

**Subject:** Biology

**Topic:** Enzyme

**Level:** S.4

**Background information:**

In S.3, students have learnt about

- i. the chemical nature and the function of the seven food substances in Chapter 11 Food and Human
- ii. the digestive system, the saliva in the mouth and the digestion of starch to sugar

**Learning objectives:**

The extract is from the middle of the first lesson. Before this, students learn how to write a definition for metabolism and metabolic rate.

2. Language:

Students will

- ◆ Use language features to describe
- ◆ correctly use associated subject related terminology both in writing and oral language
- ◆ follow an advanced organiser to write a short text to show a sequence

Now, students are guided to give a definition for enzyme orally. They are also trained to use the correct sentence pattern in describing the action of enzyme. i.e. **amylase speed up the digestion of starch**. It is important because a sentence like “Amylase digests starch” implies a wrong concept that enzyme takes part in the reaction, which they will learn in the next lesson.

Also a scenario (cooking rice) is used to help students to realize the meaning of “speeding up a chemical reaction.” The story is used as a set to arise their interest.

Content obligatory vocabulary like: **enzyme, speed up chemical reaction, biological catalyst, amylase, protease and lipase** are introduced. Students are asked to pronounce the words or use the words in answering questions.

An advanced organizer is written on board which serves the purpose of:

- i. Giving introduction
- ii. Guiding the learning progress
- iii. Giving helps to students in answering questions
- iv. Giving conclusion

**S.4 Biology**  
**Effect of temperature on enzyme action**  
**Worksheet 2**

Name : \_\_\_\_\_ No.: \_\_\_\_\_ Class: \_\_\_\_\_ Date: \_\_\_\_\_

**Activity 1**

Read page 44 of your textbook (Certificate Biology, New Mastering Basic Concepts, Book 1). This topic explains how enzyme activities are affected by temperature. Use the information from the text to fill in the table below and answer the questions below.

Temperature range	Cause (enzyme activity)	Effect (reaction rate)
At very low temperature (below 10°C)	Enzyme is _____	The reactive rate is _____
From 10°C to optimum	Enzymes become more _____ Because they have _____.	As temperature increases, _____ _____
At optimum temperature	Enzyme is the _____	Reaction rate is the _____
Above the optimum temperature	Enzyme is _____	As temperature increases, _____ _____

1. Explain why the enzyme is more active as the temperature increases from 10°C to the optimum temperature?

It is because when temperature increases, enzymes \_\_\_\_\_.

They move \_\_\_\_\_ and increase the chance of \_\_\_\_\_

Therefore the reaction rate increases.

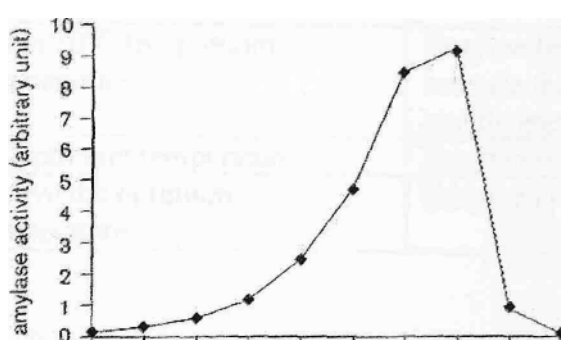
2. Explain why the reaction rate drops when the enzyme is denatured?

When the enzyme is denatured, the shape of \_\_\_\_\_.

The substrates \_\_\_\_\_. Therefore, \_\_\_\_\_.

**Activity 2**

An investigation was carried out to study the effect of temperature on the activity of barley amylase. For each temperature, the same amount of crushed grains and water were used. The amylase activity was estimated by the rate of the disappearance of starch using the iodine test. The results obtained are shown in the graph below.



1. What is the effect of temperature on reaction rates at the following temperature ranges:

- i. Below 10°C
- ii. 10°C to 70°C
- iii. at 70°C
- iv. above 70°C

i. At very low temperature (below 10°C),

ii. From 0°C to 70°C,

iii. At optimum temperature (\_\_\_°C) ,

iv. \_\_\_\_\_

2. Using **enzyme theory**, describe and explain the effect of temperature on the rate of reaction.

At very low temperature, the reaction \_\_\_\_\_ because \_\_\_\_\_

As temperature rises, enzyme becomes \_\_\_\_\_. They moves \_\_\_\_\_

\_\_\_\_\_

Therefore \_\_\_\_\_

At optimum temperature, ( \_\_\_°C) \_\_\_\_\_

Above the \_\_\_\_\_

## Answer to worksheet 2:

### Activity 1

Temperature range	Cause (enzyme activity)	Effect (reaction rate)
At very low temperature (below 10°C)	Enzyme is <u>inactive</u>	The reactive rate is <u>slow</u>
From 10°C to optimum temperature	Enzyme becomes <u>more active</u> because they have <u>more kinetic energy</u>	As temperature increase, <u>reaction rate increase.</u>
At optimum temperature	Enzyme is the <u>most active</u>	Reaction rate is the highest
Above the optimum temperature	Enzyme is <u>denature</u>	<u>As temperature increases, reaction rate decreases.</u>

1. It is because when temperature increases, enzyme has more energy. They moves faster and increase the chance of forming enzyme-substrate complex. Therefore reaction rate increases.
2. When enzyme is denatured, the shape of the active site changes. The substrates cannot fit into the active site. Therefore, the reaction rate drops.

### Activity 2

1. At very low temperature (below 10°C), the reaction rate is slow.

From 10°C to 70 °C, as temperature increases, the reaction rate increases.

At optimum temperature (70 °C) , the reaction rate is the highest.

Above the optimum temperature, the reaction rate decreases as temperature increases.

2. At very low temperature, the reaction is slow because enzyme is inactive.

As temperature rise, enzyme becomes more active and has more energy. They moves faster and increase the chance of forming enzyme-substrate complex. Therefore reaction rate increases.

At optimum temperature, the reaction rate is highest because enzyme is most active.

Beyond the optimum temperature, the enzyme is denatured. The shape of the active site changes. The substrates cannot fit into the active site. Therefore, the reaction rate drops.  
Therefore reaction rate drops as temperature increase