



Solar collection investigation

Time needed for activity 30 minutes plus

Location Outdoors or indoors

Context

This STEM activity investigates the way colour affects the rate at which solar heat is absorbed. It's a good way to start exploring some of the science behind solar water heaters and solar panels.

Natural Resources Wales' purpose is to pursue the sustainable management of natural resources in all of its work. This means looking after air, land, water, wildlife, plants, and soil to improve Wales' well-being, and provide a better future for everyone.

Curriculum for Wales

Mathematics and Numeracy

- **What matters -** The number system is used to represent and compare relationships between numbers and quantities.
- **What matters -** Statistics represent data, probability models chance, and both support informed inferences and decisions.

Humanities

- **What matters -** Informed, self-aware citizens engage with the challenges and opportunities that face humanity and are able to take considered and ethical action.
- **What matters -** Enquiry, exploration and investigation inspire curiosity about the world, its past, present and future.

Science and Technology

- **What matters -** Forces and energy provide a foundation for understanding our universe.
- **What matters -** Being curious and searching for answers is essential to understanding and predicting phenomena.

Health and Wellbeing

- **What matters -** Our decision-making impacts on the quality of our lives and the lives of others.

Objectives

Learners will be able to:

- work together to complete a field-based trial.
- use their mathematical skills to measure and predict.
- observe and consider the optimum conditions for collecting solar energy.
- begin to consider how environmental features affect solar energy capture and use this knowledge to deliberate on the placement of solar panels and solar farms.



Resources and equipment

- [Information note - Energy](#) (optional)
- [Worksheet - Solar collection investigation](#)
- Clipboards
- Pencils and pens
- Stopwatches
- Sheets of white and black paper
- Scissors
- 4 small containers such as cups
- Measuring jug
- Water
- Thermometer
- Plastic wrap
- Elastic bands

What to do

Before beginning the practical elements of the activity, please discuss health and safety considerations with your group.

1. Begin the session by asking the group to discuss the pros and cons of renewable energy. What is it? What types of renewable energy are there? What are the benefits and considerations of different renewable energies? To support this, check out our [Activity plan - Community energy supply](#).
2. Explain to the group that they are going to observe and investigate solar radiation collection, i.e. the collection of sunlight. Why is this an important thing for humans to be able to do? Do they know any methods of solar collection?
3. Divide your learners into pairs or small groups and give each group a [Worksheet - Solar collection investigation](#), a few sheets of white and black construction paper, scissors and 4 small containers such as cups.
4. Task each group with cutting two circles from each of the black and white paper sheets that are big enough to fit the bottom of the containers.
5. Ask them to place a white paper circle in the bottom of two of the containers and a black circle in the bottom of the other two containers.
6. Pour 40ml of cold water into each of the containers.
7. Each group can now take the temperature of the water in each cup and record it on their [Worksheet - Solar collection investigation](#).
8. Use some plastic wrap to cover one black and one white container, securing with an elastic band. You now have 4 different container set ups to compare.
9. Now carefully position all 4 containers in direct sunlight, ideally with the sun directly overhead. If it's a cloudy day the experiment can still be done but there won't be as much of a range in temperature and recordings will be lower. Learners could also carry out the experiment on different days with different weather conditions to see if this makes a difference to their results.
10. Ask each group to predict what will happen to the water in the containers. What temperature do your learners predict the water will be in 5 minutes/10 minutes/20 minutes? They should make and record a prediction for each reading before they take the actual reading. Ask them to make an overall prediction of which of the four containers will heat the water to the highest temperature and keep the water heated the longest. Learners could also rank the four containers from predicted highest to lowest temperatures. Discuss with your learners what the experiment is trying to measure and why this information would be useful to a scientist.



11. Your learners should record the temperature of the water in all 4 containers at 5 minute and ten-minute intervals and record these results on the worksheet. You can change the interval timings to suit, for example, first thing in the morning, mid-day and mid-afternoon.
12. Once the investigation is complete discuss and compare the findings of each group.
 - How did the different container set ups compare? Did all groups get the same results? Were there any anomalies. If so what?
 - Did one set up provide higher temperature readings? Why?
 - Which set up provided the lowest reading? Why?
 - Did the location of each group influence any different readings?
 - What difference did the white and black paper have on the temperature readings? Which absorbs the sun's heat, and which reflects the heat most efficiently?
 - What difference did the plastic wrap have on the temperature readings?
13. The aim of this activity is to ascertain what is needed to ensure the most solar radiation is collected and therefore what colour a solar collector will need to be most efficient. Solar panels are typically used to collect solar radiation. Apart from the colour and the need for a way of capturing the heat energy, what else must be taken into consideration? Discuss with learners ideas such as:
 - The location of solar panels
 - The direction they face
 - The angle of the solar panel
 - The environment they are located in, i.e. open space or vegetated.
14. Discuss what other factors could make a difference to the outcomes of this experiment. For instance, the position of the sun, the time of day or the time of year. What would the comparison be if you tried this in a shaded area or on a cloudy day.
15. Use the collected data of the whole group to create graphs and temperature maps of the area.

Suggested key questions

- What is solar energy?
- How can we capture energy from the sun?
- How can we store renewable energy?
- What effect does the position of the sun in relation to Wales throughout the year, have on how we create renewable solar energy?

Adapting for different needs or abilities

More support

- Provide adult support for each group.
- Complete as an adult led, whole group activity.

More challenge

- Complete as 1 of 2 activities, alongside the Wind speed investigation to build a bigger picture of renewable energy systems.
- Create charts and graphs to represent findings across both investigation activities.
- Create a profile of the locations most suited to the capture of each type of renewable energy.



Follow up activity/extension

Try out our:

- **Activity plan - Wind speed investigation.**
- **Activity plan - Creating an enviro-vlog.** Choose one type of renewable energy and create a media campaign to encourage people to use it.
- Use natural art to illustrate renewable energy sources.
- Investigate the different types of solar collectors.
- Survey how many solar panels they can see in the areas in which they live and where are they located?

Additional Information

Find out more about Natural Resources Wales' work to address climate change at www.naturalresourceswales.gov.uk

Natural Resources Wales/Climate change overview

Looking for more learning resources, information and data?

Please contact: education@naturalresourceswales.gov.uk or go to <https://naturalresources.wales/learning>

Alternative format; large print or another language, please contact: enquiries@naturalresourceswales.gov.uk 0300 065 3000

