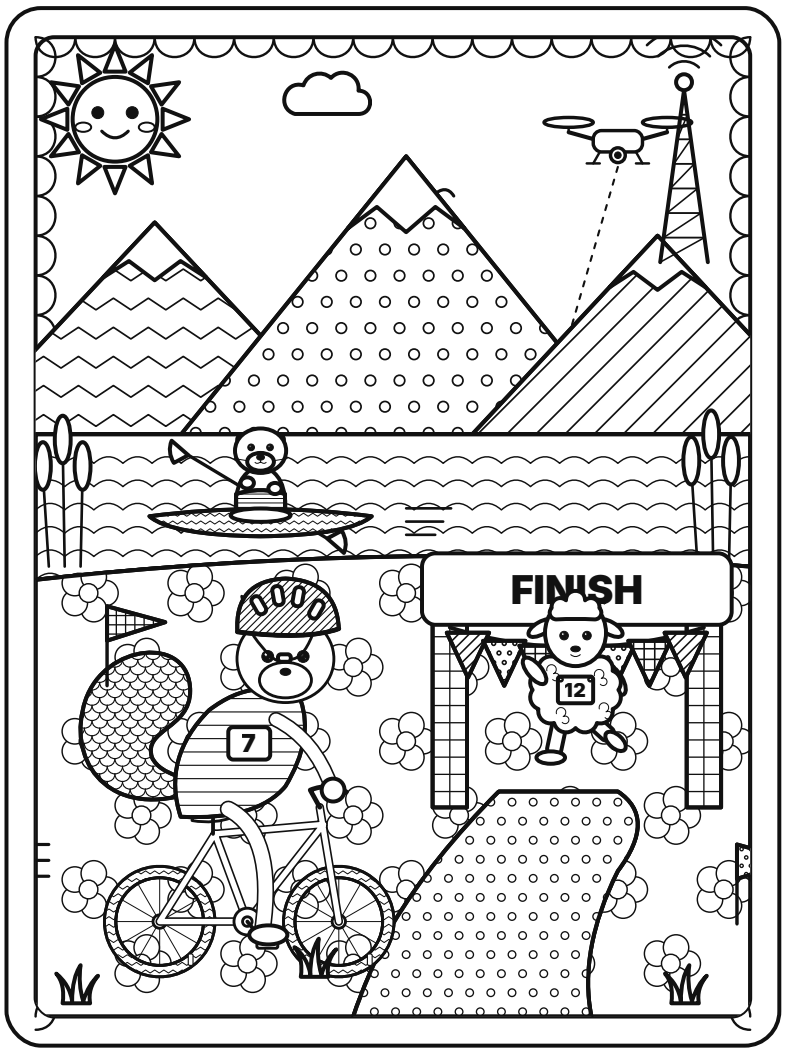
REAL-LIFE SCIENCE

Applications of Science

Workbook for National 4 Science

Unit: Applications of Science



C. Blewis

Blewis LEARNING

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How to use this book

This book is about science in everyday life: how we send messages around the world, the new materials we make and use, and how science helps us spot and reduce risk. 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.

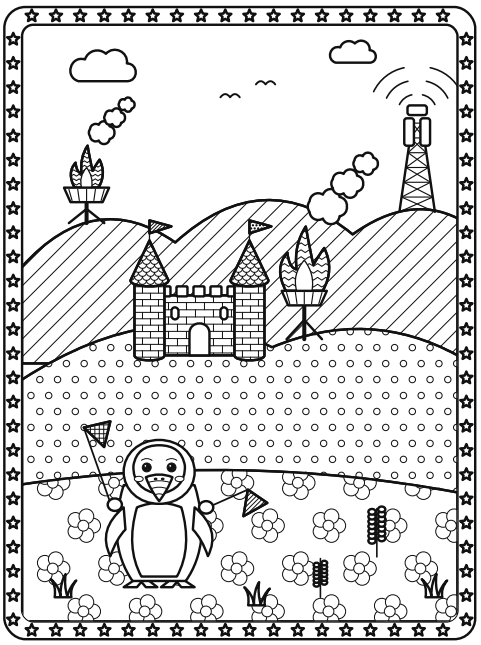
NO LAB TODAY?

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.

Sending signals



A text can reach the other side of the world in under a second. Long ago, a message travelled only as fast as a horse, or a fire lit on a hilltop.

Theme: beacon night. Glen Arrin lights the old beacon on Carn Beag every autumn. This year Isla and Finn are helping the history group, and want to find out how messages were sent before phones, and how they travel now.

IN THIS TOPIC YOU WILL LEARN TO

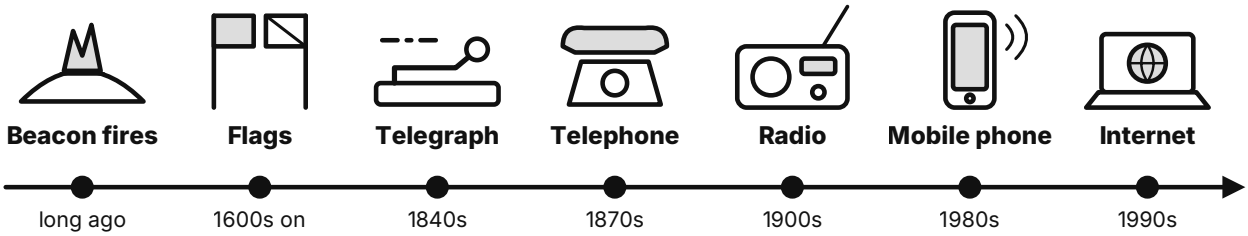
Skill 1	describe how communication has changed and its effects on society
Skill 2	compare signals carried by sound waves and electromagnetic waves, including their speeds
Skill 3	plan an investigation into how the length of a string telephone affects the message

KEY WORDS

Signal	information sent from a transmitter to a receiver
Sound wave	a vibration passed from particle to particle; it needs a material to travel through
Electromagnetic wave	a wave, like radio, microwaves or light, that can travel through empty space
Analogue	a signal that changes smoothly and can have any value
Digital	a signal with only two values, on (1) and off (0)
Morse code	letters sent as patterns of short and long pulses

❶ From beacon fires to the internet

For most of history a message could only travel as fast as a person, a horse or a ship. **Beacon fires** and **flags** were fast but carried very little information. The **electric telegraph** (1840s) sent **Morse code** along wires, so news crossed a country in minutes. The **telephone** carried the voice itself. **Radio** needed no wires at all. Today **mobile phones** and the **internet** carry huge amounts of information as digital signals, by radio waves, microwaves and light in glass fibres.



1 Give **one** advantage and **one** disadvantage of using a beacon fire to send a warning.

Answer:

2 The telegraph and the telephone both used wires. What could the telephone send that the telegraph could not?

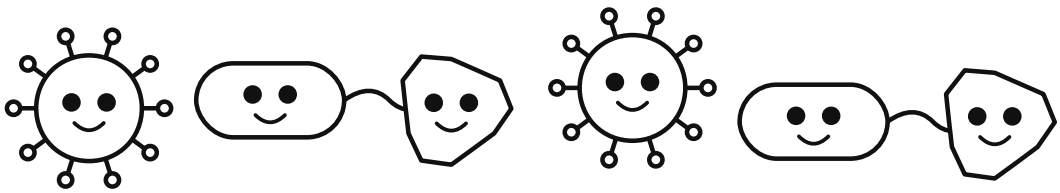
Answer:

3 Before the telegraph, how long might news take to travel from Glen Arrin to London, about 800 km away, by horse at 15 km per hour?

WORKING

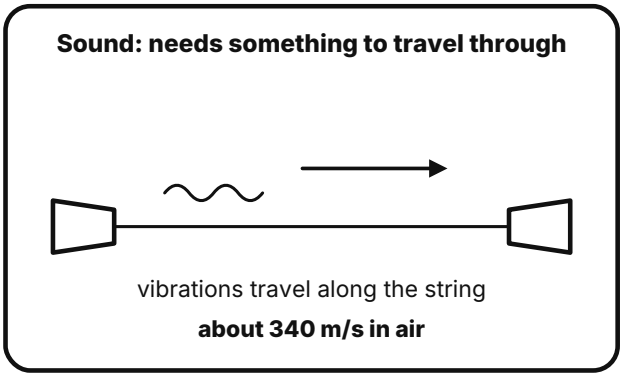
Answer:

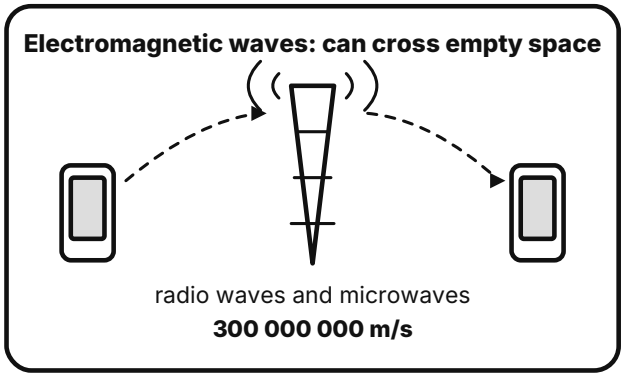
DOODLE CORNER



❷ Sound waves and electromagnetic waves

Sound waves are vibrations passed from particle to particle, so sound needs a material (a **medium**) to travel through. In air it travels at about **340 m/s**. **Electromagnetic waves** (radio waves, microwaves and light) do not need a medium: they travel through empty space at **300 000 000 m/s**. Modern communication uses electromagnetic waves because they are so fast and can reach satellites in space.





METHOD

Time	time = distance ÷ speed
Example	Sound travelling 1700 m: 1700 ÷ 340 = **5 s**. A radio signal takes 1700 ÷ 300 000 000 = 0.000 005 7 s, almost no time at all.

1 Why can astronauts on a spacewalk not talk to each other using sound, but can use radio?

Answer:

2 Kai shouts to Finn across the loch, 680 m away. How long does the sound take to reach him?

WORKING

Answer:

3 Give **two** reasons why phone networks use electromagnetic waves, not sound.

Answer:

PRACTICAL 1

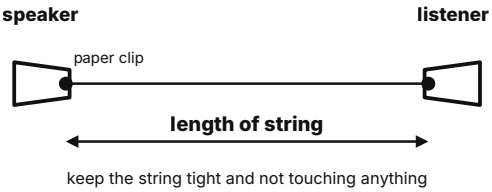
Plan it: string telephone

AIM To find out how the **LENGTH OF THE STRING** in a string telephone affects how well a message is heard.

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

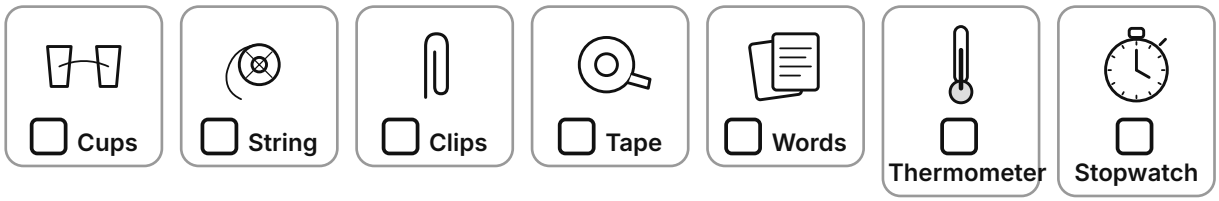


I think that .....

because .....

3 Equipment

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



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?
String stretched across the room	Someone trips over it or walks into it	Use the string away from doors and walkways. Tell people it is there.

Method and results

5 Write your method

Write clear steps someone else could follow.

1. How will you make the telephone and set the length of the string?

2. How will you make sure the message is said the same way each time?

3. How will you measure how well the message is heard?

4. Which lengths 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

Words heard in three trials: 8, 7 and 7. (8 + 7 + 7) ÷ 3 = 22 ÷ 3 = **7.3 words** (to 1 decimal place).

NO LAB TODAY? USE THESE RESULTS

Length (m)	Trial 1 (words)	Trial 2 (words)	Trial 3 (words)	Average (words)
2	10	9	10	
4	9	9	8	
6	8	7	7	
8	6	5	6	
10	4	5	4	

Ten words read each time, in a normal voice. Work out the averages yourself, to 1 decimal place.

Analyse and evaluate

7 Draw a line graph

Choose your own scales. Label both axes with units. Plot the averages and draw a line of best fit.



8 Conclusion

As the length of the string increased,

9 Explain

This happens because

10 Evaluate

a The speaker's voice is a variable that is hard to control. Suggest how you could control it.

Answer:

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

Answer:

FREE SAMPLE

Applications of Science (N4 Science)

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

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