CHEMICAL REACTIONS
AND
ENZYMES

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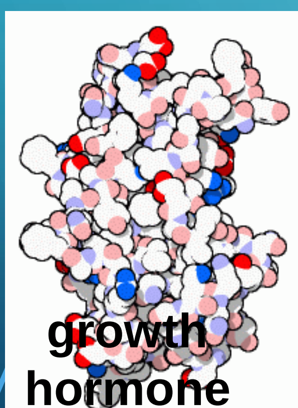
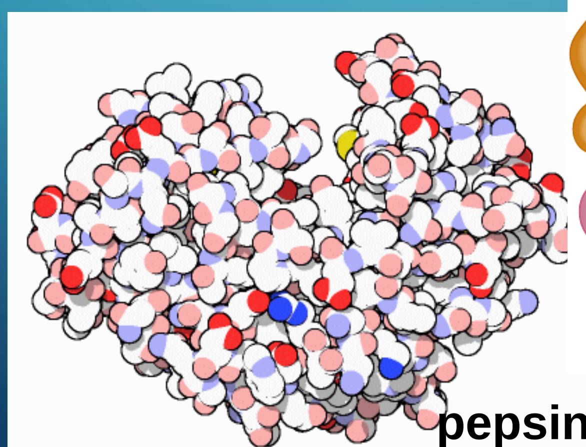
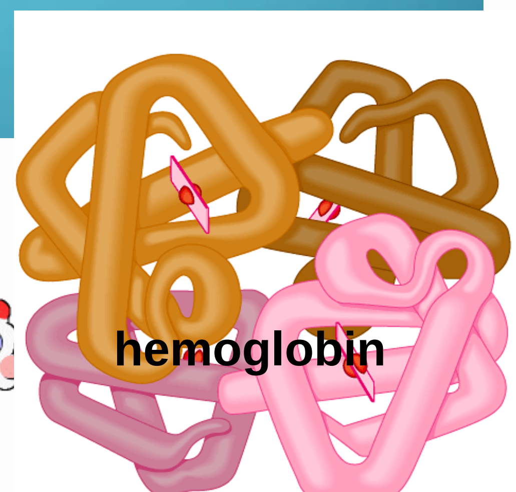
[redacted]

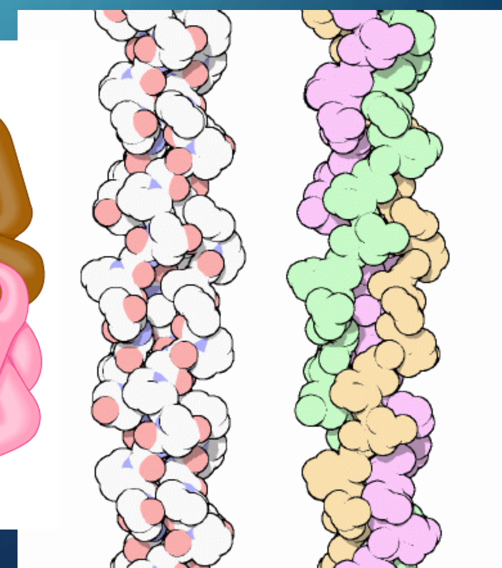
FOR PROTEINS: SHAPE MATTERS!

- Proteins fold & twist into 3-D shape
- Different shapes = different jobs
- Order of amino acids is important
- Enzymes are substrate specific





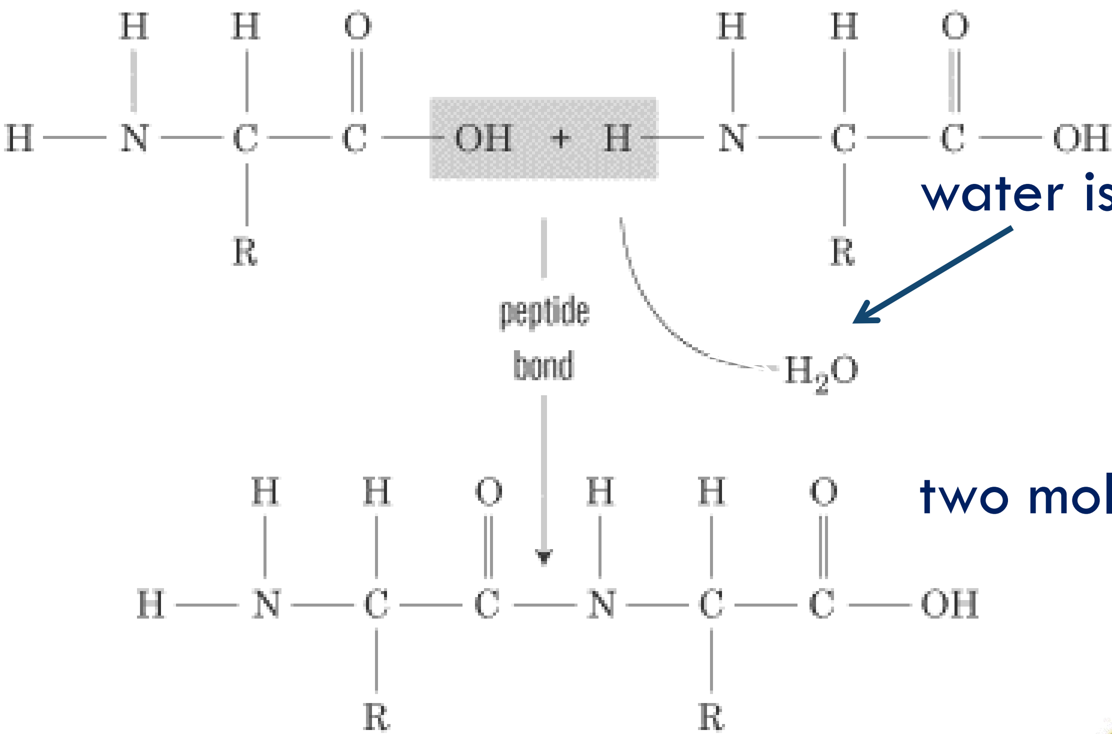




collagen

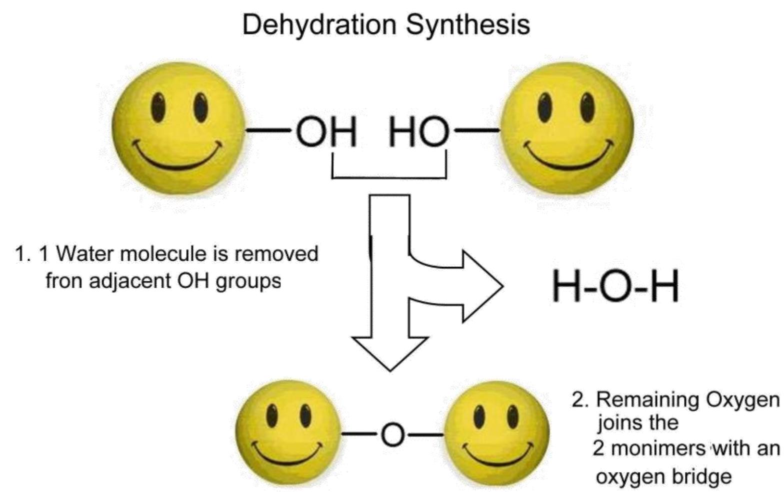
CHEMICAL REACTIONS IN THE BODY

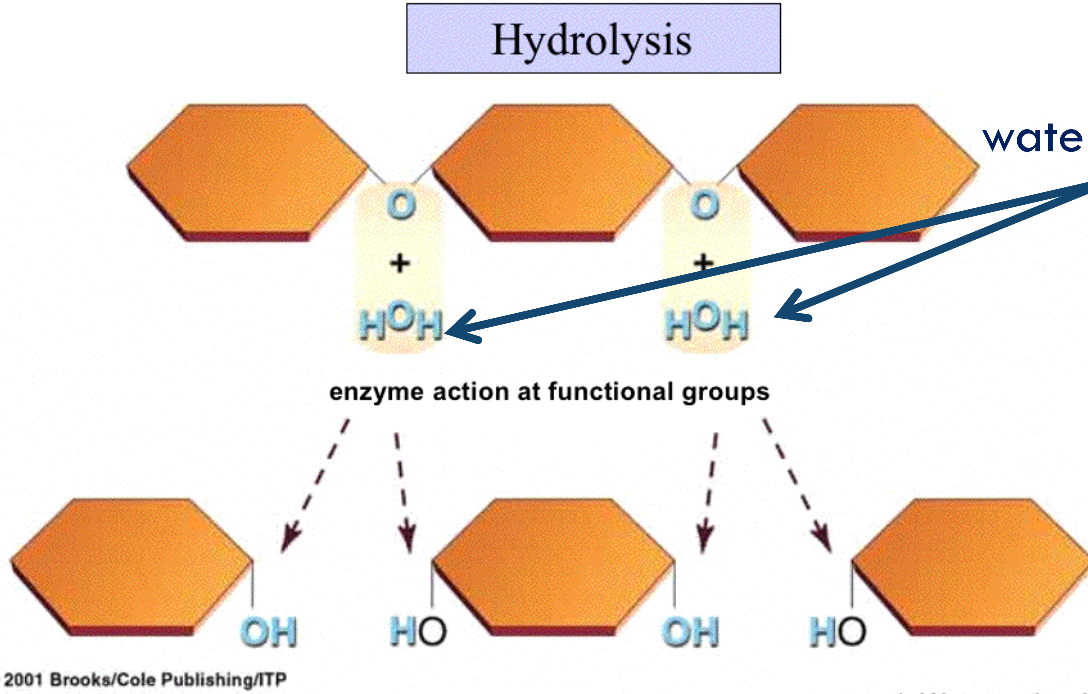
- Dehydration Synthesis – Water removed to build a new molecule (polymer)
- Hydrolysis – the splitting of a polymer by adding water



water is removed here

two molecules combine to form ONE molecule

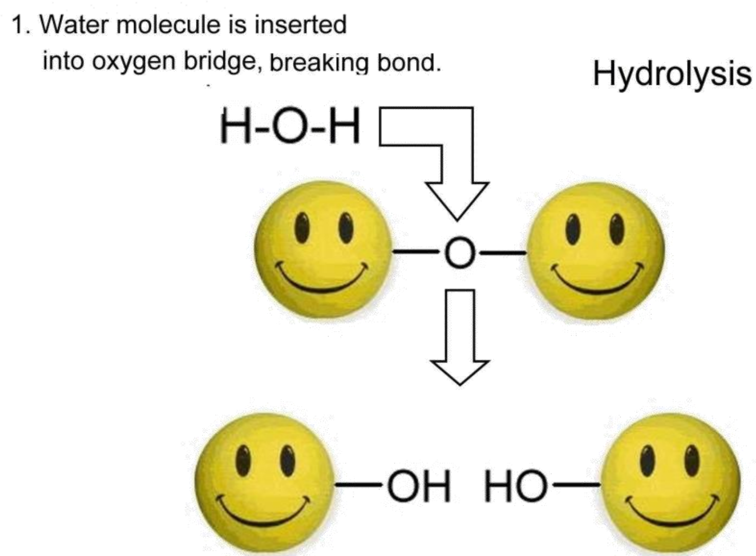




water is added here

the three molecules

are broken apart




Any Questions?

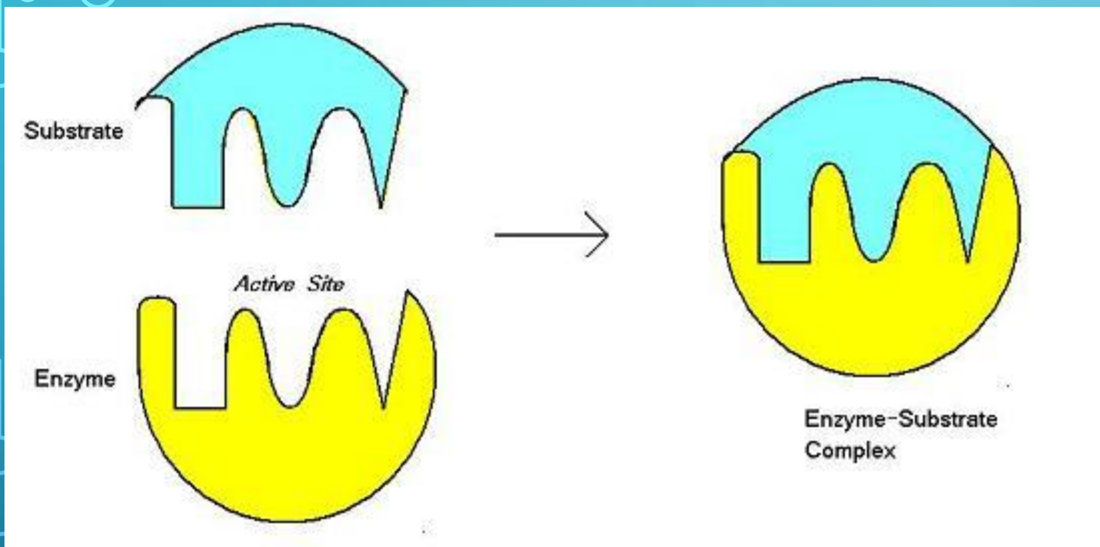
ENZYMES

WHAT ARE ENZYMES?

- Enzymes are PROTEINS
- Enzymes serve as a biological CATALYST
  - A CATALYST starts a chemical reaction
- FUNCTIONS:
  - Increases the rate of chemical reactions
    - Chemical reactions occur about 1 MILLION times faster with an enzyme than they would without one.
  - Decreases the activation energy of a chemical reaction.
    - Activation energy is the energy needed to start a chemical reaction.

ENZYME SPECIFICITY

ENZYMES HAVE A VERY SPECIFIC SHAPE



Lock-and-key Model.- The substrate and enzyme active site have complementary shapes

Enzymes are SUBSTRATE SPECIFIC.

- Each enzyme has a particular place where the substrates bind known as the ACTIVE SITE

Each enzyme's active site has a specific shape which only allows the substrate with the same shape to bind to it.

The way an enzyme and the substrate fit together is known as an INDUCED FIT.

CHEMICAL REACTIONS

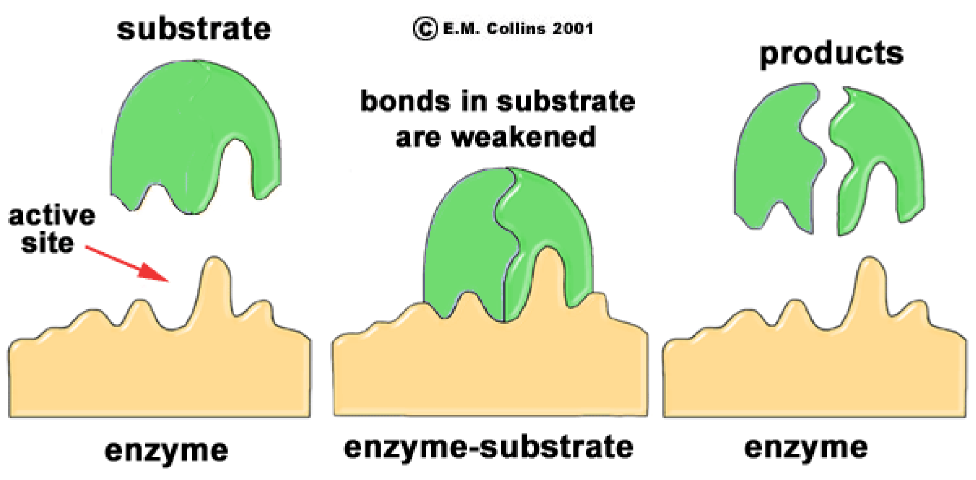
- The sum of all cellular reactions that occur in an organism is referred to as METABOLISM
  - In cellular reactions, materials are either produced, maintained, or destroyed
- Types of chemical reactions
  - ANABOLIC (anabolism)
    - Small molecules are bonded together to form larger molecules
  - Catabolic (catabolism)
    - Large molecules are broken down into smaller molecules

PARTS OF A CHEMICAL REACTION

- SUBSTRATE
  - The substance an enzyme metabolizes (breaks down or builds up)
- ACTIVE SITE
  - The place on the enzyme where the substrates bind
- PRODUCT
  - After the chemical reaction has occurred, the enzyme releases newly synthesized molecules.

HOW AN ENZYME WORKS

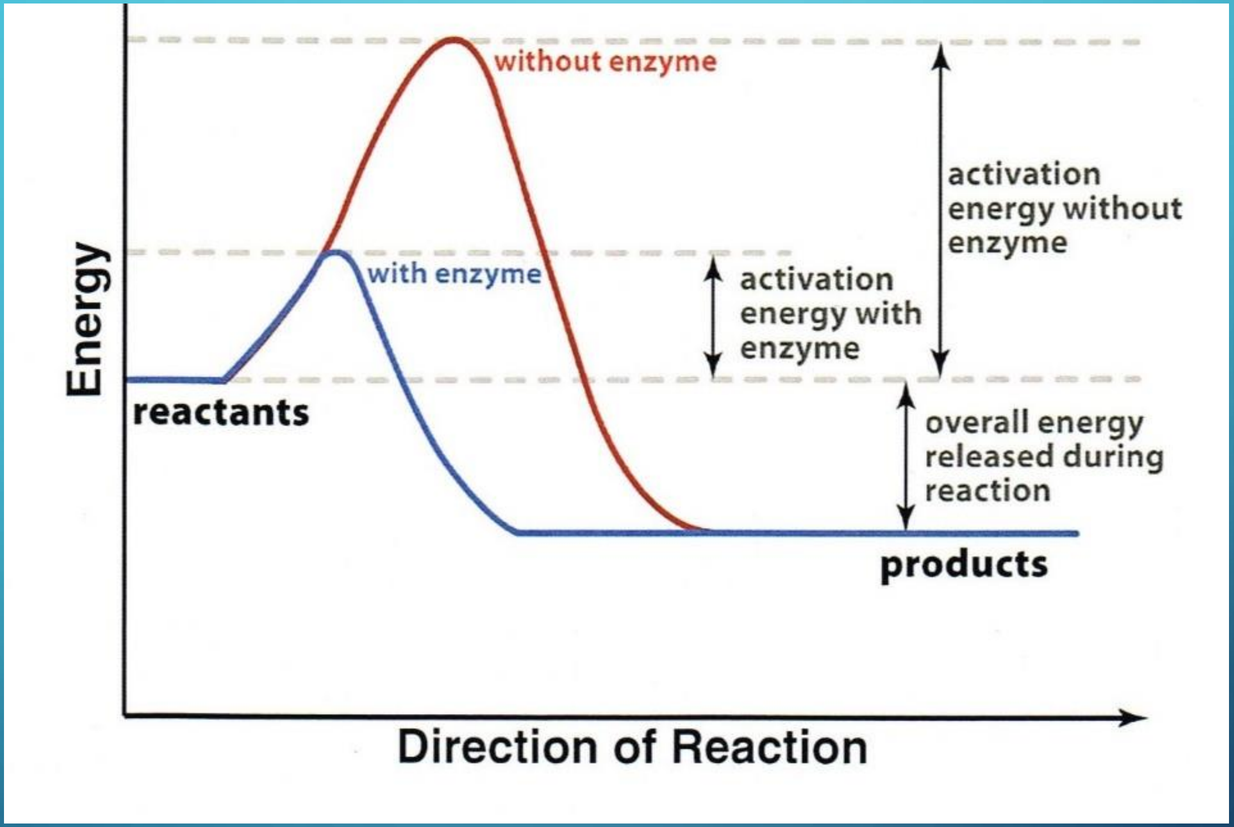
1. The substrate binds to the enzyme at the active site. If the substrate fits in the active site, it forms an induced fit.
2. The substrate binds to the active site, forming an enzyme-substrate complex.
3. The bond between the two molecules in the substrate breaks, forming products.
4. The products are released.
5. The enzyme goes on to be reused by another reaction.
6. The reverse can happen too! Two subtrates could attach and be bonded together by the enzyme.



ENZYMES FUNCTION BEST AT SPECIFIC CONDITIONS

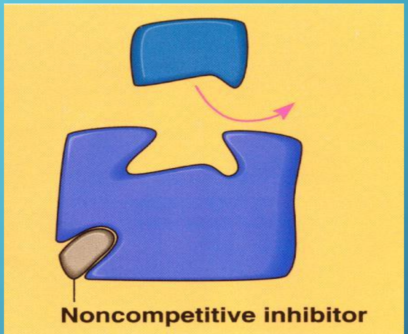
- Environmental factors within the cell can affect how an enzyme functions.
  - HIGH TEMPERATURES
    - High temperatures can denature (breakdown) an enzyme, changing its shape.
  - LOW TEMPERATURES
    - Low temperatures can slow down the activation energy necessary for a chemical reaction to occur.
  - OPTIMAL TEMPERATURE
    - Optimal temperature is somewhere in between. The activation energy necessary for a chemical reaction to occur is at its maximum.
  - pH
    - Enzymes function best in environments where the pH range is 6-8.
      - The exception is digestive enzymes which function better when the pH is at a range around 2

EFFECT OF ENZYME ON ACTIVATION ENERGY



INHIBITORS

- Some substances stop or inhibit substrates from binding to an enzymes active site.
    - Competitive inhibitor – blocks the active site of the enzyme preventing the substrate from binding to the enzyme



    - Non-competitive inhibitor – changes the shape of the enzymes thus changing the shape of the active site.

WHAT HAPPENS TO THE ENZYME AFTER THE CELLULAR REACTION IS OVER?

The enzyme goes on to catalyze another reaction!

Enzymes are used over and over again!