
Enzymes
It’s all about speeding things up~!

Lesson Objectives:

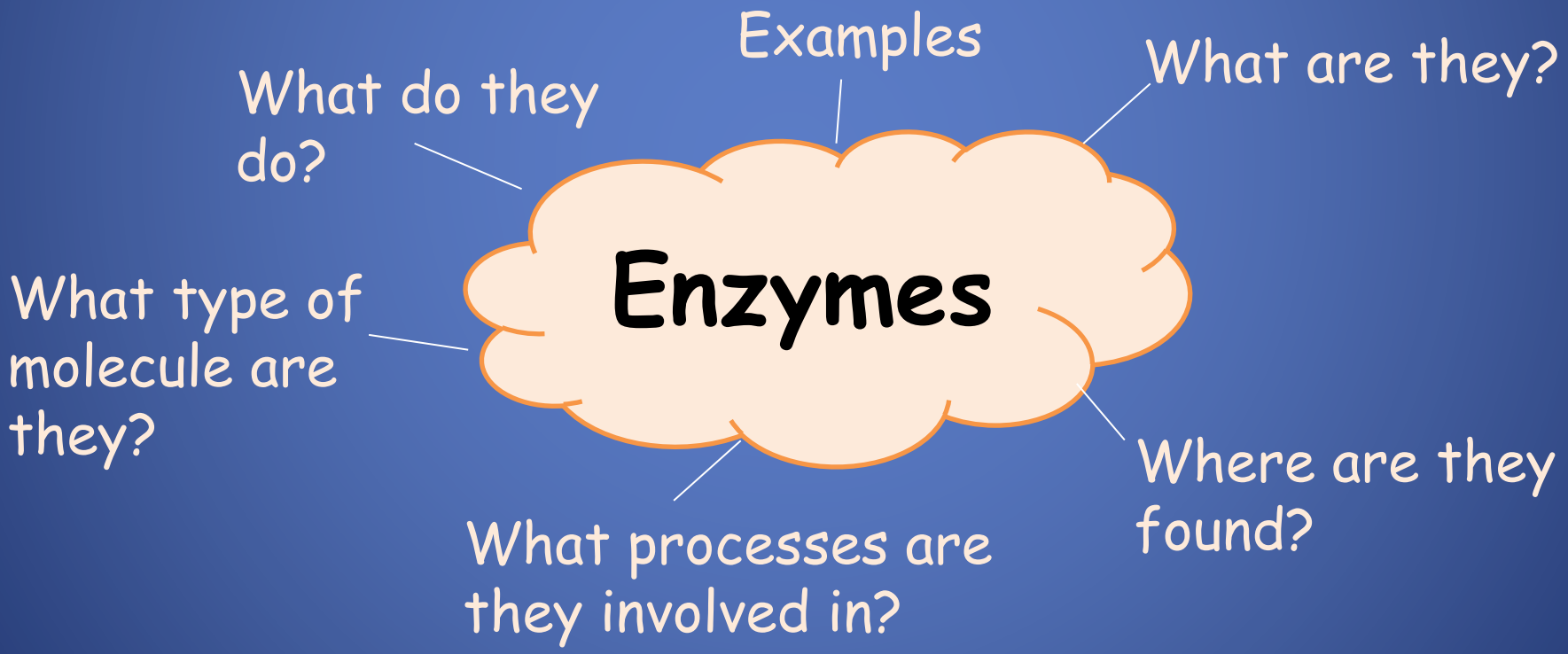
Define	Define the term catalyst and enzyme.
Describe	Describe the role of enzymes in catalysing reactions in living cells
State	State two factors that affect the rate of an enzyme-controlled reaction.
Describe	Describe the effect of two factors on the rate of an enzyme-controlled reactions.

Discuss:

i. Meaning of the word catalyst.
ii. Link between enzymes and catalysts
iii. Function of enzymes
iv. 55 000 different enzymes in the body….think up as many metabolic reactions as possible.

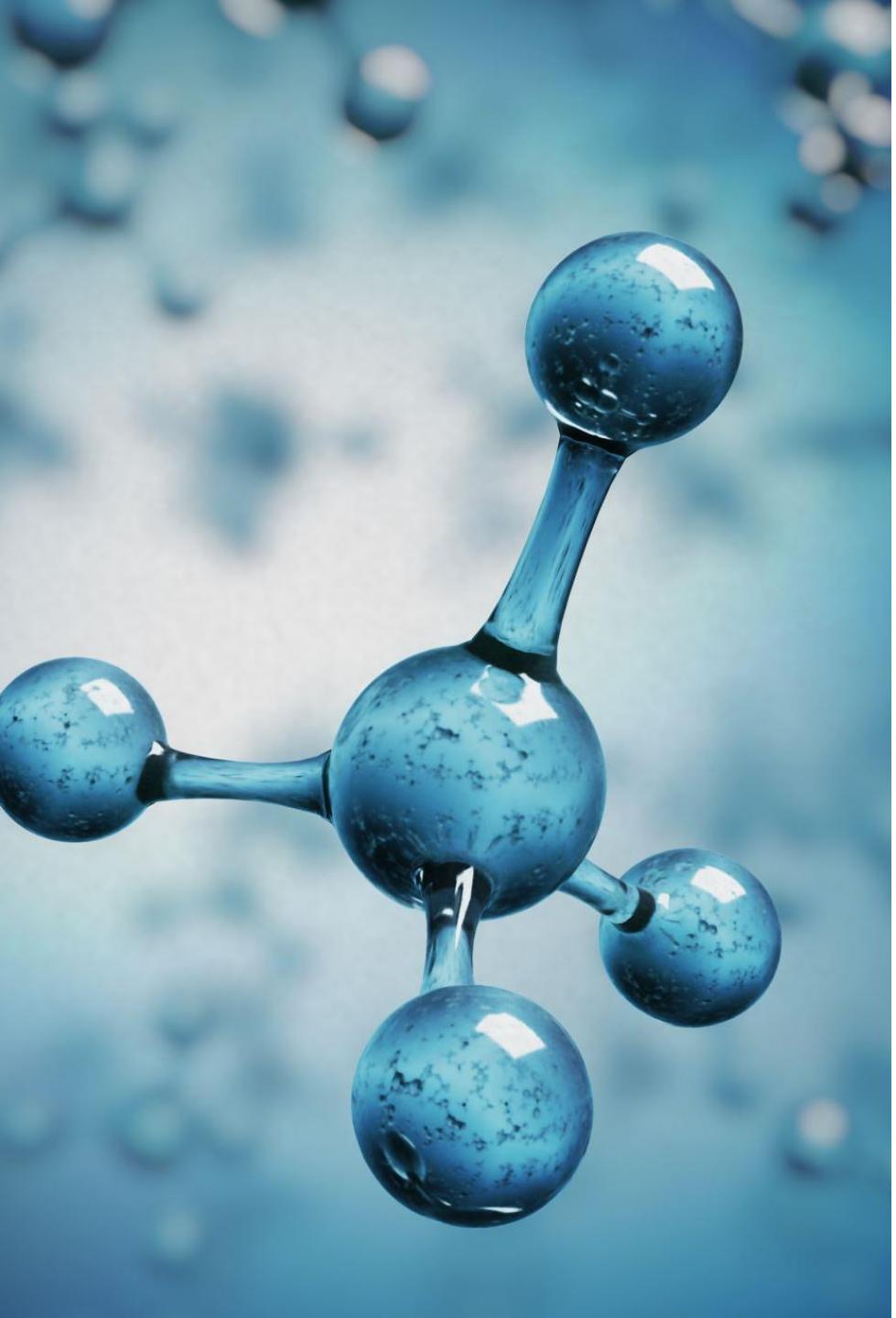
Enzymes

Add as many ideas as you can about enzymes:



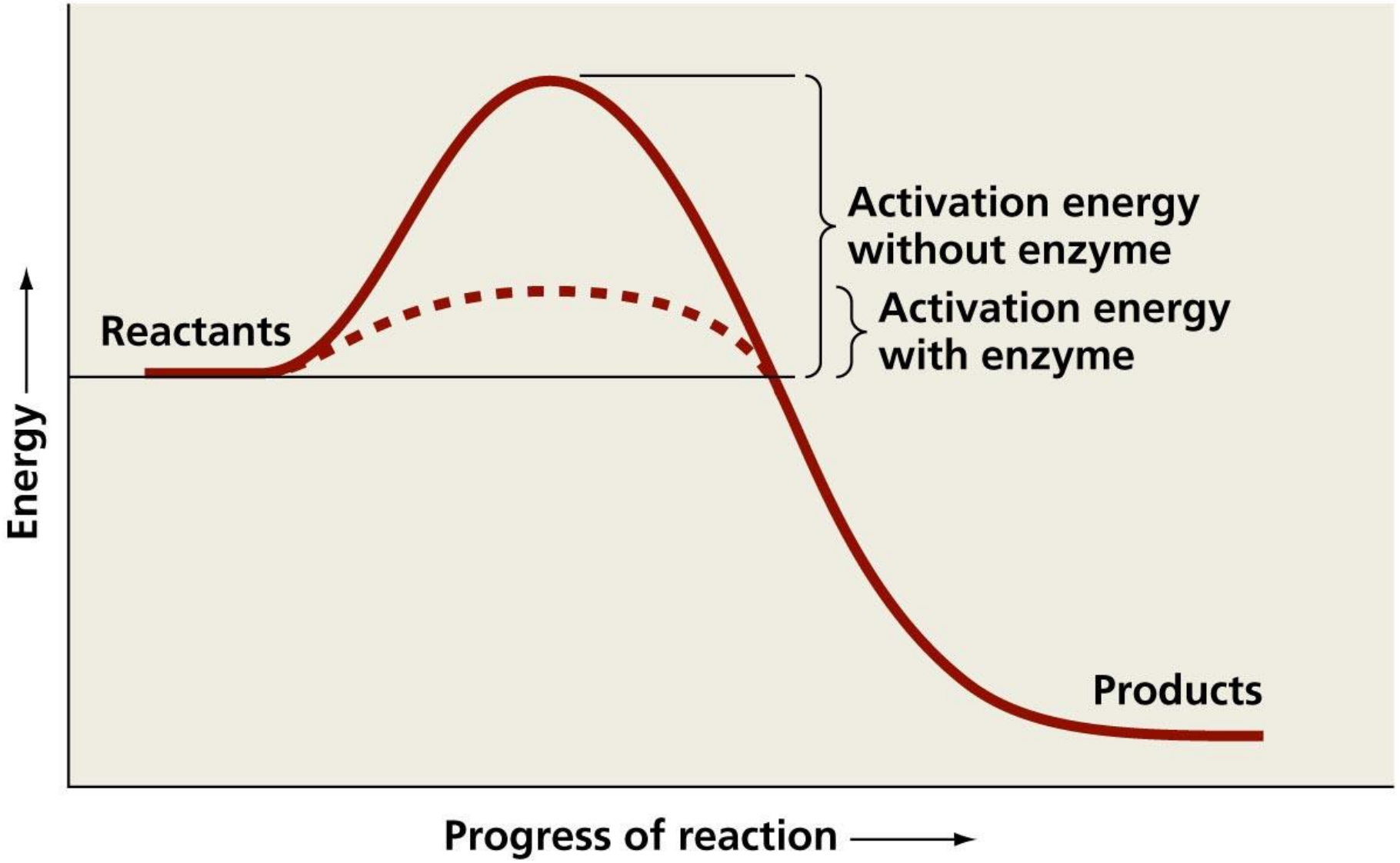
What are enzymes?

- Proteins that act as **catalyst**
  - Speeds up a reaction
  - Does not get used up



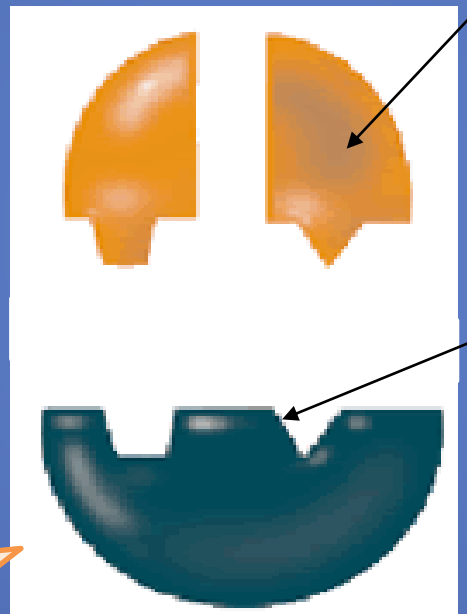
Definition:

- A **catalyst** is a chemical that speeds up the rate of a chemical reaction *without being used up*.
- Enzymes are biological catalysts.
- Enzymes speed up the rate of chemical reactions inside the body / metabolic reactions.



Enzyme structure

Products
Substrate broken down into smaller pieces



Active Site
Releases the products which no longer fit into the active site. Now free to bind with another substrate molecule

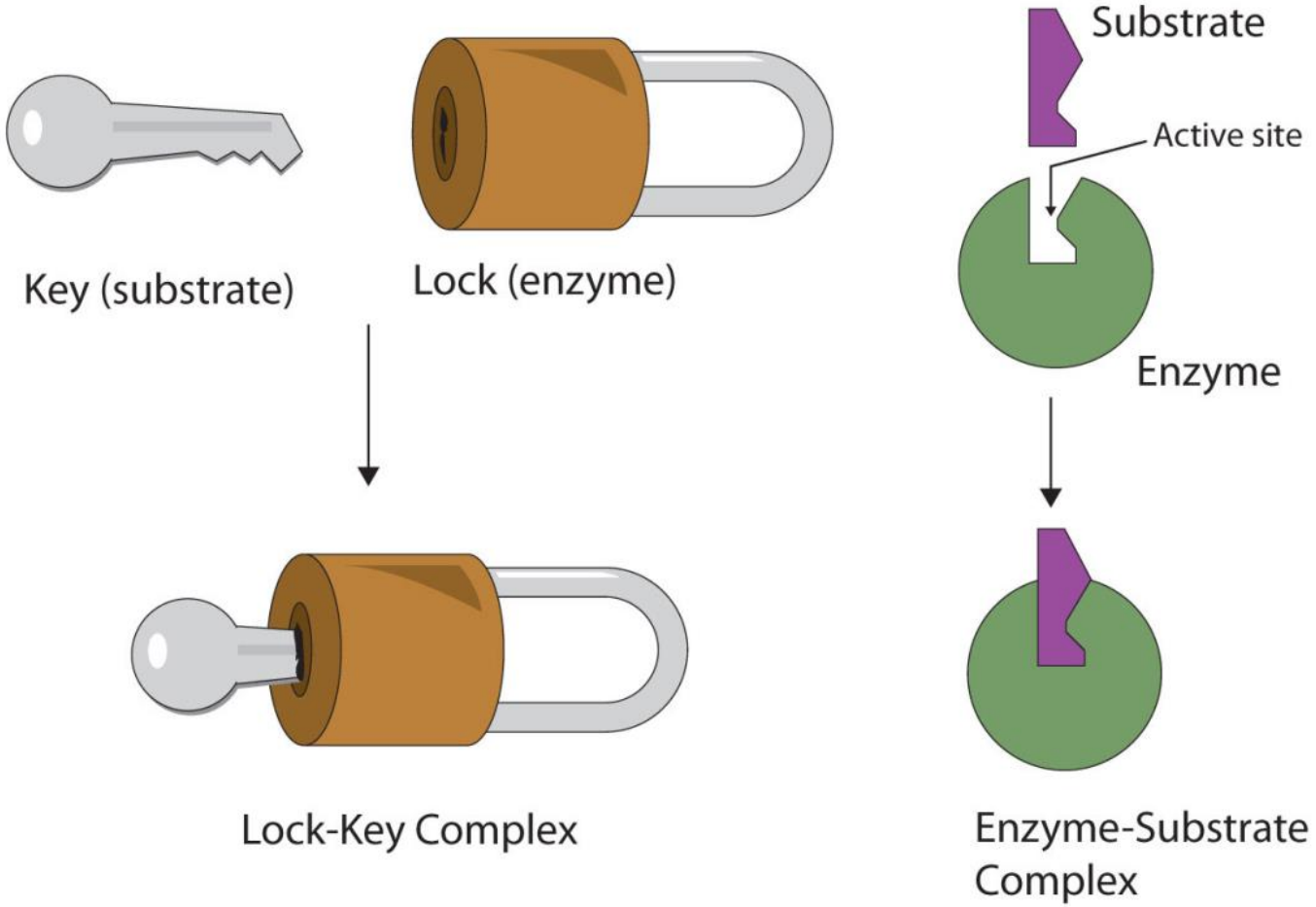
Enzyme-substrate complex
A substrate fits exactly into the active site of the enzyme

Extension:
What does this mechanism remind you of?

Do you know how lock works?

What are enzymes?

- Specific
  - ‘lock and key’ model
  - Active sites



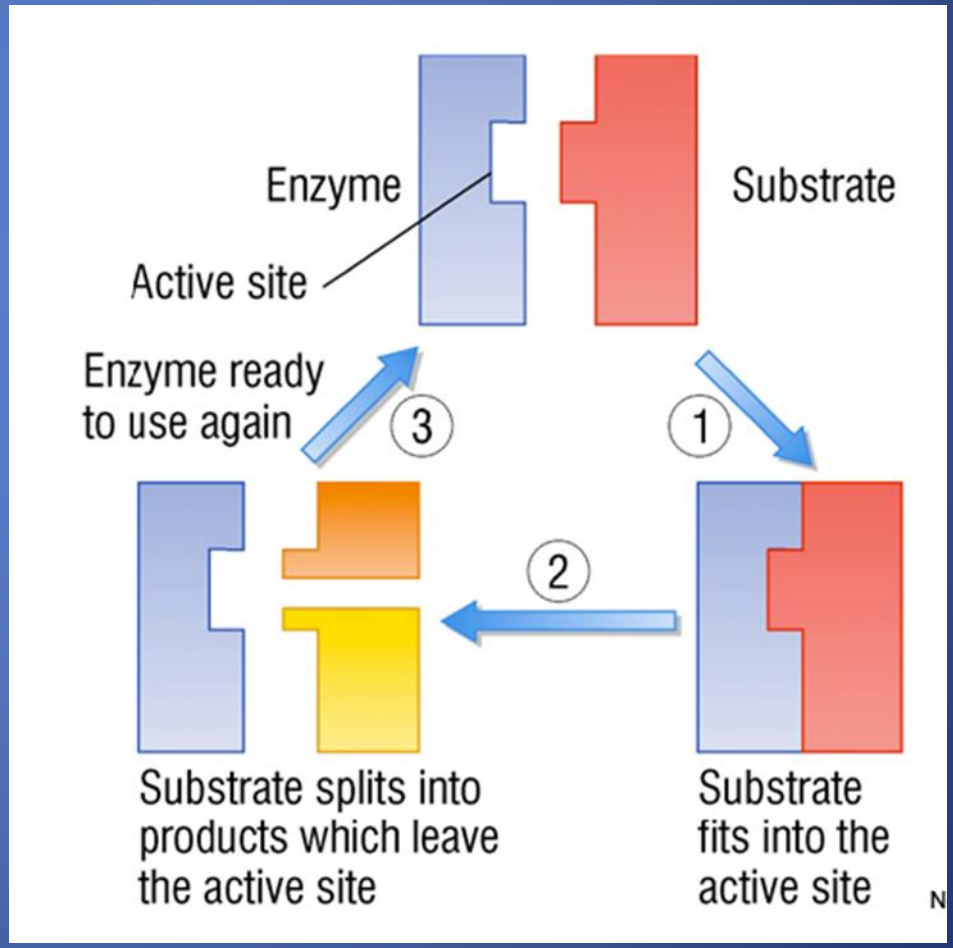
How enzymes work:

Task:

Watch the following videos. Create your own storyboard on how enzymes work.

Key words:

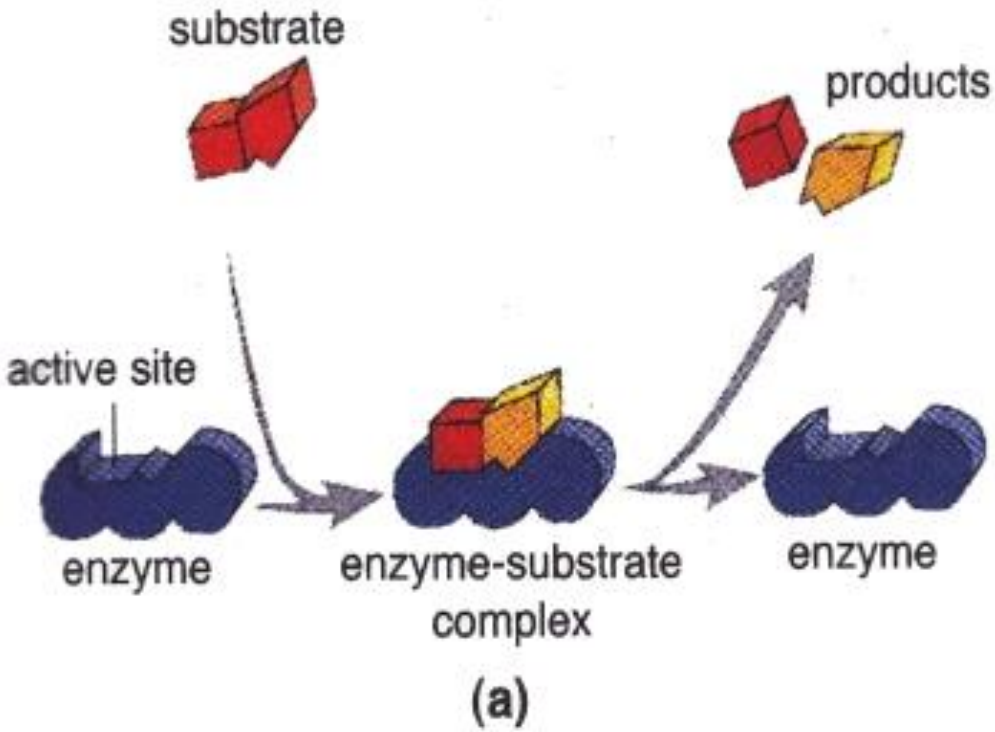
Enzyme, substrate, active site, lock and key, enzyme-substrate complex, product



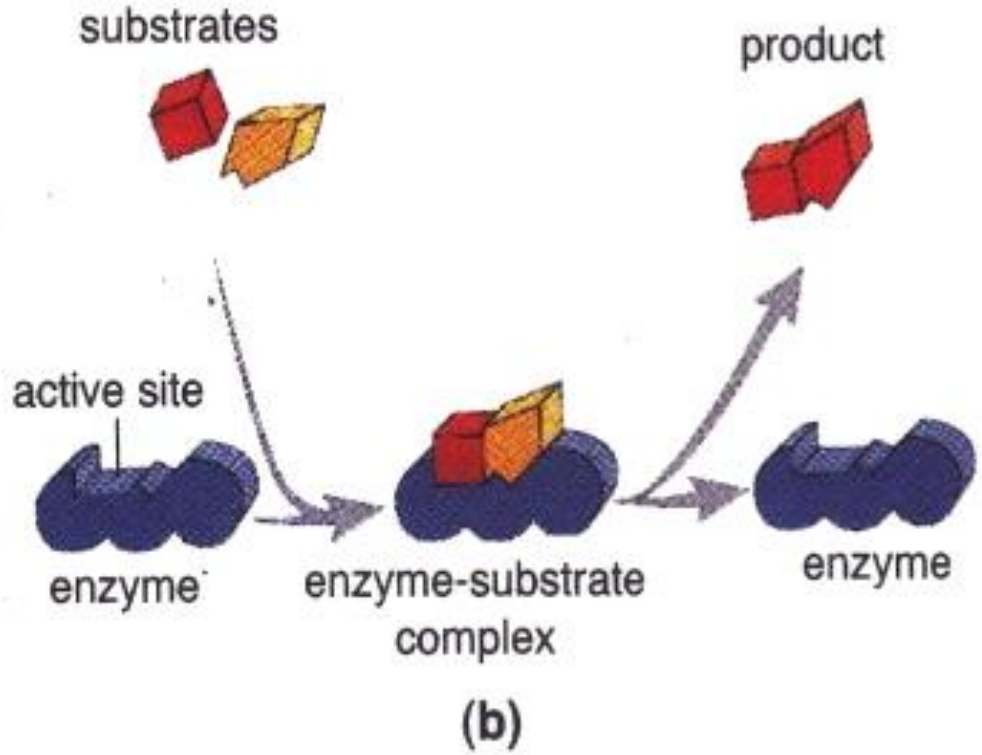
1

Enzymes – a fun introduction https://www.youtube.com/watch?v=XTUm-75-PL4

Two-way mechanism



Catabolic reaction



Anabolic reaction

Nomenclature

Named according to the substance on which they act on, or the reaction which they promote

Usually ends with **–ase**

Substrate/Purpose	Name of enzyme
Sucrose	Sucrase
Proteins	Protease
Removes hydrogen	Dehydrogenase
Hydrolysis of chemical bond	Hydrolase
Addition of water molecule	Hydrase

Catalase Plenary

Hydrogen peroxide is an unstable colourless liquid H_2O_2.
It 'decomposes' to form water and oxygen:

$$2H_2O_2 \rightarrow 2H_2O + O_2$$

This reaction can be sped up with a catalyst or an enzyme – e.g. catalase, which is found in living tissue

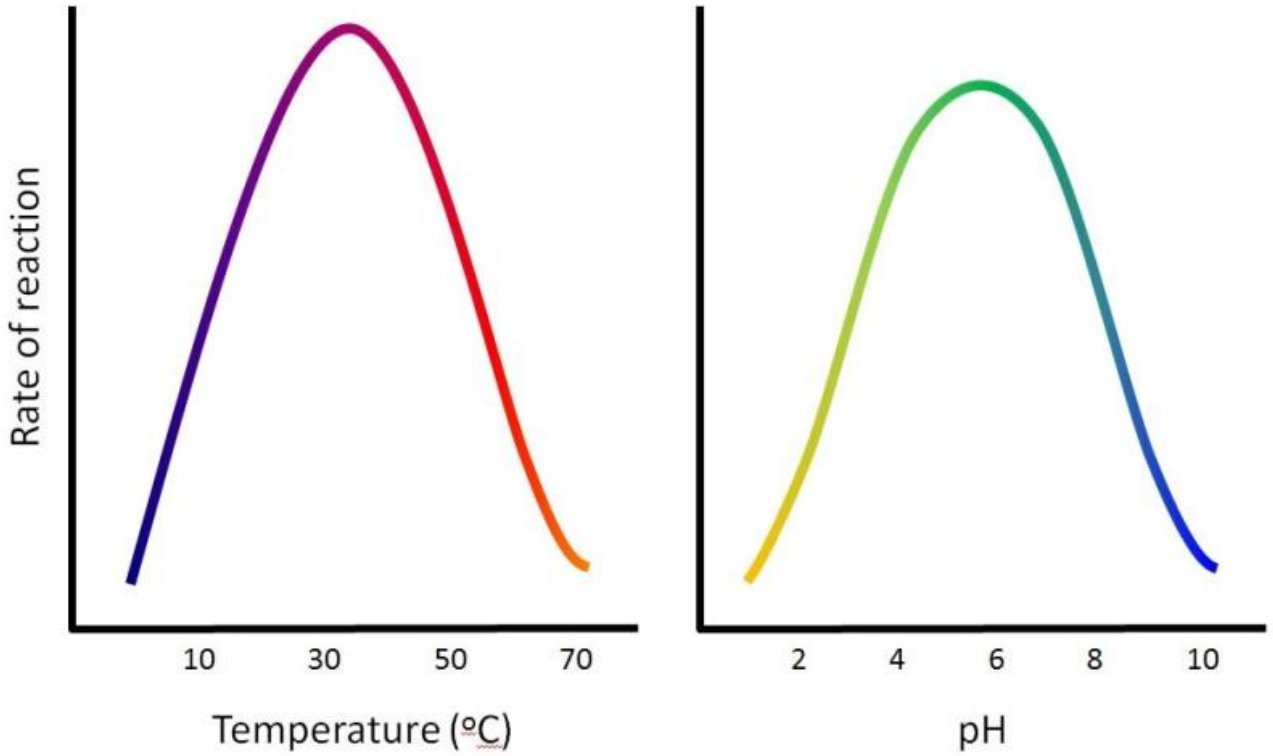
Catalase Plenary

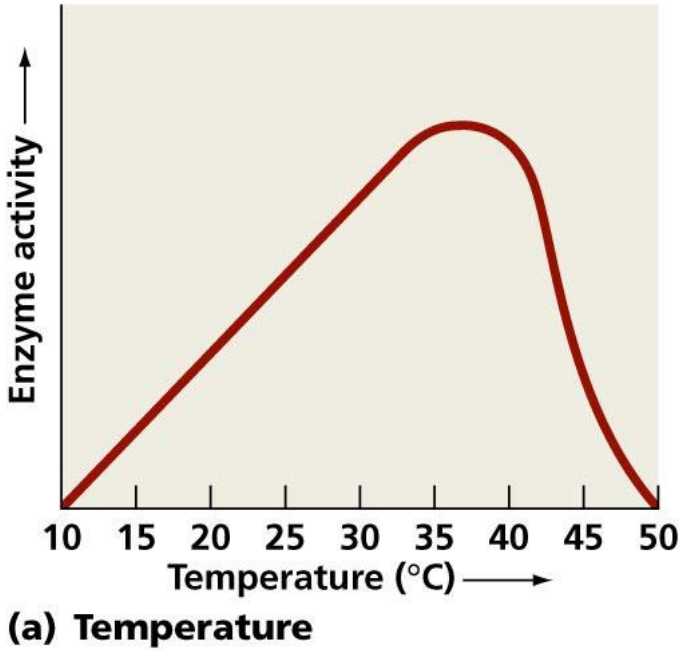
Living tissue	Maximum froth height (mm)
Liver	130
Muscle	10
Apple	1
Potato	8
Boiled liver	2
Tube with H_2O_2 only	0

- Which tissue do you think contained the most catalase?
- Can you explain the result for boiled liver?

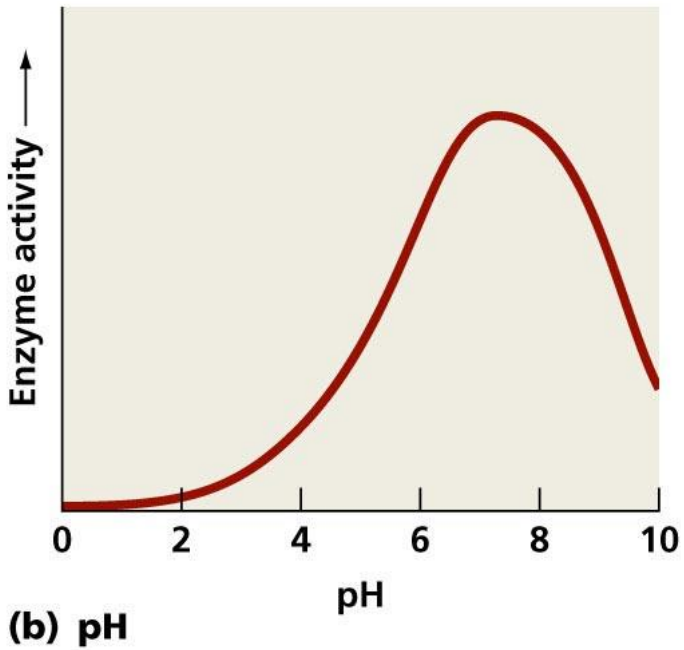
Factors affecting enzyme activity

- Temperature
- pH
- Concentration of substrate
- Concentration of enzyme
- Presence of competitive inhibitor

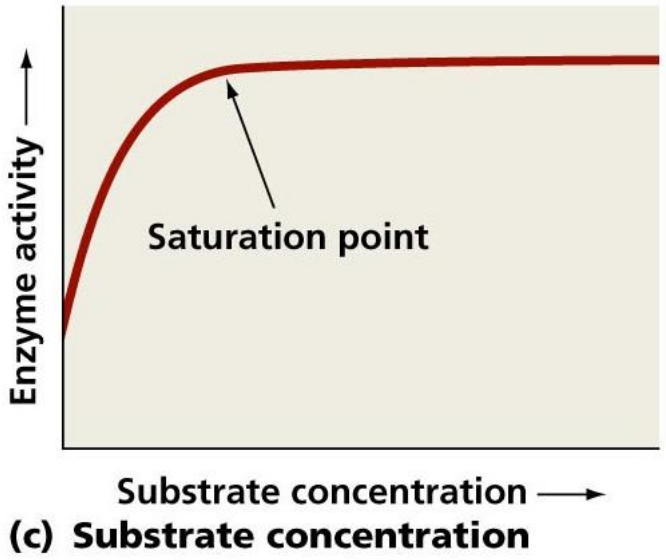




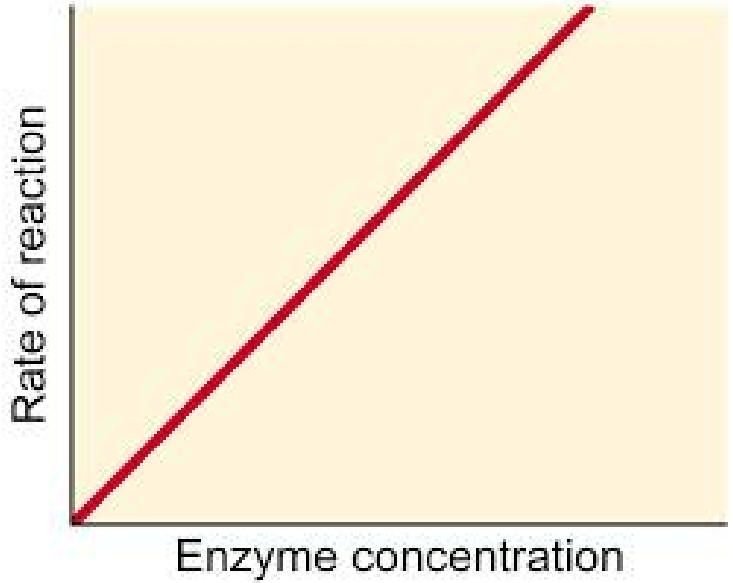
(a) Temperature



(b) pH



(c) Substrate concentration



The rate of an enzyme controlled reaction is affected by temperature

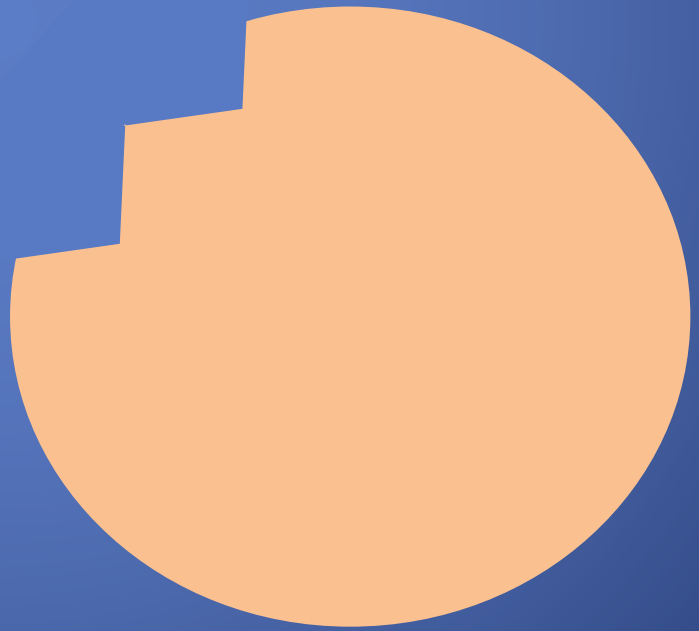
At low temperatures enzyme controlled reactions go slowly because the molecules have low kinetic energy.

The rate of an enzyme controlled reaction is affected by temperature

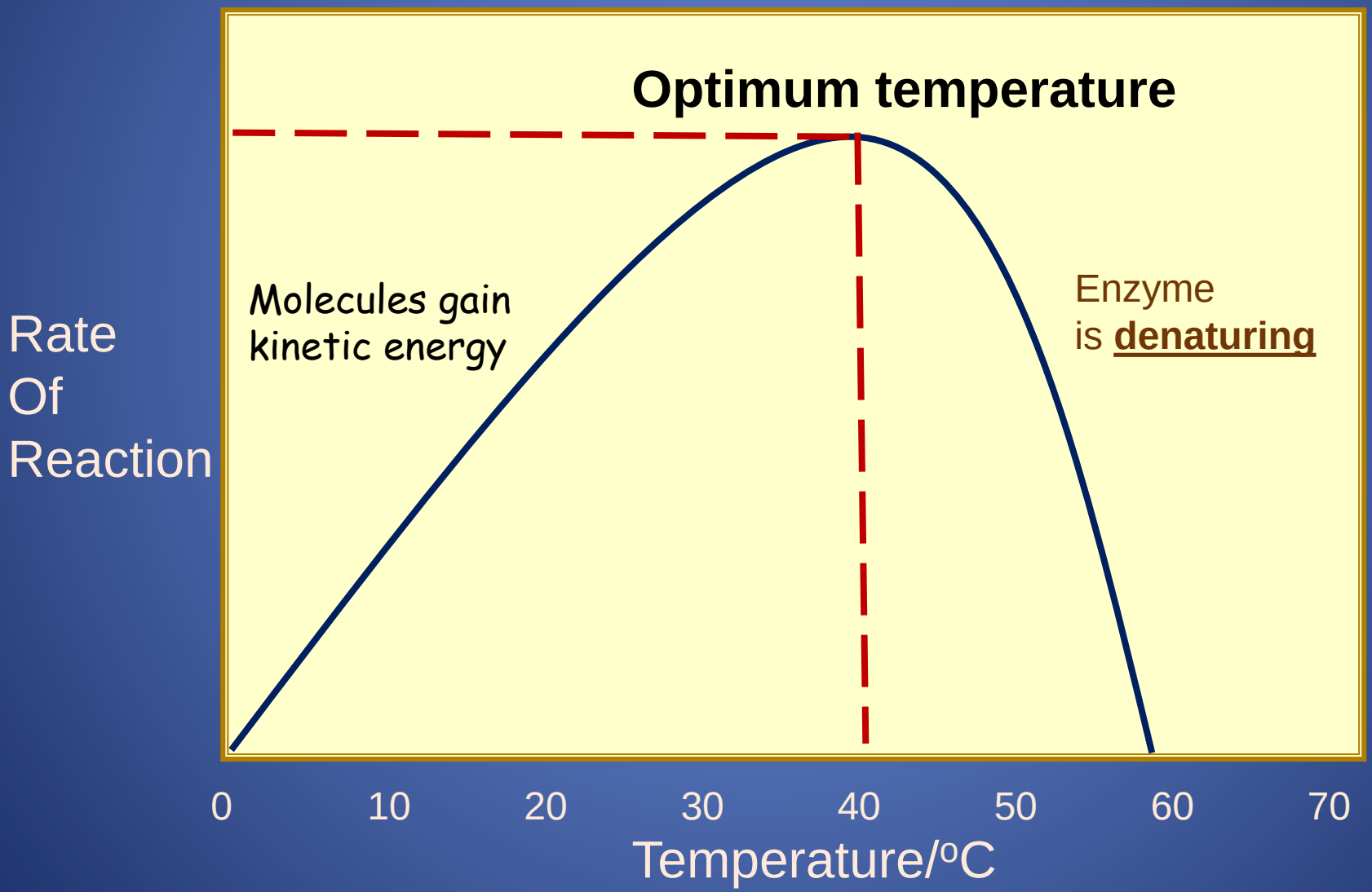
- When temperature increases the reaction also increases as the molecules have more kinetic energy

But this only occurs up to the **optimum temperature** (usually about 40°C)

The temperature at which the rate of reaction is fastest is known as the optimum temperature



Rate of reaction of an enzyme reaction changes at different temperatures



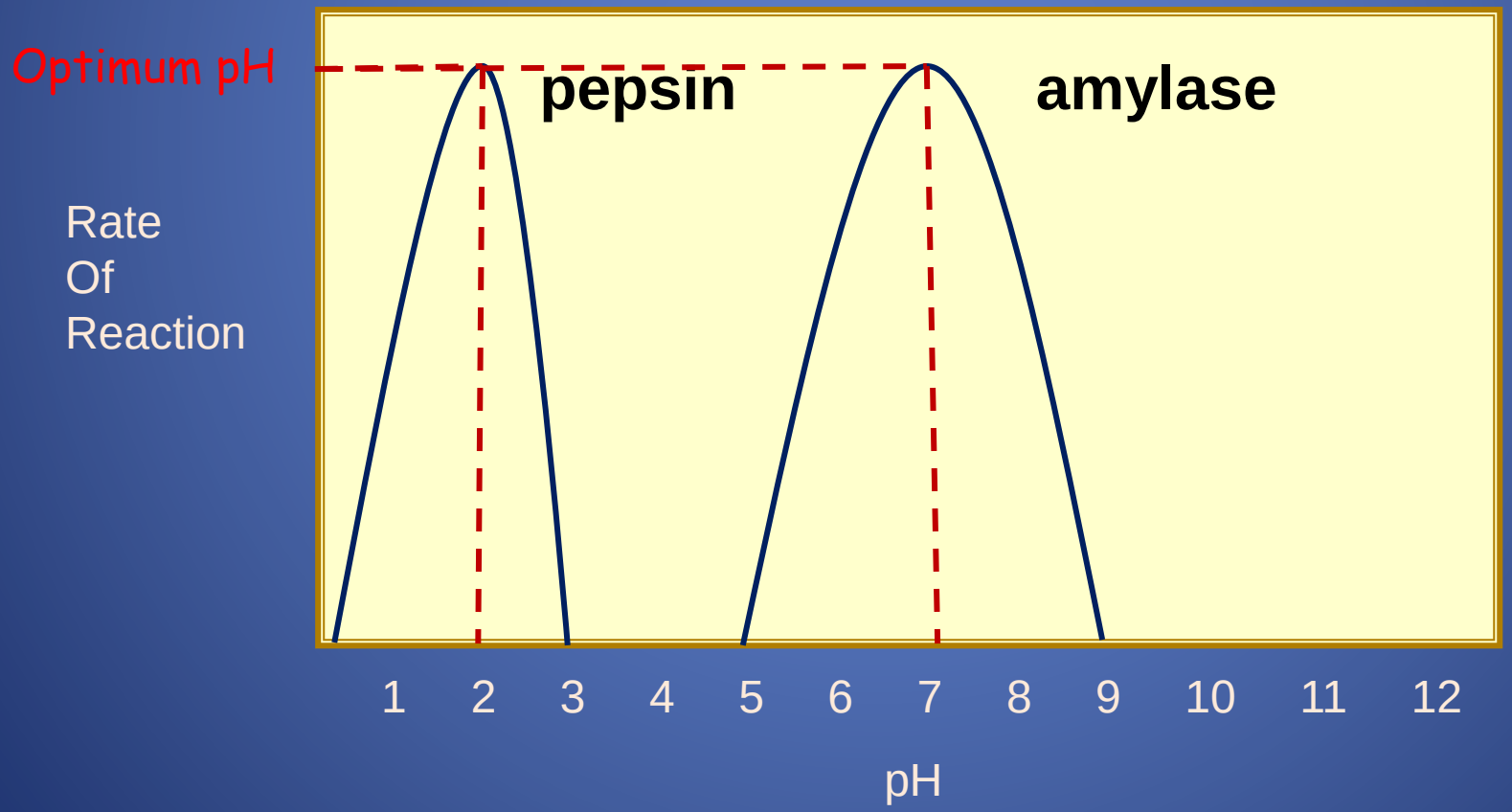
The rate of an enzyme controlled reaction is affected by temperature

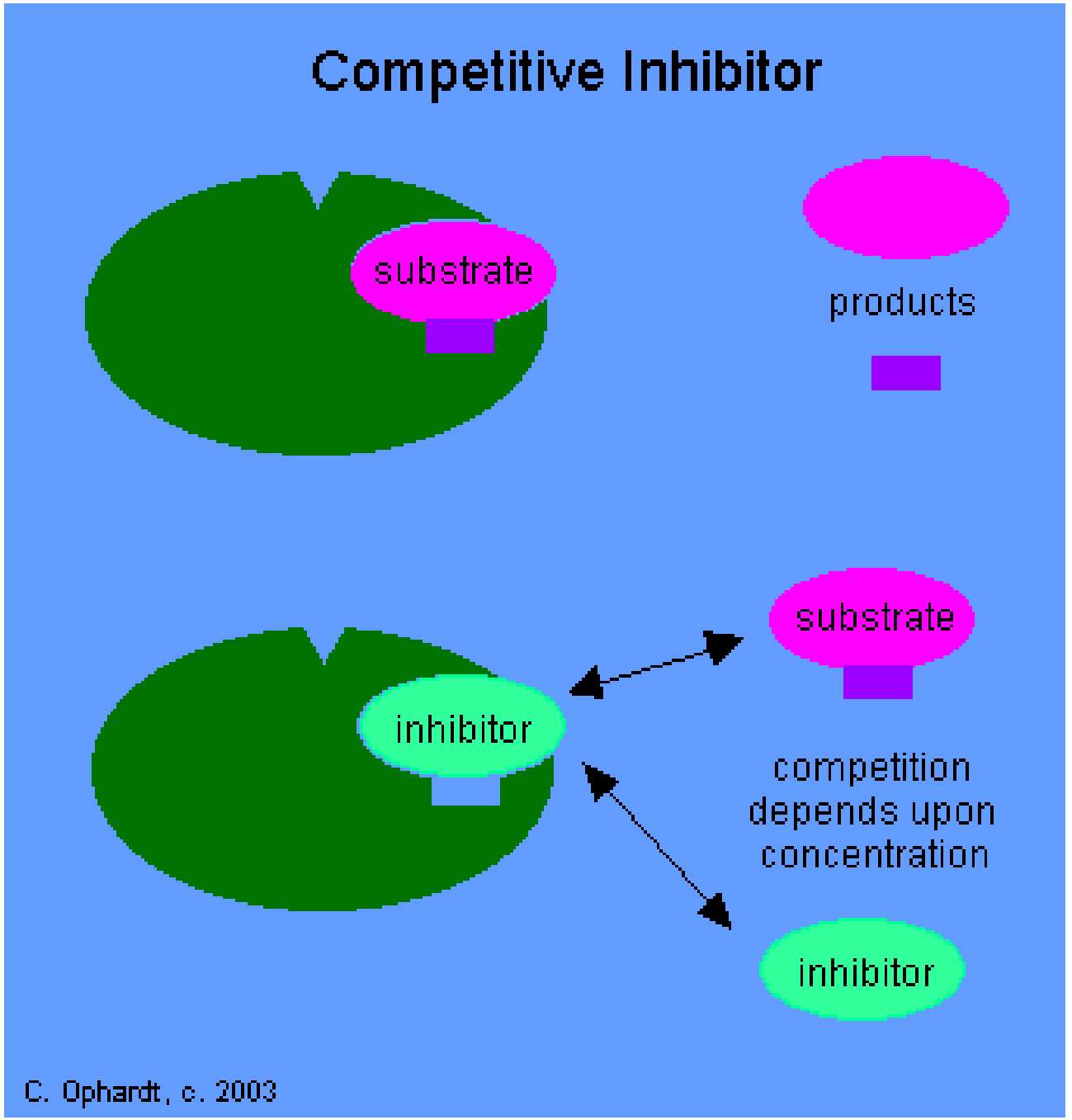
After the optimum temperature the heat causes the enzyme to **denature**.

The enzyme changes **shape** and the active site no longer matches the shape of the substrate molecule.

The activity and shape of enzymes is also affected by pH

- Enzymes prefer to work at an optimum pH. Outside of its pH range the enzyme is denatured.




Competitive Inhibitor
substrate
products
substrate
inhibitor
competition
depends upon
concentration
inhibitor
C. Ophardt, c. 2003