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**



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. 

**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.

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.



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**



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**.



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

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

**No enzymes = No Life.**