ENZYMES

Characteristics of enzymes:

- Enzymes are **proteins**
- Names end in **-ase**
  - ex. Maltase – this enzyme breaks down MALTOSE into two glucose molecules
  - Lipase – breaks down lipids
- **CATALYSTS**: enzymes speed up reactions
  - most reactions in the cell are sped up by enzyme catalysts
    Without enzymes, reactions would be too slow to maintain life
- **VERY SPECIFIC**: only work on one type of **SUBSTRATE**
- Affected by environmental factors like changes in **TEMPERATURE** and **pH**
  - these proteins can be **DENATURED** and when they lose their shape they can no longer function properly

ACTIVATION ENERGY

All reactions require some **ENERGY** for them to start. This energy is called **ACTIVATION ENERGY (E_A)**

Most common source for activation energy \((E_A)\) : **HEAT**

PROBLEM: the extra heat may **DENATURE** the enzyme (protein)

SOLUTION: enzymes lower the activation energy without adding extra heat
HOW ENZYMES WORK (Enzyme activity)

Enzymes act on REACTANTS called SUBSTRATES.

Active site: the location where the substrate binds to the enzyme
(usually a small groove or pocket in the 3-D structure of the protein)

- the active site on an enzyme has a unique shape that will only FIT
  a SPECIFIC substrate

one type of enzyme only works on one substrate
ex. maltase only works on maltose

Induced-fit model: as the substrate enters the active site, the protein (enzyme)
changes shape to better fit the substrate

Enzyme-substrate complex: created when the substrate attaches to the enzymes
active site

see book pg 52 fig 3

Enzyme activity and the environment

Remember that enzymes are protein catalysts and are easily denatured by changes in
TEMPERATURE.

Every enzyme has an OPTIMAL TEMPERATURE at which it works best.
Too cold - enzyme and substrate take longer to combine
Too hot – enzyme denatures and can no longer function properly

Most enzymes function best at normal body temperature: 37 °C

pH: some enzymes work at different pH (acid or alkaline) levels

ex. pepsin – an enzyme in your stomach works best in acid (pH=2)
trypsin - an enzyme in the small intestine prefers a basic (alkaline) pH=8
amylase – an enzyme in saliva prefers a neutral pH=7

Most enzymes work best very close to pH=7 (neutral)
INDUSTRIAL USES OF ENZYMES

- **FOOD INDUSTRY**: brewing, baking, wine making
  - An enzyme in **YEAST** catalyzes the conversion of **GLUCOSE** into **ETHANOL** (alcohol) and **CARBON DIOXIDE** in a process called **FERMENTATION**

- **FUEL production**: glucose obtained from nonedible products like feed corn, wheat, barley by first using **AMYLASE** and **MALTASE** to break down **STARCHES** in these plant materials
  - The glucose is then **FERMENTED** using yeast to produce **ETHANOL FUEL**

- **CLEANING INDUSTRY**
  - Enzymes added to **DETERGENTS** to help remove tough stains in **COLD water**
  - **STAINS**: ex. blood (protein) and grease (lipids)
    - Proteinases and lipases are enzymes that can break down these components of stains

- **HEALTH**
  - Enzymes like **LACTASE** added to milk to break down milk into glucose and galactose which can now be digested by lactose-intolerant individuals

HELPFUL WEBSITES

http://www.emc.maricopa.edu/faculty/farabee/BIOBK/BioBookEnzym.html