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Circuit Makers - Year 6

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Teacher overview

Purpose

Year 6 Science. Investigate complete electrical circuits and explain energy transfer and transformation in adult-checked low-voltage devices. Essential question: how is energy transferred and transformed in an electrical circuit?

Teaching routes

Full route: ten lessons of about 60 minutes. Compact route: eight 60-minute sessions using selected slides from the same ten files. It combines lessons 2/3 and 9/10. The same essential assessment finishes in compact session 8. No additional compact-route decks.

Learning evidence

Collect an initial question, labelled circuit model, energy explanation, controlled material comparison with repeated observations, systematic troubleshooting and an explanation for a classmate. Include scientific collaboration, a responsible recommendation and a relevant limitation.

Vocabulary

Circuit: conducting path through a load between supply terminals. Current: flow of electric charge. Energy: transferred and transformed. Conductor/insulator: behaviour under stated test conditions. Switch: opens/closes a path.

Access

Students may speak, draw, write, point to pictures/symbols, use a communication board/device, dictate to a scribe or demonstrate. Chunk instructions and provide labelled symbols. An adult can manage connections while a student directs and explains. Judge the same science.

Challenge

Use a specific problem, uncertain outcome, model limitation or safe new case. More writing, higher voltage and elaborate construction do not improve the learning demand.

Resource use

D1/D2 introduce the concepts and evidence reasoning. C1-C8 are case cards. The three-page game supports discussion. W01-W10 record lesson evidence; each matched answer follows its worksheet. A1/A2 and R1 support flexible final assessment.

Preparation, safety and evidence

Adult preparation

Before class, inspect approved educational cell holders, insulated leads and correctly rated bulb modules. Adult checks supply voltage, ratings, any manufacturer-required protection and connections. Use approved protected LED modules only, not bare LEDs. Buzzer/motor modules must match the supply; guard moving parts.

Safety boundaries

No mains outlets, coin/button/lithium cells, dismantled batteries/devices, shorts or overload. Never bridge supply terminals. Every test path includes the correctly rated load. Keep equipment dry. Disconnect before any setup change, inspection or sample replacement. Stop for warmth, damage or uncertainty. Never touch a component to test for heat.

Practical method

Adult checks before each brief reconnection. Agree on an observation rule and viewing conditions. A timer may keep a brief interval such as five seconds consistent, where the adult and equipment guidance approve. Record categories: glow, no glow, unclear. This is not an ammeter/current measurement.

Samples and care

Use approved dry bare metal paperclip, elastic strip, wooden craft stick and rubber eraser. The adult prepares the tester gap with the lead in every path. Reuse prepared classroom samples. Do not damage habitat or collect living materials from Country/Place.

Honest evidence

Keep actual trials blank until observed. Label every supplied case/table illustrative, model or fictional. Answers and data are examples, never predetermined classroom results. Preserve unexpected/unclear trials and add checked repeats separately. Use labelled secondary/model evidence if equipment is unavailable; do not claim students performed a practical they did not do.

Interpretation

No glow may reflect contact quality, coating, weak supply or tester sensitivity. Limit conductor conclusions to the tested samples and conditions. Brightness alone cannot establish energy efficiency. Current is moving charge and is not used up; components transfer energy.

Presentation files: Lessons 1–5

Lesson 01

Circuit Makers - Year 6 - Lesson 01 - Presentation.pptx — Energy in a device.

Lesson 02

Circuit Makers - Year 6 - Lesson 02 - Presentation.pptx — Complete paths.

Lesson 03

Circuit Makers - Year 6 - Lesson 03 - Presentation.pptx — Represent a circuit.

Lesson 04

Circuit Makers - Year 6 - Lesson 04 - Presentation.pptx — Switches control paths.

Lesson 05

Circuit Makers - Year 6 - Lesson 05 - Presentation.pptx — Plan a conductor circuit.

Compact mapping

Sessions 1/2/3/4/5/6/7/8 use lesson files 01 / 02+03 / 04 / 05 / 06 / 07 / 08 / 09+10. Select the mapped model/task slides in the integrated activity sequence. Use one opening, focus and closing in combined sessions. Do not run both whole disks end-to-end.

PREVIEW

Presentation files: Lessons 6–10

Lesson 06

Circuit Makers - Year 6 - Lesson 06 - Presentation.pptx — Collect test evidence.

Lesson 07

Circuit Makers - Year 6 - Lesson 07 - Presentation.pptx — Transformations.

Lesson 08

Circuit Makers - Year 6 - Lesson 08 - Presentation.pptx — Diagnose a circuit.

Lesson 09

Circuit Makers - Year 6 - Lesson 09 - Presentation.pptx — Circuit assessment.

Lesson 10

Circuit Makers - Year 6 - Lesson 10 - Presentation.pptx — Design responsibly.

Session timing

Each compact session: 5 minutes retrieve, 10 minutes model, 30 minutes practical/application, 10 minutes evidence/conference, 5 minutes safe disconnect and cleanup. Prepare before class. Split practical work across meetings if necessary without reducing the learning time.

PREVIEW

Eight-session route: Sessions 1–4

1: Energy in a device

Use full lesson 1. Trace source, transfer and outputs. Collect W01, initial question and current/energy distinction.

2: Complete circuits and diagrams

Use lesson 2 model/setup/evidence and collaboration slides, then lesson 3 symbol/model/diagram checks. Build or analyse one circuit, compare its open/closed path and draw its connections before disconnecting. Collect W02/W03 and collaboration reasoning.

3: Switches

Use lesson 4. Predict and compare switch positions with controlled repeated observations. Collect W04, safe method and kept-same conditions.

4: Plan the material comparison

Use lesson 5. Plan variables, observation categories, consistent timing, contacts and load protection. Adult approves W05 before testing.

PREVIEW

Eight-session route: Sessions 5–8

5: Collect evidence

Use lesson 6. Perform safe approved comparisons with three trials each. Record individual outcomes, counts and uncertainties in W06. A simple column graph can use sample names and glowing-trial counts 0-3.

6: Energy transformations

Use lesson 7. Compare bulb/buzzer/guarded-motor outputs and energy models. Include different expertise and evaluate an unsupported efficiency claim. Collect W07 and collaboration reasoning.

7: Troubleshoot and prepare portfolio

Use lesson 8. Collect one-change fault evidence and a bounded community-decision response. Select existing W01-W08 records for assessment, rather than starting a new portfolio.

8: Assessment and responsible design

Use lesson 9 evidence/task/transfer slides then lesson 10 purpose/criteria/recommendation slides. Students explain the path, material test, energy, safe method, fault evidence and limitations. Include real collaboration and a concise safe design recommendation with criteria and unknowns. Complete A1/A2 and teacher judgement.

Conference access

During the 30-minute task block, collect short recordings, spoken-to-adult, drawn or supported explanations. A 10-minute cannot cover the class. Combine them with existing practical/portfolio evidence. No student loses assessment because public speaking is inaccessible.

PREVIEW

Scientific collaboration and game guide

Real official example

Taronga describes partnerships with UNSW and San Diego Zoo Wildlife Alliance in platypus research. Threat/habitat evidence and genetic/reproductive management contribute to conservation decisions. Teach why different expertise and previous findings improve explanations. This biological example illustrates collaboration; it is separate from the circuit investigation.

Fictional application

Observer, modeller and reviewer roles apply that reasoning to a fictional circuit problem. Ask what one role alone might miss. Classroom teamwork alone is insufficient evidence of scientific advances.

Cards 1-2

1: Trace a continuous path from one supply terminal through the load to the other. 2: Explain that the open-switch gap can prevent output; disconnect and ask an adult to check.

Cards 3-4

3: Predict that fixing one loose contact may reproduce problem; preserve before/after observations and other possibilities. 4: Change component only keep supply/load/leads/contact rule/viewing/time consistent.

Cards 5-6

5: Preserve unclear evidence to avoid forcing a prediction; ask for a checked repeat. 6: Current is flowing charge energy transfer and changes form in a component.

Cards 7-8

7: Explain how different evidence or review improves a claim, with the real official case discussed separately. 8: Recommend a safe purpose-based change, such as comfortable switch access, with criteria and unknowns.

Game use

Groups of 2-4 discuss a challenge at each of six trail stops. Ask a respectful question and check these criteria. Use large counters or point. No speed requirement. Discussion uses models only; an adult manages real equipment.

Source

Based on: Taronga Conservation Society Australia, Platypus. Teacher-viewing link: <https://www.taronga.org.au/wildlife-and-conservation/animals/detail/platypus>. Short original factual summary only; no official image reproduced.

Lesson 1: Energy in a device — Teaching

Learning

Explain how a battery-powered device transfers and transforms energy.

Prepare

Checked educational battery holder and supply, insulated leads, correctly rated bulb module, optional approved buzzer or motor module.

Retrieve — 5 minutes

Explain the source and useful output of a low-voltage device. Notice an output. Describe how energy reaches the component. First thought: what changes when a torch lights?

Model — 10 minutes

Current is the flow of electric charge in a circuit. A battery supplies energy. The circuit transfers energy to components. Energy changes form in components. Current is not used up by a bulb. Chemical energy stored in the battery becomes electrical energy transferred through the circuit. The bulb transforms energy into light and thermal energy. This model explains the energy changes. It does not show what happens inside the battery.

Practical/application — 30 minutes

Use adult-checked, school-approved low-voltage equipment only. Disconnect the supply before every change. Keep a correctly rated load in the path. An adult checks component ratings, dry leads and intact connections. No mains sockets, coin/button/lithium cells, dismantled devices, shorts or unprotected LEDs. Question: how does the bulb output change when the approved switch opens? Predict an outcome and give a reason about the path. The switch is closed. Change. Keep the same supply, bulb and leads. Inspect the checked device with the supply disconnected. Ask the adult to approve the connected setup, then observe the output briefly. Disconnect. Record what you saw or use the labelled example if equipment is unavailable. Use W01 to identify the source, transfer and output. Explain the same idea by writing, drawing, speaking or showing selected pictures. Challenge: identify a less useful energy output and a limit of your model.

Lesson 1: Energy in a device — Evidence and access

Evidence/conference — 10 minutes

W01 energy explanation, initial question and observation. Distinguish moving charge from energy transferred. Use the matching learning record and accessible explanation. Gather individual reasoning, not participation alone.

Reflection and cleanup — 5 minutes

Complete: energy is transferred to the bulb, where it becomes ... How is current different from energy? Save your first question and explanation for the final portfolio. Disconnect, return dry equipment and clear the working space safely.

Support and challenge

Chunk the task; offer labelled symbols, partner-supported choices, communication board/device, adult scribing or practical direction. Challenge with a relevant uncertainty/model limit or a new safe case. Maintain the same concept.

Source note

Original unit models/cases. Keep actual observations distinct from illustrative examples.

PREVIEW

Lesson 2: Complete paths — Teaching

Learning

Explain why a load needs a complete conducting path between supply terminals.

Prepare

Adult-checked low-voltage supply, correctly rated bulb module, insulated leads, approved switch.

Retrieve — 5 minutes

Trace one complete path through the bulb and back to the other supply terminal. Explain why an open path stops a bulb lighting. Retrieve: what does a bulb transform energy into?

Model — 10 minutes

A closed circuit has a continuous conducting path through a load between supply terminals. An open switch or loose connection creates a break. A bulb also needs suitable components and supply, so a complete-looking path alone is not proof. Use adult-checked, school-approved low-voltage equipment only. Disconnect the supply before every change. Keep a correctly rated load in the path. Keep the bulb in the path. Never join supply terminals directly. The adult approves the setup before the supply connects.

Practical/application — 30 minutes

With the supply disconnected, build the approved bulb circuit. The adult checks it. Observe closed-switch output, then disconnect. Open the switch. Reconnect only after approval, observe, then disconnect again. In 102, draw or trace the path and identify the break. Record your actual outcome using supplied diagram, label it a model. Explain how the evidence supports a closed-loop complete path. Taronga describes work with UNSW and San Diego Zoo Wildlife Alliance. The partnership connects research on threats with genetic and reproductive management. Ask: what might a team miss if it considered only one kind of evidence? A reviewer checks the bulb output. A modeller checks the drawn path. A reviewer compares the connection evidence with earlier circuit findings. Explain how their different evidence could improve a diagnosis. This team is fictional.

Lesson 2: Complete paths — Evidence and access

Evidence/conference — 10 minutes

W02 complete-path explanation, safe practical observation or labelled model interpretation, collaboration response. Use the matching learning record and accessible explanation. Gather individual reasoning, not participation alone.

Reflection and cleanup — 5 minutes

Point to or explain the whole path between terminals through the bulb. How did the observation support your explanation? What else would you check if the path looked complete? Disconnect, return dry equipment and clear the working space safely.

Support and challenge

Chunk the task; offer labelled symbols, partner-supported choices, communication board/device, adult scribing or practical direction. Challenge with a relevant uncertainty/model limit or a new safe case. Maintain the same concept.

Source note

Original summary based on Taronga Conservation Society Australia, Platypus (taronga.org.au). This real case and fictional circuit learnings have different evidence origins.

PREVIEW

Lesson 3: Represent a circuit — Teaching

Learning

Match circuit symbols and connections to a real or model circuit.

Prepare

Same checked circuit, D1 and D2, W03, drawing tools.

Retrieve — 5 minutes

Draw a diagram that represents the actual connections. Use a key consistently so another person can follow the path. Retrieve: where does an open switch break a circuit?

Model — 10 minutes

A cell uses one long and one short parallel line. A battery has more than one cell. A lamp symbol is a circle with a cross. An open switch symbol has a gap. Lines represent conducting connections. Labels clarify the approved components. Trace from one supply terminal through the load and switch to the other terminal. A diagram shows electrical connections rather than exact classroom distances. Never draw or build a direct connection between supply terminals that bypasses the load.

Practical/application — 30 minutes

Keep the supply disconnected while you identify each component. Use W03 to draw the circuit with the switch closed. Check each drawn connection against the actual setup or D2 model. Copy your diagram and change only the switch symbol to show the gap. Explain why the load output stops in the open model. Leave every other component and connection in the same position. Yet another traces the path without looking at the equipment. Does the diagram identify the supply, load and switch? Explain and correct one unclear connection together. The adult checks any physical change.

Lesson 3: Represent a circuit — Evidence and access

Evidence/conference — 10 minutes

W03 labelled diagram with correctly connected components and an explanation of a model limitation. Use the matching learning record and accessible explanation. Gather individual reasoning, not participation alone.

Reflection and cleanup — 5 minutes

Explain one symbol and the connection it represents. You may point, describe, draw or use a communication board/device. Save the diagram as evidence alongside its actual observation or model label. Disconnect, return dry equipment and clear the working space safely.

Support and challenge

Chunk the task; offer labelled symbols, partner-supported choices, communication board/device, adult scribing or practical direction. Challenge with a model limitation/uncertainty/model limit or a new safe case. Maintain the same concept.

Source note

Original unit models/cases. Keep actual observations distinct from illustrative examples.

PREVIEW

Lesson 4: Switches control paths — Teaching

Learning

Ask a testable question about a switch and compare outcomes fairly.

Prepare

Adult-approved supply, bulb, insulated leads and switch; W04.

Retrieve — 5 minutes

Explain how a switch controls a conducting path. Predict and compare the outcomes of open and closed positions. Retrieve: how does a circuit diagram show a break?

Model — 10 minutes

Closing the switch joins its contacts. Opening it creates a gap. In our checked single-loop circuit, this controls the bulb output. The switch controls the path. It does not provide the energy. Question: what happens to the bulb when the switch opens? Prediction: the bulb stops glowing because the conducting path is broken. State this before testing, then compare it with your observations.

Practical/application — 30 minutes

Change: switch position only. Keep: the same supply, bulb, leads and room viewing conditions. Observe: bulb glows, does not glow, or outcome unclear. Do not guess. Use adult-checked, school-approved low-voltage equipment only. Disconnect the supply before every change. Keep a correctly rated load in the path. The adult approves each condition before reconnecting. Observe briefly, disconnect before the next condition and stop if anything is warm or damaged. Repeat through brief trials for each position in W04. Use yes, no or unclear for the bulb output. View actual observations. A supplied example is illustrative, never your measured result. Compare your results with the prediction. Use the switch gap and conducting path to explain the pattern. If outcomes disagree, check connection consistency with the adult rather than changing the record.

Lesson 4: Switches control paths — Evidence and access

Evidence/conference — 10 minutes

W04 prediction, changed/kept-same conditions and three honest trials for each switch position. Use the matching learning record and accessible explanation. Gather individual reasoning, not participation alone.

Reflection and cleanup — 5 minutes

What changed? What stayed the same? Which observation supports your switch explanation? What question could you test next within the same safety limits? Disconnect, return dry equipment and clear the working space safely.

Support and challenge

Chunk the task; offer labelled symbols, partner-supported choices, communication board/device, adult scribing or practical direction. Challenge with a relevant uncertainty/model limit or a new safe case. Maintain the same concept.

Source note

Original unit models/cases. Keep actual observations distinct from illustrative examples.

PREVIEW

Lesson 5: Plan a conductor test — Teaching

Learning

Plan a controlled comparison of dry materials with an approved tester.

Prepare

Teacher-prepared rated bulb tester with sample gap, approved dry samples such as bare metal paperclip, plastic strip, wooden craft stick and rubber eraser.

Retrieve — 5 minutes

Plan a safe test of whether each dry sample completes a conducting path. Keep the setup constant so the comparison has meaning. Retrieve: what must remain in the circuit to avoid a short?

Model — 10 minutes

A conductor allows charge to move through it readily. An insulator strongly resists charge movement under our test conditions. Our tester gives evidence for these particular samples and conditions. The adult prepares a sample gap in a correctly rated bulb circuit. Every possible path still includes the load. Never place a sample directly across supply terminals. Disconnect before inserting or removing it.

Practical/application — 30 minutes

Question: which dry samples allow the bulb to glow in our tester? Predict for each sample and explain using its material. A coated metal sample may differ from bare metal. Testing checks the prediction. Change sample material. Observe: bulb glows, does not glow or unclear. Keep: supply, bulb, leads, contact positions and observation time. Use three brief trials for each sample and record them separately. 1. Disconnect. Insert an approved sample at the gap. 2. Adult checks contacts and load. Reconnect briefly and observe. 3. Disconnect, record the outcome, then repeat the same method. Agree on how to judge the glow in the same room conditions. Use the same brief observation time, for example five seconds with a timer. We record categories, not current in amperes. Our equipment does not measure current.

Lesson 5: Plan a conductor test — Evidence and access

Evidence/conference — 10 minutes

W05 question, reasoned prediction, variables, load protection, controls, repeatable procedure and observation categories. Use the matching learning record and accessible explanation. Gather individual reasoning, not participation alone.

Reflection and cleanup — 5 minutes

Why must the bulb stay in every tester path? Which kept-same condition protects the fairness of your conclusion? Reuse dry prepared samples. Leave natural habitats and living things undisturbed. Disconnect, return dry equipment and clear the working space safely.

Support and challenge

Chunk the task; offer labelled symbols, partner-supported choices, communication board/device, adult scribing or practical direction. Challenge with a relevant uncertainty/model limit or a new safe case. Maintain the same concept.

Source note

Original unit models/cases. Keep actual observations distinct from illustrative examples.

PREVIEW

Lesson 6: Collect test evidence — Teaching

Learning

Record repeated observations honestly and reach a bounded conclusion.

Prepare

Adult-approved tester and the unchanged W05 sample set; W06; timer for the agreed brief observation time.

Retrieve — 5 minutes

Use the approved plan to collect repeated observations. Compare samples using the recorded evidence. Retrieve: what will you change and what will stay the same?

Model — 10 minutes

Use adult-checked, school-approved low-voltage equipment only. Disconnect the supply before every change. Keep a correctly rated load in the path. Check your circuit and observation rule, dry samples and safe contacts. An adult approves the setup before each reconnection. W06 has separate columns for trials 1, 2, and 3. Record glow, no glow or unclear immediately after each trial. Record what happens, even if it disagrees with your prediction.

Practical/application — 30 minutes

Disconnect and insert the approved sample. The adult checks the circuit. Reconnect briefly, observe for the agreed time, then disconnect and record the outcome. Repeat twice without changing the comparison conditions. Repeat for the other approved dry samples. If a trial is unclear, preserve that record and allow for a checked repeat. Use the same light conditions and timing rule for each sample. Count how many trials showed a glow for each sample. Summarise the count from two to three, keeping unclear trials visible. You can draw a simple column graph. List sample names and number of glowing trials. Use the results to say which tested samples showed a conducting path. Limit the claim to our tester and sample conditions. No glow alone does not prove a perfect insulator. Poor contact or low sensitivity can affect it.

Lesson 6: Collect test evidence — Evidence and access

Evidence/conference — 10 minutes

W06 individual trial outcomes, categorical pattern summary, conclusion and a relevant limitation. Use the matching learning record and accessible explanation. Gather individual reasoning, not participation alone.

Reflection and cleanup — 5 minutes

How did repeated trials help you judge a pattern? What source of uncertainty matters most in your test? Which change would make a future safe comparison more useful? Disconnect, return dry equipment and clear the working space safely.

Support and challenge

Chunk the task; offer labelled symbols, partner-supported choices, communication board/device, adult scribing or practical direction. Challenge with a relevant uncertainty/model limit or a new safe case. Maintain the same concept.

Source note

Original unit models/cases. Keep actual observations distinct from illustrative examples.

PREVIEW

Lesson 7: Transformations — Teaching

Learning

Explain useful and less useful energy outputs without treating current as used up.

Prepare

Adult-approved single-load bulb, buzzer and guarded motor modules used separately; W07; optional labelled secondary observations.

Retrieve — 5 minutes

Compare how three suitable components transform energy. Explain the useful output and a less useful output for a purpose. Retrieve: what is the difference between current and transferred energy?

Model — 10 minutes

A battery transforms stored chemical energy into electrical energy transferred to a component. A bulb produces light and thermal energy. A buzzer produces sound and thermal energy. A motor produces movement and thermal energy. Outputs depend on the device and conditions. In a steady single-loop circuit, current flows throughout the complete path. A component transfers energy without being uncharged. Our simple model does not measure current or describe every internal process.

Practical/application — 30 minutes

Use adult-checked, school-approved low-voltage equipment only. Disconnect the supply before every change. Keep a correctly rated load in the path. An adult selects suitable components and protection. Use one load at a time. Keep fingers clear of moving parts. Stop and disconnect if a component becomes warm or damaged. Observe each approved output briefly and disconnected before changing loads. Record what you can actually see or hear. Avoid touching to avoid fire. Explain energy changes using the taught model. Label supplies, examples illustrative. Light is useful for a torch. Movement is useful for a fan. Some transferred energy becomes unwanted thermal energy for these purposes. Do not claim an exact efficiency from observations that contain no energy measurements. Taronga combines university and wildlife expertise in platypus conservation research. Genetic and reproductive evidence can join information about threats and habitats. Explain why earlier findings help teams decide which new questions to investigate. A circuit observer describes the outputs. A modeller explains the energy changes. A reviewer asks whether the measurements support an efficiency claim. This fictional team applies the collaboration idea. Its results are not Taronga findings.

Lesson 7: Transformations — Evidence and access

Evidence/conference — 10 minutes

W07 energy chains, comparison of outputs, explanation of collaboration and model limits. Use the matching learning record and accessible explanation. Gather individual reasoning, not participation alone.

Reflection and cleanup — 5 minutes

Explain why saying current gets used up can mislead someone. Which observation supports an output claim, and which part comes from a model? Save the comparison and collaboration response for assessment. Disconnect, return dry equipment and clear the working space safely.

Support and challenge

Chunk the task; offer labelled symbols, partner-supported choices, communication board/device, adult scribing or practical direction. Challenge with a different uncertainty/model limit or a new safe case. Maintain the same concept.

Source note

Original summary based on Taronga Conservation Society Australia, Platypus (taronga.org.au). This real case and fictional circuit forms have different evidence origins.

PREVIEW

Lesson 8: Diagnose a circuit — Teaching

Learning

Troubleshoot systematically and use evidence to discuss a community choice.

Prepare

Teacher-prepared safe open-switch, loose-contact or missing-connection cases; no deliberately dangerous faults; W08.

Retrieve — 5 minutes

Diagnose a safe circuit fault using evidence and one change at a time. Use science to explain a practical community choice. Retrieve: why can no glow have more than one possible cause?

Model — 10 minutes

The bulb is off. The switch appears closed. One lead is loose. That loose contact is a possible break in the conducting path. Predict the outcome of fixing only that contact. This is an illustrative case. Disconnect. Visually inspect the path and approved component ratings. Ask the adult to check one suspected connection. Reconnect only after approval, observe briefly, then disconnect and record.

Practical/application — 30 minutes

Changing several parts at once can make the cause unclear. Record the suspected cause, single change and before/after observation. A matching prediction supports a cause. It does not rule out every other possible fault. Use W08 and the teacher-prepared safe case. Repeat the checked observation to see whether the fix is consistent. If the outcome stays unclear, preserve the evidence and ask for adult review. The school needs a reading light for a supervised display. Option A is bright but has an awkward switch. Option B is easier to control. What evidence about lighting, safe control and energy use should the school collect? Recommend a choice for a named purpose using relevant evidence. Consider adult approval, visibility and ease of control. Brightness alone cannot establish energy efficiency. Explain what remains unknown.

Lesson 8: Diagnose a circuit — Evidence and access

Evidence/conference — 10 minutes

W08 fault record, prediction, one checked change, repeat observation, uncertainty and community-decision response. Use the matching learning record and accessible explanation. Gather individual reasoning, not participation alone.

Reflection and cleanup — 5 minutes

Which observation best supports your fault diagnosis? What cannot be concluded from that observation alone? Prepare your circuit, diagram, test and troubleshooting evidence for assessment. Disconnect, return dry equipment and clear the working space safely.

Support and challenge

Chunk the task; offer labelled symbols, partner-supported choices, communication board/device, adult scribing or practical direction. Challenge with a relevant uncertainty/model limit or a new safe case. Maintain the same concept.

Source note

Original unit models/cases. Keep actual observations distinct from illustrative examples.

PREVIEW

Lesson 9: Circuit assessment — Teaching

Learning

Communicate a circuit explanation using your collected evidence and its limitations.

Prepare

Saved W01-W08 records, documented/working adult-checked circuit, assessment pages A1-A2 and rubric R1.

Retrieve — 5 minutes

Explain your circuit to a Year 6 classmate using collected evidence. Show your method and a meaningful limitation. You may speak, draw, write, demonstrate or use supported picture choices.

Model — 10 minutes

Choose a circuit diagram, energy explanation and repeated natural-list record. Include one systematic troubleshooting record. Label each item actual observation, model, illustrative data or official source summary. Claim: the checked conducting path let the bulb glow. Evidence: refer to an actual recorded observation or labelled model case. Reason: energy transfers to the bulb through the complete circuit and changes into light and thermal energy.

Practical/application — 30 minutes

Explain your changed condition kept-some conditions and observation rule. Show repeated trials and preserve under outcomes. Explain how the adult-approved setup kept a rated load in the path than a limit connected to your evidence. For example, no glow may reflect a weak contact or the test sensitivity. Explain how a specific safe improvement could reduce uncertainty. Use A1 to organise the existing portfolio. Use A2 for a concise explanation. The teacher collects observation and conference evidence alongside your records. A longer written report or confident public speaking is not required. A changed buzzer stays silent although its switch looks closed. What safe check comes first? How could a complete path change energy outputs? Explain why you need evidence before claiming that the buzzer is faulty.

Lesson 9: Circuit assessment — Evidence and access

Evidence/conference — 10 minutes

Complete-path/material/energy explanation, controlled investigation, troubleshooting, collaboration and reasoned transfer response. Use the matching learning record and accessible explanation. Gather individual reasoning, not participation alone.

Reflection and cleanup — 5 minutes

Which piece of evidence best supports your explanation? What would you revise after a further safe check? Assessment uses the taught ideas and evidence, with the same expectations for every response mode. Disconnect, return dry equipment and clear the working space safely.

Support and challenge

Chunk the task; offer labelled symbols, partner-supported choices, communication board/device, adult scribing or practical direction. Challenge with a relevant uncertainty/model limit or a new safe case. Maintain the same concept.

Source note

Original summary based on Taronga Conservation Society Australia, Platypus (taronga.org.au). This real case and fictional circuit forms have different evidence origins.

PREVIEW

Lesson 10: Design responsibly — Teaching

Learning

Recommend a safe purpose-based improvement using evidence and scientific collaboration.

Prepare

Saved circuit evidence, W10, fictional supervised display-light scenario; no new device construction required.

Retrieve — 5 minutes

Recommend an improvement for a supervised school display light. Justify the idea using circuit and energy evidence. Use the same taught safety limits. This lesson needs no new construction.

Model — 10 minutes

A fictional display needs clear reading light and a switch easy to control. Any electrical design must use adult-approved components and safe connections. Separate the user need from the proposed scientific explanation. Propose a position the approved switch where the user can operate it comfortably. Reason the switch controls the complete path through the light. The adult evaluates the setup before any physical change.

Practical/application — 30 minutes

Criterion: the checked switch reliably controls the light in repeated brief trials. Criterion: a supervised user can operate it comfortably. Energy-efficiency claims would need appropriate measurements. Do not infer them from brightness alone. Taronga describes partners contributing knowledge to platypus conservation research. Different evidence helps teams ask better questions and review decisions. Earlier findings guide new studies. This example is separate from our fictional circuit design. An observer checks light output. A modeller checks both an energy explanations. A user reviewer checks switch access. An adult checks safety and component ratings. Explain one contribution that another role might otherwise miss. Use W10 to address a school audience. Give the purpose, proposal, evidence, evaluation criterion and one unknown. Use written, spoken, drawn or supported responses to show the same reasoning.

Lesson 10: Design responsibly — Evidence and access

Evidence/conference — 10 minutes

W10 recommendation for school audience, scientific reason, evaluation criterion, unknowns and collaboration contribution. Use the matching learning record and accessible explanation. Gather individual reasoning, not participation alone.

Reflection and cleanup — 5 minutes

What science supports your recommendation? What evidence could change your mind? In the eight-session route, this concise transfer response completes assessment in session 8. Disconnect, return dry equipment and clear the working space safely.

Support and challenge

Chunk the task; offer labelled symbols, partner-supported choices, communication board/device, adult scribing or practical direction. Challenge with a relevant uncertainty/model limit or a new safe case. Maintain the same concept.

Source note

Original summary based on Taronga Conservation Society Australia, Platypus (taronga.org.au). This real case and fictional circuit board have different evidence origins.

PREVIEW

Circuit Makers: Key Ideas

Circuit:

A complete conducting path through a load between supply terminals.



Conductor:

A material that lets electric charge move through it readily.



Insulator:

A material that strongly resists charge movement in our test conditions.



Switch:

Opens or closes a conducting path.



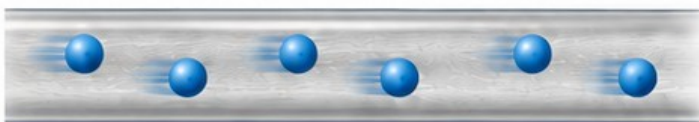
Open
(path broken)



Closed
(path complete)

Current:

The flow of electric charge.



Moving charge

Energy:

Transferred by the circuit and transformed in components.



Current is **not used up** by a bulb.
A battery supplies energy.

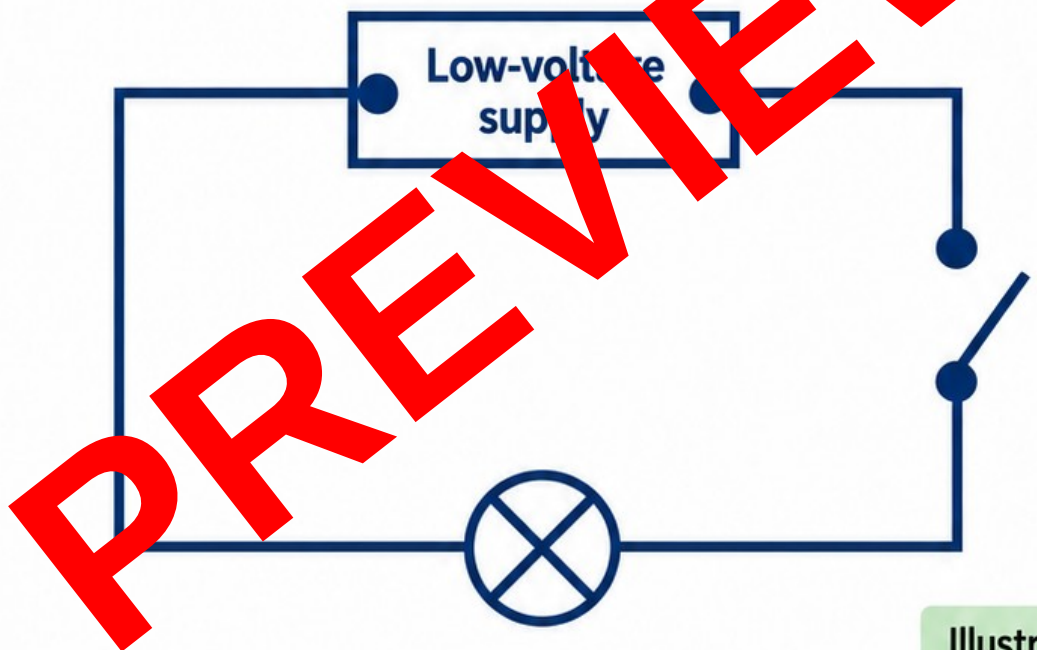
How We Explain Our Evidence

1 Question

Why might a bulb not light in an open circuit?

2 Evidence

The bulb is off.
The switch has a gap.



Illustrative model

3 Explanation

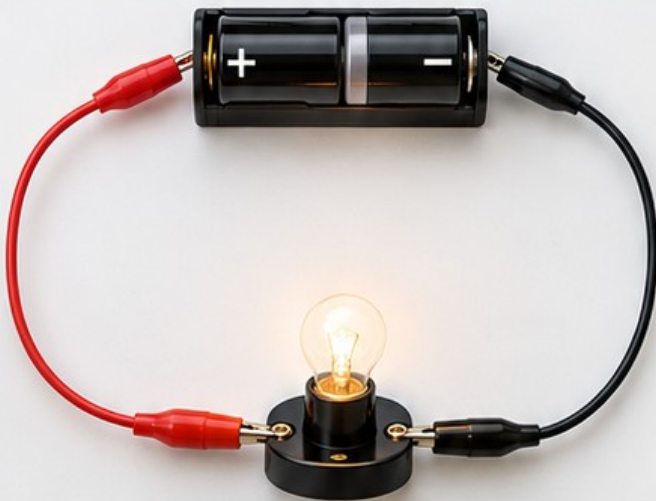
The gap breaks the conducting path.
Disconnect and ask the adult to check the approved setup.

A complete-looking path does not prove every component works.

Circuit Case Cards 1

C1 | A complete loop

A correctly rated bulb lies in the conducting path between supply terminals. Trace the whole path.



C2 | An open switch

Illustrative case: an open switch creates a gap. Why can the bulb be off?



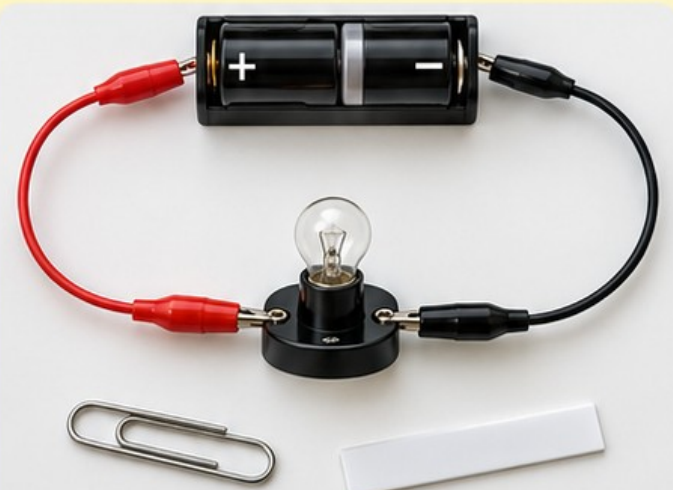
C3 | A loose connection

Fictional case: one lead is loose. Disconnect. What would the adult check first?



C4 | Material evidence

A bare metal paperclip and a dry plastic strip are approved samples. Predict, then test with the rated load in place.



Circuit Case Cards 2

C5 | Honest observations

A trial is unclear. Preserve that record and ask for a checked repeat. Why is guessing unhelpful?



C6 | Energy outputs

A bulb gives light, a buzzer gives sound, and a motor gives movement. Each also transfers some energy as heat.



C7 | Different perspectives

Fictional team... an observer records outputs, a modeller checks the plan, and a reviewer checks the claim. What can they learn together?



C8 | A responsible choice

Fictional school: a display light needs safe control and comfortable switch access. What evidence would support an improvement?



Evidence Trail: How to Play

2-4 students. Cooperate and explain. No race or speed limit.

1

Choose a challenge card. Point to a stop on the trail.



2

Give an answer using evidence. Speak, draw, point or use a communication board/device.



3

A partner asks one respectful question. Check the teacher response guide.



4

Keep or improve the explanation, then move to the next stop.



5

Visit all six stops. Reuse cards when a new explanation would help.

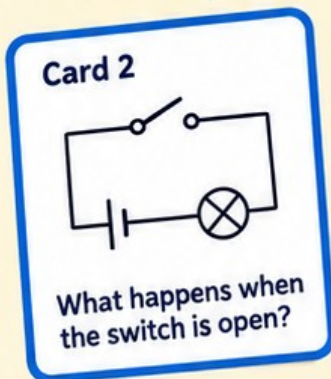


Use large counters or point.



Worked Example

Card 2 asks about an open switch. I choose Explain.



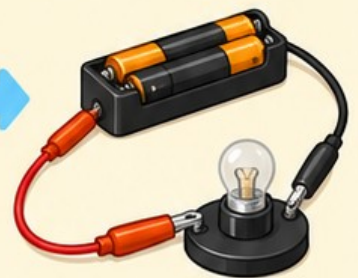
The switch gap breaks the path, so the bulb may be off.



My partner asks: what would you check safely?



We disconnect and ask the adult to inspect the approved setup.



Discuss diagrams only. An adult manages any real equipment.

Evidence Trail

Follow the trail to think like a scientist!



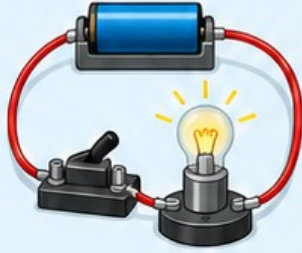
Choose a card at each stop.

Explain, ask a respectful question, then check the teacher guide.

Evidence Trail: Challenge Cards

1 Notice

C1: Trace the whole conducting path through the bulb.



2 Explain

C2: Why might the bulb be off when the switch is open?



3 Ask

C3: Predict what may change after the adult fixes one loose contact.



4 Compare

C4: What changes and what stays the same in material?



5 Reflect

C5: Why should an unclear trial remain in the record?



6 Explain

C6: What is the difference between current and transferred energy?



7 Apply

C7: Explain one benefit of different scientific expertise.



8 Apply

C8: Recommend one safe improvement and evidence still needed.

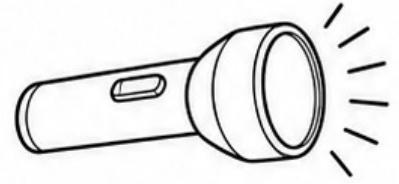


Energy in a Device

Name: _____

Date: _____

Notice: Identify the source and useful output of an approved battery-powered device.



Record: Draw and label a model of its energy changes.

PREVIEW

Explain: How is current different from energy?

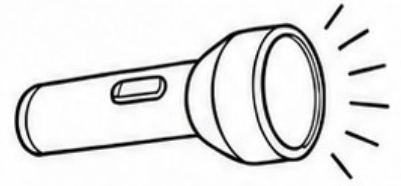
Reflect: What did you observe? What does your model leave out?

Energy in a Device

Name: ANSWERS

Date: _____

Notice: Identify the source and useful output of an approved battery-powered device.



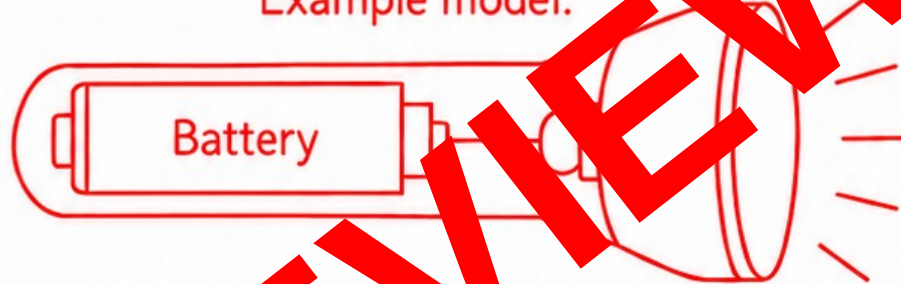
Record: Draw and label a model of its energy changes.

Example: battery-powered torch.

Source: battery.

Useful output: light.

Example model.



Stored chemical energy in battery -> electrical energy transferred -> light and thermal energy at bulb.

Explain: How is current different from energy?

Current is flowing electric charge.

Energy transfers to the bulb and changes form.

Charge is not used up.

Reflect: What did you observe? What does your model leave out?

Example only: I observed light.

The model omits details inside the battery.

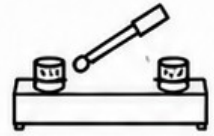
Accept other accurate devices and honest observations.

Name: _____

Date: _____

Complete Paths

Notice: A bulb is off and the approved switch is open.
This is an illustrative model case.



Record: Draw the circuit, including supply, bulb and switch. Mark the break.

PREVIEW

Explain: Why might the bulb be off?

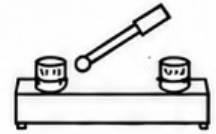
Reflect: What safe check comes before a change? What else could cause no glow?

Name: **ANSWERS**

Date: _____

Complete Paths

Notice: A bulb is off and the approved switch is open.
This is an illustrative model case.



Record: Draw the circuit, including supply, bulb and switch. Mark the break.



Explain: Why might the bulb be off?

THE OPEN SWITCH BREAKS THE CONDUCTING PATH, SO THE BULB MAY BE OFF.

Reflect: What safe check comes before a change? What else could cause no glow?

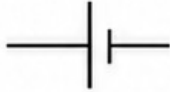
DISCONNECT AND ASK THE ADULT TO INSPECT. A LOOSE CONTACT, FAULTY COMPONENT OR UNSUITABLE APPROVED SUPPLY COULD ALSO PREVENT GLOW. EXAMPLE MODEL, NOT A CLASSROOM OBSERVATION.

Represent a Circuit

Name: _____ Date: _____

Notice: Use the checked bulb circuit or D2 model. A key explains what each symbol represents.

Key



cell



lamp



closed switch



open switch

Record: Draw a circuit with cell, lamp and closed switch. Label each component.

Compare: Draw the same circuit with an open switch.

Explain: What does a diagram show? What does it leave out?

Keep the load in the path. Never connect supply terminals directly.

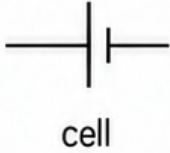
Represent a Circuit

Name: **ANSWERS**

Date: _____

Notice: Use the checked bulb circuit or D2 model. A key explains what each symbol represents.

Key



cell



lamp

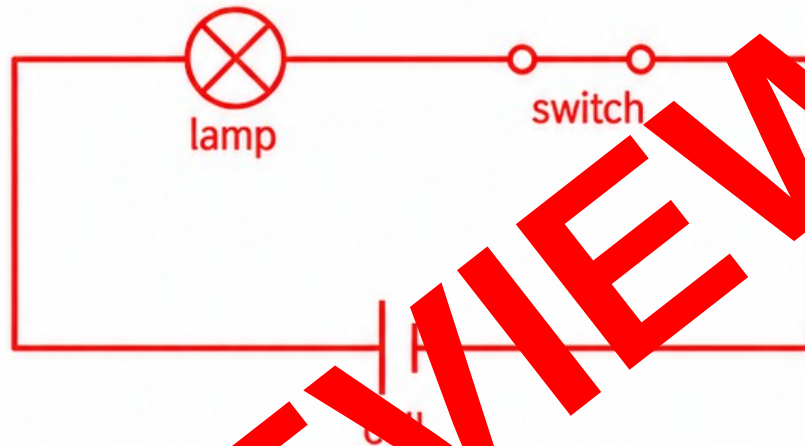


closed switch

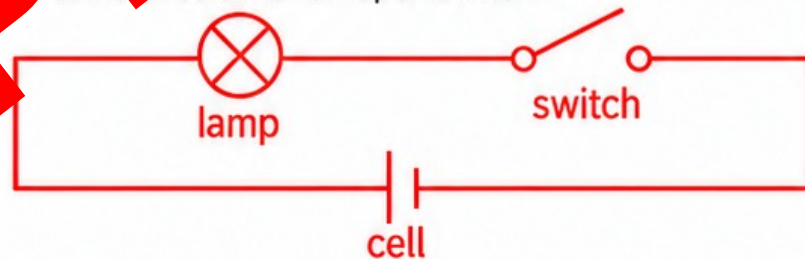


open switch

Record: Draw a circuit with cell, lamp and closed switch. Label each component.



Compare: Draw the same circuit with an open switch.



Explain: What does a diagram show? What does it leave out?

A diagram shows components and their connections.

It omits exact distances, component ratings and hidden faults such as a broken lead.

Example model. Accept any accurate equivalent circuit.

Keep the load in the path. Never connect supply terminals directly.

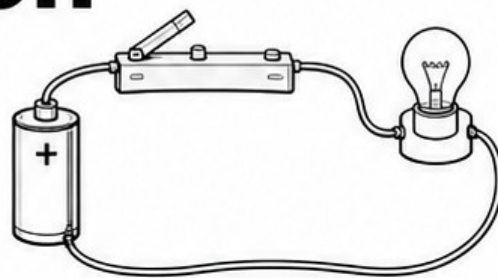
Name: _____

Date: _____

Switch Investigation

Notice:

Question: What happens to bulb output when the approved switch opens?



Predict and explain:

Record:

Switch position	Trial 1	Trial 2	Trial 3
Closed			
Open			

Keep the same:

Explain:

 Compare observations with your prediction.

Record glow, no glow or unclear. Disconnect before changes. Adult checks each condition.

Name: _____

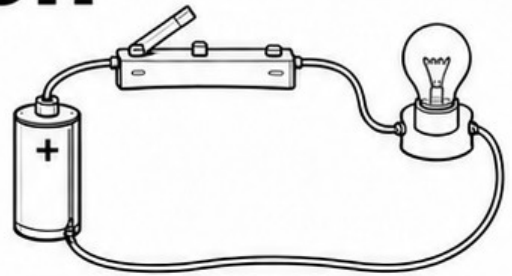
ANSWERS

Date: _____

Switch Investigation

Notice:

Question: What happens to bulb output when the approved switch opens?



Predict and explain:

I predict no glow when open because the path has a gap.

Record:

Switch position	Trial 1	Trial 2	Trial 3
Closed	GLOW	GLOW	GLOW
Open	NO GLOW	NO GLOW	NO GLOW

Illustrative only; your results may differ.

Keep the same:

Supply, bulb, leads and room viewing conditions.

Explain: Compare observations with your prediction.

The example supports complete-path reasoning. Preserve unexpected or unclear observations and ask for a checked repeat.

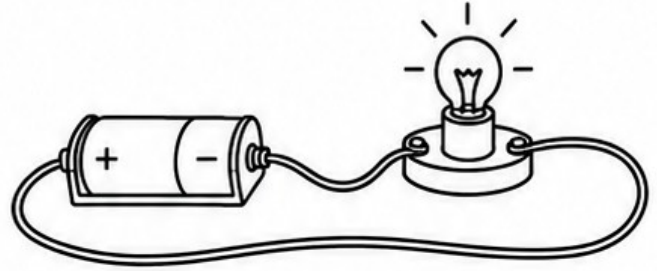
Record glow, no glow or unclear. Disconnect before changes. Adult checks each condition.

Name: _____

Date: _____

Plan a Conductor Test

Notice: Which approved dry samples let the bulb glow in our tester?



Predict: Which materials will let the bulb glow? Give reasons for your predictions.

Record:

Changed condition: _____ Observation: _____

Kept-same conditions:

Method:

1. _____
2. _____
3. _____
4. _____

Safety: Why must a rated bulb stay in every path?

Adult checks setup. Never bridge supply terminals. Disconnect before each change.

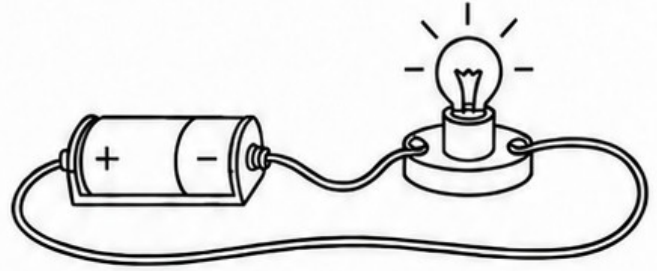
Name: _____

ANSWERS

Date: _____

Plan a Conductor Test

Notice: Which approved dry samples let the bulb glow in our tester?



Predict: Which materials will let the bulb glow? Give reasons for your predictions.

BARE METAL MAY ALLOW GLOW; DRY PLASTIC MAY NOT. PREDICTIONS NEED CHECKING.

Record:

Changed condition: **SAMPLE MATERIAL** Observation: **GLOW, NO GLOW OR UNCLEAR**

Kept-same conditions:

SUPPLY, BULB, LEADS, CONTACT POSITIONS, ROOM LIGHT AND BRIEF OBSERVATION TIME.

Method:

- 1. DISCONNECT AND INSERT AN APPROVED DRY SAMPLE.**
- 2. ADULT CHECKS CONTACTS AND RATED LOAD.**
- 3. RECONNECT BRIEFLY, OBSERVE, DISCONNECT AND RECORD.**
- 4. COMPLETE THREE TRIALS PER SAMPLE IN TOTAL.**

Safety: Why must a rated bulb stay in every path?

THE RATED LOAD PREVENTS A DIRECT CONNECTION BETWEEN SUPPLY TERMINALS. EXAMPLE PLAN; ADULT APPROVAL STILL REQUIRED.

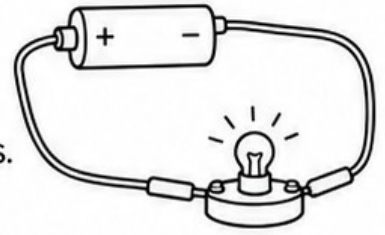
Adult checks setup. Never bridge supply terminals. Disconnect before each change.

Name: _____

Date: _____

Collect Test Evidence

Notice: Use the approved W05 plan. Observation time: _____ seconds.
Keep the same conditions.



1. Record

Sample	Trial 1	Trial 2	Trial 3
Bare metal paperclip			
Dry plastic strip			
Wooden craft stick			
Rubber eraser			

2. Pattern

Count glowing trials for each sample.

3. Explain

What conclusion does your evidence support?

4. Reflect

What limitation or uncertainty matters?

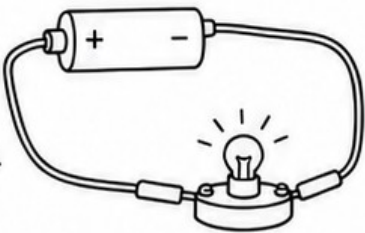
Record glow, no glow or unclear. These are categories, not current measurements.

Name: **ANSWERS**

Date: _____

Collect Test Evidence

Notice: Use the approved W05 plan. Observation time: **5** seconds.
Keep the same conditions.



1. Record

Sample	Trial 1	Trial 2	Trial 3
Bare metal paperclip	GLOW	GLOW	GLOW
Dry plastic strip	NO GLOW	NO GLOW	NO GLOW
Wooden craft stick	NO GLOW	NO GLOW	NO GLOW
Rubber eraser	NO GLOW	NO GLOW	NO GLOW

2. Pattern

Count glowing trials for each sample.

GLOWING TRIALS: PAPERCLIP 3; EACH OTHER SAMPLE 0. ILLUSTRATIVE DATA, NOT ACTUAL TRIALS.

3. Explain

What conclusion does your evidence support?

IN THIS EXAMPLE, THE BARE PAPERCLIP ALLOWED A CONDUCTING PATH IN THIS TESTER.

4. Reflect

What limitation or uncertainty matters?

CONTACT QUALITY, COATING AND TESTER SENSITIVITY LIMIT THE CLAIM.

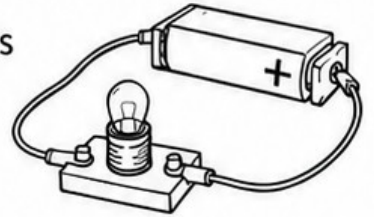
Record glow, no glow or unclear. These are categories, not current measurements.

Name: _____

Date: _____

Energy Transformations

Notice: Compare adult-approved bulb, buzzer and motor modules separately, or use labelled examples.



Record: Draw and label an energy chain for each component.

Bulb	
Buzzer	
Motor	

Explain: Why is current not used up in a component?

Reflect: Why does brightness alone not prove efficiency?

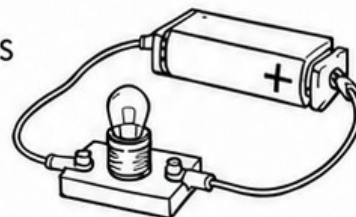
Do not touch components to test for heat. Disconnect before every change.

Name: **ANSWERS**

Date: _____

Energy Transformations

Notice: Compare adult-approved bulb, buzzer and motor modules separately, or use labelled examples.



Record: Draw and label an energy chain for each component.

Bulb	chemical -> electrical -> light + thermal Example energy models
Buzzer	chemical -> electrical -> sound + thermal
Motor	chemical -> electrical -> movement + thermal

Explain: Why is current not used up in a component?

Moving charge continues around a steady single loop.

Components transfer energy without using up charge.

Reflect: Why does brightness alone not prove efficiency?

Brightness does not measure input energy or total outputs.

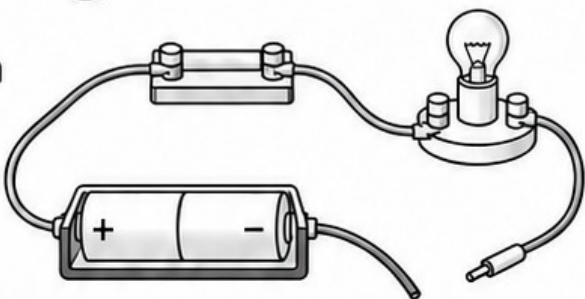
A fair efficiency comparison needs appropriate measurements.

Do not touch components to test for heat. Disconnect before every change.

Name: _____ Date: _____

Circuit Troubleshooting

Notice: Fictional case: the bulb is off, the switch looks closed, and one lead is loose.



1. Predict a cause:

2. Record:

Suspected cause	One adult-checked change	Before	After	Repeat

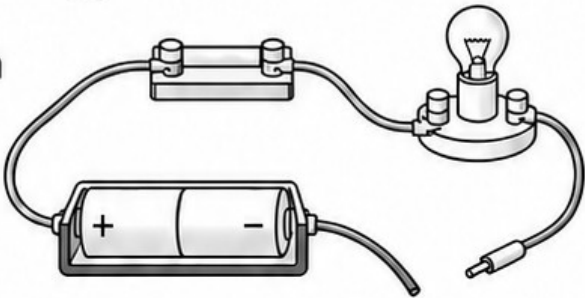
3. Explain: Which evidence supports your diagnosis?

4. Reflect: What remains uncertain? What safe check comes next?

Disconnect before inspection or changes. Never create a dangerous fault to test.

Circuit Troubleshooting

Notice: Fictional case: the bulb is off, the switch looks closed, and one lead is loose.



1. Predict a cause:

The loose lead may break the conducting path.

2. Record:

Suspected cause	One adult-checked change	Before	After	Repeat
Loose contact <i>(Illustrative only)</i>	Adult reconnects that lead	No glow	Glow	Glow again

3. Explain: Which evidence supports your diagnosis?

Glow after one checked change supports the loose-contact explanation.

4. Reflect: What remains uncertain? What safe check comes next?

Other faults may exist. Preserve the observations and ask the adult to inspect if the outcome stays unclear.

Name: _____

Date: _____

My Circuit Explanation



Notice: Audience: a Year 6 classmate. Use your saved circuit, material-test and fault records.

My claim and labelled model:

PREVIEW

Specific evidence:

PREVIEW

Reasoning about path, materials and energy:

PREVIEW

One limitation and safe improvement:

PREVIEW

Write, draw, speak, demonstrate or use supported choices. Label actual, model or illustrative evidence.

Name: **ANSWERS**

Date: _____

My Circuit Explanation



Notice: Audience: a Year 6 classmate. Use your saved circuit, material-test and fault records.

My claim and labelled model:

Example claim: a complete conducting path lets energy reach the bulb. An open switch creates a break.

Specific evidence:

Refer to specific saved trials. Example only:

closed glow, open no glow, paper no glow, plastic no glow.

Reasoning about path, materials and energy:

Conducting materials complete the path. Energy changes to light and thermal energy at the bulb; charge is not used up.

One limitation and safe improvement:

A weak contact could affect no-glow evidence. Ask the adult to check contacts and repeat. Accept any accurate explanation tied to honest evidence.

Write, draw, speak, demonstrate or use supported choices. Label actual, model or illustrative evidence.

Name: _____ Date: _____

Design Responsibly



Notice: Fictional school display: reading light needs safe control and comfortable switch access. No new construction required.

Our purpose and recommendation:

Scientific reason and supporting evidence:

Evaluation criterion:

Different expertise and evidence still needed:

Recommend only adult-approved changes. Brightness alone cannot prove energy efficiency.

Name: **ANSWERS**

Date: _____

Design Responsibly



Notice: Fictional school display: reading light needs safe control and comfortable switch access. No new construction required.

Our purpose and recommendation:

Example: move the approved switch to a comfortable position for the supervised user.

Scientific reason and supporting evidence:

The switch controls the conducting path. Use repeated checked open/closed observations and user-access evidence.

Evaluation criterion:

The light switch is reliable and the user can operate it comfortably in a supervised check.

Different expertise and evidence still needed:

Observer checks outputs, modeller checks explanation, user reviewer checks access, adult checks safety. Proper measurements are needed for efficiency claims. Other evidence-based safe ideas are valid.

Recommend only adult-approved changes. Brightness alone cannot prove energy efficiency.

Assessment and quiz guidance

Assessment task

A working or accurately documented circuit, energy explanation, controlled conductor/insulator investigation and repeatable troubleshooting record. A1 organises the evidence; A2 supports a concise conference and new-case application; R1 gives four criteria. Complete assessment in full lesson 9/10 or compact session 8.

Evidence criteria

Check accurate path/material/energy understanding, controlled safe repeated method, evidence-linked explanation, meaningful uncertainty and responsible application. Include different scientific expertise and a named audience. Judge demonstrated science, not drawing neatness, writing length or confidence. Supports do not lower achievement.

New-case anchor

Silent approved buzzer with closed switch: disconnect, inspect the path with the adult, check one suspected connection before retesting. A complete-locking switch alone cannot prove all parts work. Energy transforms to sound and thermal energy when the device operates.

Recommendation anchor

Comfortable switch access for a supervised school display light is one valid purpose-based proposal. Require repeated control evidence, use access checks, adult safety approval and a specific criterion. Brightness cannot establish efficiency without suitable input/output measurements.

Quiz

The separate quiz contains ten questions, each followed by an answer/explanation slide, plus instructions and revision. Use supported responses and discuss acceptable equivalent reasoning. The quiz supplements practical/portfolio evidence; it is not the sole assessment.

Circuit Makers: Assessment Plan

Name: _____ Date: _____

Audience: a Year 6 classmate. Use your saved evidence. No new device construction required.

1 My circuit: Supply, load and switch. Draw or attach a labelled model.



2 My investigation: Question, changed condition, kept-same conditions, observation rule and repeated evidence.



3 My troubleshooting: Suspected cause, one safe change, before/after and repeat evidence.



Label actual observation, model, illustrative data or official source summary. Explain by writing, drawing, speaking, demonstrating or supported choices. Adult checks all real equipment.

Circuit Makers: Evidence Conference

Name: _____ Date: _____

Path, materials and energy: Explain your circuit using specific saved evidence.

Method and uncertainty: Explain fairness, safe repeats, a limitation and one improvement.

Different scientific expertise: Explain how the real Tāwhiri partnership combines knowledge. Apply the idea to a clearly fictional circuit to

New case: An approved buzzer stays silent with a closed switch. Explain the first safe check and the energy output if it works.

Responsible decision: Recommend one safe display-light improvement for a school audience. State an evaluation criterion and evidence still needed.

The teacher may record spoken, drawn, demonstrated or supported responses. Same learning expectations.

Circuit Makers: Assessment Rubric

Criterion	Developing	Sound	Extending
Understanding	Important gap in path, material or energy reasoning.	Correctly explains path, tested materials and energy changes.	Transfers all three ideas to a new case with a model limit.
Evidence and process	Method or claim lacks a usable evidence link.	Uses a controlled safe method, repeated records and systematic fault evidence.	Evaluates a specific confound and justifies a safe improvement.
Explanation and application	Explanation or recommendation lacks a scientific reason.	Explains for a classmate and justifies a safe purpose-based recommendation.	Identifies alternatives, criteria and needed evidence.
Reflection and responsibility	Uncertainty or expertise contribution is missing.	Identifies a relevant limitation and explains different scientific expertise.	Explains how further evidence and combined expertise could change a decision.

Communication supports do not look for achievement, demonstrated science, not handwriting, confidence or amount of writing.

Teacher notes:

Circuit Makers - Year 6
Lesson 1
Energy in a device



Our learning

Explain the source and useful output of a low-voltage device.

Notice an output. Describe how energy reaches the component.

First thought: what changes when a switch is closed?

PREVIEW

Current and energy

Current is the flow of electric charge in a circuit.

A battery supplies energy. The circuit transfers energy to components.

Energy changes form in a component. Current is not used up by a bulb.

PREVIEW

A torch model

Chemical energy stored in the battery becomes electrical energy transferred through the circuit.

The bulb transforms energy into light and thermal energy.

This model explains the energy change. It does not show every process in the battery.



Safe classroom equipment

Use adult-checked, school-approved low-voltage equipment only.

Disconnect the supply before every change. Keep a correctly rated load in the path.

An adult checks component ratings, dry cells and intact connections.

No mains sockets, coin/button lithium cells, dismantled devices, shorts or unprotected LEDs.

A testable question

Question: how does the bulb output change when the improved switch opens?

Predict an outcome and give a reason about the path.

The switch position is the change. Keep the same supply, bulb and leads.

PREVIEW

Observation task

Inspect the checked device with the supply disconnected.

Ask the adult to approve the connected setup, then observe the output briefly.

Disconnect. Record what you saw or use the labelled example if equipment is unavailable.

PREVIEW

Your energy explanation

Use W01 to identify the source, transfer and output.

Explain the same idea by writing, drawing, speaking or showing selected pictures.

Challenge: identify a less useful energy output and a limit of your model.

Evidence check

A bulb glowed in a checked circuit. What was observed?

What energy change explains the light?

A prediction is a reasoned expectation. An observation is what the trial shows.

PREVIEW

Reflection

Complete: energy is transferred to the bulb, when it becomes ...

How is current different from energy?

Save your first question and explanation for the final portfolio.

PREVIEW

Well done!
Energy in a device



Circuit Makers - Year 6

Lesson 2

Complete paths



Our learning

Trace one complete path through the bulb and back to the other supply terminal.

Explain why an open path stops a bulb lighting.

Retrieve: what does a bulb transform energy into?

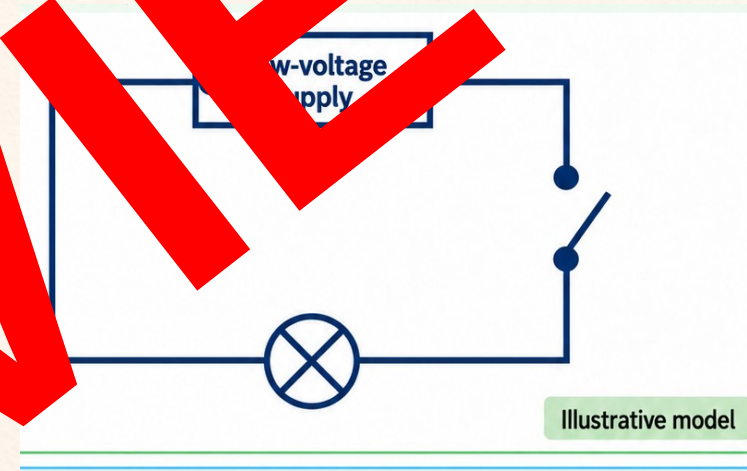
PREVIEW

An open and closed path

A closed circuit has a continuous conducting path through a load between supply terminals

An open switch or loose connection creates a break.

A bulb also needs suitable components and supply, so a complete-loop path alone is not proof.



Safe setup

Use adult-checked, school-approved low-voltage equipment only.

Disconnect the supply before every change. Keep a correctly rated load in the path.

Keep the bulb in the path. Never join supply terminals directly.

The adult approves the setup before the supply connects.

One circuit, two conditions

With the supply disconnected, build the approved bulb circuit.

The adult checks it. Observe closed-switch output, then disconnect.

Open the switch. Reconnect only after approval, observe, then disconnect again.

PREVIEW

The evidence record

In W02, draw or trace the path and identify the break.

Record your actual outcome. If using a supplied diagram, label it a model.

Explain how the evidence supports a claim about a complete path.

PREVIEW

Scientists combine expertise

Taronga describes work with UNSW and San Diego Zoo Wildlife Alliance.

The partnership connects research on threats with genetic and reproductive management.

Ask: what might a team miss if it considers only one kind of evidence?

Based on: Taronga Conservation Society Australia, Platypus (taronga.org.au)

A fictional circuit team

An observer checks the bulb output. A modeller checks the drawn path.

A reviewer compares the connection evidence with evidence circuit findings.

Explain how their different evidence could improve a diagnosis. This team is fictional.

PREVIEW

A guided explanation

Illustrative case: a bulb is off and the approved switch is open.

The break can explain the observation. Check the parts carefully before drawing a conclusion.

If the bulb remains off after closing the switch, another fault may exist.

Reflection

Point to or explain the whole path between terminals through the bulb.

How did the observation support your explanation?

What else would you check if the bulb looked complete?

PREVIEW

Well done!
Complete paths



Circuit Makers - Year 6

Lesson 3

Represent a circuit



Our learning

Draw a diagram that represents the actual connections.

Use a key consistently so another person can follow the path.

Retrieve: where does an open switch break a circuit?

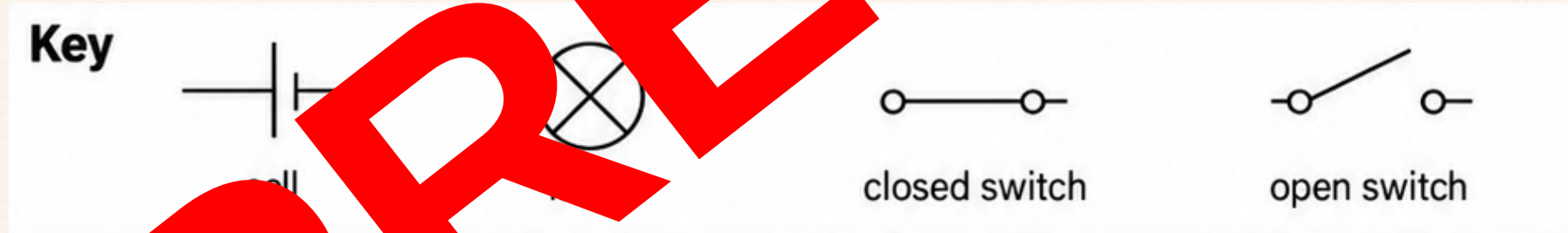
PREVIEW

Symbols represent components

A cell uses one long and one short parallel line. A battery has more than one cell.

A lamp symbol is a circle with a cross. An open switch symbol has a gap.

Lines represent conducting connections. Labels clarify the approved components.



Connections matter

Trace from one supply terminal through the load and switch to the other terminal.

A diagram shows electrical connections rather than exact classroom distances.

Never draw or build a direct connection between supply terminals that bypasses the load.

From equipment to a model

Keep the supply disconnected while you identify each component.

Use W03 to draw the circuit with the switch closed.

Check each drawn connection against the actual setup or D2 model.

PREVIEW

An open-switch variation

Copy your diagram and change only the switch symbol to show the gap.

Explain why the load output stops in the ideal model.

Leave every other component and connection in the same position.

PREVIEW

Partner check

Your partner traces the path without looking at the equipment.

Does the diagram identify the supply, load and switch?

Explain and correct one unclear connection together. The adult checks any physical change.

PREVIEW

A model has limits

The symbols omit wire length, component ratings, and details inside the supply.

A neat diagram cannot prove that a real lead is working.

Challenge: name evidence you would need to confirm that the circuit operates.

PREVIEW

Reflection

Explain one symbol and the connection it represents.

You may point, describe, draw or use a communication board/device.

Save the diagram as evidence alongside its actual observation or model label.

PREVIEW

Well done!
Represent a circuit



Circuit Makers - Year 6
Lesson 4
Switches control paths



Our learning

Explain how a switch controls a conducting path.

Predict and compare the outcomes of open and closed positions.

Retrieve: how does a circuit diagram show a break?

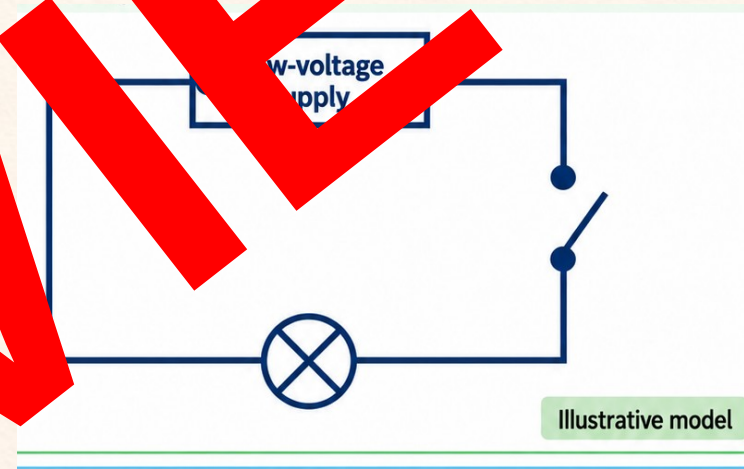
PREVIEW

A switch changes a connection

Closing the switch joins its contacts. Opening it creates a gap.

In our checked single-loop circuit, this controls the bulb output.

The switch controls the path. It does not provide the energy.



Our question and prediction

Question: what happens to the bulb when the switch opens?

Prediction: the bulb stops glowing because the conducting path is broken.

State this before testing, then compare it with your observations.

A fair comparison

Change: switch position only.

Keep: the same supply, bulb, leads and room viewing conditions.

Observe: bulb glows, does not glow, outcome unclear. Do not guess.

PREVIEW

Safe repeated method

Use adult-checked, school-approved low-voltage equipment only.

Disconnect the supply before every change. Keep a correctly rated load in the path.

The adult approves each condition before connecting.

Observe briefly. Disconnect before the next condition and stop if anything is warm or damaged.

Your trial record

Record three brief trials for each position in W04.

Use yes, no or unclear for the bulb output.

Write actual observations. A supplied example is illustrative, never your measured result.

PREVIEW

The explanation

Compare your results with the prediction.

Use the switch gap and conducting path to explain the pattern.

If outcomes disagree, check connection consistency with the adult rather than changing the record.

PREVIEW

Care and access

Use dry classroom samples and keep all equipment away from water.

Reuse prepared equipment. Do not remove materials from habitats or damage Country/Place.

Choose a safe observer, recorder or explainer role. Every student shows the same reasoning.

PREVIEW

Reflection

What changed? What stayed the same?

Which observation supports your switch in explanation?

What question could you test next within the same safety limits?

PREVIEW

Well done!
Switches control paths



Circuit Makers - Year 6
Lesson 5
Plan a conductor test



Our learning

Plan a safe test of whether each dry sample completes a conducting path.

Keep the setup constant so the comparison has meaning.

Retrieve: what must remain in the circuit to avoid a short?

PREVIEW

Conductors and insulators

A conductor allows charge to move through it readily.

An insulator strongly resists charge movement under our test conditions.

Our tester gives evidence for the particular samples and conditions



The approved tester

The adult prepares a sample gap in a correctly wired loop circuit.

Every possible path still includes the load.

Never place a sample directly across supply terminals. Disconnect before inserting or removing it.

PREVIEW

Question and prediction

Question: which dry samples allow the bulb to glow in our tester?

Predict for each sample and explain using its nature.

A coated metal sample may differ from bare metal. Testing checks the prediction.

The fair-test plan

Change: sample material. Observe: bulb glows, does not glow or unclear.

Keep: supply, bulb, leads, contact position and observation time.

Use three brief trials for each sample and record them separately.

PREVIEW

Repeatable steps

1. Disconnect. Insert an approved sample at the gap.
2. Adult checks contacts and load. Reconnect carefully and observe.
3. Disconnect, record the outcome, then repeat the same method.

PREVIEW

A useful observation rule

Agree on how to judge the glow in the same room conditions.

Use the same brief observation time, for example five seconds with a timer.

We record categories, not current in amperes. Our equipment does not measure current.

PREVIEW

Your investigation plan

Complete W05 before any testing. Ask the adult to check it.

A partner should be able to repeat the method from your steps.

Challenge: explain how coating or contact area could confuse the comparison.

PREVIEW

Reflection

Why must the bulb stay in every tester path?

Which kept-same condition protects the integrity of your conclusion?

Reuse dry prepared samples. Leave natural habitats and living things undisturbed.

PREVIEW

Well done!
Plan a conductor test



Circuit Makers - Year 6
Lesson 6
Collect test evidence



Our learning

Use the approved plan to collect repeated observations

Compare samples using the recorded evidence

Retrieve: what will you change and what will stay the same?

PREVIEW

Before each trial

Use adult-checked, school-approved low-voltage equipment only.

Disconnect the supply before every change. Keep a correctly rated load in the path.

Check your agreed observation rule, dry samples and safe contacts.

An adult approves the setup before each reconnection.

PREVIEW

A clear trial record

W06 has separate columns for trials 1, 2 and 3.

Record glow, no glow or unclear immediately after each trial.

Record what happened, even if it disagrees with your prediction.

PREVIEW

Guided first sample

Disconnect and insert the approved sample. The adult checks the circuit.
Reconnect briefly, observe for the agreed time, then disconnect.
Record the outcome. Repeat twice without changing the comparison conditions.

PREVIEW

Your comparisons

Repeat for the other approved dry samples.

If a trial is unclear, preserve that record and do a fresh repeat.

Use the same light conditions and timing rule for each sample.

PREVIEW

From table to pattern

Count how many trials showed a glow for each sample.

Summarise the count from zero to three, keeping only materials visible.

You can draw a simple column graph. Label sample names and number of glowing trials.

PREVIEW

Evidence-based conclusion

Use the results to say which tested samples allowed a conducting path.

Limit the claim to our tester and sample conditions.

No glow alone does not prove a perfect insulator. Poor contact or low sensitivity can affect it.

PREVIEW

Illustrative alternatives

If equipment is unavailable, analyse the supplied illustrative table.

Label the work illustrative/model data. Do not claim you carried out those trials.

Practical participation can use an accessible adult-supported role when safe equipment is available.

PREVIEW

Reflection

How did repeated trials help you judge a pattern?

What source of uncertainty matters most in your test?

Which change would make a future life comparison more useful?

PREVIEW

Well done!
Collect test evidence



Circuit Makers - Year 6

Lesson 7

Transformations



Our learning

Compare how three suitable components transform energy.

Explain the useful output and a less useful output for a purpose.

Retrieve: what is the difference between current and transferred energy?

PREVIEW

Energy through a circuit

A battery transforms stored chemical energy into electrical energy transferred to a component.

A bulb produces light and thermal energy.
A buzzer produces sound and thermal energy.

A motor produces movement and thermal energy. Outputs depend on the device and conditions.



Current continues around a loop

In a steady single-loop circuit, charge flows through the complete path.

A component transfers energy without using up charge.

Our simple model does not measure current but describe every internal process.

PREVIEW

Safe output comparisons

Use adult-checked, school-approved low-voltage equipment only.

Disconnect the supply before every change. Keep a correctly rated load in the path.

An adult selects suitable components and protection. Use one load at a time.

Keep fingers clear of moving parts. Stop and disconnect if a component becomes warm or damaged.

Observation and explanation

Observe each approved output briefly and disconnect before changing loads.

Record what you can actually see or hear. Avoid touching to test for heat.

Explain energy changes using the taught model. Label supplied examples illustrating .

Purpose changes the useful output

Light is useful for a torch. Movement is useful for a fan.

Some transferred energy becomes unwanted thermal energy for these purposes.

Do not claim an exact efficiency from observations that contain no energy measurements.

PREVIEW

Different scientific expertise

Taronga combines university and wildlife expertise in platypus conservation research.

Genetic and reproductive evidence can join information about threats and habitats.

Explain why earlier findings help teams decide which new questions to investigate.

Based on: Taronga Conservation Society Australia, Platypus (taronga.org.au)

A fictional review team

A circuit observer describes the outputs. A modeler explains the energy changes.

A reviewer asks whether the measurements support an efficiency claim.

This fictional team applies the collaborative idea. Its results are not Taronga findings.

PREVIEW

Your comparison

Use W07 to show energy chains for the three components.

Explain one model limitation and one output useful for a named purpose.

Challenge: identify evidence needed to compare energy use fairly.

Reflection

Explain why saying current gets used up can mislead someone.

Which observation supports an output claim, and which part comes from a model?

Save the comparison and collaboration responses for assessment.

PREVIEW

Well done! Transformations



Circuit Makers - Year 6
Lesson 8
Diagnose a circuit



Our learning

Diagnose a safe circuit fault using evidence and make change at a time.

Use science to explain a practical community choice

Retrieve: why can no glow have more than one possible cause?

PREVIEW

Evidence before a change

The bulb is off. The switch appears closed. One lead is loose.

That loose contact is a possible break in the conductive path.

Predict the outcome of fixing only that contact. This is an illustrative case.

PREVIEW

The safe troubleshooting order

Disconnect. Visually inspect the path and approved component ratings.

Ask the adult to check one suspected connection.

Reconnect only after approval, observe briefly, then disconnect and record.

PREVIEW

One change gives clearer evidence

Changing several parts at once can make the cause unclear.

Record the suspected cause, single change and before/after observation.

A matching prediction supports a cause. It does not rule out every other possible fault.

PREVIEW

Your fault investigation

Use W08 and the teacher-prepared safe case.

Repeat the checked observation to see whether the result is consistent.

If the outcome stays unclear, present the evidence and ask for adult review.

PREVIEW

A fictional community decision

The school needs a reading light for a supervised display.

Option A is bright but has an awkward switch. Option B is easier to control.

What evidence about lighting, safe controls and energy use should the school collect?

A justified recommendation

Recommend a choice for a named purpose using relevant evidence.

Consider adult approval, visibility and ease of control.

Brightness alone cannot establish energy efficiency. Explain what remains unknown.

PREVIEW

Method evaluation

Could loose contacts, sample coating or changed light conditions affect results?

Name one weakness in your method and a realistic safe improvement.

Keep actual evidence separate from fictional decision information.

PREVIEW

Reflection

Which observation best supports your fault diagnosis?

What cannot be concluded from that observation alone?

Prepare your circuit, diagram, test and troubleshooting evidence for assessment.

PREVIEW

Well done!
Diagnose a circuit



Circuit Makers - Year 6
Lesson 9
Circuit assessment



Our learning

Explain your circuit to a Year 6 classmate using collected evidence.

Show your method and a meaningful limitation.

You may speak, draw, write, demonstrate or use supported picture choices.

PREVIEW

The evidence portfolio

Choose a circuit diagram, energy explanation and generated material-test record.

Include one systematic troubleshooting record.

Label each item actual observation, model, illustrative data or official source summary.

PREVIEW

A complete scientific explanation

Claim: the checked conducting path let the bulb glow

Evidence: refer to an actual recorded observation or a labelled model case.

Reason: energy transfers to the bulb through the complete circuit and changes into light and thermal energy

Fair and safe inquiry

Explain your changed condition, kept-same conditions and observation rule.

Show repeated trials and preserve clear outcomes.

Explain how the adult-approved setup kept rated load in the path.

PREVIEW

A useful limitation

Name a limit connected to your evidence.

For example, no glow may reflect a weak content or a tester sensitivity.

Explain how a specific safe improvement could reduce that uncertainty.

PREVIEW

Your assessment task

Use A1 to organise the existing portfolio. Use A2 to give a concise explanation.

The teacher collects observation and conference evidence alongside your records.

A longer written report or consistent public speaking is not required.

Transfer to a new case

A checked buzzer stays silent although its switch looks closed.

What safe check comes first? How could a component with change energy outputs?

Explain why you need evidence before claiming that the buzzer is faulty.

PREVIEW

Different expertise and decisions

Explain how the real Taronga partnership connects different scientific expertise.

Then explain how a fictional circuit team could improve a diagnosis.

Recommend a safe device improvement and state evidence still needed.

Based on: Taronga Conservation Society Australia, Platypus (taronga.org.au)

Reflection

Which piece of evidence best supports your explanation?

What would you revise after a further safe check?

Assessment uses the taught ideas and evidence, with the same expectations for every response mode.

PREVIEW

Well done!
Circuit assessment



Circuit Makers - Year 6
Lesson 10
Design responsibly



Our learning

Recommend an improvement for a supervised school display light.

Justify the idea using circuit and energy evidence.

Use the same taught safety limits. The lesson needs no new construction.

PREVIEW

The design purpose

A fictional display needs clear reading light and a switch that is easy to control.

Any electrical design must use adult approved components and safe connections.

Separate the user need from a proposed scientific explanation.

PREVIEW

A bounded improvement

Proposal: position the approved switch where the user can operate it comfortably.

Reason: the switch controls the complete path through the light.

The adult evaluates the setup before any physical change.

PREVIEW

Evidence and criteria

Criterion: the checked switch reliably controls the light in repeated brief trials.

Criterion: a supervised user can operate it comfortably.

Energy-efficiency claims would need appropriate measurements. Do not infer them from brightness alone.

PREVIEW

The real collaboration case

Taronga describes partners contributing knowledge to platypus conservation research.

Different evidence helps teams ask better questions and review decisions.

Earlier findings guide new studies. This example is separate from our fictional circuit design.

Based on: Taronga Conservation Society Australia, Platypus (taronga.org.au)

A fictional circuit design team

An observer checks light output. A modeller checks power and energy explanations.

A user reviewer checks switch access. An adult checks safety and component ratings.

Explain one contribution that another role might otherwise miss.

Your recommendation

Use W10 to address a school audience.

Give the purpose, proposal, evidence, evaluation, criticism and one unknown.

Use written, spoken, drawn or supported responses to show the same reasoning.

PREVIEW

Evidence can change a decision

If a trial disagrees with your prediction, keep the record

Review the method before choosing a new explanation

Recommend further safe evidence rather than claiming an untested improvement will work.

PREVIEW

Reflection

What science supports your recommendation?

What evidence could change your mind?

In the eight-session route, this concept transfer response completes assessment in session 8.

PREVIEW

Well done!
Design responsibly



Circuit Makers - Year 6

Unit quiz



Quiz instructions

Think first. Explain your answer using the taught science.

Respond by speaking, drawing, writing, pointing or using a communication board/device.

All practical decisions keep the adult-checked low-voltage safety limits.

PREVIEW

Question 1

Why might a bulb not light in an open circuit?

PREVIEW

Answer 1

The conducting path is incomplete. Disconnect and ask the adult to check connections and approved supply/component safety.

PREVIEW

Question 2

Does all the current get used up by the first bulb?

PREVIEW

Answer 2

No. A component transfers energy without using up charge. In a steady single-loop circuit, current flows through out the complete path.

PREVIEW

Question 3

How does a closed switch affect our simple bulb circuit?

PREVIEW

Answer 3

It joins the contacts and completes the conducting path through the bulb, assuming suitable working components and supply.

PREVIEW

Question 4

Which condition should change in a conductor compression?

PREVIEW

Answer 4

Change only the approved dry sample. Keep the supply, bulb, leads, contact rule and viewing conditions constant.

PREVIEW

Question 5

Why should the bulb remain in every path of the circuit?

PREVIEW

Answer 5

The correctly rated load prevents a direct connection between supply terminals. An adult checks every change before reconnection.

PREVIEW

Question 6

A sample glows in two trials and the third is unclear. What should you record?

PREVIEW

Answer 6

Record both glowing trials and the unclear trials accurately. Preserve the record and ask for a checked repeat. Do not change a result to match a prediction.

PREVIEW

Question 7

What does a bulb transform transferred energy into?

PREVIEW

Answer 7

Light and thermal energy. Light may be useful for a reading lamp.
Observing brightness alone does not measure efficiency.

PREVIEW

Question 8

How can different scientific expertise improve an explanation?

PREVIEW

Answer 8

Different specialists connect evidence and review assumptions. Taronga describes university and wildlife partnerships in conservation research. A classroom team alone is not proof of scientific advance.

Based on: Taronga Conservation Society Australia, Platypus (taronga.org.au)

Question 9

New case: a checked buzzer stays silent with a checked switch. What safe check comes first?

PREVIEW

Answer 9

Disconnect and inspect the conducting path with the result. Check one suspected connection at a time before an approval reset. A closed switch alone does not prove the full circuit works.

PREVIEW

Question 10

New case: a fictional school compares two equally bright display lights.
Can it claim they use equal energy?

PREVIEW

Answer 10

No. It needs suitable energy-use measurements under comparable conditions, safe approval and user-access evidence. Brightness alone cannot establish equal energy use or efficiency.

PREVIEW

Reflection

Which explanation needs stronger evidence?

Which safety rule protects a circuit investigation?

The quiz supports your learning. Your practical and portfolio evidence also matter.

PREVIEW

Well done!
Use evidence to explain

