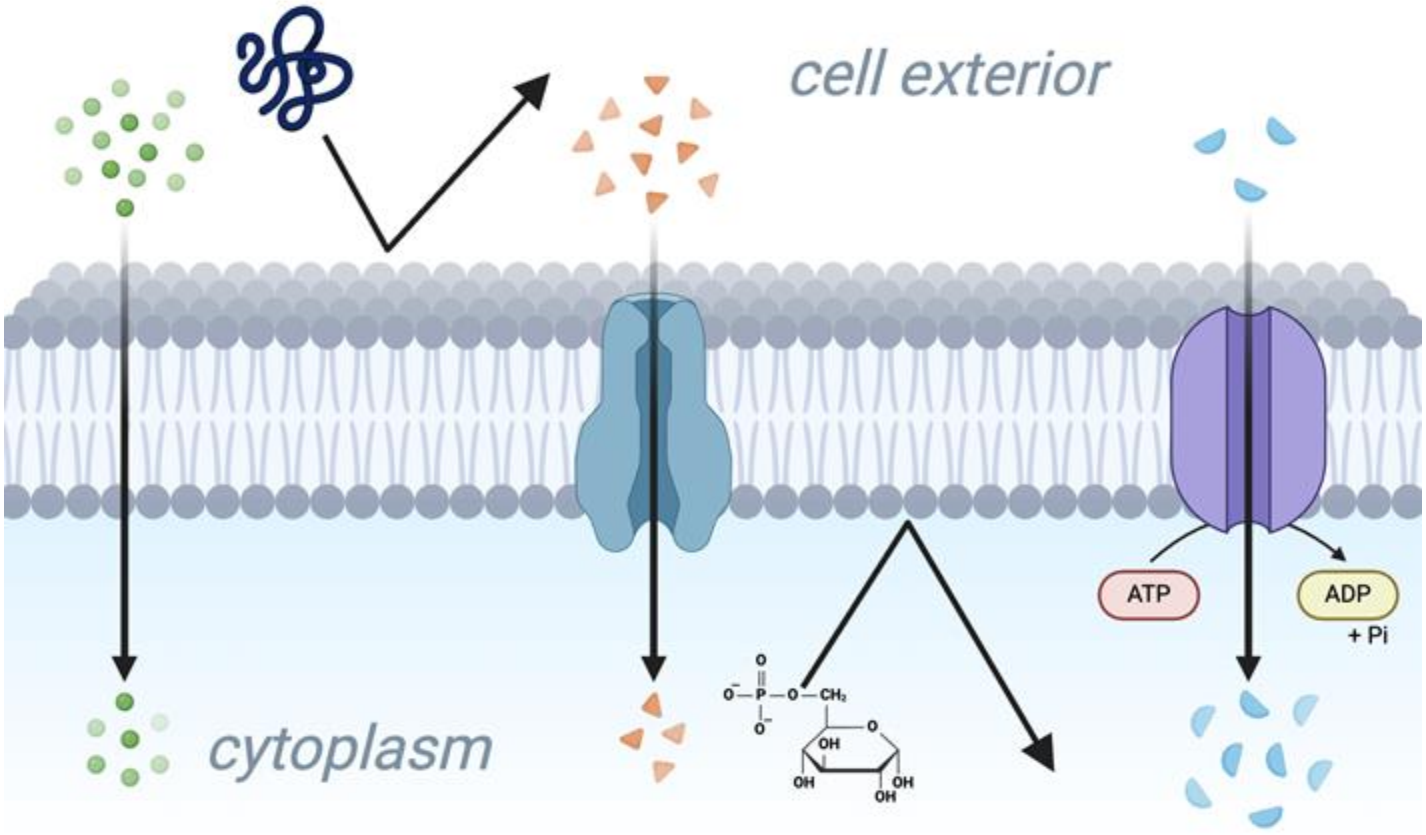
Cell Membrane Structure

What is the function of the cell membrane?



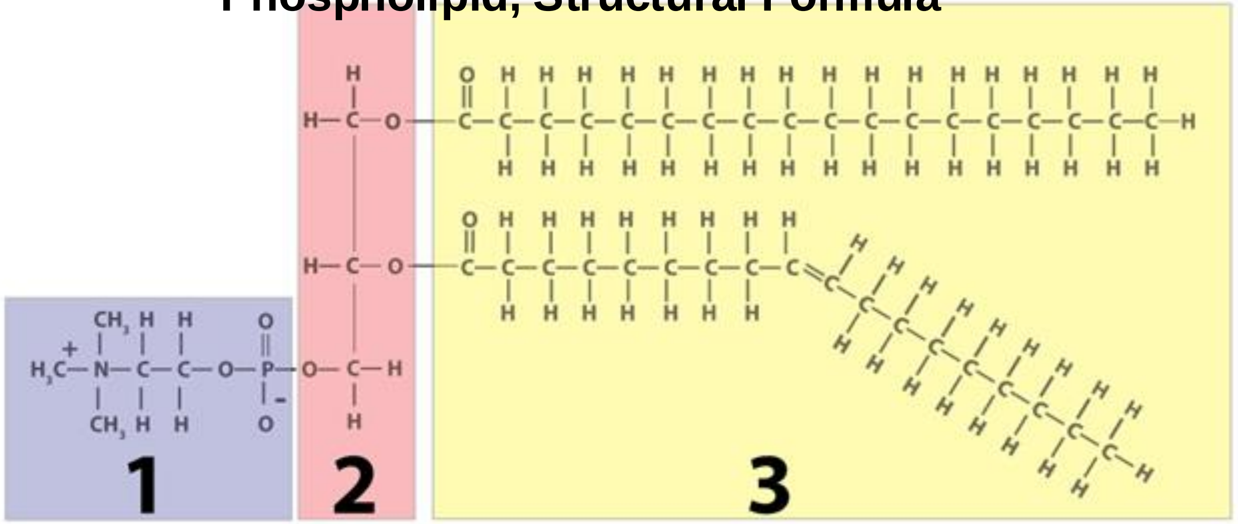
- Separates the highly organized contents of the cell from the cell's environment
- **Selectively permeable boundary**: Allows passage of some substances and particles, but not others.

Selective permeability

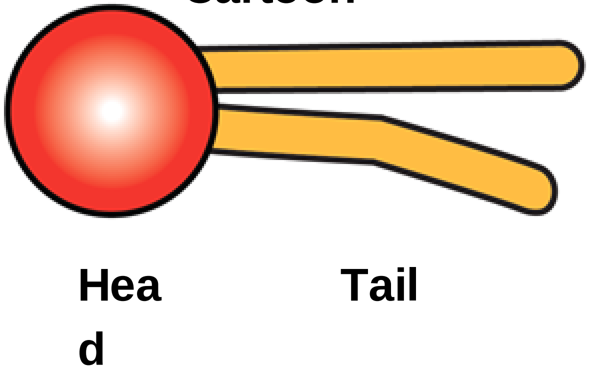


Phospholipids: key structural components of membranes

Phospholipid, Structural Formula

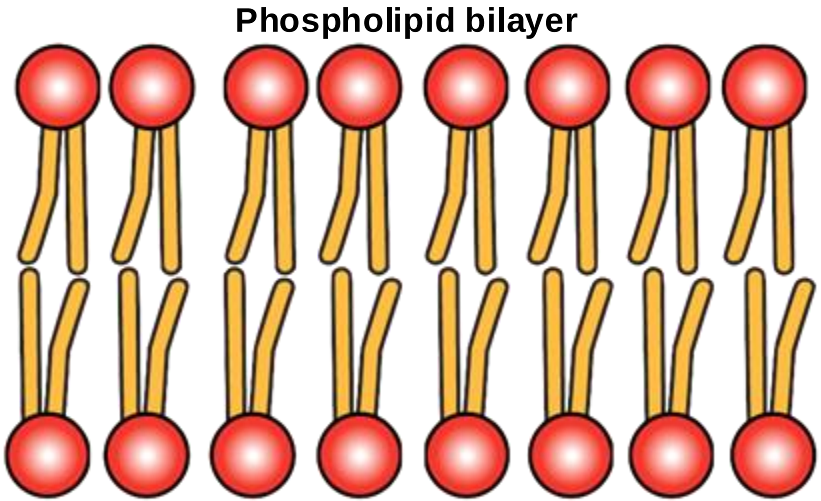


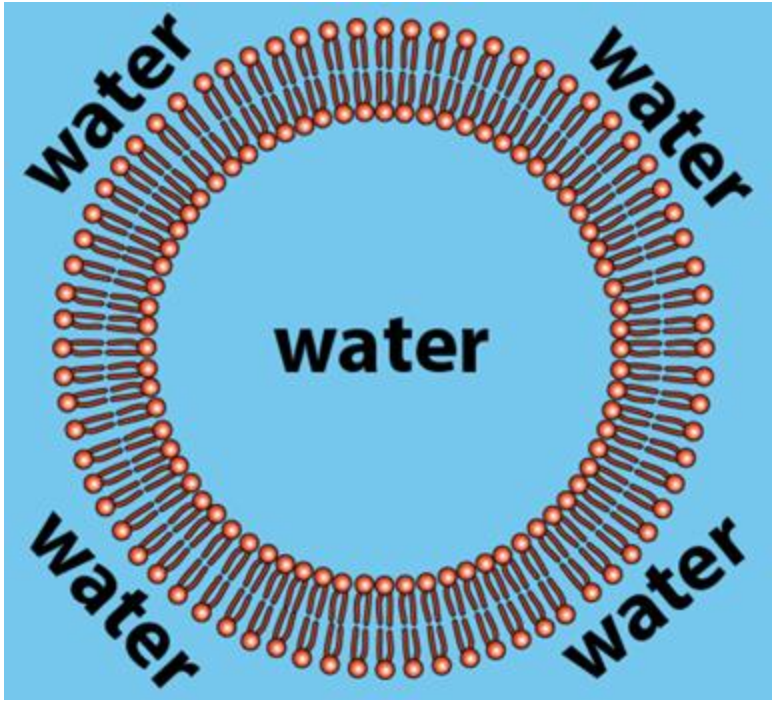
Phospholipid, Cartoon



- Hydrophobic/nonpolar tail (3)
- Hydrophilic/polar head (1)
- Glycerol (2)

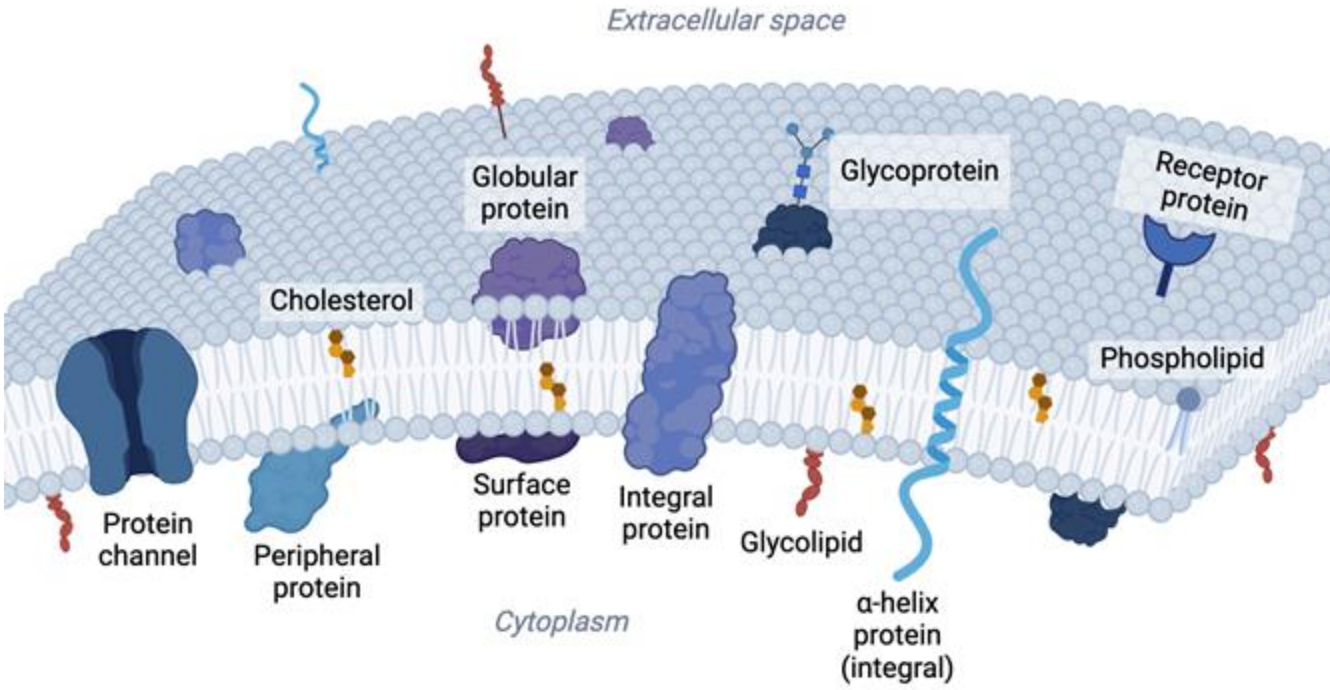
In water, phospholipids form bilayers





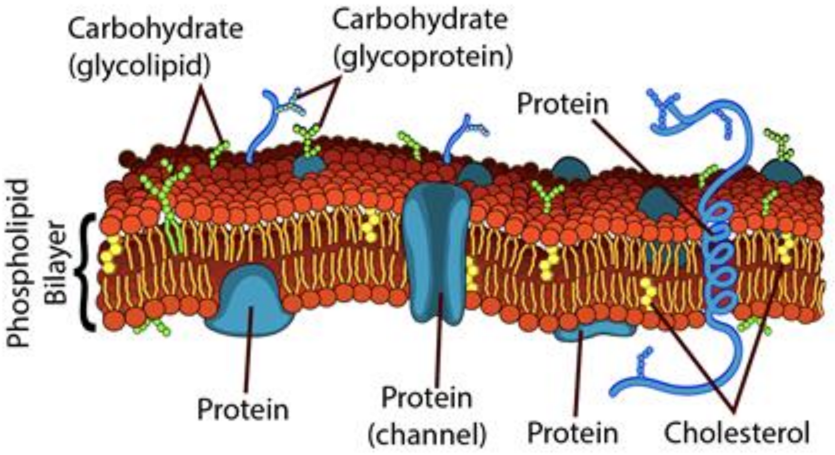
- In solution, the heads bond with water molecules, while the tails form a water-free zone
- Creates a *bilayer:* the framework of the membrane.
- P-L bilayer is stabilized by weak bonds between the tails

Proteins, cholesterol, and carbohydrates play key roles in membrane structure and function



- **Proteins:** Cytoskeleton attachment, channels, receptors, membrane embedded enzymes
- **Cholesterol:** membrane stabilization
- **Glycoproteins** (protein + short polysaccharide): cell recognition (e.g. A, B, O blood types)

The fluid mosaic model

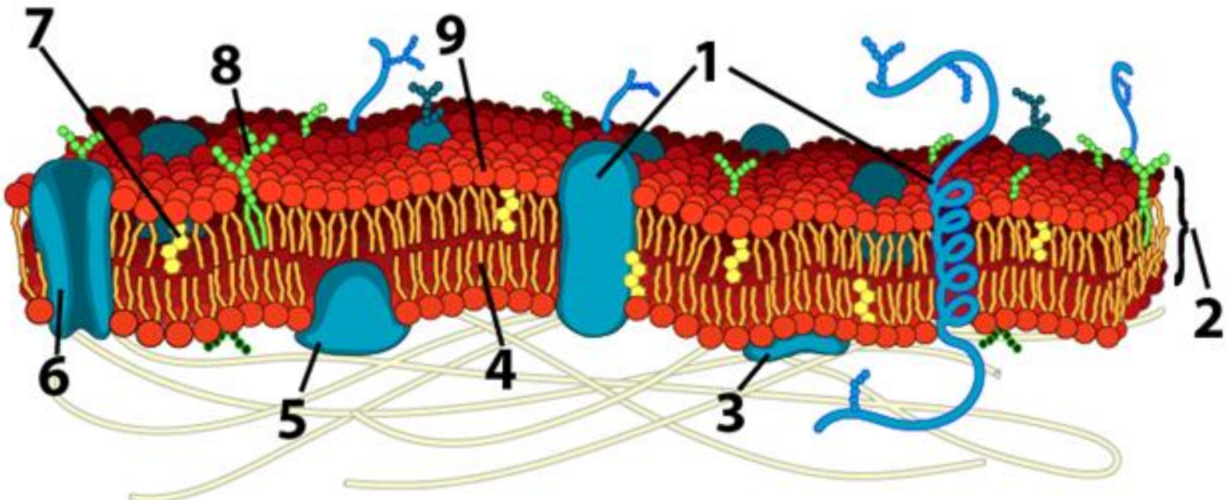


A mosaic

Phospholipids + proteins + cholesterol, in motion.

- **FLUID** because components are moving laterally within the plane of the phospholipid bilayer
- **MOSAIC** because it’s composed of a variety of pieces:
  - WITHIN BILAYER: Phospholipids, proteins, and cholesterol
  - INSIDE AND OUTSIDE BILAYER: Additional molecules might be attached to proteins or phospholipids, including

How proteins fit into the cell membrane.



- **Transmembrane proteins** (1):
  - Hydrophobic core fits into the nonpolar inner portion of membrane
  - Hydrophilic regions extend into the cytoplasm or membrane exterior.
- **Integral proteins** (5):
  - Nonpolar region embeds into the hydrophobic membrane middle;
  - A single hydrophilic region juts into the cytoplasm or cell exterior.
- **Peripheral proteins** (3): attach to phospholipid heads that on the cytoplasmic side of the membrane or the cell exterior.

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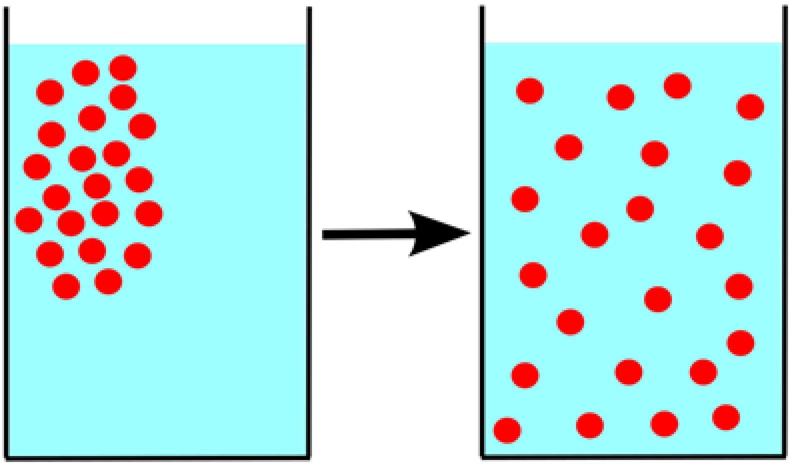
QUESTIONS (and comments)

?s

TOPIC 2.5

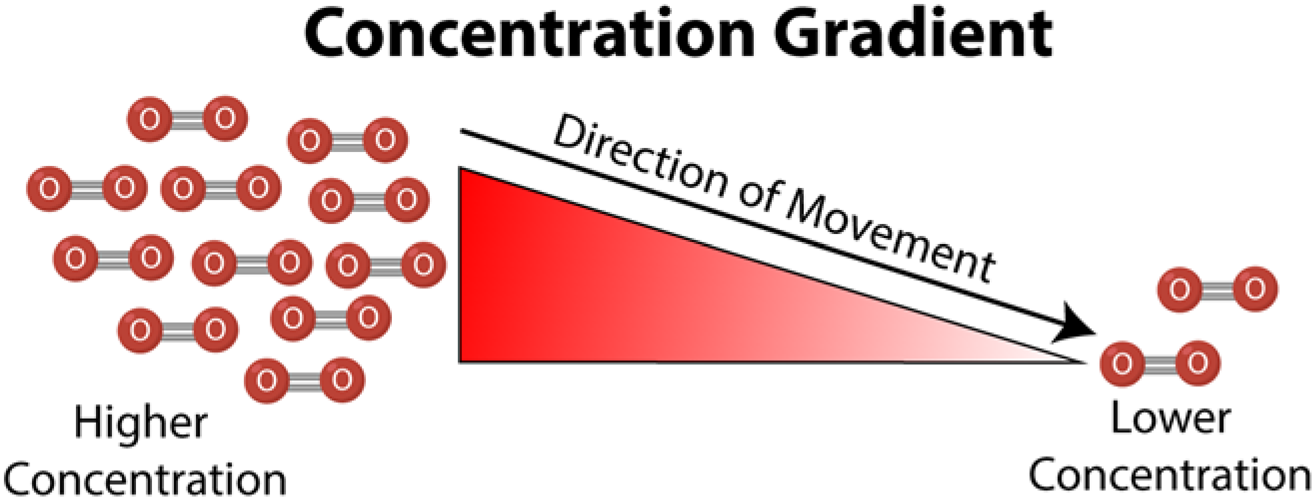
Membrane Transport



Diffusion is how many substances enter and leave cells.

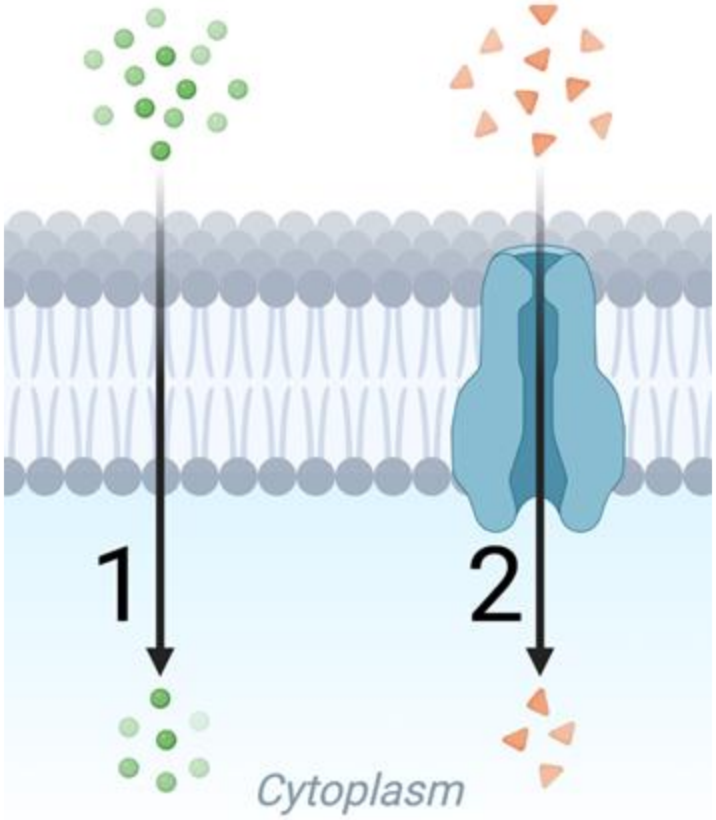
Definition: the tendency of molecules to spread out from where they’re more concentrated to where they’re less concentrated.

Molecules spontaneously flow *down* their concentration gradients.



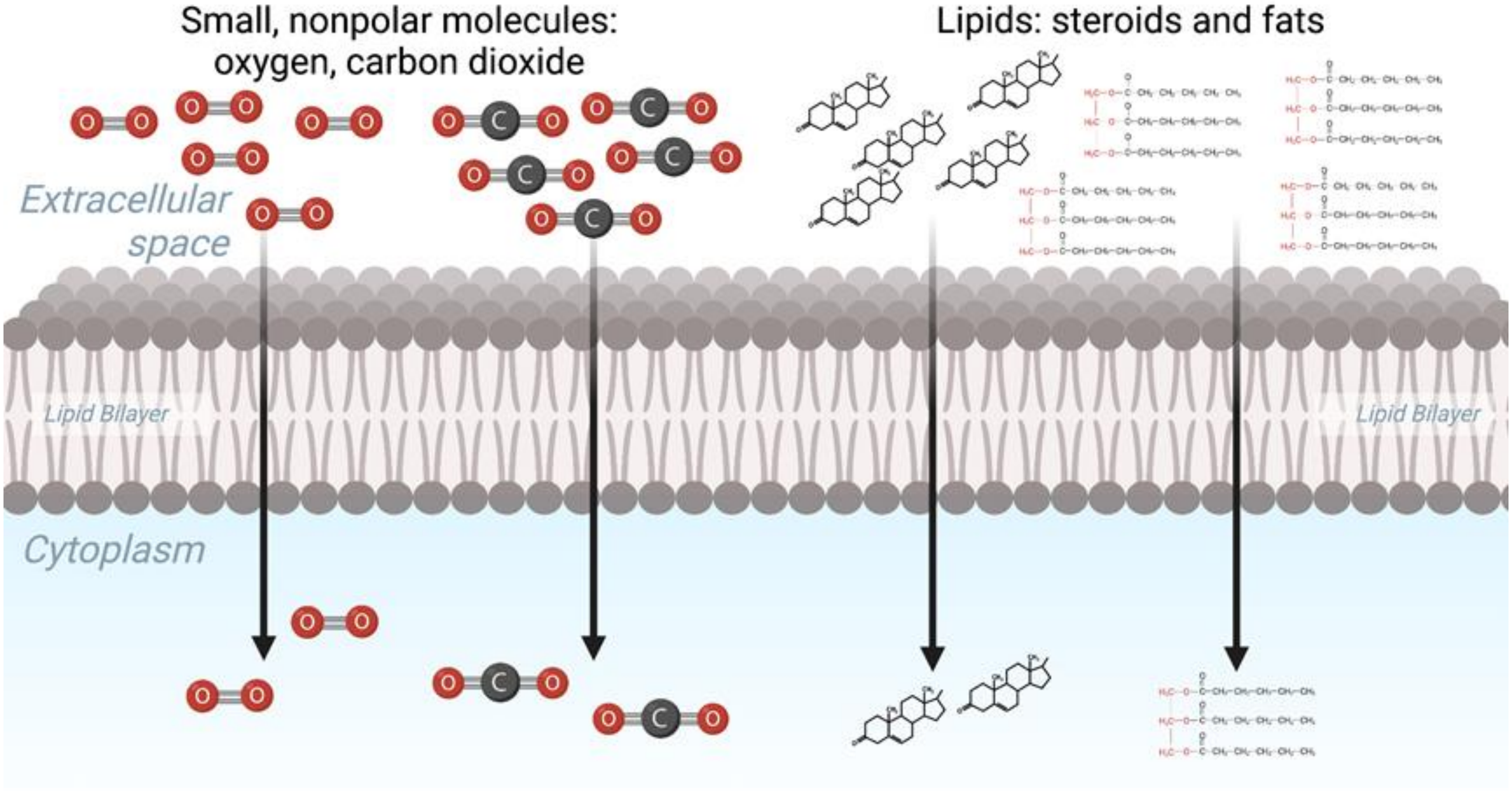
Diffusion ="Passive Transport"

.

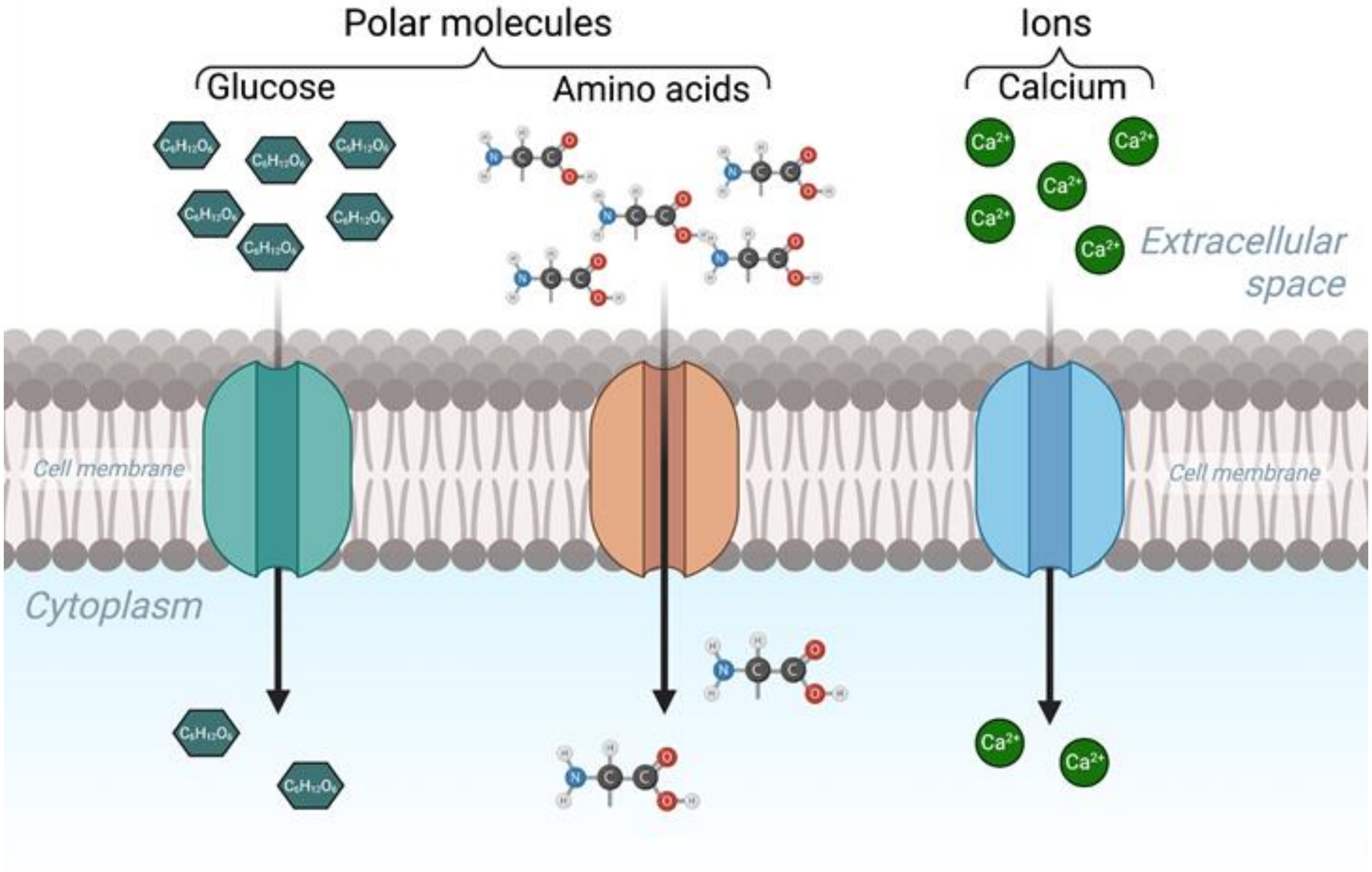


- No cellular energy is required
- Two forms
  - Simple diffusion (1)
  - Facilitated diffusion (2)

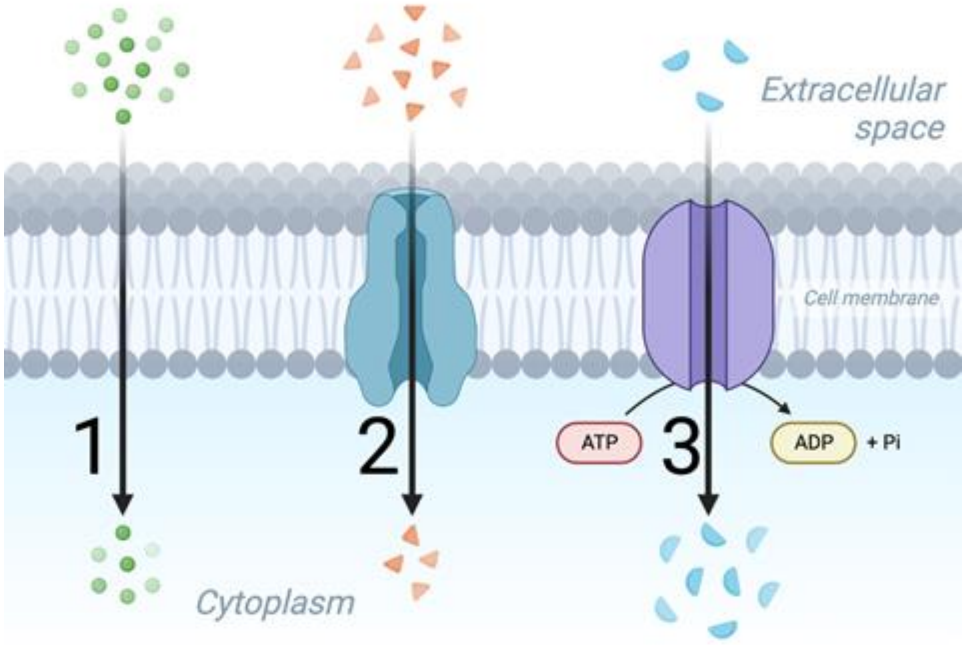
Simple diffusion: substances diffuse across the phospholipid bilayer



Facilitated diffusion is for polar and ionic substances

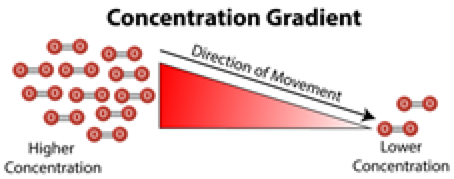


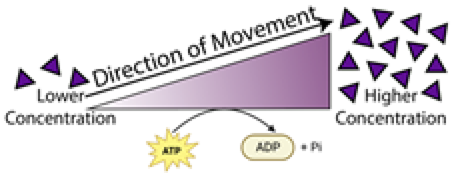
Requires *protein channels:* transmembrane proteins that only let specific molecules or ions pass



Passive Transport

Active Transport



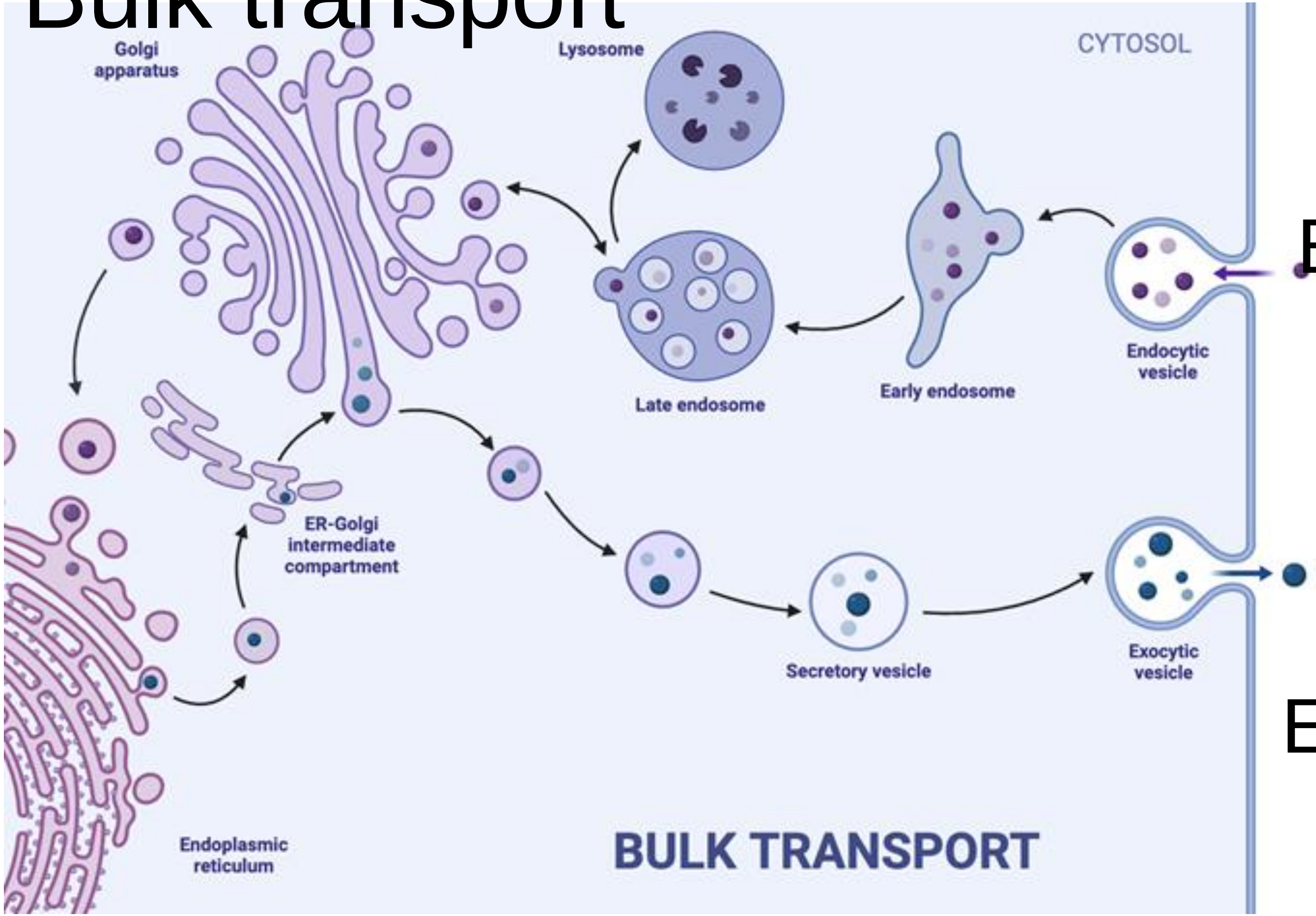


Active transport (3) involves pumping a molecule *up* its concentration gradient.

Requires energy on the part of the cell.

- Usually ATP to ADP to power the pumping process
- Also electron flow (in the proton pumps used by chloroplasts and mitochondria to power ATP synthesis).

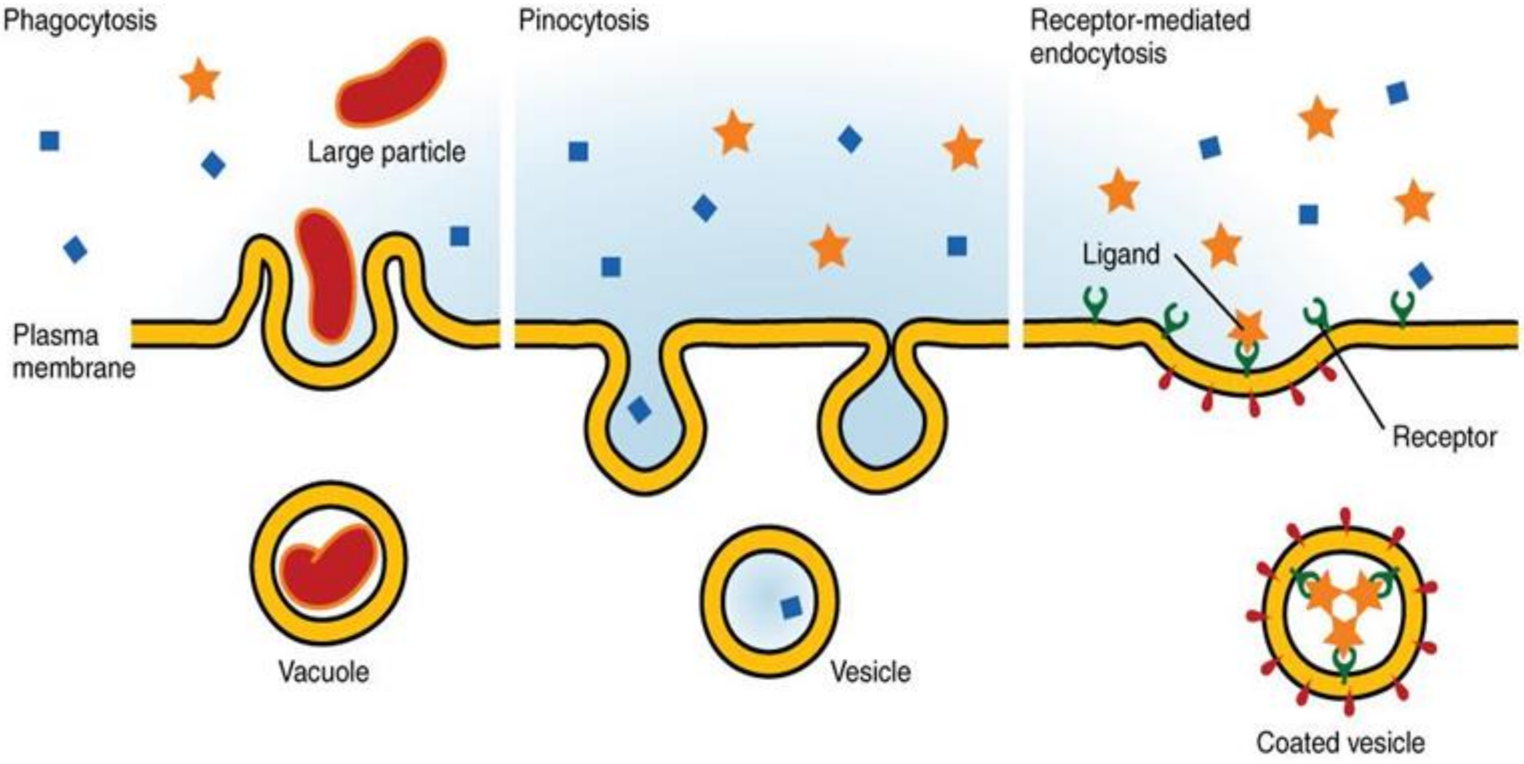
Bulk transport



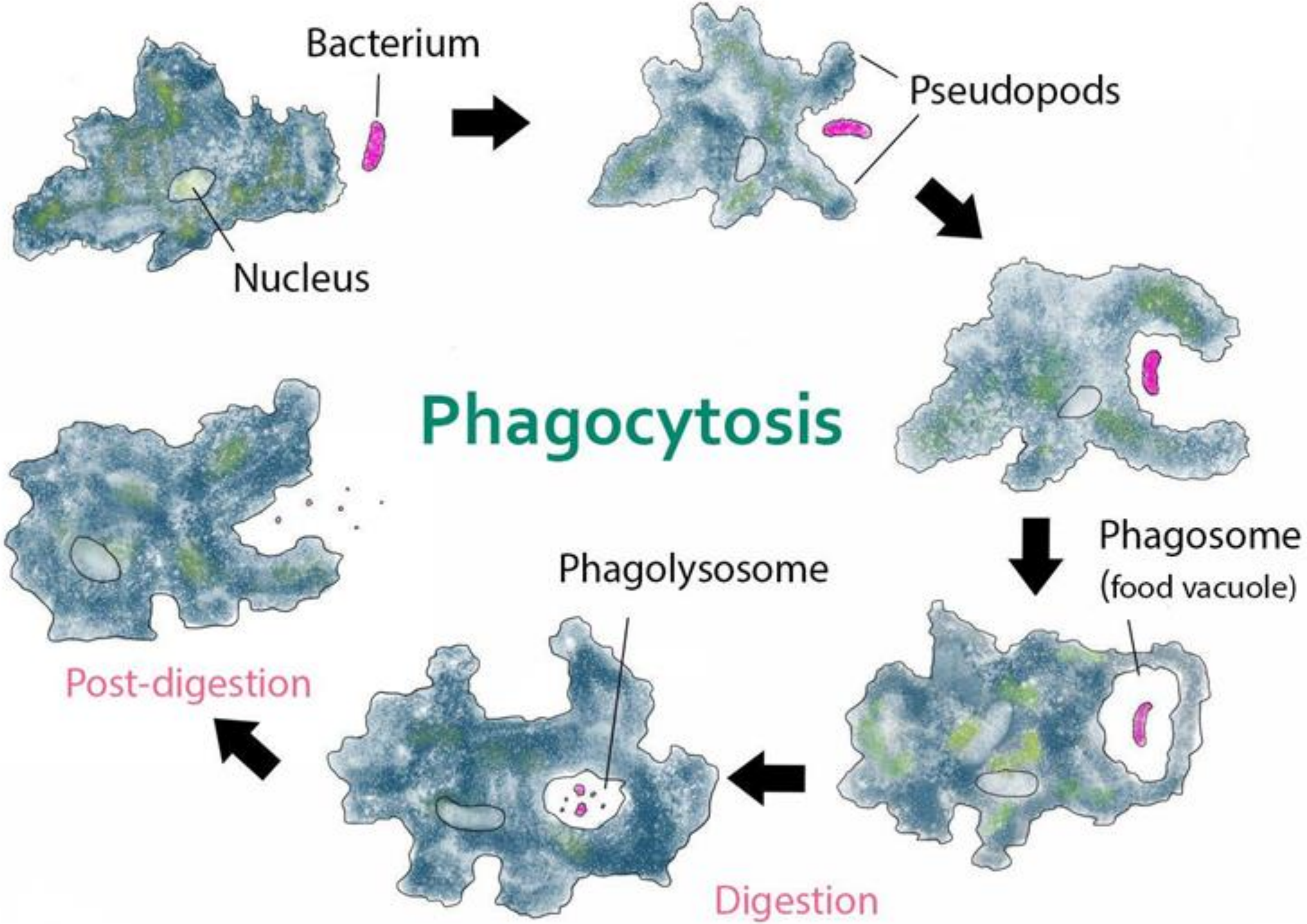
Endocytosis

Exocytosis

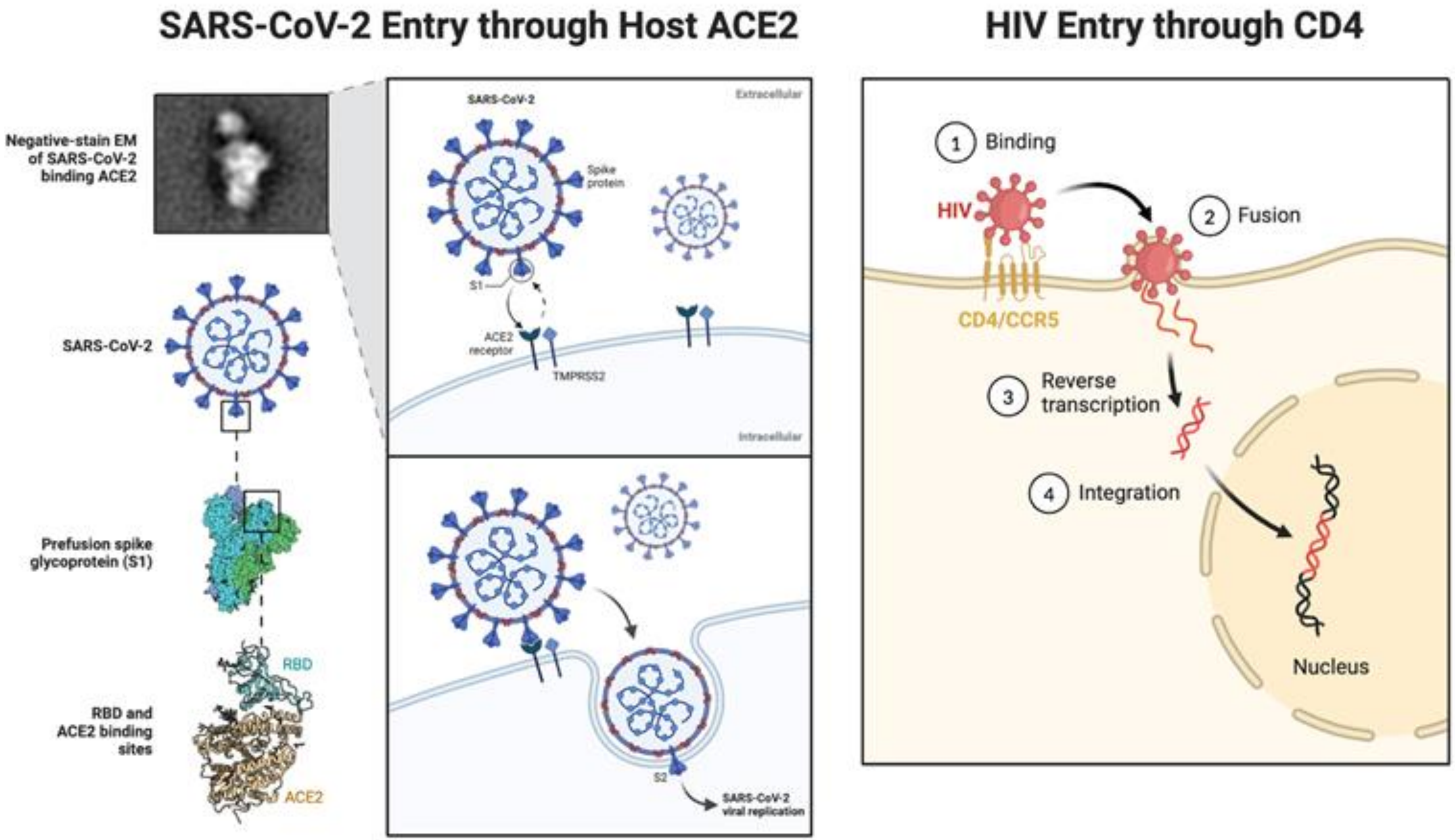
Endocytosis



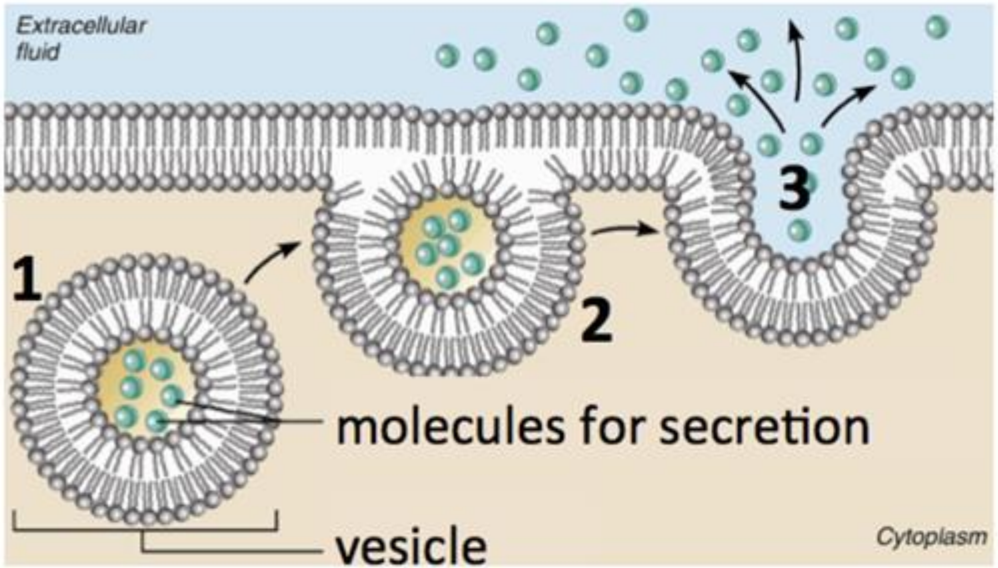
Membrane pinches in to surround a molecule, a particle, or some extracellular fluid, creating a cavity that becomes a vesicle

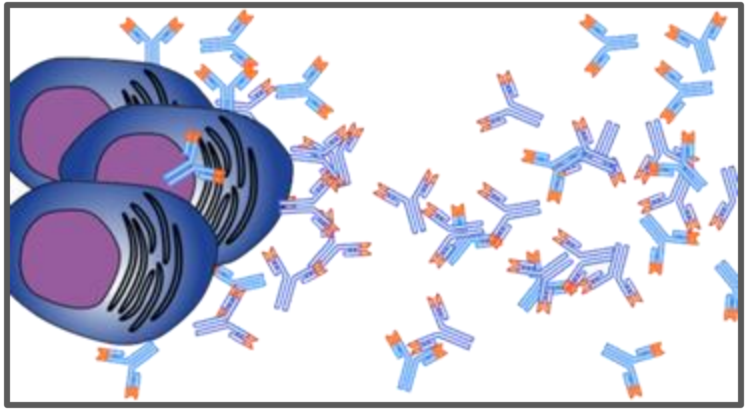

Bacterium
Pseudopods
Nucleus
Phagocytosis
Phagosome
(food vacuole)
Phagolysosome
Post-digestion
Digestion

Receptor-mediated endocytosis can be exploited by viruses



Exocytosis

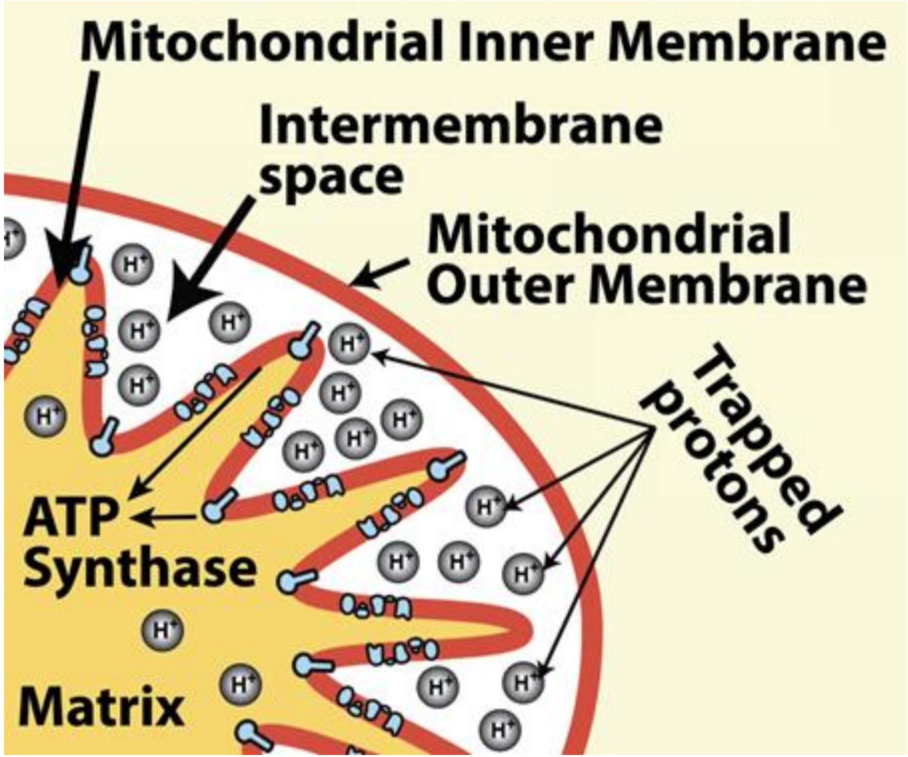




B-cell secreting antibodies through exocytosis

- Vesicles (1) fuse with membrane, releasing their contents

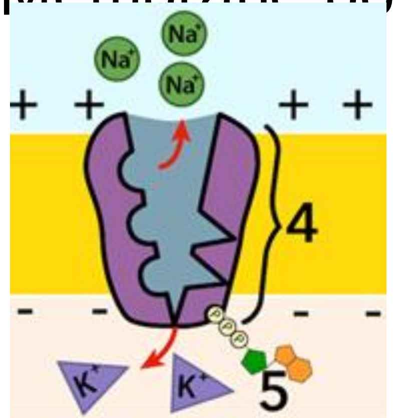
Membrane Potential



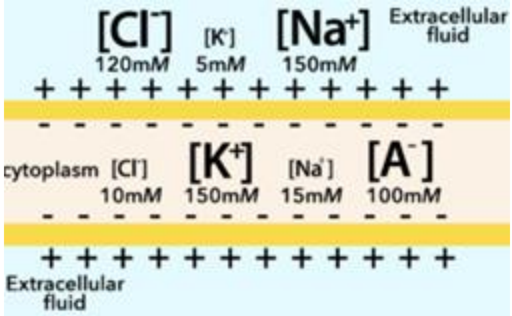
Proton Gradient→ Membrane Potential

- An electrical charge across a membrane.
- CREATED by pumping ions across membranes (active transport)
- KEY EXAMPLE (preview of Unit 3)
  - Mitochondria pump protons from the mitochondrial matrix to the intermembrane space.
  - Gives intermembrane space a positive charge relative to the matrix.
  - Creates an electrochemical gradient that pulls protons through ATP synthase back to the matrix, generating ATP.

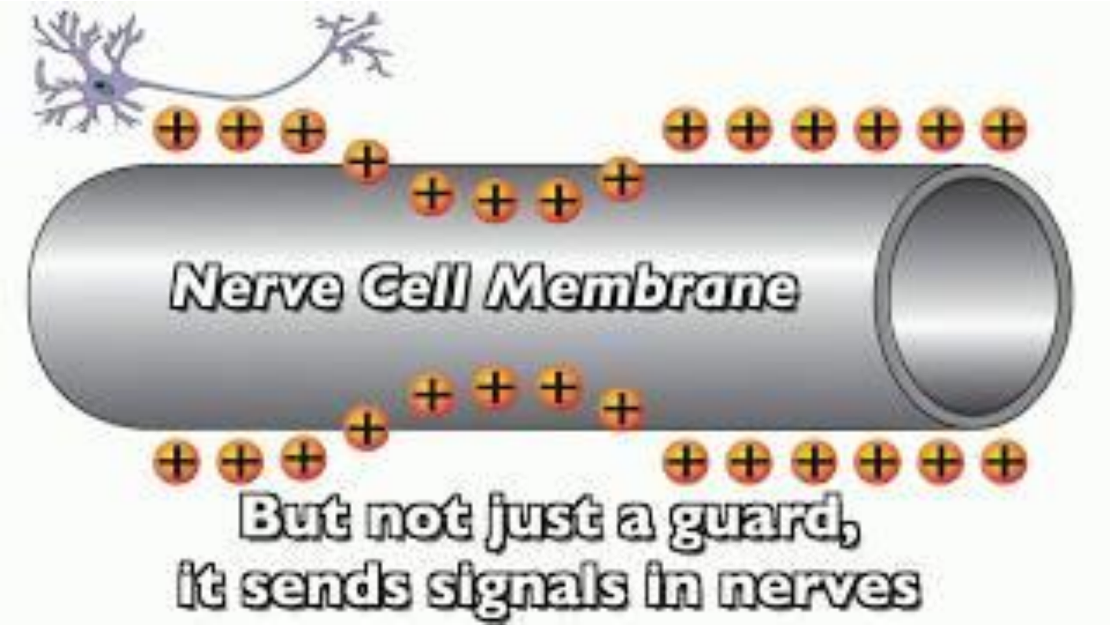
Membrane potential generated by the sodium/potassium pump



Sodium/ potassium pump is powered by ATP



Creates a -70 mV charge across nerve cell membranes



Makes nerve impulse transmission possible

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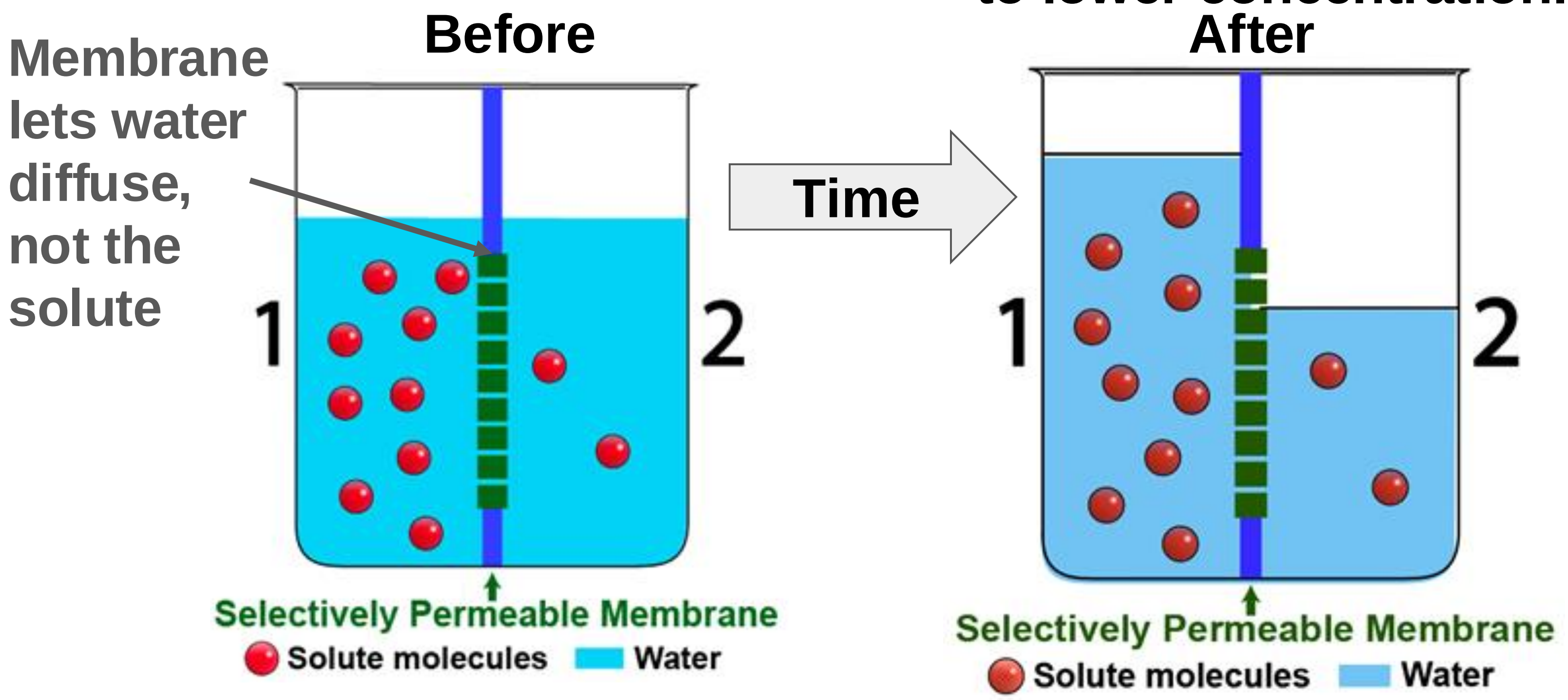
TOPIC 2.8, part 1

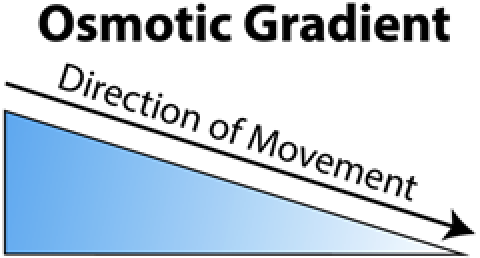
Osmosis and its consequences

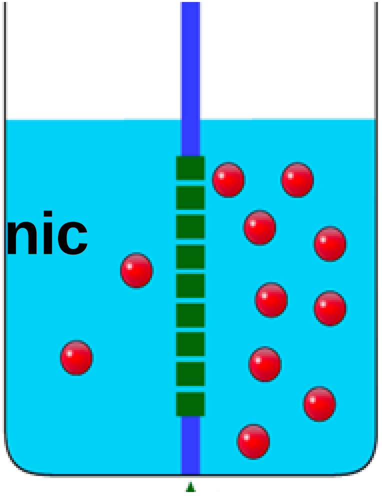
Osmosis is the diffusion of water.

Movement of water from higher to lower concentration.



Water flows down its concentration gradient from hypotonic to hypertonic.



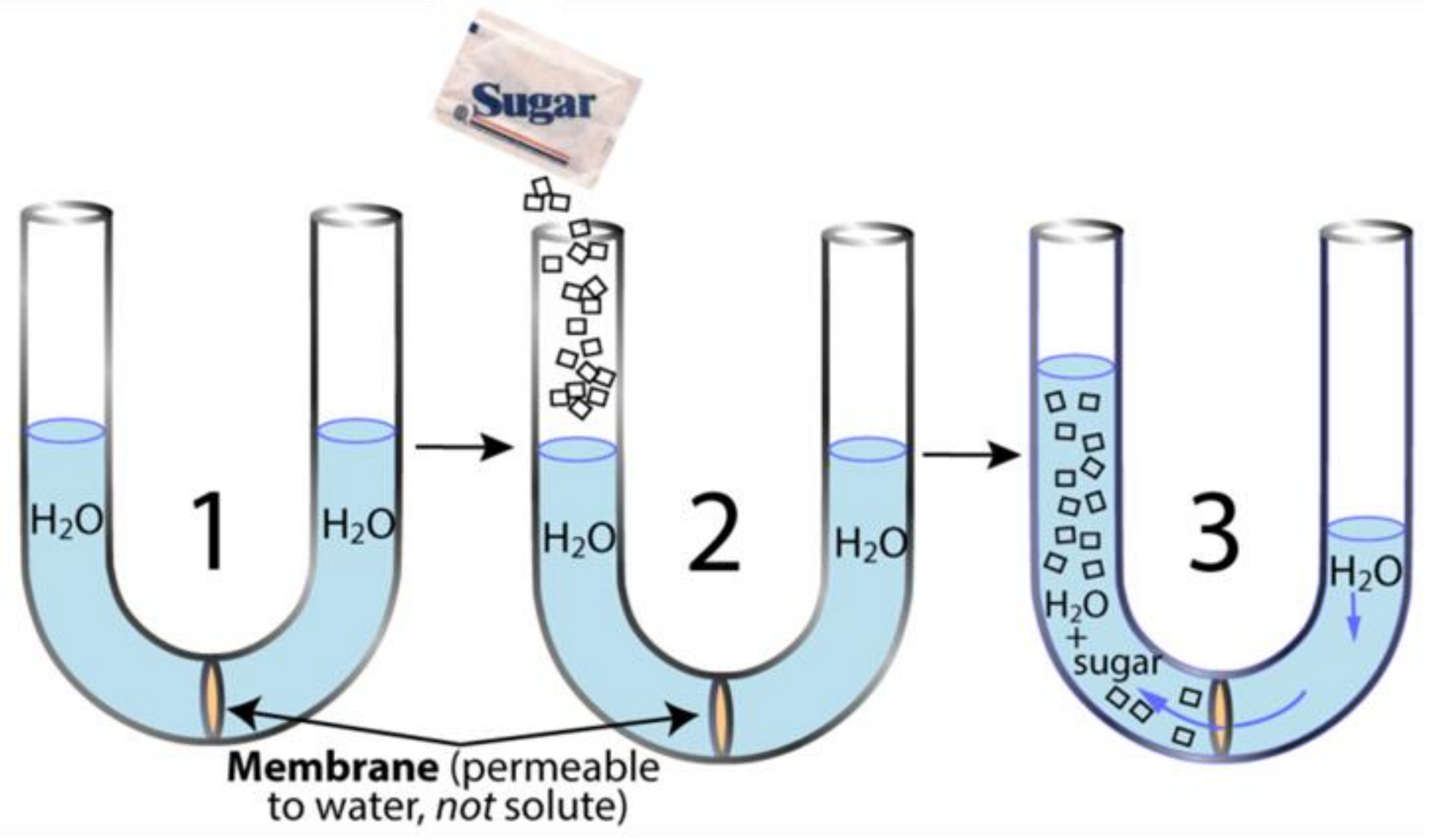


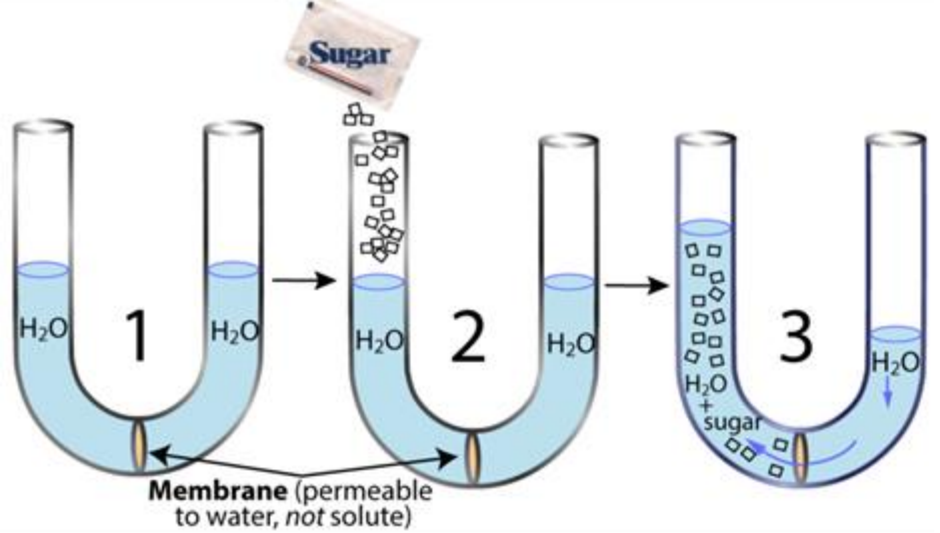
Hypotonic **Hypertonic**

- Hypotonic:
  - *Relatively* more water
  - *Relatively* less solute
- Hypertonic
  - *Relatively* less water
  - *Relatively* more solute

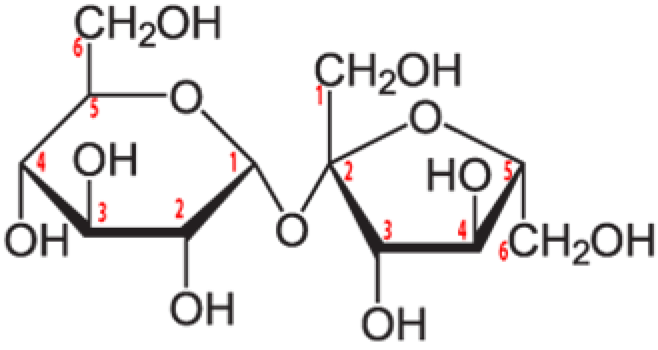
MEMORIZE: Water diffuses from hypotonic to hypertonic

Water flows from hypotonic to hypertonic: U-tube example

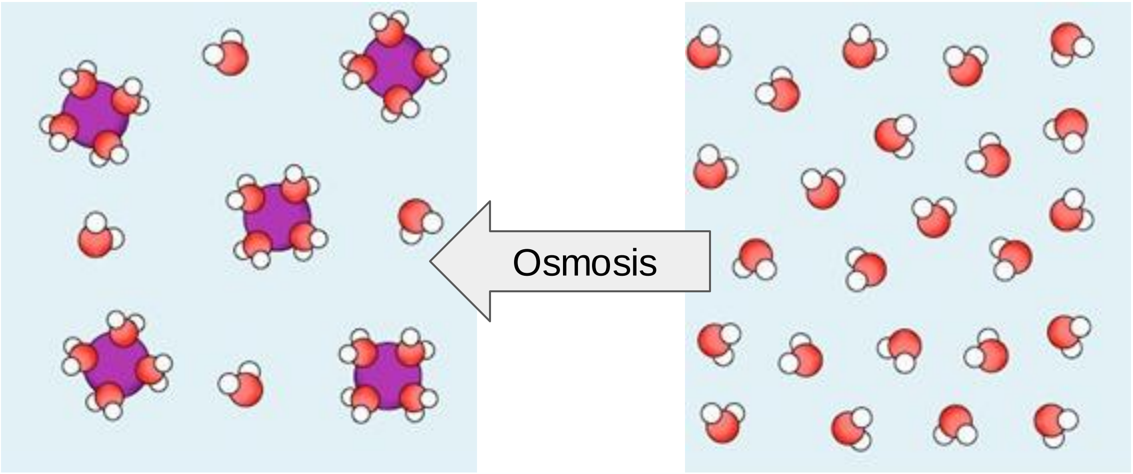




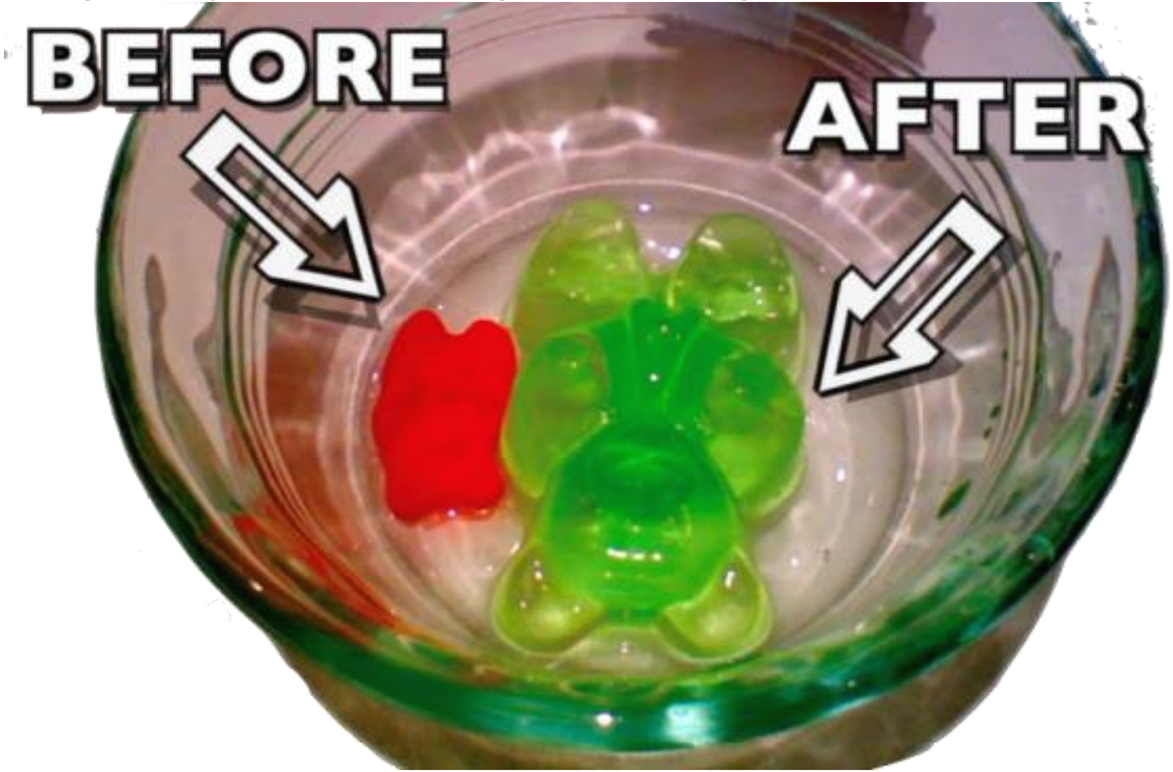
What's happening on a molecular level



Sucrose

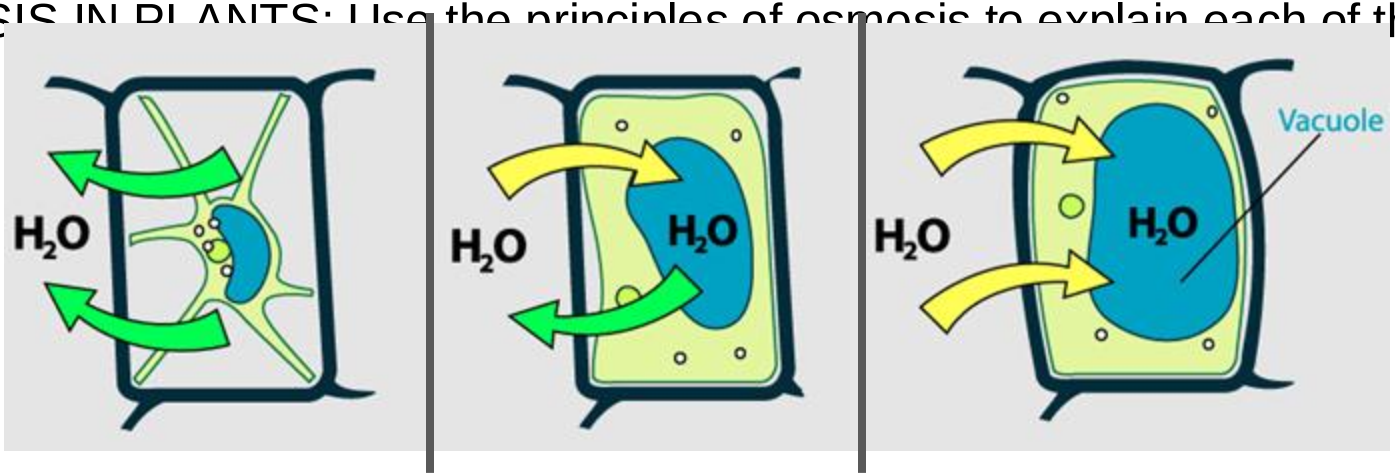


A student places a gummy bear in a bowl of water overnight. The next day, the gummy bear has expanded. Explain.



- Gummy bear is mostly sugar.
- Water in bowl is 100% water.
- Water flows from the hypotonic solution in the bowl to the hypertonic gummy bear.

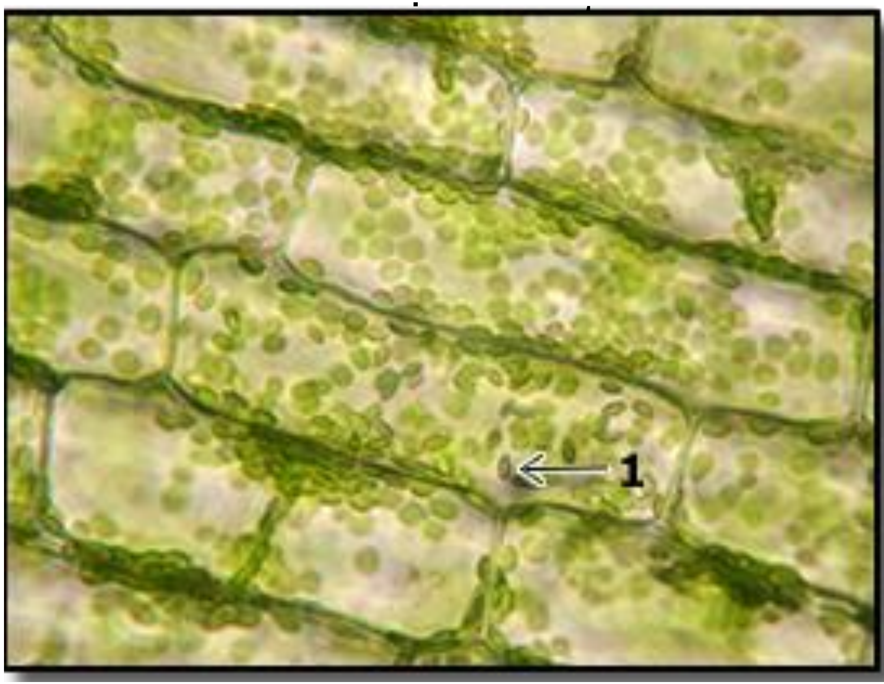
OSMOSIS IN PLANTS: Use the principles of osmosis to explain each of the images below.



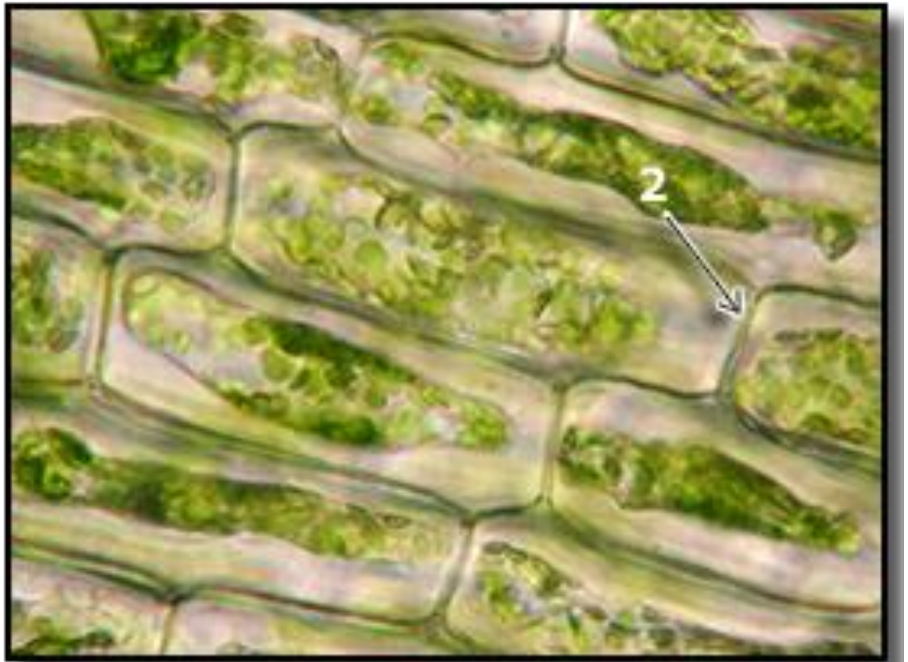
- LEFT: Cell is hypotonic to environment. Water leaves the cell, the membrane peels away from wall: AKA: *plasmolysis*. Vacuole shrinks. Plant wilts.
- CENTER: Cell is isotonic to environment. Water enters and leaves the cell at the same rate.
- RIGHT: Clell is hypertonic to environment. Water flows into the cells. Turgor pressure → vacuole to expand.

Explain

Elodea in its normal freshwater

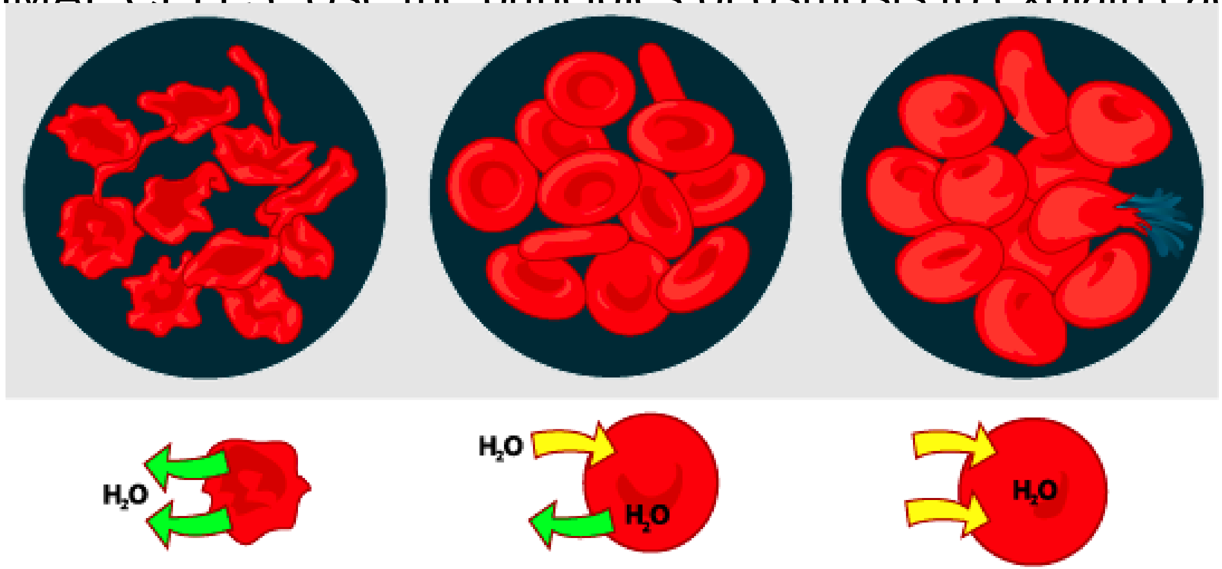


Elodea placed in saltwater



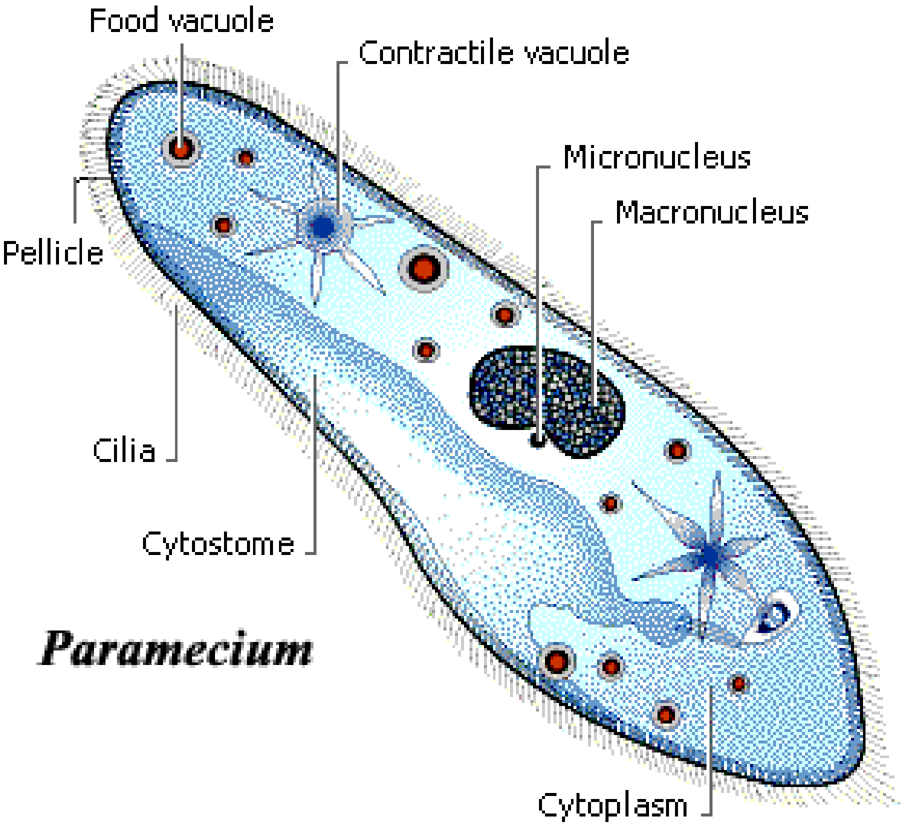
- The salt makes the cells hypotonic to their environment. Water leaves the cell, the membrane peels away from wall: AKA: *plasmolysis*.

OSMOSIS IN ANIMAL CELLS: Use the principles of osmosis to explain each of the images below.



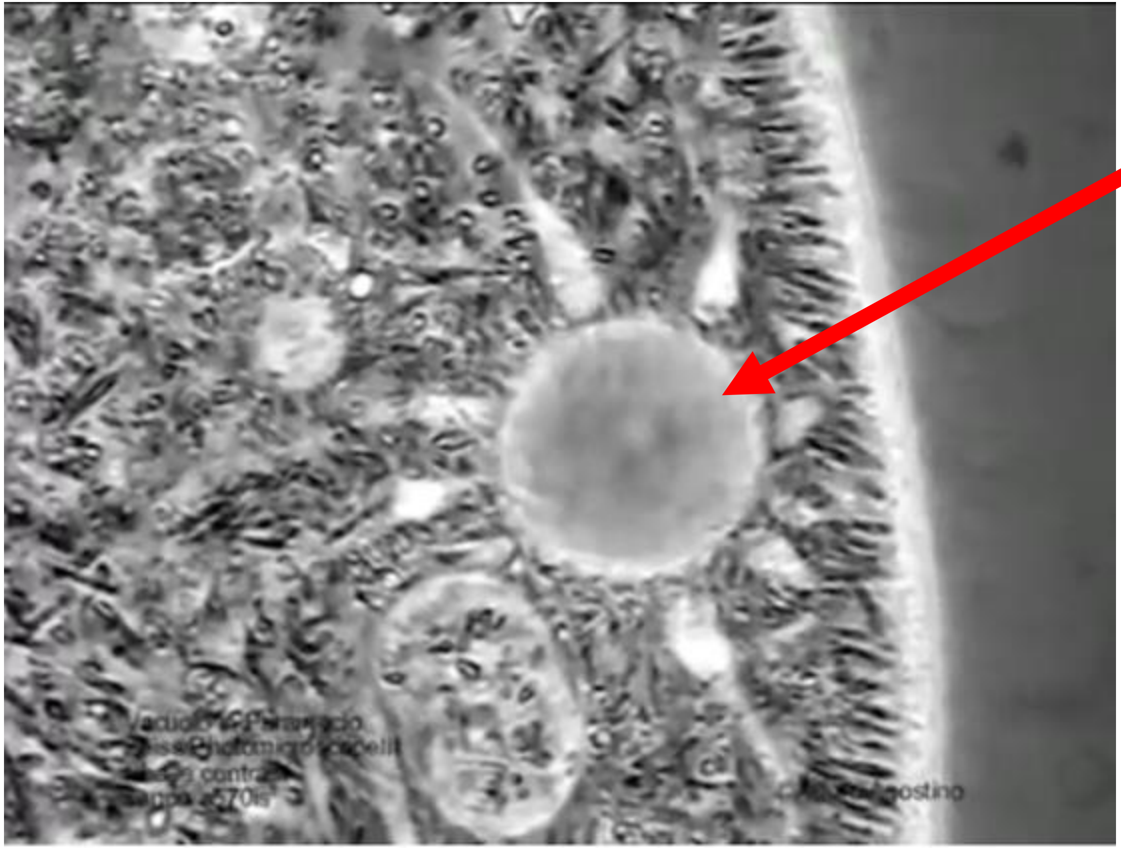
- LEFT: Cell is hypotonic to environment. Water leaves the cell, cell shrinks.
- MIDDLE: Cell is isotonic to environment. Water enters and leaves the cell at the same rate.
- RIGHT: Cell is hypertonic to environment. Water flows into the cells. Cell bursts

Explain the function of the contractile vacuole in freshwater protists such as *Paramecia*

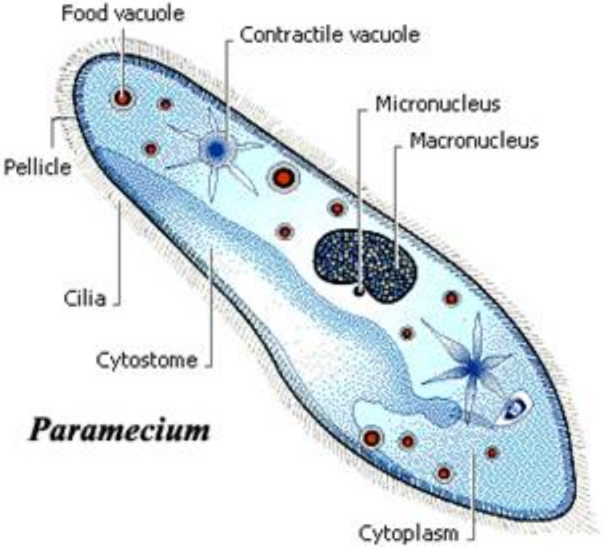


- Protists in freshwater are hypertonic to their freshwater environment.
- As a result, water moves into these cells by osmosis.

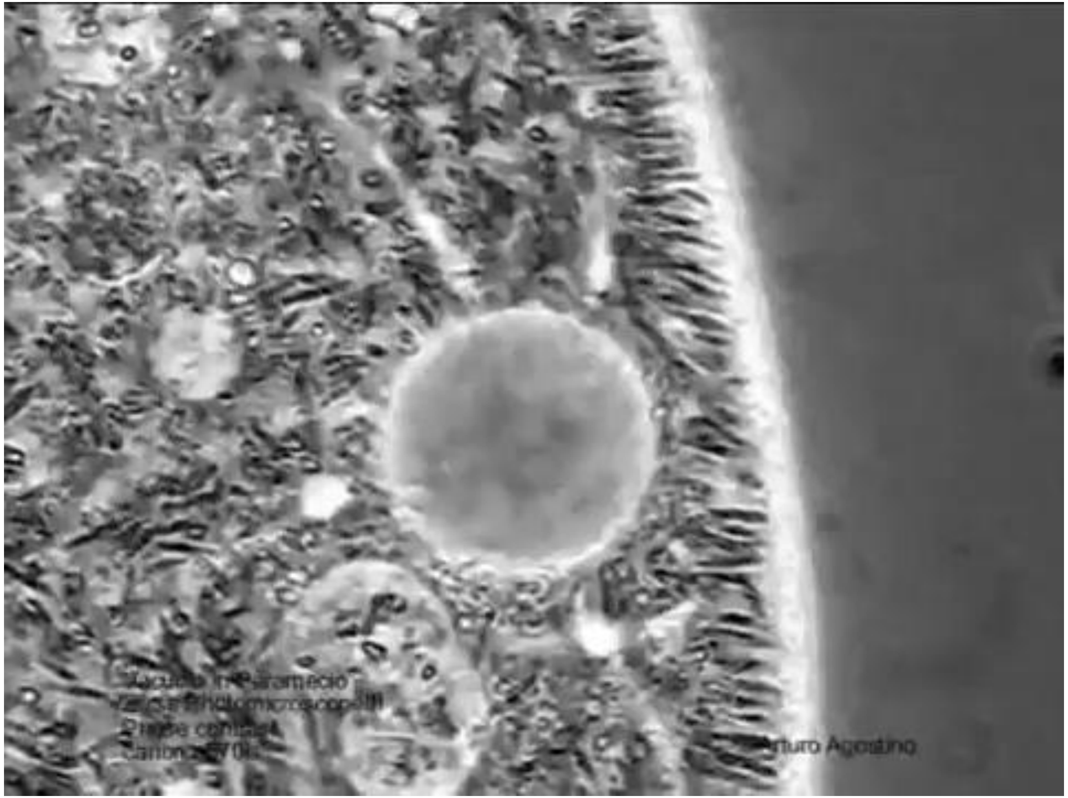
Explain the function of the contractile vacuole in freshwater protists such as *Paramecia*.



Contractile vacuole

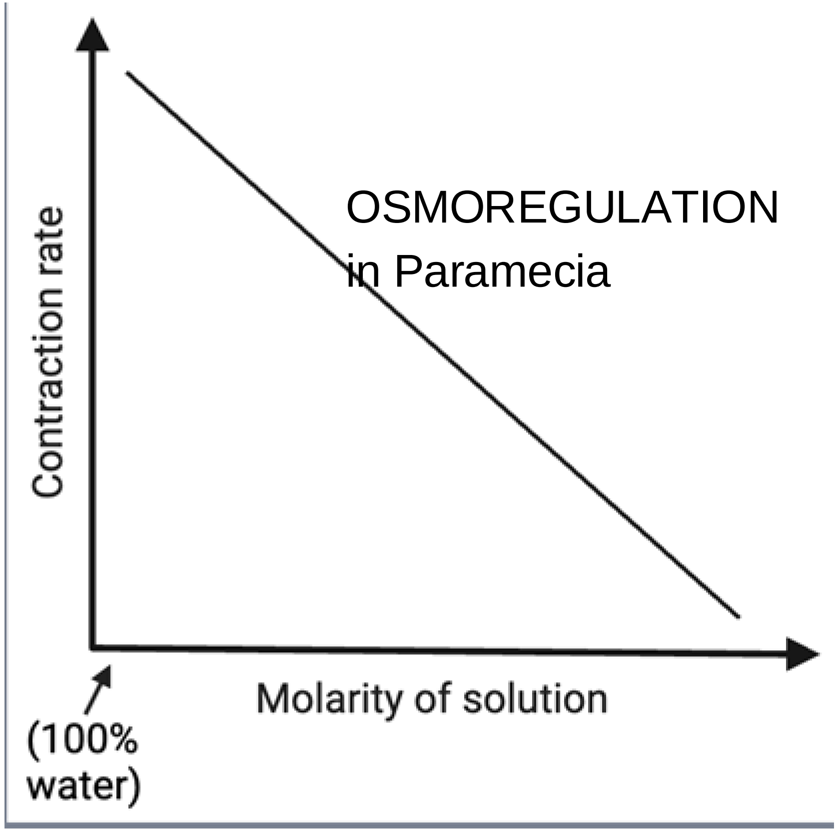


Explain the function of the contractile vacuole in freshwater protists such as *Paramecia*.



To osmoregulate, the contractile vacuole fills with water and then contracts to expel water from the cell.

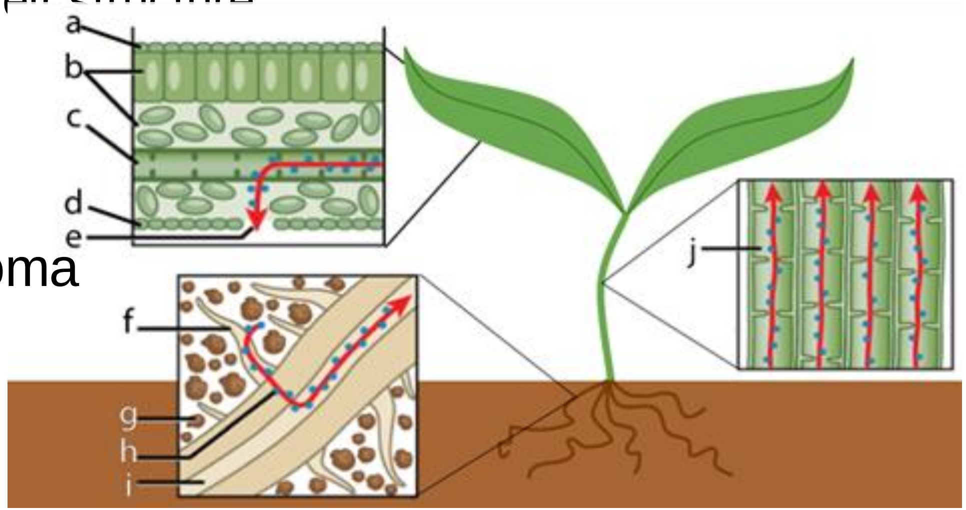
Explain the function of the contractile vacuole in freshwater protists such as *Paramecia*.

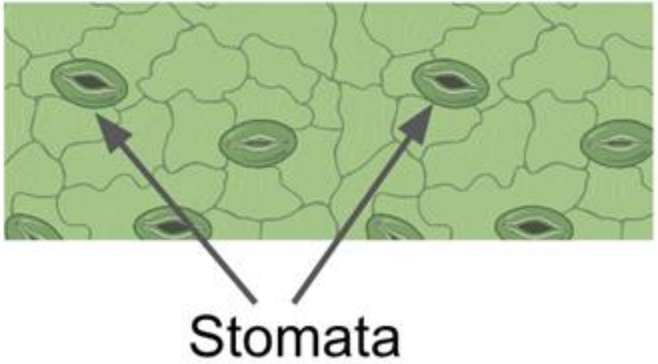


- If the environment becomes more hypertonic, the cell can adapt by decreasing its rate of contractile vacuole contraction
- It can do the reverse in more hypotonic environments.

Stomata are used for osmoregulation in plants. Describe their structure

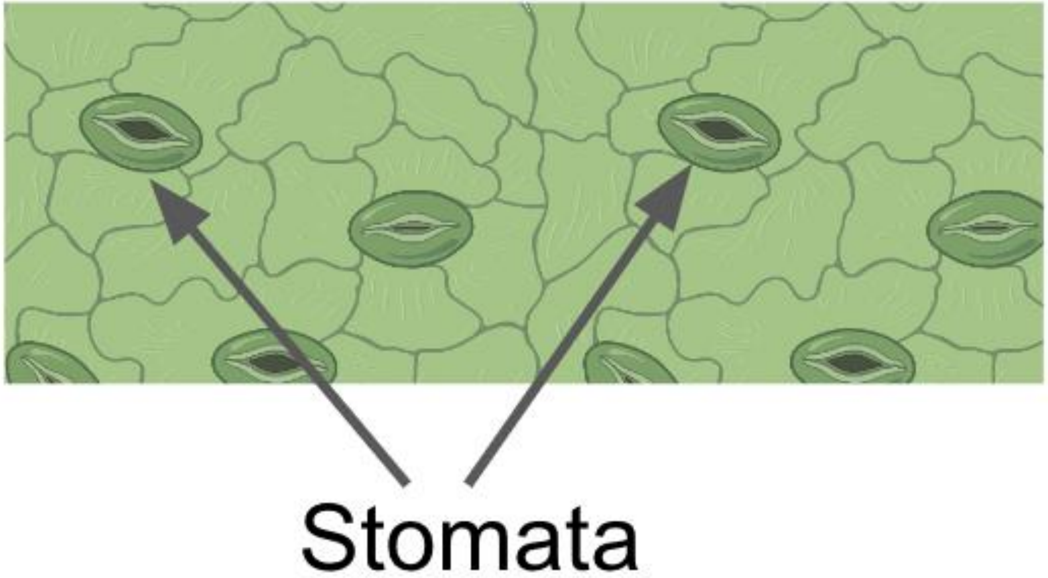
Stoma





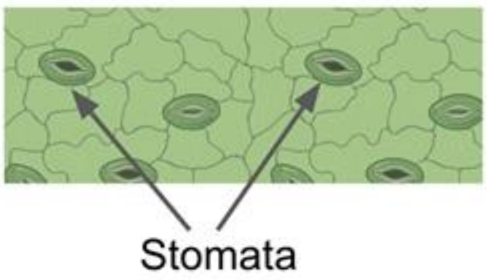
- Pores on the underside of leaves
- Each stoma (singular) is formed by two guard cells.

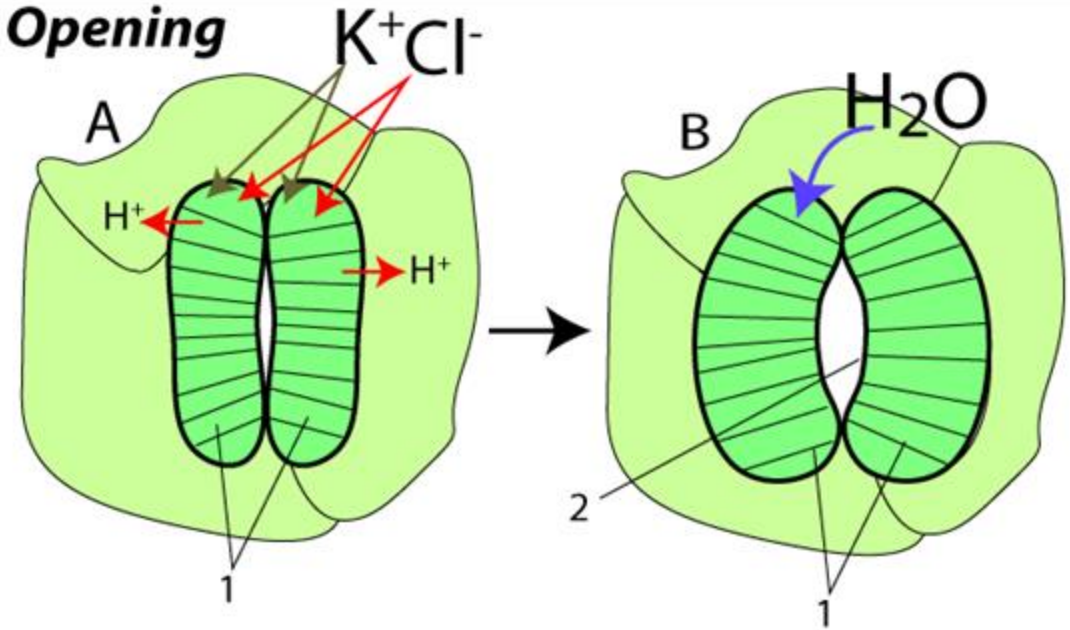
Describe the structure of leaf stomata.



- With sufficient water, guard cells buckle outward
- This creates a pore (stoma) that allows CO_2 to enter the leaf for photosynthesis
- PROBLEM: this also allows water vapor to escape.
- Stomata close in response to environmental cues, including water stress

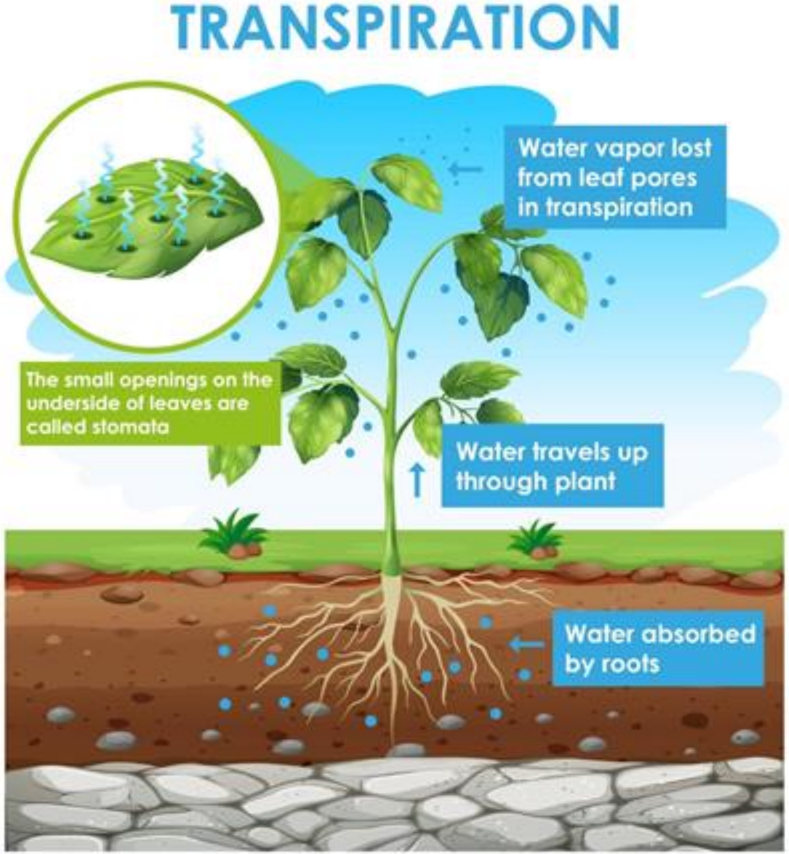
Explain how guard cells are regulated in order to open and close stomata.





- When water is available, adjacent cells pump potassium ions into the guard cells.
- Water follows by osmosis, causing the guard cells to buckle and open.
- When water is scarce, this pumping stops. Potassium ions flow out of the guard cells, and water follows, causing the stomata to close.

Understanding stomata is key to understanding the transpiration lab



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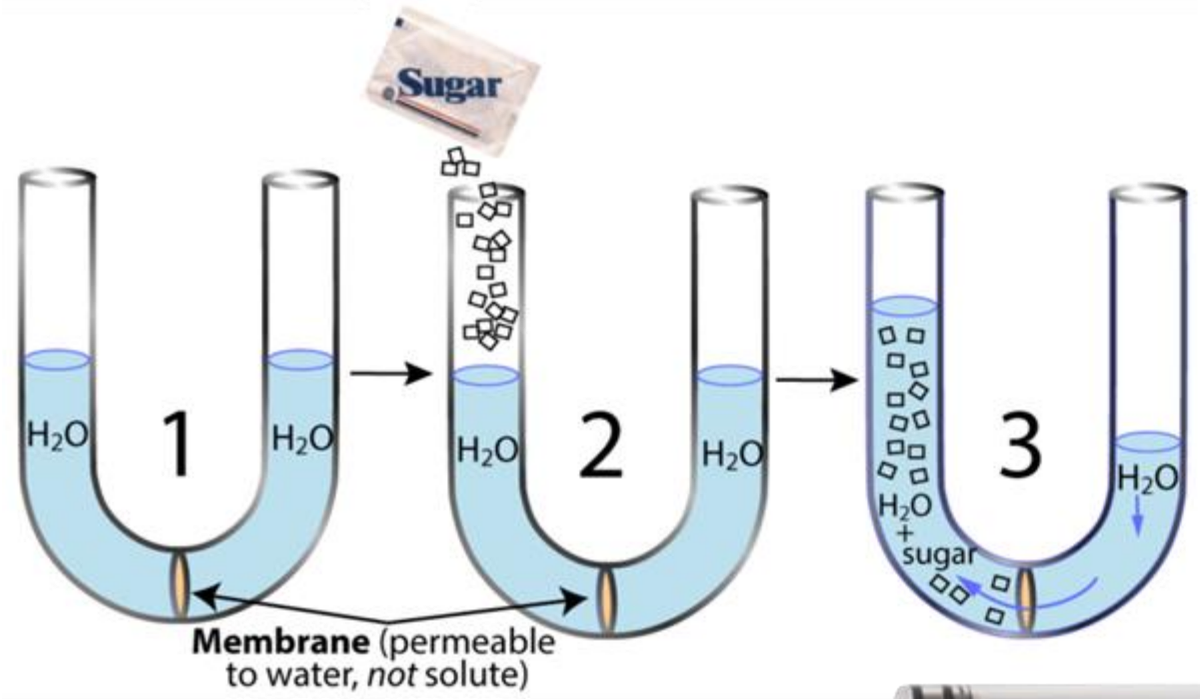
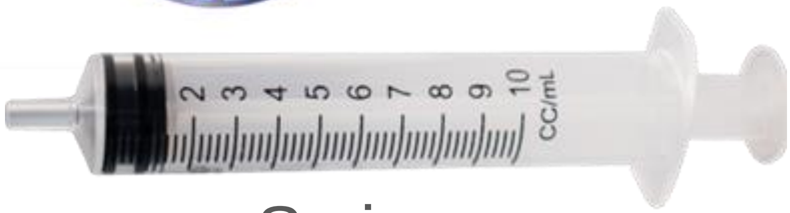
TOPIC 2.8, part 2

Water Potential

What is water potential (Ψ)?

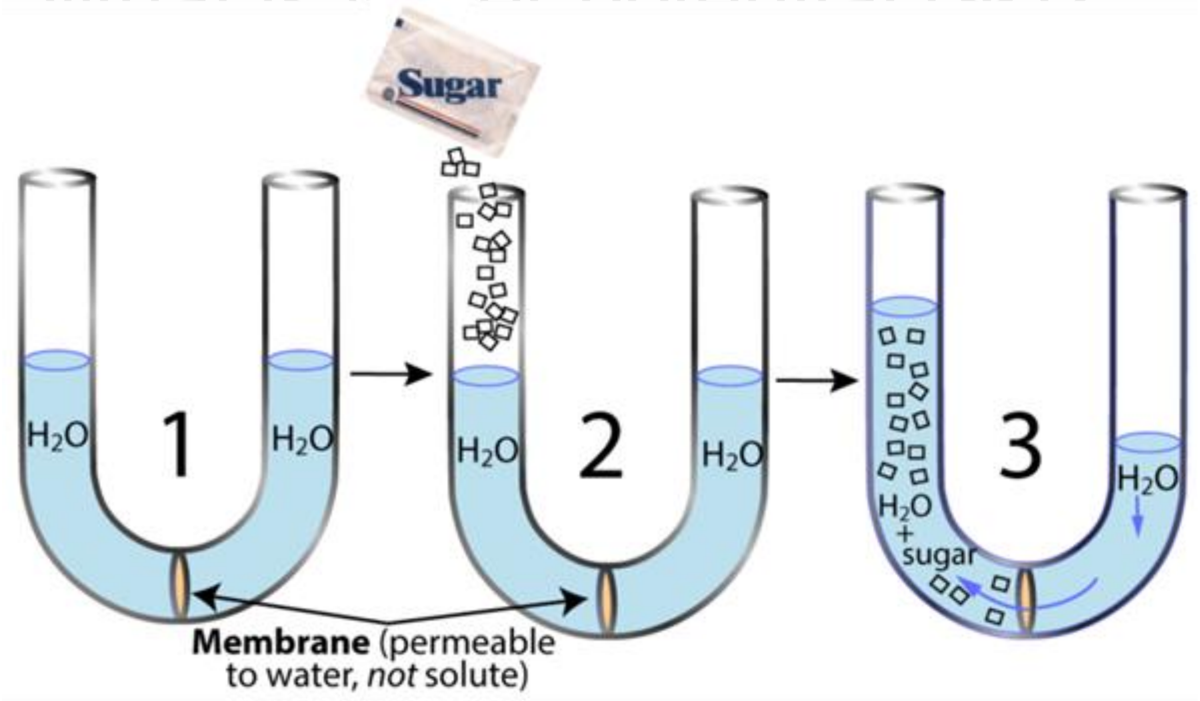


- Ψ: A measurement of water's tendency to move from where it is to where it's not
- Adding solute decreases water potential
- Pressure increases water potential.



Syringe

What is water potential (Ψ)?



MEMORIZE THIS RULE:

Water flows from areas of higher water potential to areas of lower water potential.

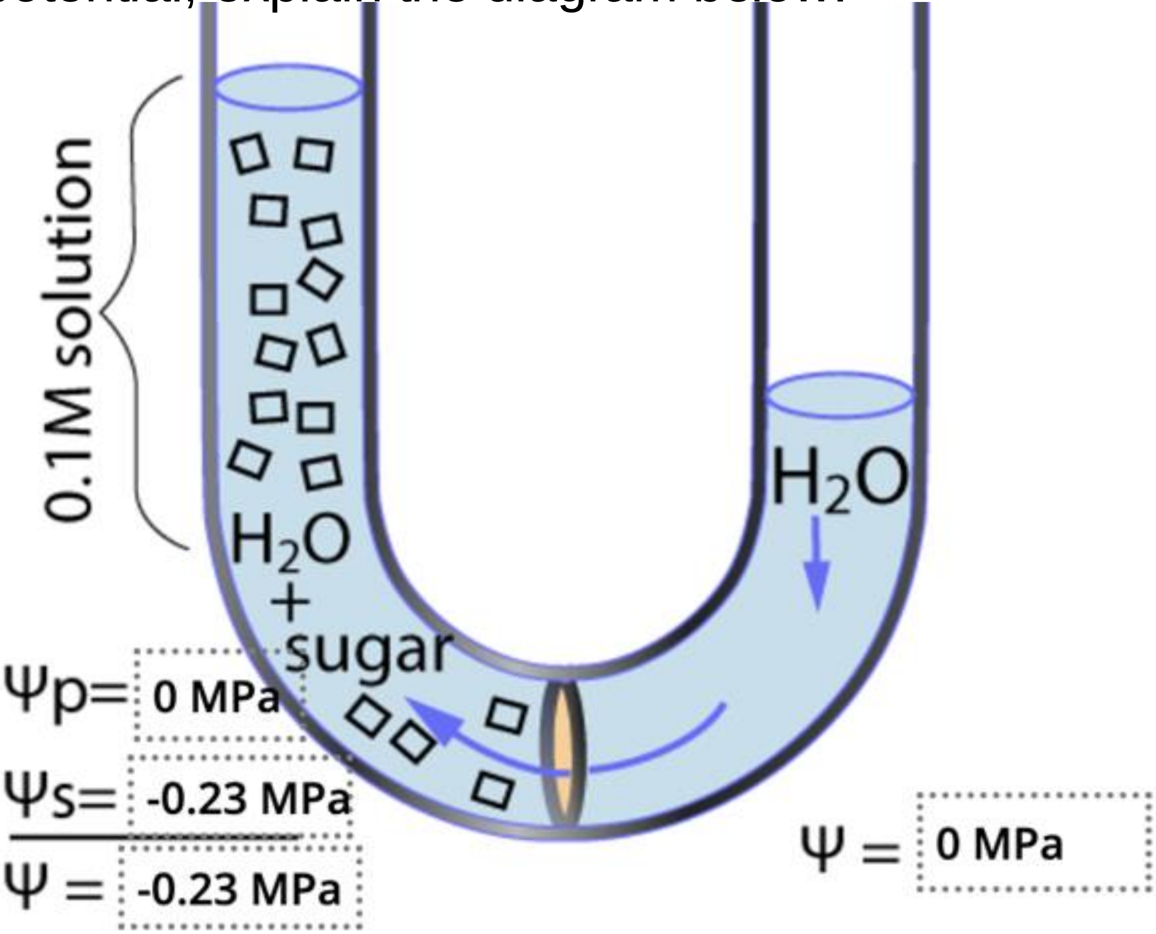
Explain the formula for water potential.

$$\Psi = \Psi_S + \Psi_P$$

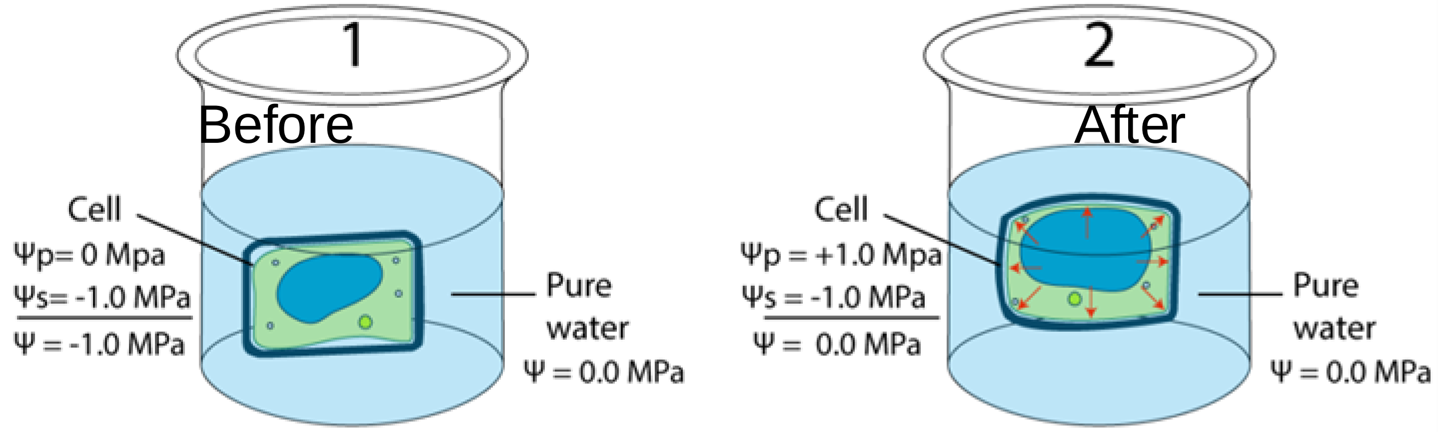
Water potential — Solute potential — Pressure potential

- Ψ : water potential
- Ψ_S: solute potential.
  - Adding solute to water *decreases* its water potential.
- Ψ_p: pressure potential.
  - Adding pressure (like pressing on the plunger of a syringe) increases water potential

Using water potential, explain the diagram below.



Using the concept of water potential, explain what's happening in the diagram below



- There's no pressure (Ψp = 0 Mpa)
- There's lots of solute in cytoplasm, creating a negative solute potential (Ψs = -1 Mpa)
- $\Psi = \Psi_S + \Psi_P = 0.1 + 0 = -1.$

- Water flows from the beaker (Ψ = 0 MPa) to the cell (Ψ = -1 Mpa)
- This increases the pressure in the cell until it reaches equilibrium with the beaker ((Ψp = 1 Mpa)

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Special topic

Sidewalks and Osmosis

Osmosis!

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Special topic

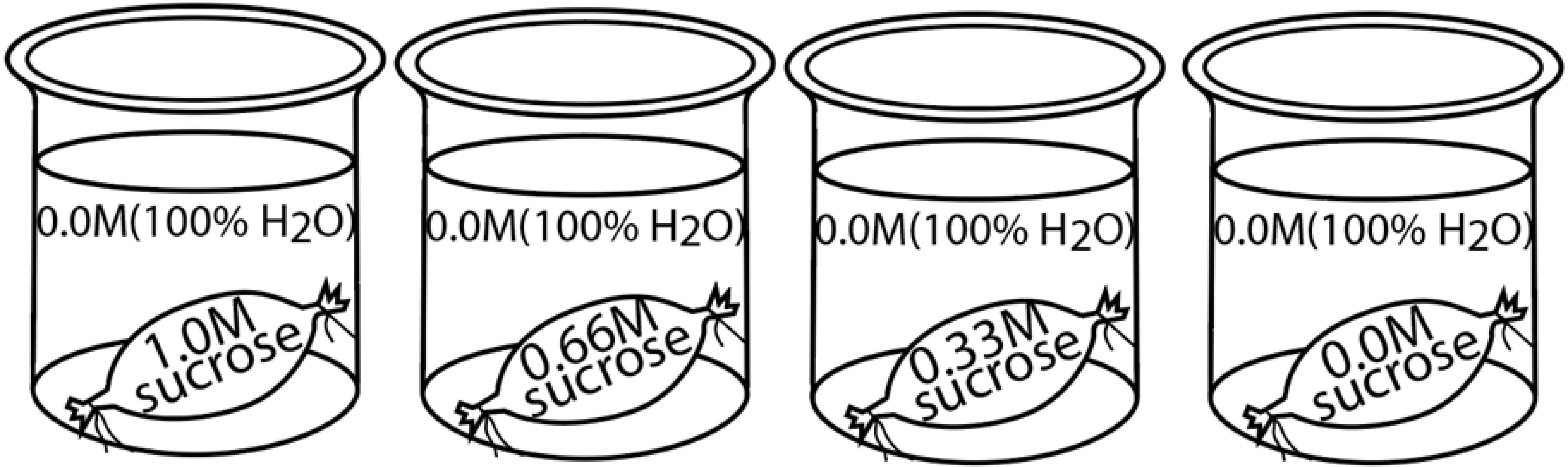
Diffusion and Osmosis Labs

All of these labs use dialysis tubing.

Selectively permeable

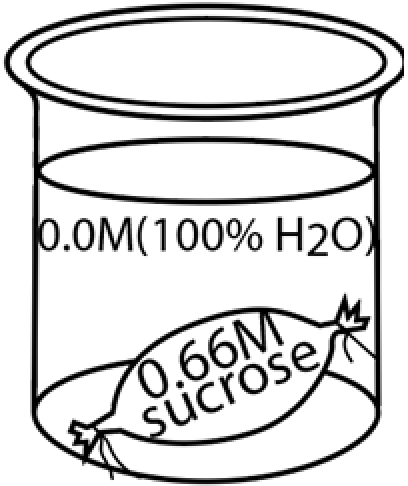
- Permeable to water, ions, and monosaccharides
- Impermeable to sucrose (a disaccharide) and larger molecules

Lab # 1: Sucrose solution in dialysis bags



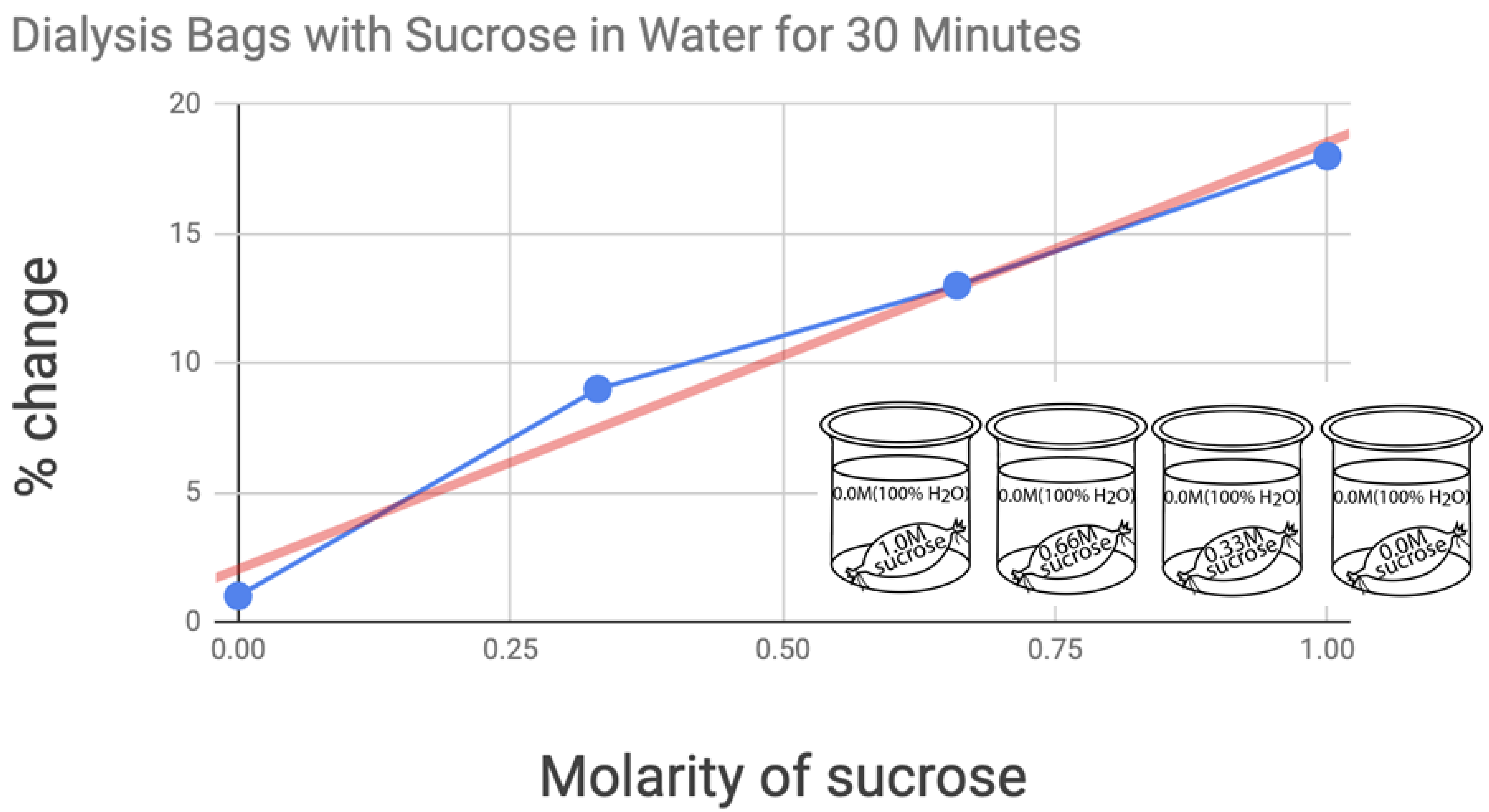
- The cup/beaker has distilled water
- The bags have sucrose solution.
- The bags sit in the water for 30 minutes. PREDICT what will happen. JUSTIFY your prediction.

You're going to calculate % change

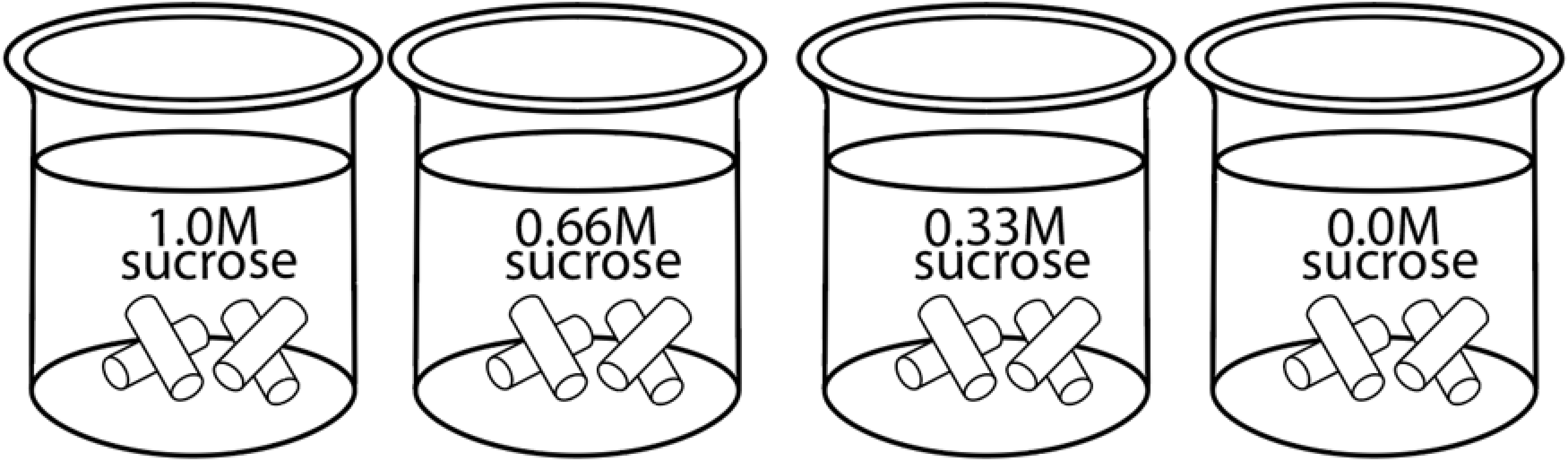


$$\text{percent change} = \frac{\text{final} - \text{initial}}{|\text{initial}|} \times 100$$

$$\frac{70\text{ g} - 50\text{ g}}{70\text{ g}} = \frac{20\text{ g}}{70\text{ g}} = 0.28 \times 100 = 28\%$$

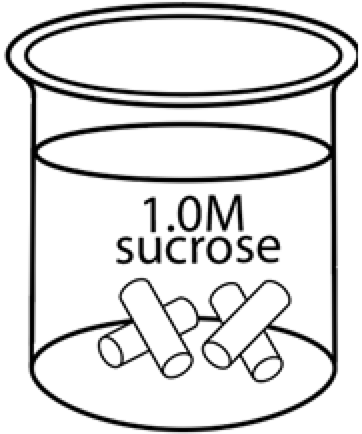

Dialysis Bags with Sucrose in Water for 30 Minutes
% change
20
15
10
5
0
0.00
0.25
0.50
0.75
1.00
Molarity of sucrose
0.0M(100% H2O)
1.0M sucrose
0.0M(100% H2O)
0.66M sucrose
0.0M(100% H2O)
0.33M sucrose
0.0M(100% H2O)
0.0M sucrose

Lab # 2: Potato cores in solutions of varying molarity



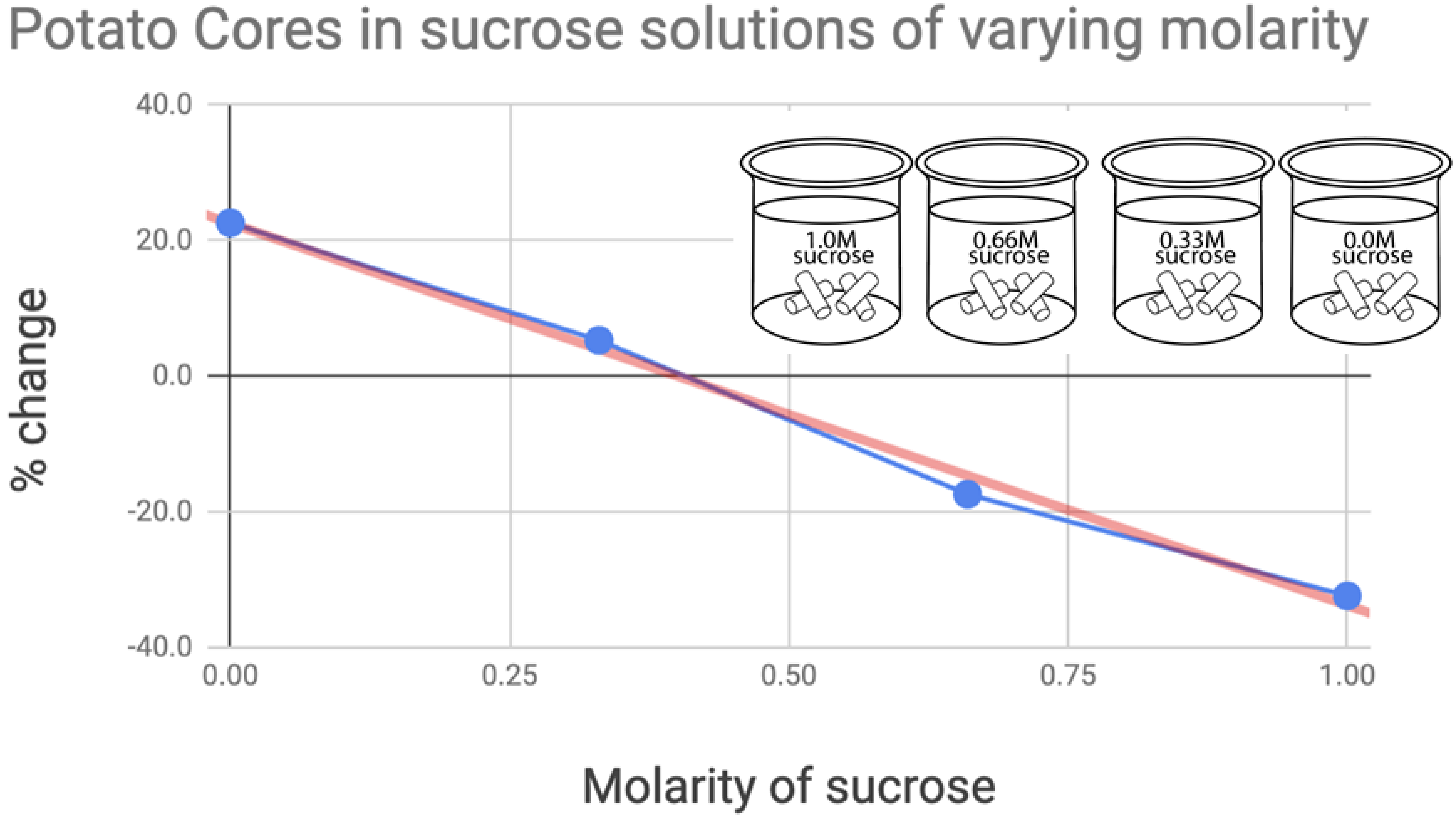
- PREDICT: what will happen to the mass of the potato cores over time?

You're going to calculate % change (which can be negative)



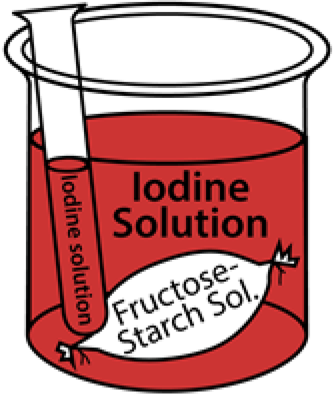
$$\text{percent change} = \frac{\text{final} - \text{initial}}{|\text{initial}|} \times 100$$

$$\frac{50\text{ g} - 70\text{ g}}{70\text{ g}} = \frac{-20\text{ g}}{70\text{ g}} = -0.28 \text{ X } 100 = -28\%$$

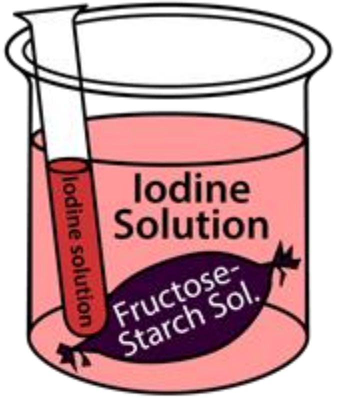

Potato Cores in sucrose solutions of varying molarity
40.0
20.0
0.0
-20.0
-40.0
% change
0.00
0.25
0.50
0.75
1.00
Molarity of sucrose
1.0M sucrose
0.66M sucrose
0.33M sucrose
0.0M sucrose

Diffusion Lab

Before After

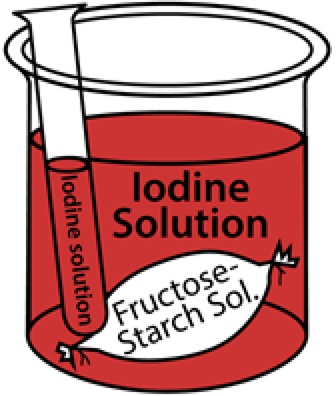


Before

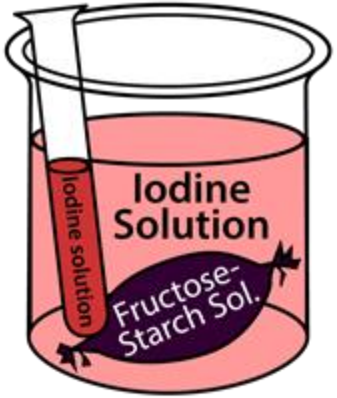


After

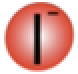
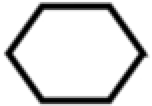
	Initial	**Final**
Color of Solution in the bag	White	Black/Purple
Color of Solution in the cup	Darker Red	Lighter Red/ Clear
Fructose Present in the Cup?	No	Yes
Iodine Present in the bag	No	Yes

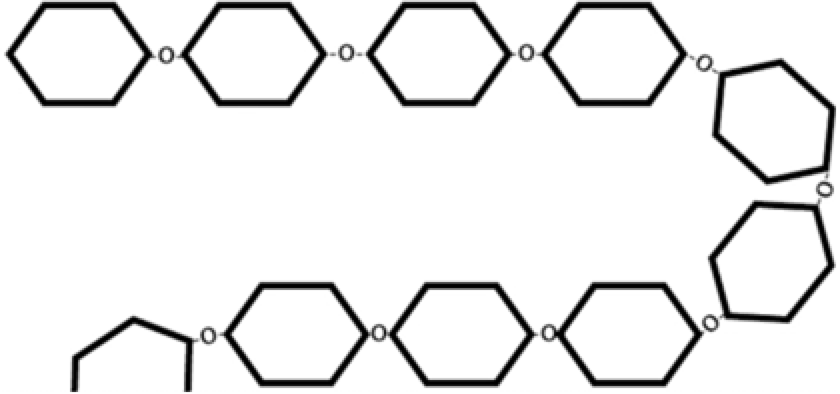


Before



After

- Iodine: 
- Fructose: 
- Starch:



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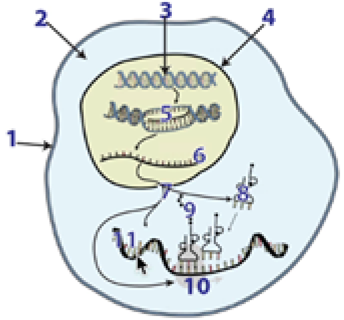
- Unit 1: Chemistry of Life
- Unit 2: Cell Structure and Function
- Unit 3: Cellular Energetics (Energy, Cellular Respiration, Photosynthesis)
- Unit 4: Cell Communication; Feedback and Homeostasis; the Cell Cycle; Cancer and Apoptosis
- Unit 5: Heredity (Meiosis and Genetics)
- Unit 6: Gene Expression and Regulation
- Unit 7: Evolution
- Unit 8: Ecology

Topic 6.4, Part 2: Translation/Protein Synthesis

1. Introduction

In previous tutorials in Unit 6, we learned about transcription and the genetic code. In this tutorial, we'll look at the cellular mechanisms involved in translation. During translation, which is also known as *protein synthesis*, ribosomes (10) "read" an mRNA message (6 and 11). With the assistance of tRNAs (8), the ribosome translates the mRNA message into a polypeptide (9): a sequence of amino acids that makes

f those genes leads to an organism's
gets transcribed into RNA, which gets
et's go.



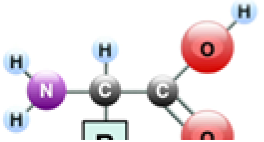
Transcription and Translation Overview

Interactive tutorials with readings, videos, flashcards, and quizzes teach students everything they need to know about every topic in AP Biology

w. If you feel that you remember that material well, jump down to the protein

1. Proteins are ***polymers of amino acids***. As shown below, each amino acid consists of a central carbon atom. The central carbon is bonded to an amino group (—NH_2) on one side, a carboxylic acid group (—COOH) on the other side, and a side chain (also known as an "R-group"). The side chains vary in their composition and chemistry and can be polar/hydrophilic, non-polar/hydrophobic, acidic, or basic.

2. There are 20 amino acids. You can think of them as an alphabet. In the same way that English uses the 26 letters of the alphabet to create hundreds of thousands of words, cells use various combinations of amino acids to create hundreds of thousands of proteins. As a result, *proteins are the most diverse macromolecule*



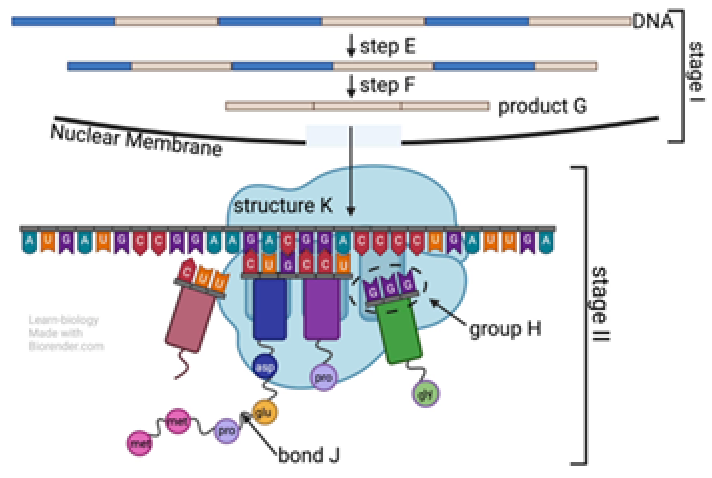
Multiple choice

Unit 6 Multiple Choice Quiz 2

7

20 questions, 7 responses, 3 correct, 4 incorrect, 17 to go

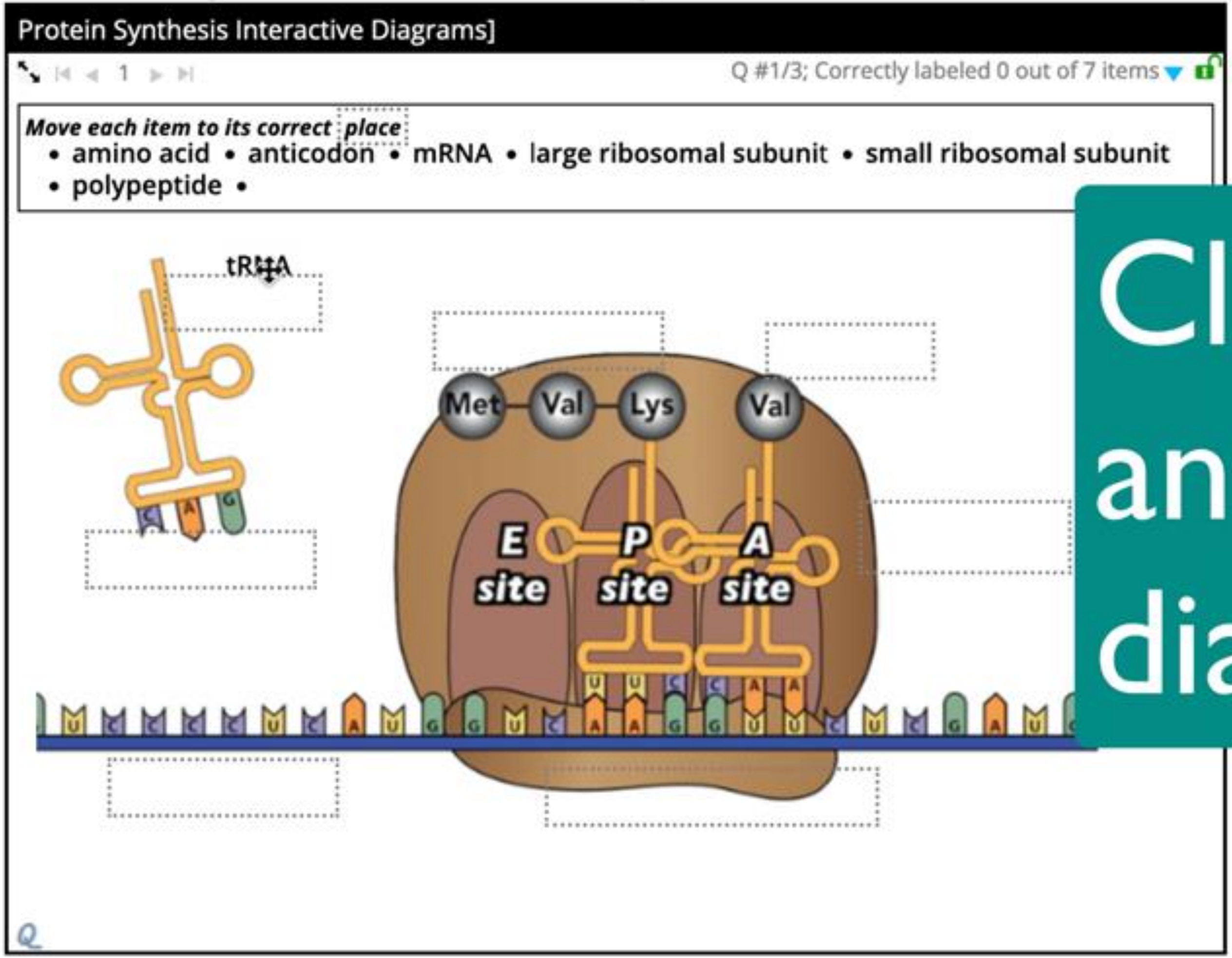
In the diagram below, step E directly results in the production of



- ○ messenger RNA.
- ○ pre-messenger RNA.
- ◉ a polypeptide chain.
- ○ complementary DNA (cDNA).

No. Polypeptide chains are sequences of amino acids, and that has to do with proteins. Here, your answer is going to be some type of RNA.

Next question



Click-and-drag diagrams

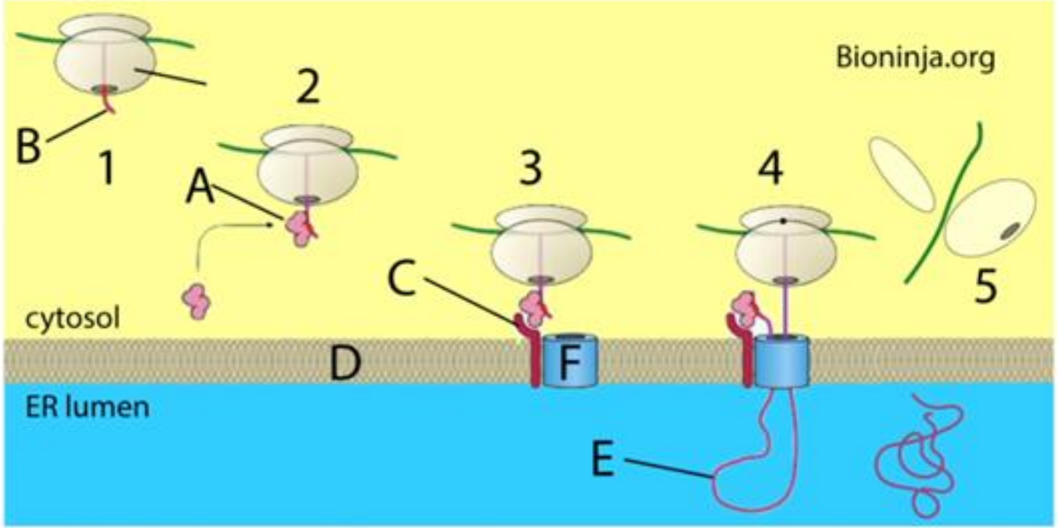
Identify the part

Protein Targeting

1

13 questions, 1 response, 1 correct, 0 incorrect, 12 to go

In the diagram below, the signal polypeptide is shown at letter



b

Terrific! "B" shows the signal polypeptide.

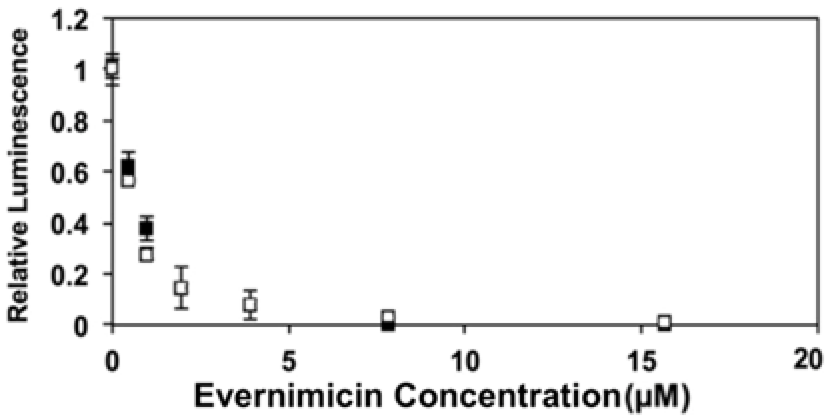
Next question

Free Response

Unit 6 Practice FRQs

10 questions, 2 responses, 2 correct, 0 incorrect, 8 to go

Scientists are studying the effectiveness of a drug, Evernimicin, on inhibiting ribosome function in the bacteria *Escherichia coli*. To do this, they measured the synthesis of luciferase, a genetically engineered protein introduced into *E. coli* to make them luminescent (glow). In their experiment, scientists tested different concentrations of Evernimicin at both 37° Celsius (white boxes) and 25° Celsius (black boxes).



PART 1: **Identify** the control group in this experiment and **describe** the difference in ribosome function in the control group in terms of relative luminescence at 37° and 25° Celsius.

PART 2: **Explain** the relationship between ribosome function and luciferase production in *E. coli*.

PART 3: A scientist proposes that Evernimicin's effect is mostly on the cell membrane of *E. coli*. **Identify** one part of the plasma membrane that could be affected by an elevated dose of Evernimicin in *E. coli*.

Show the answer

Positive Feedback for Correct Responses

Quiz: Transcription

4 — 30 questions, 4 responses, 4 correct, 0 incorrect, 26 to go

In a gene, the strand which gets transcribed into RNA is called the

- (•) template strand
- ( ) transcription unit
- ( ) promoter

Yes. The DNA strand that gets transcribed into RNA is called the <u>template strand.</u>

Next question

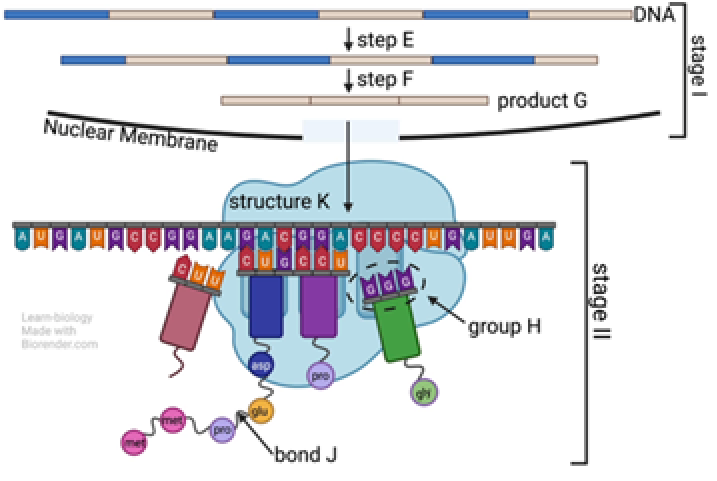
Hints and repetition for incorrect responses

Unit 6 Multiple Choice Quiz 2

7

20 questions, 7 responses, 3 correct, 4 incorrect, 17 to go

In the diagram below, step E directly results in the production of



- messenger RNA.
- pre-messenger RNA.
- a polypeptide chain.

No. Polypeptide chains are sequences of amino acids, and that has to do with proteins. Here, your answer is going to be some type of RNA.

Next question

Student Learning Guides tell students exactly what to do

Name: ______________________________ Period: _____ Date: ________

Topics 7.6 - 7.8, Evidence for Evolution: Student Learning Guide (AP Bio v2.0)

Getting started:

- Go to learn-biology.com, then AP Bio v2.0, then Unit 7, Natural Selection/Evolution
- Start with "Topics 7.6 – 7.8, Part 1: What Constitutes Evidence for Evolution? Historical Observations"
- If you're submitting this electronically to your instructor, please type your answers in **blue**, **red**, or any other color your instructor suggests.
- As you go, click on this ❑ to change it to ☑

Topics 7.6 – 7.8, Part 1: What Constitutes Evidence for Evolution? Historical Observations

☐ 1 -4. Read the introduction, section 2 ("A Theory is much more than a hypothesis"), and complete the "Theory vs. Hypothesis" flashcards and quiz.

☐ 5. Read "To prove evolution true…"

CHECKING UNDERSTANDING: In your own words, explain how the scientific meaning of the word *theory* is different from the word *hypothesis*.

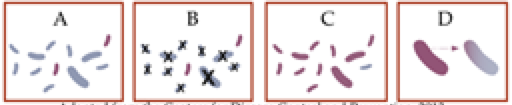
SUMMARIZE: In the space below, describe the claims that evolution makes.

☐ 6. Read "The Evolution of SARS-CoV-2 Variants.

☐ 7. Read, "Evolution of antibiotic-resistant bacteria…"

☐ 8. Complete the flashcards: SARS-CoV-2 Variants and

b. Explain how bacteria have evolved antibiotic resistance.



Adapted from the Centers for Disease Control and Prevention, 2013

☐ 9. Read about "The Evolution of Pesticide Resistance in Mosquitoes"

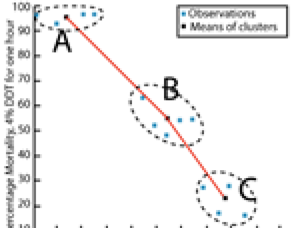
☐ 10. Read the "Evolution of new phenotypes … in the Soapberry bug"

☐ 11. Read "More Examples of Historically Observed Evolution." Follow at least one link to learn more so you can summarize that example below.

☐ 12 - 13. Complete the "Historical Examples of Evolution Flashcards and Quiz.

CHECKING UNDERSTANDING

TASK 1: Explain Pesticide resistance in Mosquitoes



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