Chapter 3

Chemistry of Life

Content Objectives
Write these down!

I will be able to identify:

- Where living things get energy.
- How chemical reactions occur.
- The functions of lipids.
- The importance of enzymes to living things.

Chapter 3 Section 4:
Energy & Metabolism

Key Vocabulary Terms

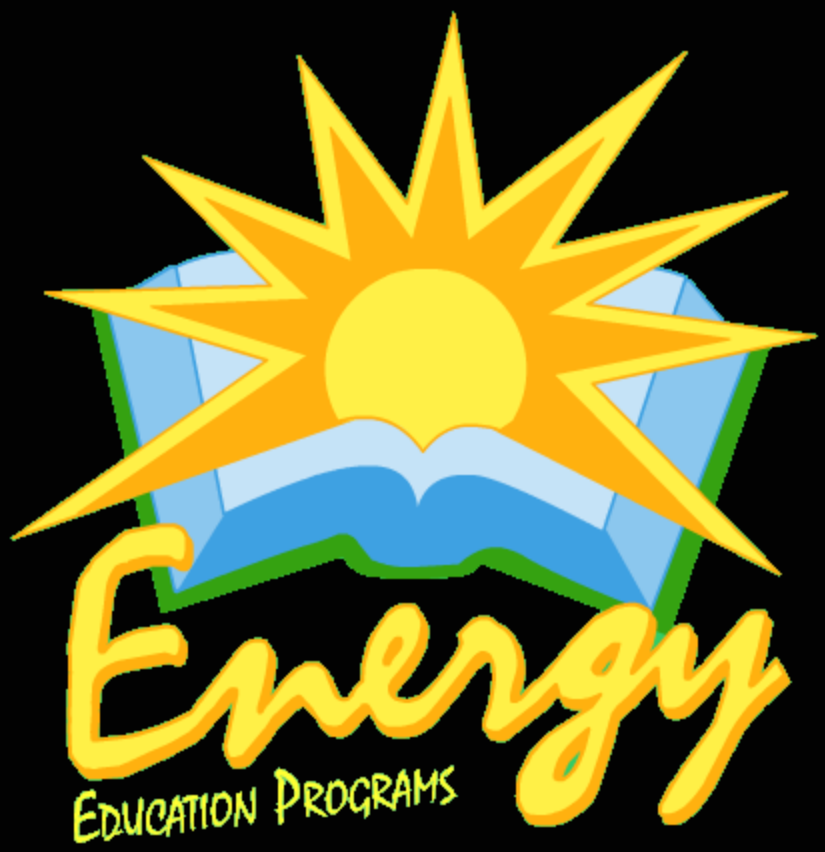
Adapted from Holt Biology 2008

Energy

The capacity to do work.

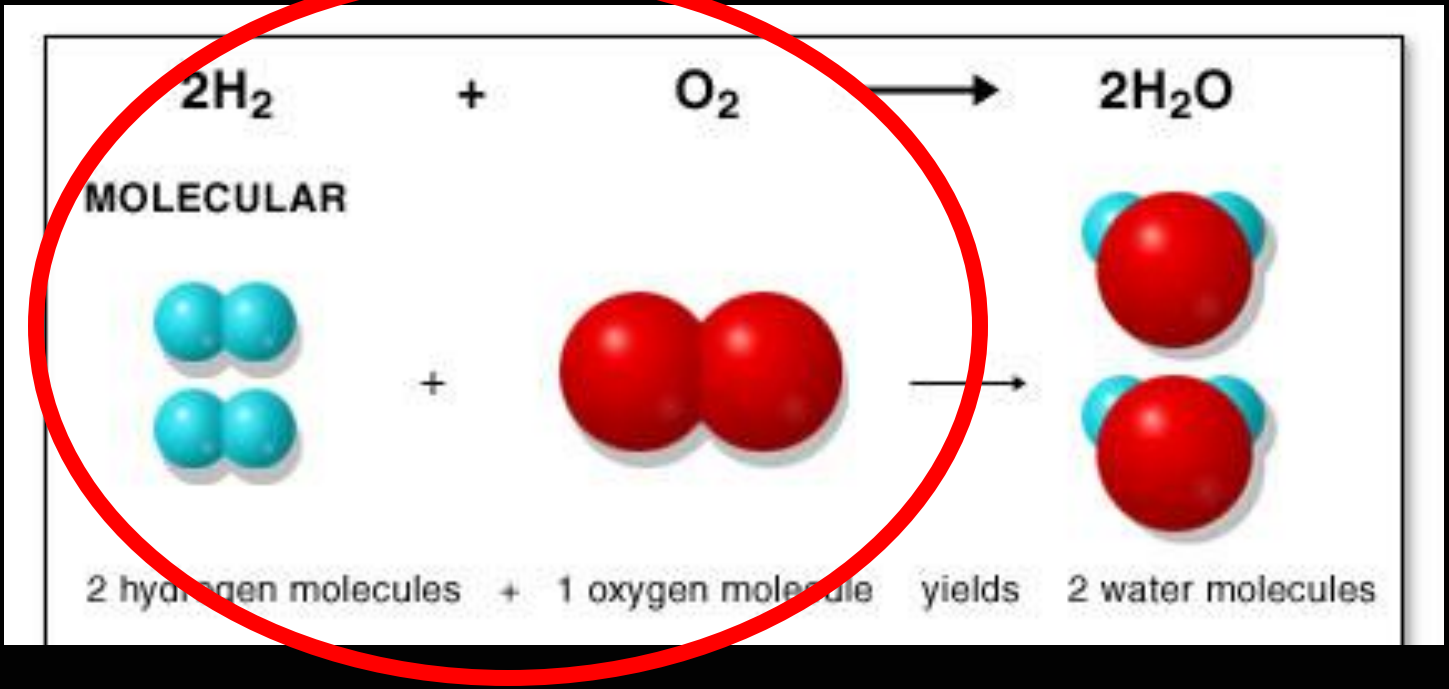
The ability to move or change matter.

Energy exists in many forms—including light, heat, chemical energy, mechanical energy, and electrical energy—and it can be converted from one form to another.



Adapted from Holt Biology 2008

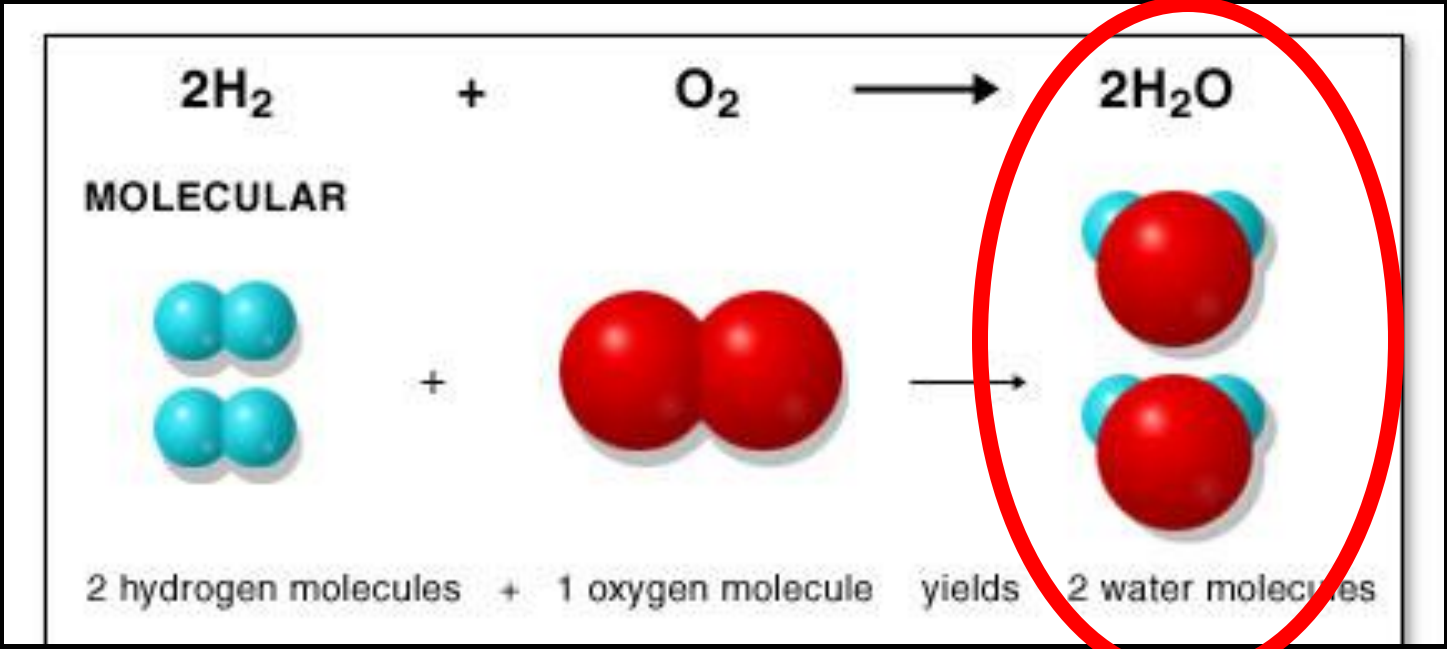
Reactant



A substance or molecule that participates in a chemical reaction.

Adapted from Holt Biology 2008

Product

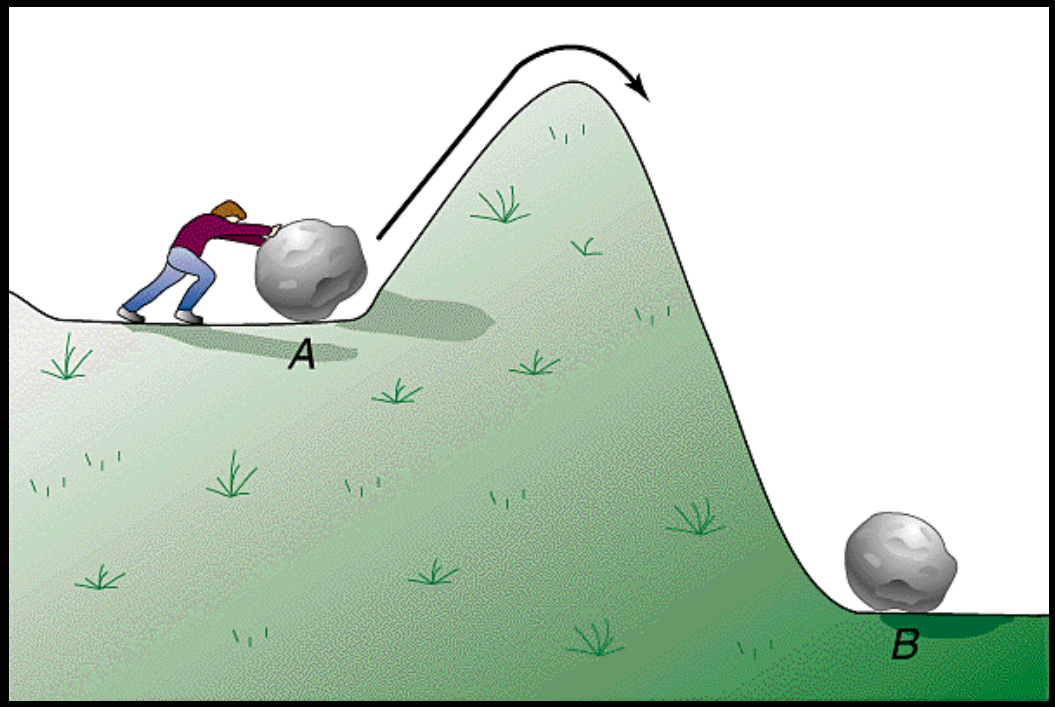


A substance that forms in a chemical reaction.

Adapted from Holt Biology 2008

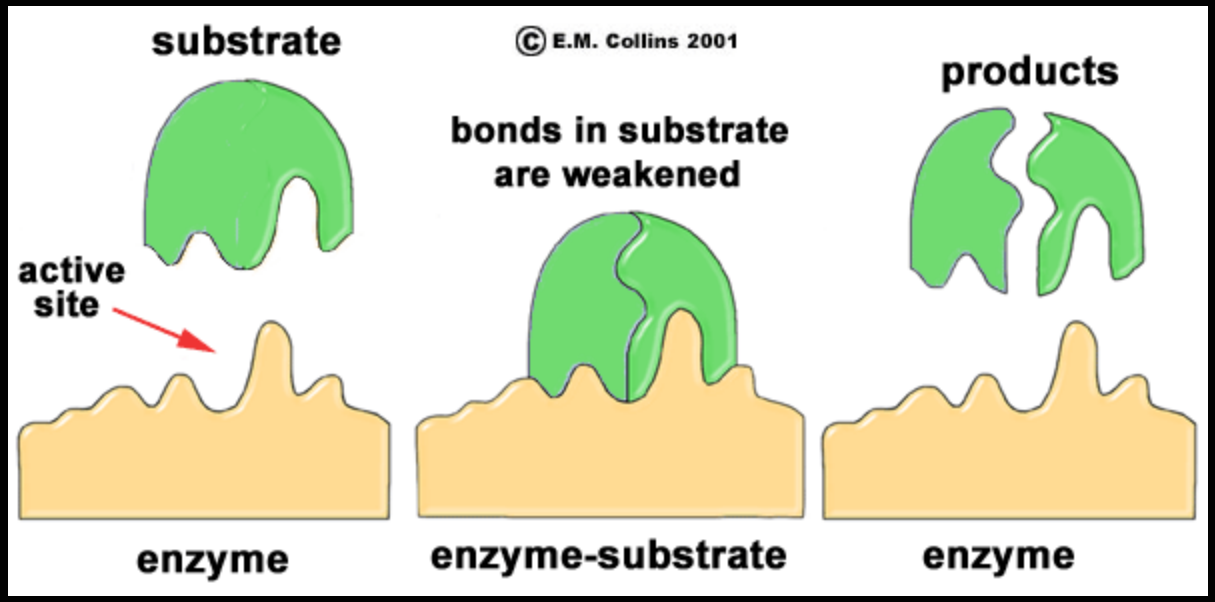
Activation Energy

The minimum amount of energy required to start a chemical reaction.



Adapted from Holt Biology 2008

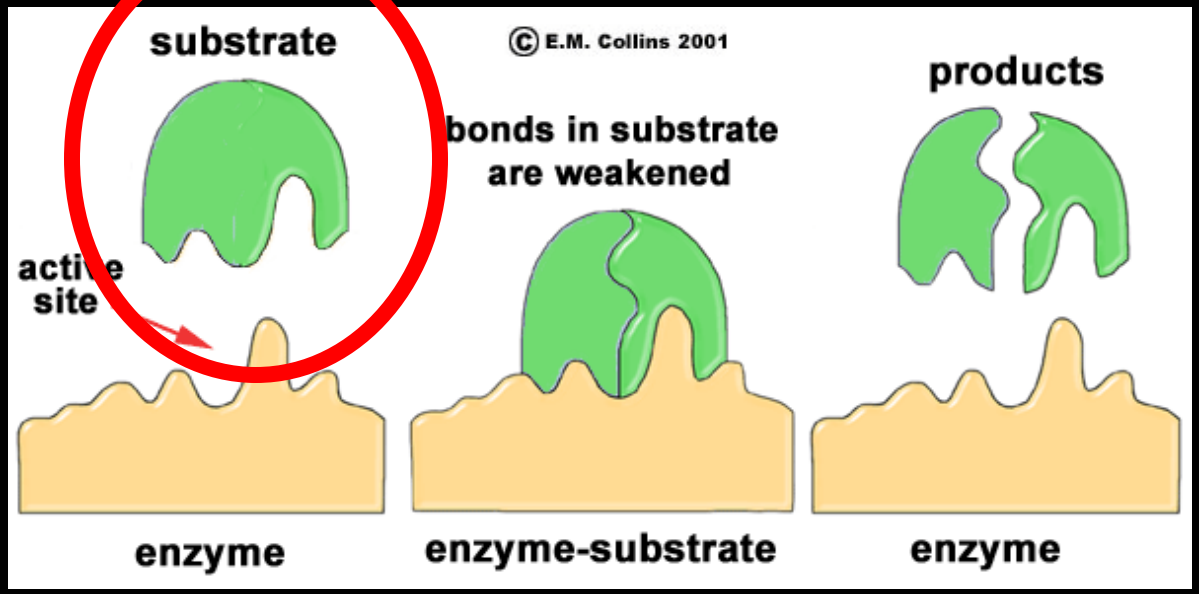
Enzyme



A molecule, either protein or RNA, that speeds up chemical reactions in living things without being permanently changed or destroyed.

Adapted from Holt Biology 2008

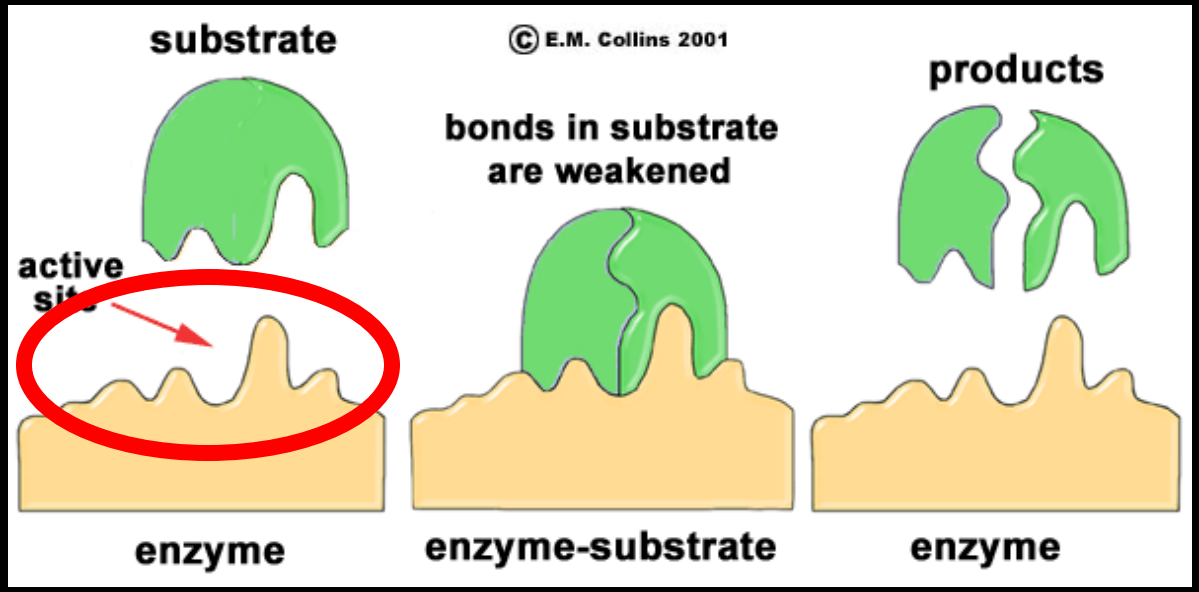
Substrate



A part, substance, or element that lies beneath and supports another part, substance, or element; the reactant in reactions catalyzed by enzymes.

Adapted from Holt Biology 2008

Active Site



On an enzyme, the site that attaches to a substrate.

Adapted from Holt Biology 2008

Chapter 3
Section 4:
Energy & Metabolism

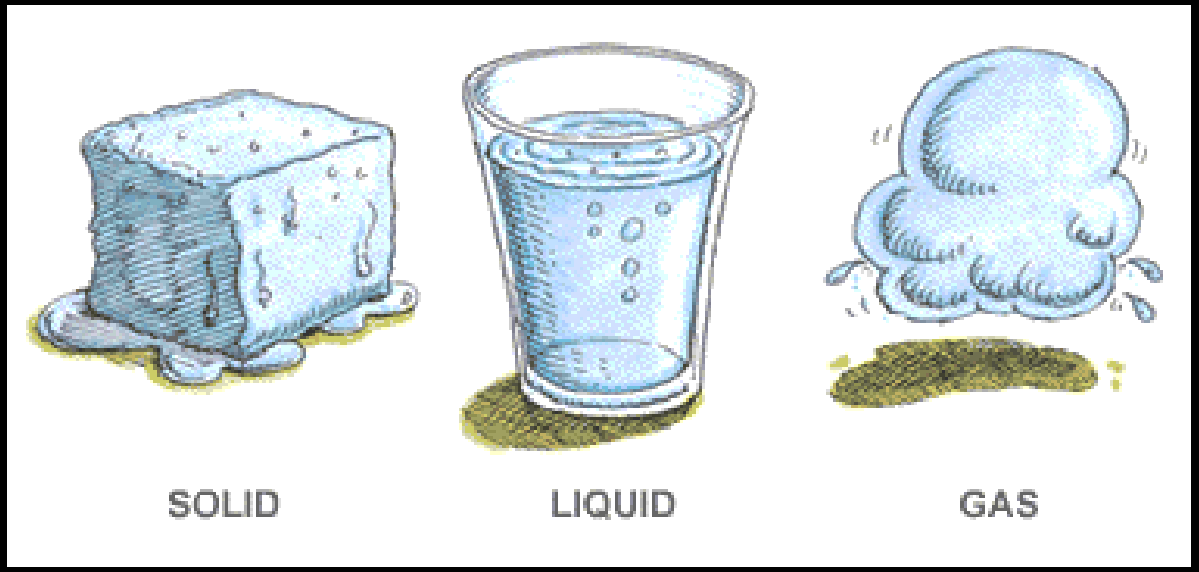
Notes

Adapted from Holt Biology 2008

Changing Matter

- Living things are made of matter.
- Changes constantly occur in living things.

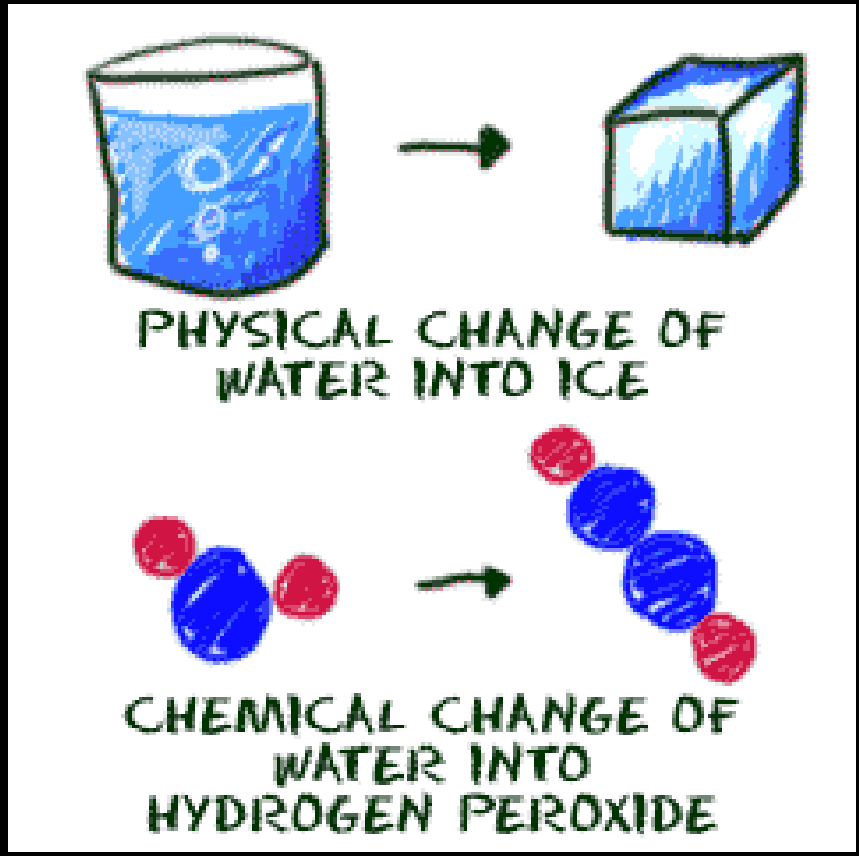
Changing Matter



A physical change occurs when only the form or shape of the matter changes but the substance itself is unchanged.

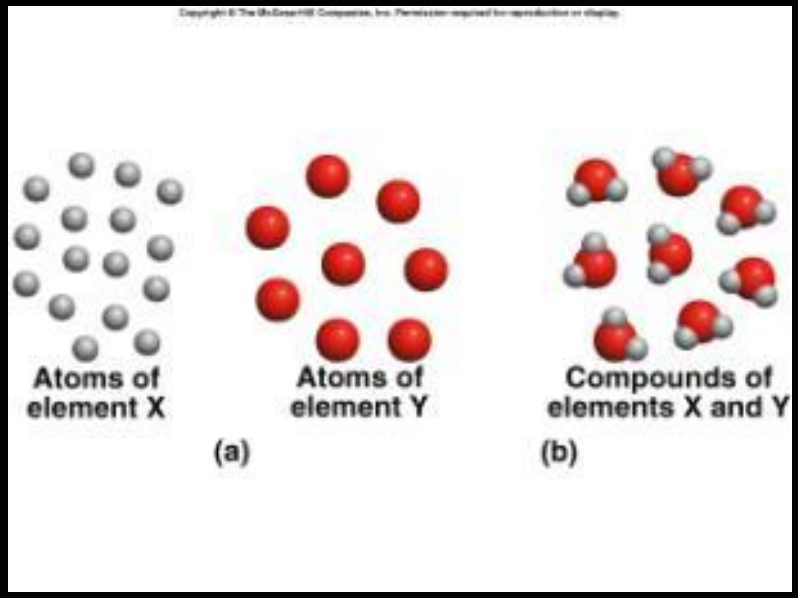
Changing Matter

A chemical change occurs when a substance changes into a different substance.



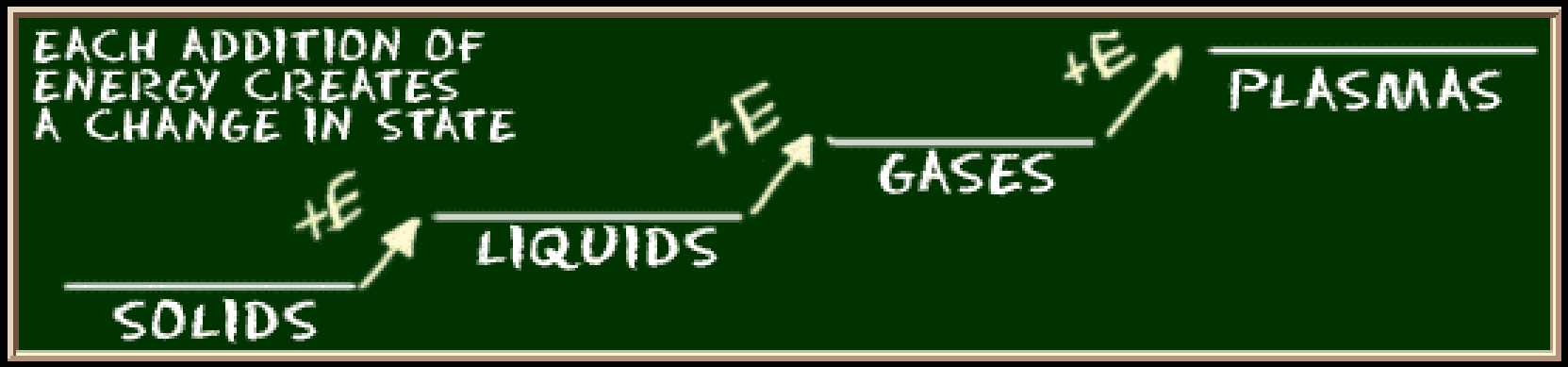
Changing Matter

Matter is neither created nor destroyed in any change. This observation is called the *law of conservation of mass.*

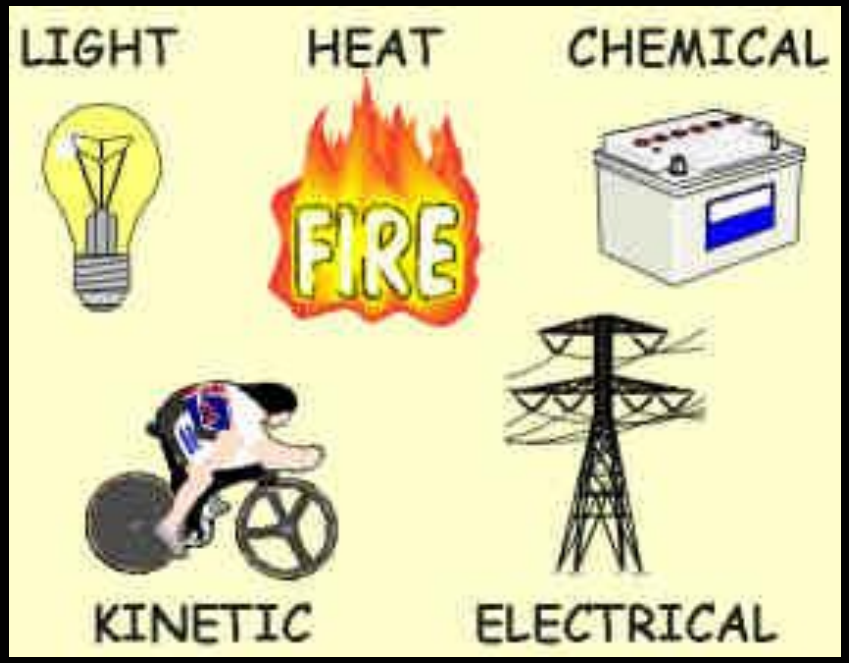


Changing Matter and Energy

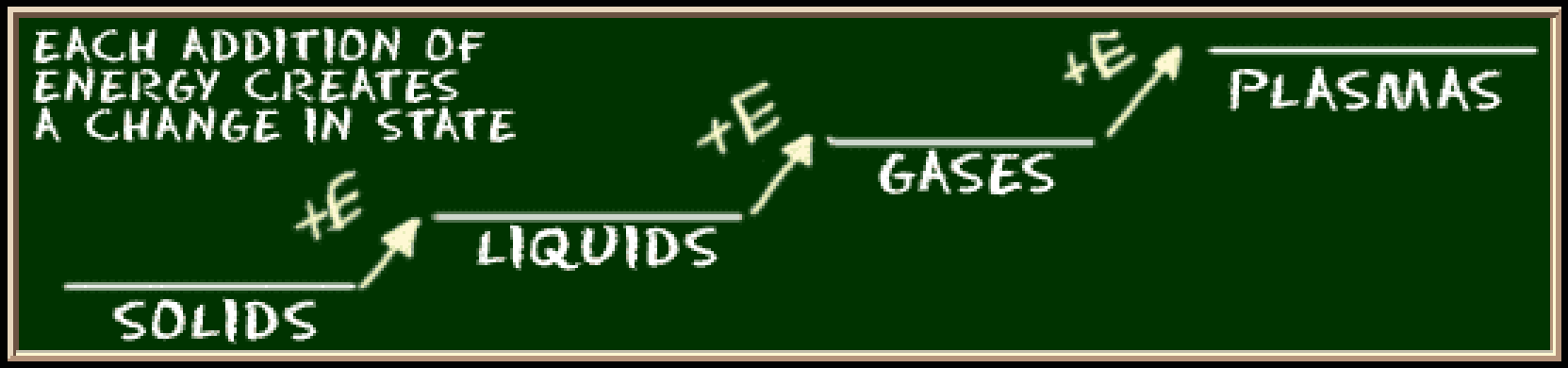
Energy is the ability to move or change matter.



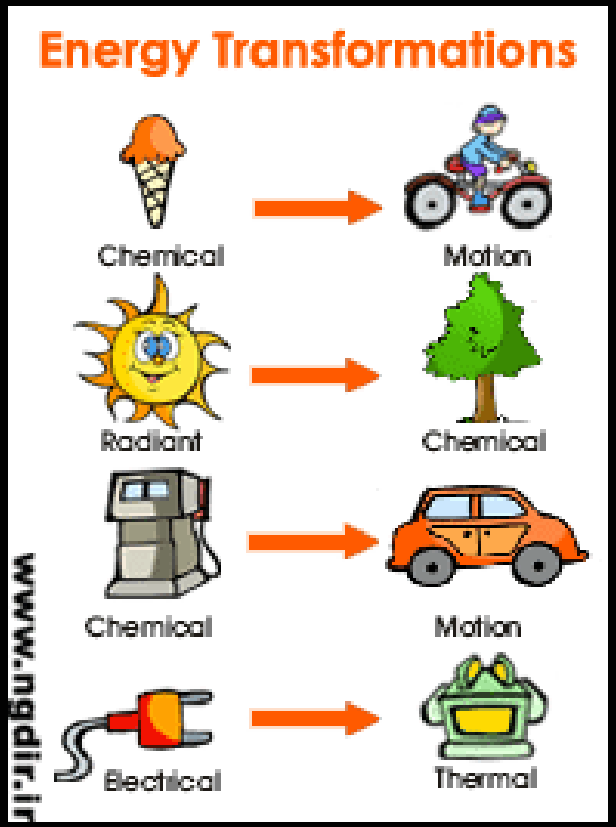
Energy exists in many forms and can be converted from one form to another.



Every change in matter requires energy.

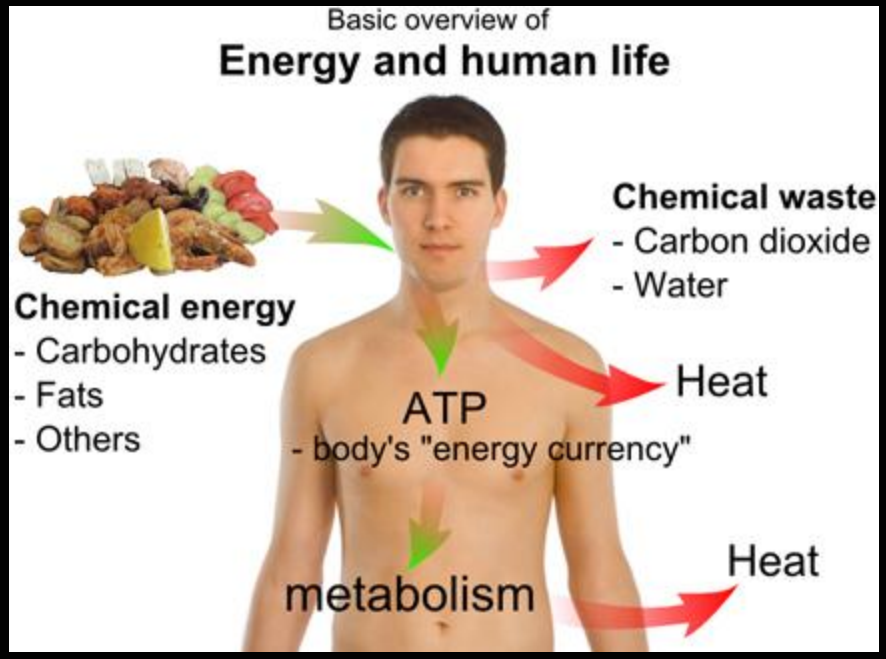


Energy may change from one form to another, but the total amount of energy does not change. This observation is called the *Law of Conservation of Energy.*



The total amount of usable energy decreases because some energy is given off to the surroundings as heat.

Living things use different chemical reactions to get the energy needed for life processes.



Think, Share, Write #1

What is a chemical change?

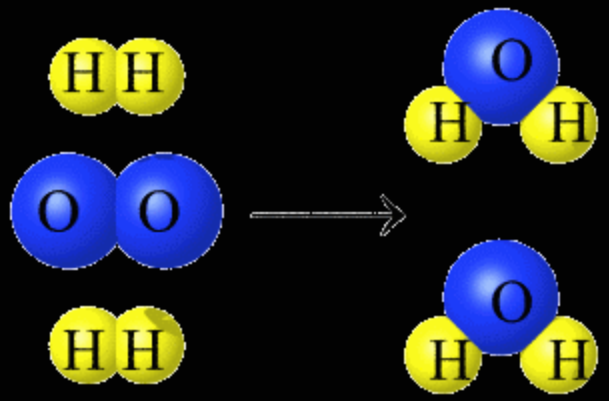
Think, Share, Write #1

What is a chemical change?

A chemical change is a change that occurs when the identity of the substance changes.

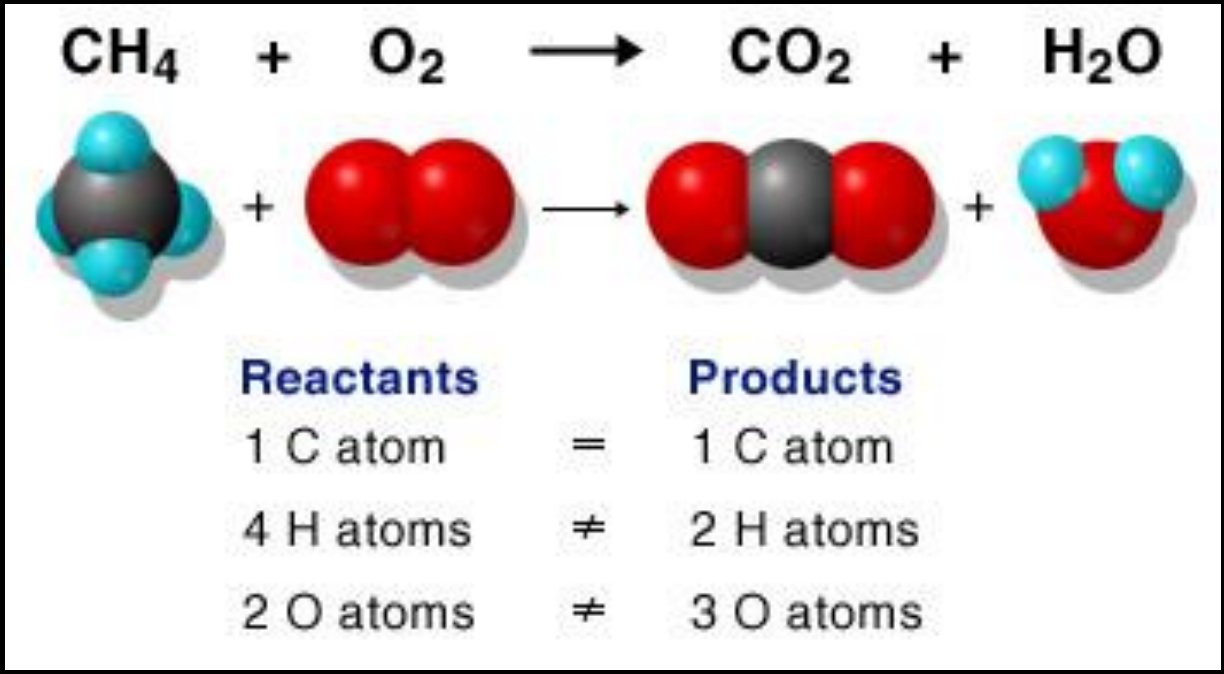
Chemical Reactions

Changing a substance requires a chemical reaction. During this process, bonds between atoms are broken, and new ones are formed.



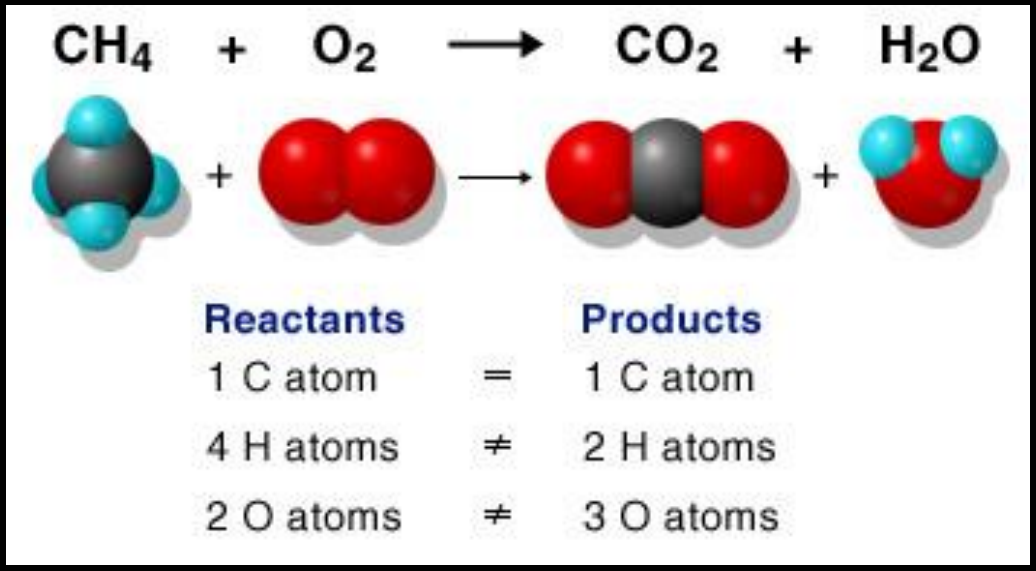
Chemical Reactions

A **reactant** is a substance that is changed in a chemical reaction



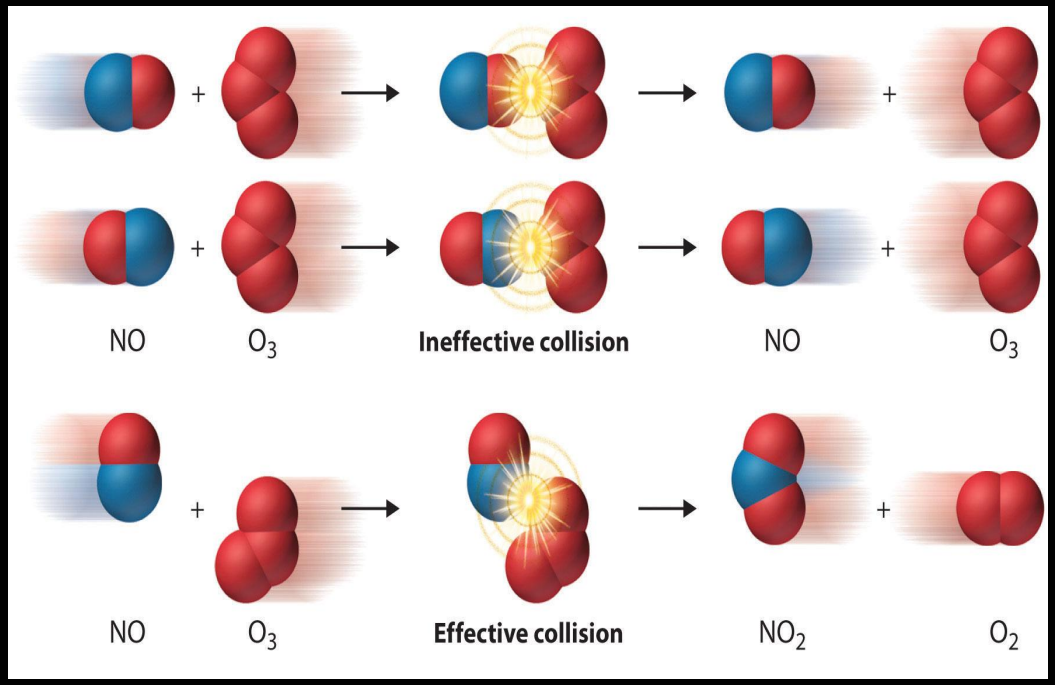
Chemical Reactions

- A **product** is a new substance that is formed.
- Sometimes products can reform reactants.



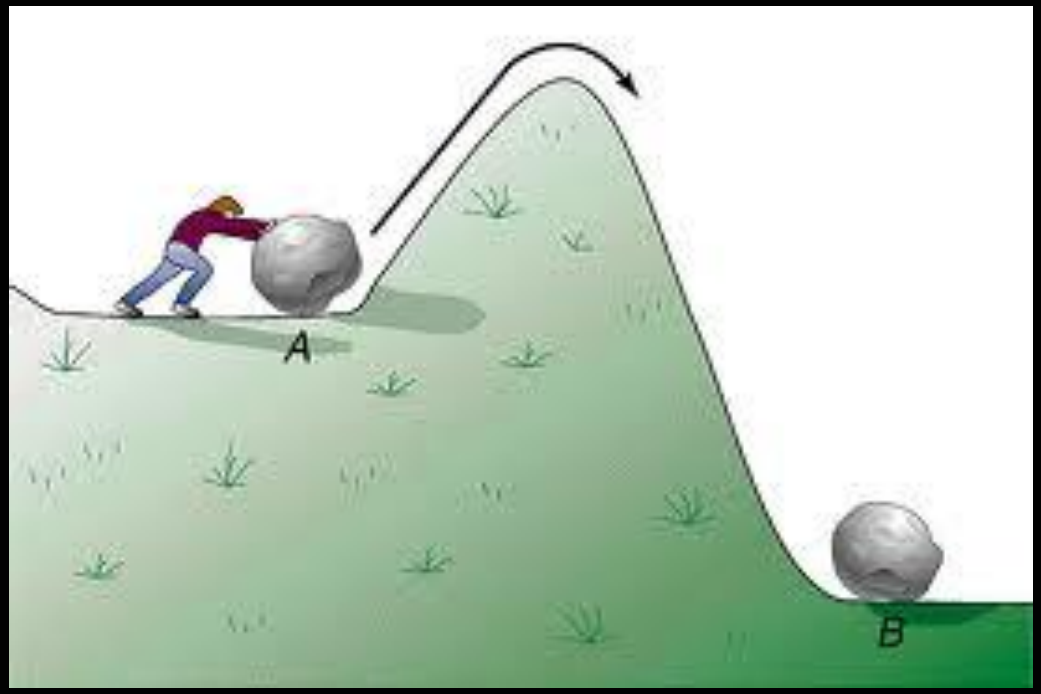
Activation Energy

Chemical reactions can only occur under the right conditions.



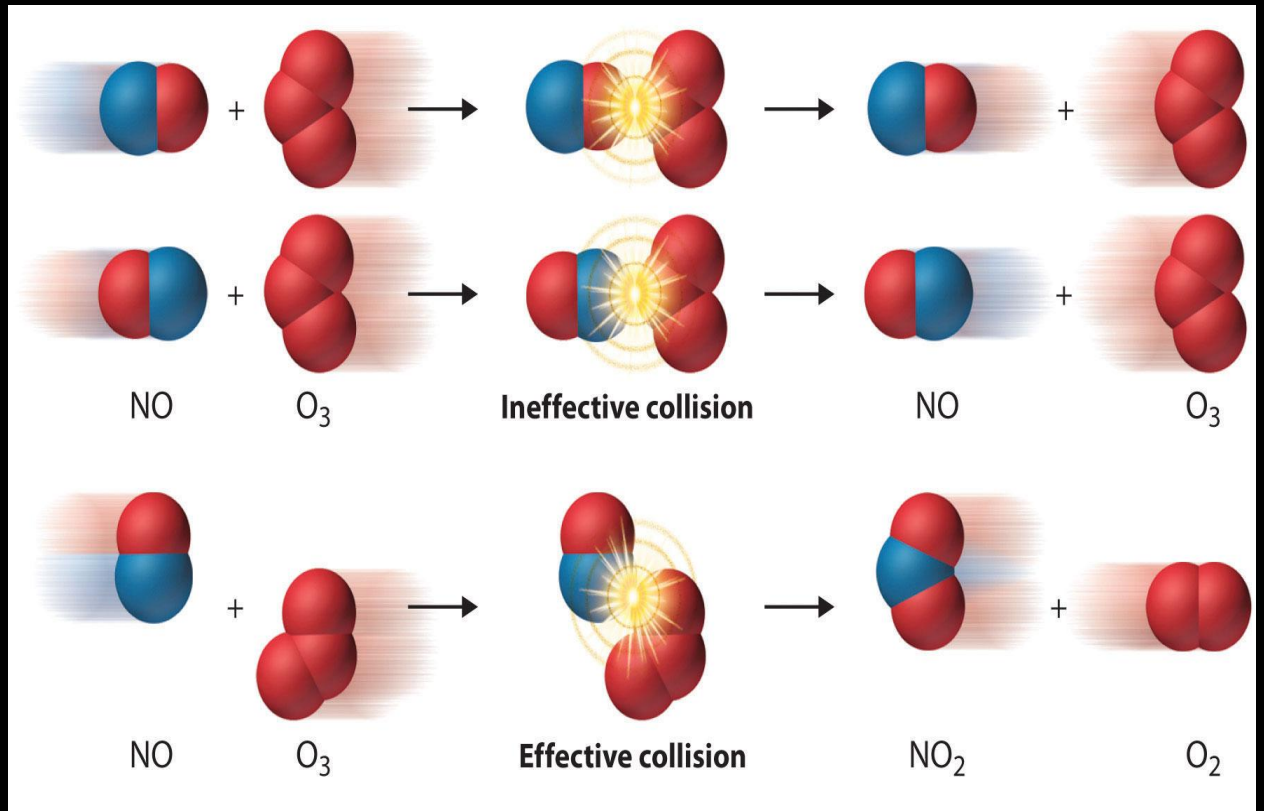
To form new bonds, the particles must collide fast enough to overcome the repulsion between their negatively charged electron clouds.

The **activation energy** of a reaction is the minimum kinetic energy required to start a chemical reaction.

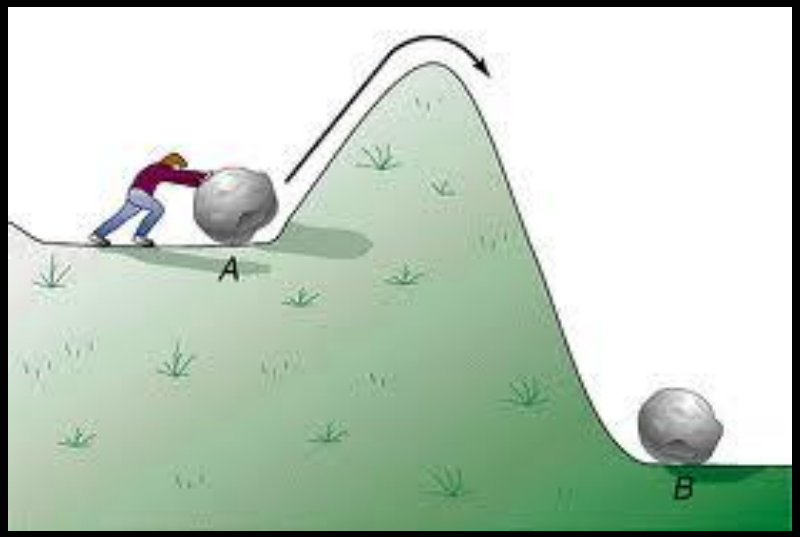


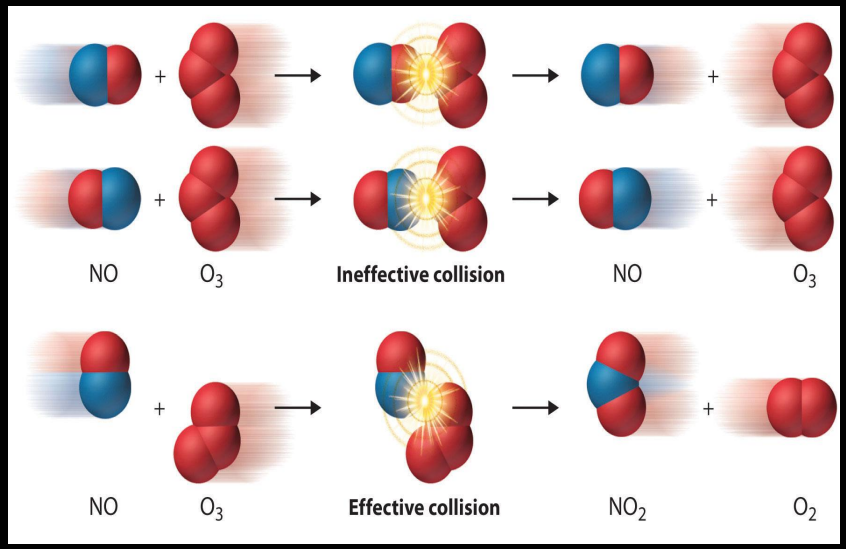
Alignment, continued

Even if enough energy is available, the product still may not form.



Chemical reactions can only occur when the activation energy is available and the correct atoms are aligned.





Think, Share, Write #2

What causes particles
to repel other particles?

Think, Share, Write #2

What causes particles to repel other particles?

Particles repel other particles due to their negatively charged electron clouds.

Reaction Conditions

Reaction Conditions

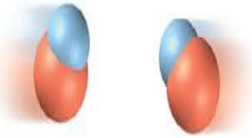
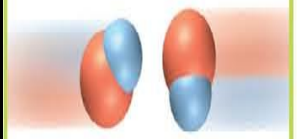
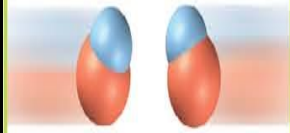
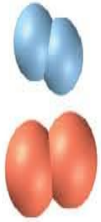
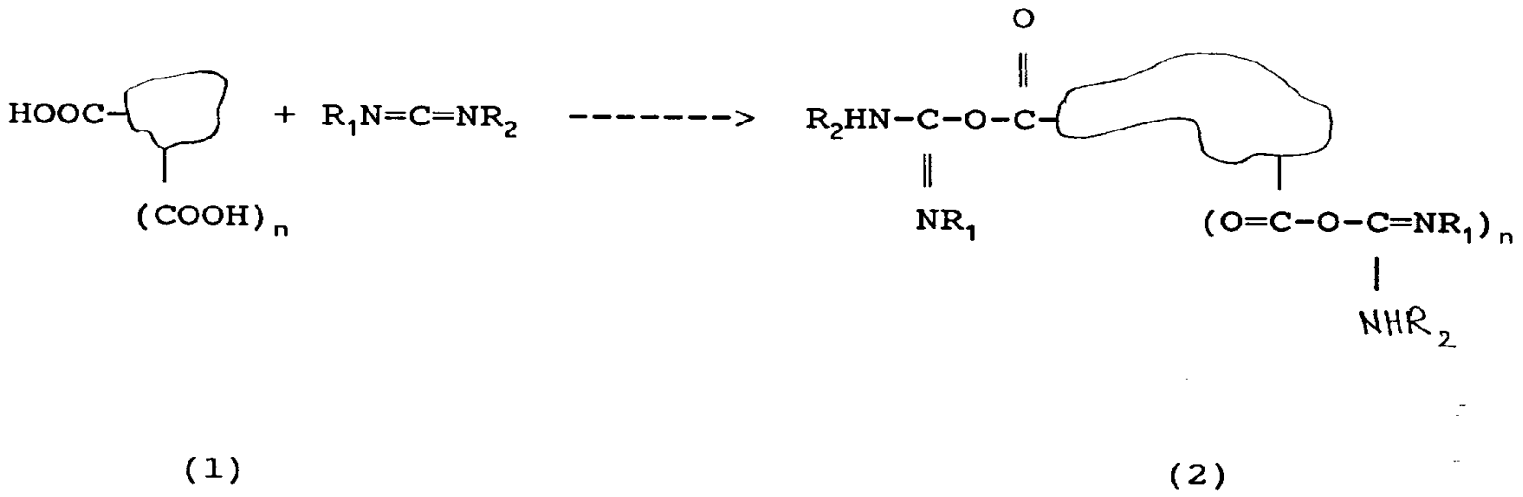
Reactants	Conditions	Result	Products
	not enough energy	no reaction	none
	enough energy; wrong orientation	no reaction	none
	enough energy; proper orientation	reaction	

Figure 15 Chemical reactions can occur only under the right conditions. The correct atoms of reactants must be aligned, and they must collide with enough energy.

What term describes the minimum amount of energy needed for a reaction to occur?

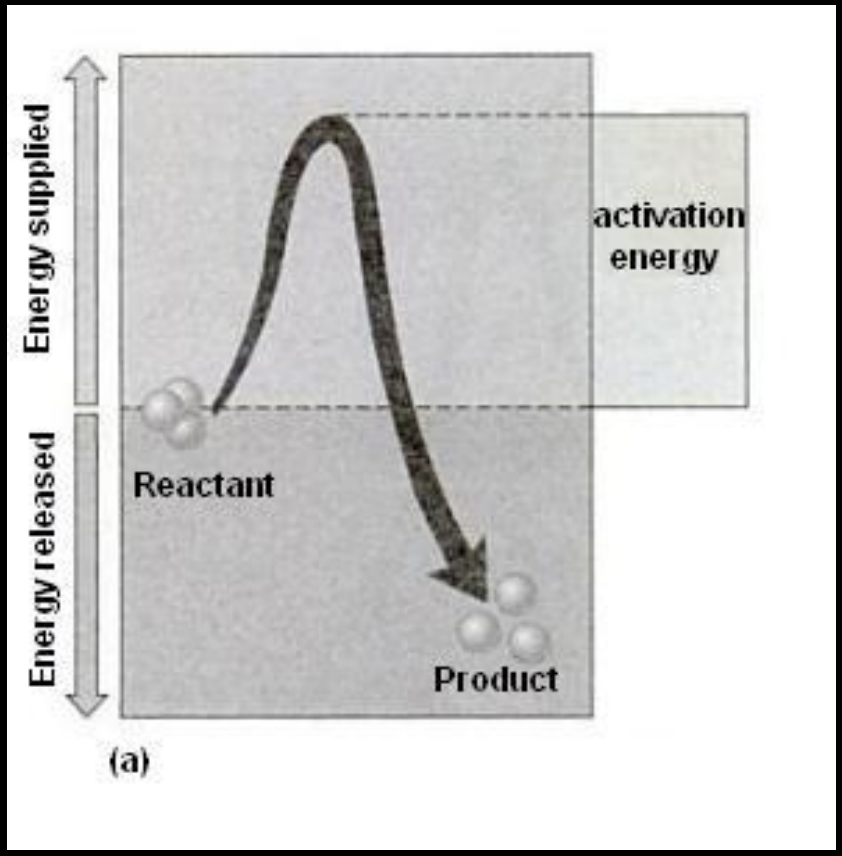
Biological Reactions

In living things, chemical reactions occur between large, complex biomolecules.



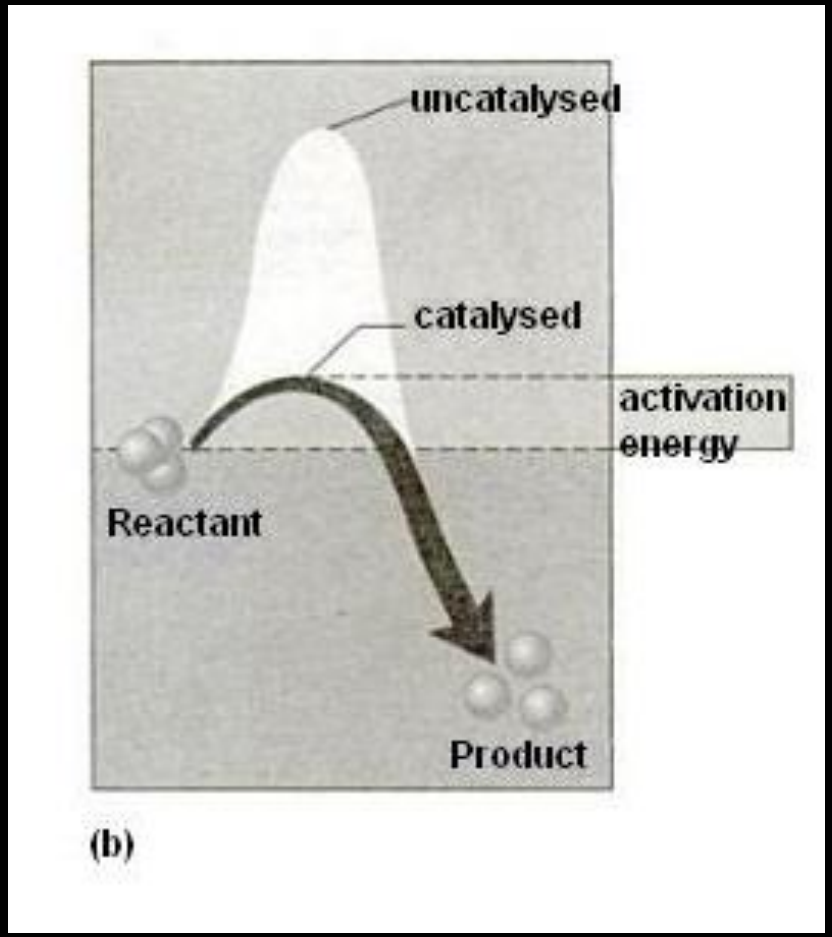
Biological Reactions

Many of these reactions require large activation energies.

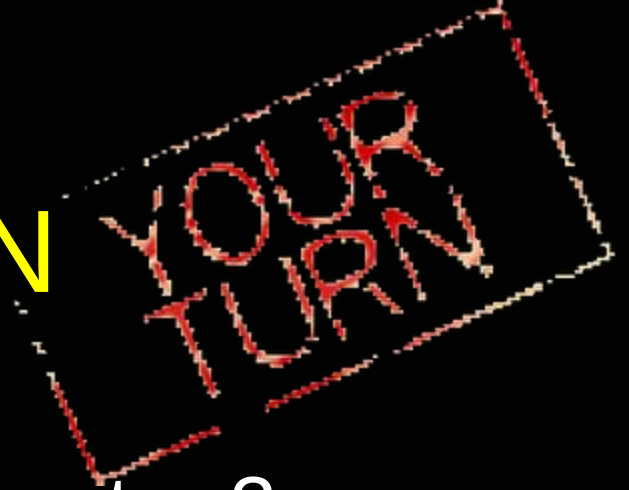


Biological Reactions

Many of these reactions would not occur quickly enough to sustain life without the help of enzymes.



YOUR TURN



- With a partner read the Chapter 3 Section 4 Active Reading – Energy and Metabolism.
- 1st - Take turns reading the questions aloud to each other, alternating questions.
- 2nd - Take turns reading the selection aloud to each other, alternating sentences or paragraphs.

Adapted from Holt Biology 2008

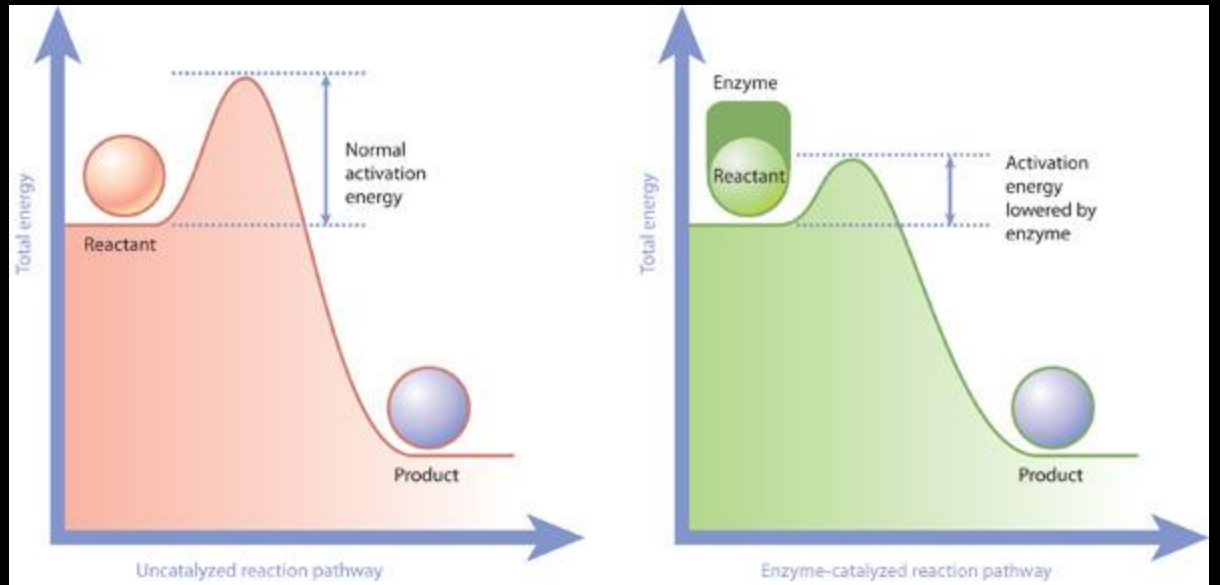
YOUR TURN

- As you read discuss the content.
- Reread and discuss each question. Write down the best answer to the question using full descriptive sentences.
- Be prepared to share with the class.

Adapted from Holt Biology 2008

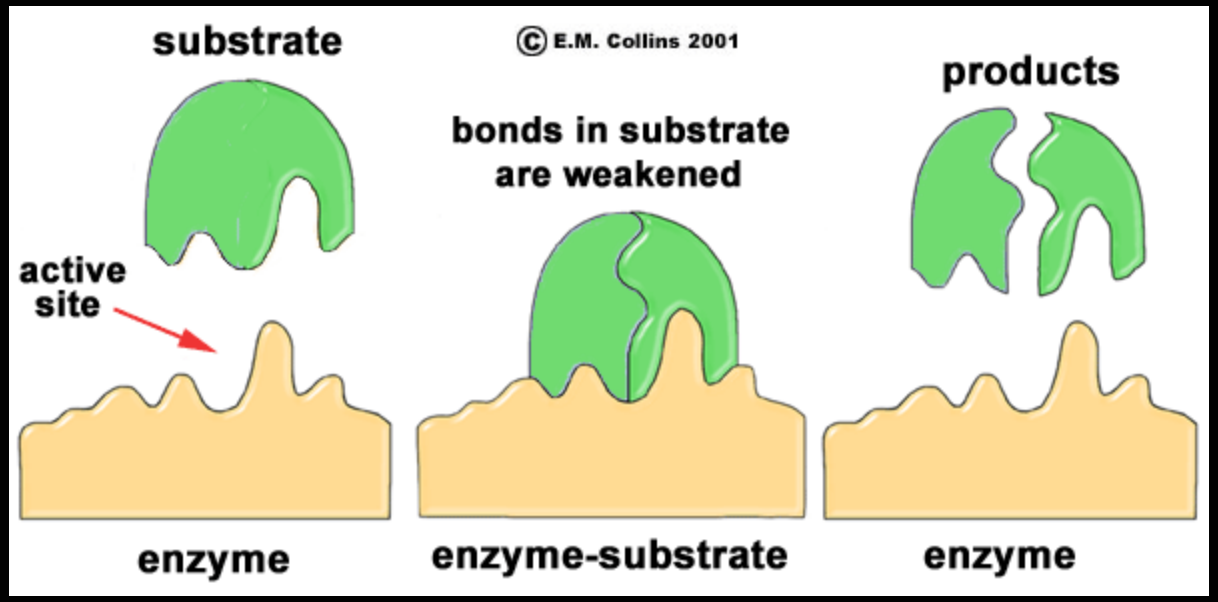
Enzyme

- A molecule that increases the speed of biochemical reactions.
- Lowers the activation energy of a reaction.



Enzyme

- Assists in necessary biochemical reactions.
- Help organisms maintain homeostasis.



Effect of Enzyme on Activation Energy

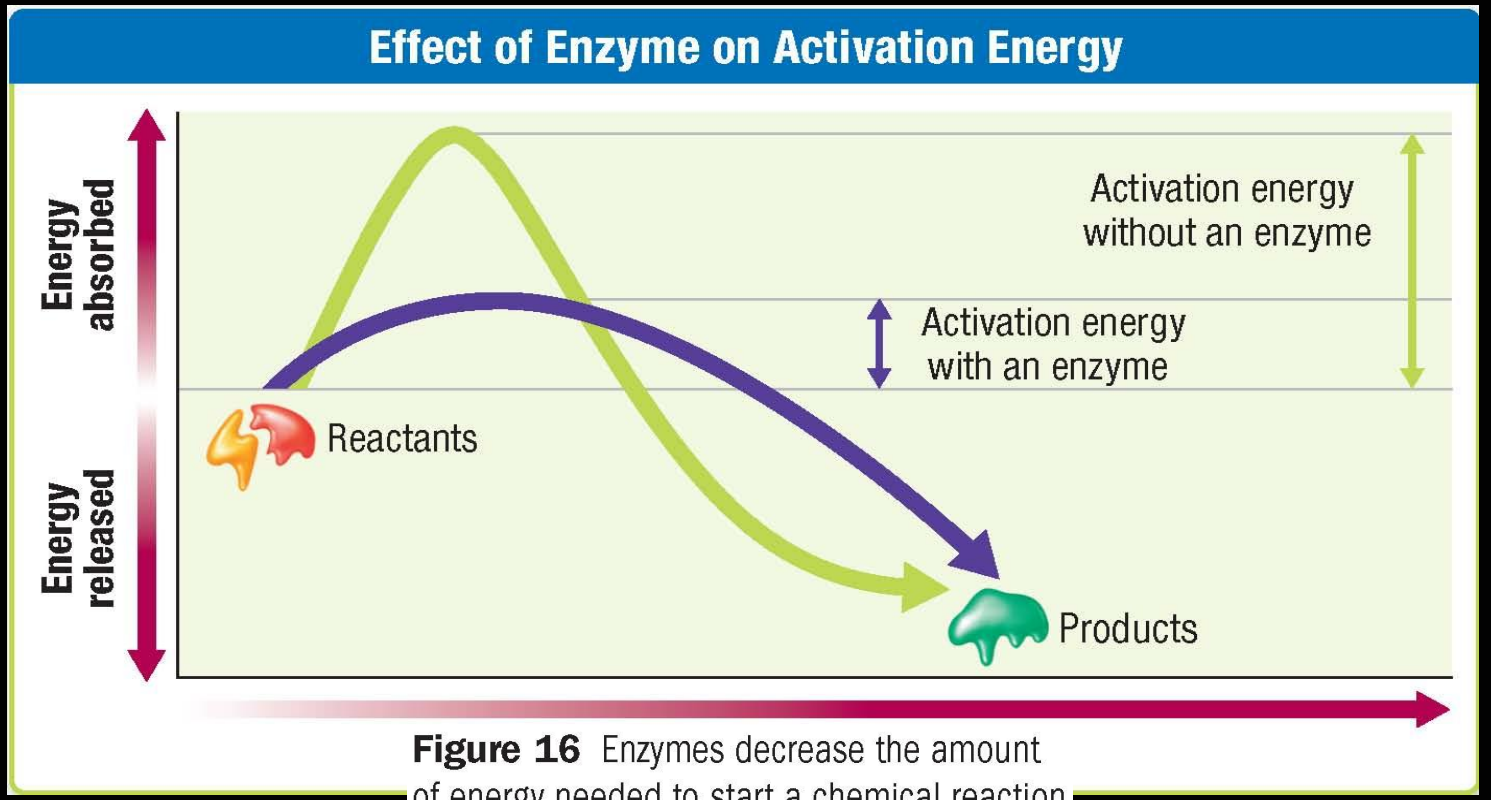
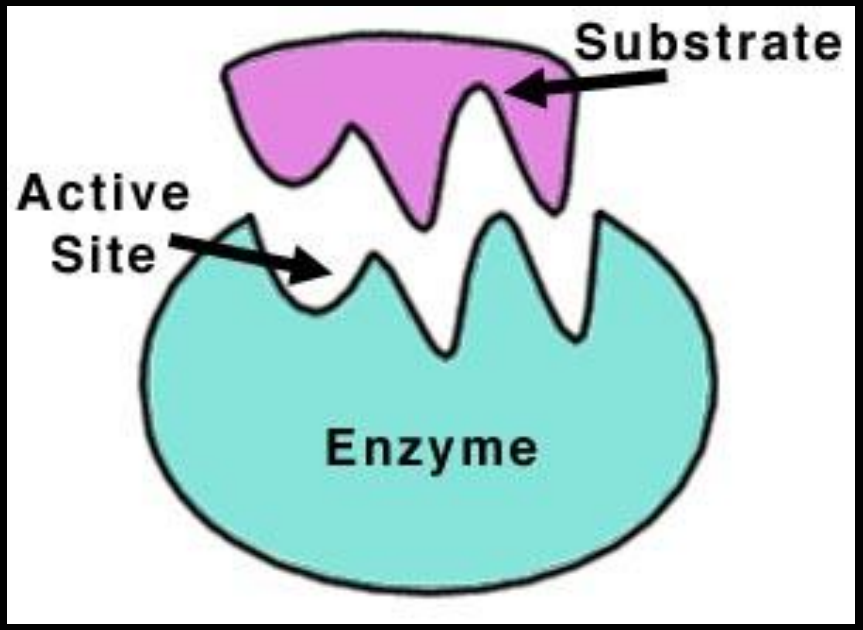
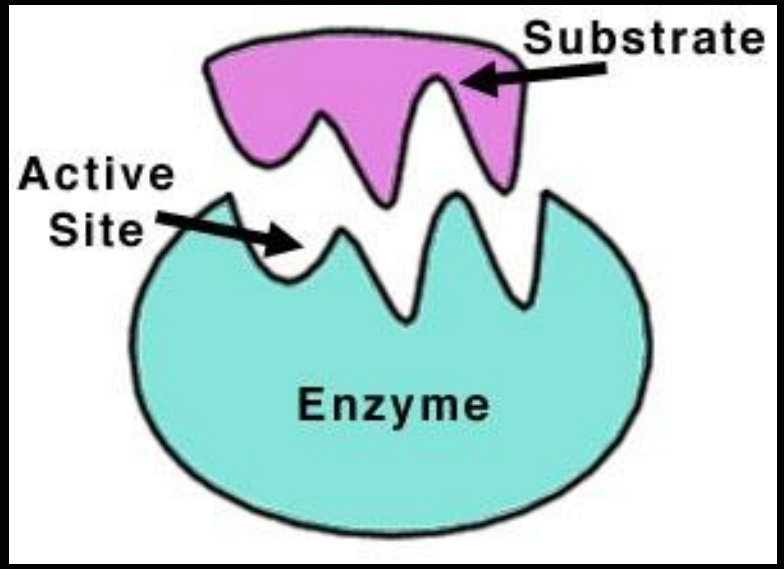


Figure 16 Enzymes decrease the amount of energy needed to start a chemical reaction without changing the amount of energy contained in either the reactants or the products.

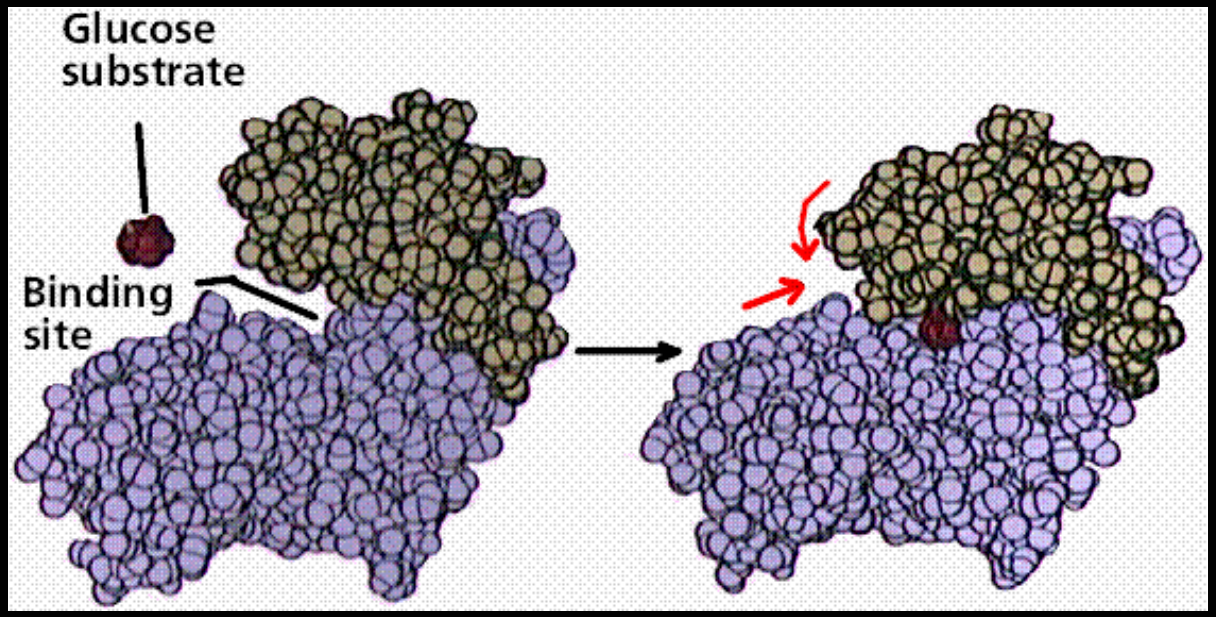
Each enzyme has an **active site,** the region where the reaction takes place.



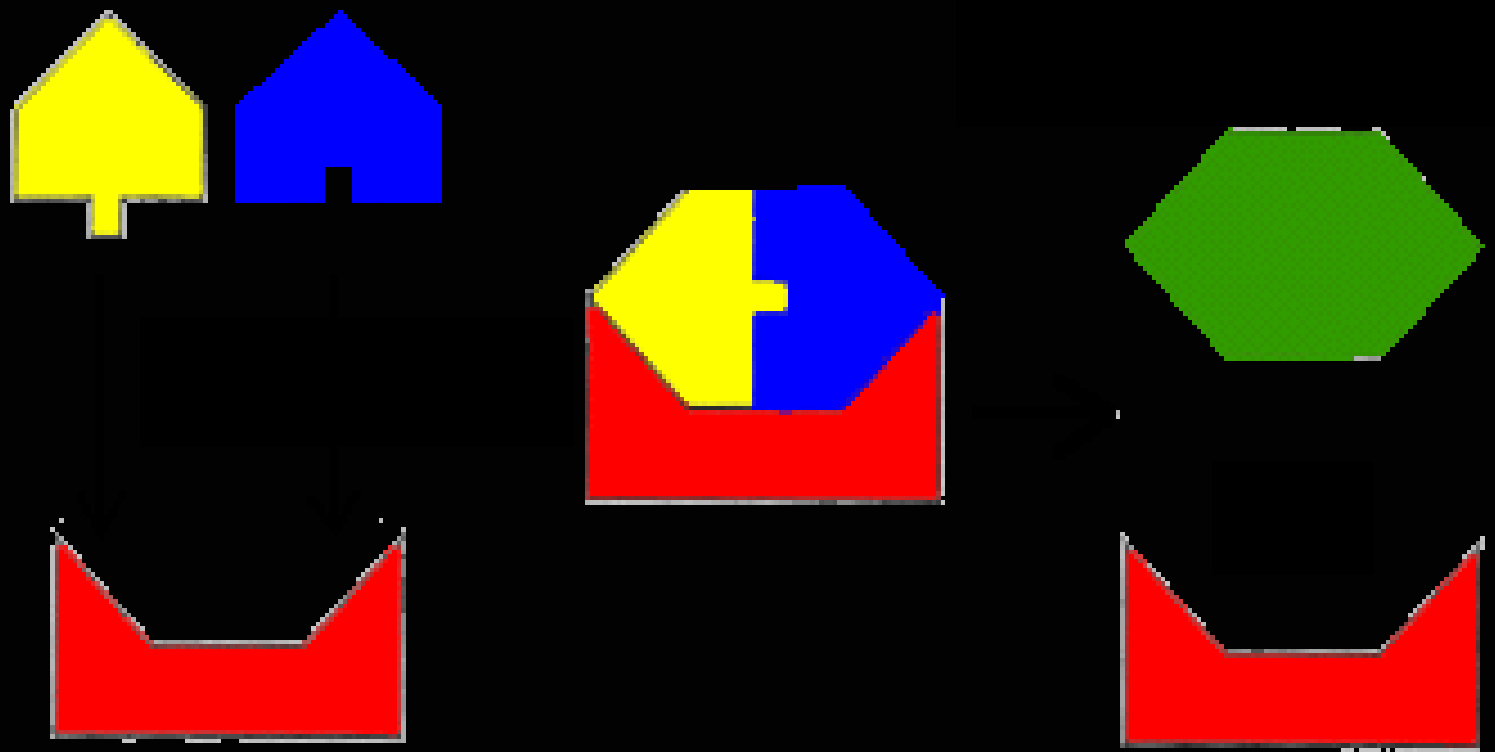
The shape of the active site determines which reactants, or **substrates,** will bind to it. Each different enzyme acts only on specific substrates.



Binding of the substrates causes the enzyme's shape to change. This change causes some bonds in the substrates to break and new bonds to form.

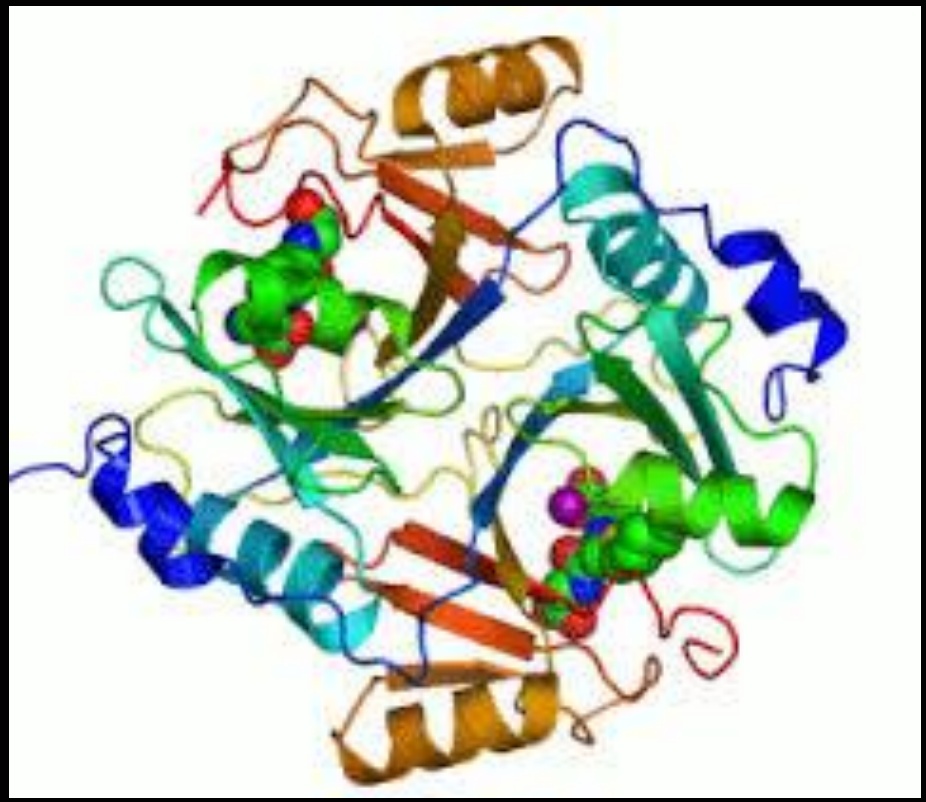


Enzyme Action



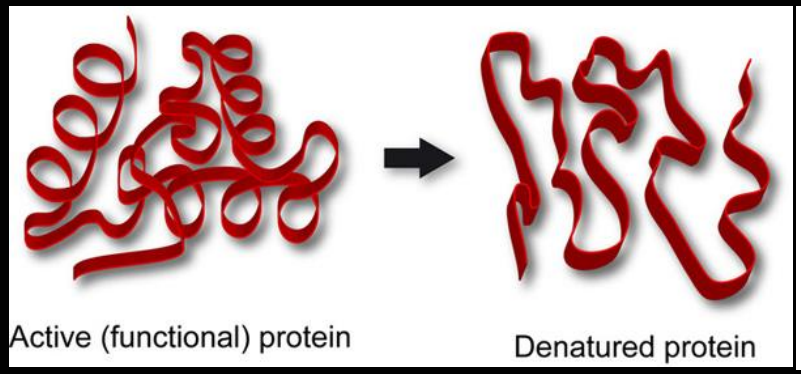
Enzymes, *continued*

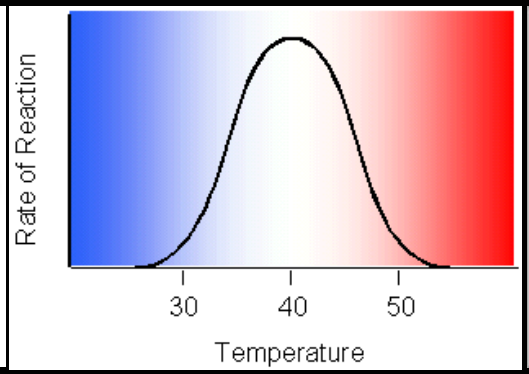
Many enzymes are proteins. Changes in temperature and pH can change a protein's shape.

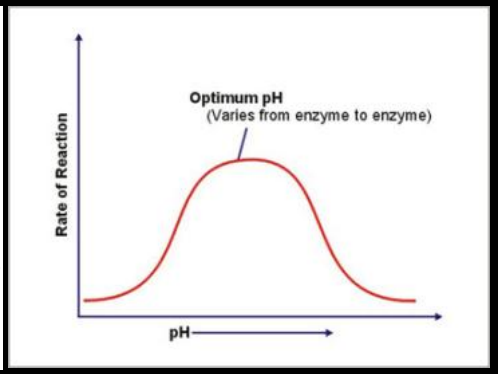


Enzymes, *continued*

- If an enzyme changes shape, it won't work well.
- Most enzymes need a certain range of temperatures and pH.

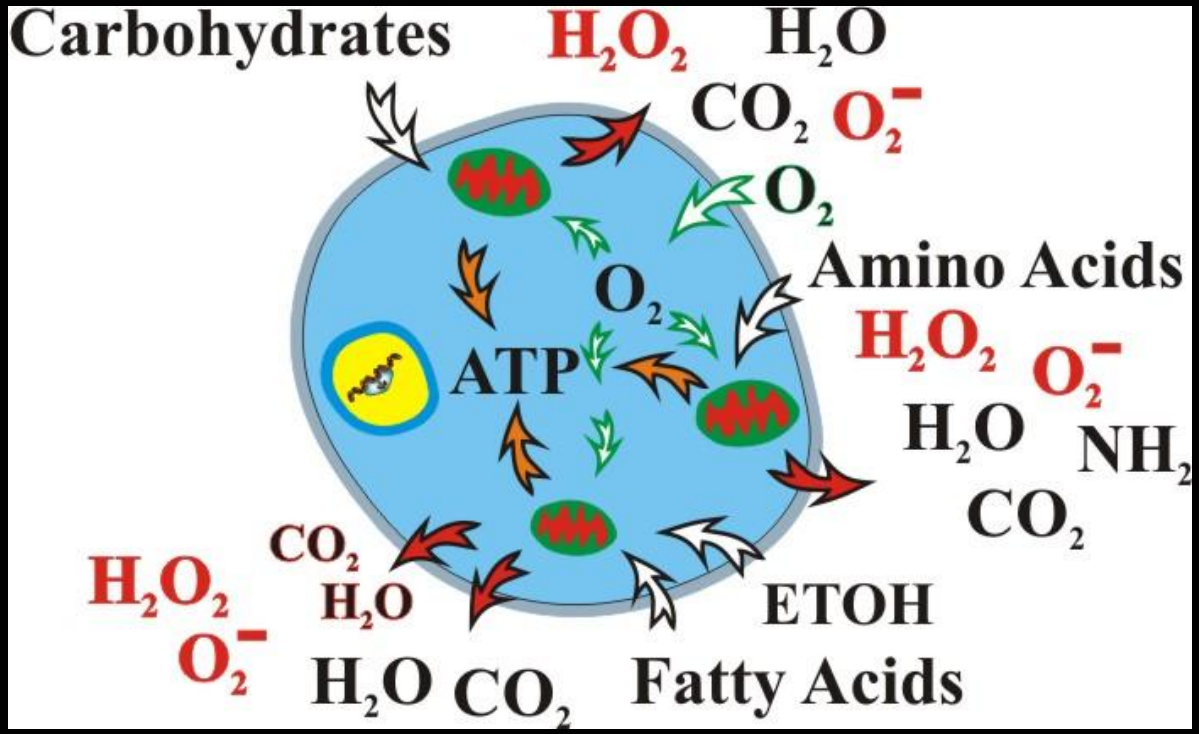




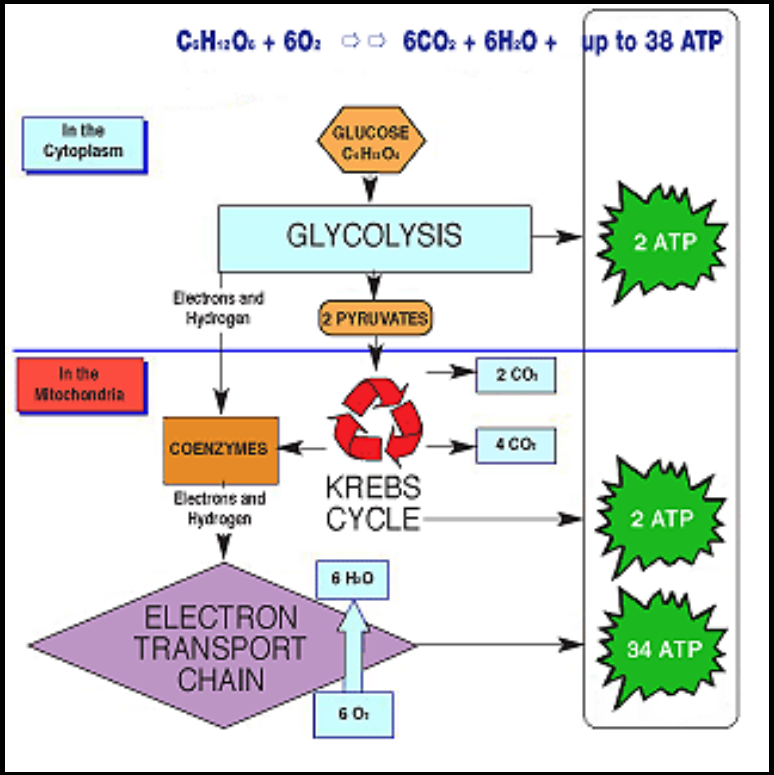


Metabolism

Cells get most of the energy needed for metabolism by breaking down food molecules.

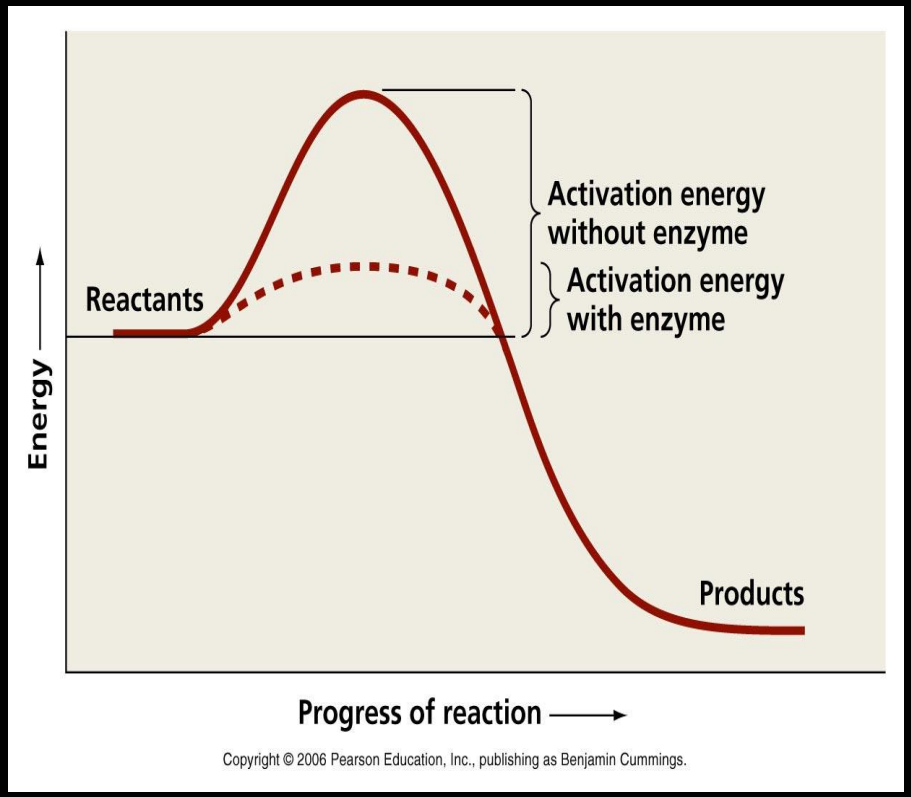


The release of energy from food molecules occurs in a series of reactions using many enzymes to capture energy in the form of ATP molecules.



Metabolism, *continued*

The enzymes reduce the activation energy so much that only a little energy is needed to start the reactions. In this process, very little energy is lost as heat.



Think, Share, Write #3

Why is the shape of an enzyme important?

Think, Share, Write #3

Why is the shape of an enzyme important?

The shape of an enzymes active site determines which reactant will bind to that active site. Shape helps determine function.