Honors Biology Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_  
NDHS Date: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Enzymes and Metabolism**

**Metabolism**: sum of all chemical reactions in a cell

Parts of a Chemical Reaction:

**Reactants** 🡪 **Products**

Examples: **2 H2 + O2 🡪 2 H2O**

**Two types of Metabolism:**

**Catabolism**: Reactions that **break down molecules and release energy**

Called **Exothermic or Exergonic** Reactions

Example: **CH4 +2 O2 🡪 CO2 + 2 H2O**

**Anabolism**: Reactions that **build molecules and store energy**

Called **Endothermic or Endergonic** Reactions

Example: **6 CO2 + 6 H2O 🡪 C6H12O6 + 6 O2 = photosynthesis**

All Chemical Reactions Need **Energy** to start = **Activation Energy**

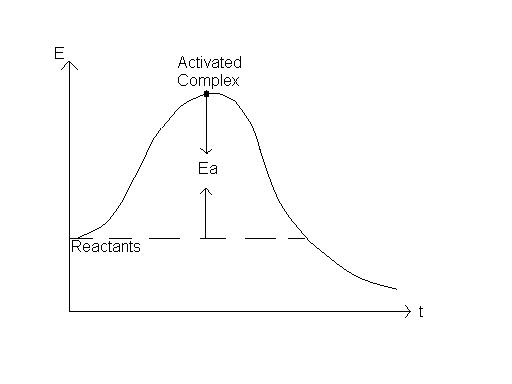
Reactions that have enough energy to start at room temperature are called **Spontaneous**

Reactions that don’t have enough energy to start at room temperature are call **Non-Spontaneous.**

**Energy Profile of a Chemical Reaction**Key: E = amount of Energy  
 t = time  
 Ea = Activation Energy

**Exothermic Reaction:**

The products have **less energy** than the reactants = **energy is given off**

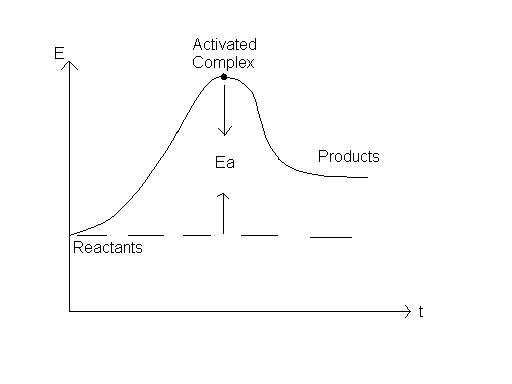


Change in Energy

Products

**Endothermic Reaction:**

The products have **more energy** than the reactants = energy is **stored in chemical bonds**



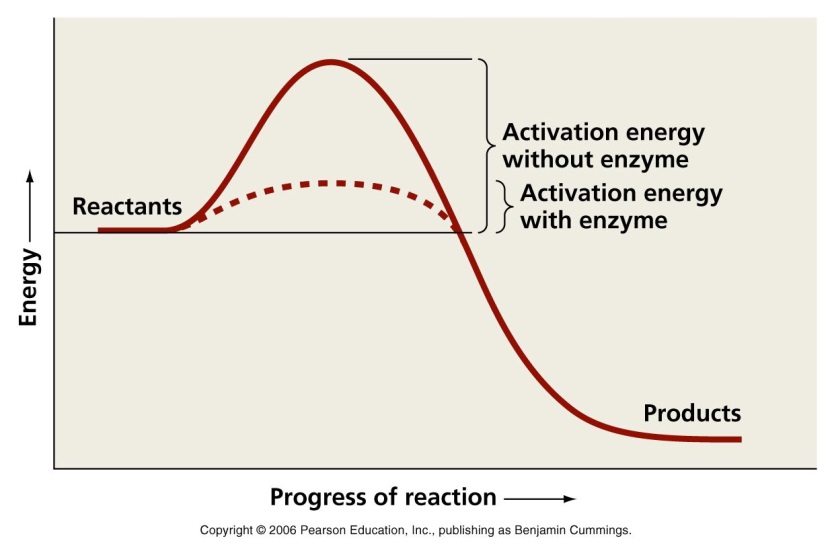
Change in Energy

**Role of Enzymes:**

Enzymes are **Protein Catalysts**.

Enzymes Lower the **Activation energy**

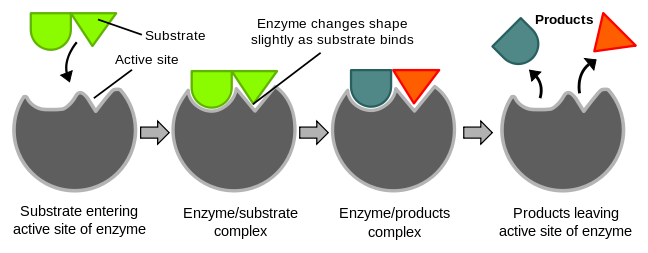
* Give a **short cut** for reactions
* Reactions happen **faster and at a lower temperatures**

[](http://www.google.com/url?sa=i&rct=j&q=&esrc=s&frm=1&source=images&cd=&cad=rja&docid=uAy8xLum_EVCKM&tbnid=Gn8TmdNuJEv_wM:&ved=0CAUQjRw&url=http://academic.pgcc.edu/~kroberts/Lecture/Chapter%205/enzymes.html&ei=KeRJUsWWA47e8ATG1oD4DQ&bvm=bv.53217764,d.eWU&psig=AFQjCNE_tYeqEEx4sR4OoiX8rTyU_mGc7A&ust=1380660618729472)

Enzymes are **three dimensional** structures that bind to **chemicals called substrates** and cause them to **react faster**.

Substrates fit **specifically** into the **reaction center** of the enzyme called the **ACTIVE SITE** and cause the enzyme to **change shape slightly** – called a **conformational change or an INDUCED FIT.**

EX: Putting your hand in a glove.

The enzyme-substrate complex (when the two are bound together) create a **special environment** that allows the reaction to happen faster. [](http://www.google.com/url?sa=i&rct=j&q=&esrc=s&frm=1&source=images&cd=&cad=rja&docid=jt6YIsRAJ8_0cM&tbnid=ZhDNBkKMBartMM:&ved=0CAUQjRw&url=http://en.wikipedia.org/wiki/Enzyme&ei=_edJUtnVAoX48wT30IHwDQ&bvm=bv.53217764,d.eWU&psig=AFQjCNFrg1b4srbcrdgoiJskKO5by8E58w&ust=1380661455508084)

**Factors that Affect Enzymes:**1) **Temperature**:

Increase in temperature **speeds up** a reaction because it provides more energy and makes the molecules collide faster.  
 HOWEVER, if the temperature **increases too much, the enzyme DENATURES and no longer functions**

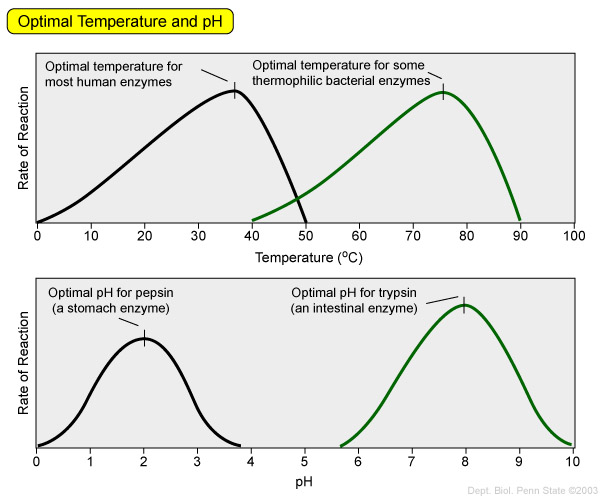
**Denature**: to **undo** the chemical structure of a molecule – **break it down**

Ex: Cooking an egg, having a fever

2) **pH** – all enzymes work best at a specific pH – **Optimal pH**

Most work best between **6 – 8** .

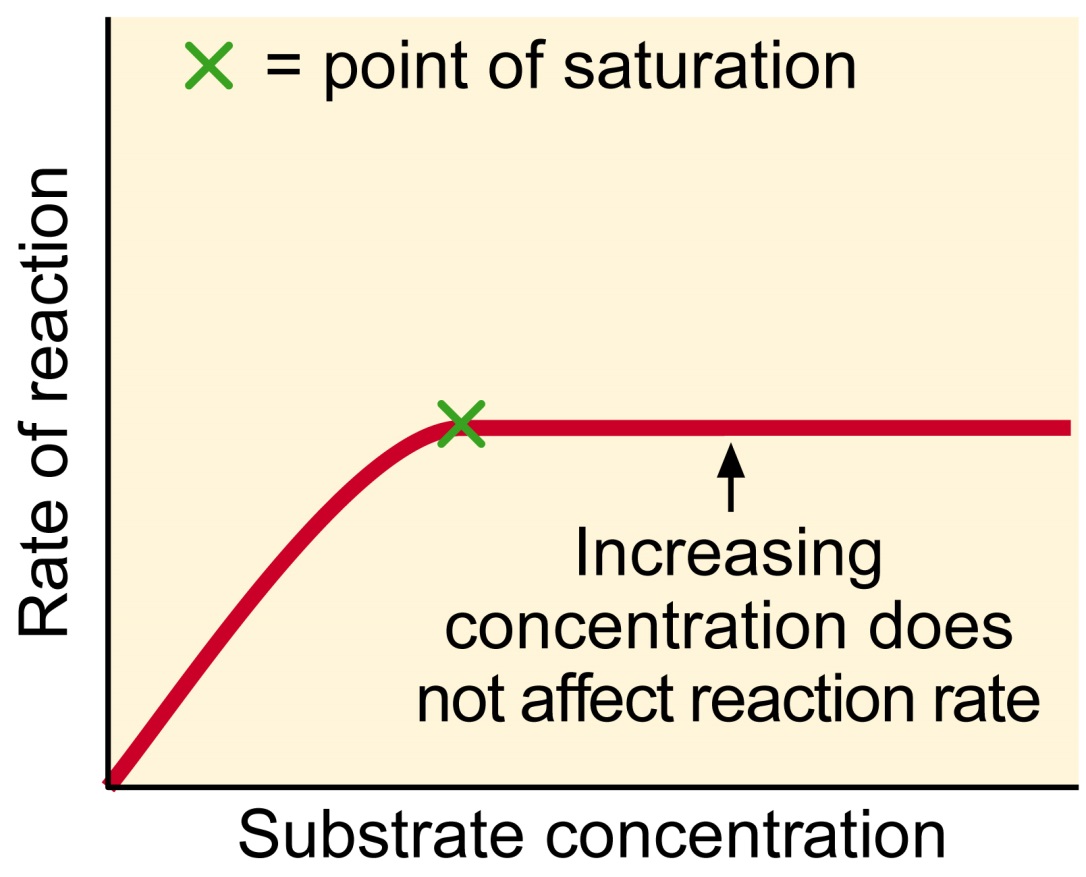
Some work better in acidic conditions and some in basic.

If the pH is **too high or too low** the enzyme will **denature** and stop working.[](https://www.google.com/url?sa=i&rct=j&q=&esrc=s&frm=1&source=images&cd=&cad=rja&docid=4bZimrZy59TTiM&tbnid=XG8VO-c6p-wIgM:&ved=0CAUQjRw&url=https://wikispaces.psu.edu/pages/viewpage.action?pageId%3D112527060%26navigatingVersions%3Dtrue&ei=2uVJUsfBDJPA9QS_hYGQDQ&bvm=bv.53217764,d.eWU&psig=AFQjCNHJFuccNWrlV7eL1ztubt9x4AlvzA&ust=1380661074034817)

3) **Enzyme and Substrate Concentrations**

If you have **lots of substrate** and you **increase the number of enzymes**, the reaction will go **faster until the level of substrate gets too low**.

If you have **lots of enzymes** and increase the amount of **substrate**, the reaction will go **faster** until you reach the point of **Enzyme Saturation** and the enzymes are working at **full capacity**. Adding more substrate will not make the reaction go any faster.

[](http://www.google.com/url?sa=i&rct=j&q=&esrc=s&frm=1&source=images&cd=&cad=rja&docid=zqMgG2dJ-JFwYM&tbnid=COV30s2HMjOBgM:&ved=0CAUQjRw&url=http://www.rsc.org/Education/Teachers/Resources/cfb/enzymes.htm&ei=PeZJUt72EJDo8wSm9YGYBQ&bvm=bv.53217764,d.eWU&psig=AFQjCNGSxDb8e36ZMXN3SpR4MgYrgkIULA&ust=1380661166593839)

4) **Presence of Co-factors and Co-enzymes**

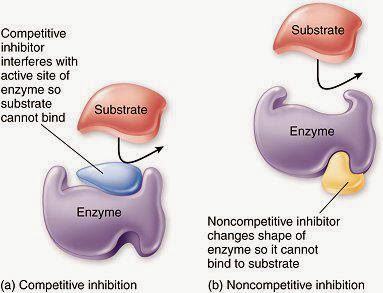
Substances that **bind** to enzymes and **make them work properly** Co-factor = **metal ions**   
 Ex: **Iron** in hemoglobin  
 **Zinc** in DNA polymerase (builds new DNA)  
 Co-enzyme = **vitamins**   
 Ex: Riboflavin (B2) and Niacin (B3) for components in cellular respiration = **energy production**

5) **Inhibitors**: Substances that bind to the enzyme and **stop it functioning**.

**Types**:

1) **Competitive Inhibitors**: Bind to the **active site** and **COMPETE with the substrate**

2) **Non-competitive Inhibitors**: Bind to **another area** of the enzyme **causing the active site to undergo a conformational change** (change in shape) so the **substrate can’t bind**

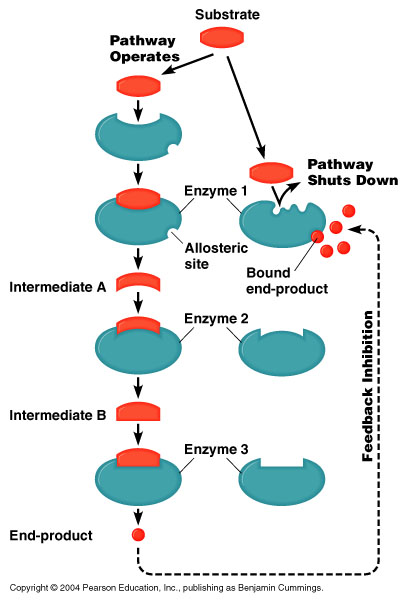
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6) **Regulatory Feedback**

Some enzymes and metabolic pathways (a series of several enzymatic reactions) are **regulated by the products of the reaction.**

When **enough product is made**, excess product **binds to the enzyme and turns it off**.

This keeps the cell from making too much of one product and **wasting energy and resources**.

[](http://www.google.com/url?sa=i&rct=j&q=&esrc=s&frm=1&source=images&cd=&cad=rja&docid=EMERxzUAFBQhEM&tbnid=6944bWPI7rJfyM:&ved=0CAUQjRw&url=http://classes.midlandstech.com/carterp/Courses/bio225/chap05/ss2.htm&ei=4OpJUu_XMYXE9gTz9oCgCw&psig=AFQjCNFrg1b4srbcrdgoiJskKO5by8E58w&ust=1380661455508084)

**ARE ENZYMES IMPORTANT?   
!!!!!YES!!!!!**

They control **EVERYTHING** that happens inside your cells.

**No enzymes = No Life.**