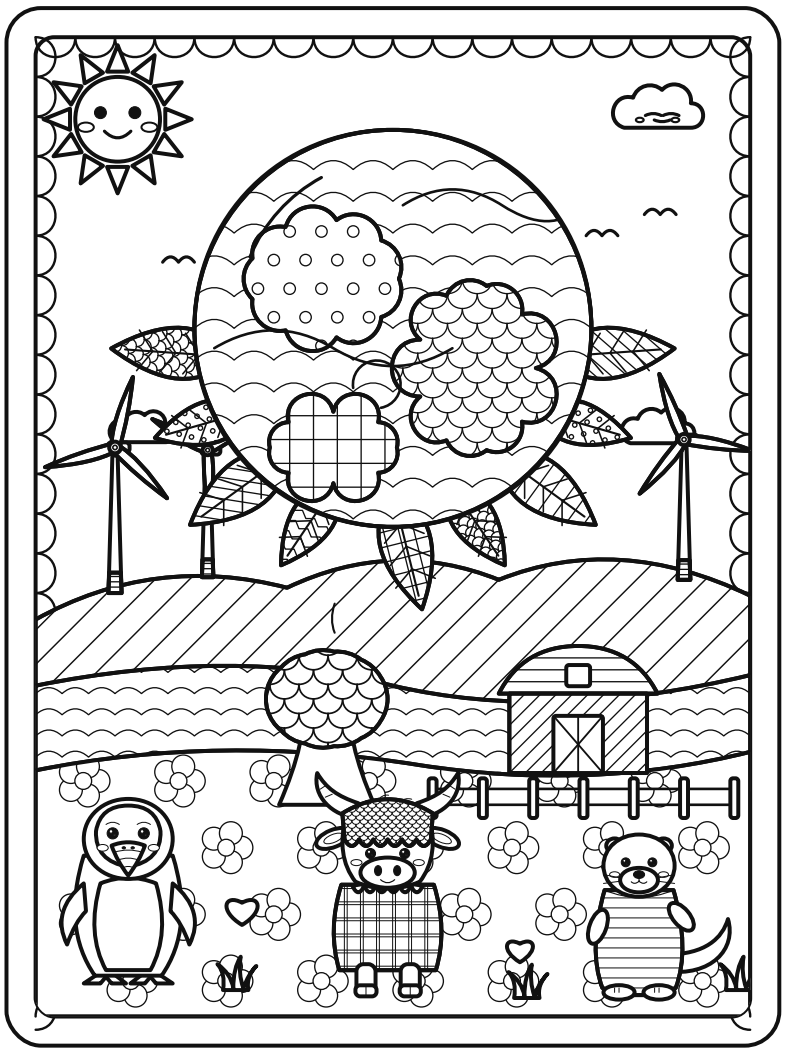
REAL-LIFE SCIENCE

Fragile Earth

Workbook for National 4 Science

Unit: Fragile Earth



C. Blewis

Blewis LEARNING

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How to use this book

This book is about the resources our planet gives us: energy, metals, water and food. You will find out where they come from, how we use them, the problems this causes, and what we can do to help. 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.

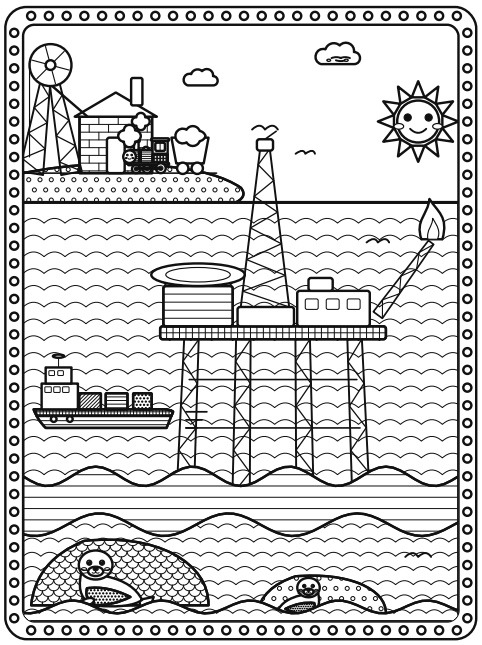
NO LAB TODAY?

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.

Fuels and energy



We burn fuels to heat our homes, cook our food and drive our cars. But where do fuels come from, and what happens when we burn them?

Theme: energy for Glen Arrin. The Glen Arrin Youth Club is running an energy week. Mia's uncle works offshore in the North Sea, and he is coming to talk about where our oil and gas come from. The club wants to find out how fuels work and what burning them does to our planet.

IN THIS TOPIC YOU WILL LEARN TO

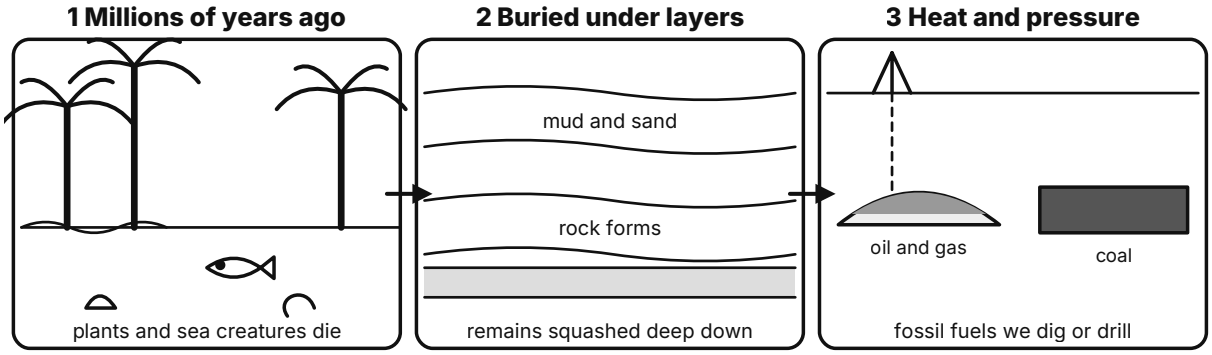
Skill 1	explain how fossil fuels formed and why they are finite
Skill 2	write a word equation for burning a fuel
Skill 3	explain how acid gases and carbon dioxide affect the environment

KEY WORDS

Fuel	a substance that releases energy when it burns
Fossil fuel	coal, oil or natural gas, formed over millions of years from dead plants and sea creatures
Finite	non-renewable: there is a fixed amount and it will run out
Combustion	burning: a reaction of a fuel with oxygen that releases energy
Acid gas	a gas such as sulfur dioxide that dissolves in water to make an acid
Climate change	long-term change in weather patterns, linked to extra carbon dioxide in the air

❶ What is a fuel?

A **fuel** is a substance that releases **energy** when it burns. The energy is stored in the fuel as **chemical energy**. **Coal**, **crude oil** and **natural gas** are **fossil fuels**. Coal formed from ancient plants in swamps. Oil and gas formed from tiny sea creatures buried under mud on the sea bed. Heat and pressure over millions of years turned them into fuels trapped in the rocks.



KEY FACTS

Fossil fuels are **finite** (non-renewable). They take millions of years to form but we are using them up in a few hundred years. Petrol, diesel and heating oil are all made from crude oil.

1 Explain why fossil fuels are described as finite.

Answer:

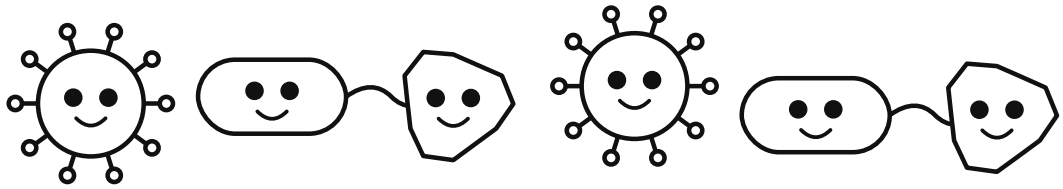
2 Coal and oil formed in different ways. Describe **one** difference.

Answer:

3 Name **two** fuels made from crude oil, and say what each is used for.

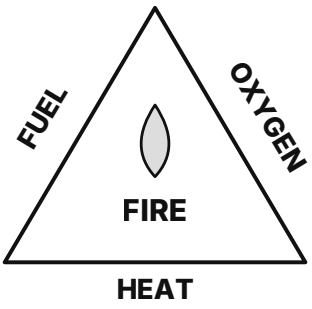
Answer:

DOODLE CORNER



❷ Burning fuels

Burning is a chemical reaction called **combustion**. The fuel reacts with **oxygen** from the air and releases energy as heat and light. Most fuels are **hydrocarbons**: compounds made of hydrogen and carbon only. When they burn completely, the carbon makes **carbon dioxide** and the hydrogen makes **water**.



hydrocarbon + oxygen → carbon dioxide + water

NOT ENOUGH OXYGEN?

Burning in too little oxygen makes poisonous **carbon monoxide** and black soot. This is why gas boilers must be serviced and homes need a carbon monoxide alarm.

1 Natural gas is mainly methane, a hydrocarbon. Write a word equation for methane burning.

Answer:

2 Explain why a fire goes out when a fire blanket covers it. Use the fire triangle.

Answer:

3 Carbon dioxide turns limewater cloudy. Describe how you could show that a candle makes carbon dioxide when it burns.

Answer:

4 Why is carbon monoxide especially dangerous? Give **one** way to stay safe.

Answer:

PRACTICAL 1

Plan it: which fuel releases the most heat?

AIM To plan a fair test, carried out by your teacher, to compare the heat given out by four fuels.

Teacher demonstration only. These fuels catch fire easily, so your teacher burns them behind a safety screen. You plan the test and analyse the results.

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 what is needed. Not everything here is useful.



☐ Spirit burners



☐ Metal can



☐ Thermometer



☐ Balance

☐ Cylinder



☐ Solar cell



☐ Magnet

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?
Flammable fuels	A fire or burns	Teacher only. Safety screen. Caps on burners when not lit. Stock bottles kept well away.

Method and results

5 Write the method

Write clear steps your teacher could follow.

1. How much water, and how will it be measured? What is measured before burning?

2. How will the same mass of each fuel be burned? How is this checked?

3. What is measured at the end, and how is the temperature rise worked out?

4. How many times will each fuel be tested? How will the next test start fairly?

6 Results

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

Fuel				Average rise
Ethanol				
Propanol				
Butanol				
Pentanol				

WORKING OUT THE AVERAGE

Rises of 30 °C, 28 °C and 32 °C. Average = (30 + 28 + 32) ÷ 3 = 90 ÷ 3 = **30 °C**.

NO LAB TODAY? USE THESE RESULTS

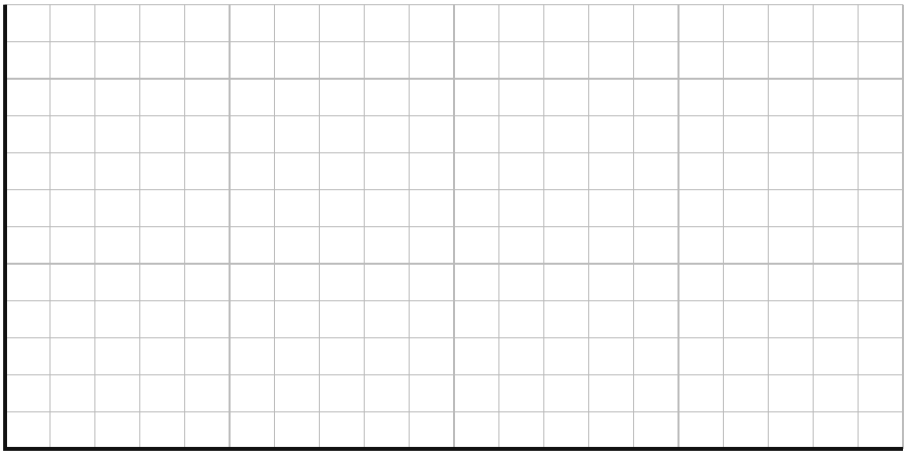
Fuel (1 g burned)	Rise 1 (°C)	Rise 2 (°C)	Rise 3 (°C)	Average rise (°C)
Ethanol	21	19	23	
Propanol	24	26	22	
Butanol	25	27	26	
Pentanol	28	26	27	

Each test heated 100 cm^3 of water. Work out the averages yourself.

Analyse and evaluate

7 Draw a bar chart

Draw a bar chart of the average temperature rise for each fuel. Choose your scale and label both axes.



8 Conclusion

The fuel that released the most heat per gram was .....

.....

9 Explain

a Energy given to the water (J) = 100 × 4.2 × temperature rise. Work out the energy for ethanol.

Answer: .....

b Burning 1 g of ethanol really releases about 30 000 J. Suggest why your answer to (a) is much smaller.

Answer: .....

10 Evaluate

a Why was each fuel tested three times?

Answer: .....

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

Answer: .....

FREE SAMPLE

Fragile Earth (N4 Science)

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

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