

energy

5 Energy Sources

b - Energy from the wind

Purpose

To explore sourcing our energy from the wind

Key concepts

- Wind energy is a natural and renewable resource
- Wind energy can be converted to electricity

After exploring the many forms and uses of energy (and the impacts they can have on the environment), consider possible ways to reduce your energy use. Also consider how you could increase your use of energy forms that won't harm the environment.

Consider

- How can you produce wind energy for use in your school?
- What are other alternatives?

Evaluate/Reflect

- To what extent were you able to produce and use wind energy in your school?
- What were the alternatives and were they more feasible?

Activities

5b.1 Make a windmill

5b.2 Wind generation

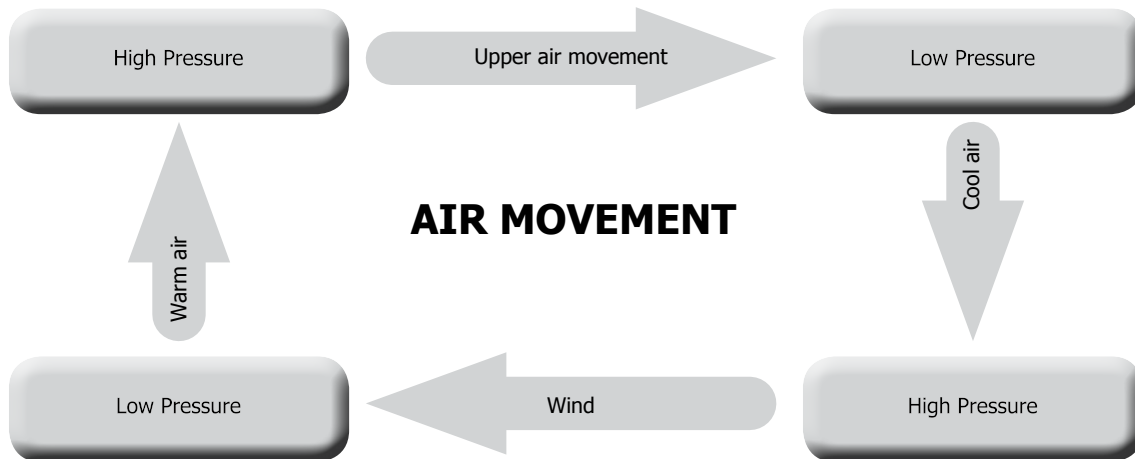
Little Green Readers (MAC) in Energy Kit

- Blow wind blow
- The big wind race

Background text

Energy From The Wind

Energy from the wind is a clean, renewable energy source. Wind is a natural force and it is part of our weather system. The sun's energy heats some parts of the earth's surface more than other parts. Warm air rises and creates an area of low pressure near the ground. In another area cool air is falling creating high pressure. Air always moves from areas of high pressure to areas of low pressure. This moving air makes a wind or breeze.



Many countries use wind turbines to generate electricity and the number of wind turbines is growing. A wind farm is a collection of wind turbines. Wind farms are usually sited on hill tops or on ridges of high land because this is where wind is strongest. Some countries have built wind turbines out to sea as the winds are stronger and more reliable. The direction of the wind is important in choosing a site for a wind turbine. In New Zealand the prevailing winds (most frequent) come from the north west. New Zealand has some areas with consistent and strong wind levels, for example, in the Manawatu. This provides the best conditions for wind farming. New Zealand already has a number of wind farms supplying electricity and more are planned for the future.

How a wind turbine works.

The kinetic energy of the wind is converted into mechanical energy by the wind turbine. The rotor is made up of two or more blades which rotate in the wind. As the blades spin, they turn the drive shaft which turns the generator. The turning generator produces electricity.

Advantages and disadvantages of using wind turbines to generate electricity

- Renewable source of energy
- Will work at night (unlike solar panels)
- Does not use fuel like coal, oil or gas which can cause air pollution
- Wind farms are highly visible and change the way a natural landscape looks
- Clean form of electricity generation
- The noise from the turning blades can be quite loud and disturb the quiet of the countryside
- Wind energy is an unlimited, free source of energy
- Wild bird populations may be endangered if the turbines are sited on their flight paths
- Not always windy

Read about the effects of wind farms. Useful websites are:

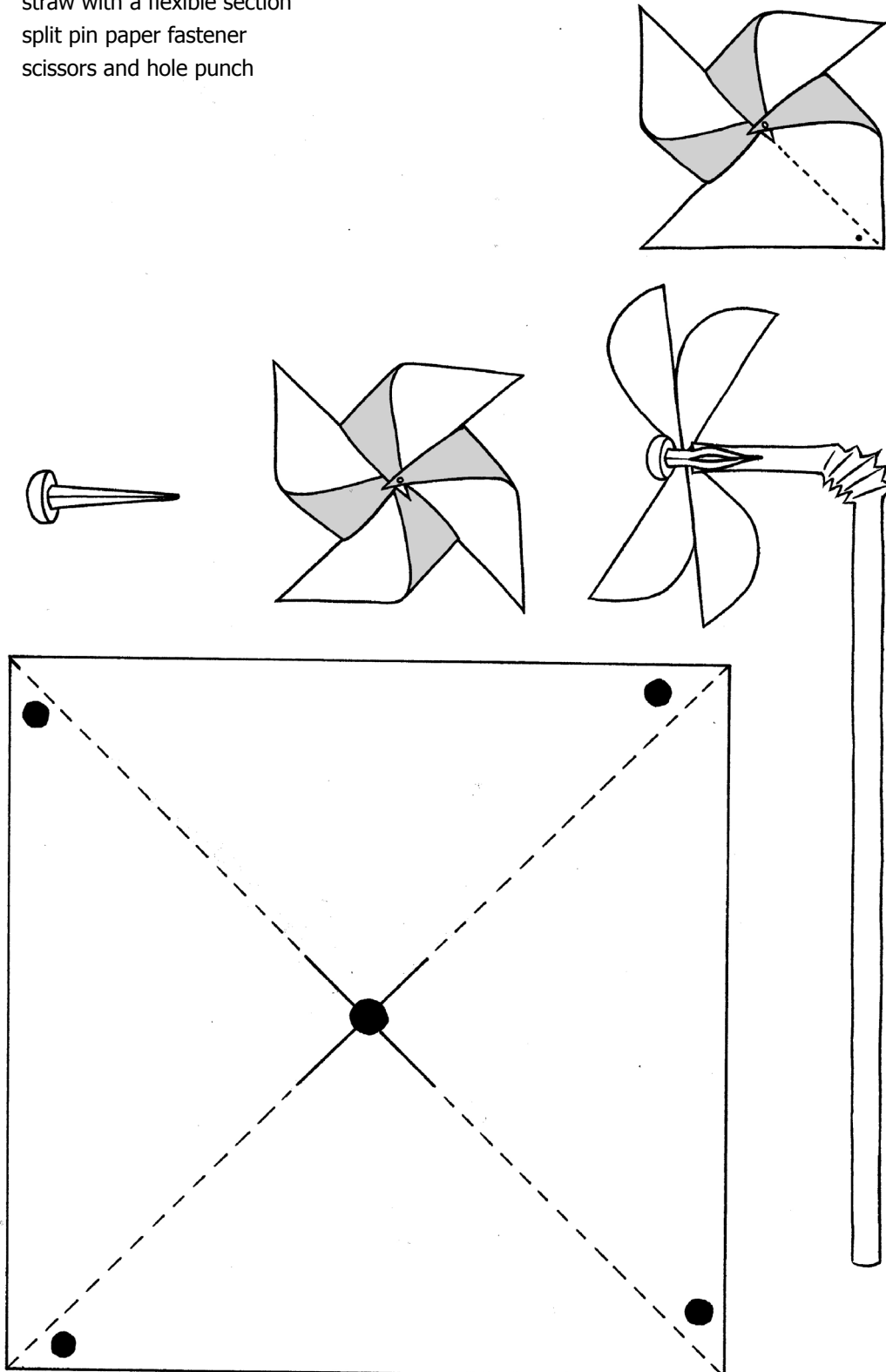
<http://www.windenergy.org.nz> (lesson plan and fact sheet)

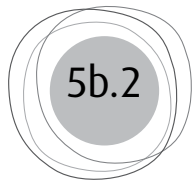
<http://www.nationalgeographic.com/education>

5b.1 Make A Windmill

You will need one of each per student

- copy of this page or one A3 at front of class – students could use colourful recycled pages to make the square
- straw with a flexible section
- split pin paper fastener
- scissors and hole punch





5b.2 Wind Generation

You will need per group

- The wind turbine model from the energy toolkit
 - An electric fan (or a windy day)
-

- 1 Place the wind turbine facing the wind. On a windy day this model can be set up outside. If there is insufficient wind, an electric fan can be used to simulate the wind. The fan settings simulate varying wind speeds. The wind speed needed to start up the rotor blades is 1.6m/s. The 'cut in' wind speed of 2.5m/s is when the generator starts to generate electricity from the turning blades.
- 2 The vane will automatically align the generator to the direction of the wind. At a wind speed of 8km/hr it takes one minute to charge up the storage capacitor. When electricity is being generated, a small red LED light inside the main body will light up. Can you see the red light?
- 3 Observe when there are changes in wind speed or direction. Discuss what happens and why you think that happens, what would the effects be if this was your only source of energy for electricity generation?
- 4 Complete the following sentences with the correct words
 - The higher the wind speed the faster/slower the wind turbine blades turn
 - The faster the blades turn, the more/less electricity is generated
 - The more electricity is generated the brighter/duller the LED light will be
 - When the wind (or fan) speed drops below 8km/hr the light will go on/out

Evaluate/Reflect

- In your area would wind power be sufficient for your energy usage?
- Scenario: You live in a house in the country. You chose to live in this rural area because it is beautiful, peaceful and you are interested in bird watching. You can see sheep grazing on the hills and flocks of birds flying by. You care about the environment and the way we use natural resources. You try to be energy efficient, and reuse and recycle things as much as you can. You have just had a letter explaining a proposal to build a wind farm on the hill that you can see from your house. For more information see www.meridianenergy.co.nz/about-us/generating-energy/ How would you feel about this proposal?

Extensions

- A wind farm is where many wind turbines are built on one site. Investigate on-shore wind farms in New Zealand and around the world as well as off shore wind farms.

Extension - Measuring Wind Speed

The Beaufort scale is an empirical measure for the intensity of the weather based mainly on wind power. The scale was created by the British naval commander Sir Francis Beaufort around 1806.

Draw a picture to show what would be happening on land for each of the Beaufort scale measurements.

Beaufort number	Wind Speed Knots	Units in km/h	Description	Sea conditions	Land conditions	Picture of land conditions
0	<1	0	Calm	Flat	Calm	
1	1-3	19 km/h or less	Light air	Ripples without crests	Wind motion visible in smoke	
2	4-6	20 - 29 km/h	Light breeze	Small wavelets	Leaves rustle	
3	7-10	30 - 39 km/h	Gentle breeze	Large wavelets	Smaller twigs in constant motion	
4	11-16	40 - 50 km/h	Moderate breeze	Small waves	Small branches begin to move	
5	17-21	51 - 62 km/h	Fresh breeze	Moderate longer waves	Smaller trees sway	
6	22-27	63 - 75 km/h	Strong breeze	Large waves with foam crests	Large branches in motion	
7	28-33	76 - 87 km/h	Near gale	Sea heaps up and foam begins to streak	Whole trees in motion	
8	34-40	88 - 102 km/h	Gale	Moderately high waves with breaking crests	Twigs broken from trees	
9	41-47	103 - 117 km/h	Severe gale	High waves with dense foam	Light structure damage	
10	48-55	118 km/h or more	Storm	Very high waves. The sea surface is white	Trees uprooted. Considerable structural damage	
11	56-63		Violent storm	Exceptionally high waves	Widespread structural damage	
12	64-71		Hurricane	Sea completely white with driving spray	Massive and widespread damage to structure	

