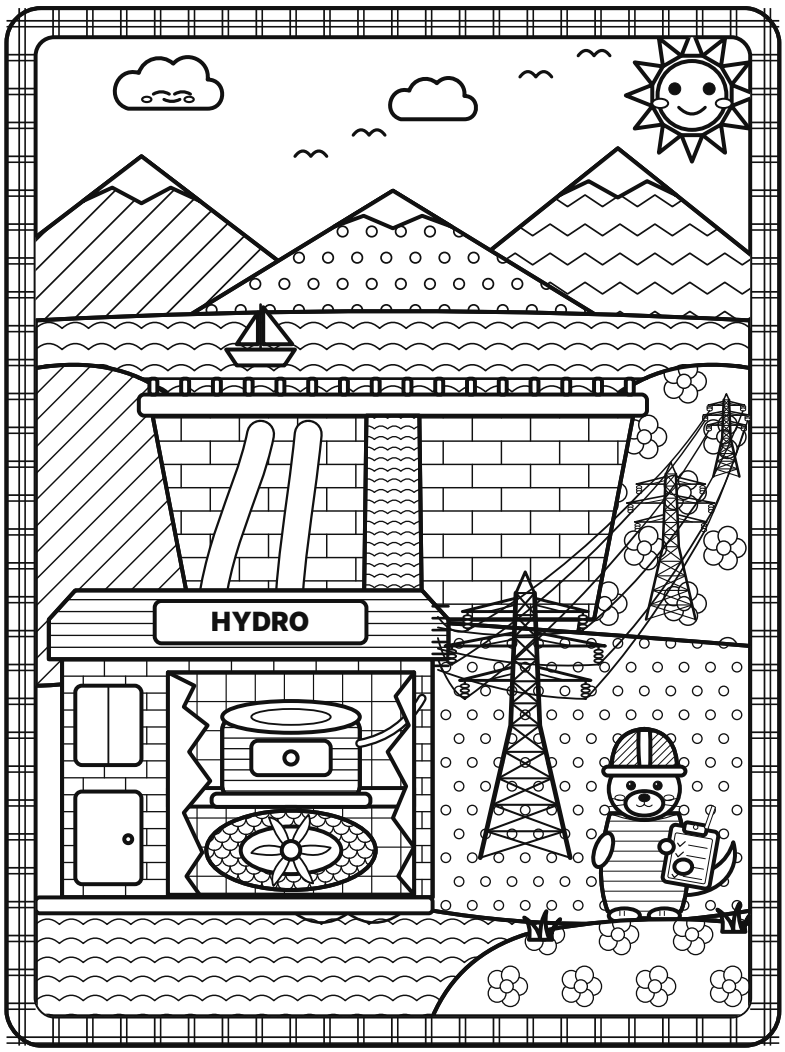
REAL-LIFE PHYSICS

Electricity and Energy

Workbook for National 4 Physics

Unit: Electricity and Energy



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Blewis LEARNING

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How to use this book

This book is about electricity and energy: where our electricity comes from, how we use it, how magnets and circuits work, and how gases behave. Each topic follows the same pattern, so you always know what comes next.

EACH TOPIC HAS

Opener	the story for the topic, what you will learn and the key words
Learn pages	short explanations with diagrams, and questions to try
Practical	You plan the investigation yourself, carry it out safely, take repeat readings, draw a graph and evaluate your method.
Brain break	a calm puzzle or colouring page
Check-up	a few questions to show what you know, and a checklist

PRACTICAL WORK: STAY SAFE

- Only start a practical when an adult says it is OK.
- Read the whole method and the Stay safe table first.
- Tell your teacher about anything that might affect you, like asthma or an allergy.
- Stop and tell an adult if you feel unwell or something goes wrong.

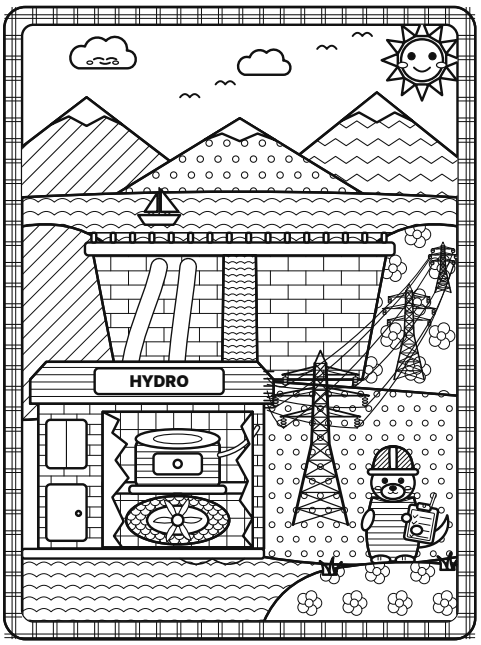
NO LAB TODAY?

Every practical has a set of example results. If you could not do the experiment, use these to finish the results, graph and conclusion.

DOODLE CORNERS

Some pages have a doodle corner. Colour it or doodle in it when you need a short break.

Generating electricity



Almost everything we do uses electricity. But electricity is not found ready-made. It has to be generated from an energy source.

Theme: the eco club. The eco club at Glen Arrin School wants the school to go greener. Ruby and Amir have been asked to find out where the school's electricity comes from, and which energy sources Scotland could rely on in the future.

IN THIS TOPIC YOU WILL LEARN TO

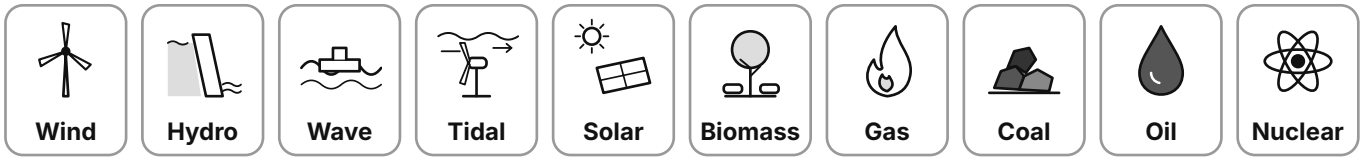
Skill 1	describe renewable and non-renewable energy sources and compare their advantages and disadvantages
Skill 2	describe how a power station works and the energy transformations in it
Skill 3	plan and carry out a test on the output of a solar cell

KEY WORDS

Energy source	something we get energy from, like wind, gas or sunlight
Renewable	will not run out, because it is replaced naturally
Non-renewable	will run out one day; it cannot be replaced
Fossil fuel	coal, oil or gas, formed from plants and animals over millions of years
Turbine	a set of blades turned by steam, wind or water
Generator	a machine that changes kinetic energy into electrical energy

❶ Energy sources

Power stations use an **energy source** to generate electricity. Some sources are **renewable**: they are replaced naturally and will not run out. Others are **non-renewable**: once we have used them up, they are gone.



KEY FACTS

Fossil fuels	coal, oil and gas took millions of years to form. We are using them far faster than they form, so they are non-renewable. Burning them releases carbon dioxide, which adds to climate change.
Nuclear	uses uranium, which is mined. It is non-renewable, but it gives out no carbon dioxide while it runs.
Biomass	wood, crops or waste. It counts as renewable if new plants are grown to replace what is burned.
Scotland	has strong winds, fast rivers in the hills, big waves on the west coast and strong tides around the islands.

1 Sort the ten energy sources above into the table.

Renewable	Non-renewable

2 Explain why gas is called a **non-renewable** energy source.

Answer: .....

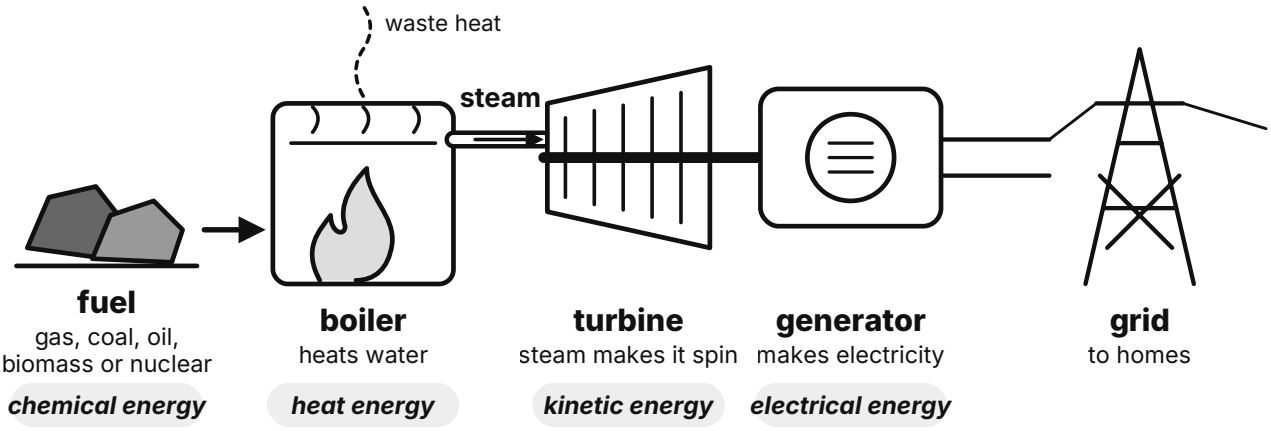
3 Give **two** reasons why many countries are trying to burn less coal, oil and gas.

Answer: .....

.....

❷ How a power station works

Most power stations work the same way. Energy from the source is used to **spin a turbine**. The turbine turns a **generator**, which changes kinetic energy into **electrical energy**. In a thermal power station, the fuel heats water to make steam first.



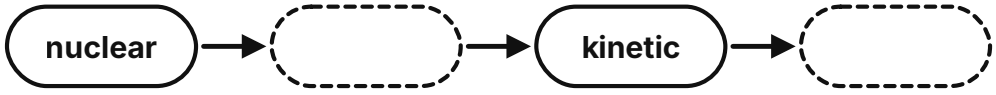
In wind, wave, tidal and hydro power, moving air or water turns the turbine directly, so there is no fuel, boiler or steam.

Power station	Energy transformations
Gas, coal, oil or biomass	chemical → heat → kinetic → electrical
Nuclear	nuclear → heat → kinetic → electrical
Wind turbine	kinetic (moving air) → electrical
Hydroelectric	gravitational potential (water up high) → kinetic → electrical
Solar cell	light → electrical (no turbine at all)

1 Put these parts of a gas power station in the right order: **generator** **boiler** **fuel** **turbine** **steam**



2 Fill in the missing energy forms for a **nuclear** power station.



3 What is the job of the **generator**?

Answer:

PRACTICAL 1

Plan it: what affects the output of a solar cell?

AIM To find out how the **DISTANCE FROM A LAMP** affects the **CURRENT** from a solar cell.

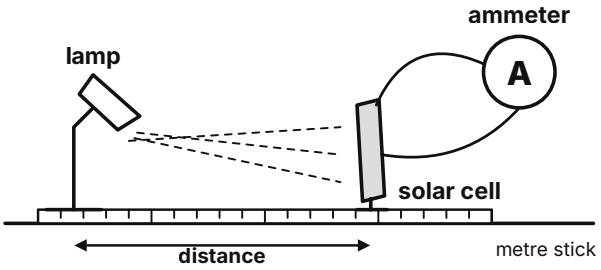
1 Variables

I will change the independent variable	
I will measure the dependent variable	
I will keep the same controlled variables (give two)	

2 Prediction

I think that .....

because .....



3 Equipment

Tick the equipment you need. Not everything here is useful.


☐ Solar cell


☐ Desk lamp



☐ Ammeter


☐ Leads

☐ Metre stick


☐ Stopwatch


☐ Balance

4 Stay safe

The first row is done for you. Add two more hazards.

Hazard What could cause harm?	**Risk** What could happen?	**Control** How will I stay safe?
Hot lamp bulb or lamp shade	Burns to fingers	Do not touch the bulb. Move the lamp by its base. Let it cool before packing away.

Method and results

5 Write your method

Write clear steps someone else could follow.

1. How will you connect the solar cell and the ammeter?

2. How will you set and measure the distance between the lamp and the cell?

3. What will you keep the same? Think about the room lights, the angle of the cell and the lamp.

4. How many distances will you test, and how many times will you repeat each one?

6 Results

Complete the headings, including units. Then fill in your results.

				Average

WORKING OUT AN AVERAGE

Add the repeats, then divide by how many there are. Readings 15, 16 and 14 mA: $\frac{15 + 16 + 14}{3} = \frac{45}{3} =$ **15 mA**. mA means milliamps; 1000 mA = 1 A.

NO LAB TODAY? USE THESE RESULTS

Distance (cm)	Current 1 (mA)	Current 2 (mA)	Current 3 (mA)	Average current (mA)
10	48	51	49	
20	27	25	26	
30	15	16	14	
40	10	9	11	
50	7	6	7	

Room lights off and blinds closed. The cell always faced the lamp straight on. Work out the averages yourself.

Analyse and evaluate

7 Draw a line graph

Choose your own scales. Label both axes with units. Plot the averages and draw a smooth curve.



8 Conclusion

As the distance from the lamp increased,

9 Explain

This happens because

10 Evaluate

a Light from windows and room lights can also reach the cell. How could this affect your results?

Answer:

b Give one improvement to your method and explain how it would make the results more reliable or accurate.

Answer:

FREE SAMPLE

Electricity and Energy (N4 Physics)

This sample shows a few pages. The full printed workbook is available from Amazon.

blewislearning.co.uk

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