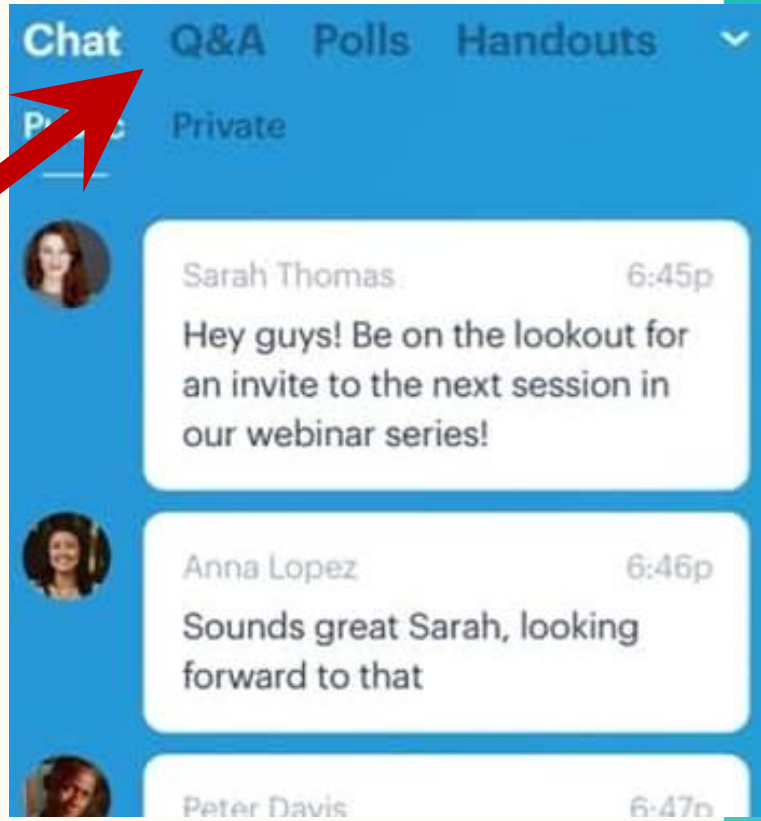
MARCO LEARNING

Jumpstart Session 3: Midterm Content Review

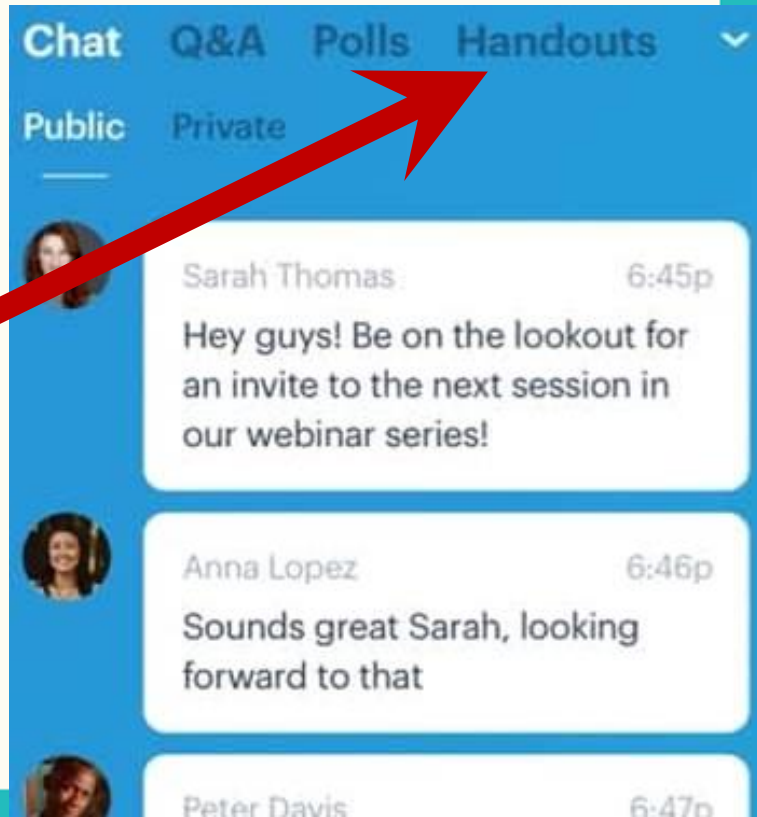
with
Tiffany Jones
& Josh Kaspar

Don’t be shy! Talk to us in the **Chat** section

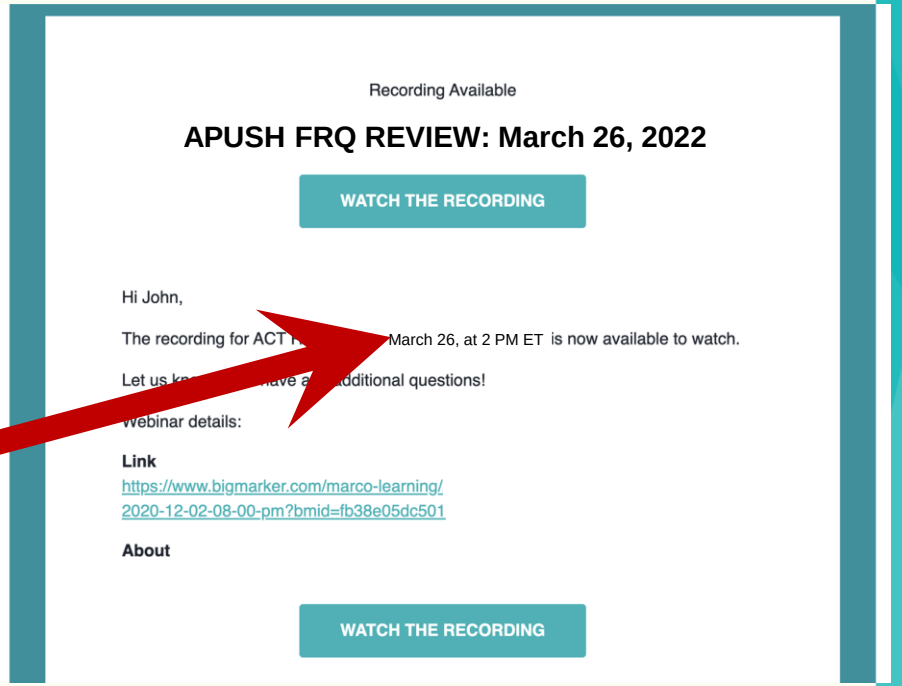
Post your questions in the **Q&A Section** and upvote your favorite questions.



Download your handouts and links in the **Handouts** tab.



All sessions **will be recorded** and sent to you via email.



Welcome – Who Are You?

Mr. Joshua Kaspar

- 10 Years of AP Biology
- Florida
- B.A. in Science Education – Biology
- AP teacher trainer and mentor

Welcome – Who Are You?

Mrs. Tiffany Jones

- 11 years of AP Biology
- Georgia
- AP Reader
- B.S. in Biology
- Ed.S. in Instructional Tech

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Semester 1

Suggested topics

Unit	Topic	Exam Weight
1	Chemistry of Life	8–11%
2	Cell Structure and Function	10–13%
3	Cellular Energetics	12–16%
4	Cell Communication and Cell Cycle	10–15%

Don’t worry if your teacher hasn’t covered these yet!

Unit 1: Chemistry of Life

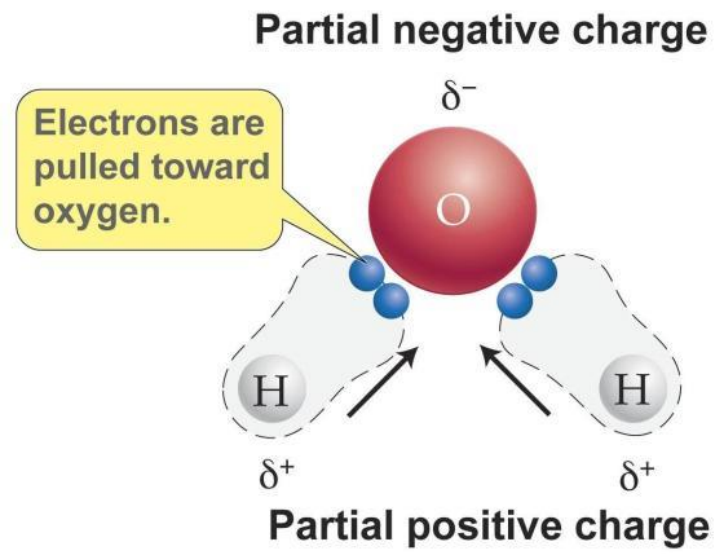
Main Idea: Living systems are organized into a hierarchy

Be able to:

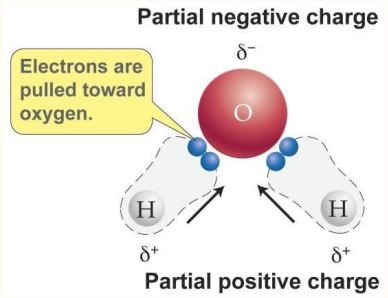
- Explain how the properties of water that result from its polarity and hydrogen bonding affect its biological function.

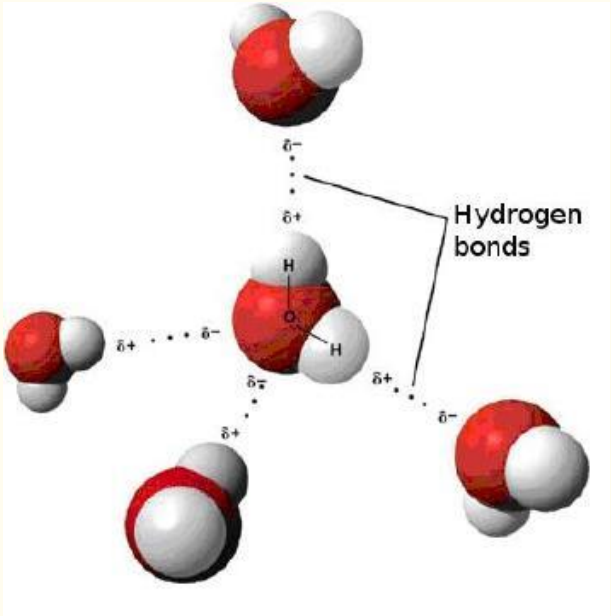
Quizizz:
5712 3747

Water is polar which causes hydrogen bonding



Water is polar which causes hydrogen bonding





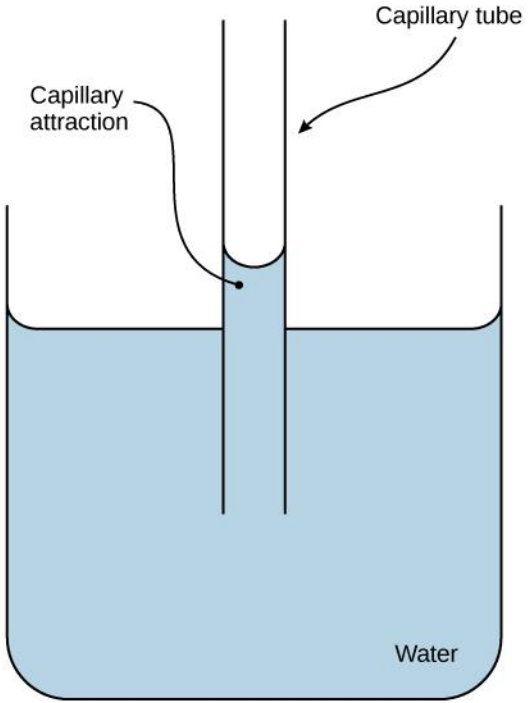
Living systems depend on the special properties of water

Due to polarity and hydrogen bonding

- Cohesion
- Adhesion

Capillary action

- Surface tension
- High specific heat capacity
- Solid is less dense
- Universal solvent
  - supports reactions



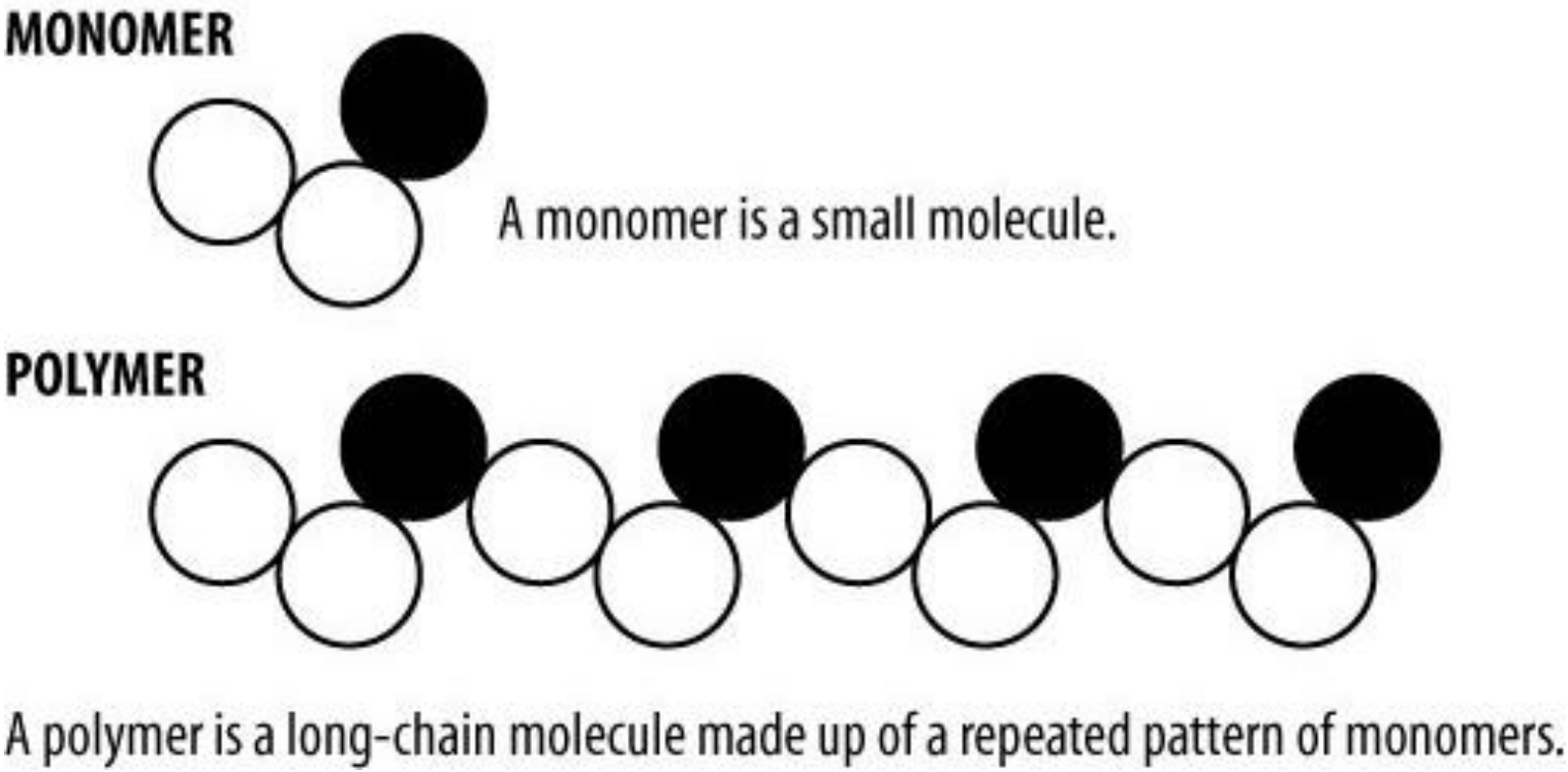
Unit 1: Chemistry of Life

Main Idea: Living things are constantly exchanging matter and energy with the environment

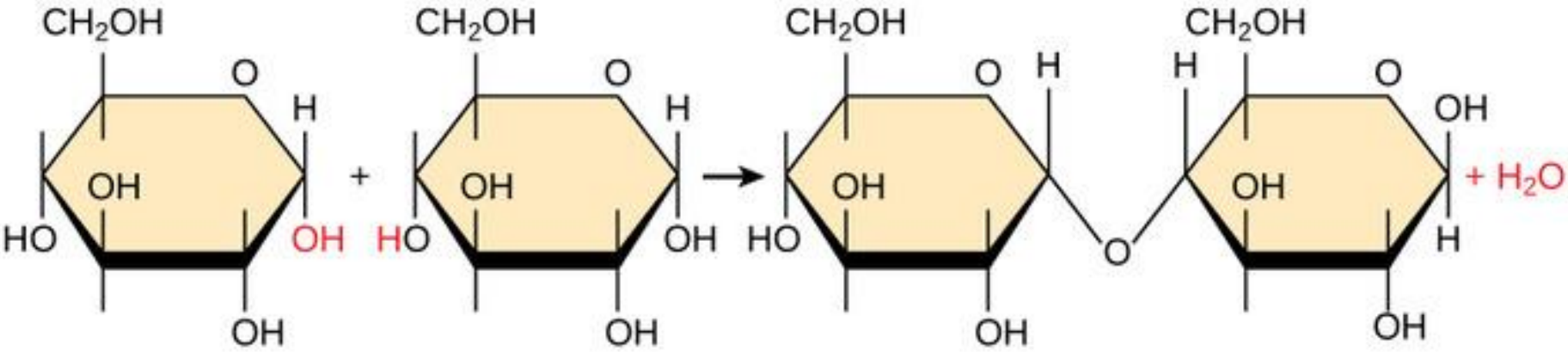
Be able to:

- Describe the composition of macromolecules
- Name the monomers of macromolecules and describe their properties
  - Including the types of bonds that connect them

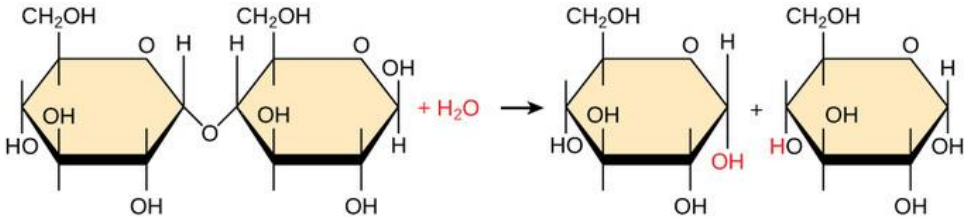
Structure and function of polymers are derived from the way their monomers are assembled



Synthesized via dehydration synthesis (condensation)



Decomposed via hydrolysis



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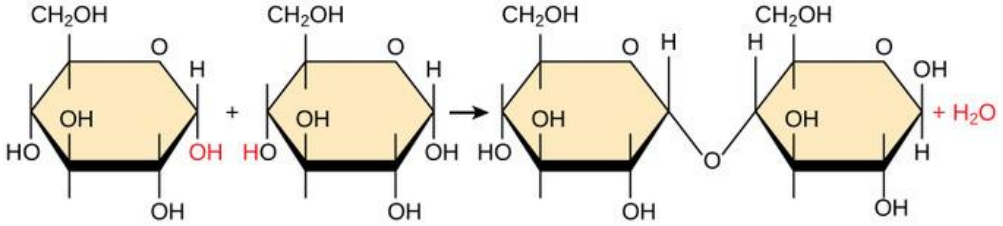
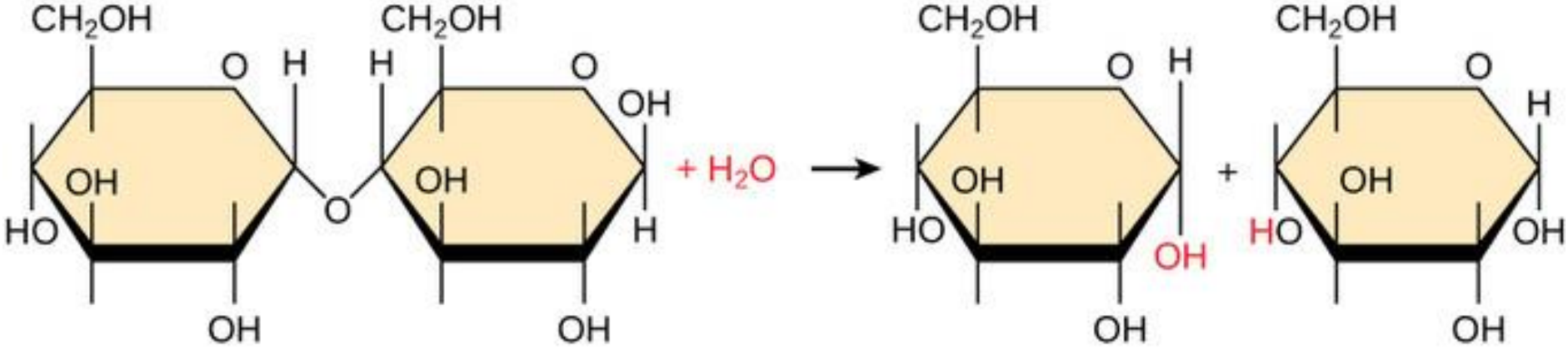


Decomposed via hydrolysis

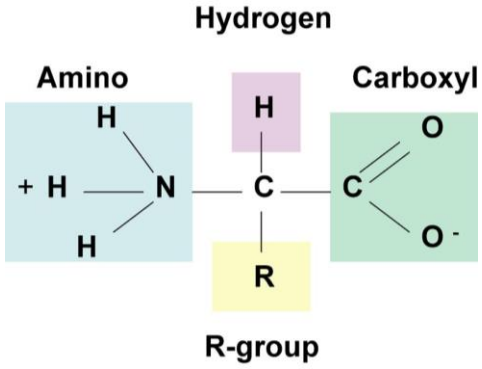


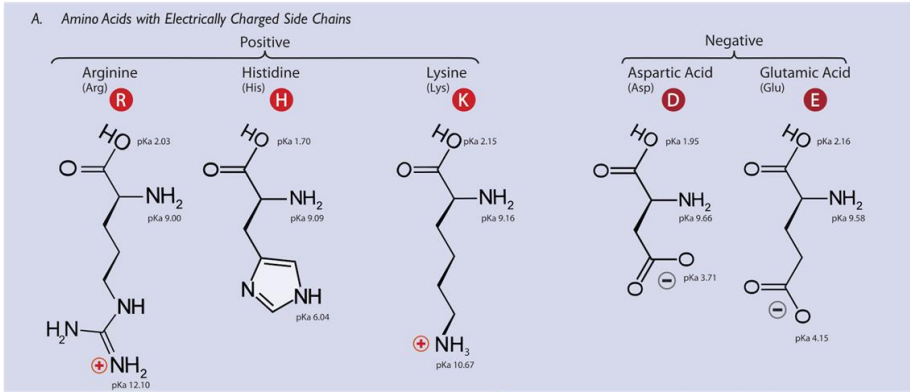
Proteins

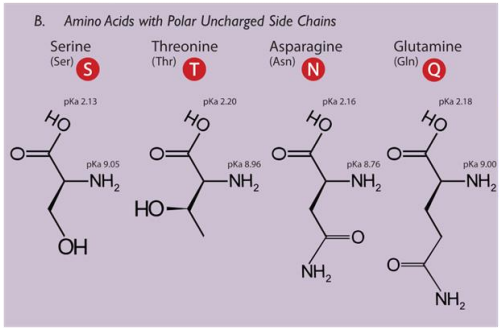
Serve crucial functions in essentially all biological processes

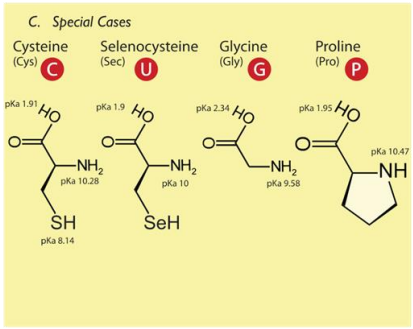
Monomer: Amino Acid (20 kinds)
Polymer: Polypeptide

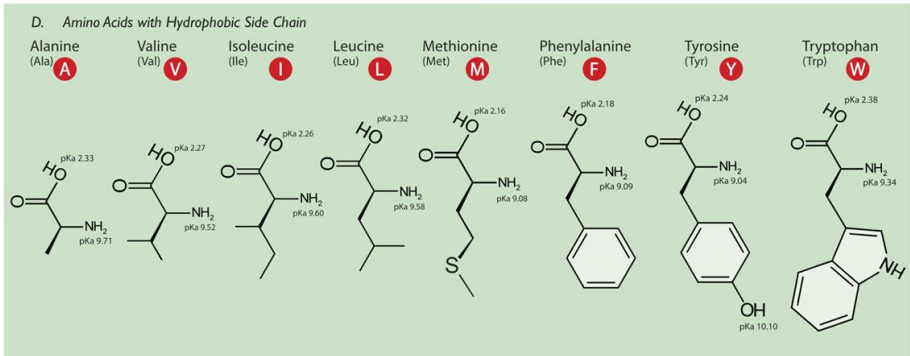
🔑‘R’ group determines identity and function of the amino acid





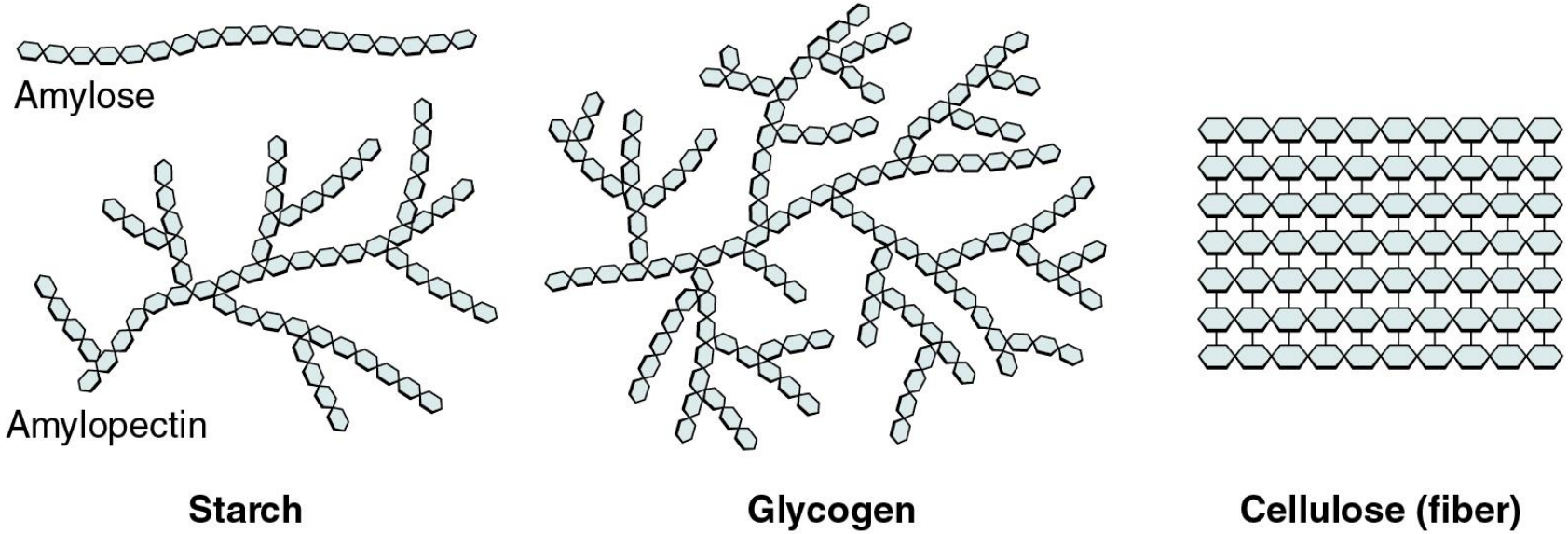






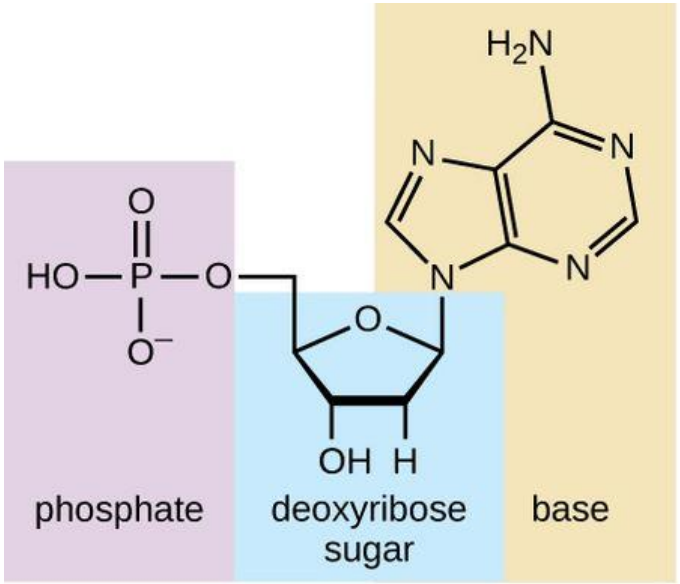
Carbohydrates

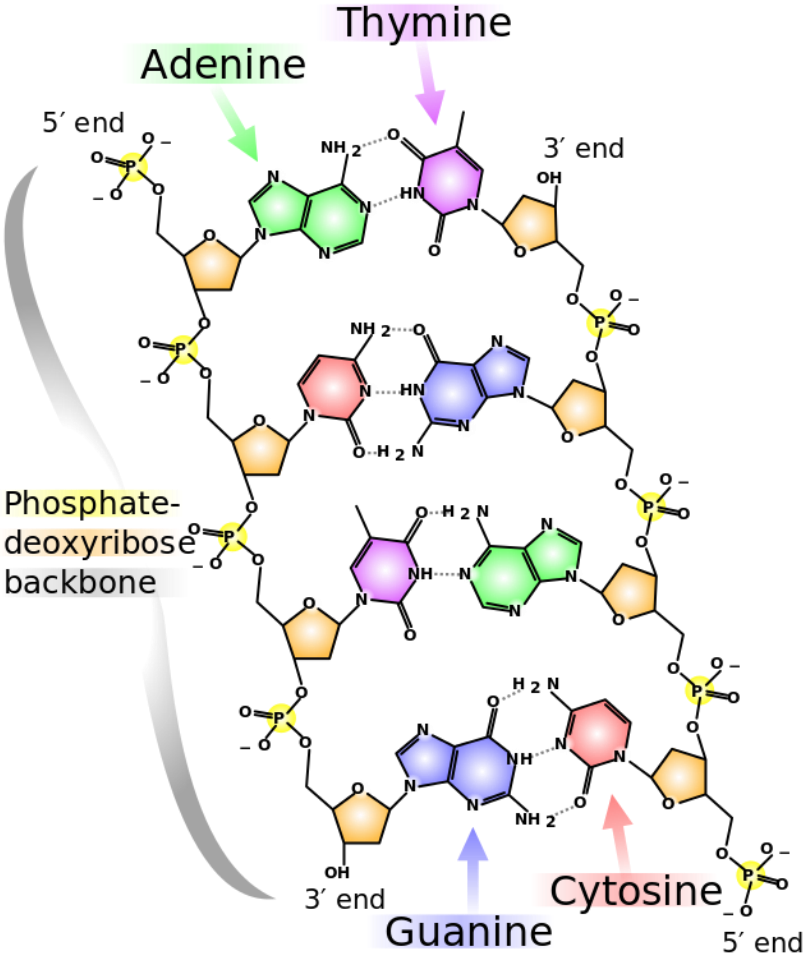
- Monomer: Monosaccharide
- Polymer: Polysaccharide



Nucleic Acids

- Monomer: nucleotide
- Polymer: nucleic acid (i.e. DNA, RNA)





Polymer	Example	Monomer	Function	Elements
Protein	Keratin, Hemoglobin, Histones, etc	Amino acid	Vast array of biological structures and functions	CHON
Carbohydrates	Sugars, starch, cellulose, etc	Mono-saccharide	Structure, short-term energy storage	CHO
Lipids	Waxes, oils, fats	No monomer/ polymer structure	Long-term energy storage, membrane structure	CHO(P)
Nucleic acids	DNA, RNA	Nucleotide	encode biological information	CHONP

Unit 1: Chemistry of Life

Main Idea: Living systems are organized into a hierarchy

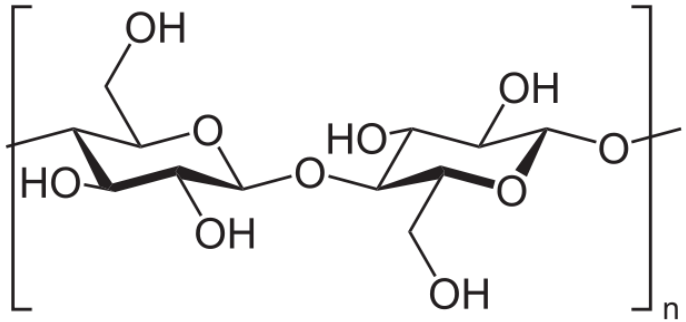
Be able to:

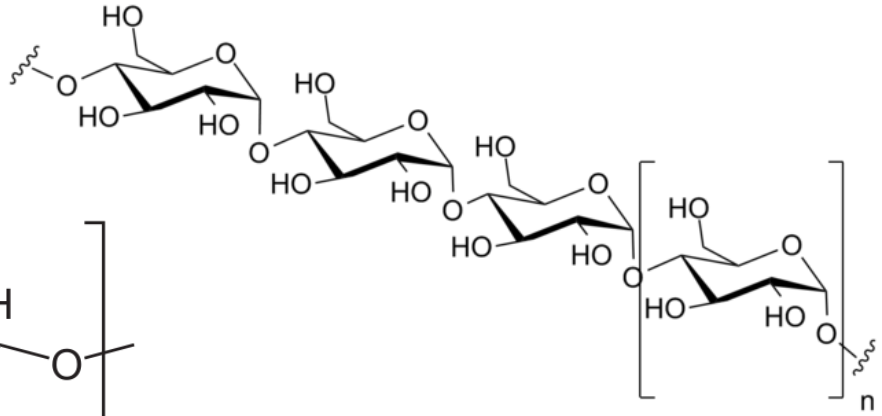
- Explain how a change in a monomer can affect the polymer that it is part of.

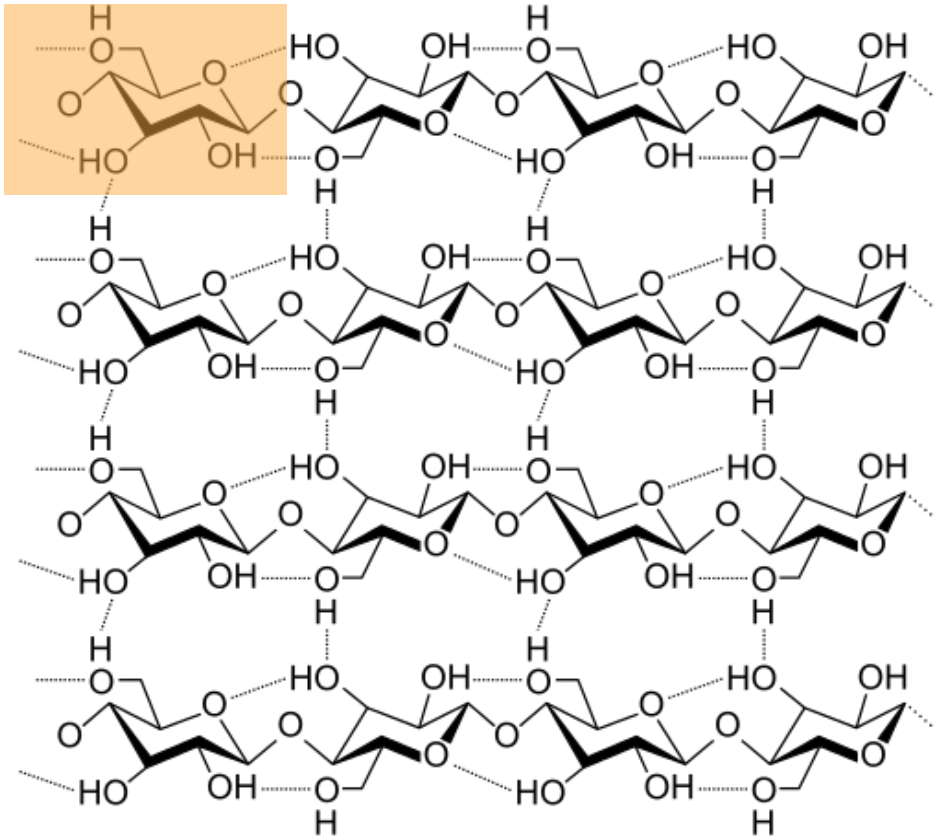
🔑 The function of biological molecules is determined by their structure

- … which is determined by the sequence and orientation of their monomers

Ex. Cellulose vs starch



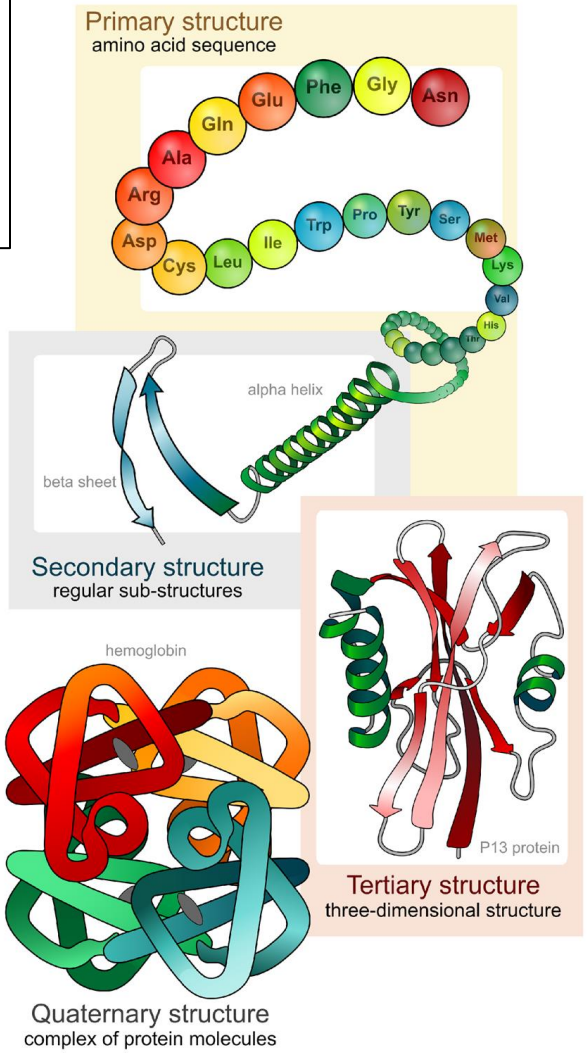




4 levels of protein structure

Because proteins have such complex structures, their organization is considered at 4 levels of resolution.

🔑Each level is a result of different interactions among amino acids.



Unit 1: Chemistry of Life

Main Idea: Organisms pass genetic information on to the next generation

Be able to:

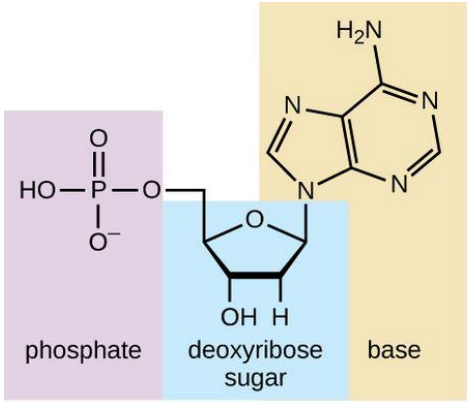
- Compare and contrast the structure and function of DNA and RNA

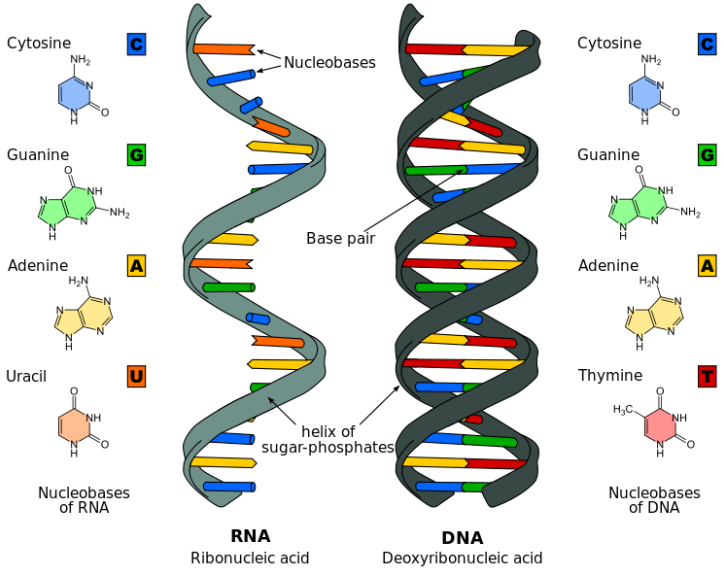
Nucleic acid structure

Each nucleotide has:

- a five-carbon sugar (deoxyribose or ribose)
- a phosphate
- a nitrogen base
  - adenine, thymine, guanine, cytosine or uracil

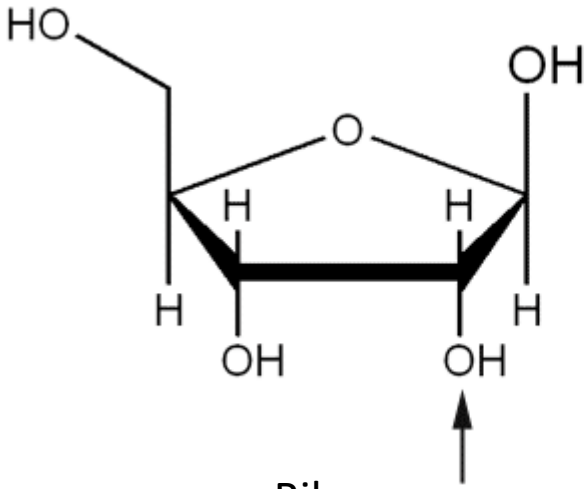
🚫You don't need to memorize the structures of the different nucleotides outside of knowing which are purines/pyrimidines and the number of hydrogen bonds they form



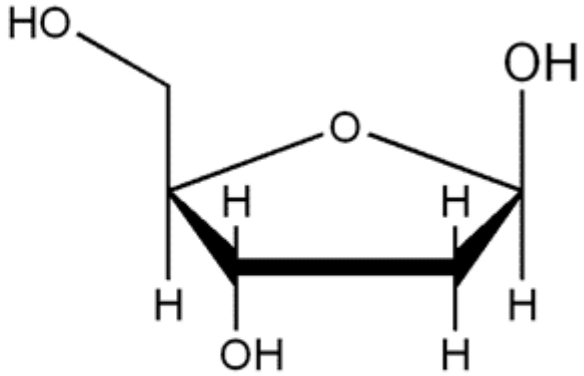


DNA vs. RNA

1. DNA sugar is **deoxyribose**, RNA is **ribose**.



Ribose



Deoxyribose

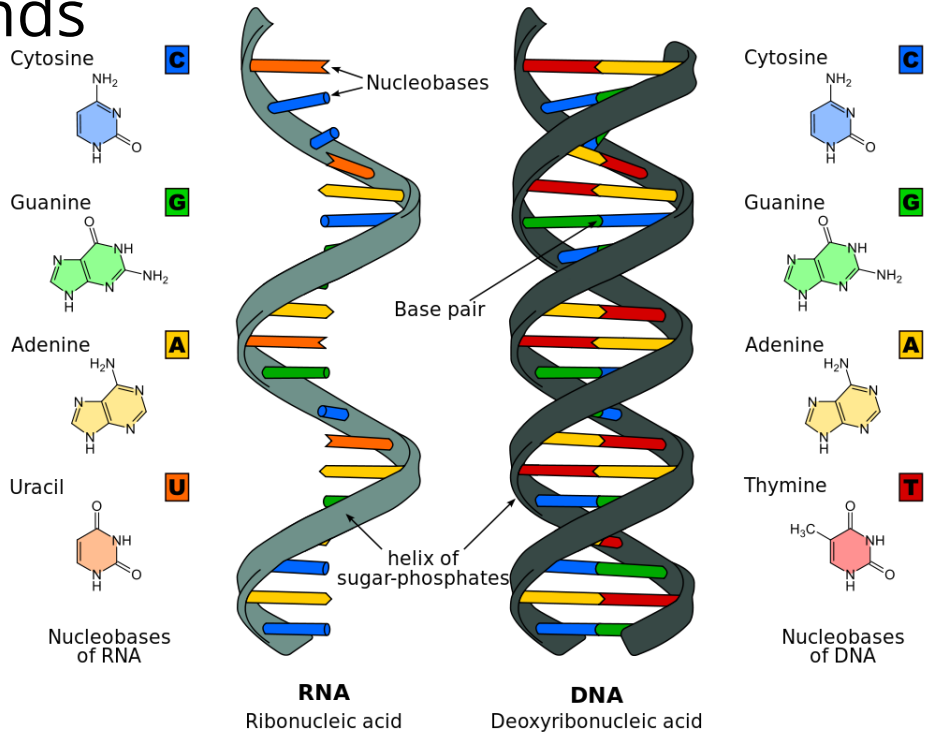
DNA vs. RNA

RNA = AUCG

DNA = ATCG

RNA = 1 Strand

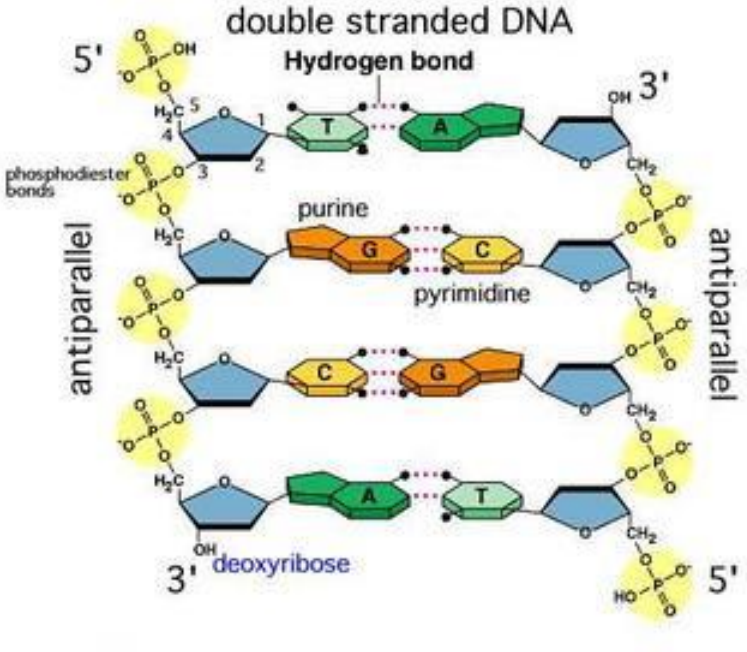
DNA = 2 strands



Nucleic Acid Directionality

3’ end = hydroxyl group
5’ end = phosphate

2 strands are “**antiparallel**” in orientation.



Unit 1 Quizizz Game Codes

1.1: 5712 3747
1.2: 2042 3587
1.3: 5135 6579
1.4: 1570 4995
1.5: 5659 9459
1.6: 5455 1459
Compiled: 2794 6283

Unit 2: Cell Structure and Function

Main Idea: Living systems are organized into a hierarchy

Be able to:

- Describe the structure and function of organelles
- Explain how organelles and other structures contribute to cell function
  - Especially the ones that capture and store energy

Cellular Organelles

Nucleus

Structure:

- Double membrane (nuclear envelope) with pores

Functions:

- Stores genetic information (DNA)
- Synthesis of RNA
- Ribosome subunit assembly

Rough ER

Structure:

- Membrane studded with ribosomes attached to nuclear envelope

Functions:

- Site of membrane-bound protein and secreted protein synthesis
- Cell compartmentalization
- Mechanical support
- Role in intracellular transport

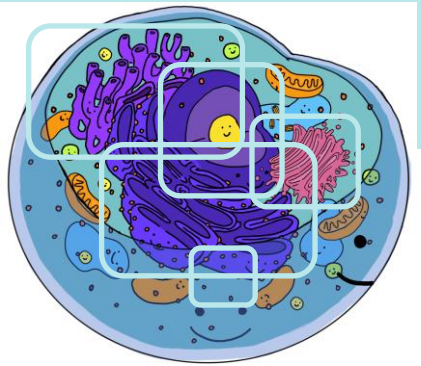
Smooth ER

Structure:

- Folded, tubelike structure (cisternae)

Functions:

- Detoxification
- Calcium Storage
- Lipid synthesis



Golgi Complex

Structure:

- Membrane-bound structure composed on flattened sacs (cisternae)

Functions:

- Folding and chemical modification of synthesized proteins
- Packaging protein traffic

Ribosomes

Structure:

- Composed of rRNA and protein
- Large & small subunits
- Types: bound or free (cytoplasmic)

Functions:

- Protein synthesis

Cellular Organelles

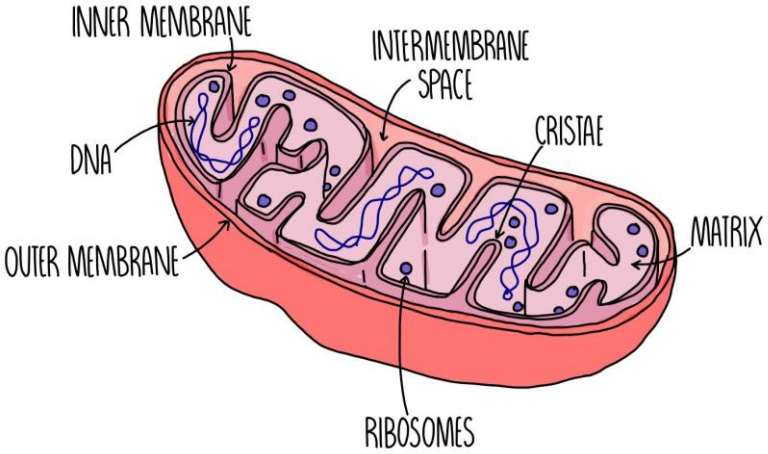
Mitochondria

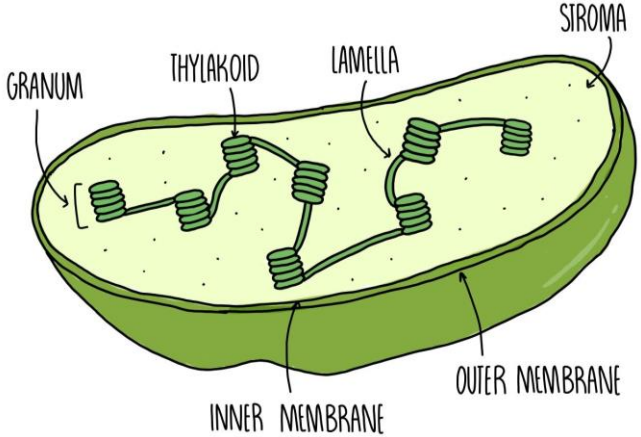
Structure:

- Double membrane (outer: smooth; inner: highly folded)

Functions:

- Site of oxidative phosphorylation (cristae/inner membrane)
- Site of Krebs Cycle (matrix)





Structure:

- Double outer membrane (thylakoid sac stacked: grana and fluid: stroma)

Functions:

- Site of photosynthesis
- Thylakoid: Light Reactions
- Stroma: Calvin-Benson Cycle

Chloroplast

Cellular Organelles

Mitochondria

Structure:

- Double membrane (outer: smooth; inner: highly folded)

Functions:

- Site of oxidative phosphorylation (cristae/inner membrane)
- Site of Krebs Cycle (matrix)

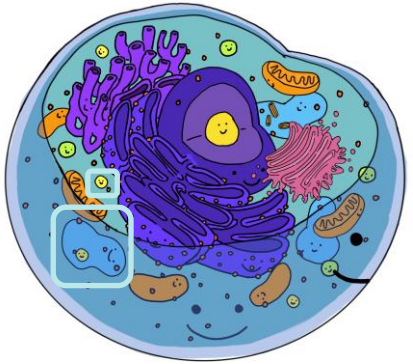
Lysosome

Structure:

- membrane-enclosed sacs that contain hydrolytic enzymes

Functions:

- Intracellular digestion (recycle cell organic materials & programmed cell death: apoptosis)



Vacuole

Structure:

- membrane-bound sac

Functions:

- storage and release of macromolecules and cellular waste products
- Central: water retention – turgor pressure
- Contractile: osmoregulation (protist)
- Food: phagocytosis, fuse with lysosome

Chloroplast

Structure:

- Double outer membrane (thylakoid sac stacked: grana and fluid: stroma)

Functions:

- Site of photosynthesis
- Thylakoid: Light Reactions
- Stroma: Calvin-Benson Cycle

Unit 2: Cell Structure and Function

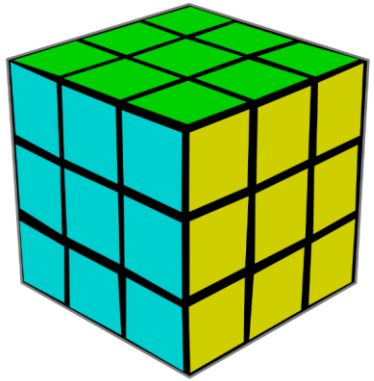
Main Idea: Living things are constantly exchanging matter and energy with the environment

<u>Be able to</u>:

- Explain why smaller cells are more efficient due to their surface-are-to-volume ratio
- Explain the special structures that organisms use to increase their efficiency

Surface area-to-volume ratios affect diffusion across the membrane

As cells increase in volume, the relative surface area decreases.



sides = 3
surface = 3^2 x 6 = 54
volume = 3^3 = 27

surface/volume = 2

sides = 2
surface = 2^2 x 6 = 24
volume = 2^3 = 3

surface/volume = 3

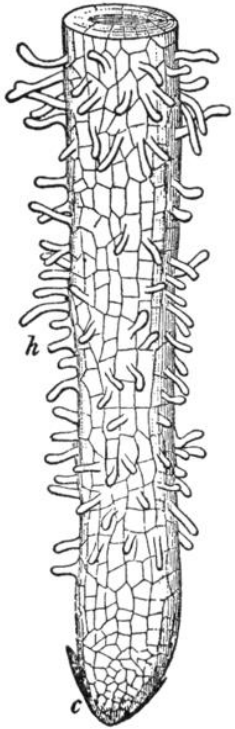
sides = 1
surface = 1^2 x 6 = 6
volume = 1^3 = 1

surface/volume = 6

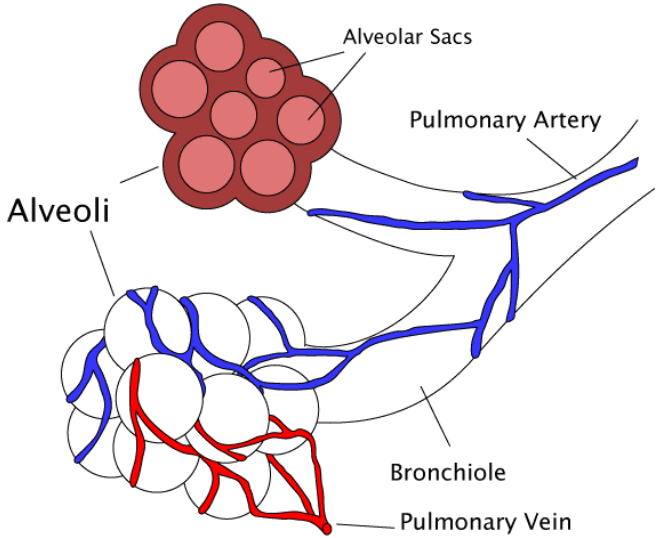
The surface area of the plasma membrane must be large enough to adequately exchange materials

- smaller cells have a more favorable surface area-to-volume ratio for exchange of materials with the environment.
- More complex cells are larger and demand more resources
- Solution: specialized cellular structures

root hairs



alveoli



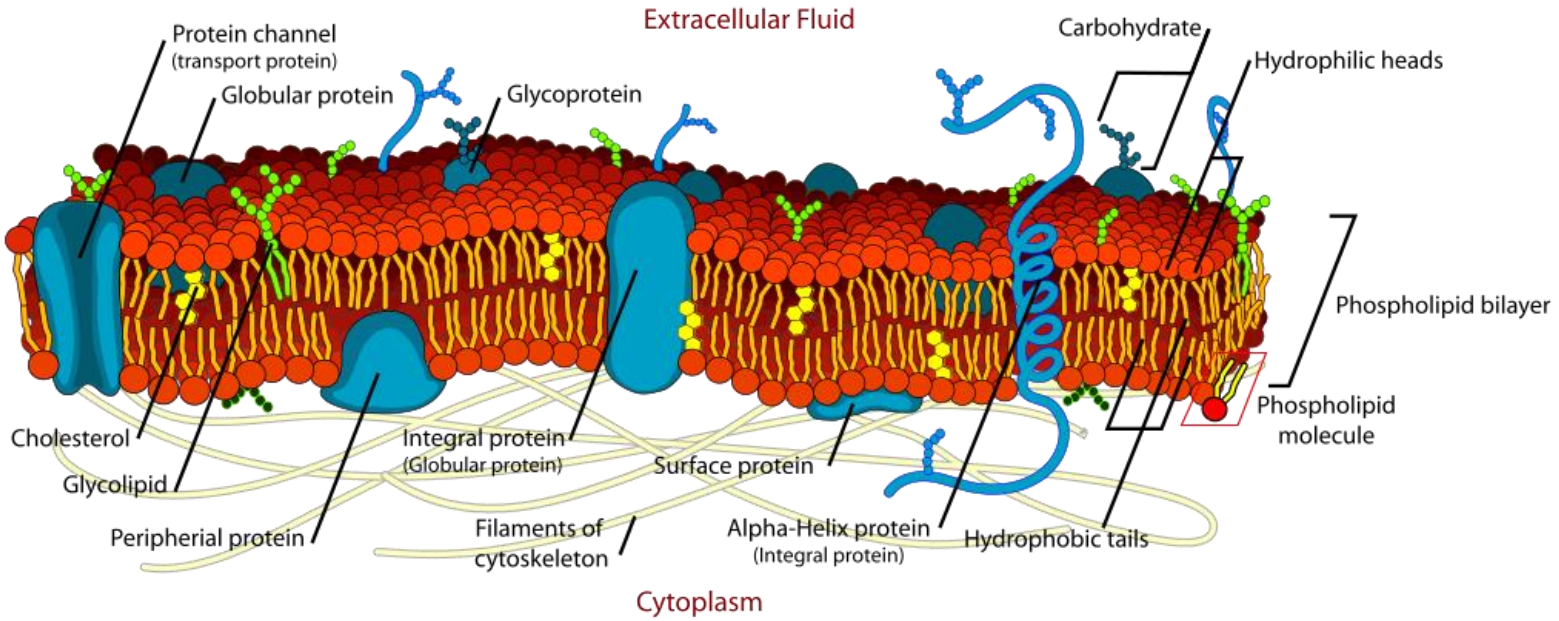
Unit 2: Cell Structure and Function

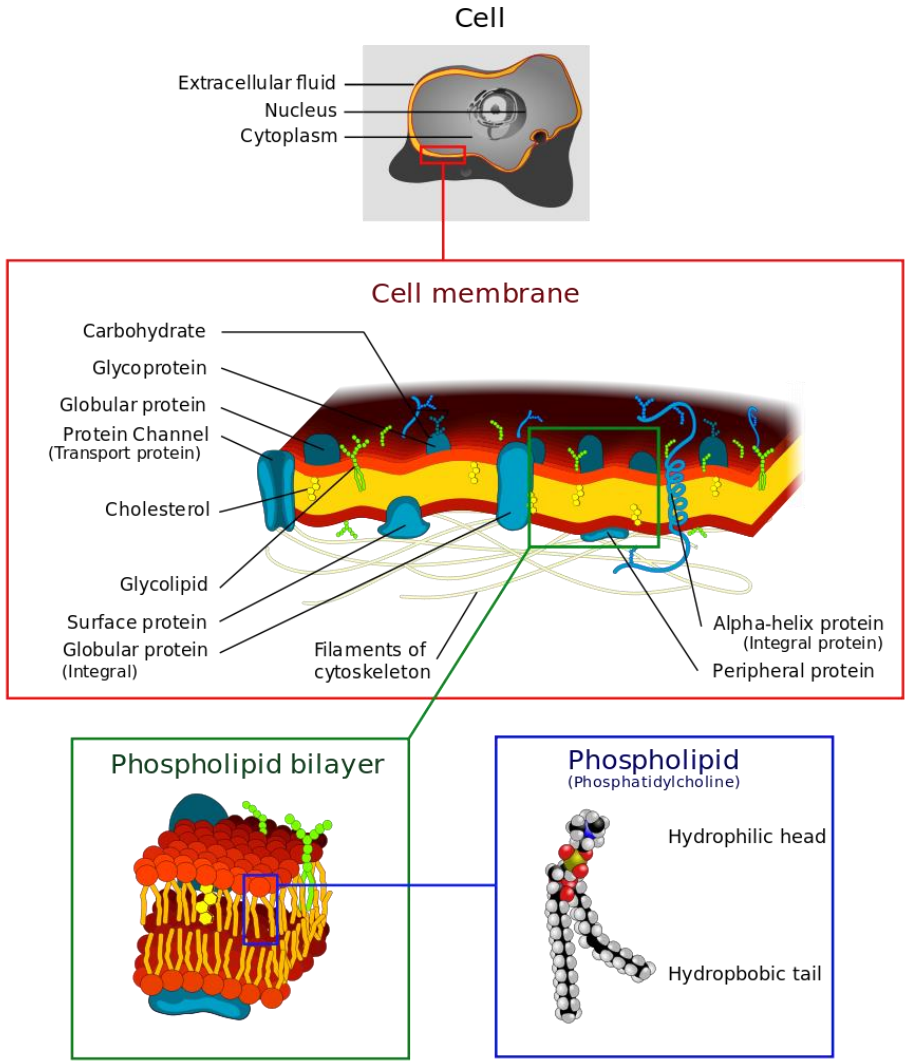
Main Idea: The cell membrane separates the inside of the cell from the environment

Be able to:

- Explain role phospholipids and proteins play in the cell membrane
- Describe the fluid mosaic model

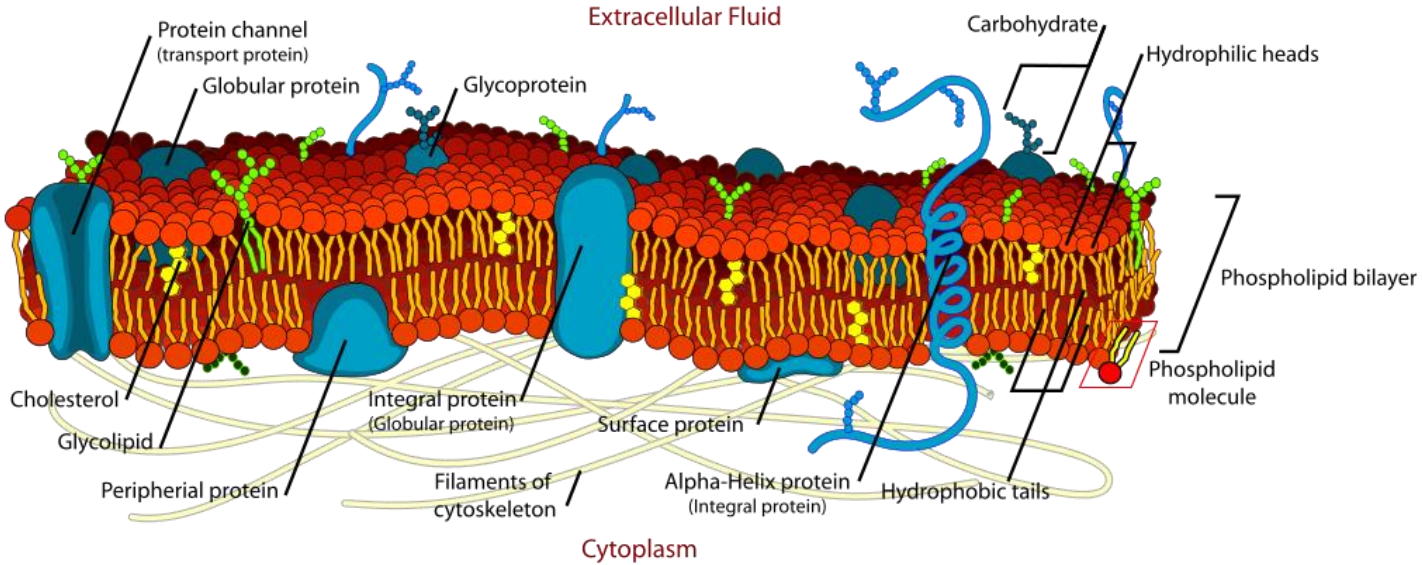
Cell membranes separate the internal environment from the external environment




Cell
Extracellular fluid
Nucleus
Cytoplasm
Cell membrane
Carbohydrate
Glycoprotein
Globular protein
Protein Channel
(Transport protein)
Cholesterol
Glycolipid
Surface protein
Globular protein
(Integral)
Filaments of
cytoskeleton
Alpha-helix protein
(Integral protein)
Peripheral protein
Phospholipid bilayer
Phospholipid
(Phosphatidylcholine)
Hydrophilic head
Hydropbobic tail

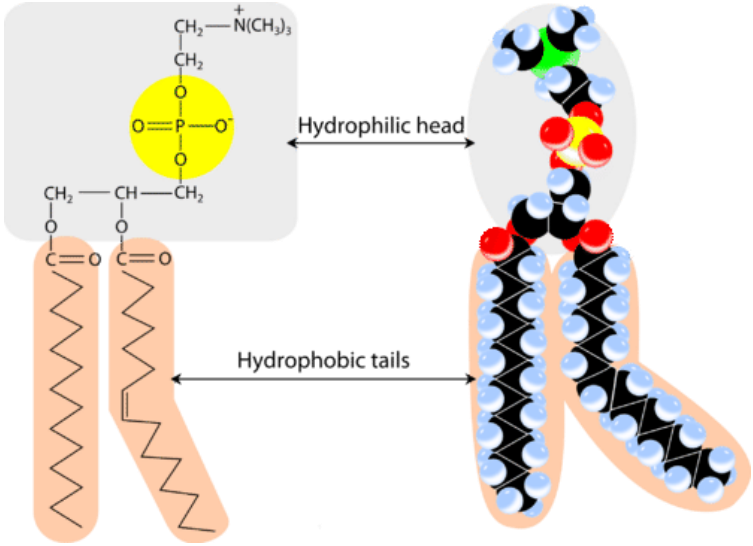
Selective permeability is a direct consequence of membrane structure

Fluid mosaic model - phospholipids slide around each other and are embedded with proteins



Structural framework of the membrane

- phospholipid molecules
  - glycerol attached to a phosphate and two carbon chains
  - amphipathic
- embedded proteins
  - can span membrane or face one side
- cholesterol
  - adds structure, decreases fluidity
- glycoproteins and glycolipids
  - carbohydrate bound to a protein (or lipid)
  - uses include signaling, structure, and protection



Unit 2: Cell Structure and Function

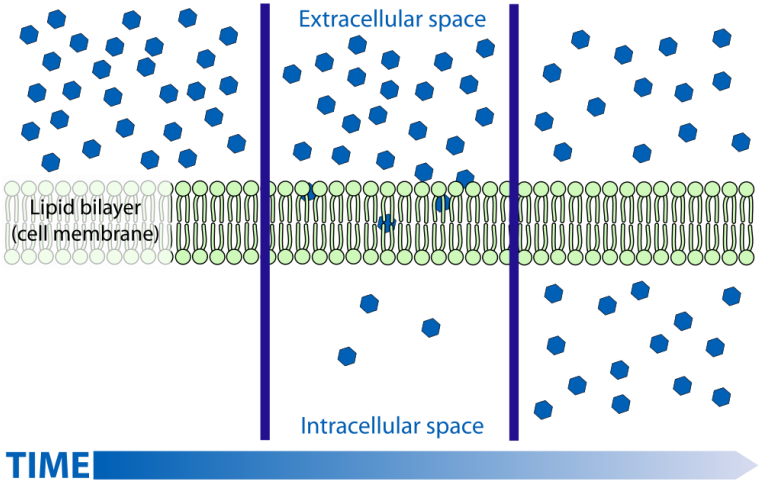
Main Idea: The cell membrane separates the inside of the cell from the environment

Be able to:

- Explain how concentration gradient affects the movement of molecules across the membrane
- Explain how cells move polar and charged particles across the membrane

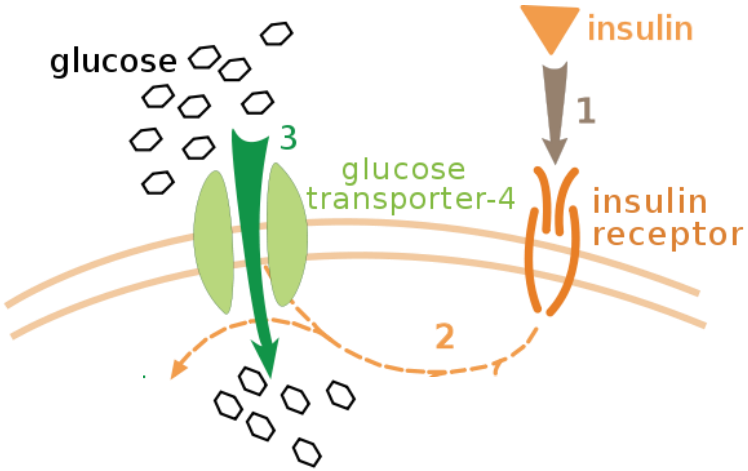
Passive transport does not require energy

- Passive transport
  - Movement of molecules from high concentration to low concentration
  - “down” the concentration gradient
  - does not require energy
- Used for
  - Import of resources
    - ex. oxygen, water, hormones
  - Export of waste
    - ex. carbon dioxide, lactic acid



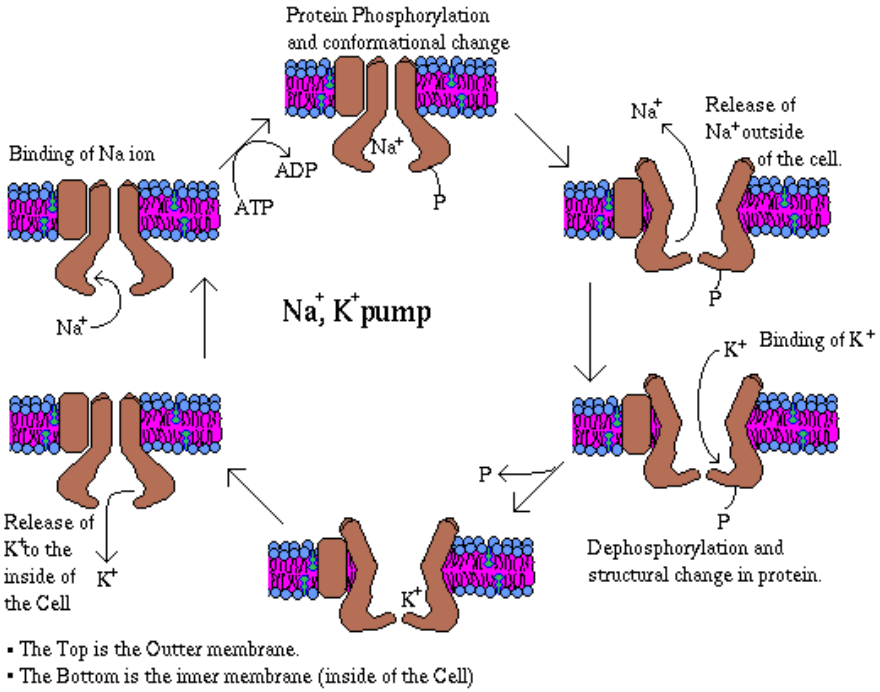
Facilitated diffusion is a type of passive transport

- Requires transmembrane proteins
  - specific to the substance that is transported
- Does not require ATP
- ex. glucose transporters



Active Transport requires energy

- Via membrane proteins
- "Up" the concentration gradient
- Requires energy
  - Usually ATP
- Polar, charged, molecules and proteins
- Example: Na^+ / K^+ pump



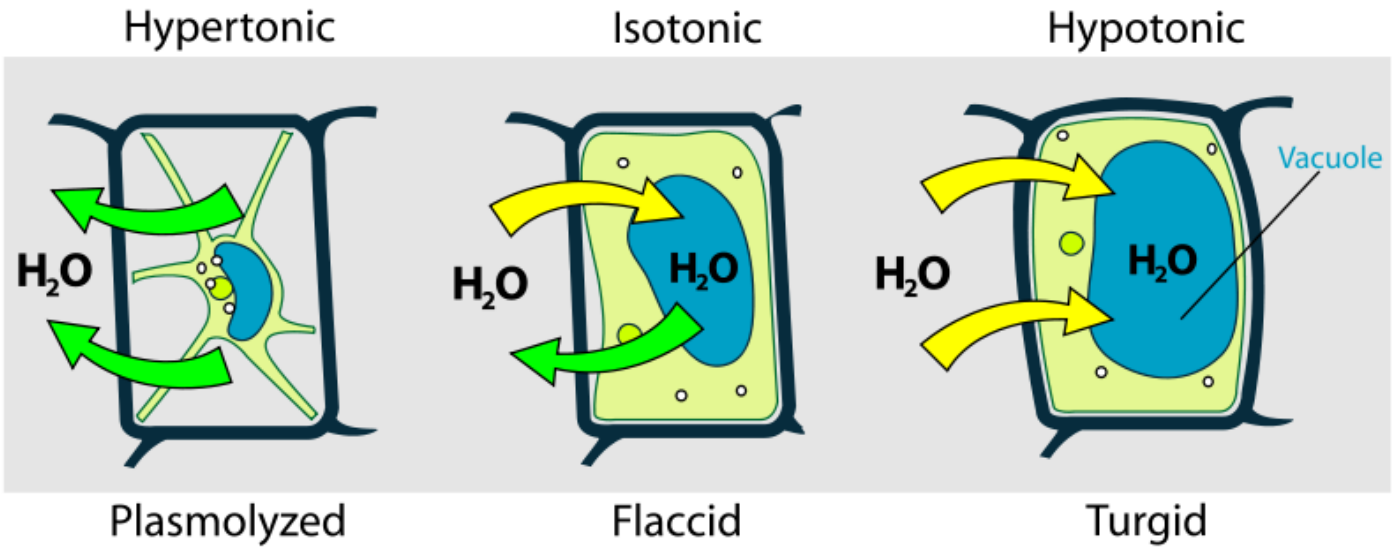
Unit 2: Cell Structure and Function

Main Idea: The cell membrane separates the inside of the cell from the environment

Be able to:

- Describe the mechanisms that cells use to:
  - Maintain water and solute balance
  - Move large molecules across the membrane
- Use the structure of a molecule to predict if/how it will pass through the membrane

Osmosis



Across a membrane, water moves from areas of low solute concentration, to areas of high solute concentration

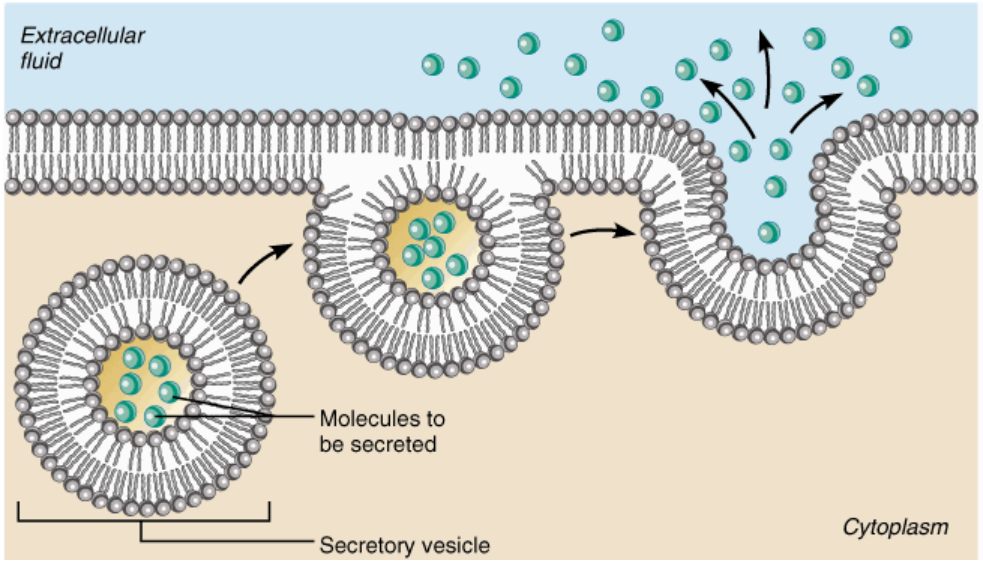
Endocytosis and exocytosis move large molecules

Exocytosis

- Movement of large molecules <u>out of</u> the cell
- Internal vesicles fuse with the plasma membrane
- Ex. Neurotransmitters

Endocytosis

Movement of large molecules <u>into</u> the cell



Unit 2 Quizizz Game Codes

2.1: 2661 1043
2.2: 0563 9523
2.3: 2241 6739
2.4: 3080 5347
2.5: 0354 2371
2.6: 0773 6675
2.7: 2451 3891
2.8: 6645 6931
2.9: 6645 6931
2.10: 6645 6931
2.11: 0511 5235

Compiled:
3641 0155

Unit 3: Cellular Energetics

Main Idea: Living things are constantly exchanging matter and energy with the environment

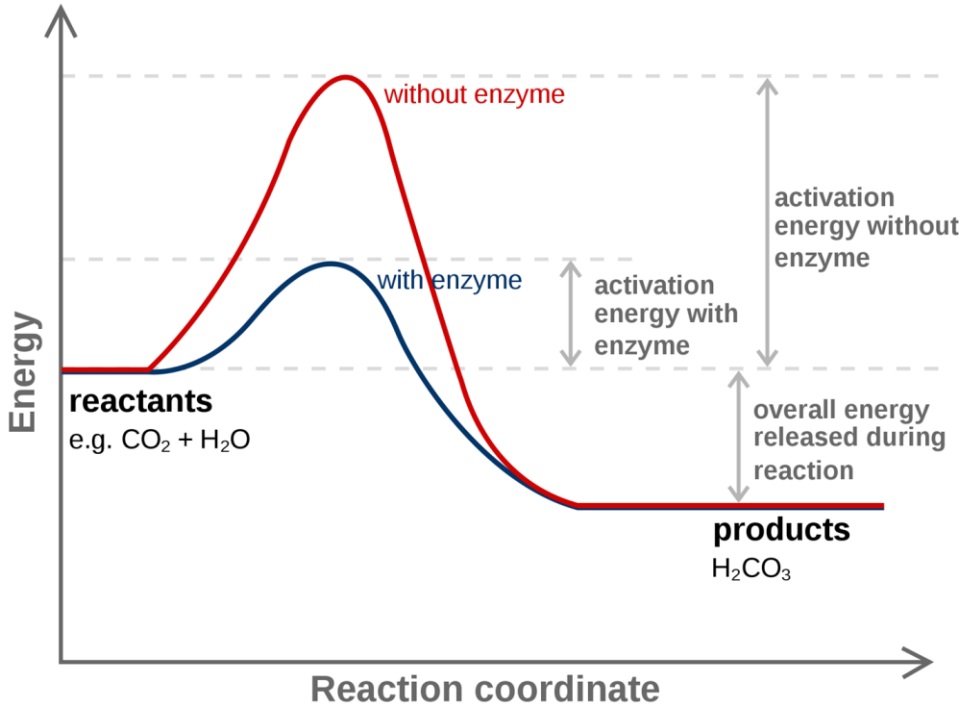
Be able to:

- Explain how enzymes increase the rate of biological reactions
- Explain how changes to the structure of an enzyme may affect its function.
- Explain how environment of the cell can affect enzyme activity

Enzymes are Catalysts

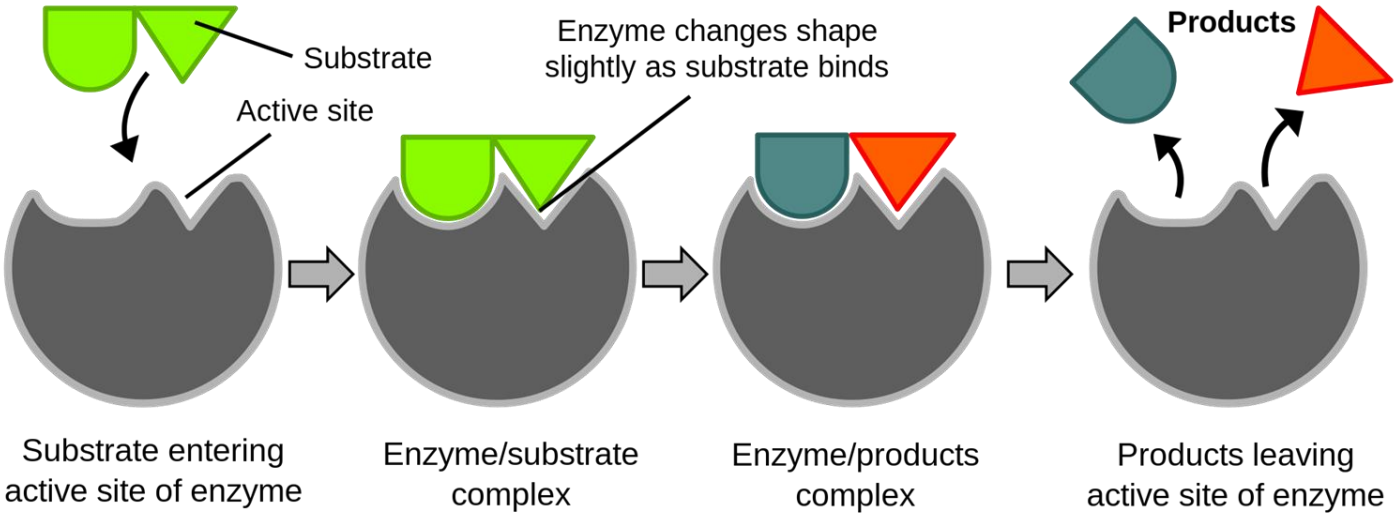
Increase rate of the reaction by lowering activation energy (E_A)

- Not changed by the reaction



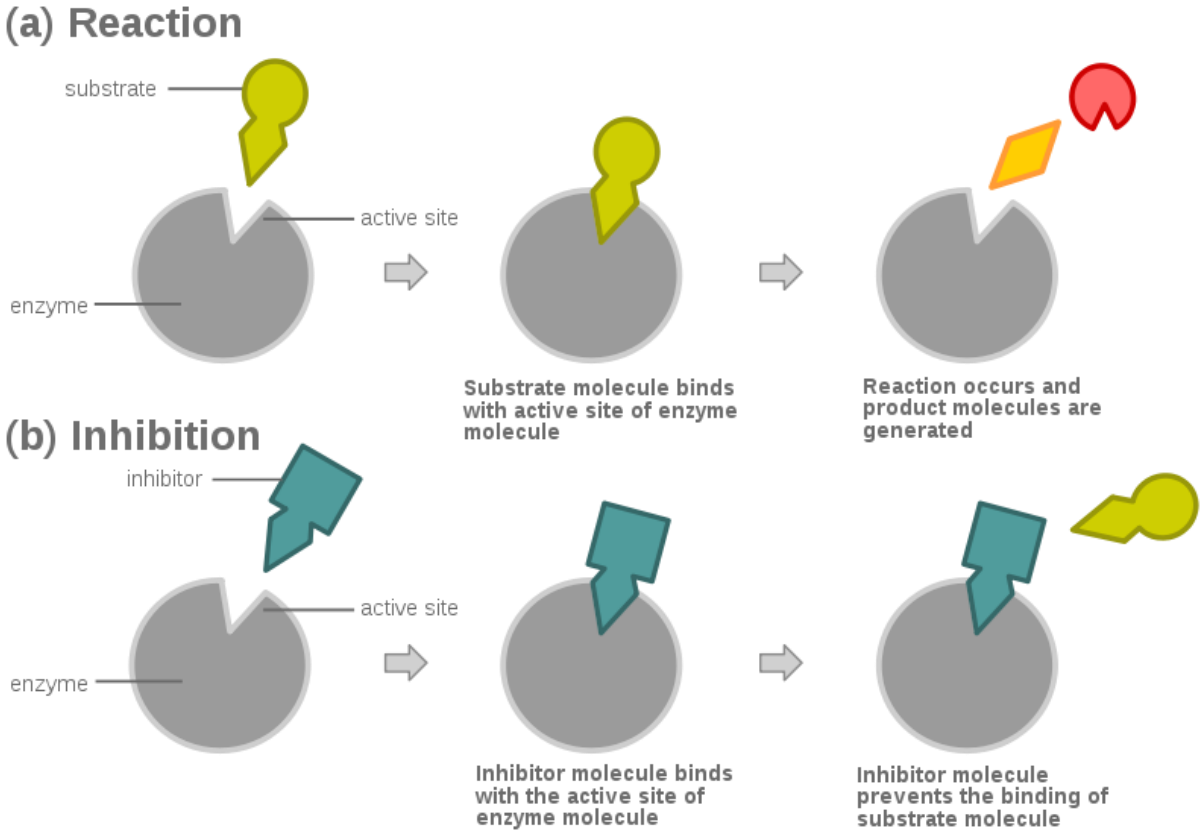
Enzyme action

- Orient reactants to each other
  - increase chances of proper collision
- The molecule they act on is called a **substrate**
- Can combine or break down molecules

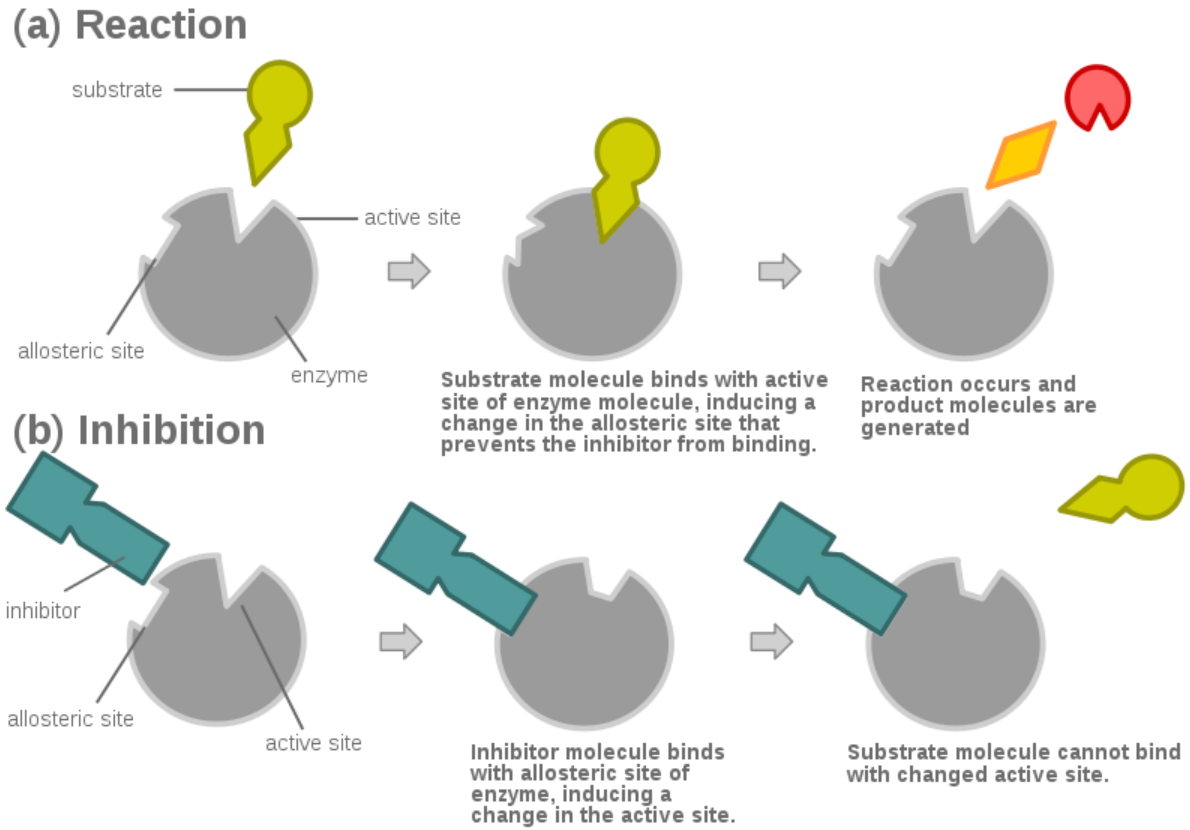


Competitive Inhibition

Inhibitor prevents binding of substrate



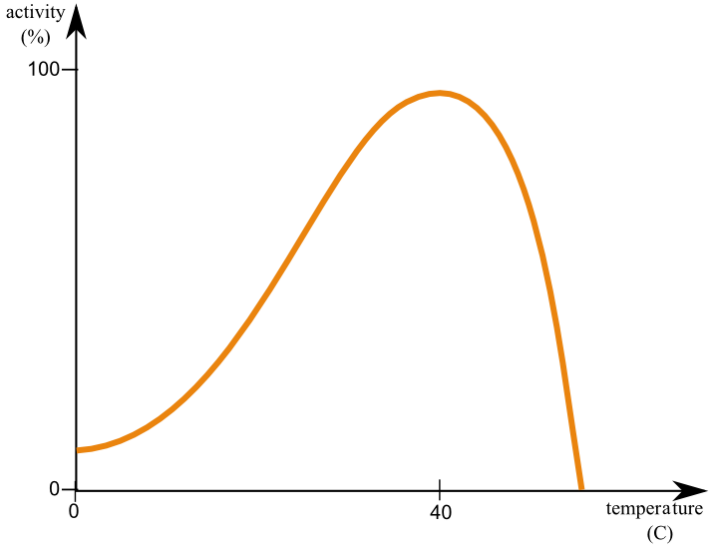
Allosteric inhibition causes a conformational change in the enzyme which prevents binding of the substrate

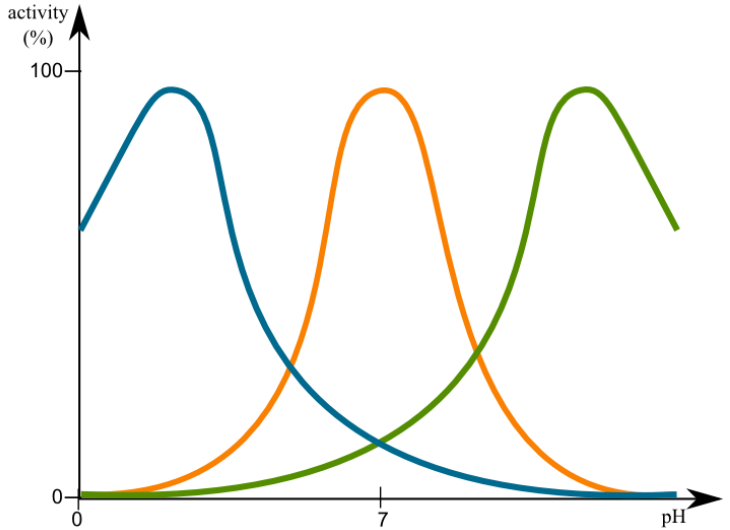


Environmental Influences on Enzyme Function

Enzymes are (usually) proteins

- The local environment can affect the shape of the enzyme, which will affect its function.
- Ex. Temperature and pH





Unit 3: Cellular Energetics

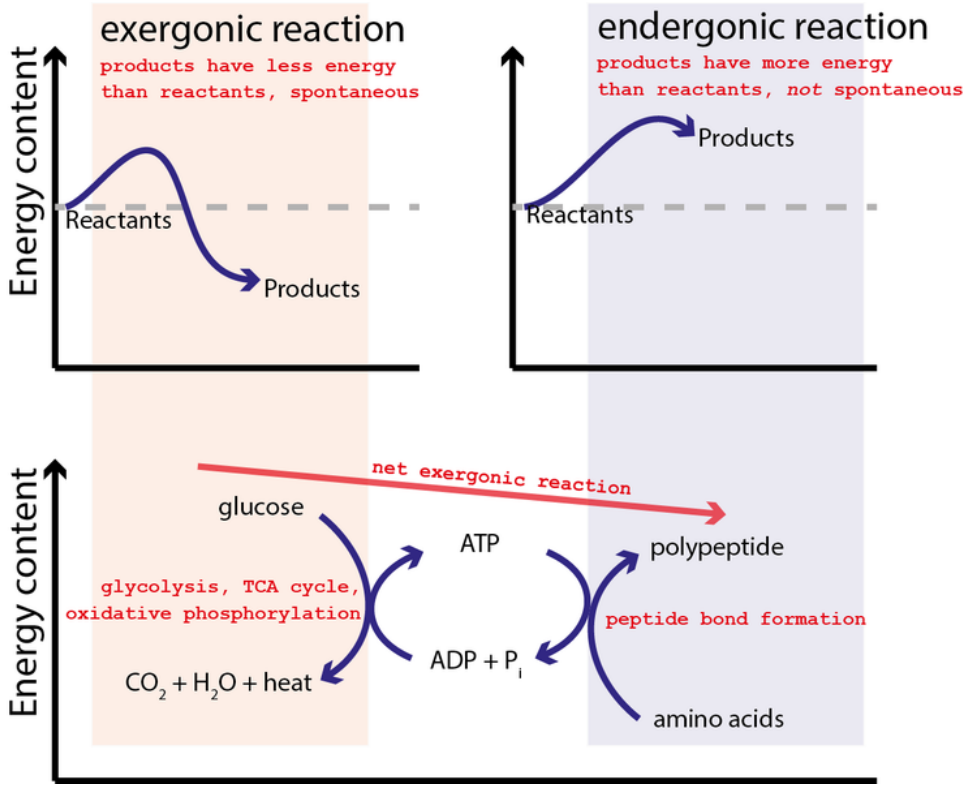
Main Idea: Living things are constantly exchanging matter and energy with the environment

Be able to:

- Describe the role of energy in living organisms

Living systems do not violate the second law of thermodynamics

- Order is maintained by coupling cellular processes that increase entropy with those that decrease entropy
- Energetically favorable exergonic reactions can be coupled with reactions that have a positive free energy change
  - Example: ATP→ADP,
  - used to maintain or increase order in a system

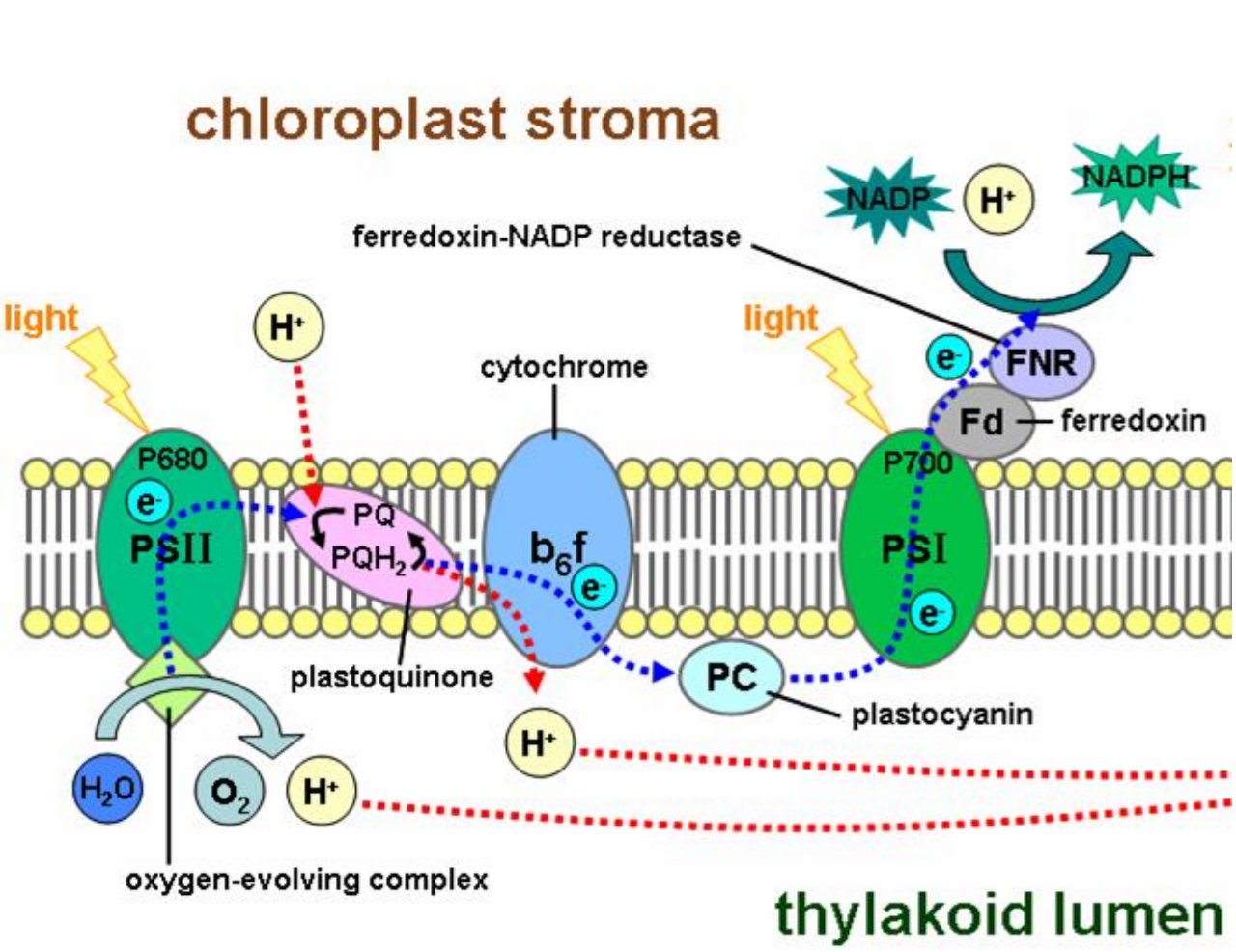


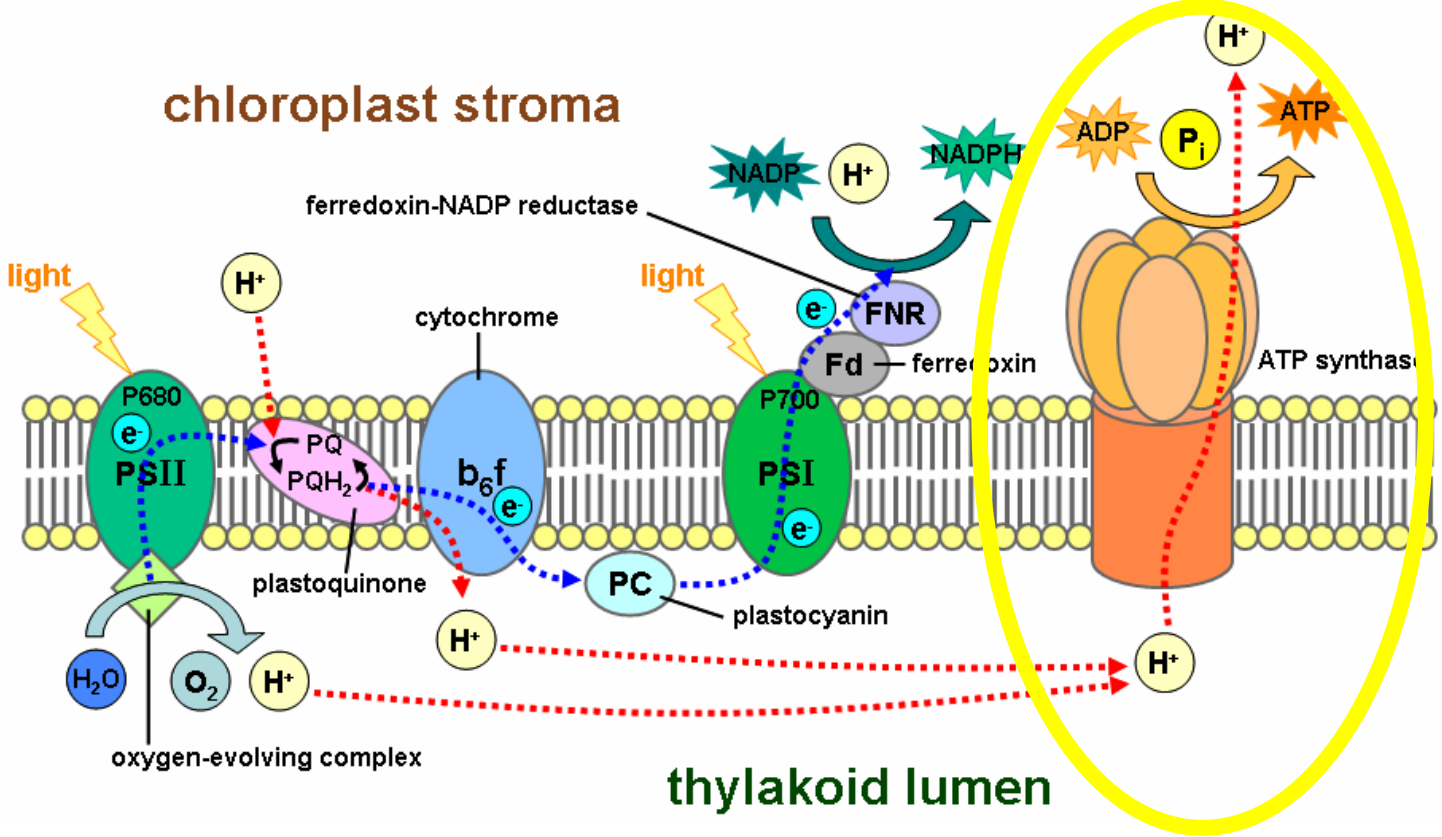
Unit 3: Cellular Energetics

Main Idea: Living things are constantly exchanging matter and energy with the environment

Be able to:

- Describe the processes that allow photosynthesis organisms to capture and store energy.
- Explain how cells capture energy from light and transfer it to chemical energy

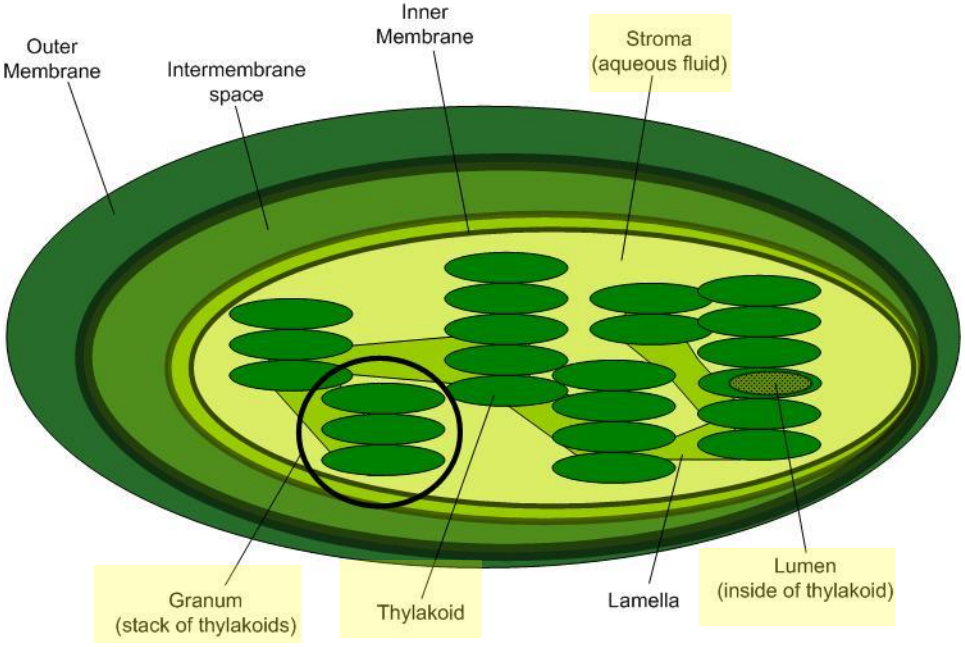

chloroplast stroma
NADP
H+
NADPH
ferredoxin-NADP reductase
light
H+
cytochrome
light
e-
FNR
Fd
ferredoxin
P680
e-
PSII
PQ
PQH2
b6f
P700
PSI
e-
e-
plastoquinone
PC
plastocyanin
H+
H2O
O2
H+
oxygen-evolving complex
thylakoid lumen



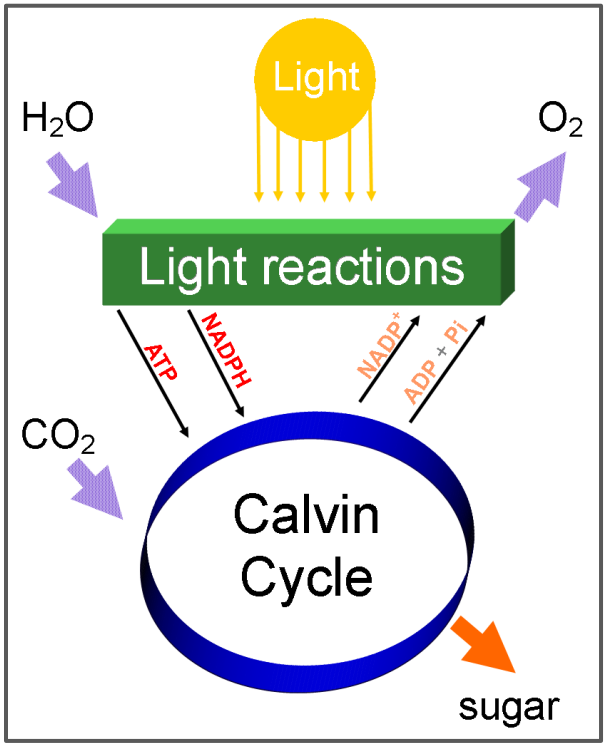
The formation of the proton gradient is a separate process, but it is linked to the synthesis of ATP via ATP synthase

The Calvin cycle

- Occurs in the stroma of the chloroplast
- Produces carbohydrates from CO_2
- Powered by ATP and NADPH produced during light-dependent reactions



The Calvin cycle



You don’t need to memorize of the steps or the molecules in the Calvin cycle (with the exception of ATP synthase)

Unit 3: Cellular Energetics

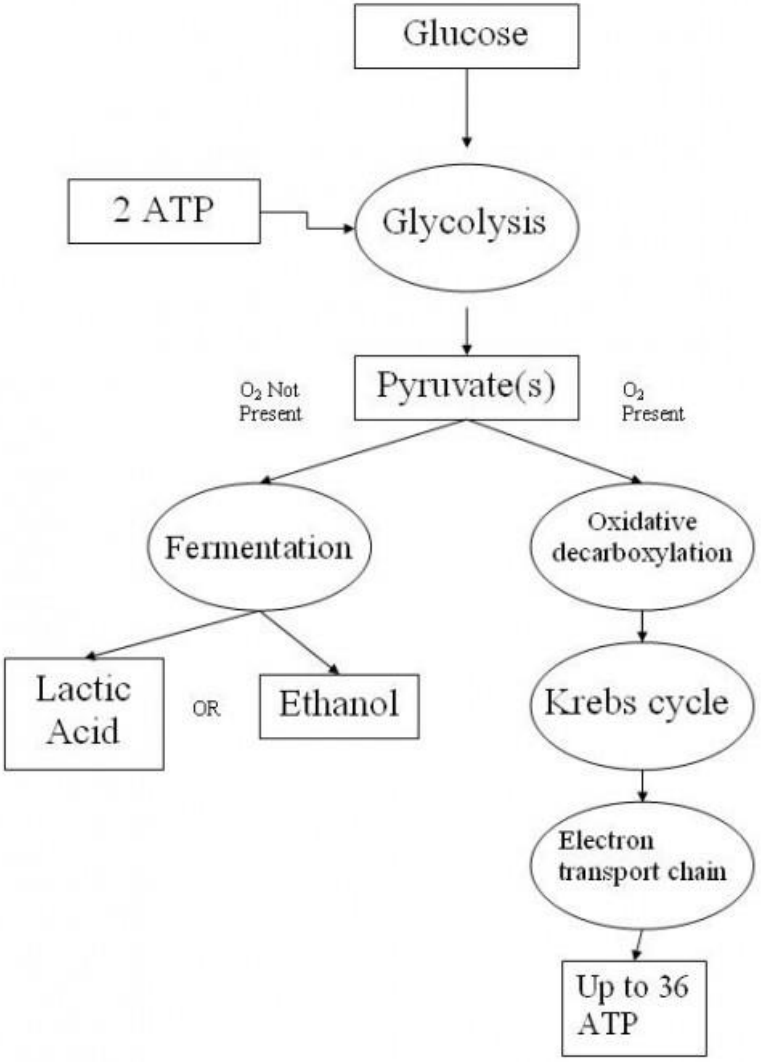
Main Idea: Living things are constantly exchanging matter and energy with the environment

Be able to:

- Describe the processes that allow organisms to use energy stored in macromolecules.
- Explain how cells obtain energy from macromolecules and use it to power cellular functions.

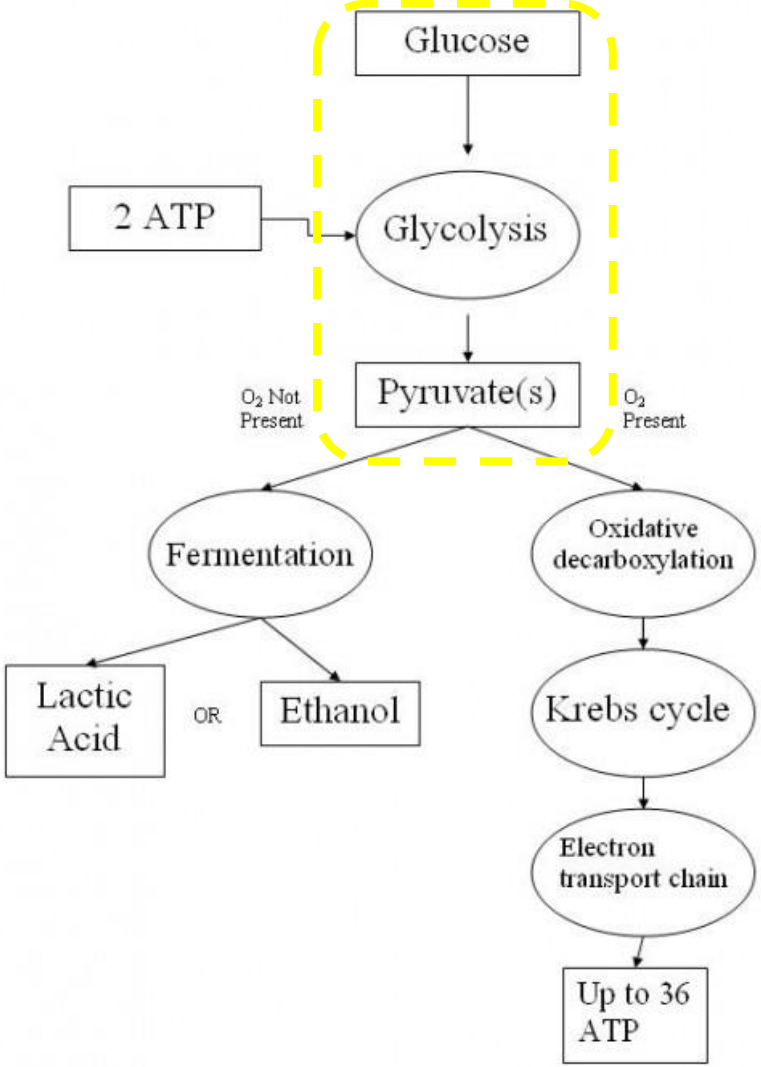
Cellular Respiration

- series of coordinated reactions
- enzyme-catalyzed
- harvests free energy from simple carbohydrates



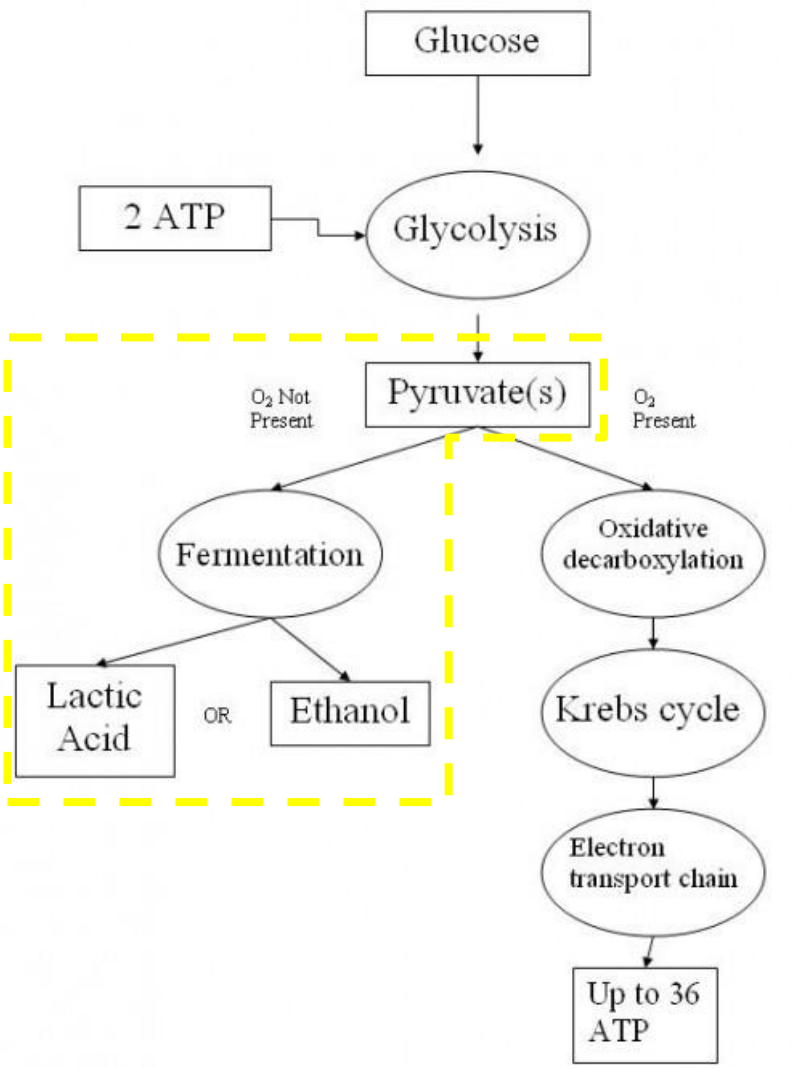
Glycolysis

- Glucose (6C) is broken into 2 pyruvate (3C)
  - energy released to form 4 ATP (net 2)
  - $NAD^+ \rightarrow NADH$
  - Occurs in cytosol of cell



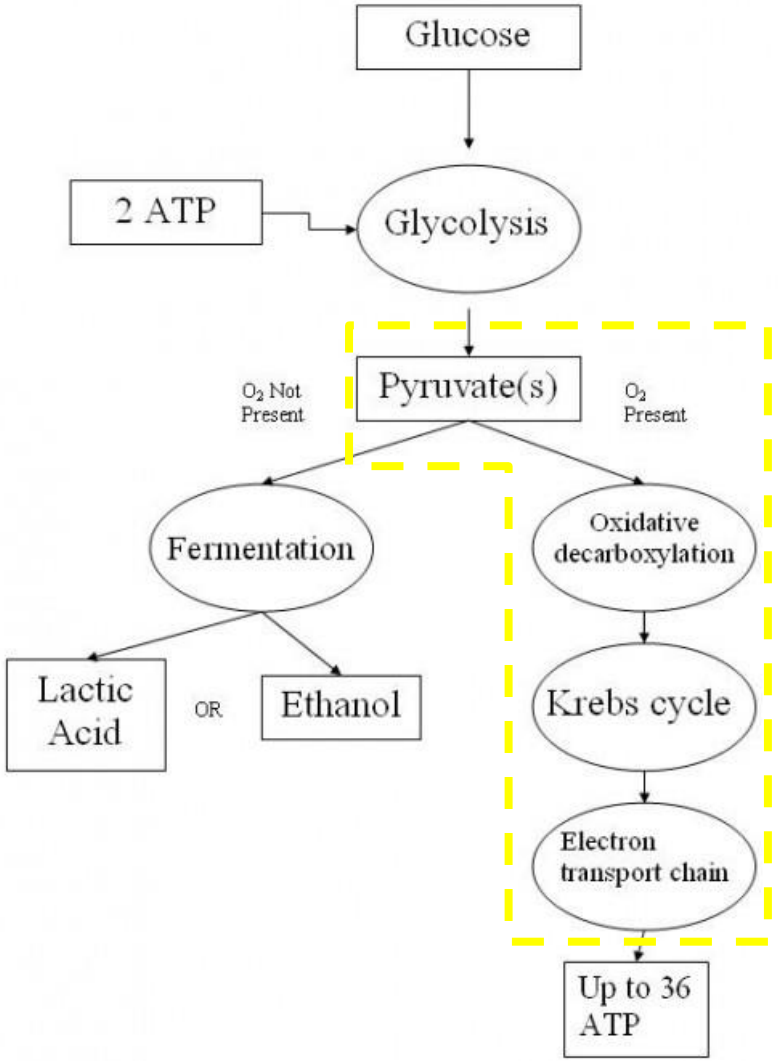
Anaerobic Respiration

- In the absence of oxygen
- regenerate NAD^+
- occurs in cytosol



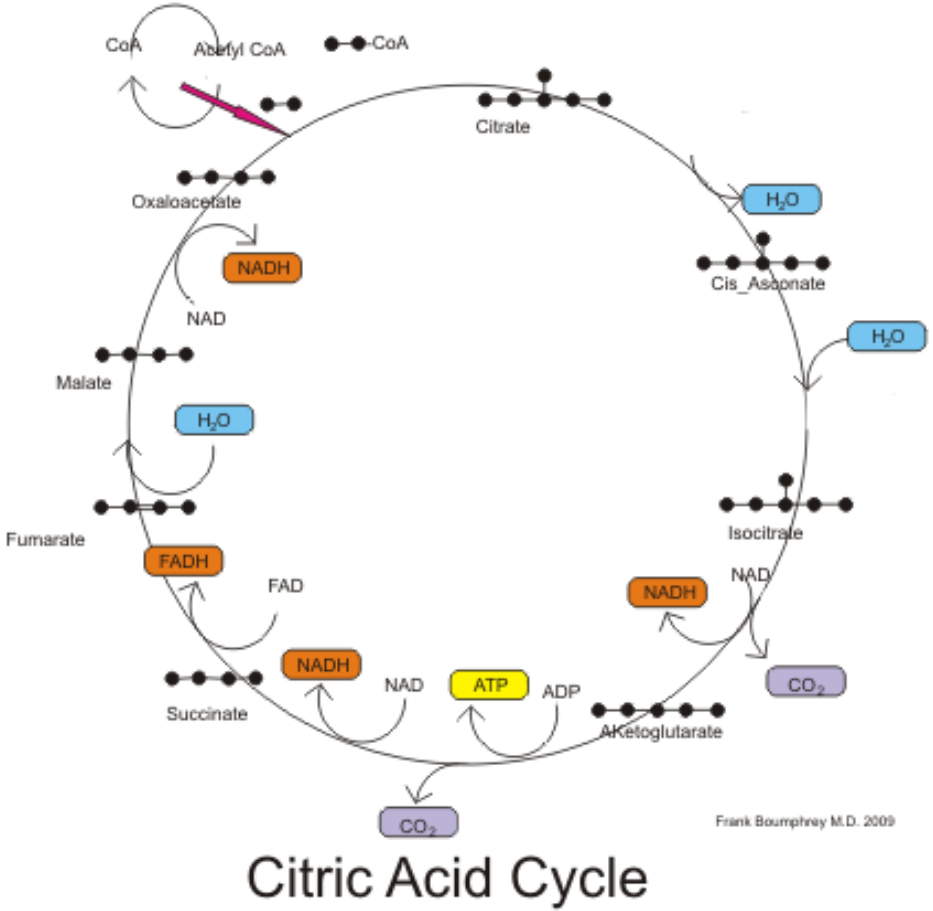
Aerobic respiration

- In the presence of oxygen
- animals, plants, fungi, protozoa, bacteria
- Occurs in mitochondria



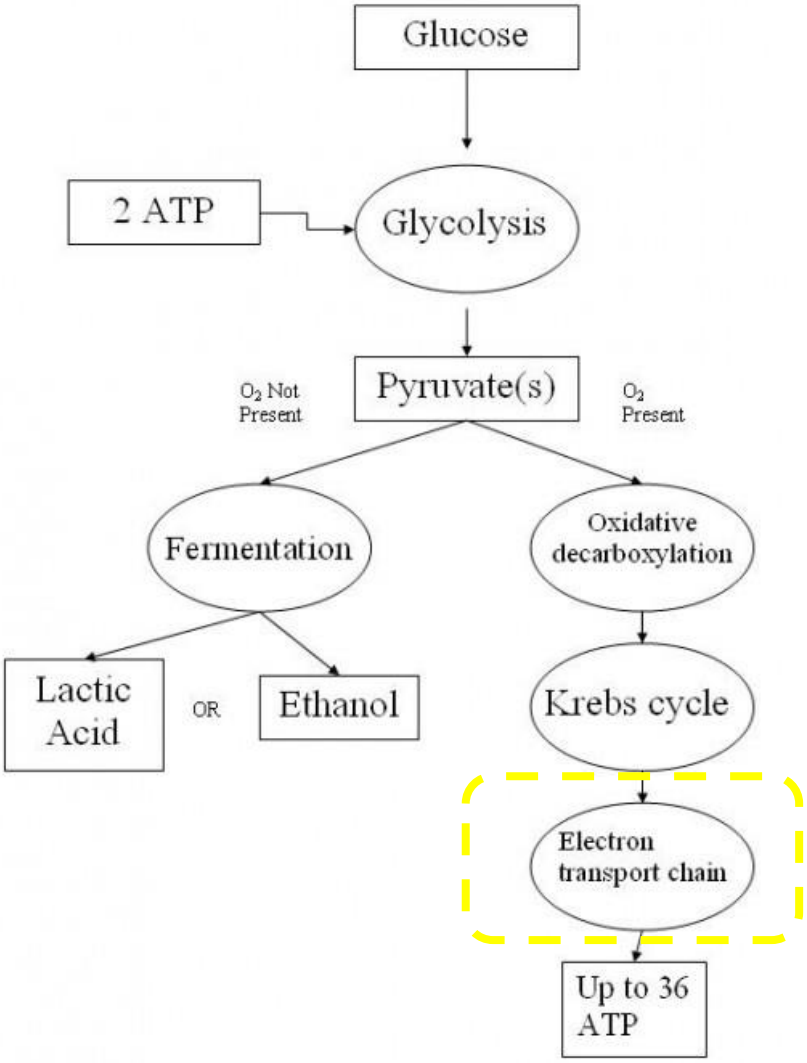
Krebs (citric acid) cycle

- CO_2 is released
- 2 ATP are synthesized
  - substrate level phosphorylation
- Electrons are extracted by NADH and $FADH_2$, carried to the electron transport chain

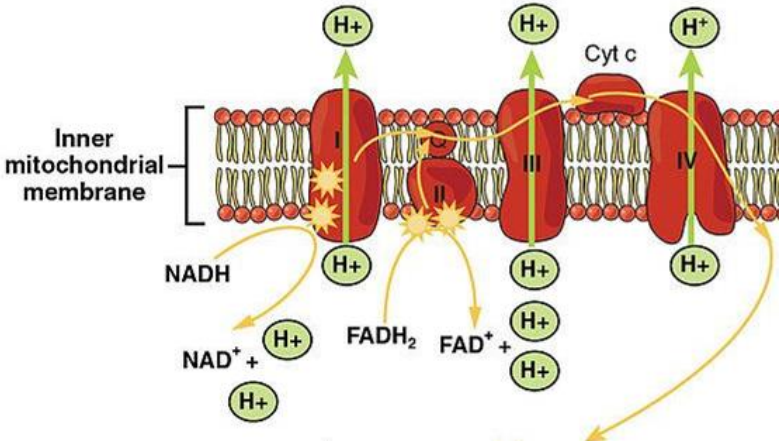


Electron transport chain

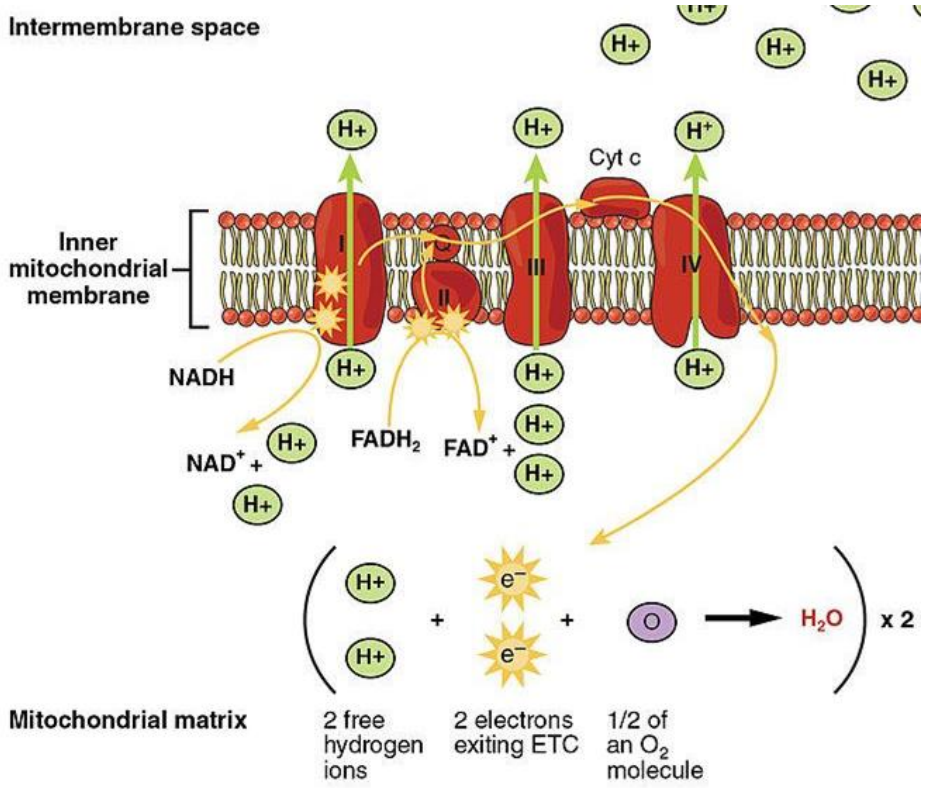
- Source of most ATP in aerobic cellular respiration



Electron Transport Chain in mitochondria

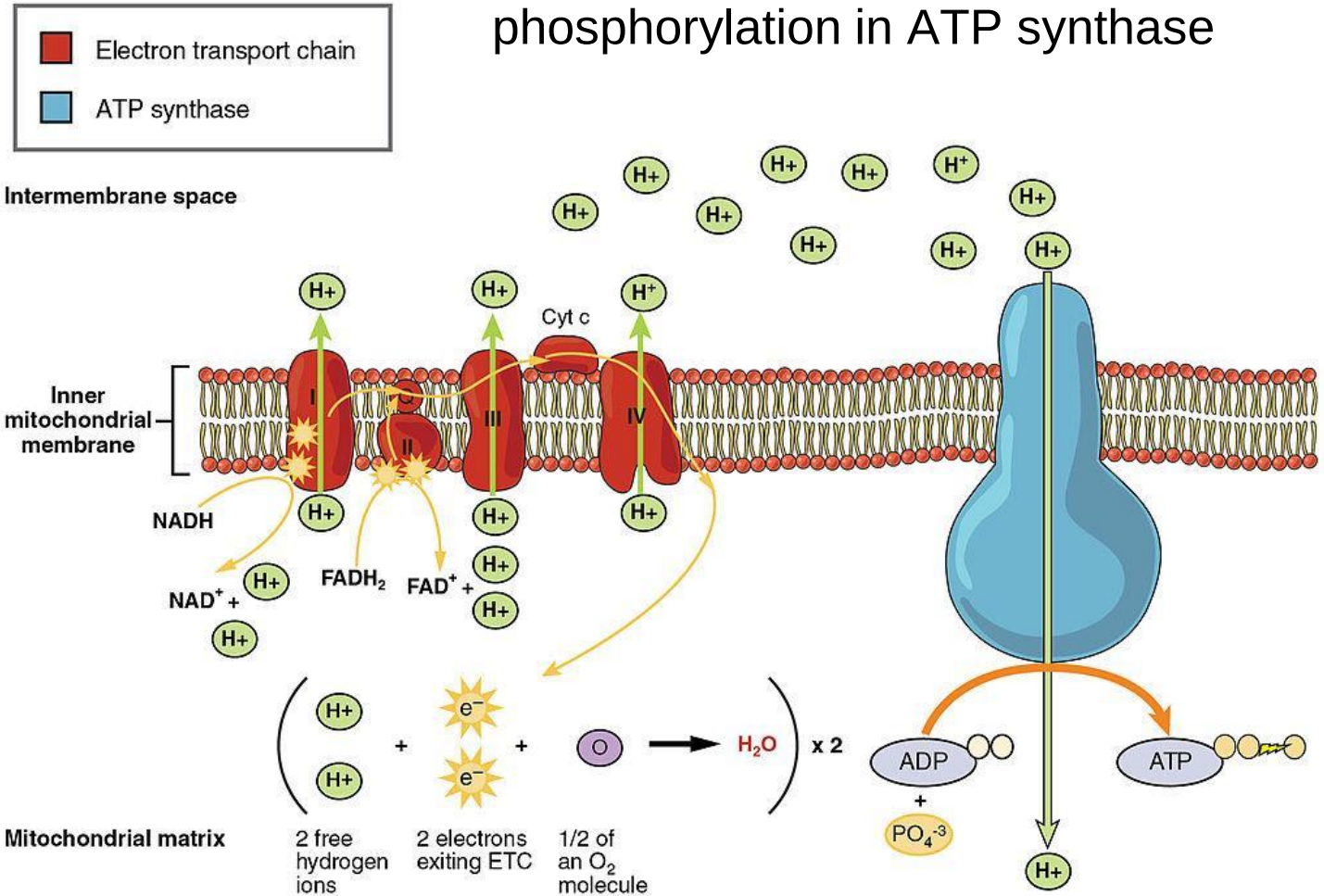


- Electrons are delivered by NADH and $FADH_2$ to the ETC
- Energy from the electrons are used to move protons
  - electrochemical gradient



- Oxygen is the final electron acceptor
- Water is produced

- 32 - 38 ATP are produced via oxidative phosphorylation in ATP synthase



Unit 3 Quizizz Game Codes

3.1: 0898 6211
3.2: 5197 7827
3.3: 1291 8371
3.4: 2235 5555
3.5: 6377 4307
3.6: 5014 2819
3.7: 5158 4611
Compiled: 5974 0971

Unit 4: Cell Communication and Cell Cycle

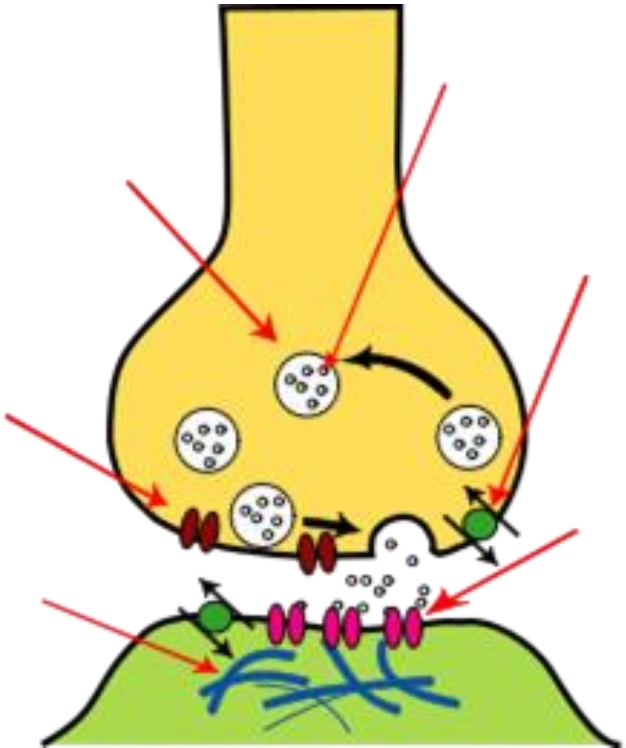
Main Idea: Cells communicate by generating, transmitting, receiving, and responding to chemical signals.

Be able to:

- Describe the ways that cells can communicate with each other
- Explain how cells communicate over short and long distances
- Describe signal transduction pathways and how they produce a cellular response

Cells communicate over short distances by using local regulators that target cells in the vicinity of the emitting cell

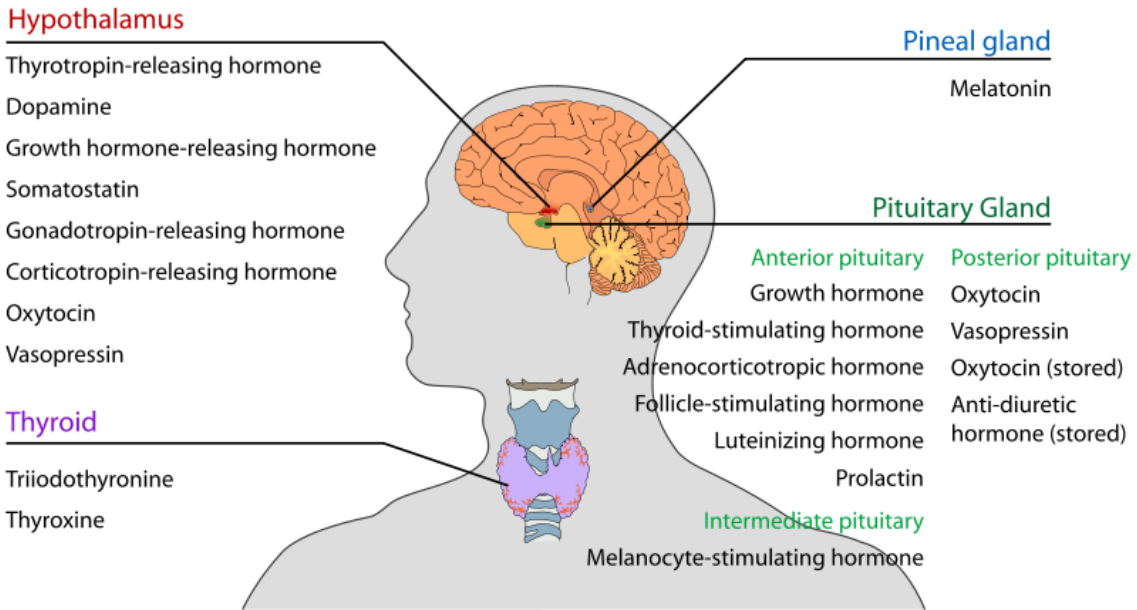
- Called paracrine signals
- Example: Neurotransmitters



Signals released by one cell type can travel long distances to target cells of another cell type

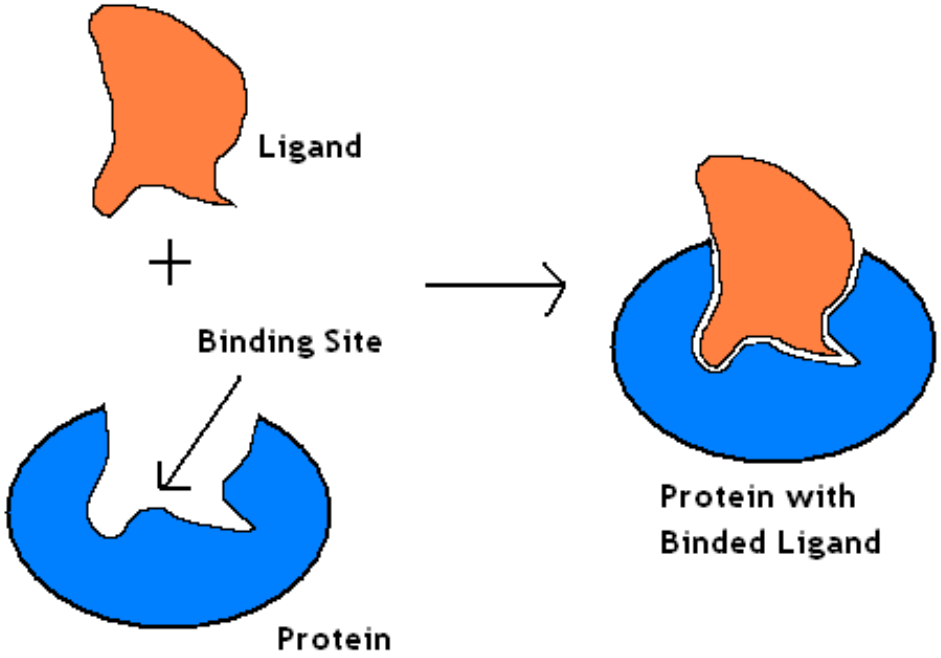
called Endocrine signals

Example:Insulin and other endocrine system signals



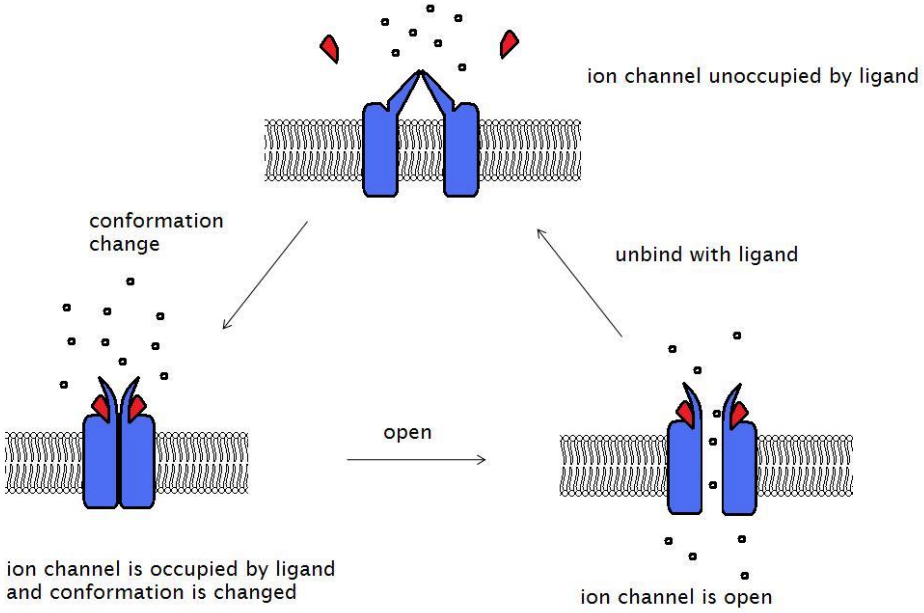
Signaling begins with a ligand

- Chemical messengers
  - peptides
  - small chemicals
  - proteins
- Specific to the receptor



Receptor protein

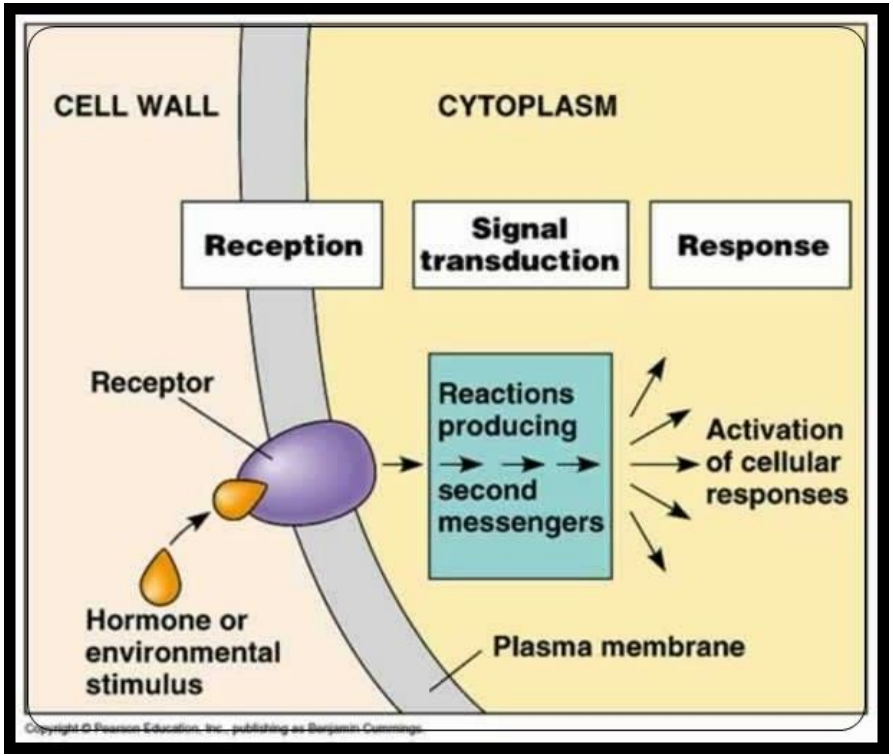
1. Signal molecules binds to the receptor protein
2. protein changes shape
   - conformation change
3. Initiates transduction of the signal



The process of signal transduction

Converts signal to cellular response

- signal cascade
- relays signal from receptor to cell target
- often amplifying signal



Unit 4: Cell Communication and Cell Cycle

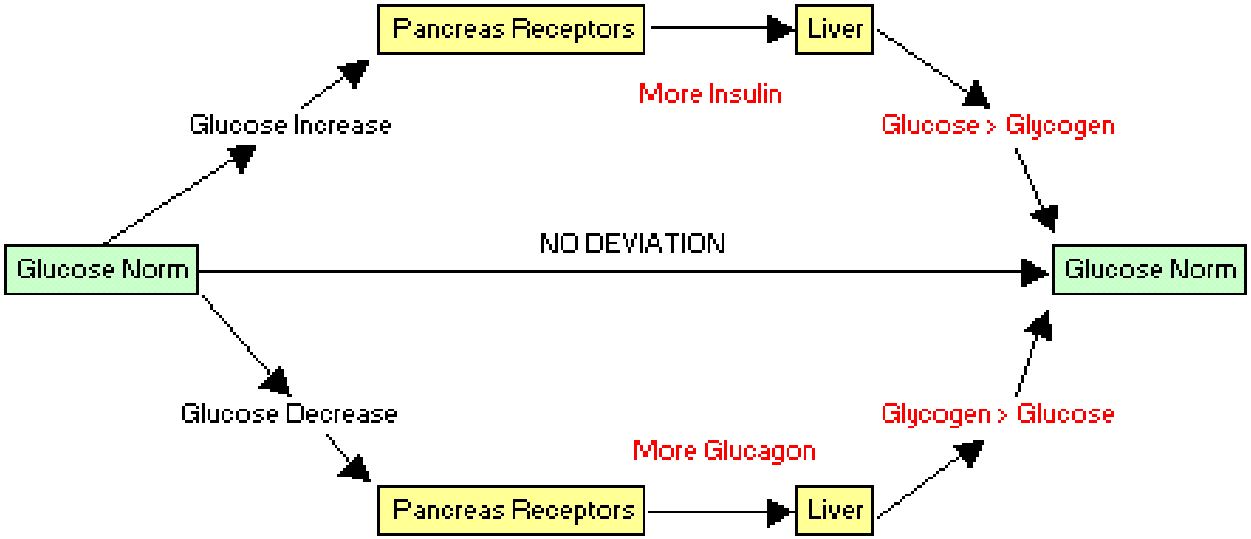
Main Idea: Organisms use environmental cues to coordinate reactions used for growth, reproduction, and homeostasis

Be able to:

- Describe positive and negative feedback and explain how negative feedback helps maintain homeostasis
- Explain how positive feedback affects homeostasis.
- Describe the role of the environment in eliciting a cellular response

Negative feedback

- The response reduces the effect of the stimulus
- Used to maintain homeostasis



Negative feedback examples

Sweat and temperature

- Exercise
  - internal temperature increases
- Sweat
  - Internal temperature returns to normal

Positive feedback

- Response magnifies effect of stimulus
- Example: Ripening fruit
  - Fruit releases ethylene gas as they ripen
  - ethylene gas signals fruit ripening

Unit 4: Cell Communication and Cell Cycle

Main Idea: Organisms pass genetic information on to the next generation

Be able to:

- Describe the events that occur in the cell cycle.
- Explain how mitosis results in two genetically identical cells

The cell cycle

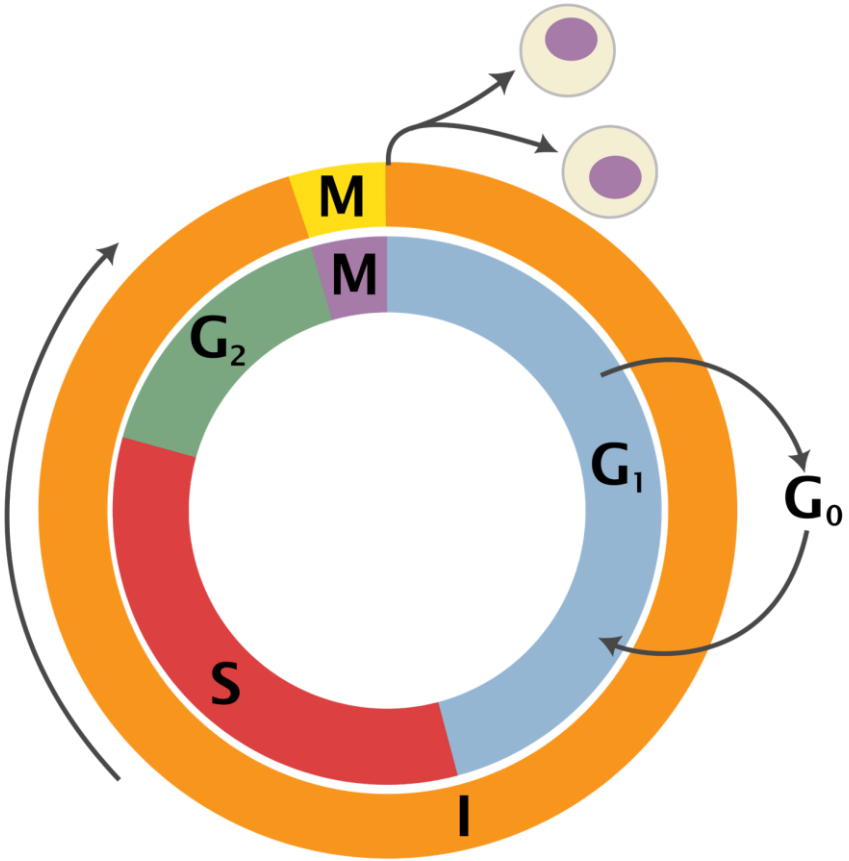
Major stages of a eukaryotic cell's life cycle.

How eukaryotic cells accomplish the processes of growth, repair, and reproduction.

Interphase: non-dividing life (most of the cell cycle).

$G_1 \rightarrow S \rightarrow G_2$

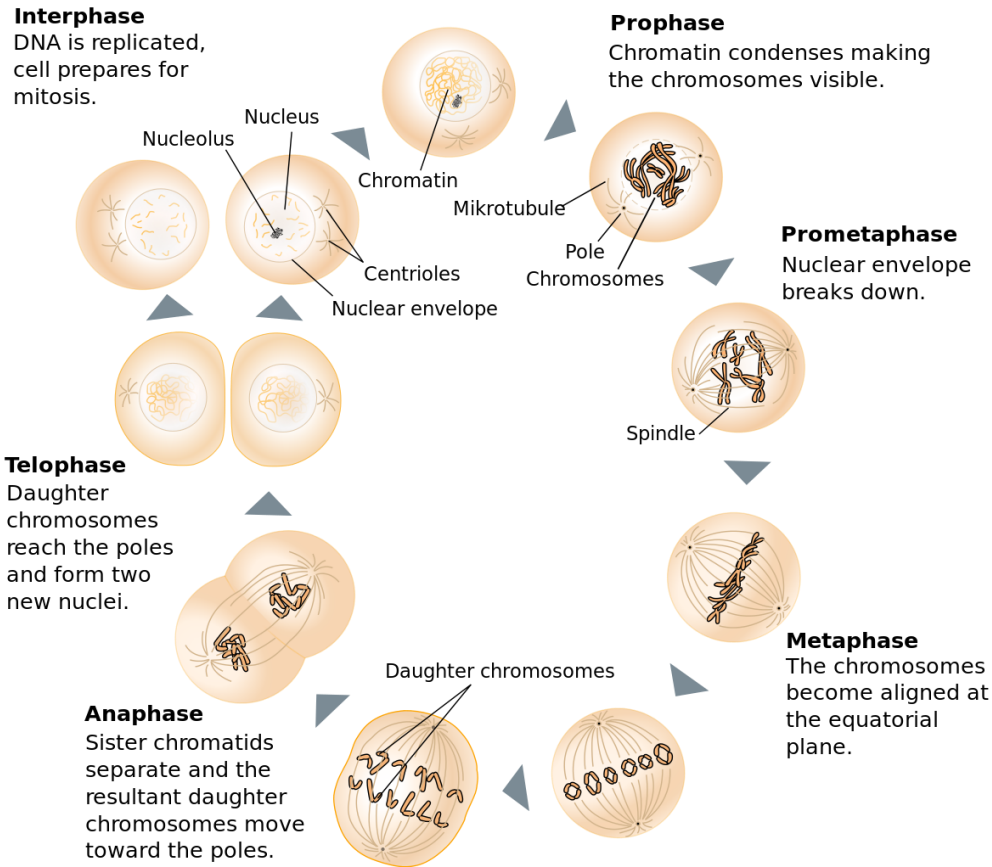
M-phase: cell division.



Mitosis

Produces two genetically identical “daughter” cells.

Chromosomes duplicated in S phase condense, align, and separate.



Unit 4: Cell Communication and Cell Cycle

Main Idea: Organisms pass genetic information on to the next generation

Be able to:

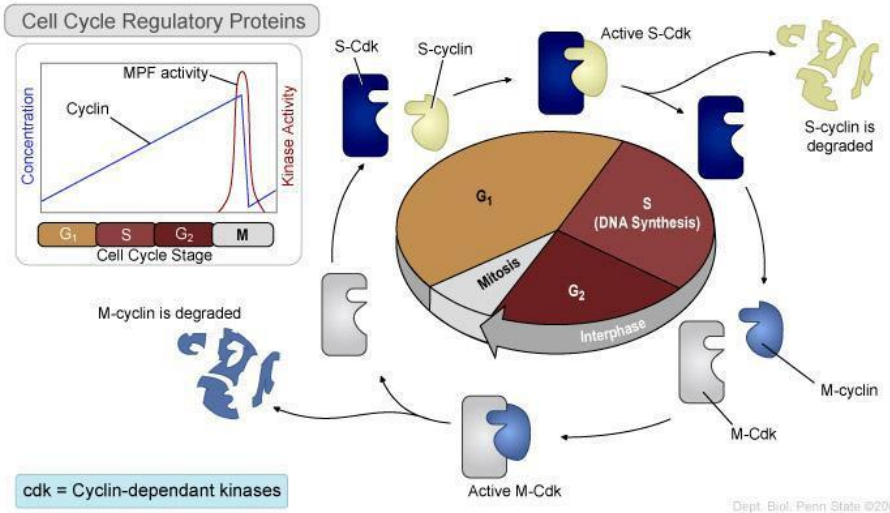
- Describe how checkpoints regulate the cell cycle.
- Explain how disruptions to these checkpoints can affect the cell and/or organism.

Control of Cell Division

Mitosis is under strict cellular control. Cells must pass through a series of “checkpoints” to be allowed to divide.

If internal conditions are not appropriate, cell division will normally be prevented.

Ex. Mitosis Promotion Factor



Unit 4 Quizizz Game Codes

4.1: 0184 5875
4.2: 4378 8915
4.3: 6476 0435
4.4: 0853 0547
4.5: 6685 7587
4.6: 0433 6243
4.7: 5466 7891
Compiled: 2833 2843

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