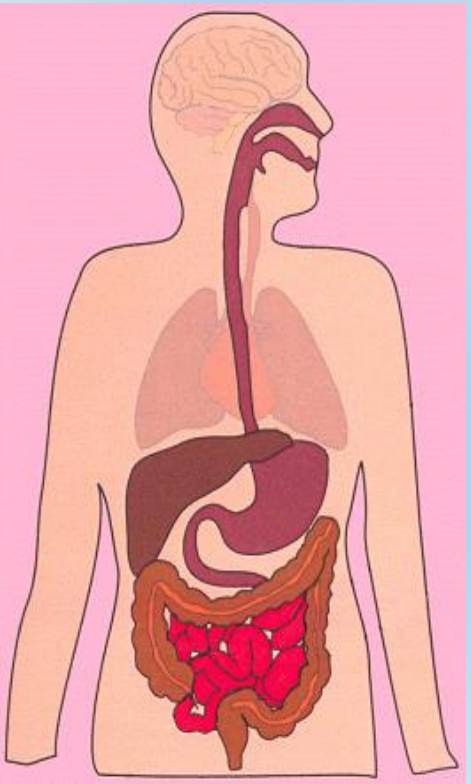
Biology Grade 9

CHAPTER 1: FROM FOOD TO NUTRIENTS: DIGESTION

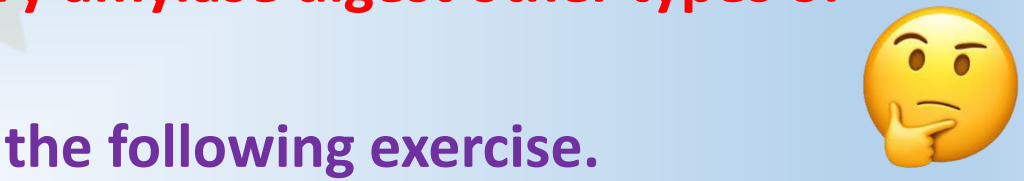


Activity 3: Enzymes, Agents of Digestion

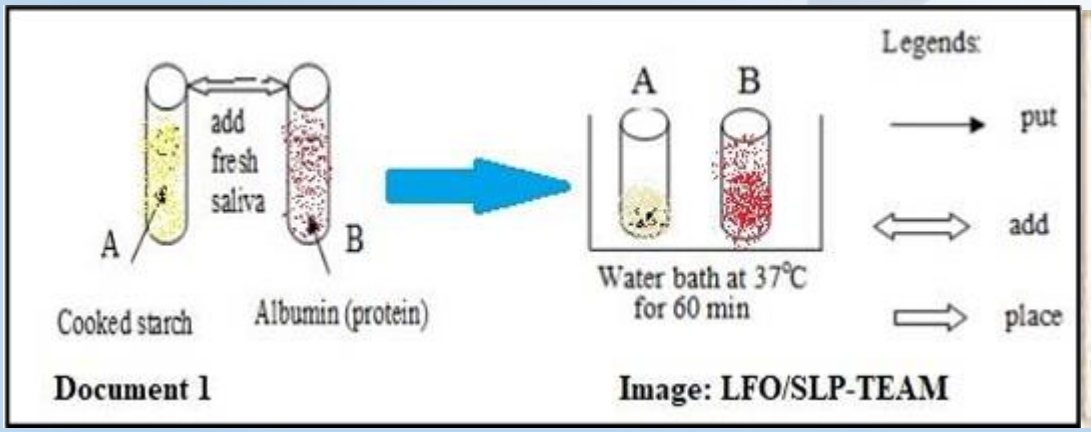
INSTRUCTOR: SUHAIB AUDI

Activity 3: Enzymes, Agents of Digestion

- we defined enzyme as a chemical substance produced by the body that facilitates the simplification of complex molecules.
- We also deduced that saliva, which contains the enzyme salivary amylase, transforms cooked starch into sugar.
- lets pose the following problem: **"Does salivary amylase digest other types of food?"**



To solve this problem, we will discuss together the following exercise.



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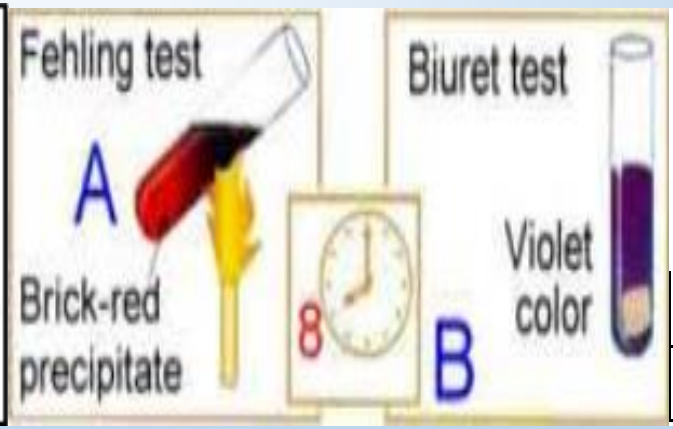


The results are shown below.

Tube	*Hot Fehling test*
A	*Brick red ppt*
Tube	*Biuret test*
B	*violet*

1- 1.1. Compare the contents of tubes (A) and (B).

Both test tubes (A) and (B) contain fresh saliva. However, tube (A) contains cooked starch while test tube (B) contains albumin.

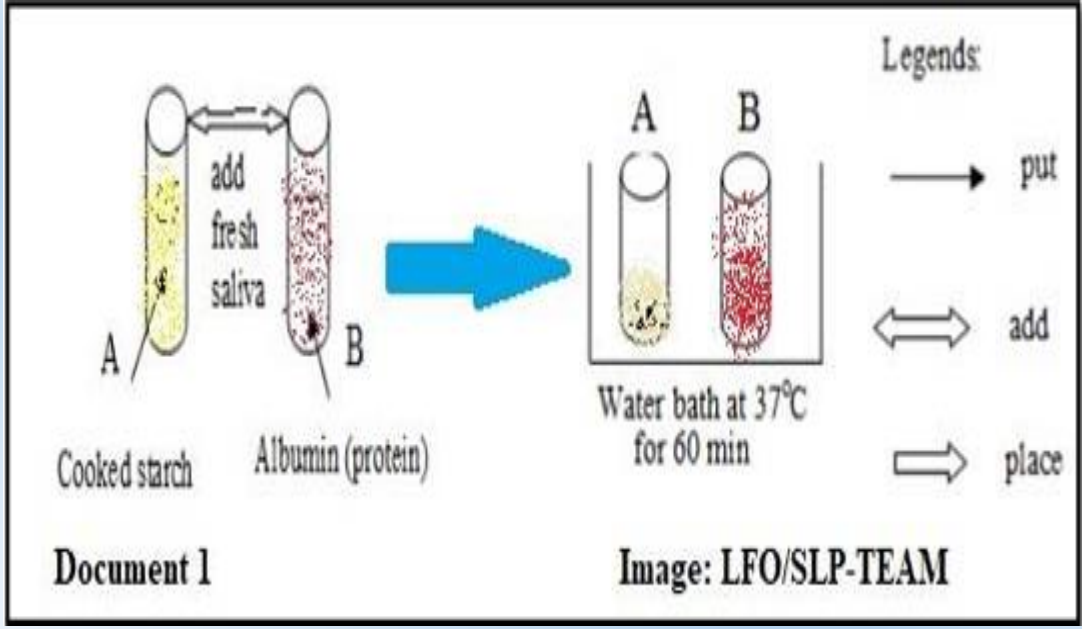
1.2. Indicate the variable factor and the constant experimental conditions.

Albumin and starch (substrates) are the **variable factors** in this experiment.

Fresh saliva, temperature 37 °C, and time for 1 hour are the **constant conditions**.

2. Describe document 1.

Put cooked starch in test tube A and **put** albumin in test tube B, **add** fresh saliva in both test tubes A and B, then **place** the two test tubes A and B in water bath at 37°C for 60min.



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3. Draw a table showing the conditions of the experiment.

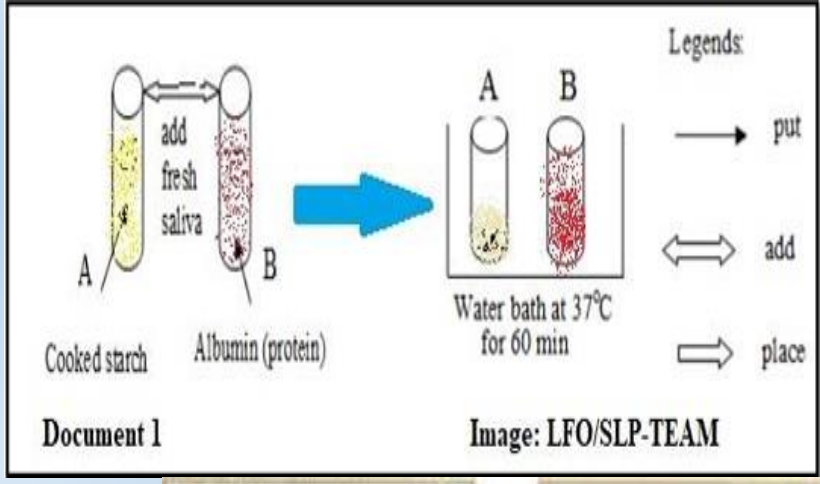
Conditions	Tube A	Tube B
Cooked starch	+	-
Albumin	-	+
Fresh saliva	+	+
Time	60 min	60 min
Temperature	37°C	37°C

Title: Table showing the conditions of the experiment.

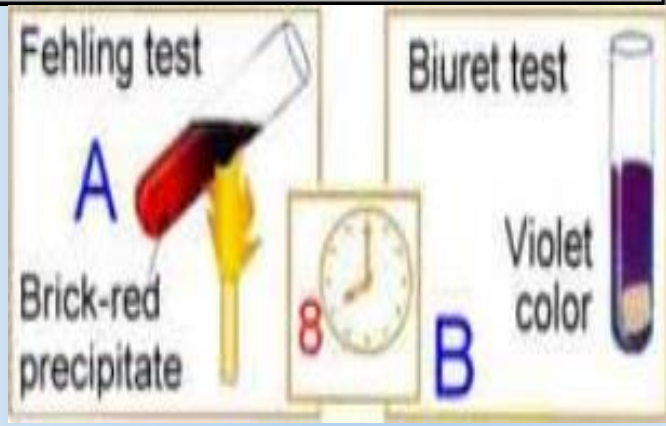
keys: +: presence -: absence

4. Interpret the results of the experiment.

Under same conditions, tube A which contains starch and fresh saliva gave brick red precipitate with fehling solution, while tube B which contains albumin and fresh saliva gave a violet color with biuret test. **This indicates that fresh saliva transforms cooked starch into reducing sugar and did not act on protein.**

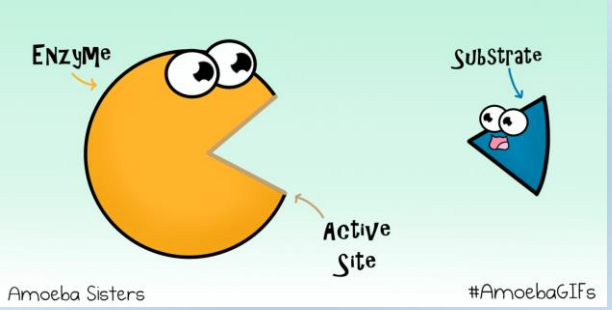


5. The results obtained reveal a property of an enzyme: the **specificity**. Explain.



- **Initially test tube (A) contained starch. When saliva was added, starch is digested into reducing sugar that gave brick red precipitate with fehling test.**
- **Initially test tube (B) contained albumin (protein). When saliva was added, no chemical digestion occurred. Albumin remained unchanged and it is identified by the biuret test that gave violet color.**

➢ **This reveals that amylase is a digestive enzyme for starch but not for proteins. Therefore, enzymes act on specific substrates.**



Conclusion:

First property of enzyme: enzymes are specific. Each enzyme acts at only one type of food.

Examples:

1. Salivary amylase acts only on cooked starch.
2. Trypsin and pepsin act only on protein.
3. Lipase acts only on lipid.

❖ Activity of an enzyme and temperature.

➢ Do enzymes act at any temperature?

1. Pick out the optimal temperature of the enzyme.

37°C is the optimal temperature of the enzyme.

2. Give a title to the graph.

A graph showing the variation of activity of enzyme (%) as the function of temperature(°C).

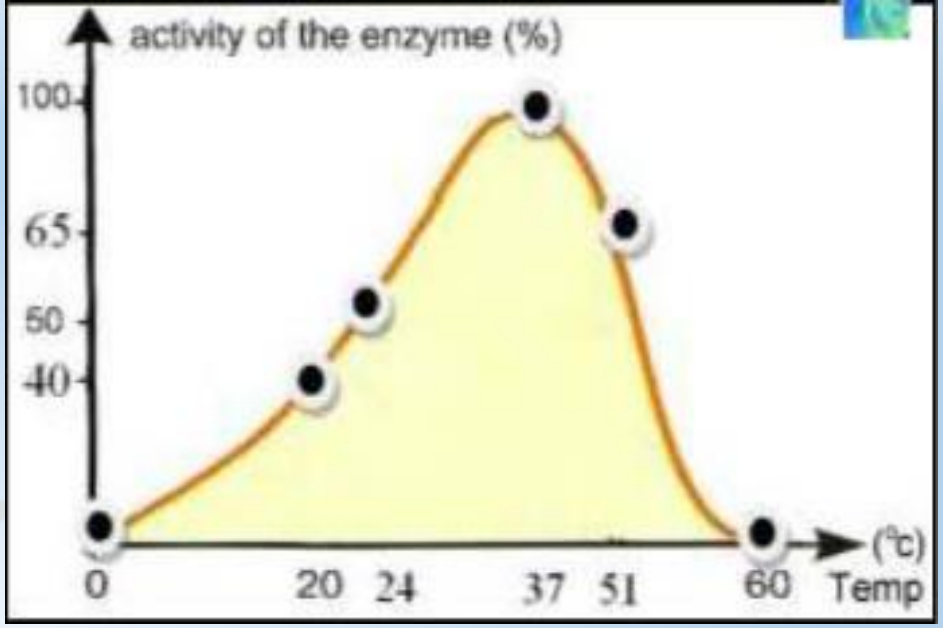
3. Analyze the graph and give a conclusion.

As temperature increases from 0°C to 37°C, the activity of enzyme increases from 0% to its maximum 100%. Then as temperature increases from 37°C to 60°C, the activity of enzyme decreases from 100% to its minimum 0%.

Thus, enzymes act at a favorable/specific temperature of 37°C.

5- Indicate the effect of cold and heat on enzymes.

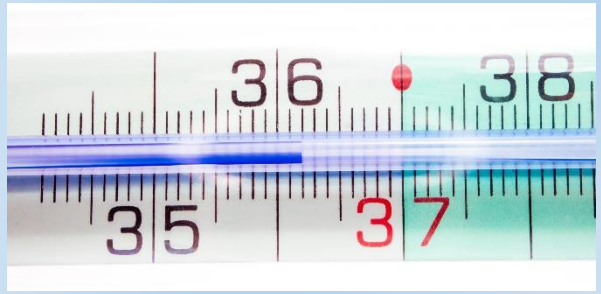
Cold renders enzymes inactive while heat destroys them.



4. Convert the graph into a table.

Temp (°C)	0	20	24	37	51	60
Activity of the enzyme (%)	0	40	50	100	65	0

Title: A table showing the variation of activity of enzyme (%) as the function of temperature(°C).



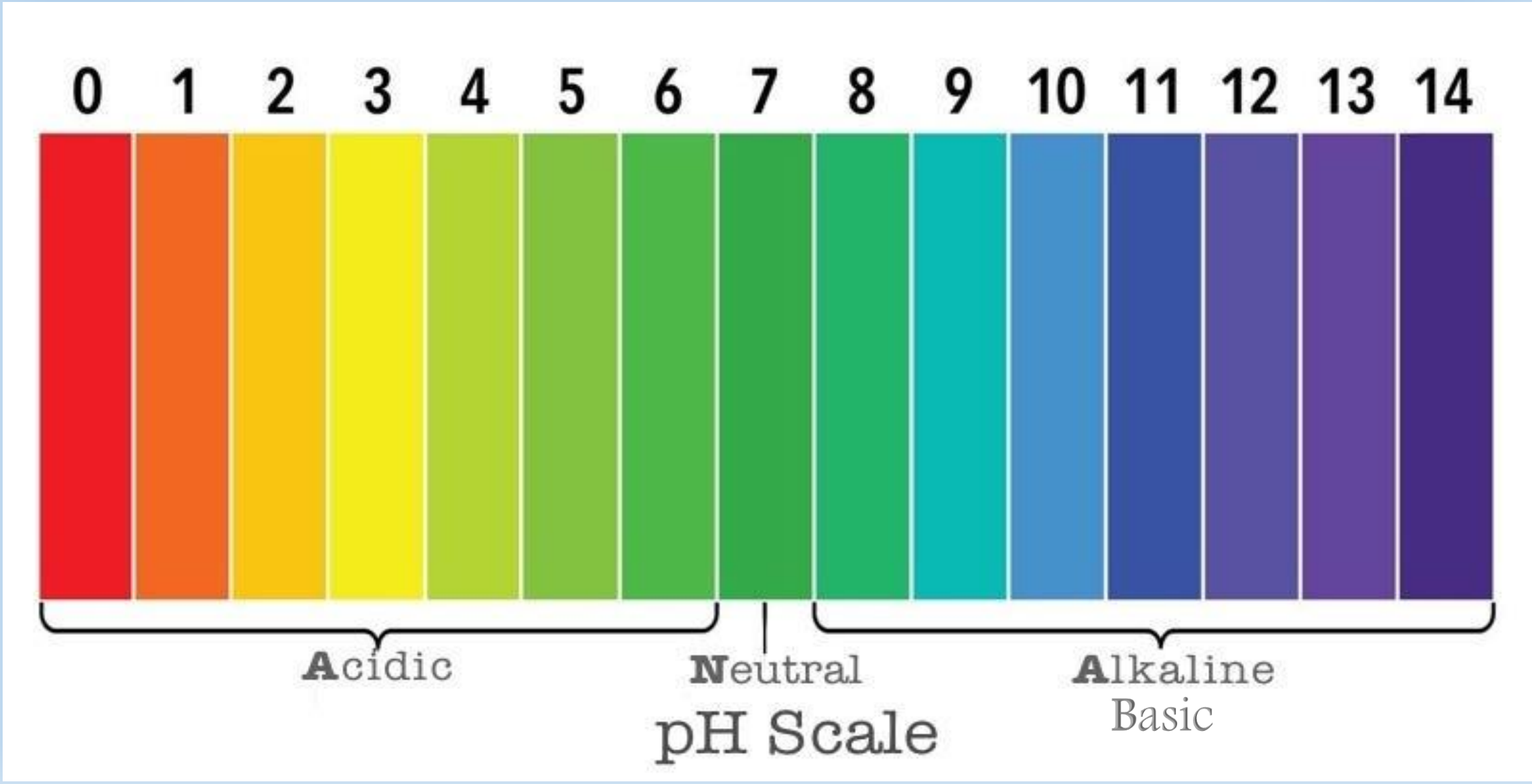
Conclusion:

Second property of enzyme: Enzymes act at normal body temperature. (35°C to 40°C)

- ✓ **As temperature increases, the activity of enzyme decreases to become destroyed at 60°C.**
- ✓ **As temperature decreases the activity of enzyme decreases to become inactive at 0°C.**

❖ Activity of an enzyme and pH of the medium

➢ Do enzymes act at any chemical (pH) medium?

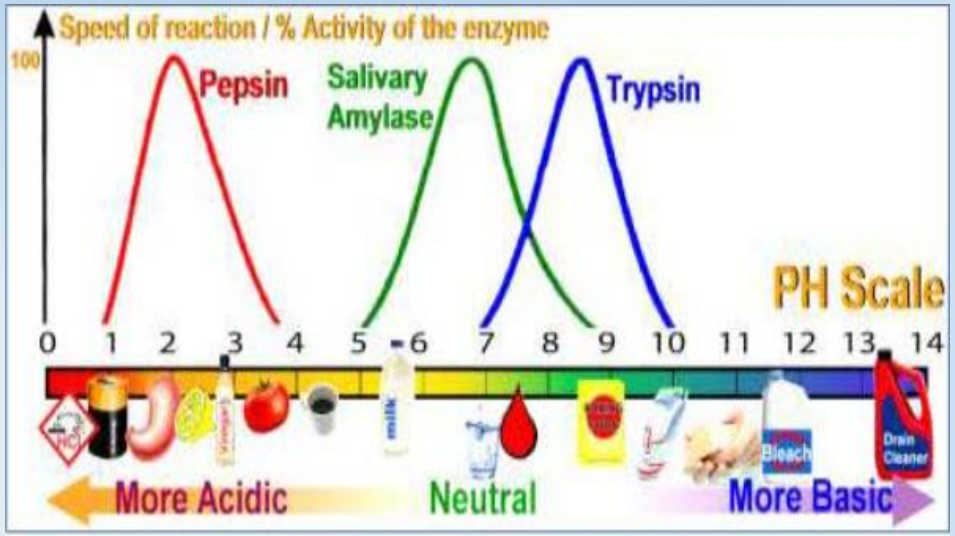


Do enzymes act at any chemical (pH) medium?

a) Give a title to the graph.

A graph is showing the variation of speed of reaction of enzyme as function of pH.

b) Analyze the graph. Derive a conclusion.



As the pH increases from 1 to 2, the speed of reaction of enzyme **pepsin** increases from 0% to 100%, then as pH increases from 2 to 4, the speed of reaction of enzyme pepsin decreases from 100% to 0%.

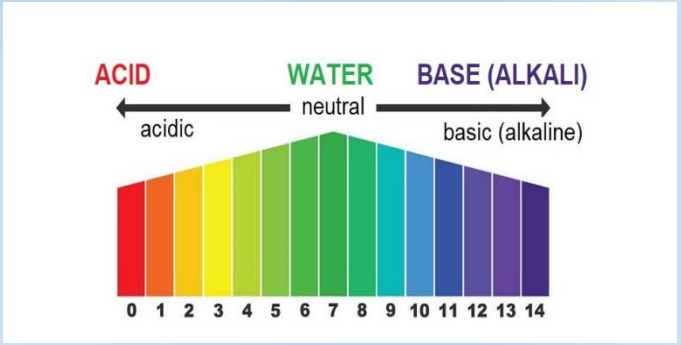
However, as the pH increases from 5 to 7 the speed of reaction of enzyme **salivary amylase** increases from 0% to 100% then as the pH increases from 7 to 9, the speed of reaction of enzyme salivary amylase decreases from 100% to 0%.

Moreover, as the pH increases from 7 to 8.5, the speed of reaction of the enzyme **trypsin** increases from 0% to 100%, then as the pH increases from 8.5 to 10 the speed of reaction of enzyme trypsin decreases from 100% to 0%.

Thus, each enzyme acts at a specific pH (chemical medium).

- Complete the following table.

Enzyme	Pepsin	Salivary amylase	Trypsin
Optimal pH value	2	7	8.5
Chemical medium	Acidic	Neutral	Basic



Conclusion:

Third property of enzyme:

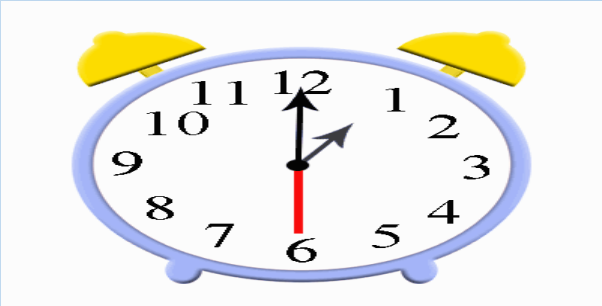
Enzymes act at suitable pH medium .

Ex. -Salivary amylase in the mouth acts in a neutral medium (pH=7)

-pepsin in the stomach acts in an acidic medium (pH=2)

-Trypsin and lipase in the small intestine act in a basic medium (pH=8)

Fourth property of enzyme:



Fourth property of enzyme:

Enzymes need enough time.

Ex.- salivary amylase needs 15 minutes to digest cooked starch.

- pepsin and trypsin need one hour to digest protein.

-lipase needs 3 hours to digest lipid.

Summary

Properties of enzymes:

A. **Enzymes are specific** in their action (according to the key-lock theory); that is, **each enzyme acts on one substrate.**

B. Each enzyme functions at a favorable temperature.

Enzymes act at normal body temperature **(37°C)**

As temperature increases, the activity of enzyme **decreases** to become **destroyed** at 60°C. **(can't be activated again).**

As temperature decreases the activity of enzyme **decreases** to become **inactive** at 0°C. **(but they can be activated again at 37 °C).**

C. Each enzyme functions in a favorable chemical medium (PH).

Note: NaOH and KOH turn the medium basic.

H_2SO_4 and HCl turn the medium acidic.

D. Each Enzyme needs enough time.