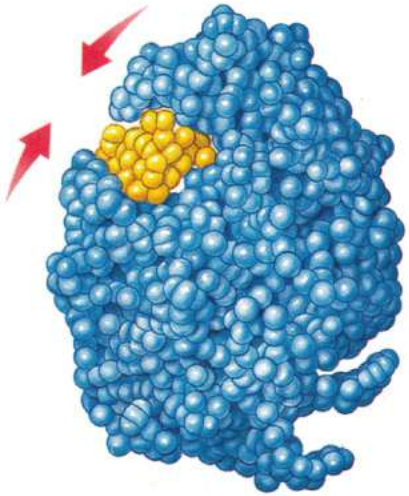
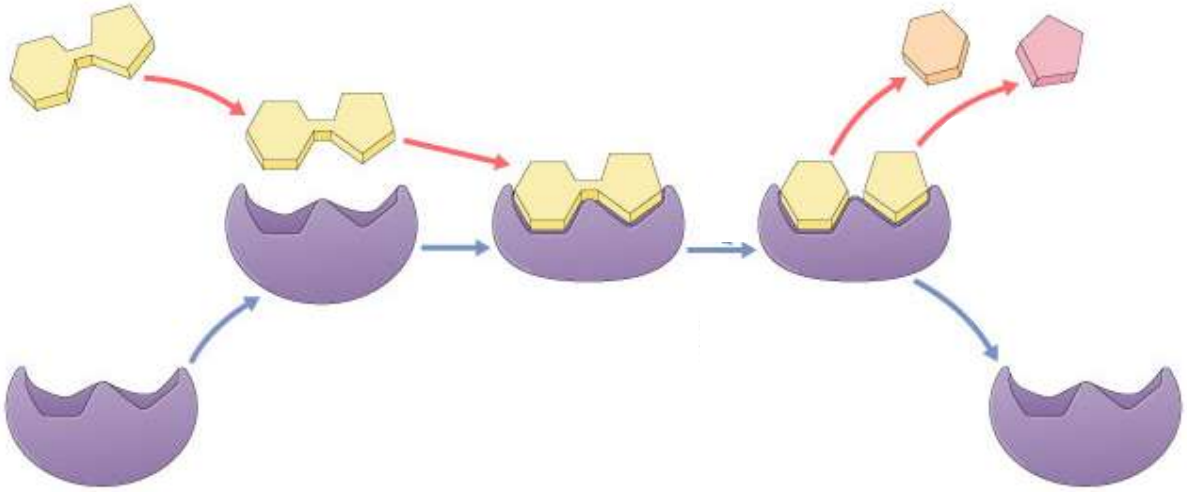


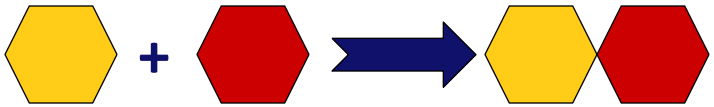
Enzymes:

"Helper" Protein molecules

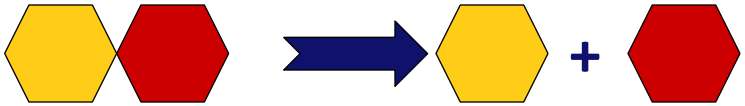


Chemical reactions of life

- Processes of life
  - building molecules
    - synthesis

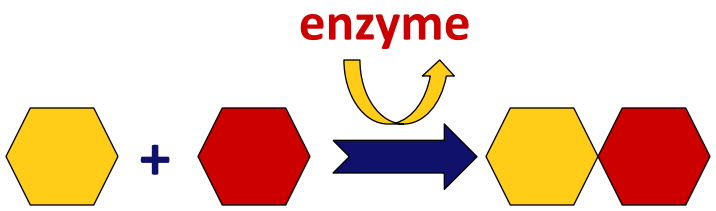


  - breaking down molecules
    - digestion

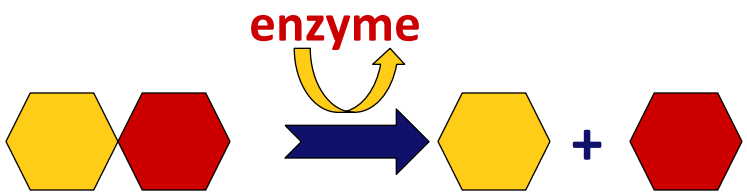


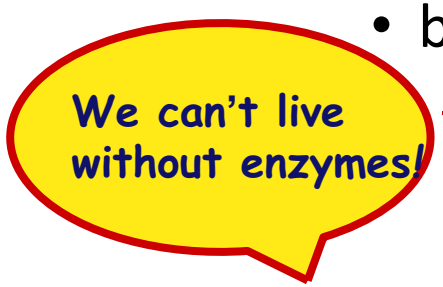
Nothing works without enzymes!

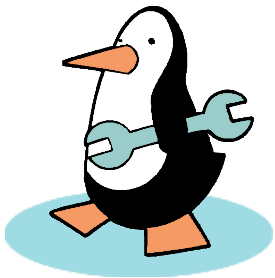
- How important are enzymes?
  - all chemical reactions in living organisms require enzymes to work
    - building molecules
      - synthesis enzymes



    - breaking down molecules
      - digestive enzymes



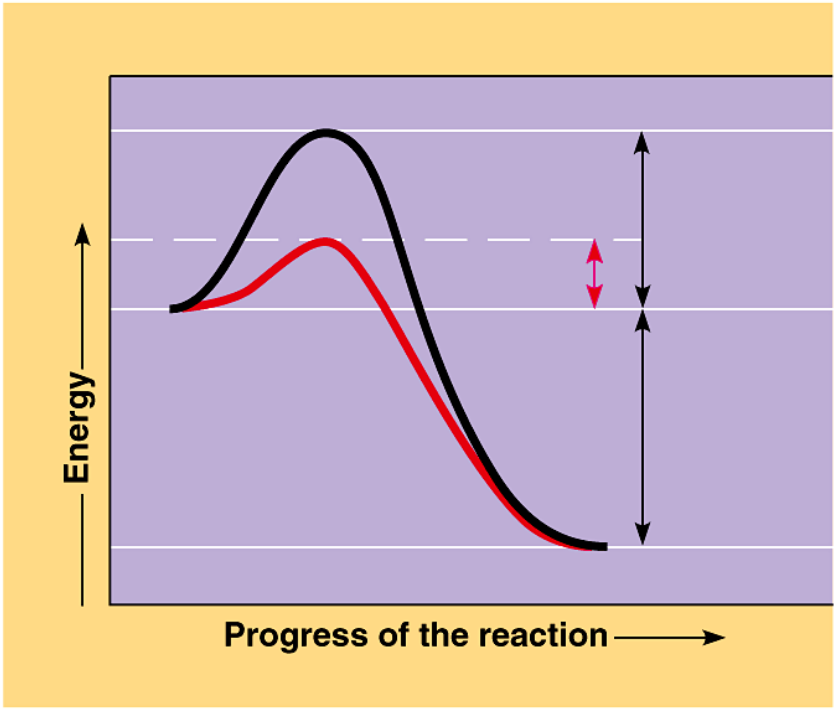




  - enzymes speed up reactions
    - "catalysts"

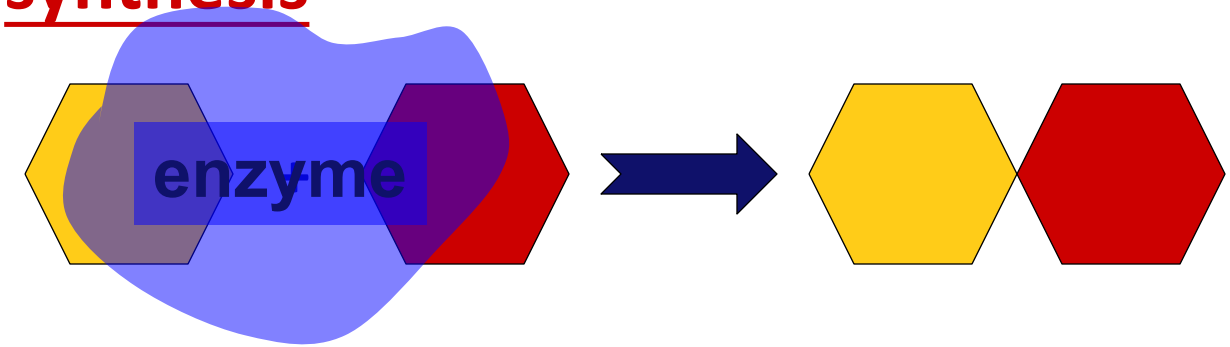
Enzymes

- A protein catalyst
- Enzymes are important proteins found in living things. An enzyme is a protein that changes the rate of a chemical reaction.
- They speed metabolic reactions.

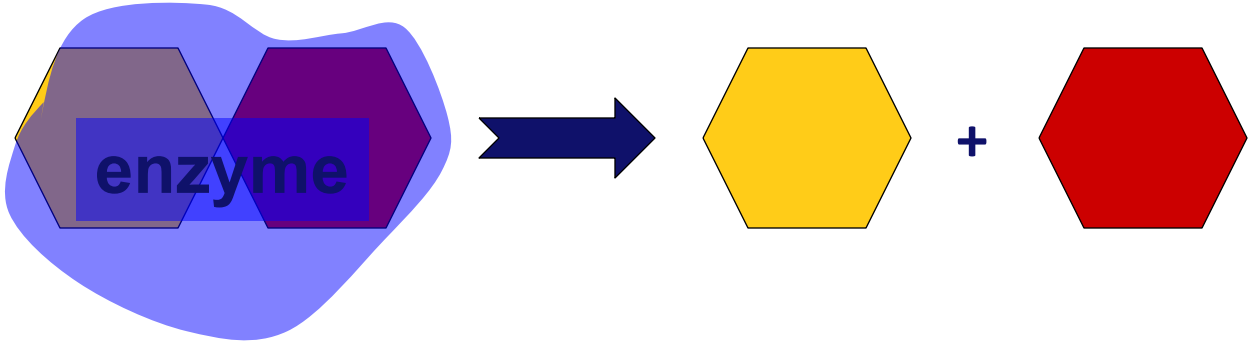


Examples

- **synthesis**



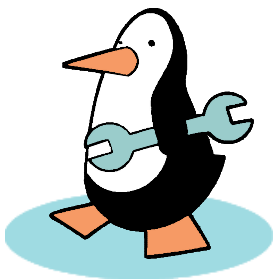
- **digestion**



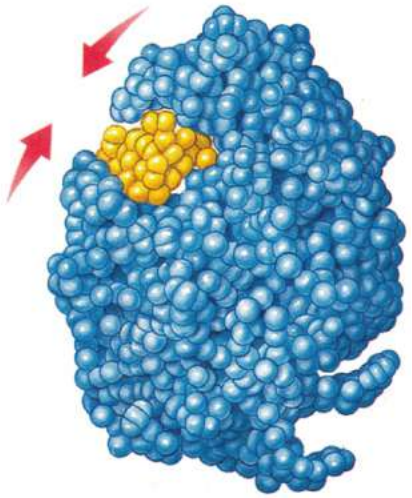
Enzymes are proteins

- Each enzyme is the specific helper to a specific reaction
- each enzyme needs to be the right shape for the job
  - enzymes are named for the reaction they help

Oh, I get it! They end in -ase

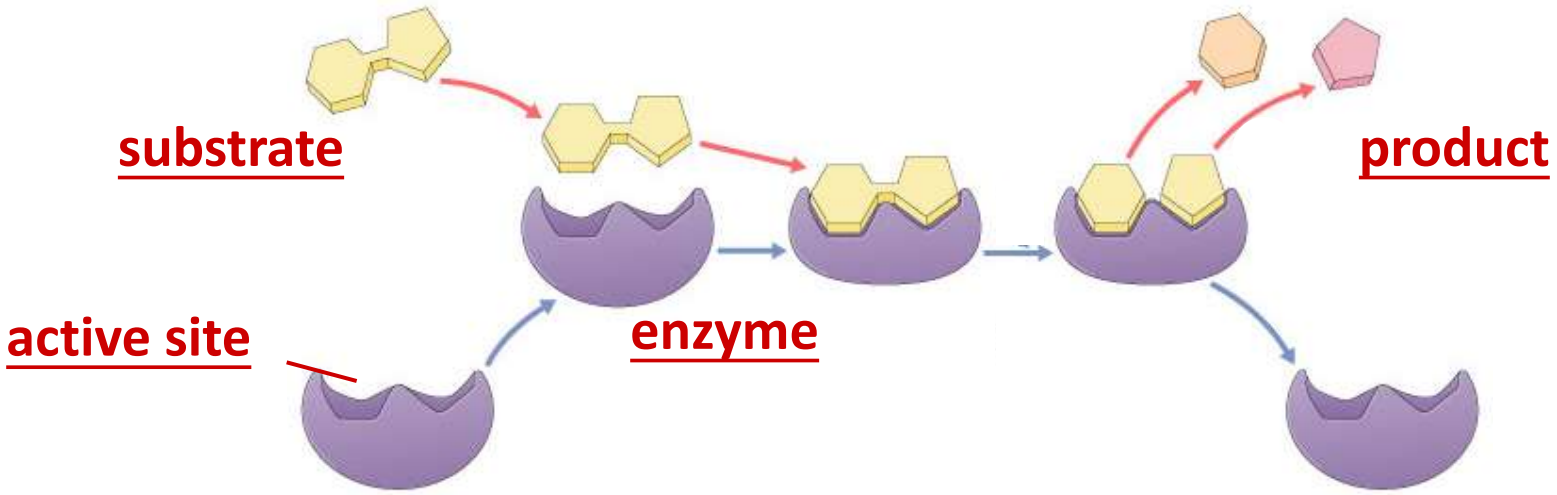


- sucrase breaks down sucrose
- proteases breakdown proteins
- lipases breakdown lipids
- DNA polymerase builds DNA



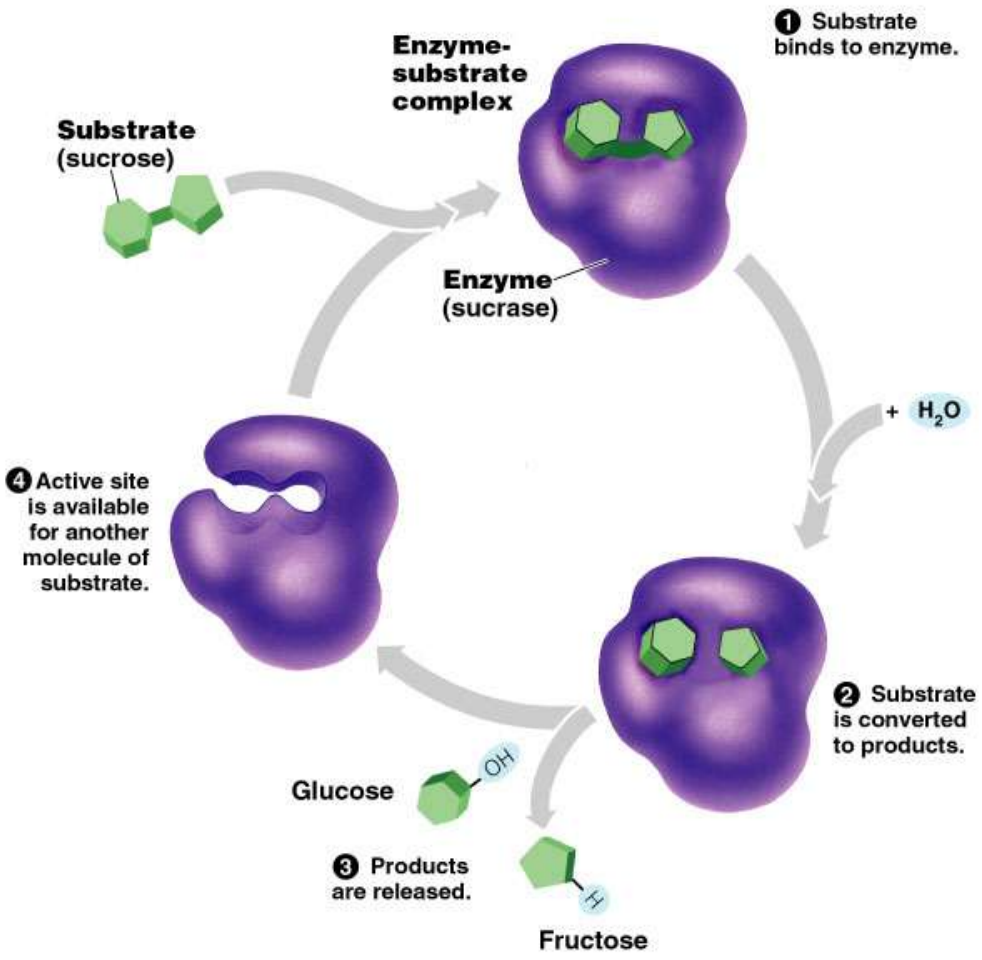
Enzymes aren't used up

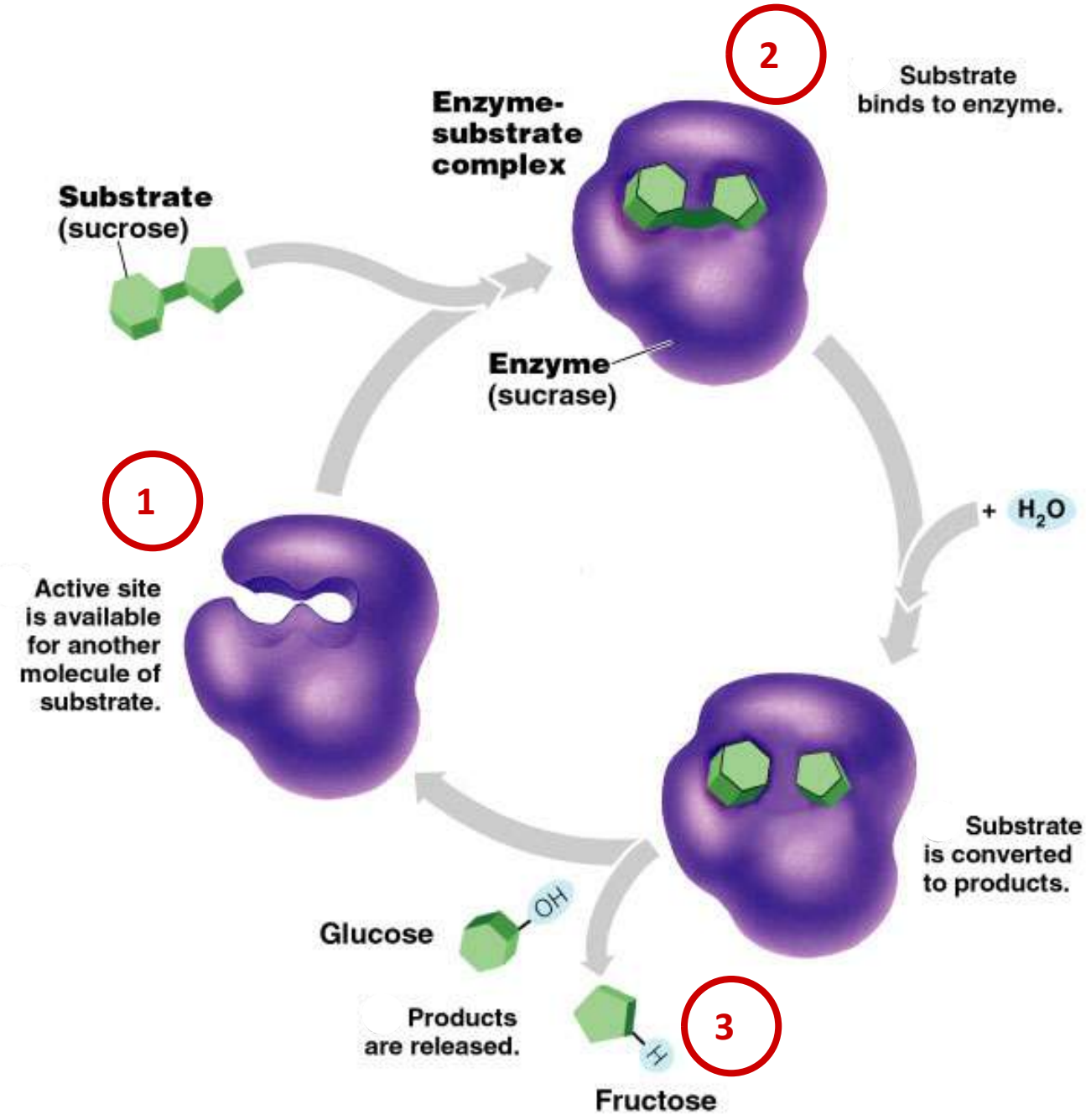
- Enzymes are not changed by the reaction
  - used only temporarily
  - re-used again for the same reaction with other molecules
  - very little enzyme needed to help in many reactions



It's shape that matters!

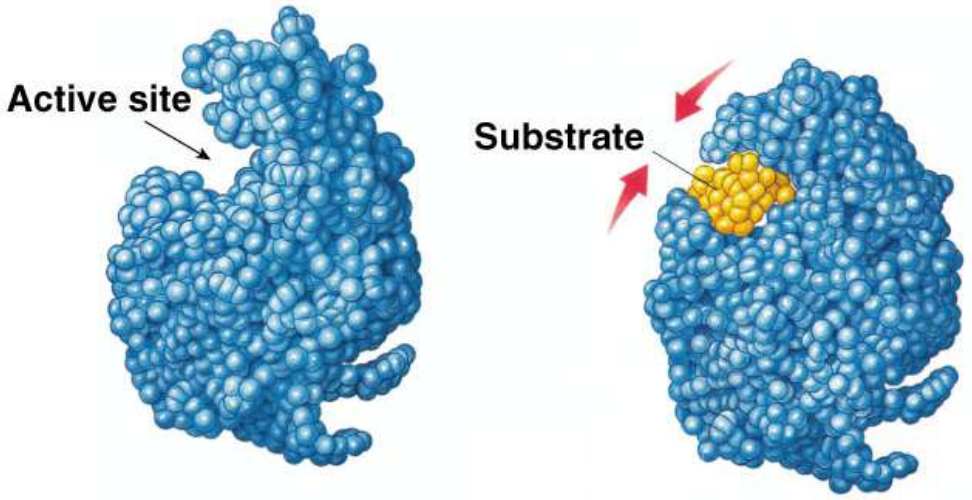
- Lock & Key model
  - shape of protein allows enzyme & substrate to fit
  - specific enzyme for each specific reaction




2
Substrate binds to enzyme.
Enzyme-substrate complex
Substrate (sucrose)
Enzyme (sucrase)
1
Active site is available for another molecule of substrate.
+ H_2O
Substrate is converted to products.
Glucose
OH
Products are released.
3
H
Fructose

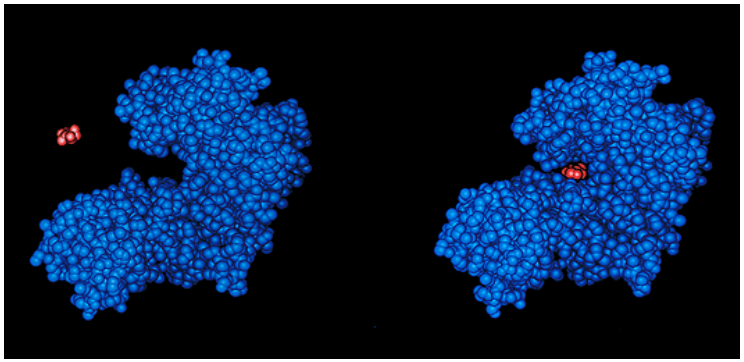
Enzyme vocabulary

- Enzyme
  - helper protein molecule
- Substrate
  - molecule that enzymes work on
- Products
  - what the enzyme helps produce from the reaction
- Active site
  - part of enzyme that substrate molecule fits into



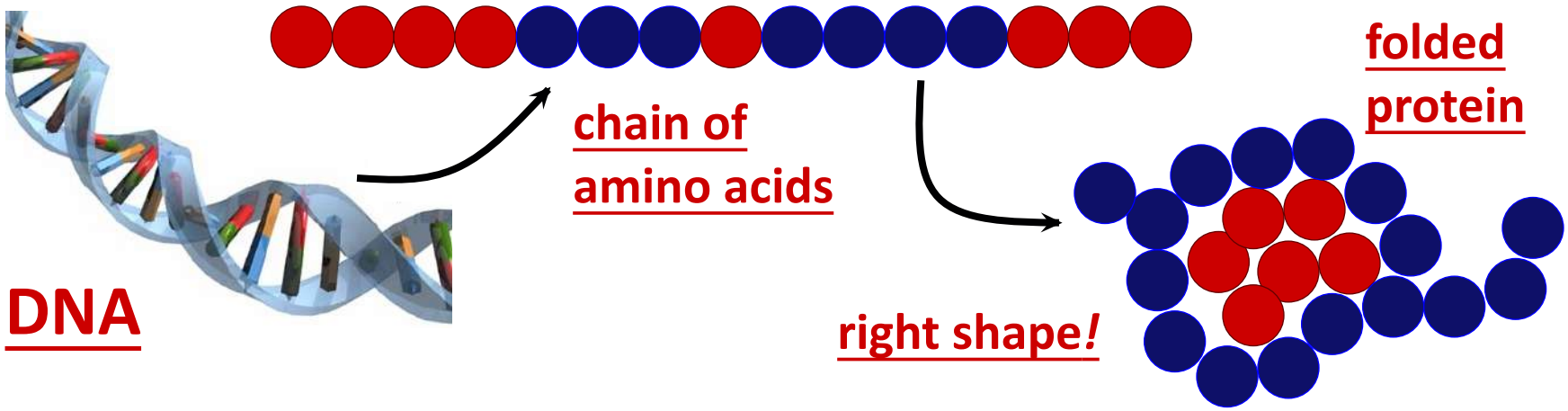
What affects enzyme action

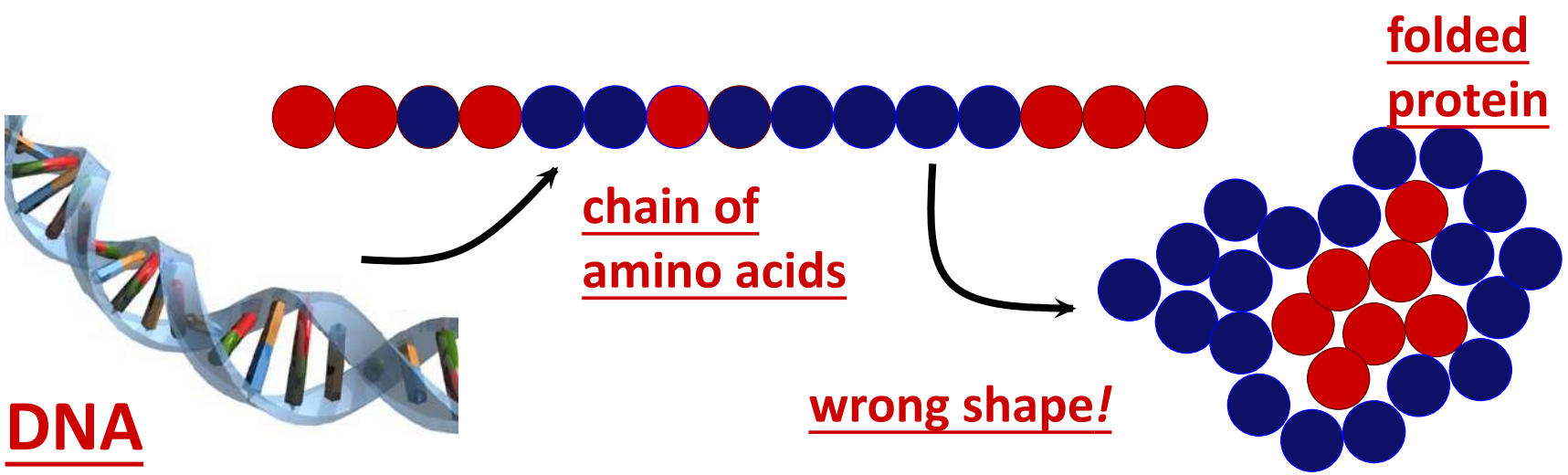
- Correct protein structure
  - correct order of amino acids
  - why? enzyme has to be right shape
- Temperature
  - why? enzyme has to be right shape
- pH (acids & bases)
  - why? enzyme has to be right shape



Order of amino acids

- Wrong order = wrong shape = can't do its job!

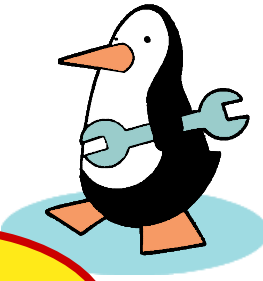


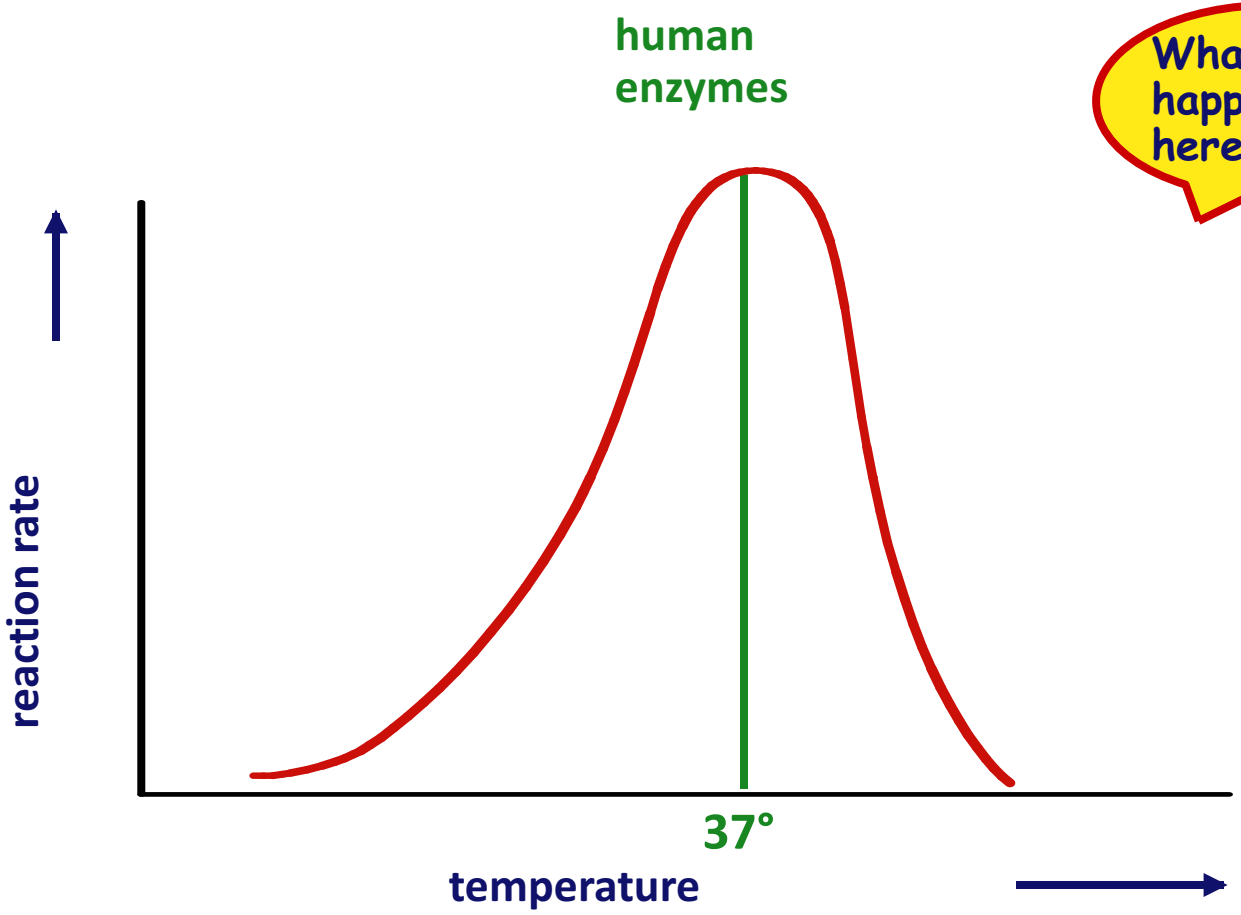


Temperature

- Effect on rates of enzyme activity
  - Optimum temperature
    - greatest number of collisions between enzyme & substrate
    - human enzymes
      - 35°- 40°C (body temp = 37°C)
  - Raise temperature (boiling)
    - **denature** protein = unfold = lose shape
  - Lower temperature T°
    - molecules move slower
    - fewer collisions between enzyme & substrate

Temperature

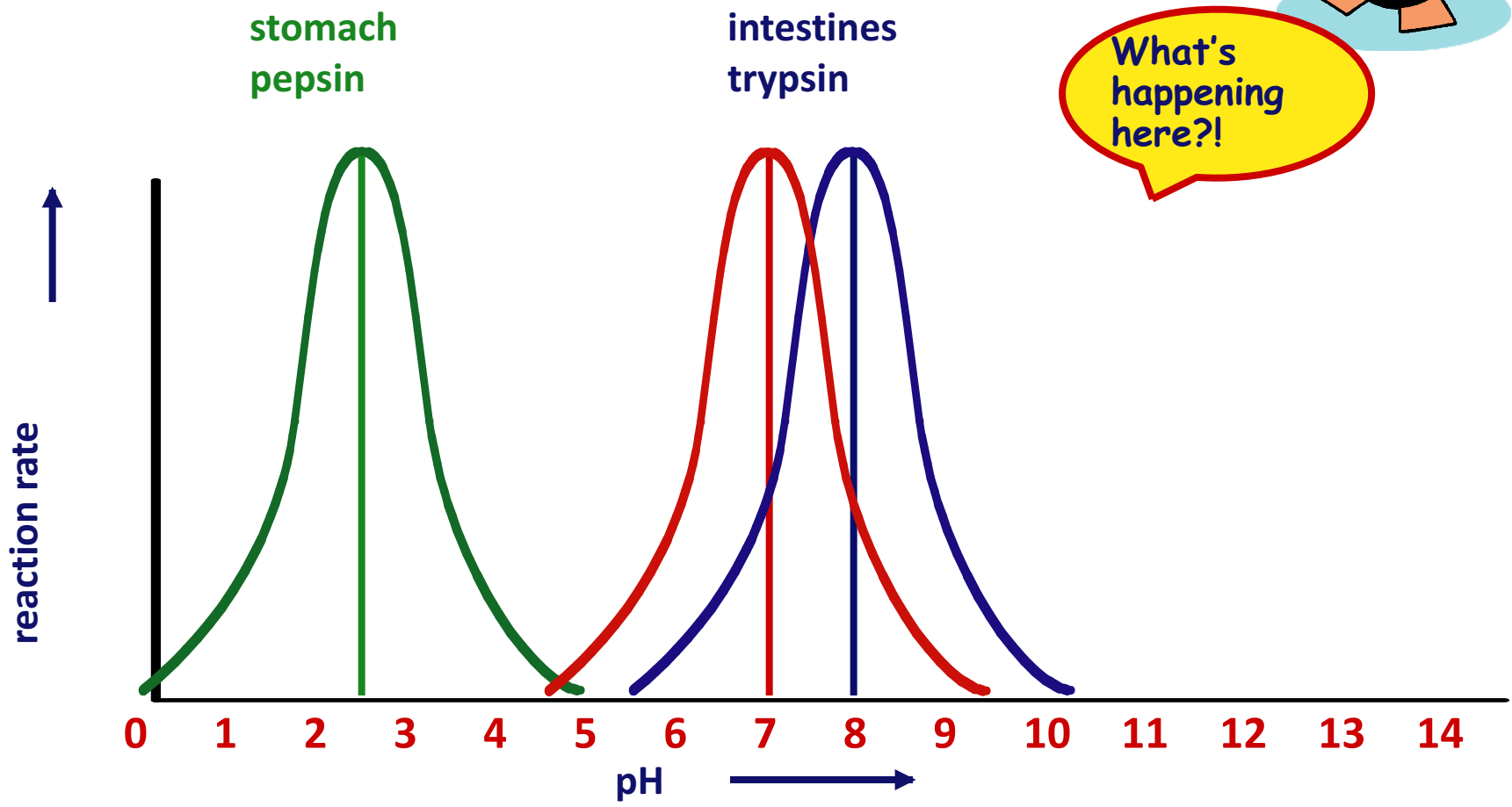




pH

- Effect on rates of enzyme activity
  - changes in pH changes protein shape~ **Denatures**
  - most human enzymes = pH 6-8
    - depends on where in body
    - pepsin (stomach) = pH 3
    - trypsin (small intestines) = pH 8

pH


stomach
pepsin
intestines
trypsin
What's happening here?!
reaction rate
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14
pH

For enzymes…

What matters?

SHAPE*!*