

Green Heating

Setting the Scene

You will investigate how solar panels work. You will carry out an investigation based on a question, an hypothesis, or a prediction, relating to the science of solar panels

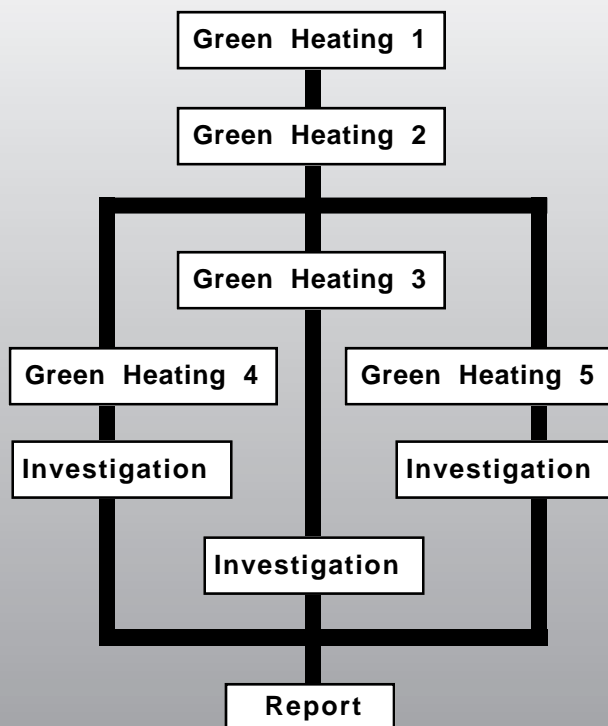
Pupil Research Brief

Study Guide

Syllabus Targets *Science you will learn about in this Brief*

- all types of electromagnetic radiation form a continuous spectrum
- when radiation is absorbed the energy it carries makes the substance which absorbs it hotter
- infrared radiation is absorbed by the skin and is felt as heat
- different wavelengths of electromagnetic radiation are reflected, absorbed or transmitted differently
- by different substances and types of surface
- dark, matt surfaces are good absorbers of radiation
- light, shiny surfaces are good reflectors of radiation
- thermal energy is the transfer of energy by waves, and particles of matter are not involved

Route through the Brief



Outcome Checklist

You will carry out an investigation based on a question, an hypothesis or a prediction. You will write a report of your findings. You can use an Investigation Flow Chart to help you plan your investigation. You should make sure you produce the following items as you work through the Brief.

Green Heating 2

- investigation flow chart showing your plans

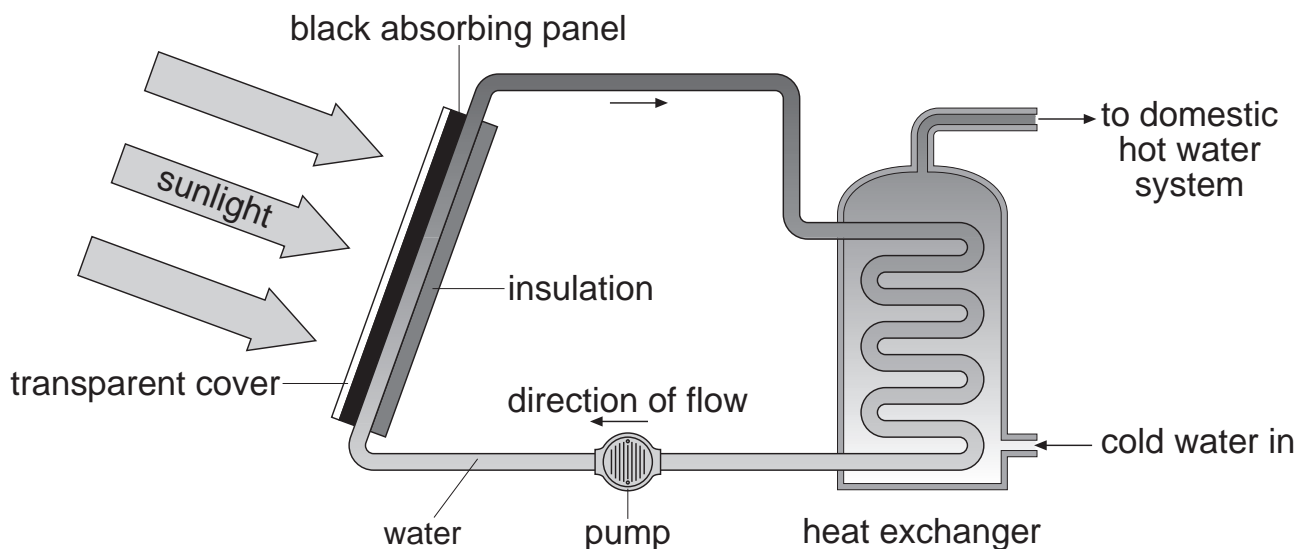
Green Heating 3,4 or 5

- report on investigation

GREEN HEATING 1

Energy from the Sun can be harnessed and used productively for domestic and industrial purposes. Two of the most common ways of 'collecting' the Sun's energy are using solar panels (which produce hot water) and photovoltaic cells (which produce electricity). Scientists are researching into ways of combining solar panels with photovoltaic cells in the same device in order to use the Sun's energy even more efficiently. However, in this PRB you will concentrate on solar panels

Figure 1. How a solar panel works



Energy reaching the Earth from the Sun can be transferred by solar panels to heat water moving around inside them. This solar energy is called infrared radiation. Radiation arriving at the outer surface is absorbed by the panel. The energy is used to heat water sealed in the solar panel unit. The energy from this water is transferred to the domestic hot water system via the heat exchanger. This hot water is used for houses, hospitals, offices or factories. The more of the Sun's energy that can be transferred to the water, the better the solar panel is. We say it is more efficient.

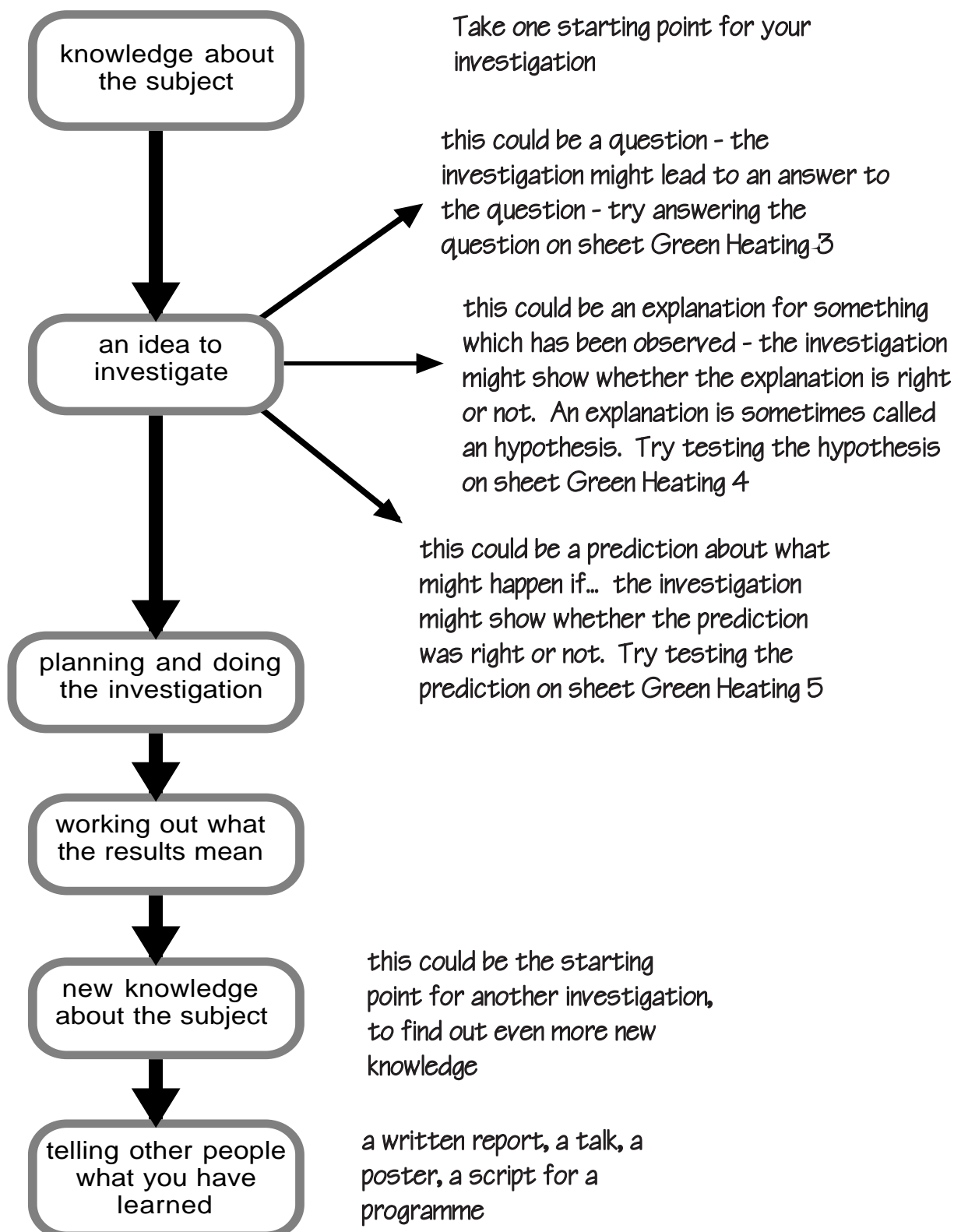
If we know how to make solar panels more efficient we can reduce the amount of energy which comes from burning fossil fuels. Coal, oil and natural gas are fossil fuels.

Read the sheet Green Heating 2 This tells you how scientists begin thinking about doing scientific investigations.

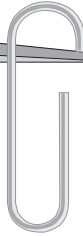
GREEN HEATING 2

Scientists do experiments and investigations. They use their knowledge to think of new ideas that they can test. The ideas could lead to new knowledge about the subject they are investigating.

Steps in an investigation



GREEN HEATING 3 ASKING QUESTIONS



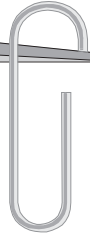
You are going to plan and carry out an investigation to find out the answer to the scientific question set out below. Solar panels absorb energy from the Sun. This type of solar energy is called infrared radiation.

Some coloured surfaces absorb most of the infrared radiation which reaches them. Solar panels with these types of surface would be good at heating up water. Other colours reflect a lot of the infrared radiation which reaches them. Solar panels with these types of surface would not be as good at heating up water.

What colour surface is best at absorbing infrared radiation?

Use the **Investigation Flowchart** to set out your ideas.

When you have finished the investigation, write a report on your work. Use your results to help you answer the question. The answer is **not just the results** - you have to **think** about what the results mean - this will give you your answer. The answer may mean you now know something new about solar panels. Write a report, or plan a short presentation to the class, to tell them what you have learned.



You are going to plan and carry out an investigation to test this hypothesis:

A solar panel with a black matt surface is better at heating water than a panel with a light shiny surface, since dark surfaces absorb more heat.

The science knowledge that the hypothesis is based on is:

electromagnetic radiation such as visible light and infrared radiation is reflected by light shiny surfaces, and absorbed by dark matt ones. Water flowing through a solar panel with a dark matt surface will be heated up by the energy transferred when it passes through the panel material by conduction.

You now have to think about how you can get evidence showing that the hypothesis is correct or not.

Use the **Investigation Flowchart** to set out your ideas.

When you have finished the investigation, write a report on your work. Use your results to think about whether the hypothesis is right or not. The answer is **not just the results** - you have to **think** about what the results mean - this will give you your answer.

You could then use your new knowledge to think of a new hypothesis about solar panels and how they work.



You are going to plan and carry out an investigation to test this prediction:

If infrared radiation is a form of electromagnetic radiation, like light, then surfaces which reflect light will reflect infrared radiation, and surfaces which absorb light will absorb infrared radiation.

The science knowledge that the prediction is based on is:

the different types of electromagnetic radiation form a continuous spectrum, only part of which is visible light. Each part of the whole spectrum is made up of radiation with wavelengths which range from the very short (gamma rays, X- rays) to the very long (radio waves). Visible light is in between these two extremes. Infrared radiation has a slightly longer wavelength than visible light, and so cannot be seen, but since its wavelength is close to visible light, it has similar properties of reflection and absorption.

You now have to think about how you can get evidence to see if the prediction is correct or not.

Use the **Investigation Flowchart** to set out your ideas.

When you have finished the investigation, write a report on your work. Use your results to think about whether the prediction was correct or not. The answer is **not just the results** - you have to **think** about what the results mean - this will give you your answer.

You could then use your new knowledge to think of a new prediction about solar panels and how they work.