

Measuring a rate

60 minutes • C1.1.9 • Chapters 7, 8 • The dry lab

How to measure an enzyme's rate, the initial rate, and planning, running and evaluating the catalase investigation

BY THE END, STUDENTS CAN

☐ Work out a rate from your own results or from secondary data, including the initial rate from a tangent C1.1.9

TIMING

0-5	5 min	Do now: elephant's toothpaste	
5-15	10 min	Chapter 8: read the rate	
15-25	10 min	Catalase over water	
25-55	30 min	The dry lab with the coach	
55-60	5 min	Exit	
	60 min	One lesson	

STARTER

5 min Do now: elephant's toothpaste

The demonstration below. Ask: "How could you measure how fast that happened?" Collect the measures students suggest: foam height, time, mass lost, volume of gas.

ON THE BOARD, FROM THE GUIDE

Open the guide on the projector at each chapter (the links work in this PDF). Every figure plays from its own buttons, and the lesson's slides have the same figures, step by step, in the order of this plan.

07 Three graphs to know

CHAPTER 07 IN THE SLIDES

Step through the figure (4 steps, the arrow keys on a projector). Stop on each caption and ask what changed before you go on.

1. Temperature: faster collisions, then **denaturation**.
2. pH: each enzyme has its own **optimum**.
3. Substrate: the rate rises, then **levels off**.
4. More enzyme raises the maximum.

Play the animation, Watch it happen: collisions, substrate and heat. It loops; pause it on each moment below and ask what is happening (in the lesson slides it is a video).

1. Molecules move at **random**, and most collisions miss the active site.
2. A **successful collision**: it binds and reacts, and the enzyme is unchanged.
3. Too hot: enzymes **denature**. Active sites lose their shape, and the rate falls.

Predict box: On a graph of rate against substrate concentration, the curve levels off. Why? Hands up or mini whiteboards first.

Answer C: Nearly every active site is already busy

Remember it: Tigers Prefer Steak (Temperature, pH, Substrate concentration).

Step through the figure (4 steps, the arrow keys on a projector). Stop on each caption and ask what changed before you go on.

1. Oxygen collected every 10 seconds.
2. Fast at first, then slower as the **substrate** runs out.
3. The **initial rate** is the gradient of a tangent at the start.
4. Warmer: a steeper start, the same total.

Predict box: A drop of a starch and amylase mixture stops turning iodine blue-black after 40 s at 30 °C and after 80 s at 20 °C. Compare the rates. Hands up or mini whiteboards first.

Answer B: The rate at 30 °C is double: rate is $1 \div \text{time}$

THE LESSON

10
min**Chapter 8: read the rate**

Product made or substrate used. Step through the figure: the points, the curve, the tangent and its gradient. At step 4, students draw their own gradient triangle on the 35 °C tangent and work out its initial rate before reading the label, then the predict (rate is $1 \div \text{time}$).

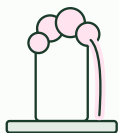
10
min**Catalase over water**

The demonstration below: how much of the oxygen made do you think ends up in the cylinder, and what could lose it? Pairs fill one row of the evaluation table: a weakness, its effect on the results, and an improvement.

30
min**The dry lab with the coach**

In pairs on [the dry lab](#). Start with How? Why? Units? in the coach, then run a temperature series with three repeats, find the means and standard deviations and draw the graph with error bars. Ask pairs to compare their curve with [chapter 7's](#) sketch graph.

ACTIVITIES

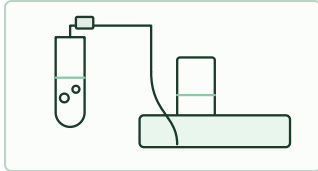


DEMONSTRATION

Elephant's toothpaste

A safe version: in a 250 cm³ measuring cylinder on a tray, put 30 cm³ of 6% (20 volume) hydrogen peroxide, a squirt of washing-up liquid and a few drops of food colouring. Tip in a tablespoon of dried yeast stirred into warm water. Foam rises, because the catalase in the yeast speeds up the breakdown of the peroxide to water and oxygen. Wear eye protection: 6% hydrogen peroxide irritates eyes and skin, so rinse splashes at once. The 30% peroxide and potassium iodide version is for the teacher alone.

Needs: the above, a tray, eye protection, gloves for the teacher.



PRACTICAL

Catalase over water

A demonstration, or pairs if there is time. A level spatula of dried yeast (weighed once, about 0.1 g) goes into 5 cm³ of 3% hydrogen peroxide in a boiling tube, and the bung is pushed in at once. A delivery tube leads to an upturned 100 cm³ measuring cylinder full of water in a trough; read the gas every 10 seconds. (5 cm³ of 3% can give about 53 cm³ of oxygen, so a 25 cm³ cylinder would overflow.) [The dry lab](#) uses potato extract and this uses yeast: two sources of one enzyme, so say so. Then the evaluation table: a weakness, its effect on the results, and an improvement. Weaknesses: gas lost before the bung goes in, reading the meniscus in a moving cylinder, the yeast at room temperature while the peroxide sits in a bath, and only one run. The improvements lead to [the dry lab's](#) gas syringe and water bath.

Needs: dried yeast, 3% (10 volume) hydrogen peroxide, boiling tubes, bungs with delivery tubes, measuring cylinders, a trough, a stopwatch, eye protection.

How	Why	Units
✓ ✓	✓	✓

PLANNING

How? Why? Units?

Before running [the dry lab](#), pairs fill the coach's variables table: for each variable, how it is set or measured, why it matters, and its unit. The planning questions become the coach's checklist: the range of values, time for the reaction, controlled variables, a negative control with no enzyme, a positive control, bringing the enzyme to temperature first, the precision of the measurement, and safety.

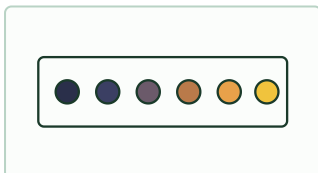
Needs: a device per pair.

DRY LAB

Catalase and hydrogen peroxide

[The dry lab](#) above, with the tasks and questions under it and the coach beneath. Results go to a CSV for a class graph, and the coach's write-up is copied into notes.

Needs: one device per pair.



PRACTICAL

The enzyme in your spit

Optional, for a practical lesson outside the three hours. The site's own lab, [the enzyme in your spit](#), with its sheet: salivary amylase and starch at cold, room and warm temperatures, iodine as the end point, and the rate worked out as $1 \div \text{time}$.

Needs: as the lab page lists.

PLENARY

5
min

Exit

Write your research question, and one weakness of the method with its improvement.

WHAT STUDENTS GET WRONG

The amount of product at the end measures the rate. It measures how much substrate went in; use the initial rate.

A longer time means a faster rate. Rate = $1 \div \text{time}$.

STRETCH AND SUPPORT

Support: the figures' captions as cut-up cards to put in order; the dotted key terms as a glossary; a writing frame for "explain the effect of temperature" (rise, optimum, fall, each with its reason).

Stretch: in [the dry lab](#), find the temperature at which half the enzyme is lost within the run. How would you design a run to separate the effect of heat on collisions from its effect on denaturation?

IN THE GUIDE

- 7** [Three graphs to know](#)
- 8** [Measuring a rate](#)
- Lab** [Dry lab: Catalase and hydrogen peroxide](#)
- A11** [The whole guide, with the figures that play](#)
- PPTX** [This lesson's slides, in the order of this plan](#)

PRACTISE AND REVISE

BUILD FOR YOUR CLASS

- [Tarsia puzzle, dominoes and picture reveal](#) on C1.1, built from its key terms and ready to print
- A [pub quiz](#) with rounds on C1.1, to present or run with no projector
- An [escape room built from the question bank](#) on C1.1

ALREADY ON THE SITE FOR C1.1

- Lesson: [Enzymes & Metabolism HL \(HL\)](#)
- Lab: [The Enzyme in Your Spit](#)
- Summary doodle: [Enzymes & Metabolism](#)
- Quiz: [Enzymes](#)
- Quiz: [Enzymes & Metabolism \(HL\)](#)
- Revision map: [C1.1 Enzymes and metabolism](#), to fill in
- Exam questions: [C1.1 in the exam maker](#), a paper with its markscheme

CARD SETS ON SPLYCR

- Open a set to host it as a class game, or make a copy to edit.
- [C1.1 Enzymes and Metabolism](#)

How this was made. The course structure, the activities and the teaching choices come from my own classroom, my presentations and my years of teaching IB and AP Biology. I use Claude, an AI, to help write and build the interactive guides, lesson plans, slides and practice questions, and to draw the diagrams and code the interactives. I direct the work and review it against the IB and AP specifications before it goes live.

EXAM PRACTICE

Check yourself

Set it for homework: a fresh paper of exam-bank questions on C1.1 at standard level each time, marked as students go and saved to their Exam practice when they are signed in.

biologybybradford.com/exam-maker/sit?topics=C1.1&level=SL&paper=quiz&marks=15&src=ep

