international ORKNEY SCIENCE FESTIVAL

Primary and Secondary teams from Orkney are challenged to design and build a miniature wind turbine and research wind technologies.

Scotland and Orkney are wind power pioneers:

The world's first electricity-generating wind machine
Built by James Blyth, near Montrose, in 1887.

At the same time, Westray had a wind-powered threshing machine.
Parts of it can still be seen at Sangar.

Young Engineers & Science Clubs Scotland

Britain's first wind turbine connected to the grid
At Costa Head, West Mainland, in 1955.

Find out about wind turbines by making one yourself!

THE CHALLENGE

4-person teams (Primary or Secondary) are challenged to:

1. **Produce a research portfolio on wind power**
2. **Design, build and test a miniature wind turbine**

Following registration, a free resource kit of components to incorporate into your model will be sent to your school. Thanks to our Orkney sponsors we can provide one kit per school. One day, maybe your students will be working for them!

[A materials list is provided if you want to buy more parts yourself]

The challenge can be delivered within an extra-curricular club, or within the curriculum, to suit the school.

PRIZES

Teams are invited to showcase their portfolio at the **Orkney Celebration of Engineering** on **1 June 2022.**

You have until the Orkney Science Festival (midnight on Saturday 3rd September) to submit your entries to:

dave.craig@scdi.org.uk.

OREF will award prizes of up to £50 to the best overall entry in each category (Primary and Secondary) at the end of the Science Festival.

HEALTH & SAFETY

Note that it is teachers' responsibility to ensure activities are carried out safely, and to complete a risk assessment before undertaking practical activities like cutting, drilling, hot melt glue and soldering. Please don't hesitate to get in touch if you require further guidance. Support is also available from SSERC: sts@sserc.org.uk

LEARNING

Working in a team to develop a solution to a current engineering challenge encourages pupils to explore exciting areas of STEM while developing valuable skills for learning, life and work.

There is ample scope to relate to the CfE Curriculum. The following outcomes are particularly relevant:

SCN 3-04b By investigating renewable energy sources and taking part in practical activities to harness them, I can discuss their benefits and potential problems.

Physics N4 Generation of electricity
Research or investigate the factors affecting the electrical output from a range of sources, for example solar cells or wind turbines.

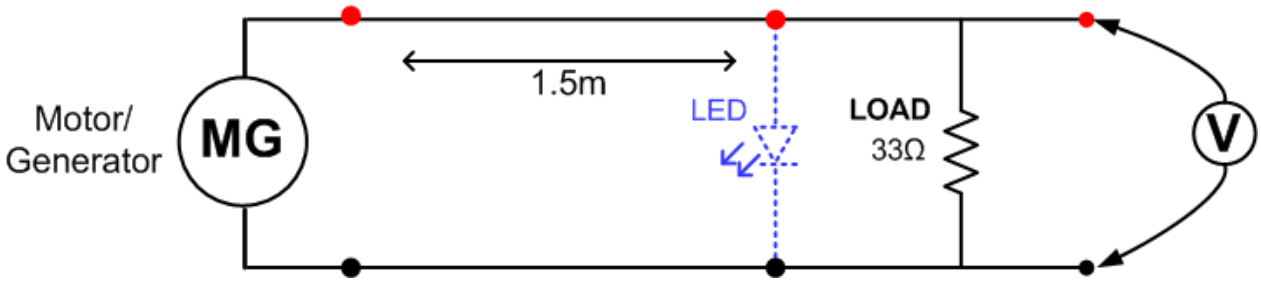
An all-class windmill activity is included, to help spread the word and encourage team recruitment.

SOME RULES

Part 1 –Turbine

Your wind turbine model:

- must use the motor/generator supplied in the kit
- must be connected to a 33Ω load resistor as shown



- The LED is optional, and is not used for testing.
- The polarity of the generator depends on the direction it spins! This only matters if you are using an LED.

Include in your entry a **picture** of your wind turbine.

Part 2 – Research Portfolio

You must produce a research portfolio **'Wind Power in Scotland and Orkney'**

Key questions :

- History of wind turbines
- Types of wind turbine(e.g. horizontal/vertical)
- Advantages and disadvantages
- The future of wind turbines
- How much electricity is produced now, how much is needed?

Any format can be used, hand-drawn is fine, no more than 4 pages.

The portfolio should be **concise**, **accurate** and **relevant.**

Part 3 – Testing

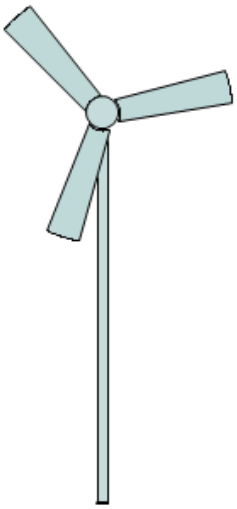
You must **record results** from your model **out of doors** on **at least two days**.

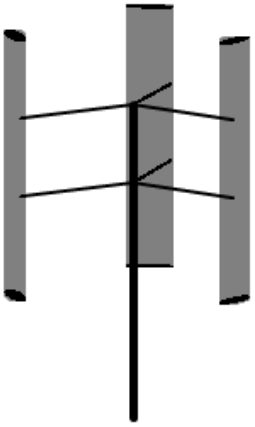
The output voltage from the turbine should be recorded over about 1 minute.

Decide what else you should record, but as with any report be sure to include **where**, **when** and **who.** A series of measurements might show how variable the wind is.

Consider making a **graph**.

CONCEPT DEVELOPMENT





Think of ideas and draw labelled sketches.

Discuss how they should work, and what might be difficult.

Models

Scale drawings or simple models will help you explore a few of the best ideas.

Design and Materials

You can use other materials in addition to what's in the kit. For example: wood, metal, plastic or wire.

Develop

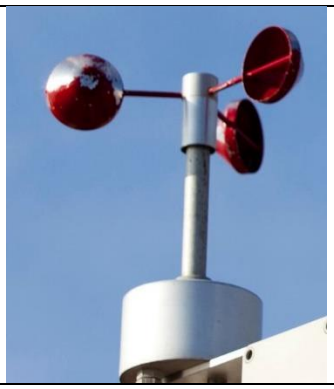
Choose the best design, which may use ideas from all your prototypes. Identify important factors and vary them systematically.

Panic Early

As in all engineering projects, time is limited. Don't waste time discussing what *might* happen or what *might* be best, when you have no real idea – try your ideas out, and find out what *is* important.

Read the Rules

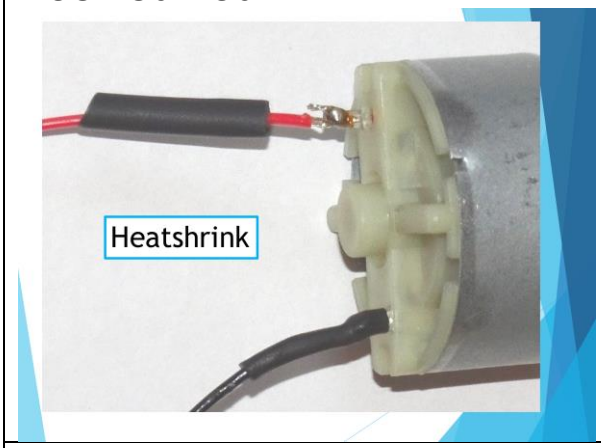
Refer to the rules and guidelines throughout, to ensure you're not disappointed at the end.

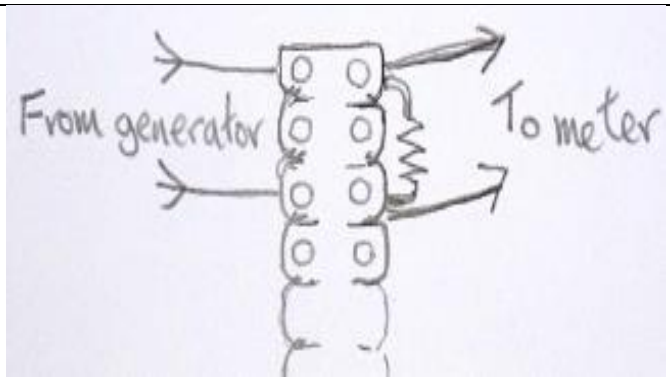
Advice: To survive outside in Orkney, small is good!	
	

TEAMWORK

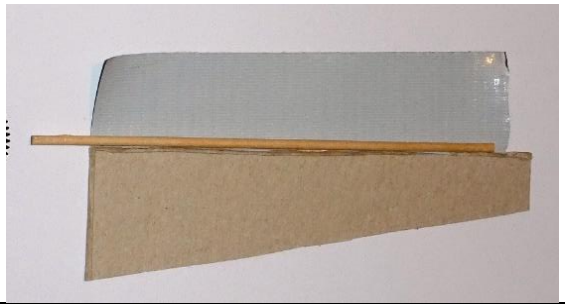
Organise! For example:

Electrical Team





Rotor/Blade Team

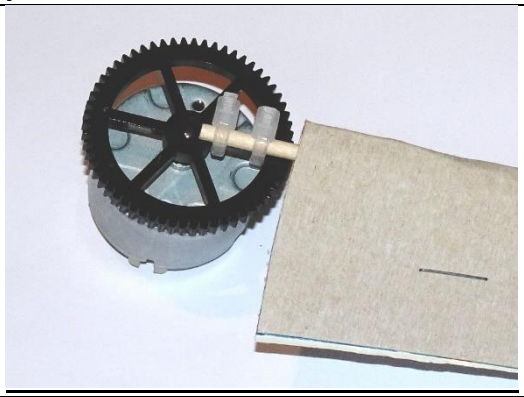


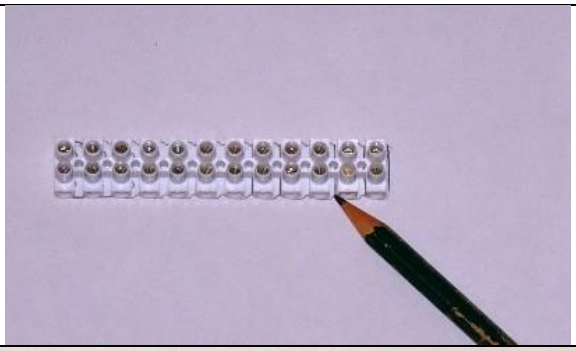
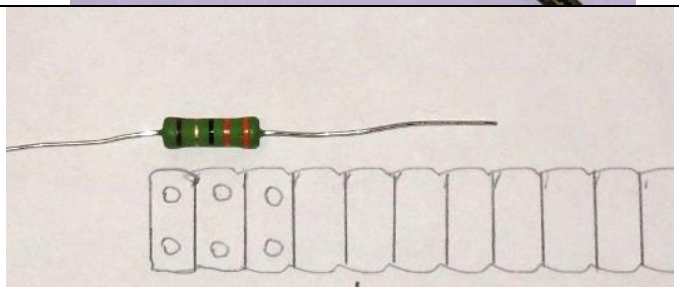
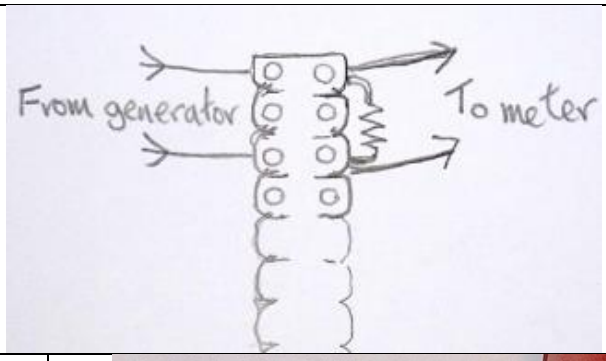
Mast team

Tip

Push the gear onto the shaft of the motor. It is tight, you may need help. Don't push it too far on.

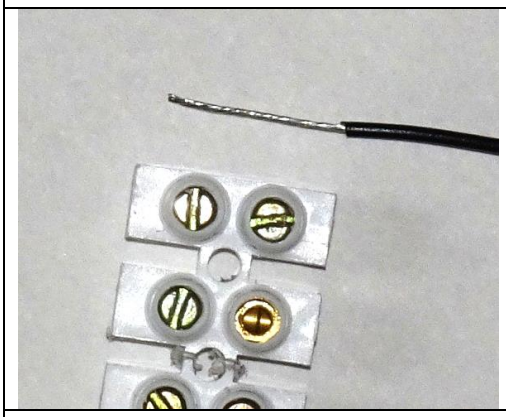
A rotor, or blades, can be attached to the gear with cable ties.
Use at least two cable ties on each spoke, and pull them as tight as you can.



Load Circuit	
1. Trace round the terminal strip	
2. Lay out the resistor to check its size. Coloured bands tell you the resistor value. A 33 ohm resistor is: Orange, Orange, plus 3 more bands. A resistor doesn't have + and -: it can be fitted either way round.	
3. Design the circuit so it will fit the terminal block	
4. You can measure the resistor to check its value. Set the meter to the 2000Ω scale. Remember to turn the meter OFF when you are finished, or else its battery will go flat.	

Load Circuit (continued)

5. If you don't have wire strippers, insulation can be removed with scissors.
The wires grip better if they go under both screws on the terminals.

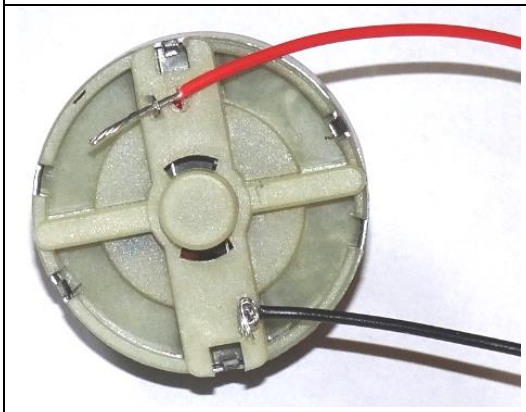


6. Finished load circuit.

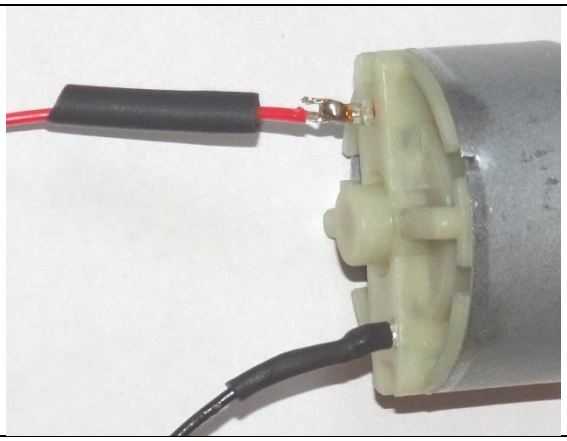
You can copy this if you like.

Set the meter to DC [V⎓] on the 2000m scale (i.e. 2V).

7. Fitting wires to the motor is tricky. Strip plenty of wire, twist the strands to keep them together. Thread through the motor,I then twist a few times



8. The best way is to use a soldering iron.



9. To stop the wires falling off, you can use a short piece of electrical tape, tightly wound. Or try using the black heat-shrink tube in the kit. Slide the tube over the joint, then get an adult to heat it up. Professionals use a heat gun or hot air paint stripper. Another way is to use a gas lighter - but you have to be quick, or the wire insulation will melt! Or hold it over the edge of a cooker ring.

If you would like any help or advice please don't hesitate to get in touch and we'll be happy to help!

dave.craig@scdi.org.uk
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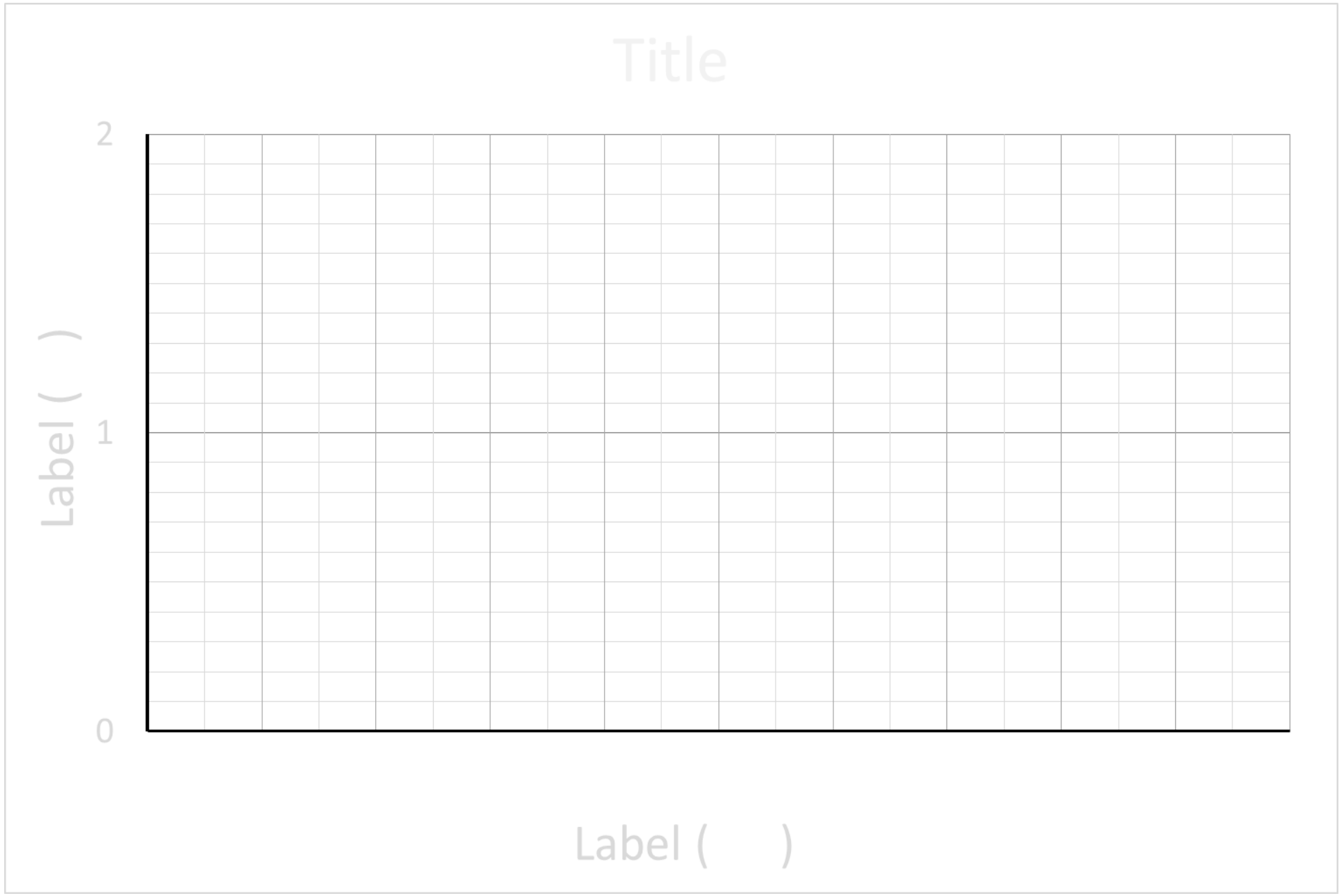
Results sheet (or use your own)

School		Names	
Test Site			
Date			
Time	Voltage	Notes	
Date			
Time	Voltage	Notes	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THE KIT

The free kit of materials is to get you started; you can buy more of these parts if you want. You can use any material you like for your wind turbine, however, you must use the generator 37-0445, and connect a 33 ohm load.

Rapid Online: https://www.rapidonline.com

56-0445	Kingbright L-7113LSRD 5mm Super Bright Red LED Low Current
86-0405	Rapid 100 x 3mm Flat Bladed Screwdriver
91-2721	PZ1 x 75mmPozidriv Screwdriver -
62-8748	TruOhm 33R 1% 2W Flame Proof Metal Film Resistor
37-0445	TruMotion Low Inertia Motor 6V 2700 RPM

CPC Farnell https://cpc.farnell.com/

PEL00884	6V Low Inertia DC Motor
TL18417	PZ1 x 75mmPozidriv Screwdriver -
IN07221	Duratool Mulitmeter D03047
TL15767	150mm Junior Hacksaw
CB19933	Equipment Wire, 7/0.20mm, Black, 10m
SD02300	60/40 Solder Wire, 1.2mm, 17g, 2.5m -
CB10957	3:1 Heatshrink Tubing 3.0mm x 1.22m Black
CB15472	Straight Terminal Strip 12 Contacts 3A
CB20047	Nylon Cable Ties, 100 x 1.8mm

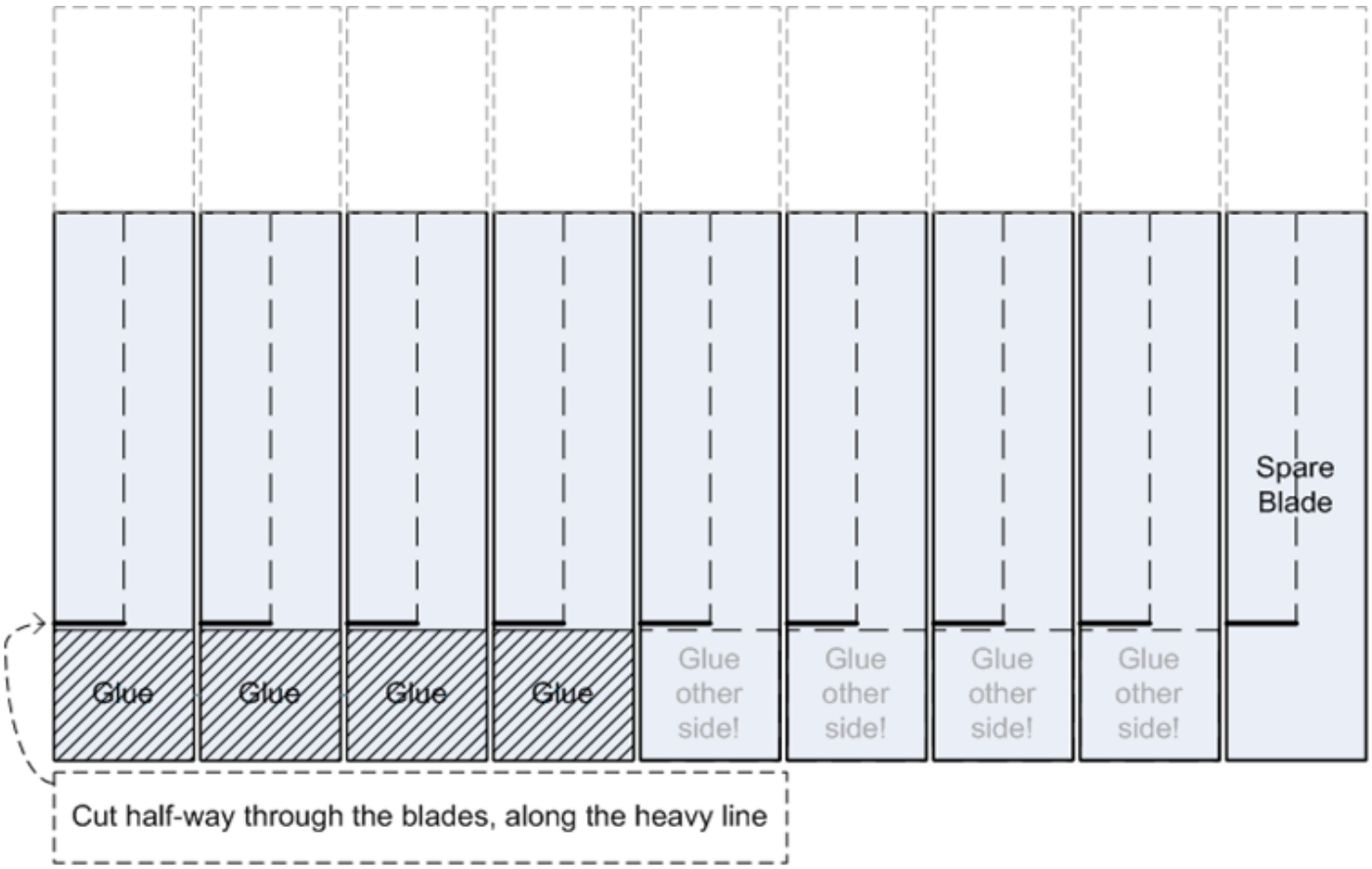
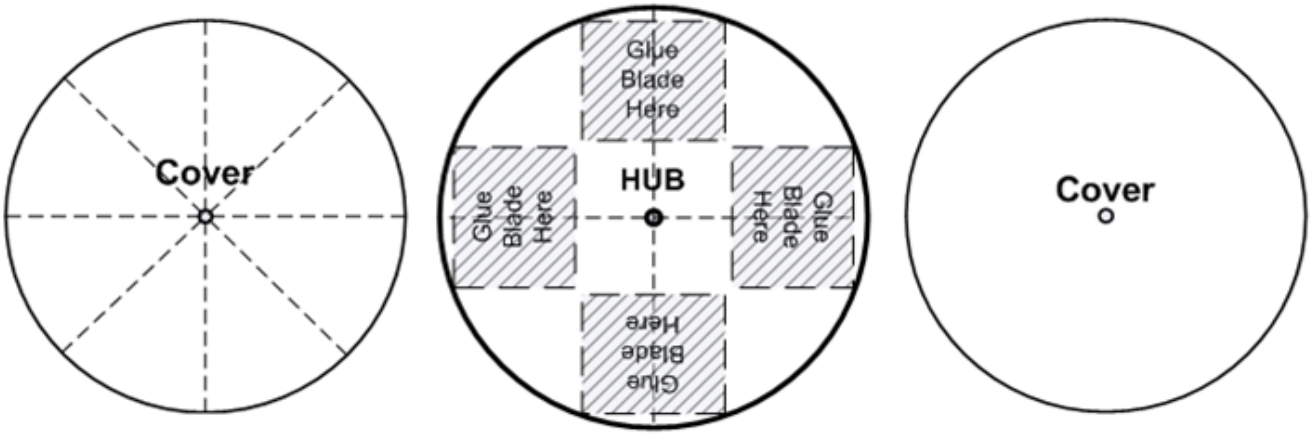
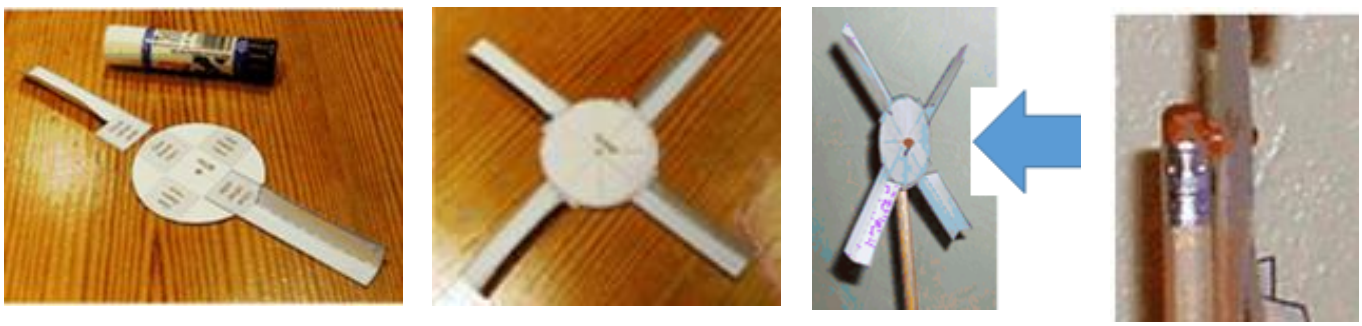
ebay

Miniature Plastic Cog Gears with 2mm Shaft Hole, Type B (60 tooth cog)
PIPE CLIPS WHITE PLASTIC COATED 1"1/4 (32MM) 25 PACK
MULTI PURPOSE WOOD SCREWS POZI: 2.5 X 16mm

Supplies for Introductory Activity

A4 160gsm card, Hama midi beads, 5mm map pins, unsharpened HB pencils with erasers

INTRODUCTORY CLASS ACTIVITY – Make a paper windmill

Kit: Pencil (with eraser, unsharpened), HAMA bead, 5mm map pin. Print this template **on 160gsm paper**.

Test with a hairdryer; measure how far away you can put your windmill, and still get it to turn.