Enzymes, active sites and temperature

Student activity • observation and reasoning

YEAR 10 / LESSON 9 / BIOLOGY + SCIENCE (DOUBLE AWARD)

The question

Why does warming an enzyme reaction not always increase its rate?

Use a molecular model and an explicitly illustrative dataset to distinguish collision frequency from denaturation.

Equipment

- Paper or reusable enzyme/substrate model pieces, graph paper, ruler and pencil

Paper modelling and data analysis only; no peroxide, biological samples or flame is used.

Course coverage: Shared Biology / Double Award: 2.10–2.11. Enzyme action and temperature.

Plan, model or apparatus sketch

Draw and label the apparatus or biological model; identify one limitation.

Method and reasoning

Read the whole sequence before starting

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1. Build a paper enzyme with an active-site shape and a matching substrate. Show binding, conversion to products and release, leaving the enzyme available again.

2. Explain why the shape model is simplified: real molecules move, interact in three dimensions and may change shape during binding.

3. Use the illustrative dataset: 10, 20, 30, 40, 50 and 60 °C correspond to relative activities 8, 16, 31, 48, 22 and 3 units. Plot the labelled values; these are not measurements.

4. Describe the increase from 10 to 40 °C using kinetic energy and more frequent successful enzyme–substrate interactions.

5. Explain the decrease at higher temperatures using changes in protein structure and the active site. Do not call an enzyme dead or assume every enzyme has the same optimum.

6. Plan the independent, dependent and control variables for the amylase investigation in Lesson 10; distinguish a model prediction from evidence.

Cleanup

- Return equipment and wash hands after practical work.

Record your evidence

Blank spaces are for your own work

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Reference and task data

Illustrative dataset: temperature / °C = 10, 20, 30, 40, 50, 60; relative activity / arbitrary units = 8, 16, 31, 48, 22, 3. The largest sampled value is at 40 °C; the exact optimum is not established between these points. Low temperature usually slows activity rather than permanently denaturing the enzyme.

Example / trial	Observation / evidence	Explanation / limit
Model: binding / release		
Illustrative temperature graph		
Variables for the investigation		

Show your calculations, labelled model or correction here.

Explain and evaluate

Use evidence and show calculation steps where relevant

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1. Define a biological catalyst.

2. What is an active site?

3. Why does activity initially increase as temperature rises?

4. Why can activity fall at a higher temperature?

5. What does this dataset establish about the optimum?

6. Which variables should the Lesson 10 investigation control?