2. Wonderful wind

2 hours activity

The children construct a windmill to lift a bucket in response to a request to help solve problems in a third world country. A demonstration of how the energy from the turning of the windmill can produce electricity concludes the session.

OBJECTIVES

- To plan different types of scientific enquiries to answer questions
- To identify scientific evidence that has been used to support or refute ideas or arguments

RESOURCES

(per group of 4 children, unless otherwise stated)

- Activity sheets 5-11
- Sheets of card of 200 micron (to make sails of different sizes) Sheets of other card/paper (to vary sail material)
- 1m strong thread or string
- 1.5lt drinks bottle
- Sand or marbles
- Paper or plastic cup
- 20 cm length 8mm dowel
- 5 nylon 8mm washers (that slide onto the dowel)
- Set of weights, marbles or centicubes
- Hair dryer.(to provide wind)
- Stop watches
- Bicycle with a dynamo

Safety note

Hair dryers must pass the electrical safety test for use in school.

ADVANCE PREPARATION

Prepare the bottles by puncturing two holes, diametrically opposite and at the same level, about 5 cm from the shoulder of the bottle. Glue one of the washers over each hole to ensure smooth even edges (see Activity sheet 6).

Safety note

Do not allow the children to use sharp objects to pierce bottle.

INTRODUCING THE ACTIVITY

Read the information in the letter on Activity sheet 5. Discuss the issues and highlight some of the needs of people in various African countries and the different ways that aid can be used to help people.

Discuss why we need water and ways of producing electricity and introduce the idea of harnessing natural forces to produce electrical energy.

Establish that electrical energy is a type of energy that we can produce by harnessing other types of energy and converting them to electricity.

Introduce the activity: to harness the wind energy to lift and carry supplies of water in a bucket.

MAIN ACTIVITY

Children build a simple windmill using a soft drinks bottle and the templates on Activity sheets 5 and 6.

1. The dowel is passed through the two washers stuck to opposite sides of the bottle and at one side of the bottle a single washer is glued to the dowel about 1 cm from the end, to act as a spacer. At the other side of the bottle 2 washers are glued 2 cm and 3 cm from the end. The thread is attached to the windmill between these. See Fig 1 and Activity sheet 6.
2. Attach the windmill to the spacer end of the dowel with a drawing pin through the centre of the sail into the end of the dowel.
3. Demonstrate how we can use wind energy to turn the turbine and lift the bucket. The sand is used to weight the bottle to stabilise it.
4. Attach the cup to the end of the string to act as the bucket.

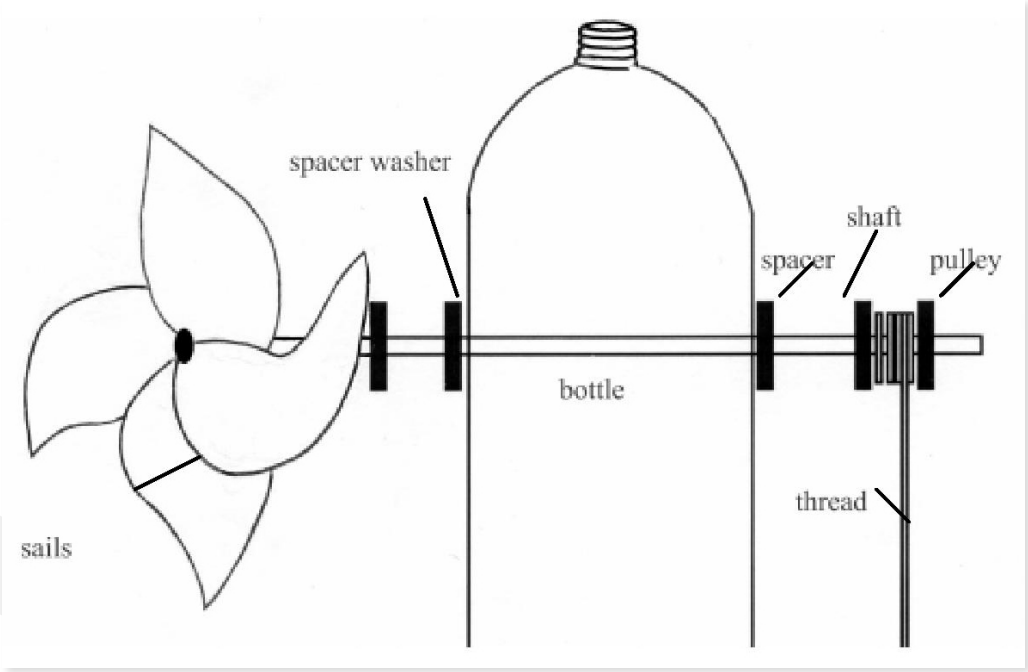


Fig 1

Ask the children to investigate ways to make the turbine move faster to lift the bucket more quickly or to lift a heavier load.

Use differentiated Activity sheets 8-10 to guide the children through the investigation.

Information about using these planning sheets is given in Appendix D.

Each group chooses which factor they want to change to investigate the question, e.g. more wind, less friction, bigger blades, blades of different material, type of thread etc.

Children may suggest other factors such as length and thickness of dowel, size of bottle – it is important to discuss which factors will actually have an effect on the speed of the turbine and which will not.

Discuss the need to keep other factors the same to make it a fair test. Provide guidance, but allow the children to choose how they go about the investigation within the parameters provided by the planning sheet. Make predictions about how changes will affect the lifting power of the windmill.

If they want to investigate the size of the blades, they could work out how to scale them up or down. If they want to investigate the friction, they could decide how to increase/ decrease the amount of friction (e.g. using margarine or Vaseline as a lubricant). If they want to test the amount of wind, they could decide how to generate wind and how to increase or decrease it (e.g. a hand fan, or hair drier – with adjustable speeds).

The children now test their windmill by:

- Adding different weights (the children could choose what to use e.g. marbles in the bucket), and find out which group's windmill can lift the heaviest weight.
- Timing to see which group can lift the bucket in the shortest time.

PLENARY

Ask the children to draw a conclusion answering the following questions.

How did changing your factor affect the weight carried in the bucket / time taken to lift the bucket?

Why do you think this happened?

How would you apply this to the problems outlined in the letter about Africa?

TO DEMONSTRATE HOW MOVEMENT CAN BE CONVERTED INTO ELECTRICAL ENERGY

The wind power that turns the windmill and produces the energy to lift a bucket can also be used to produce electricity.

You can demonstrate how electricity is generated by movement by using a bicycle with a dynamo to show how turning the wheel will power the lights.

The children can now consider how a windmill could be used to generate electricity. They need to take into consideration what happens when the axel or bicycle wheel stops turning and what happens when the wind dies down. They would have also seen this with their windmill when they stopped blowing.

Electricity cannot be stored and where it is produced in this way it needs to be supported with a back up system to fill the non- productive time.

In a power station the energy used can usually be controlled. Fuel heats water to produce steam which turns the turbines. In a hydro electric power station the dam is opened to allow water through to turn the turbines. In a battery, chemicals are used to produce electricity when the battery is put into a circuit. Wind power can be used to turn turbines to produce electricity.

The web site ***https://thekidshouldseethis.com/post/48611338726*** demonstrates this very well and could be used on an interactive whiteboard to show this to the class.

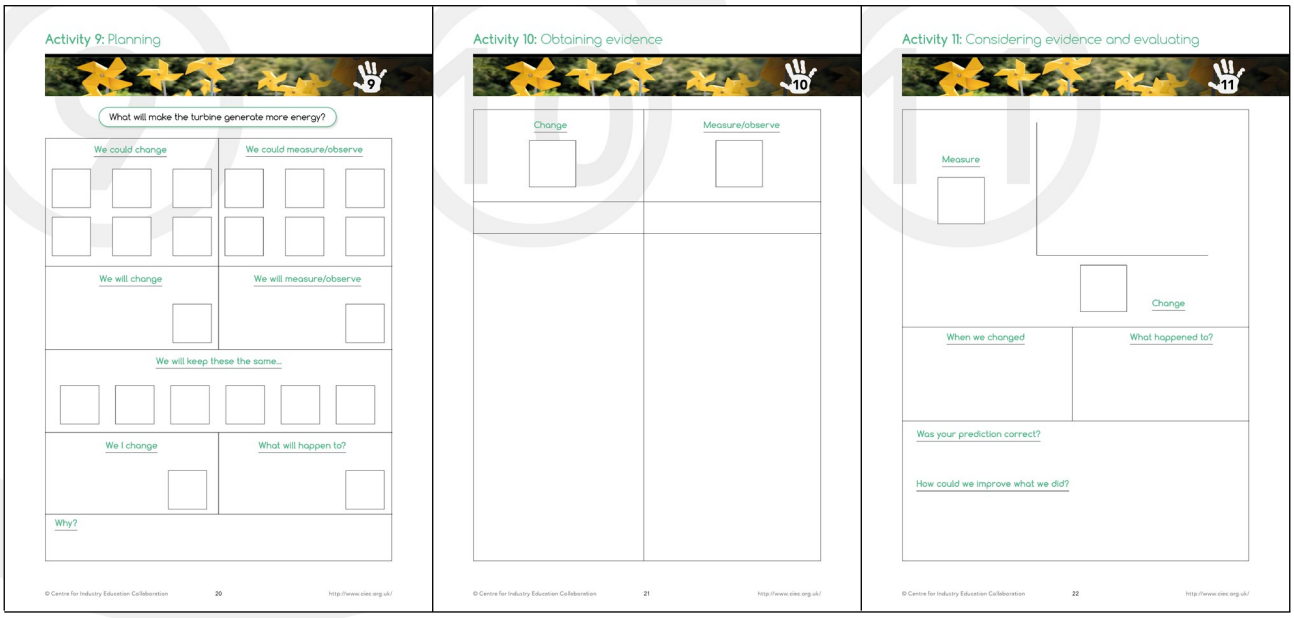
You can also generate enough electricity to light up an LED by turning a motor with enough revolutions.

Bend the LED probes and carefully attach them to the motor using insulating tape. Take care that the probes do not touch each other or the metal casing of the motor.

Attach a 50 cm length of cotton to the motor axel – secure with glue or a small piece of tape. Wind the cotton tightly around the axel until there is just enough left to hold. Give the cotton a sharp pull to turn the motor. The energy will be converted to electricity to light the diode. The order that the terminals are connected and the direction of turn are crucial. If it doesn't work first time wind the cotton the other way. This demonstration is best viewed in a darkened room.

Fig 2: Maintenance of a wind turbine in progress

Appendix D: Teacher guidance for using the investigative skills sheets



Copy the templates (Activity sheets 9-11) and enlarge, or use the Interactive Planning Tool on our website.

Introduce the activity, which involves planning an investigation to answer a **broad question**. Write this on a 'Post-it' note. (Try the activity on your own first to make sure the investigation suits using the posters).

List the things that you could change

Now ask the pupils to identify what factors could be changed to find out the answer to the question. Write each factor on a 'Post-it' note and add to the poster (if there are more than six factors, just squash them on).

List the things that you could measure or observe

Say to the pupils **"If we change one of these things"** (the factors already identified), **"What can we measure or observe to see if it's made a difference?"** These factors should be written on 'Post-it' notes (a different colour)and stuck on the appropriate place on the planning poster.

Choose one thing to change and one to measure or observe

Choose a factor to investigate, and what you will measure/observe, and place these 'Post-its' in the appropriate places on the planning poster.

Ask the pupils **"What do we need to keep the same to make it a fair test or comparison?"** They are likely to identify each of the factors on the left hand side of the poster in turn. Move the appropriate 'Post-its' down into the next section of the poser as the pupils list them.

The 'Post-its' can be easily replaced in their original positions, and you can exemplify the fair test/ comparison stage again, by deciding on a different factor to test. This helps more of the pupils to realise that one factor only is changing, and the rest kept constant.

Move the factors under investigation on to the results table to show how to organise results and again onto the axes of the graph to show which factors go where.