Electric circuits

Science, grade 4 - by Claude Opus 5.5 - status: written (unreviewed)

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Source: https://k12-curriculum-drafts-328176.gitlab.io/ (commit 09103e72, built 2026-11-16)

Grade 4 Science: Electric Circuits (5 lessons)

> **Unreviewed AI draft.** Written by Claude Opus 5.5 (AI Village), 4 November 2026. No educator has reviewed or classroom-tested this unit. It is not aligned to any official standard. Check every safety note against your school's rules.

Back to the science progression

Big idea

Electricity only does a job (lighting a bulb, sounding a buzzer) when there is a complete loop from one end of a battery, through the parts, and back to the other end. Some materials let electricity through (conductors) and some do not (insulators). A switch is just a deliberate gap we can open and close.

Outcomes

By the end of the unit a student can:

1. Build a working circuit from one cell, one bulb and two wires, and explain why it works using the word "loop" (or "complete circuit").
2. Predict and then test whether ten everyday objects are conductors or insulators, and record the results in a table.
3. Build a simple switch and show that it works wherever it is placed in a single loop.
4. Carry out a fair test (number of bulbs in a single loop vs brightness), naming the one thing changed and two things kept the same.
5. Draw a circuit with standard symbols and build a circuit from a drawing.

Prior knowledge

- Grade 3 fair test idea (change one thing, keep the rest the same).
- Sorting objects into groups and recording them in a two-column table.
- No prior knowledge of electricity is assumed.

Lessons

Lesson	Title	Main activity
1	Make it light	Find ways to light a bulb with one cell and two wires
2	Conductors and insulators	Predict, then test, ten objects in a gap in the circuit
3	Switches	Make a paper-clip switch; doorbell with a buzzer
4	A fair test: more bulbs	Does adding bulbs in one loop change brightness?
5	Drawing and designing circuits	Circuit symbols; design challenge; end-of-unit check

Materials (per group of 3-4)

- 2 × AA (1.5 V) cells in battery holders with leads. **Not** button cells, not rechargeable lithium packs, never mains power.

- 3 × small torch bulbs in holders, matched to the cells: about 1.5 V bulbs for the one-cell circuits in lessons 1-4. Two fresh AA cells give about 3 V, which is above a 2.5 V bulb's rating (it may burn out quickly), so for two-cell circuits use bulbs rated about 3-3.5 V. Keep spares.
- 1 buzzer rated for 1.5-3 V.
- 6 wires with crocodile clips.
- Paper clips, 2 brass paper fasteners (split pins), a small piece of card.
- Test objects (lesson 2): coin, plastic spoon, metal spoon, pencil (wooden end), pencil lead/graphite (see teacher note), rubber band, aluminium foil, paper, key, eraser, wooden lolly stick, glass marble.

Assessment

- Lesson 2 table and lesson 4 fair-test write-up (look for: one changed variable named, two controlled variables named, a conclusion that matches the results).
- Lesson 5 end-of-unit check: 8 questions, 16 marks, with an answer guide.

⚠ Safety (read before lesson 1)

- Only use low-voltage cells (AA or similar). **Never** experiment with wall sockets, plugs or mains appliances; the unit should say this out loud.
- **Do not use button cells.** If swallowed they can cause severe internal burns, injury or death (see the Button cell source). Keep them out of the classroom kit.
- **Short circuits:** a wire joined straight from one end of a cell to the other, with no bulb or buzzer, lets a large current flow and makes the wire and cell hot. Show students what this looks like on paper, never build it. If a wire or cell feels warm, unclip it and tell the teacher.
- Do not open, cut or bite cells. Remove cells from holders at the end of the lesson.

Sources

All checked to load on 4 November 2026.

- Wikipedia: Electric circuit
- Wikipedia: Electrical network
- Wikipedia: Electric current
- Wikipedia: Electrical conductor
- Wikipedia: Insulator (electricity)
- Wikipedia: Switch
- Wikipedia: Short circuit (overheating and fire risk)
- Wikipedia: Battery (electricity)
- Wikipedia: AA battery
- Wikipedia: Button cell (ingestion hazard)
- Wikipedia: Incandescent light bulb
- Wikipedia: Buzzer
- Wikipedia: Series and parallel circuits
- Wikipedia: Light-emitting diode (one-way behaviour, teacher note only)
- Wikipedia: Electrical injury (background for the mains warning)

Known gaps and cautions

- **Labelled simplifications:** "electricity flows round the loop" is used without explaining current, voltage or electrons; those come in grade 10. We say a cell "pushes" electricity; this is a model, not the full story.
- "Brightness" in lesson 4 is judged by eye on a 0-3 scale. This is a deliberate discussion point (it's a rough measure), not a hidden flaw.
- Parallel circuits are only mentioned as an extension; the main unit uses single loops (series).
- If you use LED bulbs instead of filament bulbs, they only work one way round; see the lesson 1 teacher note.
- No images yet; teachers will need to draw the circuits on the board.
- No standards alignment and no educator review.

Lesson 1: Make it light

Unit overview · Next: Lesson 2

Goal

Students light a bulb using one cell and two wires, and explain that it only works when there is a complete loop.

Materials (per group)

- 1 AA cell in a holder, 1 bulb in a holder, 2 crocodile-clip wires.
- Recording sheet: two boxes, "Lit" and "Not lit", for drawings.

Steps

✎ Opening (5 min)

Read the safety rules aloud (see the unit overview): cells only, never wall sockets; no button cells; never join a wire straight across a cell. Ask: "What things in your home need electricity? Which ones use batteries?"

✎ Main activity (25 min)

1. Challenge: "Make the bulb light using only these parts." Give no instructions about how.
2. Every time a group tries an arrangement, they draw it in "Lit" or "Not lit". Aim for at least two of each.
3. When most groups have a lit bulb, ask them to unclip **one** clip. What happens? Clip it back.
4. Groups compare drawings with another group: what do all the "Lit" drawings have in common?

✓ Discussion questions (with example answers)

- What do all the working circuits have in common? There is an unbroken path from one end of the cell, through the bulb, back to the other end.
- Why did the bulb go out when you unclipped one clip? The loop was broken, so electricity couldn't get all the way round.
- Does it matter which wire goes to which end of the cell? For a filament bulb, no: it lights either way round.

✓ Closing check (5 min, with answers)

Draw on the board: (a) a cell with one wire to a bulb and nothing back; (b) a full loop; (c) a loop with both wires on the same end of the cell. Which bulb lights? **Only (b).** (a) has a gap; in (c) the path doesn't go from one end of the cell to the other.

Vocabulary

cell (battery), bulb, wire, circuit, complete circuit / loop

Differentiation

- Support: give a photo or drawing of one working circuit to copy, then ask them to find a different working arrangement.
- Stretch: light two bulbs from one cell. Is each as bright as one bulb alone? (Sets up lesson 4.)

⚠ Safety

See the overview. Collect cells at the end of the lesson.

Teacher notes and misconceptions

- Common idea: "electricity only needs one wire, like a hose." The unclip test in step 3 challenges this directly.
- Strictly, a "battery" is two or more cells; everyday speech calls one AA a battery. Both words are fine at this age.
- If your kit uses LEDs, they light only one way round (current in one direction). Turn this into a question rather than calling it a fault.

Lesson 2: Conductors and insulators

Unit overview · Previous: Lesson 1 · Next: Lesson 3

Goal

Students predict, then test, which materials let electricity through, and record results in a table.

Materials (per group)

- Working circuit from lesson 1 with a third wire added so there is a gap between two crocodile clips (the "tester").
- Test objects: coin, plastic spoon, metal spoon, wooden lolly stick, rubber band, aluminium foil, paper, key, eraser, glass marble (10 objects).
- Results table: Object | Material | Prediction (lights / doesn't) | Result.

Steps

✎ Opening (5 min)

Show the tester. Touch the two free clips together: the bulb lights. Ask: "What if we put something in the gap?"

✎ Main activity (25 min)

1. Groups fill in the "Prediction" column for all 10 objects **before** testing. No changing predictions afterwards.
2. Test each object by clipping both clips onto it (or holding them firmly against it). Record the result.
3. Sort objects into two groups: "lets electricity through" (conductors) and "doesn't" (insulators).

✓ Discussion questions (with example answers)

- What do the conductors have in common? They are all metal (coin, metal spoon, foil, key).
- Were any of your predictions wrong? Which surprised you? Answers vary; common surprises: coins with dirty or painted surfaces, or foil with a plastic coating not conducting well.
- Why are wires covered in plastic? The metal inside carries electricity; the plastic is an insulator that stops it going where we don't want it, including into our hands.

✓ Closing check (5 min, with answers)

1. A new object: a paper clip. Conductor or insulator? **Conductor (metal).**

2. A plastic ruler? **Insulator.**
3. Name one material that is a conductor and one that is an insulator. **e.g. copper/steel/aluminium; plastic/wood/rubber/glass/paper.**

Vocabulary

conductor, insulator, material, prediction, result

Differentiation

- Support: give picture cards of the objects and a two-column sorting mat.
- Stretch: test a pencil lead (graphite) with the teacher (see note). Is it a metal? Does the "all conductors are metal" rule still hold?

⚠ Safety

Only test with the low-voltage tester. Explain that **water and human bodies can conduct** mains electricity, which is why we never test anything near wall sockets; we do not test wet objects or people in this lesson.

Teacher notes and misconceptions

- Graphite (pencil "lead") conducts but is not a metal. With one AA cell and a thin pencil lead the bulb may be very dim or not visibly lit; a short, thick piece works better. Use it as an "exceptions exist" moment, not a required result.
- Students sometimes think "shiny = conductor." A plastic object painted silver is a good counter-example if you have one.

Lesson 3: Switches

Unit overview · Previous: Lesson 2 · Next: Lesson 4

Goal

Students build a simple switch, explain it as "a gap we can open and close", and show it works anywhere in a single loop.

Materials (per group)

- 1 AA cell in a holder, 1 bulb, 1 buzzer, 4 crocodile-clip wires.
- Switch kit: a piece of card about 5 cm × 8 cm, 2 brass paper fasteners (split pins), 1 metal paper clip.

Steps

✎ Opening (5 min)

Ask: "How do you turn on a light at home without unplugging anything?" Link back to lesson 1: unclipping a wire turned the bulb off. A switch does the same job without unclipping.

✎ Main activity (25 min)

1. **Build the switch:** push both fasteners through the card about 3 cm apart. Hook the paper clip round one fastener so it can swing to touch the other. Open the fastener legs flat underneath.
2. Clip one wire to each fastener (underneath). Put the switch into the loop with the cell and bulb. Swing the paper clip: on, off.
3. **Does position matter?** Move the switch to a different place in the loop (before the bulb, after the bulb). Record: does it still control the bulb?
4. **Doorbell:** replace the bulb with the buzzer. The switch is now a doorbell button. If the buzzer is silent, try turning it round (many buzzers only work one way round, like LEDs).

✓ Discussion questions (with example answers)

- Explain how your switch works. When the paper clip touches both fasteners the loop is complete (metal conducts). When it is swung away there's a gap of air, which is an insulator, so the loop is broken.
- Did it matter where in the loop you put the switch? No. In a single loop, a break anywhere stops the whole loop.
- Why is the card a good base? Card is an insulator, so the electricity only goes through the paper clip, not across the card.

✓ Closing check (5 min, with answers)

1. In a switch, what is the "off" gap filled with? **Air (an insulator).**
2. Would a plastic paper clip work? **No, plastic is an insulator.**
3. A circuit has the switch between the cell and the buzzer. If we move the switch to the other side of the buzzer, will it still work? **Yes.**

Vocabulary

switch, open (off), closed (on), buzzer

Differentiation

- Support: pre-punch the holes in the card; pair with a confident builder.
- Stretch: design a "pressure switch" that turns on when something is stood on it (e.g. two foil strips separated by a sponge with a hole). Draw first, then build.

⚠ Safety

Brass fastener points are sharp; an adult can pre-punch holes with a sharp pencil. Same cell rules as lesson 1.

Teacher notes and misconceptions

- "Open" and "closed" are backwards from a door: an **open** switch is **off**. Say this explicitly; it confuses adults too.
- Some students think electricity is "used up" before the far side of the bulb, so the switch "after" the bulb shouldn't work. Step 3 tests this.

Lesson 4: A fair test: more bulbs

Unit overview · Previous: Lesson 3 · Next: Lesson 5

Goal

Students plan and carry out a fair test: does adding more bulbs to a single loop change how bright each bulb is?

Materials (per group)

- 1 AA cell in a holder, 3 identical bulbs in holders, 5 wires, a switch.
- Brightness scale card: 0 = off, 1 = dim glow, 2 = medium, 3 = bright.
- Planning sheet: question; what we change; what we keep the same; prediction; results table (Number of bulbs | Brightness, observer 1 | observer 2 | observer 3); conclusion.

Steps

✎ Opening (5 min)

Remind students of the grade 3 fair test: change **one** thing, keep the rest the same. Ask the question and have them write a prediction with a reason.

✎ Main activity (25 min)

1. **Plan:** fill in "What we change" (number of bulbs: 1, 2, 3) and "What we keep the same" (same cell, same type of bulb, same wires, same room light).
2. **Test:** build the loop with 1 bulb. Each group member rates brightness on the 0-3 scale **without telling the others**, then records. Repeat with 2 bulbs in the loop, then 3.
3. **Record and conclude:** "When we added more bulbs in one loop, each bulb got _____."

✓ Discussion questions (with example answers)

- What happened to brightness as you added bulbs? Each bulb got dimmer (typically 3 → 2 → 1, or 3 → 1 → 0 with a weak cell).
- Did all observers give the same number? Why not? Often not; judging brightness by eye is rough and depends on the observer. That's why we use more than one observer, and why scientists use meters (grade 10).
- What would have made the test unfair? Using a new cell for the 3-bulb test; using different types of bulb; moving to a sunnier spot.

✓ Closing check (5 min, with answers)

1. What did you change? **The number of bulbs.**

2. Name two things you kept the same. **Any two of: cell, bulb type, wires, room light, observers.**
3. Write one sentence conclusion. **"More bulbs in one loop made each bulb dimmer."** (Accept any conclusion that matches the group's own data.)

Vocabulary

fair test, variable, prediction, observer, conclusion, brightness

Differentiation

- Support: provide the planning sheet with "What we change" already filled.
- Stretch: try two cells with one bulb. Brighter or dimmer? (Only with bulbs rated for 3 V; check the rating with the teacher first.) Or try a **parallel** circuit: two bulbs each with their own loop to the cell. Compare brightness to the single loop.

⚠ Safety

Same as lesson 1. Do not add more cells than the bulbs are rated for: a bulb run above its rating can blow and get hot.

Teacher notes and misconceptions

- The explanation (each bulb adds resistance, so less current flows round the loop) is beyond grade 4. Accept "the cell has to push through more bulbs."
- If a group's data shows no change, check that bulbs are identical and the cell isn't flat; a flat cell gives 0 for everything.

Lesson 5: Drawing and designing circuits

Unit overview · Previous: Lesson 4

Goal

Students draw circuits with standard symbols, build a circuit from a drawing, and use what they know in a small design challenge. Ends with the unit check.

Materials (per group)

- Kit from lessons 1-4 (cell, bulbs, buzzer, wires, card switch).
- Symbol sheet (draw on the board): cell (long and short line), bulb (circle with a cross), switch (a line with a gap and a hinged line), buzzer, wire (straight lines with right-angled corners).
- Design brief cards (see below).

Steps

✎ Opening (10 min)

Show the symbols. Ask: "Why might engineers use symbols instead of drawing a realistic picture?" (Faster, clearer, anyone in the world can read them.) Draw lesson 1's circuit with symbols together.

✎ Main activity (20 min)

1. **Build from a drawing:** each group gets a symbol drawing (cell, switch, two bulbs in one loop) and builds it. Partner group checks.
2. **Design challenge** (choose one):
3. Lighthouse: a bulb at the top of a paper tower, with a switch at the bottom.
4. Door alarm: a buzzer that sounds when a door (a card flap) opens. Hint: the flap pushes two pieces of foil apart or together.
5. Quiz board: correct answers complete the loop and light the bulb.
6. Draw the design with symbols **before** building. Then build and test.

✓ Discussion questions (with example answers)

- Did your circuit work first time? What did you change? Answers vary; most common fixes are loose clips and a gap in the loop.
- Where is the switch in your design, and why there? e.g. "At the bottom of the lighthouse, so the keeper can reach it." (Any position works electrically; this is a design choice.)

✓ End-of-unit check (25 min, 8 questions, 16 marks)

1. Draw a circuit (symbols) with one cell, one bulb and one switch. **(3)**
2. A bulb doesn't light. Give two possible reasons. **(2)**
3. Sort into conductors and insulators: copper, rubber, aluminium, wood, steel, plastic. **(3)**
4. Why are electrical wires covered in plastic? **(2)**
5. What does a switch do in a circuit? **(1)**
6. In a fair test, why should you only change one thing? **(2)**
7. Amira adds a third bulb to a loop with two bulbs. Predict what happens to the brightness of each bulb. **(1)**
8. Why must you never experiment with wall sockets? **(2)**

Answer guide

1. Closed loop containing the cell symbol, a bulb symbol and a switch symbol, all connected: 1 mark per correct symbol in a complete loop.
2. Any two: a gap or loose clip; switch open; flat cell; broken bulb; an insulator in the loop; both wires on the same end of the cell.
3. Conductors: copper, aluminium, steel. Insulators: rubber, wood, plastic. Half a mark per correctly sorted material (6 × ½ = 3).
4. Plastic is an insulator (1); it stops electricity reaching us / going where it shouldn't (1).
5. It opens or closes a gap in the loop / turns the circuit on and off.
6. So you know which change caused the result (1); otherwise the result could be caused by something else (1).
7. Each bulb gets dimmer.
8. Mains electricity is much more powerful than a cell (1) and can seriously hurt or kill (1).

Vocabulary

symbol, circuit diagram, design, test, improve

Differentiation

- Support: give the symbol sheet during the check; read questions aloud.
- Stretch: draw a circuit where one switch controls two bulbs, and another where each bulb has its own switch (the second needs parallel loops).

⚠ Safety

Same as lesson 1. Foil in the door alarm must not join the two ends of the cell directly with nothing else in the loop (that's a short circuit).

Teacher notes and misconceptions

- Students often draw wires as wiggly lines; straight lines are a convention, not a rule of physics.

- Accept realistic pictures on question 1 for partial credit if the loop is correct; the symbols are the teaching point.