Goal 4

Bio.4.1 Understand how biological molecules are essential to the survival of living organisms.

Bio.4.1.1 Compare the structures and functions of the major biological molecules (carbohydrates, proteins, lipids, and nucleic acids) as related to the survival of living organisms.

Bio.4.1.2 Summarize the relationship among DNA, proteins and amino acids in carrying out the work of cells and how this is similar in all organisms.

Bio.4.1.3 Explain how enzymes act as catalysts for biological reactions.

Bio.4.2 Analyze the relationships between biochemical processes and energy use in the cell.

Bio.4.2.1 Analyze photosynthesis and cellular respiration in terms of how energy is stored, released, and transferred within and between these systems.

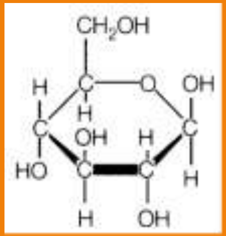
Bio 4.2.2 Explain ways that organisms use released energy for maintaining homeostasis (active transport).

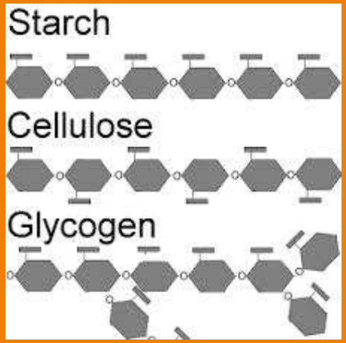
Organic Molecules

- Contain carbon
- Molecules of living things (or once living)

<table>
<tr><th>Macromolecule Group</th><th>Monomer (building block)</th><th>Polymer (large molecule)</th><th>function</th><th>structure (To Identify, Look for . . .)</th></tr>
<tr><td>Carbohydrate</td><td>Monosaccharide

Example: Glucose</td><td>Polysaccharide

Examples: starch, cellulose, glycogen</td><td>Short term energy, structure of plant cell wall (cellulose)</td><td>Made of rings of C,H, and O; –OH's on all carbons except one
Glucose
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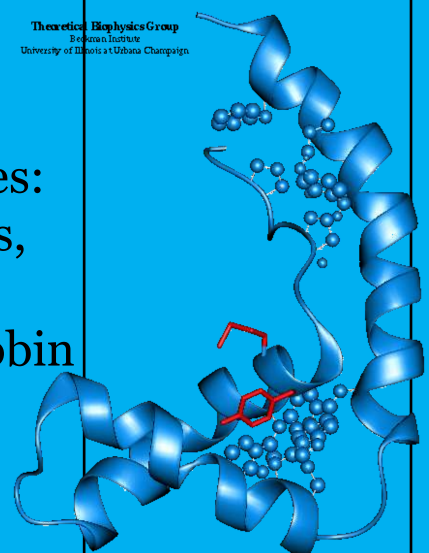
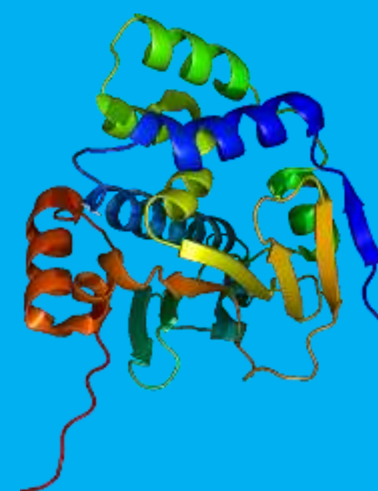
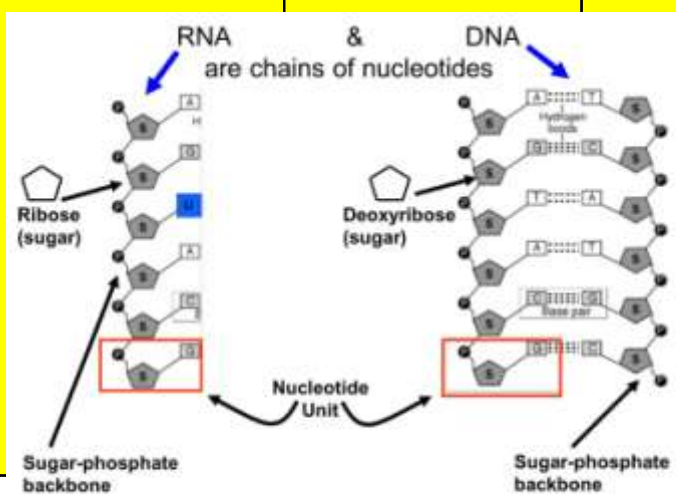
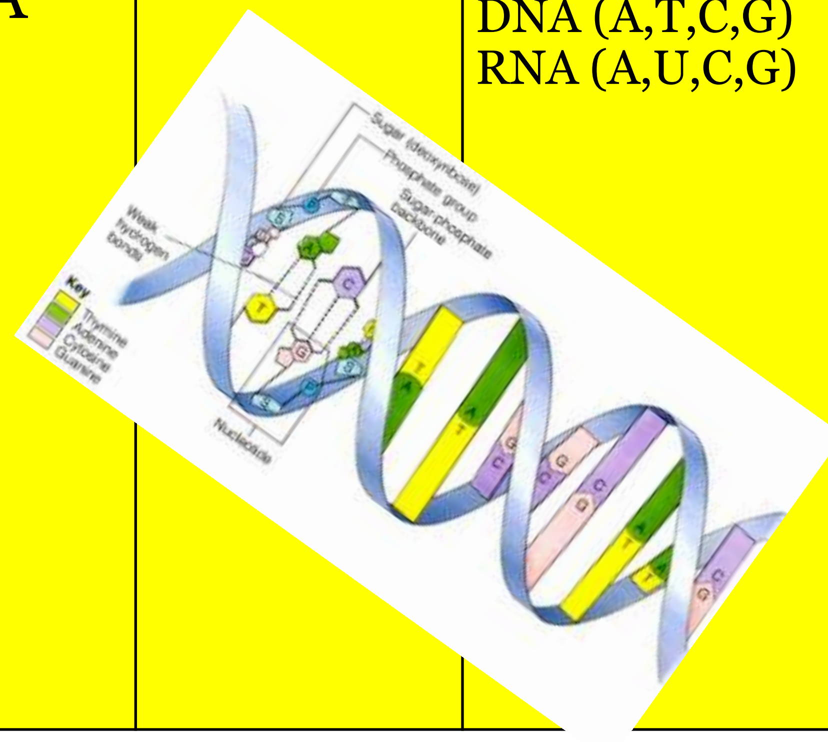
Macromolecule Group	Monomer (building block)	Polymer (large molecule)	function	structure (To Identify, Look for . . .)
Protein	Amino Acid	Polypeptide or protein Examples: Enzymes, insulin, hemoglobin	Enzymes, structure, growth and repair, transport,	Contain N, have N-C-C backbone Long Chains of amino acids joined by peptide bonds



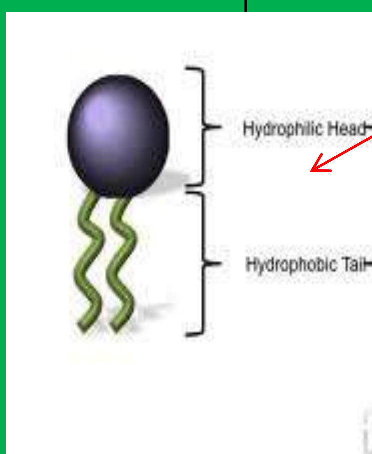


Macromolecule Group	Monomer (building block)	Polymer (large molecule)	function	structure (To Identify, Look for . . .)
Nucleic Acids	nucleotide	DNA or RNA	Carries and transfers genetic information	Made of sugars, phosphates and nitrogen bases DNA (A,T,C,G) RNA (A,U,C,G)

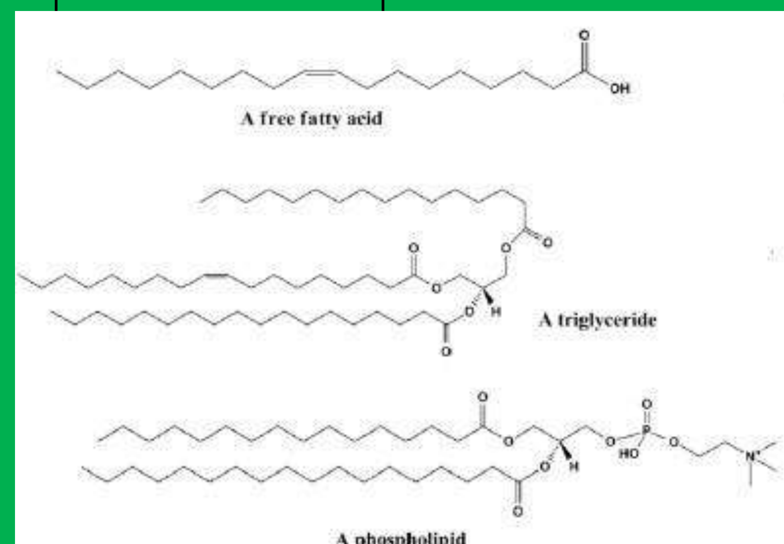




Macromolecule Group	Monomer (building block)	Polymer (large molecule)	function	structure (To Identify, Look for . . .)
Lipids	No monomer but subunits are glycerol and fatty acids	DNA or RNA	Carries and transfers genetic information	Made of sugars, phosphates and nitrogen bases DNA (A,T,C,G) RNA (A,U,C,G)



Examples: phospholipids, steroids



DNA is the code of life.

It contains the information on how to make proteins.

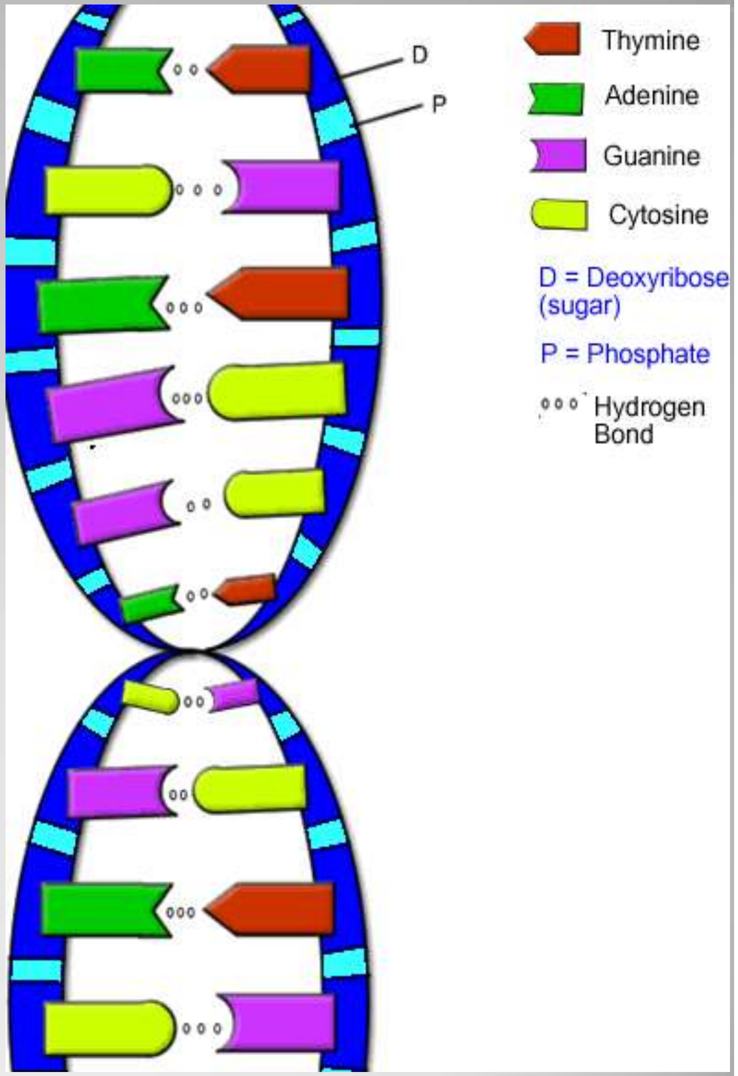
ALL LIVING THINGS USE THE SAME CODE!

DNA
(Deoxyribonucleic Acid)

- Nitrogen Bases
  - Adenine
  - Thymine
  - Guanine
  - Cytosine

Complementary Base Pairs:

- Adenine-Thymine
- Guanine-Cytosine

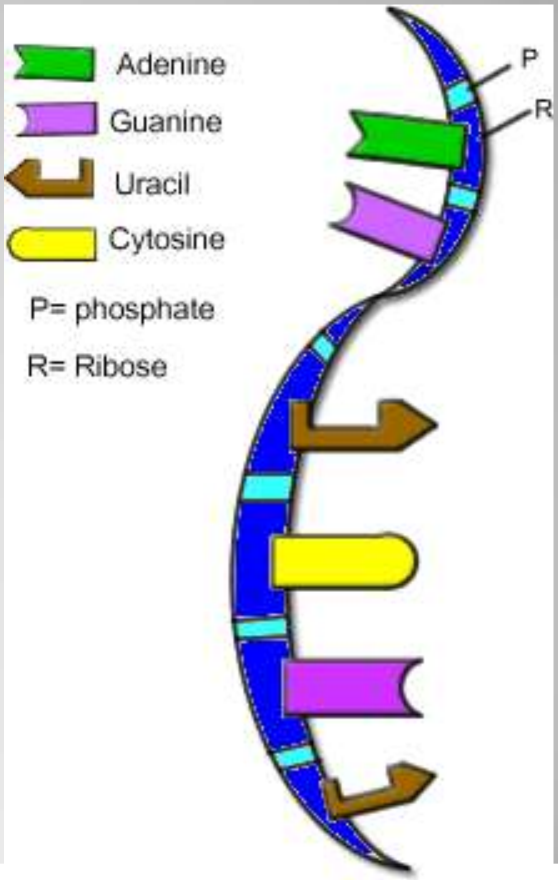


RNA
(Ribonucleic Acid)

Single strand.

Uracil instead of thymine.

Ribose instead of deoxyribose.



Types of RNA

Messenger RNA – carries DNA code from nucleus to ribosome

(why can't DNA leave the nucleus?)

Transfer RNA - carries amino acids from the cytoplasm to the ribosome

Ribosomal RNA – what the ribosome is made of

The Code

Every three nitrogen bases is the code for one amino acid.

An error in a nitrogen base is called a mutation.

Protein Synthesis

Two Steps

Transcription – copying DNA code onto the mRNA

Translation – making protein in the ribosome

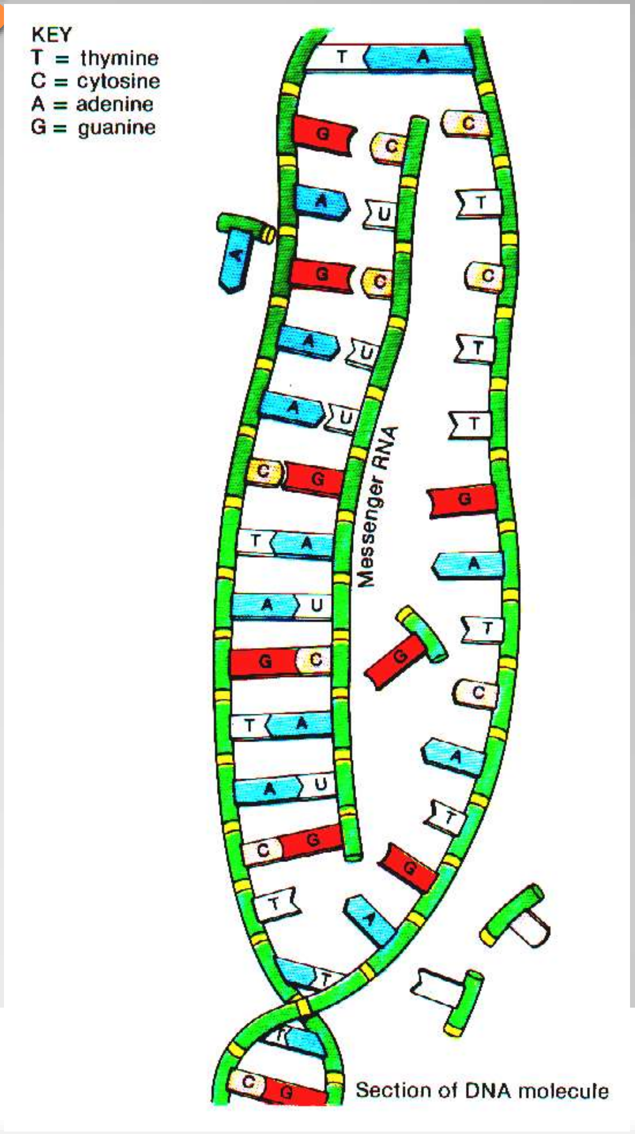
Protein Synthesis

Transcription:

DNA unwinds and unzips

mRNA nucleotides match up to the complimentary DNA nucleotide

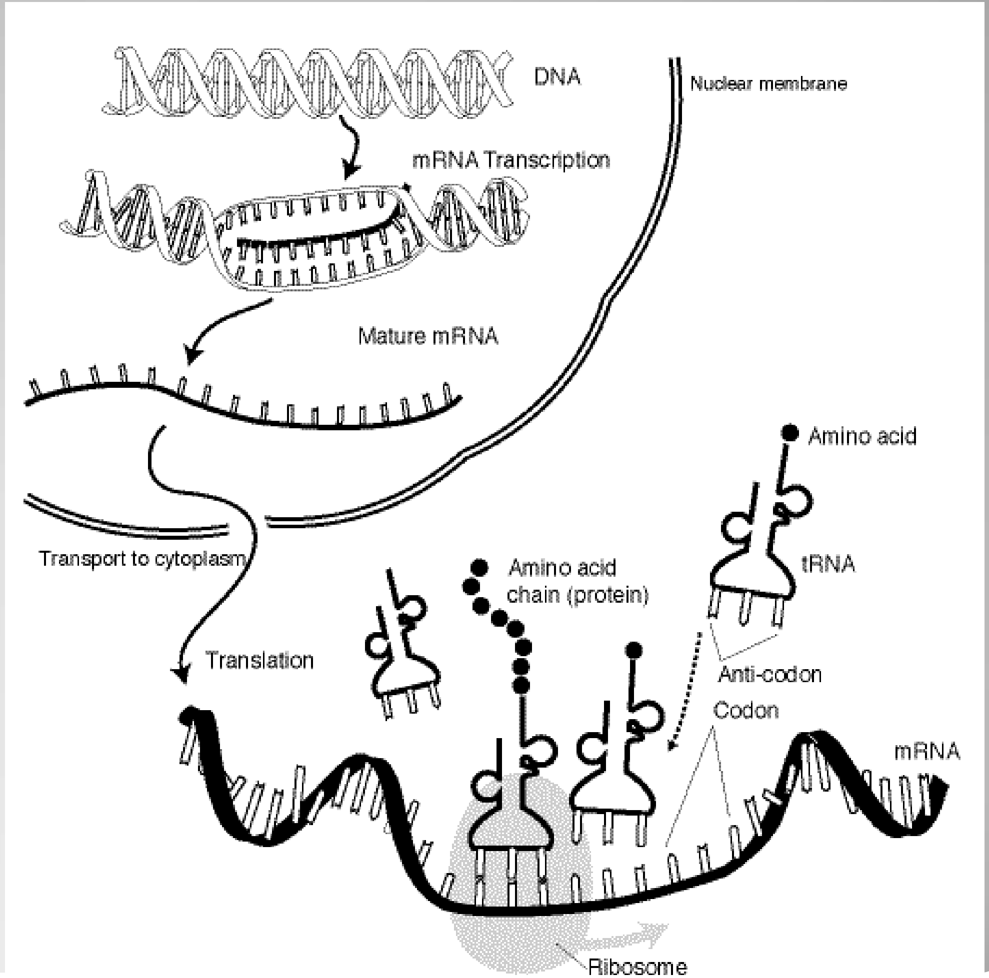
Single strand of mRNA is made with the DNA code



Protein Synthesis

Transcription Cont'd

mRNA leaves the nucleus and carries the code to the ribosome

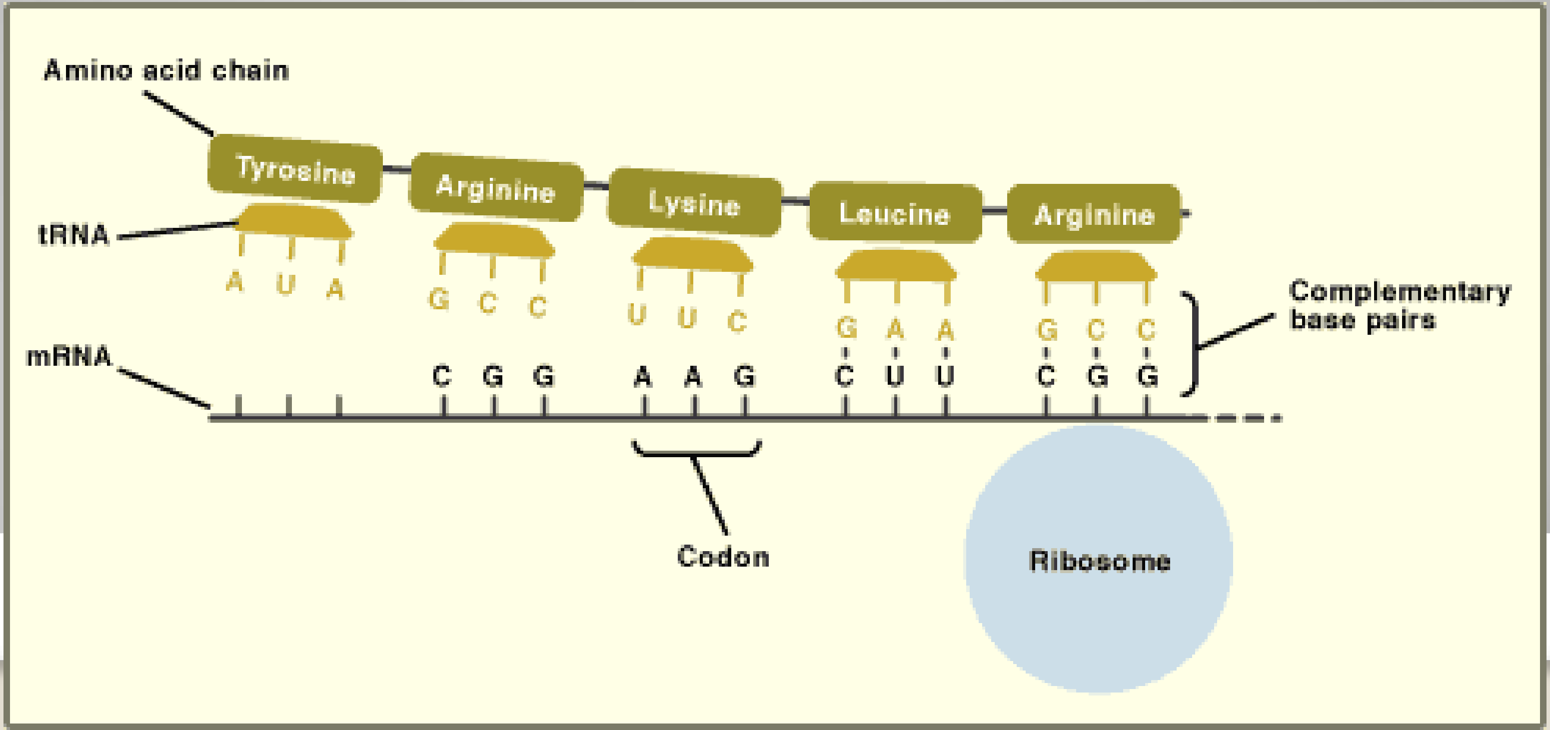


Protein Synthesis

Translation –

mRNA lines up in the ribosome

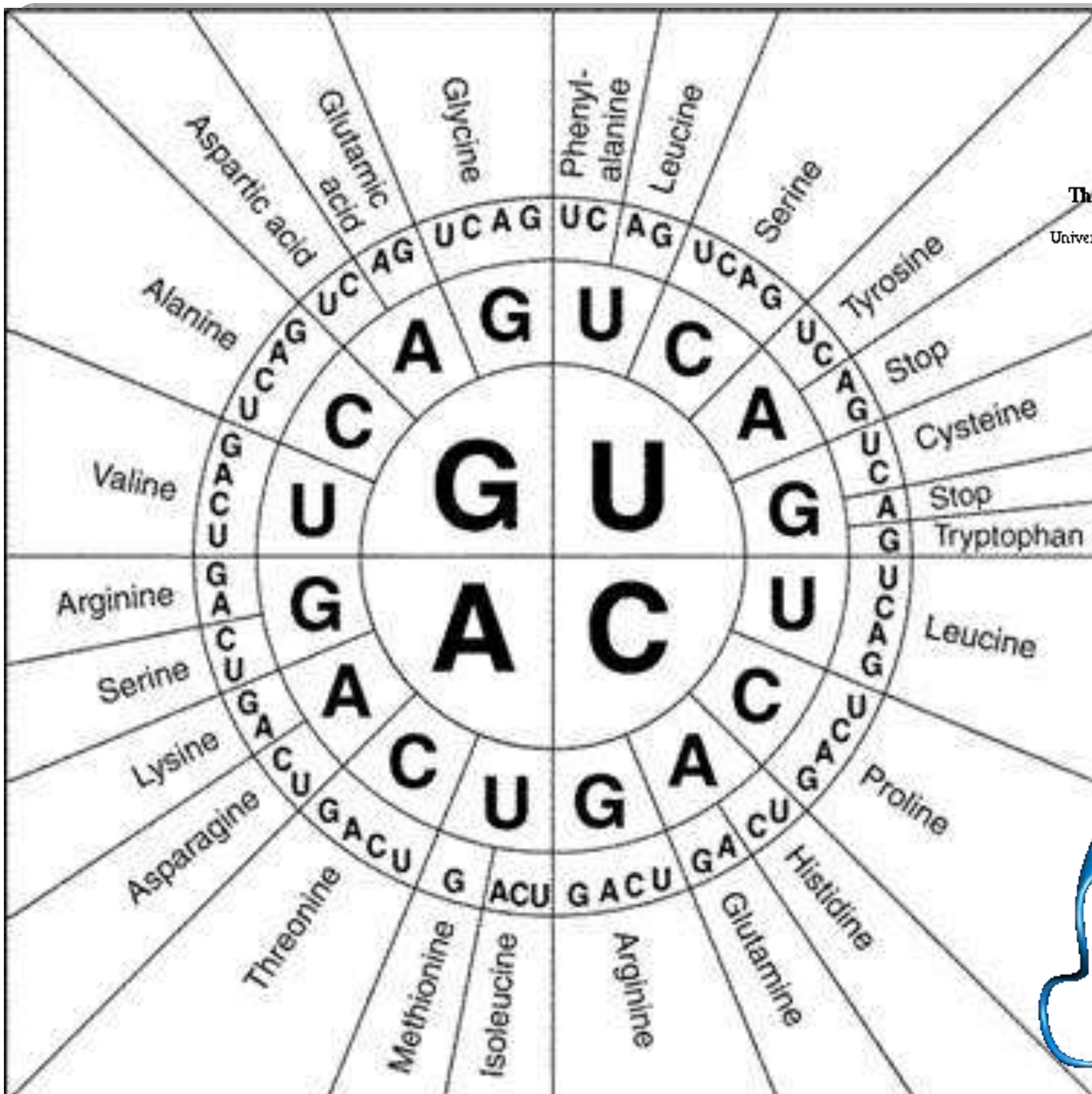
mRNA triplet codes (codons)match up with tRNA triplet codes (anticodons) and bring amino acids

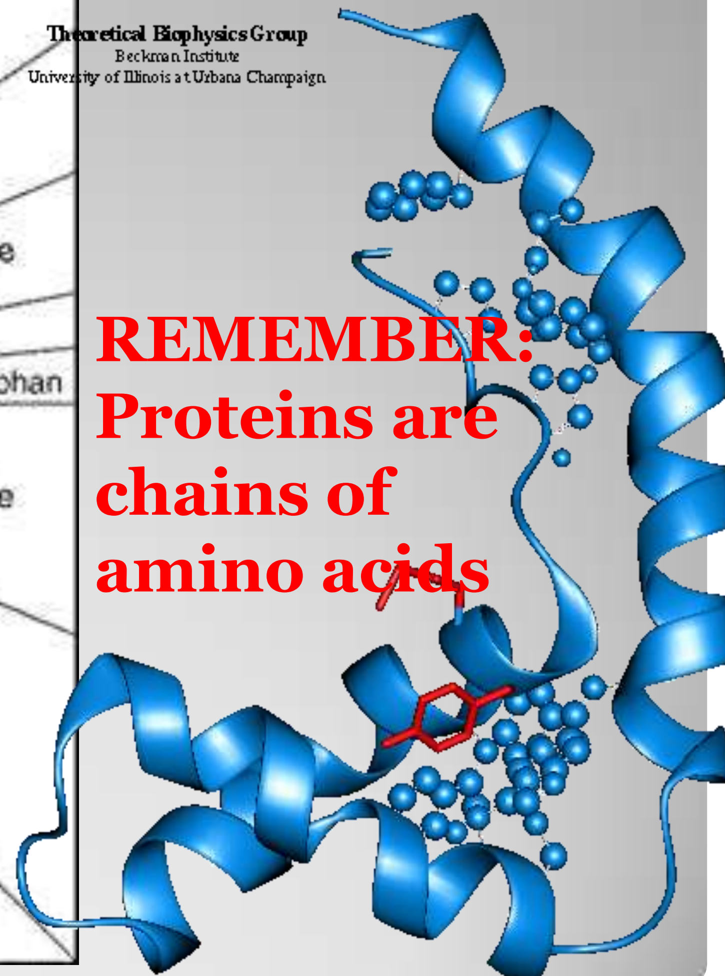


Reading and interpreting an mRNA codon chart

- Find each codon (3 base sequence) from the **mRNA**
- Use chart to find the correct amino acid that it codes for

First base	U		C		A		G		Third base
U	UUU	Phe	UCU	Ser	UAU	Tyr	UGU	Cys	U
	UUC		UCC		UAC		UGC		C
	UUA	Leu	UCA		UAA	Ocr	UGA	Opl	A
	UUG		UCG		UAG	Amb	UGG	Trp	G
C	CUU	Leu	CCU	Pro	CAU	His	CGU	Arg	U
	CUC		CCC		CAC		CGC		C
	CUA		CCA		CAA	Gln	CGA		A
	CUG		CCG		CAG		CGG		G
A	AUU	Ile	ACU	Thr	AAU	Asn	AGU	Ser	U
	AUC		ACC		AAC		AGC		C
	AUA		ACA		AAA	Lys	AGA	Arg	A
	AUG	Met	ACG		AAG		AGG		G
G	GUU	Val	GCU	Ala	GAU	Asp	GGU	Gly	U
	GUC		GCC		GAC		GGC		C
	GUA		GCA		GAA	Glu	GGA		A
	GUG		GCG		GAG		GGG		G





REMEMBER: Proteins are chains of amino acids

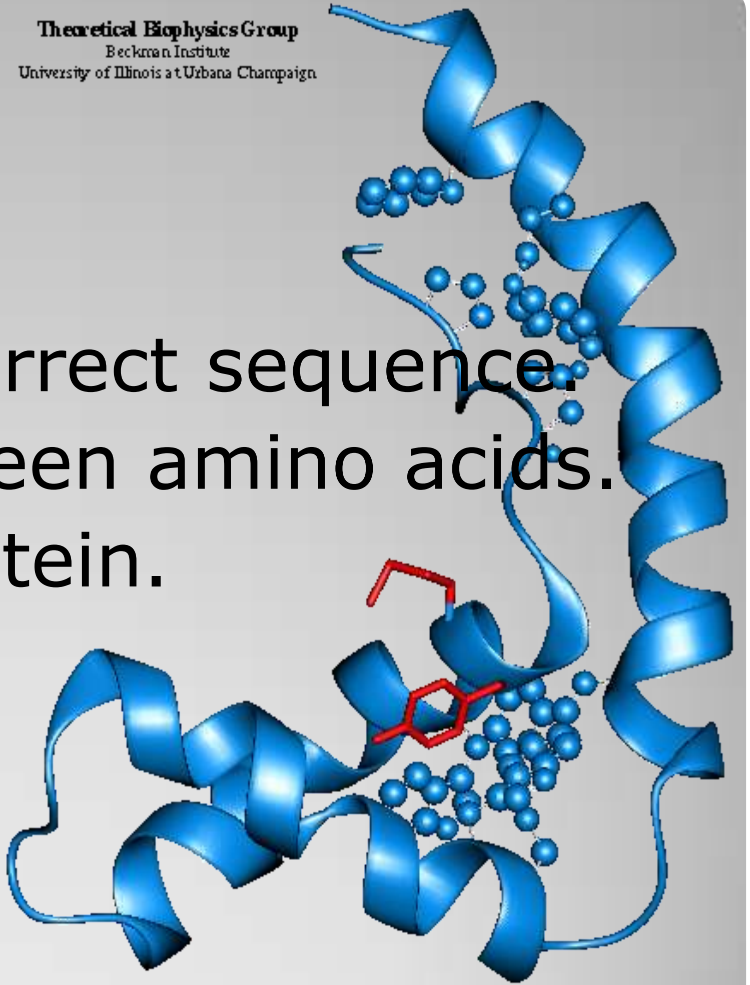
Protein Synthesis

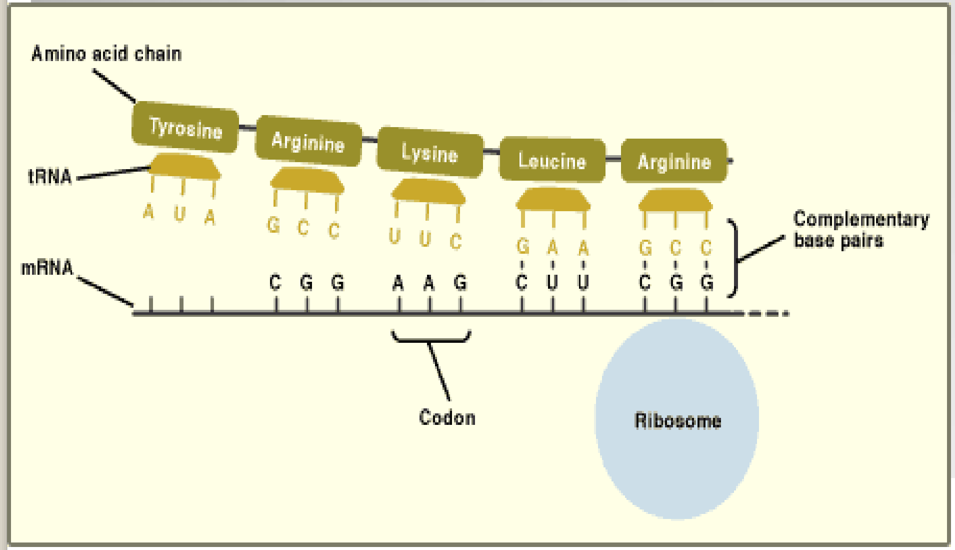
Translation continued

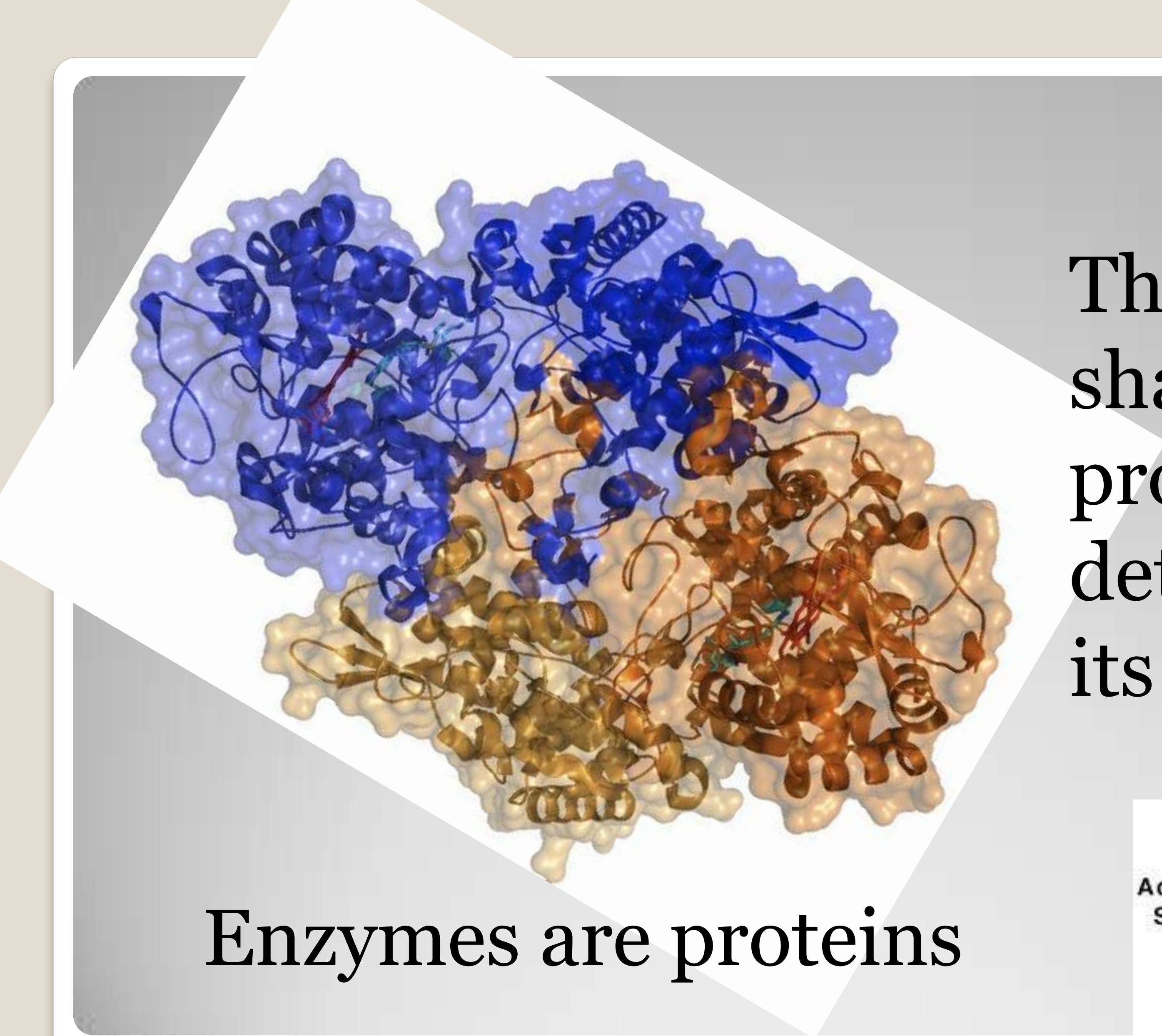
Amino acids are put in correct sequence.

Peptide bond forms between amino acids.

Polypeptide folds into protein.

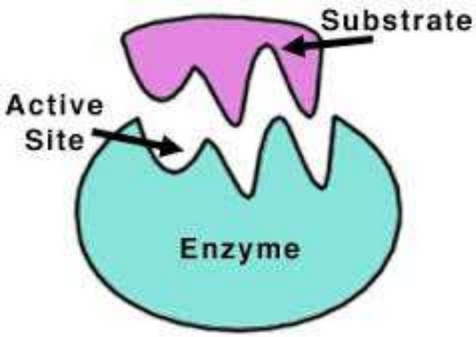




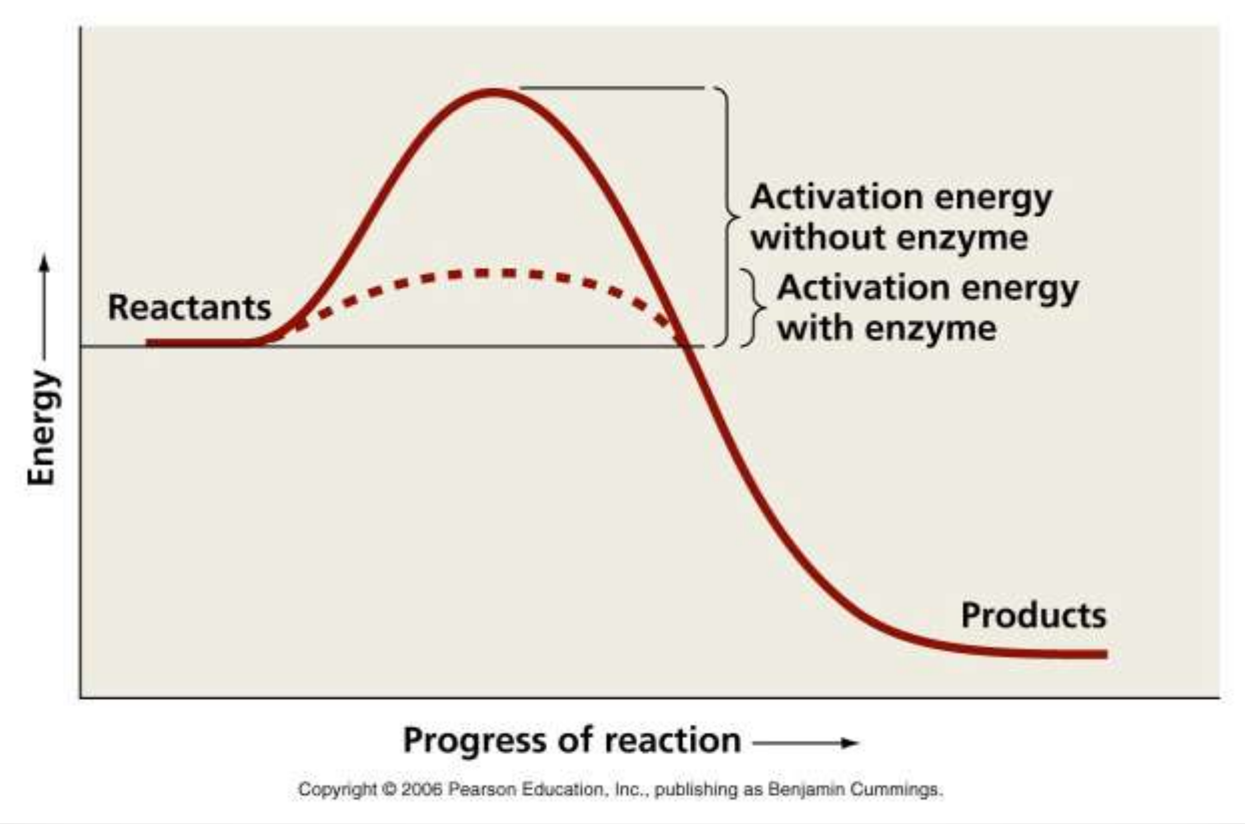


The 3D shape of the protein determines its function

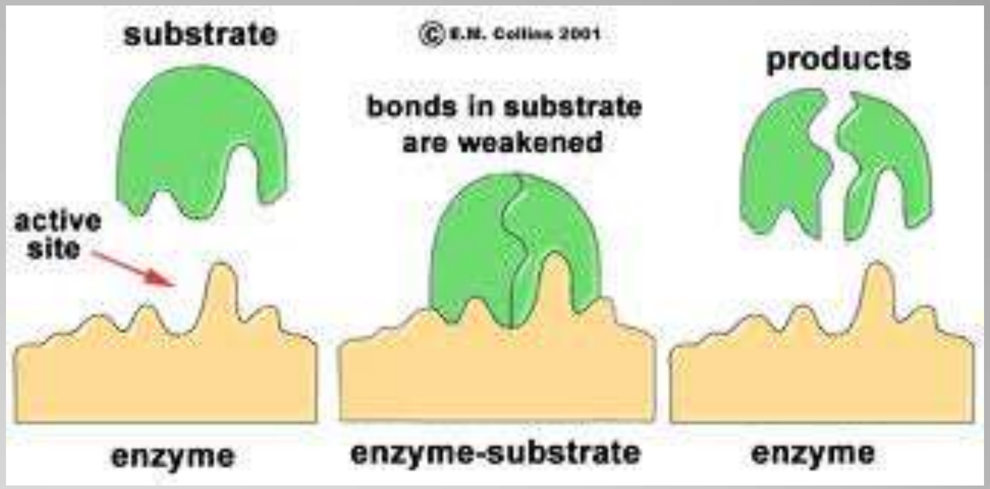
Enzymes are proteins



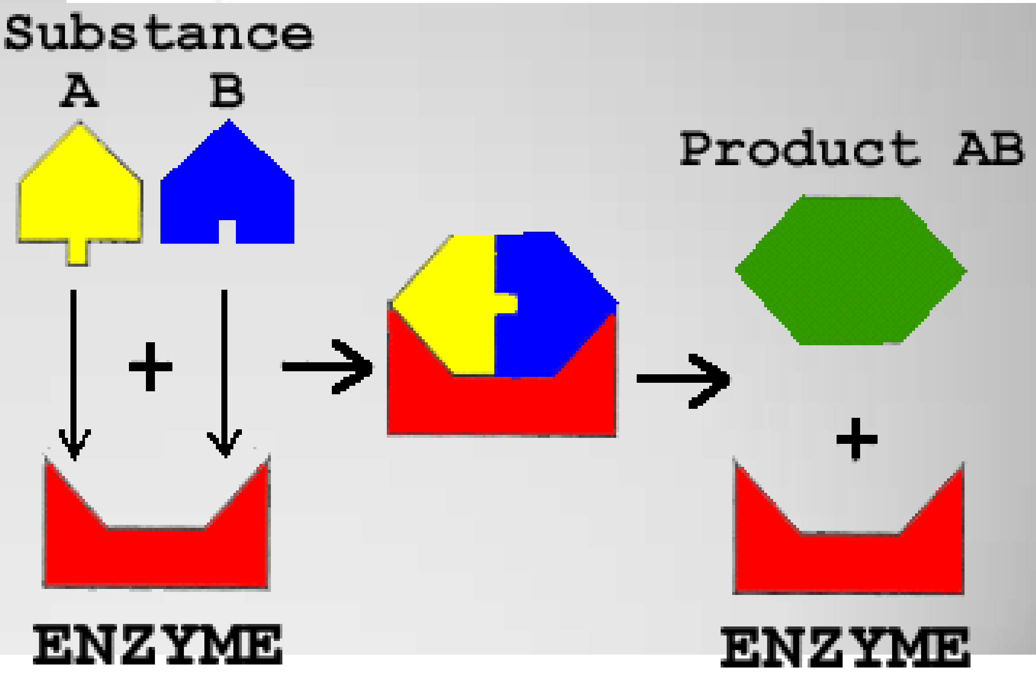
Enzymes are catalysts. This means they lower the activation energy of chemical reactions.



Different enzymes work with <u>specific</u> substrates, depending on the shape.

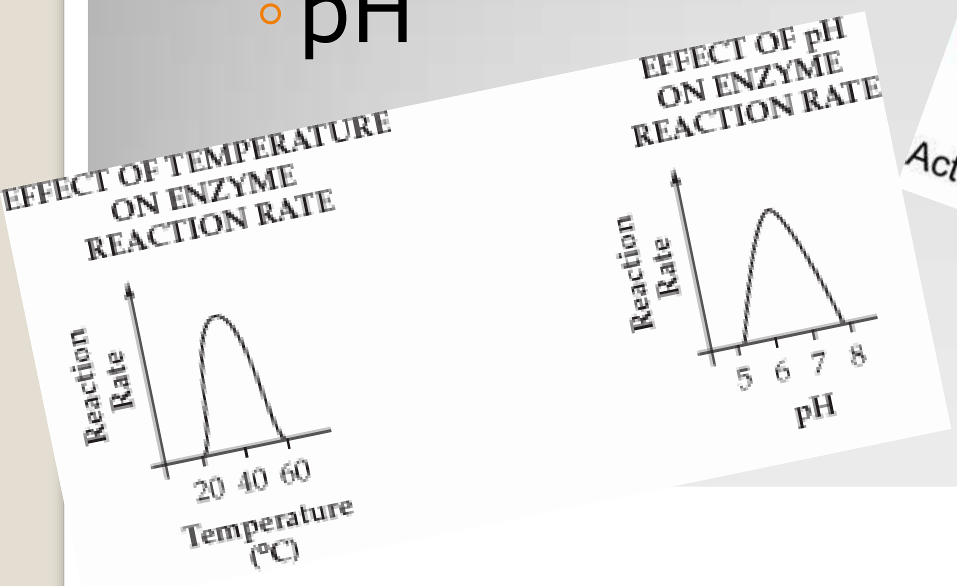


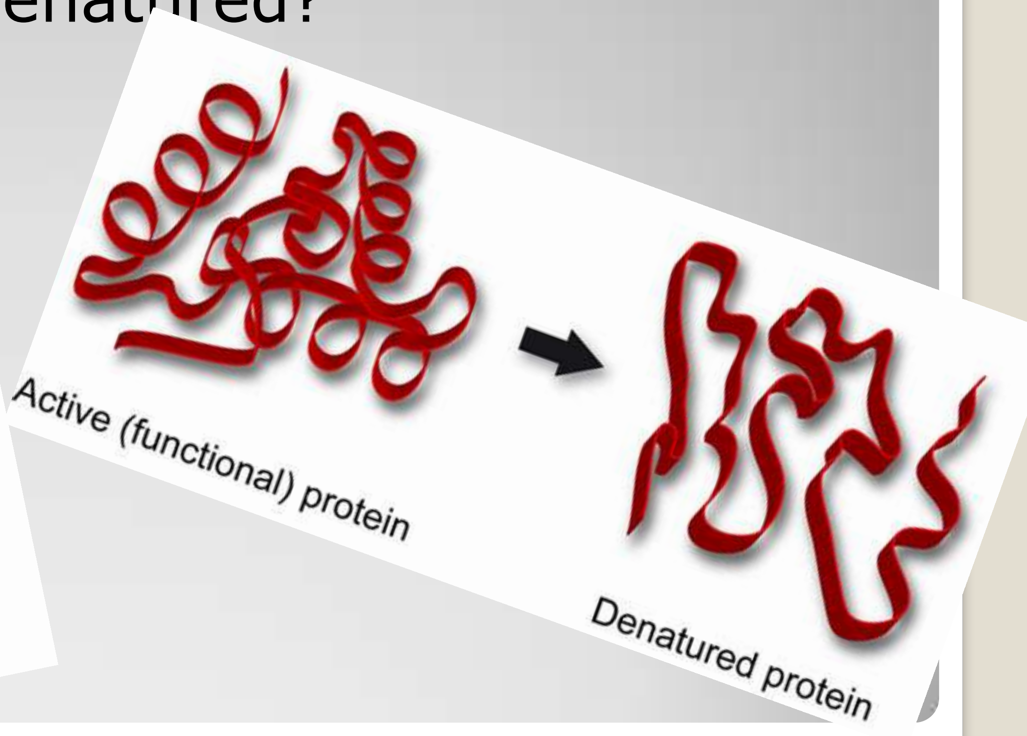
Enzymes are catalyst to over 4,000 biochemical reactions!



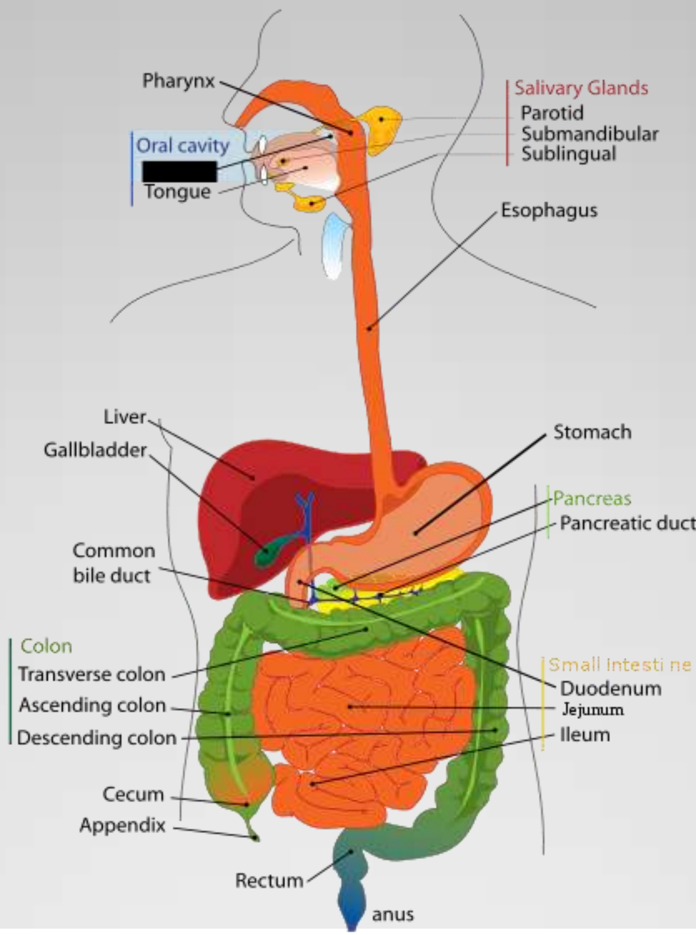
After they've done their job, enzymes are REUSEABLE !

- When an enzyme is denatured it is damaged.
- Denaturing changes the shape.
- Without the correct shape enzymes won't function properly.
- HOW are enzymes denatured?
  - Temperature
  - pH





Enzymes are used all over your body!

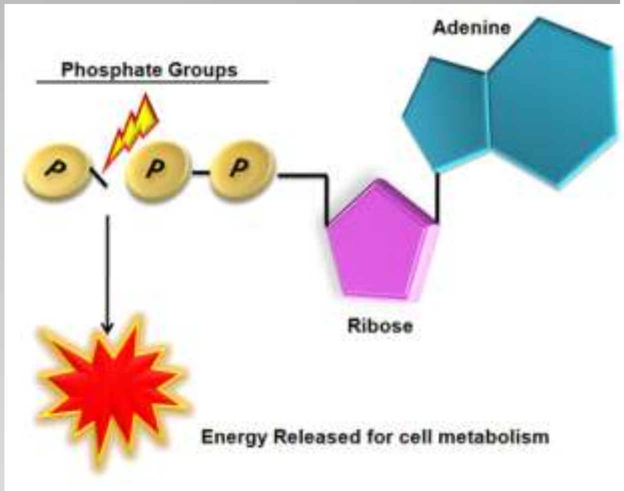


Major Digestive Enzymes

Enzyme	Produced In	Site of Release	pH Level
Carbohydrate Digestion:			
Salivary amylase	Salivary Glands	Mouth	Neutral
Pancreatic amylase	Pancreas	Small Intestine	Basic
Maltase	Small intestine	Small intestine	Basic
Protien Digestion:			
Pepsin	Gastric glands	Stomach	Acidic
Trypsin	Pancreas	Small intestine	Basic
Peptidases	Small Intestine	Small intestine	Basic
Nucleic Acid Digestion:			
Nuclease	Pancreas	Small intestine	Basic
Nucleosidases	Pancreas	Small intestine	Basic
Fat Digestion:			
Lipase	Pancreas	Small intestine	Basic

Most enzymes end in –ase

ATP



- Adenosine Tri-phosphate
- Made from ribose, adenine, and three phosphate molecules
- Energy storage molecule.
- Energy is stored when phosphate bond is formed. (ADP->ATP)
- Important cycle in respiration and photosynthesis

When high energy phosphate bond is broken → energy released and ADP made.

Cellular Respiration

All living organisms do respiration

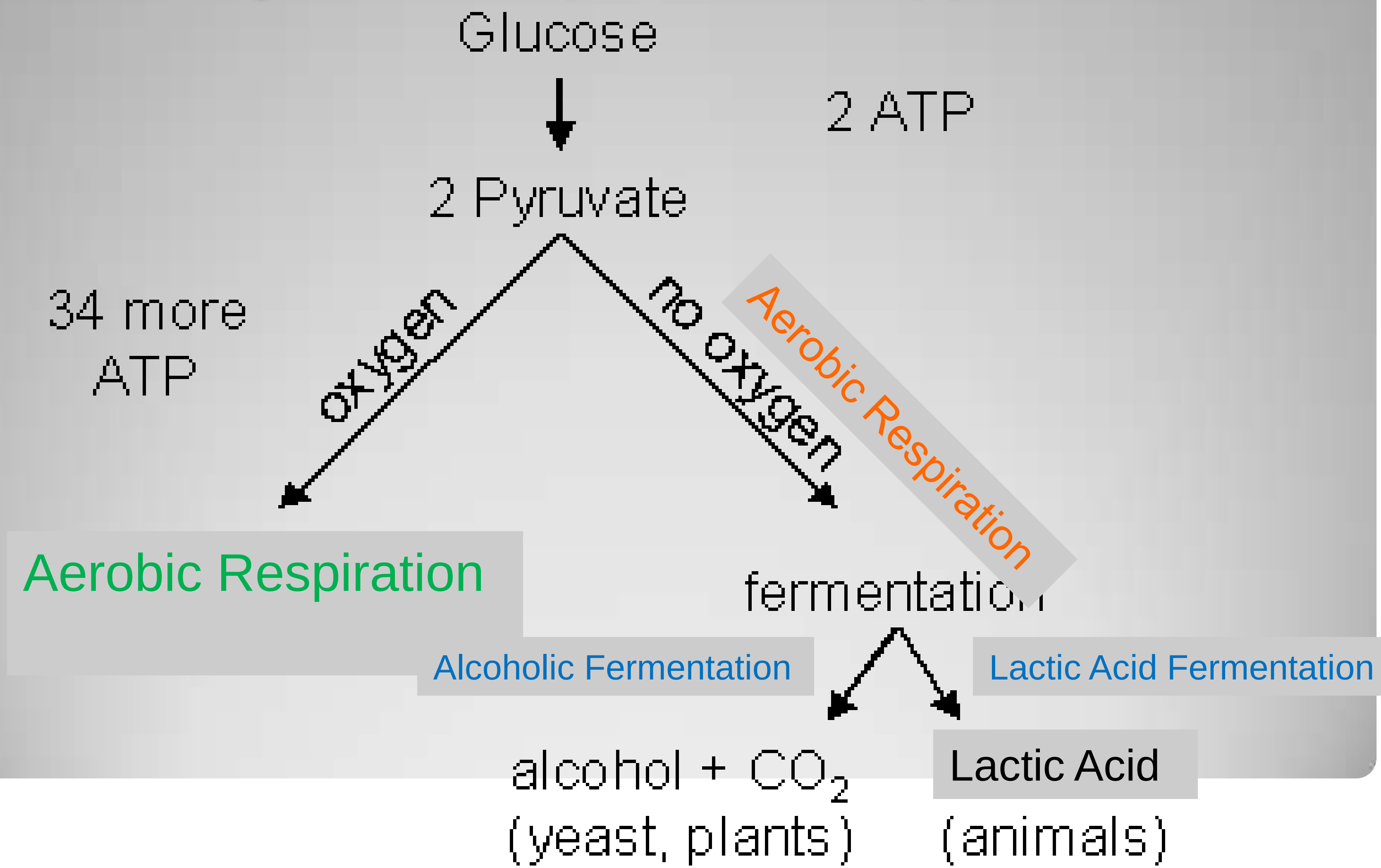
Aerobic Respiration (with oxygen)

More efficient
Occurs 24/7

$$C_6H_{12}O_6 + O_2 \rightarrow CO_2 + H_2O + ATP$$

What might effect the rate of respiration?
*Availability of glucose and/or oxygen (the reactants)
*temperature
*pH (0 to 14, 7 is neutral. Below 7 is acidic, above 7 is alkaline, or basic.)

All cellular respiration begins with glycolysis (splitting sugars)
one glucose is split into two pyruvates



Compare and Contrast

Aerobic Respiration	Anaerobic Respiration
With oxygen	Without oxygen
Mitochondria	Cytoplasm
36 ATP	2 ATP
Eukaryotes	Yeast, bacteria
24/7	24/7

Anaerobic Respiration (no oxygen)

Lactic acid Fermentation:
- Occurs in animal cells (ex. muscles) when oxygen is not present
- Occurs in some prokaryotes

Makes lactic acid

Alcoholic Fermentation
- Occurs in yeast
- Occurs in some prokaryotes
- Makes alcohol and carbon dioxide

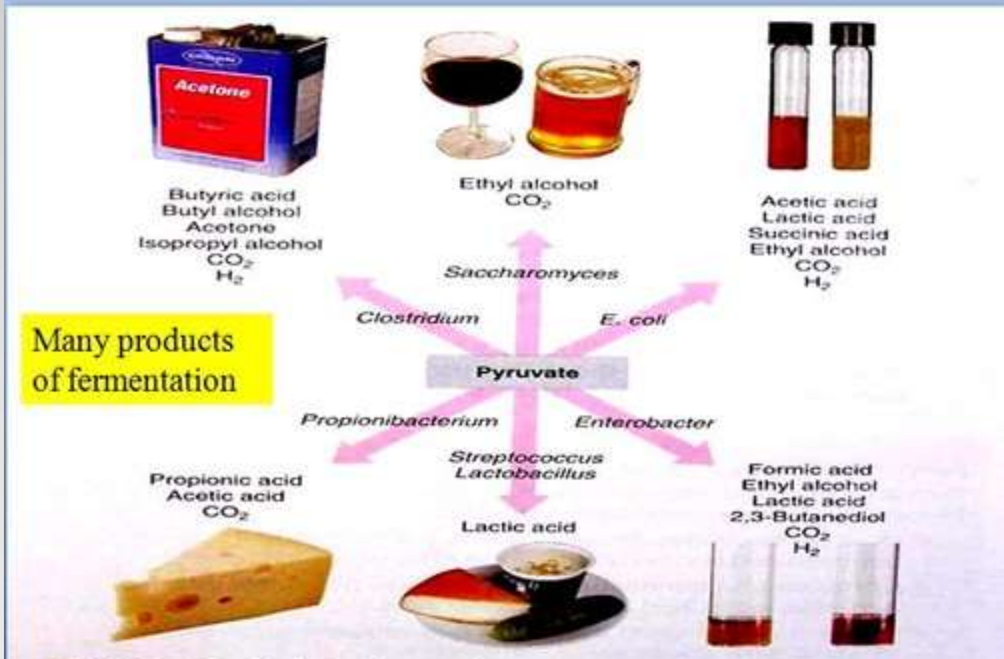
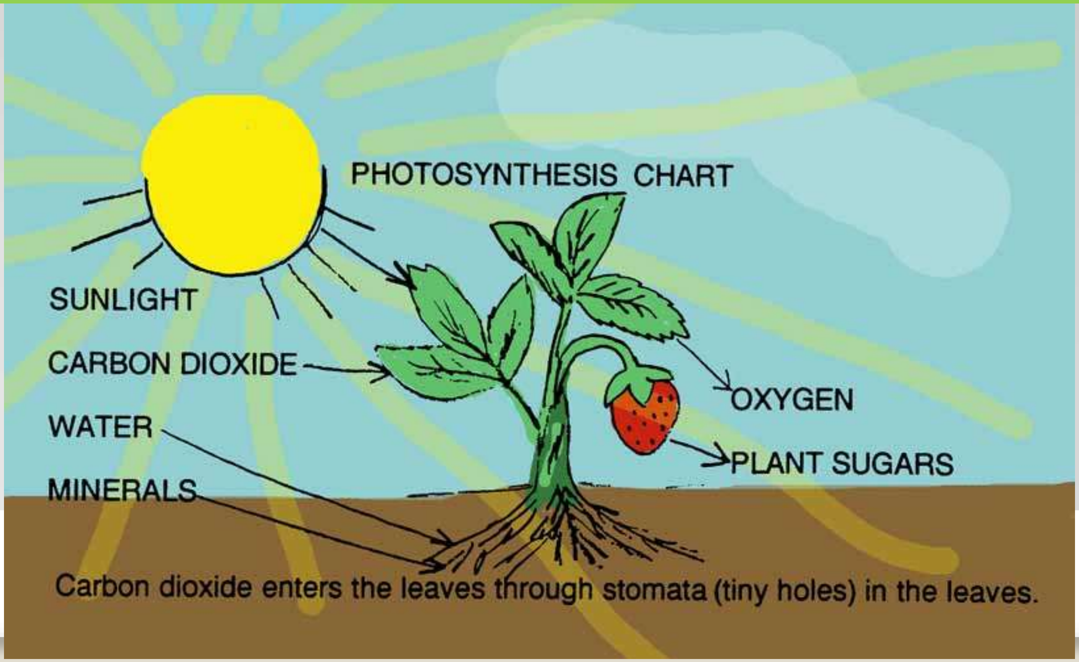


FIGURE 6.21 End Products of Fermentation Pathways Because a given type of organism uses a characteristic fermentation pathway, the end products can be used as an identifying marker. Some end products are commercially valuable.

Photosynthesis

$$6CO_2 + 6H_2O \rightarrow C_6H_{12}O_6 + 6O_2$$

- How plants take energy from sun and make glucose
- Only occurs during the day
- Plants, algae, blue-green bacteria



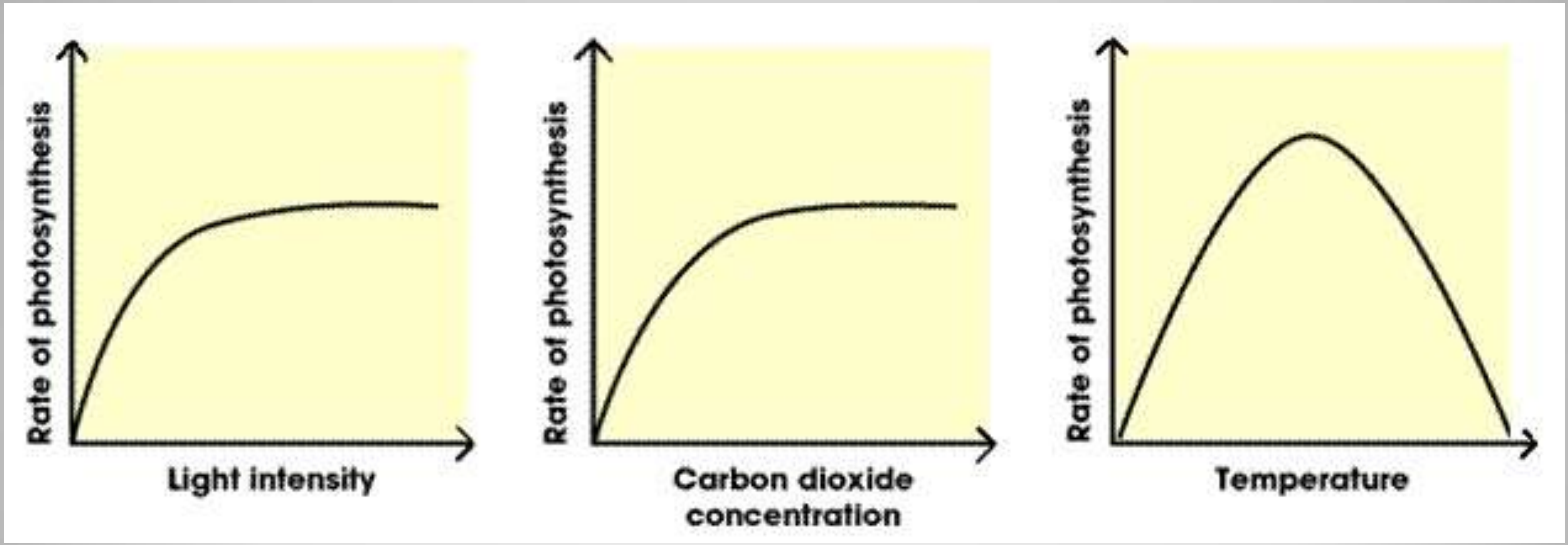
What might effect the rate of photosynthesis?

*Availability of glucose and/or oxygen (the reactants)

*Sunlight

*Temperature

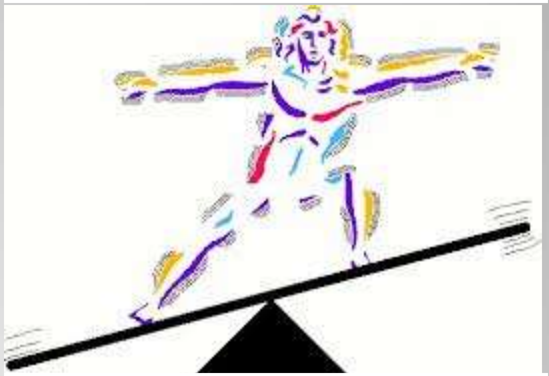
*pH (0 to 14, 7 is neutral. Below 7 is acidic, and above 7 is alkaline, or basic.)



Bio 4.2.2

Homeostasis is the ability to maintain a constant internal environment in response to environmental changes.

Homeostasis



A state of balance

Examples in the body include:

temperature control,
pH balance,
water and electrolyte balance,
blood pressure
Respiration
Active transport of needed molecules or to rid the cell of toxins
movement to avoid danger or to find food, water, and or mates
synthesizing needed molecules