

Investigation into factors affecting decomposition

Introduction

Decomposers secrete enzymes into the soil to break down waste. In this investigation the enzyme urease catalyses the breakdown of urea into ammonia. The ammonia dissolves in water to create an alkaline solution. The rate at which the solution becomes alkaline is affected by the temperature. During this reaction the red acidic solution changes to an alkaline blue.

Apparatus

10 × boiling tubes
 test tube rack
 labels
 3 × syringes
 dropping pipette
 pH colour chart
 1.5% urease solution
 1.25% ethanoic acid
 universal indicator in a dropper bottle
 1% urea solution
 stopwatch

Method

1. Label a test tube as 20 °C.
2. Use a syringe to add 2.5 cm³ of urea to the test tube.
3. Add 1 cm³ of ethanoic acid and 10 drops of universal indicator to the test tube.
4. Add 10 cm³ of urease to another test tube and place both tubes into a 20 °C water bath.
5. Pour the urease into the tube labelled 20 °C.
6. Start the stopwatch and record the time taken to turn from red to blue.
7. Repeat steps 1-6 for temperatures of 30, 40, 50 and 60 °C.

Analysis

1. Plot a graph of temperature against the time taken to change colour.

Risk Assessment

Hazard	Risk	Control measure
Urea, urease and ethanoic acid are all irritants.	Chemicals could get onto the skin when adding to test tube	Wash hands immediately if any chemical gets onto them / wear laboratory gloves.
	Chemicals could get transferred from the hands to the eyes	Wear eye protection.

Teacher/Technician notes

Thermostatically controlled water baths can be set up at specific temperatures and students can fill beakers with water from these baths to use as water baths at their desks.

Thermometers could be provided and students asked to regularly check the temperature allowing them to analyse the effectiveness of the method.

Urease enzyme has an optimum temperature of 60 °C, so it is possible that the denaturing of the enzyme may not be seen in the range of temperatures given. Students could be asked to predict what would happen to the time taken at higher temperatures.

Students should relate the results of their investigation to the enzymes involved in decomposition and the effect of temperature on the rate of decomposition.

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

Temperature (°C)	Time taken to change from red to blue (s)

Practical techniques covered

- B1 Use of appropriate apparatus to make and record a range of measurements accurately, including length, area, mass, time, temperature, volume of liquids and gases, and pH.
- B2 Safe use of appropriate heating devices and techniques including use of a Bunsen burner and a water bath or electric heater.
- B3 Use of appropriate apparatus and techniques for the observation and measurement of biological changes and or processes.