

Measuring a rate you cannot see

60 minutes • C1.2.6 • Chapter 5 • The dry lab

Measuring respiration rate: the dough lab, the respirometer, the control, and the rate per gram per minute

BY THE END, STUDENTS CAN

☐ Measure the rate of respiration with a respirometer and work it out from raw or secondary data C1.2.6

TIMING

0-5	5 min	Do now: how fast is a seed respiring?	
5-15	10 min	Rising dough	
15-25	10 min	How a respirometer works	
25-45	20 min	The dry lab with the IA coach	
45-55	10 min	Back to the dough	
55-60	5 min	Exit: work out a rate	
	60 min	One lesson	

STARTER

5 min Do now: how fast is a seed respiring?

"How could you tell how fast a seed is respiring without opening it?" Students write three ideas each. Collect them: oxygen in, carbon dioxide out, fuel used.

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.

05 A rate you cannot see

CHAPTER 05 IN THE SLIDES

Tap the parts of the figure in turn: Water bath and thermometer, Potassium hydroxide, Wire gauze, Germinating seeds, Glass bead tube, Bung and screw clip, Capillary and coloured drop and Scale.

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. Read both drops at the start and the end.
2. Take off the control's movement.
3. Turn distance into volume with the bore.
4. Divide by time and by mass.

Predict box: In the respirometer the seeds respire and the potassium hydroxide absorbs their carbon dioxide. Which way does the drop move? Hands up or mini whiteboards first.

Answer B: Towards the seeds, as they take in oxygen

THE LESSON

10 min Rising dough

Pairs make the dough, set up five tubes and take the first reading (the practical below). Readings every 5 minutes through the lesson, one student a pair keeping time.

10

min

How a respirometer works

Chapter 5: the predict about the drop, then the explore figure part by part: why the potassium hydroxide, why the beads, why the clip. Then figure 5.2's worked rate, one step at a time. Ask: "What would a negative control tell you?"

20

min

The dry lab with the IA coach

In pairs on the dry lab. First How? Why? Units? in the coach (below), then a temperature series of three trials at five temperatures, with means and standard deviations. Download the results as a CSV for a class graph.

10

min

Back to the dough

Final readings. Each pair works out its rate over 5 to 20 minutes and adds it to a class table. Compare it with the dry lab's dough mode and ask why sucrose is nearly as fast as glucose.

ACTIVITIES



PRACTICAL

Rising dough

Make one dough: stir 4 g of dried yeast into 75 cm³ of warm water (about 35 °C), then add plain flour until it is a thick batter that just drops from a spatula (about 20 spatulas). Divide it into five equal portions in small beakers and stir 2 g of one sugar into each (glucose, fructose, sucrose, starch, and none): weigh the sugar rather than using "two spatulas". Spoon each into a boiling tube to a height of 30 mm, mark the level, stand the tubes in a water bath at 30 °C (or record the room temperature), and read the height of the top every 5 minutes for 30 minutes.

Students then design their own results table (time, height in mm with its uncertainty, a column for each sugar), graph height against time with a line for each sugar, and write a conclusion and an evaluation: which sugar was fastest and why, which variables were not controlled (the consistency of the dough, the temperature), and two specific improvements.

Needs: dried yeast, plain flour, glucose, fructose, sucrose and starch, a balance, spatulas, small beakers, five boiling tubes and a rack per pair, rulers, a water bath or a thermometer, a timer.

How	Why	Units
✓		
✓		

PLANNING

How? Why? Units?

Before running the dry lab, pairs fill in the coach's variables table: for each variable, how it is set or measured, why it matters and its unit. Then they use the planning questions as a checklist: the range of values, the time for the run, the controlled variables, a negative control, the precision of the measurement, and safety.

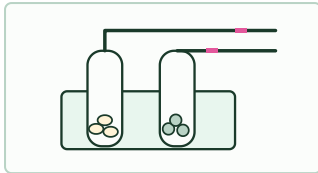
Needs: a device per pair.

DRY LAB

The dry lab

One device per pair. Results go to a CSV for a class graph, and the coach's write-up is copied into notes. Start with temperature; pairs who finish run the dough mode.

Needs: one device per pair.



DEMONSTRATION (OPTIONAL)

A real respirometer

Two boiling tubes in a beaker of water at room temperature: 3-day mung beans on a gauze over potassium hydroxide solution in one, and glass beads of the same volume over the same in the other. Fit bungs with a bent capillary and a drop of coloured water, and a screw clip on a side arm. Run it alongside the dough while students work. Safety: potassium hydroxide is corrosive; use eye protection and gloves, and the teacher sets it up.

Needs: as listed, and a mm scale behind each capillary.

PLENARY

5

min

Exit: work out a rate

A drop moved 18 mm in 5 minutes in a bore of 1 mm; the control moved 1 mm; there was 2.5 g of seeds. Work out the rate. (Students show every step and the unit.)

WHAT STUDENTS GET WRONG

The drop moves because the seeds give out carbon dioxide. It is absorbed; the drop moves because oxygen is taken up.

The control is “to compare”. The bead tube shows what moves the drop that is not respiration, so it can be subtracted.

A disaccharide must be slower than glucose for yeast. Yeast split sucrose outside the cell with an enzyme, so it is nearly as fast.

STRETCH AND SUPPORT

Support: give the captions of [chapter 4](#)'s figure as cut-up cards to sort into “with oxygen” and “without”, the dotted key terms as a glossary, and a writing frame for “compare aerobic and anaerobic respiration” (one row of the table, one sentence each).

Stretch: in [the dry lab](#), find the time with the clip open below which the control matters most, and explain from the gas law why a cold bath fakes respiration.

Stretch: design a dough experiment to separate the flour's own sugars from the added starch (hint: a flour that has been heated to destroy its enzymes).

Stretch: shadow puppets: in groups, answer two written questions from the C1.2 exam maker as shadow puppets, so the class has to explain each step aloud.

IN THE GUIDE

5 [A rate you cannot see](#)

Lab [Dry lab: Respirometer: seeds and dough](#)

A11 [The whole guide, with the figures that play](#)

PPTX [This lesson's slides, in the order of this plan](#)

EXAM PRACTICE

Check yourself

Set it for homework: a fresh paper of exam-bank questions on C1.2 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=C1.2&level=SL&paper=quiz&marks=15&src=ep



PRACTISE AND REVISE

BUILD FOR YOUR CLASS

- [Tarsia puzzle, dominoes and picture reveal](#) on C1.2, built from its key terms and ready to print
- A [pub quiz](#) with rounds on C1.2, to present or run with no projector
- An [escape room](#) built from the [question bank](#) on C1.2

ALREADY ON THE SITE FOR C1.2

- Lesson: [Cell Respiration HL \(HL\)](#)
- Lesson: [Cell Respiration](#)
- Quiz: [Cell Respiration](#)
- Quiz: [Cell Respiration \(HL\)](#)
- Revision map: [C1.2 Cell respiration](#), to fill in
- Exam questions: [C1.2 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.

- [C1.2 Cell Respiration](#)
- [B3.2–C2.2 Plant Transport, Respiration & Neural Signalling](#)

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.