

Investigation into the factors affecting enzyme action

Introduction

Iodine is an indicator that turns blue/black when starch is present, but is otherwise brown. In this investigation a blue/black solution of starch and iodine will change to brown as the enzyme amylase digests/breaks down the starch into sugar. The time taken for this reaction to occur is affected by temperature.

Apparatus

test tube rack and six test tubes
marker pen
stopwatch
25 cm³ measuring cylinder
10 cm³ measuring cylinder
beaker of 1 % starch solution
dropper bottle of iodine solution
beaker of 10% amylase solution
spotting tile
dropping pipette

Access to:

water bath or alternative method of heating water

Method

1. Measure 10 cm³ of 1 % starch solution into a test tube.
2. Measure 2 cm³ of 10% amylase solution into a second test tube.
3. Place both tubes into a water bath set at 20°C for 3 minutes.
4. Place a drop of iodine in six wells of a spotting tile.
5. Remove both test tubes from the water bath. Pour the amylase into the starch/iodine solution and start the stopwatch.
6. Immediately, use the dropping pipette to place one drop of the mixture onto the first drop of iodine. Record the colour of the solution.
7. Repeat step 6 every minute for five minutes.
8. Repeat steps 1-7 at 30°C, 40°C, 50°C, 60°C.

Analysis

1. Use your observations to reach a conclusion regarding the effect of temperature on enzyme action.
2. Evaluate your method and suggest possible improvements.

Risk Assessment

Hazard	Risk	Control measure
10% amylase enzyme solution is irritant	Amylase enzyme could get on to the skin when pouring into the test tube	Wash hands immediately if amylase gets on to them/ wear laboratory gloves
	Amylase enzyme could get transferred to the eyes from the hands	Wear eye protection.

Teacher/Technician notes

10% bacterial amylase solution is a suggested concentration. Amylase varies in its effectiveness with source and age so it will be necessary to try out the experiment before presenting it to students to establish the optimum concentrations of starch and amylase to use.

Iodine solution is a stain. It is a low hazard chemical as a dilute solution, however contact with the skin should be avoided

The method as stated does not include repeats, but students should be encouraged to carry out an appropriate number, if time allows.

Students should be encouraged to look at reproducibility by looking at the results of other groups. Evaluation should include consideration of the end point of the reaction and possible improvements.

Students should design their own table, but a suggested table format is shown below.

Temperature of solution (°C)	Colour of solution					
	at start	after 1 minute	after 2 minutes	after 3 minutes	after 4 minutes	after 5 minutes
20						
30						
40						
50						
60						

Working scientifically skills covered

2. Experimental skills and strategies

Apply knowledge of a range of techniques, instruments, apparatus and materials to select those appropriate to this experiment.

Evaluate methods and suggest possible improvements and further investigations.

3. Analysis and Evaluation

Evaluating data in terms of accuracy, precision, repeatability and reproducibility and identifying potential sources of random and systematic error.

1.2 MODERN LIVING AND ENERGY –

1.2.1 UNDERPINNING ENERGY CONCEPTS

Applied Context

It is important to understand energy transfer if we are to efficiently generate electricity or use energy in the home. Learners can apply their knowledge in a number of fields including electricity generation and sustainable development. This section is common core content.

This topic introduces some key scientific and mathematical concepts that will need to be applied to both the generation of electricity (1.2.2) and our use of energy (1.2.3).

	Spec Statement	Comment
(a)	how temperature differences lead to the transfer of energy	
(b)	Sankey diagrams to show energy transfers; energy efficiency in terms of input energy and energy usefully transferred in a range of contexts including electrical power generation, transmission and use of energy	Including Sankey diagrams drawn to scale
(c)	<p>mathematical equations to find useful information relating to both the generation and use of electricity:</p> $\% \text{efficiency} = \frac{\text{energy [or power] usefully transferred}}{\text{total energy [or power] supplied}} \times 100$ <ul style="list-style-type: none"> • power = voltage × current <p>e.g. in relation to the power output of wind turbines, water turbines and solar panels and power consumption of household appliances</p> <ul style="list-style-type: none"> • energy transfer = power × time 	<p>Manipulation of equations only on higher tier.</p> <p>On foundation tier, the equation will be given in the form required if it involves a change to the subject.</p> <p>Understand the relationship between watts and joules</p>
(d)	<p>how to investigate energy transfer and the efficiency of energy transfer in a range of contexts; the interpretation, analysis and evaluation of data and methods used in investigations. Investigations to include:</p> <ul style="list-style-type: none"> • the energy output from a renewable source (e.g. energy output and the construction / location of a wind turbine) • the efficiency of an electric kettle 	The efficiency of other electrical devices can be investigated
(e)	the terms ‘sustainable’ and ‘carbon footprint’ when applied to generation of electricity or the use of electricity and energy (e.g. natural gas)	Carbon footprint as a measure of the total amount of carbon dioxide and methane emissions of a defined

		population, system or activity
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(f)	<p>the measurement of the carbon footprint in terms of mass equivalent of carbon dioxide (kgCO₂eq) and global warming potential of a gas; the use of the relationship:</p> <p>kgCO₂eq = (mass of a gas) × (global warming potential of the gas)</p>	<p>comparison of the carbon dioxide equivalent of greenhouse gases using given data</p>
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SPECIFIED PRACTICAL WORK

- Investigation of the efficiency of energy transfer in electrical contexts