

# ATP, and two ways to make it

60 minutes • C1.2.1 to C1.2.5 • Chapters 1, 2, 3, 4

**ATP as the cell's energy currency, what it pays for, respiration against gas exchange, and aerobic against anaerobic respiration**

## BY THE END, STUDENTS CAN

- ☐ Describe ATP as a nucleotide and explain what makes it suit the job of moving energy around a cell C1.2.1
- ☐ Explain how hydrolysis of ATP releases energy for active transport, building molecules and movement, and why remaking it takes energy C1.2.2, C1.2.3
- ☐ Explain respiration as the cell's way of making ATP from carbon compounds, and tell it apart from gas exchange C1.2.4
- ☐ Compare aerobic and anaerobic respiration in humans, with word equations for both C1.2.5

## TIMING

|       |        |                            |                        |
|-------|--------|----------------------------|------------------------|
| 0-5   | 5 min  | Do now: which need energy? | <div><div></div></div> |
| 5-15  | 10 min | ATP, spent and remade      | <div><div></div></div> |
| 15-23 | 8 min  | Burning or respiring?      | <div><div></div></div> |
| 23-35 | 12 min | Compare the two routes     | <div><div></div></div> |
| 35-43 | 8 min  | The respiration film       | <div><div></div></div> |
| 43-55 | 12 min | The ATP budget             | <div><div></div></div> |
| 55-60 | 5 min  | Exit: true or false        | <div><div></div></div> |
|       | 60 min | One lesson                 |                        |

## STARTER

- 5 min** **Do now: which need energy?**
- Pairs list the functions of life they remember and star every one that needs energy (activity below). Land on: all of them. Students then say which kind of job each is.

## 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.

## 01 The cell's small change

CHAPTER 01 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 **nucleotide**: adenine, ribose and one phosphate.
2. Add a phosphate: **ADP**.
3. Add another: **ATP**, adenosine triphosphate.
4. What makes it the cell's **energy currency**.

**Predict box:** Removing one phosphate from ATP releases only a modest amount of energy. Why does that suit a cell? Hands up or mini whiteboards first.

**Answer B:** A job can take what it needs, with little wasted

## 02 Spend it, remake it

CHAPTER 02 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. ATP, ADP and phosphate: the same molecules, used again and again.
2. **Hydrolysis**: water splits off the last phosphate. Energy is **released** for pumps, building and movement.
3. Remaking ATP **needs energy**: from respiration.
4. Spent and remade, over and over: the energy flows through, and some is lost as heat.

**Predict box**: Remaking ATP from ADP and phosphate needs energy. Where does a muscle cell get it? Hands up or mini whiteboards first.

**Answer A: From respiring glucose or fat**

**Remember it**: B A M (Building, Active transport, Movement).

## 03 Fuel in, ATP out

CHAPTER 03 IN THE SLIDES

**Switch the figure** through Burning, Cell respiration and Gas exchange, and have the class say what will change before each.

**Predict box**: A leaf in bright light takes in carbon dioxide and gives out oxygen. Is it respiring? Hands up or mini whiteboards first.

**Answer C: Yes: all its living cells respire all the time**

## 04 With oxygen and without

CHAPTER 04 IN THE SLIDES

**Switch the figure** through Plenty of oxygen and Not enough oxygen, and have the class say what will change before each.

**Play the animation, Follow one glucose**. It loops; pause it on each moment below and ask what is happening (in the lesson slides it is a video).

1. One **mitochondrion**. Its inner membrane is deeply folded.
2. Splitting glucose into two pyruvate in the **cytoplasm** gives a little ATP: **2**.
3. With oxygen, pyruvate goes into a **mitochondrion**. Its carbon leaves as **carbon dioxide**; its hydrogen goes to the folds of the inner membrane.
4. **Oxygen** joins the hydrogen to make **water**. Here, at the folds, most of the ATP is made: about 30 to 32 from one glucose.
5. **Aerobic respiration**: glucose + oxygen → carbon dioxide + water. The energy released remakes ATP for the cell's work.

**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. Rest: the mitochondria keep up easily.
2. A sprint: demand outruns the oxygen supply.
3. No oxygen: what happens to the ATP from each glucose?
4. Play the rounds to fill in the record.

**Predict box**: A sprinter's leg muscles run short of oxygen. Per glucose, how much ATP does anaerobic respiration make compared with aerobic? Hands up or mini whiteboards first.

**Answer C: About one fifteenth as much**

**Remember it**: L O W (Lactate, Only 2 ATP, Without oxygen).

## THE LESSON

**10**  
min

### ATP, spent and remade

Students build ATP on mini whiteboards from a nucleotide (activity below), then play [chapter 1's](#) figure and make its predict. Then [chapter 2's](#) figure step by step, stopping on each caption, and the BAM tiles. Ask: "Where does the energy to remake ATP come from?" before step 3.

**8 min** **Burning or respiring?**  
 Chapter 3: the predict about the leaf as a vote with hands up. Run the demonstration (below), then play the figure's three settings: burning, cell respiration and gas exchange. Students decide which of the three releases energy and which makes ATP.

**12 min** **Compare the two routes**  
 Chapter 4: the predict, then students fill in the comparison table in pairs (below) and check it against the figure's two settings. Write both word equations on the board from memory. Turn over the LOW tiles.

**8 min** **The respiration film**  
 Play the SL respiration film once through. Then turn the oxygen off at the end: students call out what will change before you press it.

**12 min** **The ATP budget**  
 In pairs, rounds 1 to 4 (the game after [chapter 4](#)). Collect each pair's ATP per glucose for the sprint and the blocked blood supply on the board.

## ACTIVITIES



### DISCUSSION

#### Which need energy?

Pairs list the functions of life (nutrition, metabolism, growth, response, excretion, homeostasis, reproduction, and movement where it applies) and star the ones that need energy. Every one does: which kind of ATP job is each one (building, active transport, movement)?

**Needs:** mini whiteboards.



### MODEL

#### Build ATP

On mini whiteboards, draw three shapes for a nucleotide (a rectangle, a pentagon and a circle), then add two more circles: ADP, then ATP. Label the base, the sugar and the phosphates, and circle the part removed by hydrolysis.

**Needs:** mini whiteboards and pens.



### DEMONSTRATION

#### Burning or respiring?

Set a corn puff or a crisp alight on a mounted needle under a boiling tube of water (no nuts: allergies), beside a stoppered flask of soaked seeds with a thermometer that warms slowly over a day (set it up the day before). Same fuel and the same products; one fast and uncontrolled, the other a step at a time and making ATP. Safety: eye protection, a heat-proof mat, a fire blanket to hand, and the teacher holds the needle.

**Needs:** corn snacks, a mounted needle, a Bunsen burner, a boiling tube in a clamp, a vacuum flask of soaked seeds with a thermometer.

| with | without |
|------|---------|
|      |         |
|      |         |
|      |         |
|      |         |
|      |         |

### TABLE

#### Compare the two routes

A table to fill in pairs: substrates, oxygen needed, ATP per glucose, waste products, where in the cell, mitochondria needed, and the word equation. Check it against [chapter 4](#)'s figure.

**Needs:** the printed table.



## QUIZ

### True or false

Ten statements, five set as the exit: "Glycolysis happens in the cytoplasm" (true); "Chloroplasts are where a plant cell respire aerobically" (false: mitochondria, after glycolysis in the cytoplasm); "Anaerobic respiration in muscle makes carbon dioxide" (false); "Aerobic respiration gives about 30 to 32 ATP per glucose" (true); "The oxygen you breathe in ends up in the carbon dioxide you breathe out" (false: it ends up in water); "Plants respire only at night" (false); "ATP is the cell's long-term energy store" (false); "Lactate is made from pyruvate when oxygen is short" (true); "Anaerobic respiration in muscle makes a net 2 ATP per glucose" (true); "Respiration makes energy" (false: it releases it).

**Needs:** the statements on the board, or on cards.

## GAME

### The ATP budget

Pairs at one device, rounds 1 to 4 after [chapter 4](#). Collect each pair's ATP per glucose for rounds 3 and 4 on the board and compare: what did a sprint cost in glucose, and what happened with the blood supply blocked?

**Needs:** one device per pair.

## PLENARY

**5**  
min

### Exit: true or false

Five statements from the set below, a reason for each false one.

#### WHAT STUDENTS GET WRONG

**Respiration is breathing.** Respiration is chemistry in every cell; breathing moves air and gas exchange moves gases.

**Respiration makes energy.** It releases energy from the fuel and transfers it to ATP.

**Energy is stored in the bond between phosphates, and breaking it releases energy.** Breaking bonds takes energy; hydrolysis releases energy overall, because ADP and phosphate hold less than ATP and water did. Check the slides you borrow for this.

**ATP is an energy store.** A cell holds only a little and remakes it all the time.

**Plants photosynthesise instead of respiring.** Every living cell respire all the time.

**All of aerobic respiration happens in the mitochondria.** Glycolysis is in the cytoplasm.

**Anaerobic respiration in humans makes carbon dioxide.** The product in human muscle is lactate only.

**Muscles switch from aerobic to anaerobic.** Anaerobic respiration adds to aerobic respiration when oxygen cannot keep up.

#### 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).

**Support:** use the BAM and LOW tiles as sentence starters.

**Stretch:** a resting adult remakes roughly their own body mass of ATP each day, from a stock of well under a kilogram. How many times a day is each ATP molecule remade?

**Stretch:** compare each sprint round's ATP per glucose with the aerobic figure: how many times more glucose does the sprint need for the same ATP?

## IN THE GUIDE

- 1 [The cell's small change](#)
- 2 [Spend it, remake it](#)
- 3 [Fuel in, ATP out](#)
- 4 [With oxygen and without](#)
- 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 C1.2, 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](#)

## 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](https://biologybybradford.com/exam-maker/sit?topics=C1.2&level=SL&paper=quiz&marks=15&src=ep)



**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.