

Hydrogen off, and glycolysis HL

60 minutes • C1.2.7 to C1.2.10 • Chapters 6, 7, 8

Oxidation as hydrogen removal and NAD as its carrier, the four stages of glycolysis, and lactate and ethanol as ways to give NAD back

BY THE END, STUDENTS CAN

- ☐ Explain oxidation as the removal of hydrogen, and NAD as the carrier that is reduced when it accepts it C1.2.7
- ☐ Outline glycolysis: phosphorylation, lysis, oxidation and ATP formation, with its net yield C1.2.8
- ☐ Explain how making lactate, or ethanol and carbon dioxide in yeast, gives NAD back so glycolysis can go on, and how bakers and brewers use yeast C1.2.9, C1.2.10

TIMING

0-5	5 min	Do now: OIL RIG	
5-15	10 min	Hydrogen and NAD	
15-30	15 min	Glycolysis stepping stones	
30-42	12 min	Giving NAD back	
42-55	13 min	A written question	
55-60	5 min	Exit	
	60 min	One lesson	

STARTER

- 5 min** **Do now: OIL RIG**
- Three reactions on the board. Students label each molecule oxidised or reduced and say what moved. Then turn over the OIL RIG tiles.

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.

06 Taking hydrogen away

CHAPTER 06 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. A substrate, an enzyme, and NAD.
2. Hydrogen is removed: **dehydrogenation**. Each hydrogen is a proton and an electron.
3. The substrate is **oxidised**; NAD is **reduced**. A **redox** reaction.
4. Reduced NAD carries the hydrogen away and comes back as NAD.

Predict box: A dehydrogenase takes two hydrogens off a molecule of fuel. What has happened to that molecule? Hands up or mini whiteboards first.

Answer D: It is oxidised: it has lost electrons

Remember it: Oil Rig (Oxidation Is Loss, Reduction Is Gain).

07 Two ATP in, four out

CHAPTER 07 IN THE SLIDES

Step through the figure (6 steps, the arrow keys on a projector). Stop on each caption and ask what changed before you go on.

1. One glucose, in the cytoplasm.
2. **Phosphorylation:** 2 ATP spent, the sugar made reactive.
3. **Lysis:** split into two 3-carbon sugars.
4. **Oxidation:** hydrogen to NAD, making 2 reduced NAD.
5. **ATP formation:** 4 ATP made, so 2 gained.
6. Ten steps, ten enzymes, two pyruvate.

Predict box: Glycolysis spends 2 ATP at the start. How many does it make by the end, from one glucose? Hands up or mini whiteboards first.

Answer A: 4, so the cell gains 2

Remember it: Penguins Love Orange Anchovies (Phosphorylation, Lysis, Oxidation, ATP formation).

08 Giving NAD back

CHAPTER 08 IN THE SLIDES

Switch the figure through Glycolysis alone, Muscle and Yeast, and have the class say what will change before each.

Predict box: Without oxygen, why does a muscle cell turn pyruvate into lactate instead of leaving it as pyruvate? Hands up or mini whiteboards first.

Answer D: It gives NAD back, so glycolysis can go on

THE LESSON

10

min

Hydrogen and NAD

Chapter 6: the predict, then the figure one step at a time. NAD is a carrier that must be emptied to be used again: ask students why a cell cannot just make a lot more of it.

15

min

Glycolysis stepping stones

Pairs order the seven cards (activity below), then check against chapter 7's figure and make its predict. Turn over the Penguins tiles.

12

min

Giving NAD back

Chapter 8: the predict, then the figure's three settings: glycolysis alone, muscle and yeast. Then the ATP budget's round 5 on the board: tick and untick Lactate made and watch the NAD.

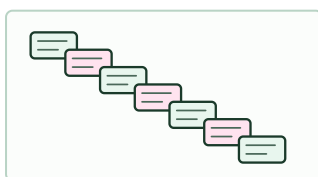
13

min

A written question

A written question on glycolysis or fermentation from the C1.2 exam maker (in Practise and revise), timed at 9 minutes and peer-marked against the markscheme. Each pair then writes one line on bread and one on beer.

ACTIVITIES



CARD ORDER · HL

Glycolysis stepping stones

Seven cards, each a half sentence, to put in order and complete: what glycolysis is; where it happens; phosphorylation by 2 ATP; the split into two 3-carbon sugars; oxidation by NAD; ATP formation; the end products and the net yield. Then a second set with gaps, for homework.

Needs: card sets, one per pair.

5

min

Exit

Why can glycolysis go on without oxygen in a muscle, and what would stop it?

WHAT STUDENTS GET WRONG

Oxidation means adding oxygen. In respiration it is mostly removing hydrogen, and so electrons.

Glycolysis needs oxygen, or happens in the mitochondrion. Neither.

Lactate is made to get rid of pyruvate. It is made to give NAD back.

Lactic acid makes muscles sore the next day. It does not: the acid of hard exercise is not lactate itself, and next-day soreness is something else.

STRETCH AND SUPPORT

Stretch: some yeasts ferment even with oxygen when sugar is plentiful. What would that do to a dough, and to the yield of ATP per glucose?

Stretch: make a Tarsia puzzle on C1.2 that is better than the site's own, in the Tarsia builder.

Consequences for ecosystems: respiration returns carbon dioxide to the air and releases heat at every transfer. Use both to start the energy flow of C4.2: where does the energy of a food chain go?

IN THE GUIDE

6 [Taking hydrogen away](#)

7 [Two ATP in, four out](#)

8 [Giving NAD back](#)

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 higher 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=HL&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.