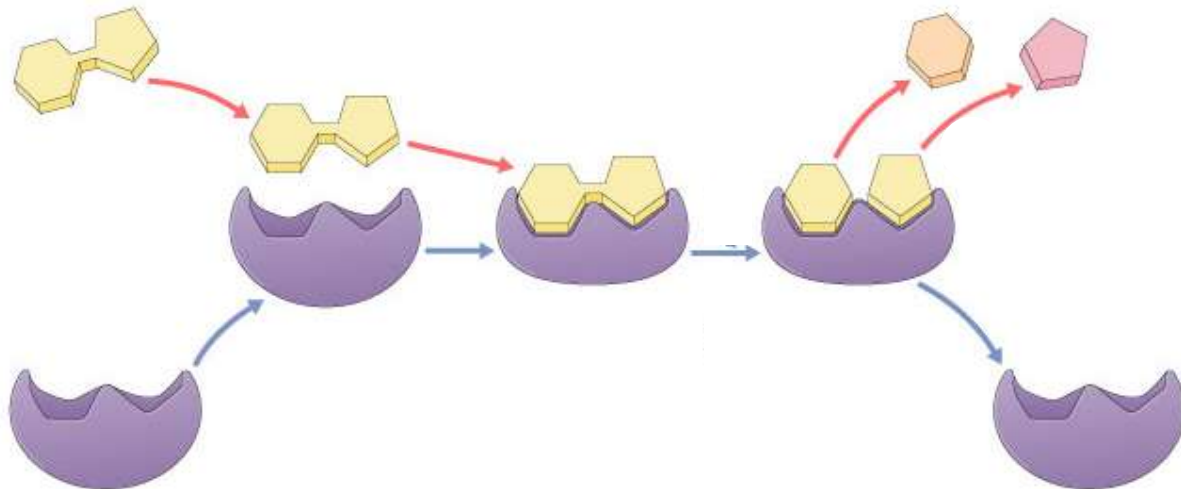
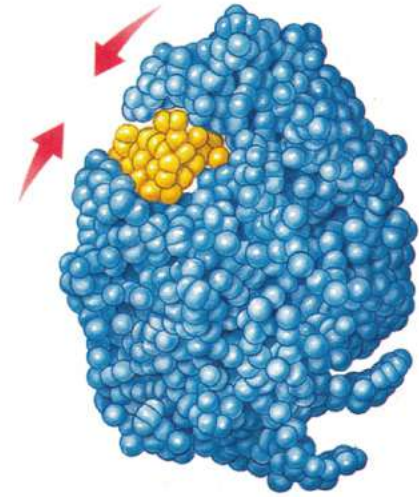


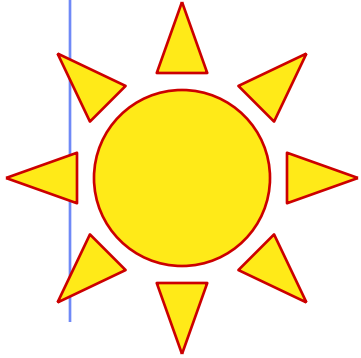
Enzymes:

“Helper” Protein molecules



Flow of energy through life

- Life is built on chemical reactions

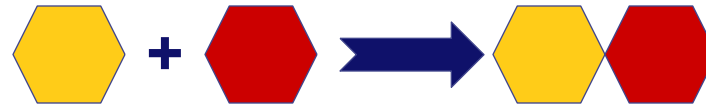


Chemical reactions of life

- Processes of life

- building** molecules

- synthesis**



- breaking down** molecules

- digestion**



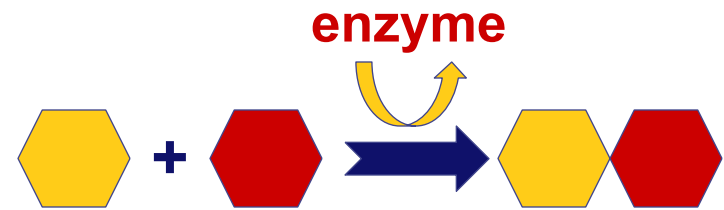
Nothing works without enzymes!

- How important are enzymes?

- all chemical reactions in living organisms require enzymes to work

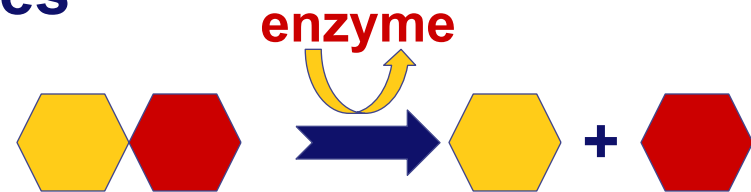
- building molecules

- synthesis enzymes



- breaking down molecules

- digestive enzymes



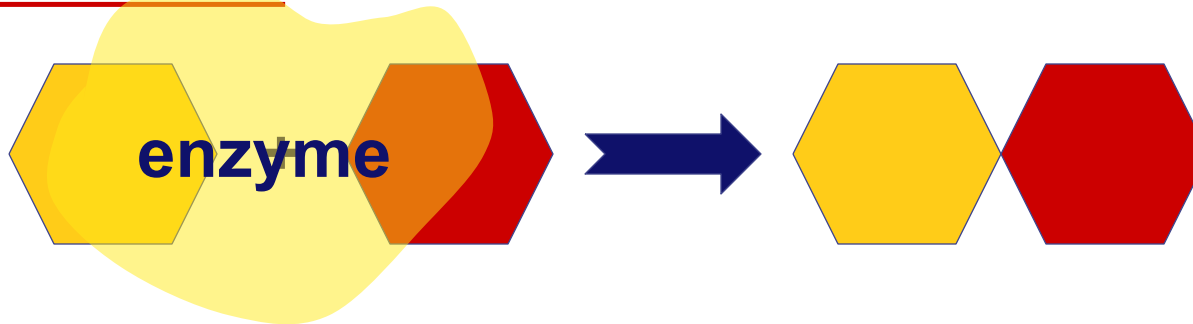
We can't live without enzymes!

- enzymes speed up reactions

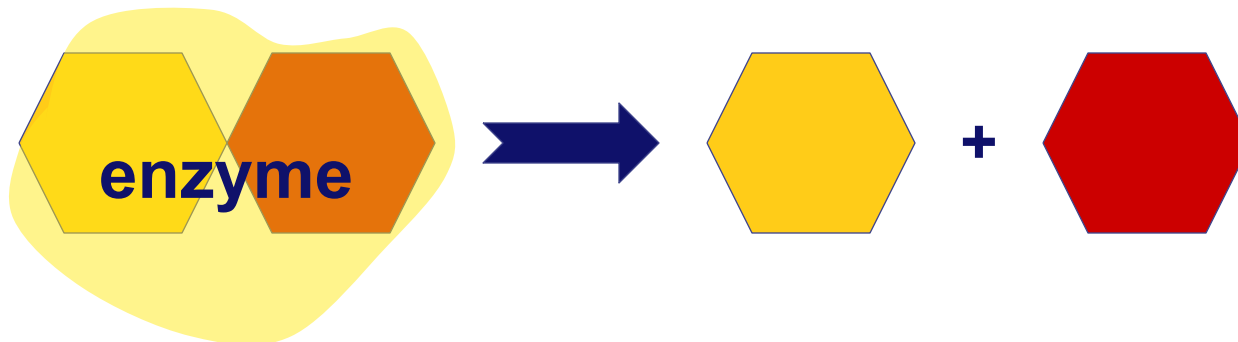
- “catalysts”

Examples

synthesis



digestion



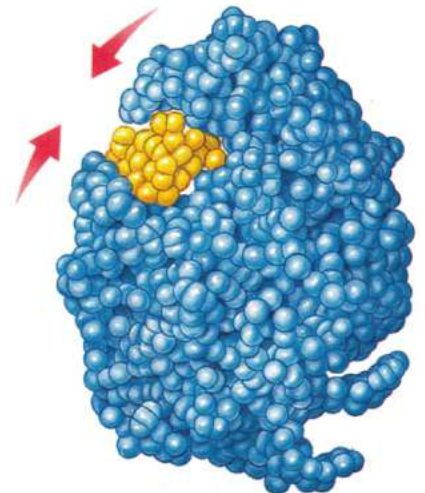
Enzymes are proteins

- 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

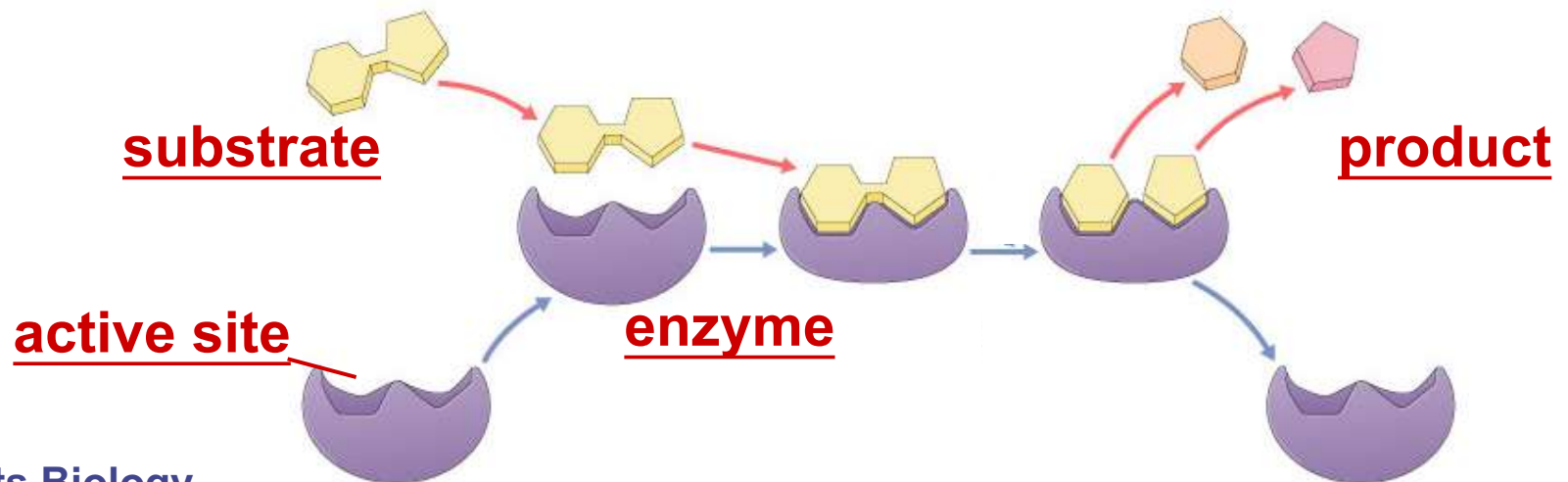
sucrase breaks down sucrose

- 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

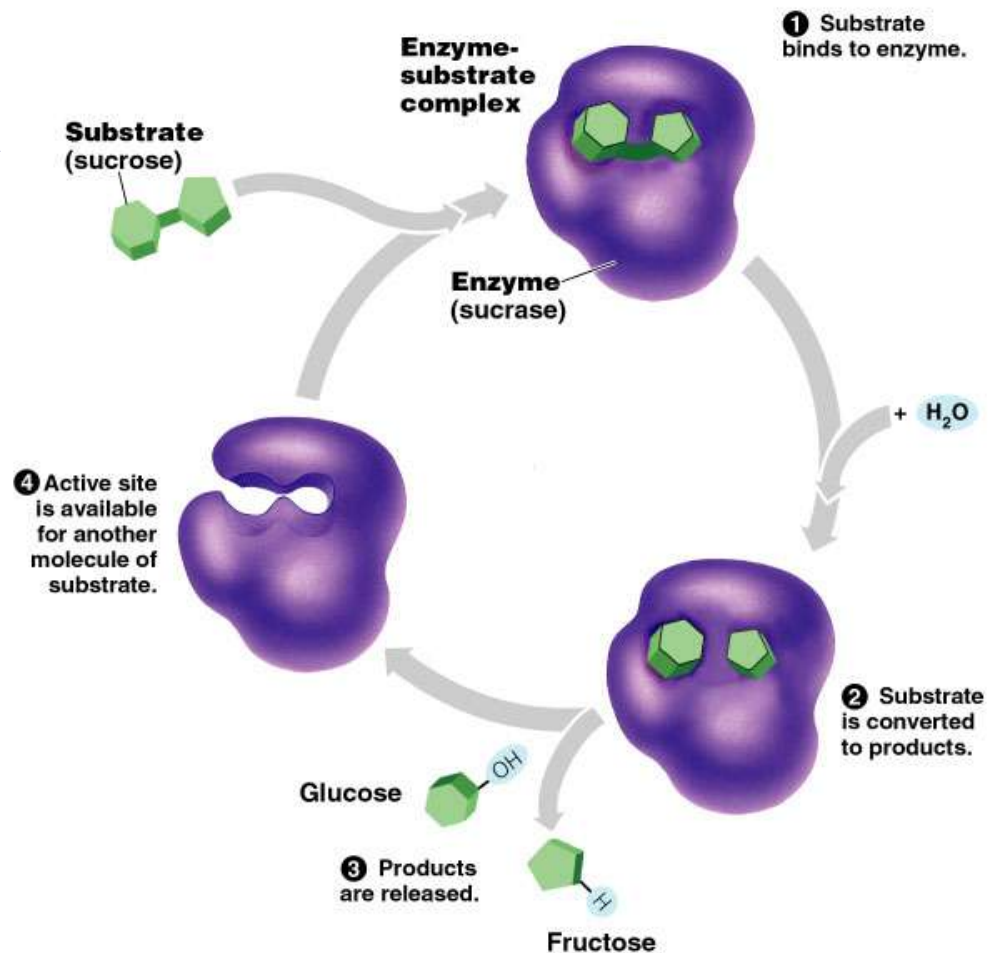


It's shape that matters!

- Lock & Key model

- ◆ shape of protein allows enzyme & substrate to fit

- ◆ specific enzyme for each specific reaction



1

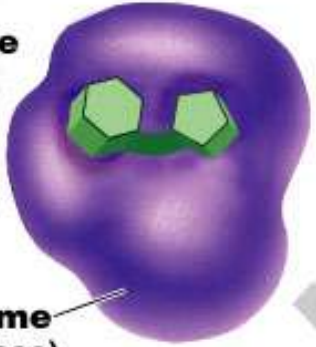
Enzyme-substrate complex

Substrate binds to enzyme.

Substrate (sucrose)



Enzyme (sucrase)



+ H₂O

2

Substrate is converted to products.

Active site is available for another molecule of substrate.

3

Glucose



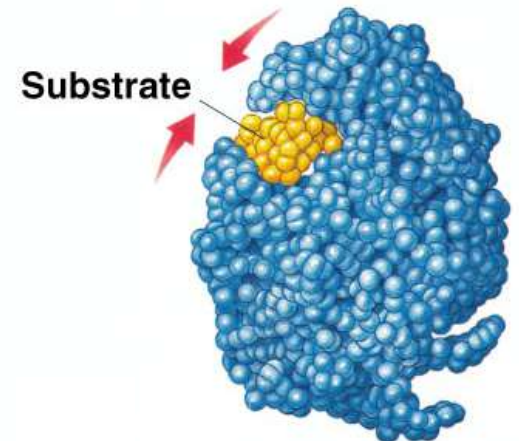
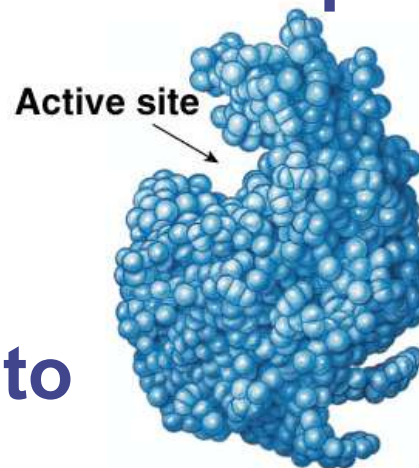
Products are released.

Fructose



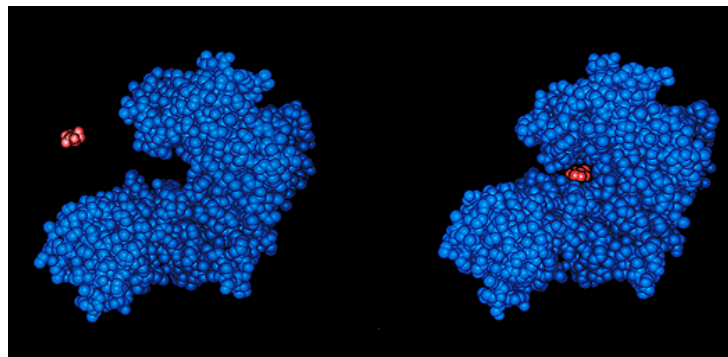
Enzyme vocabulary

- **Enzyme**
 - ◆ helper molecule
- **Substrate**
 - ◆ molecule that enzymes work on
- **Enzyme-substrate complex**
 - ◆ enzyme & molecule temporarily joined
- **Active site**
 - ◆ part of enzyme that substrate molecule fits into



What affects enzyme action

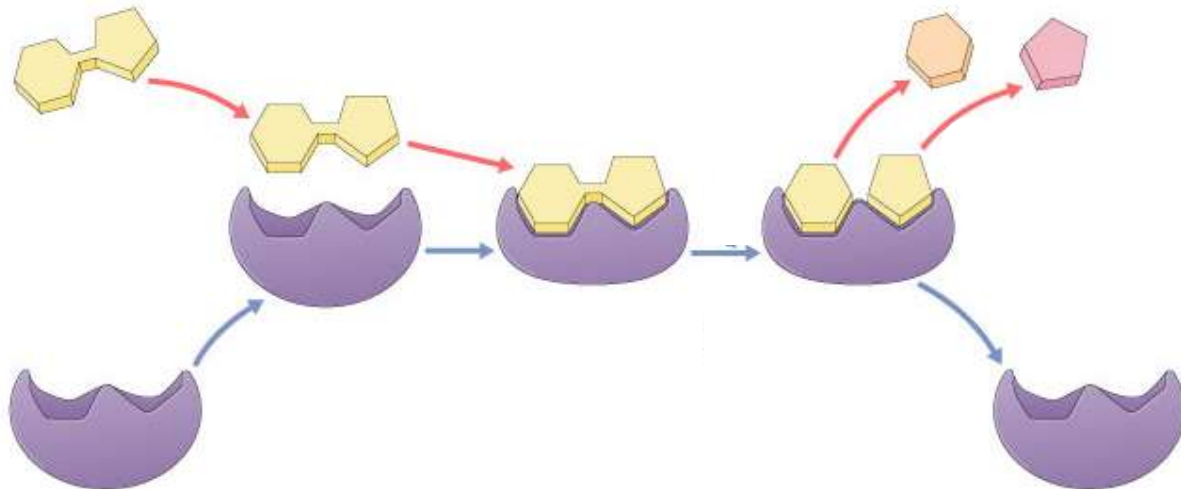
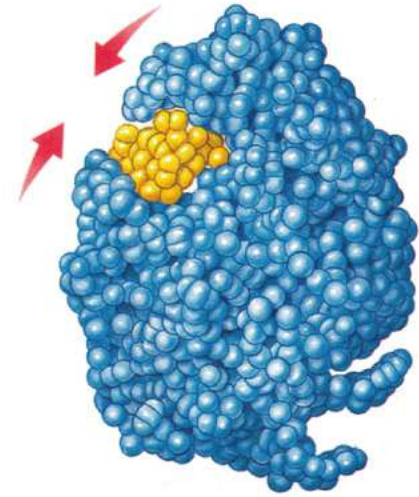
- Correct protein structure
 - ◆ correct order of amino acids
 - ◆ why? enzyme has to be right shape
- Temperature
 - ◆ why? enzyme has to be right shape
- pH (acids & bases)
 - ◆ why? enzyme has to be right shape



- 
- **Let's build some**
 - **Enzyme Models!**

More about Enzymes:

What Affects Enzymes

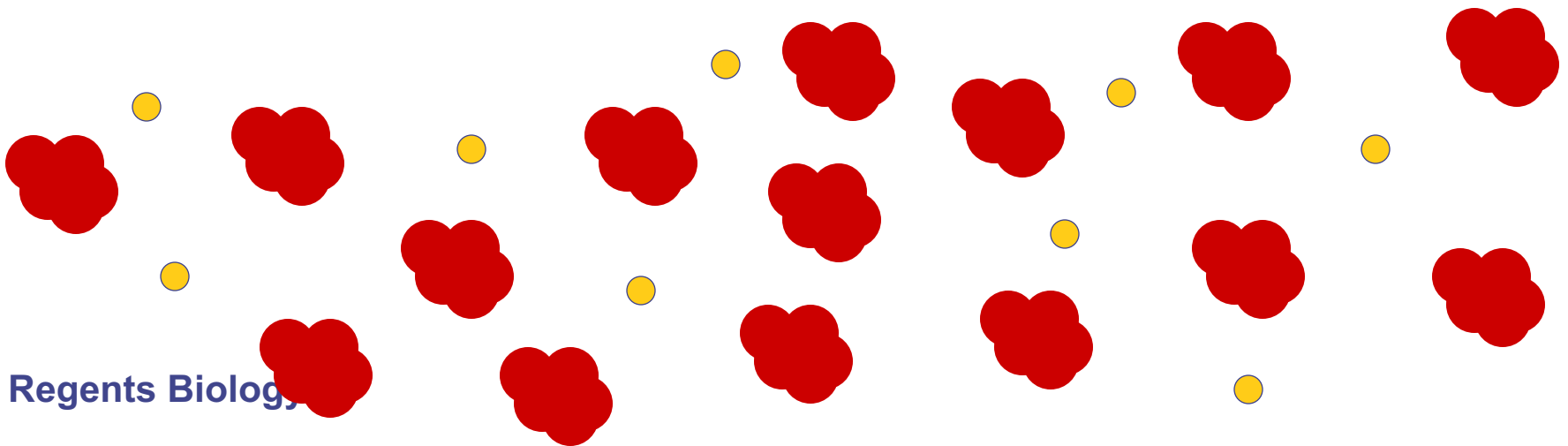


What affects how well an enzyme works?

- Correct protein structure
 - ◆ correct order of amino acids
 - ◆ why? enzyme has to be right shape
- Temperature
 - ◆ why? enzyme has to be right shape
- pH
 - ◆ why? enzyme has to be right shape

Enzyme concentration

- **Effect on rates of enzyme activity**
 - ◆ as **increase** amount of enzyme = **increases** how fast the reaction happens
 - more enzymes = more frequently they collide with substrate



Enzyme concentration

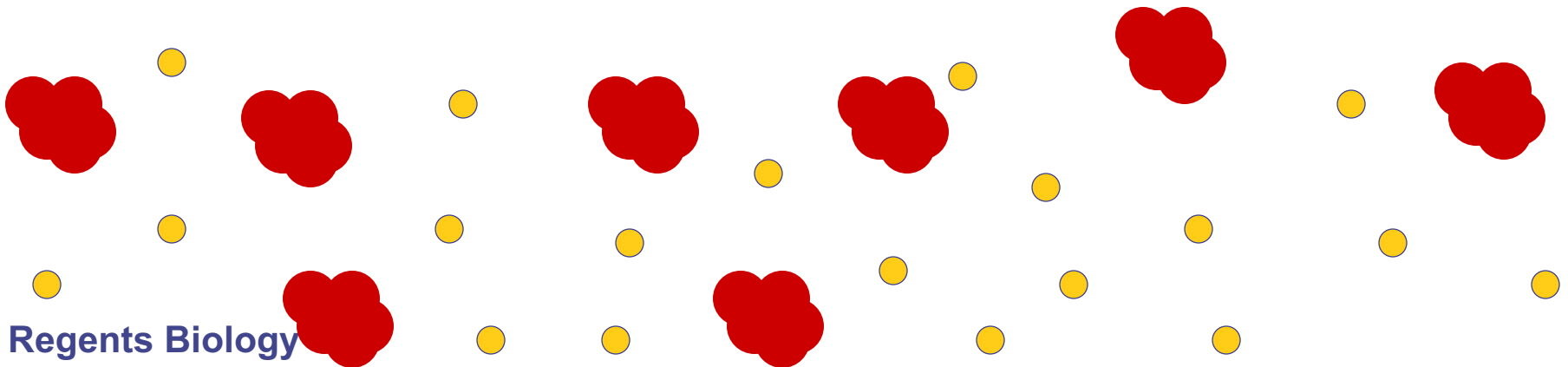
reaction rate 

amount of enzyme 

What's
happening
here?!

Substrate concentration

- Effect on rates of enzyme activity
 - ◆ as increase amount of substrate = increases how fast the reaction happens
 - more substrate = more frequently they collide with enzyme



Substrate concentration

reaction rate 

amount of substrate 

What's
happening
here?!

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**
 - **denature protein = unfold = lose shape**
 - ◆ **Lower temperature T°**
 - **molecules move slower**
 - **decrease collisions**

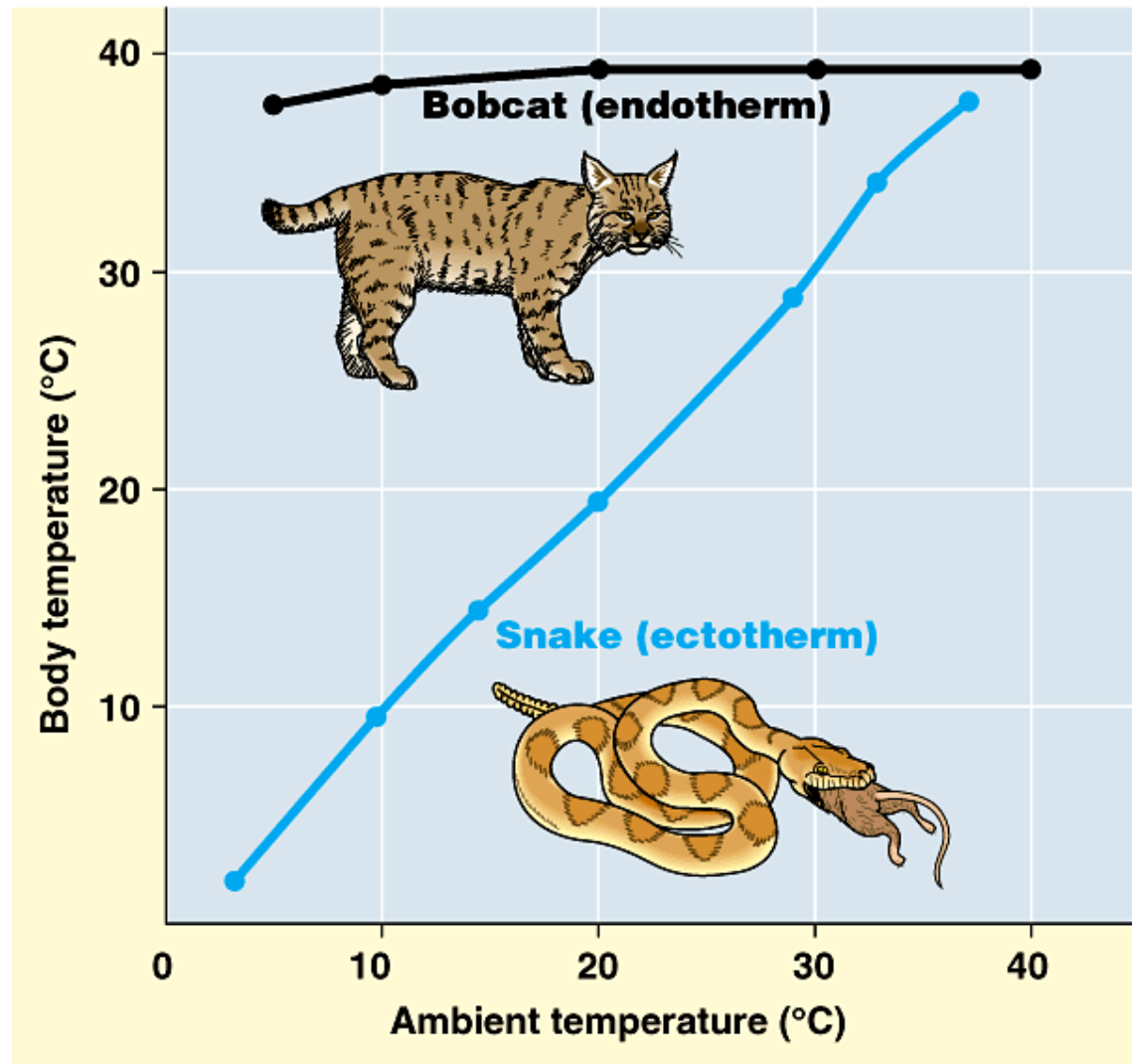
Temperature

reaction rate 

37°
temperature 

What's
happening
here?!

How do cold-blooded creatures do it?



pH

10 Effect on rates of enzyme activity

- ◆ pH changes protein shape
- ◆ most human enzymes = pH 6-8
 - depends on where in body
 - pepsin (stomach) = pH 3
 - trypsin (small intestines) = pH 8

pH

reaction rate ↑

stomach
pepsin

intestines
trypsin

What's
happening
here?!

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14

pH →

■ For enzymes...

What matters?

SHAPE!

