# A few tools anyone can make by themselves

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The following tools are easy to make, require only common materials and hopefully can be useful for physics teachers, either in regular physics lessons or as an interesting element for some kind of a science club.

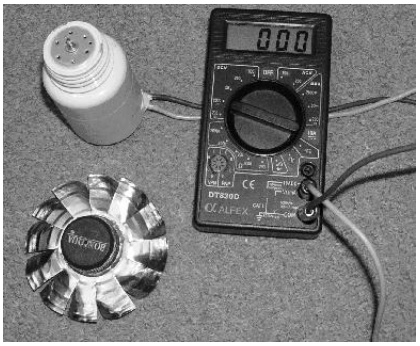
## 1) CD-ROM motor driven windmill

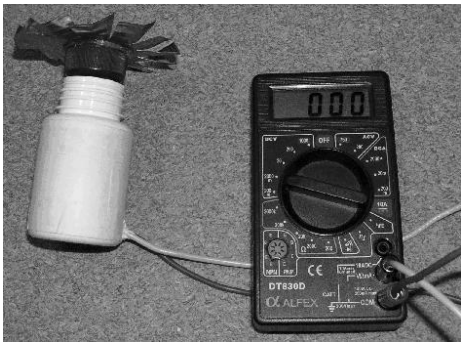
To make this tool you need a motor from an old CD-ROM, a plastic tube from pills or vitamins, a circular metal lid (cut out when opening a can), a plastic bottle lid, silicone sealant, scissors, two wires and a voltmeter.

Make two holes into the plastic tube, pull the wires through the holes and solder them to the motor. The diameter of the tube should be slightly larger than the diameter of the motor. Fill the small slit between the tube and the motor with the silicone sealant. After doing this, the motor will be glued both firmly and elastically enough to enable you to lend the tool to students' hands. Create the propeller by cutting the metal can lid and gluing it to the plastic bottle lid. Drill a small hole into the centre of the propeller and fix it to the engine.

On this simple windmill power station you can demonstrate the transformation of wind energy into electric energy. I have had good experiences with making a pupils' contest in producing maximum energy in one blow. After a few moments the students usually find out the best method of blowing (the direction, speed and intensity). Only small voltages are usually inducted with their first blow but after five or six tries they get much better results. After this experience it is much easier to explain why we need different kinds of wind power stations and why dam power stations use different turbines depending on the water stream speed.

This tool confirms the rule: "The simpler it is the more interest it attracts".



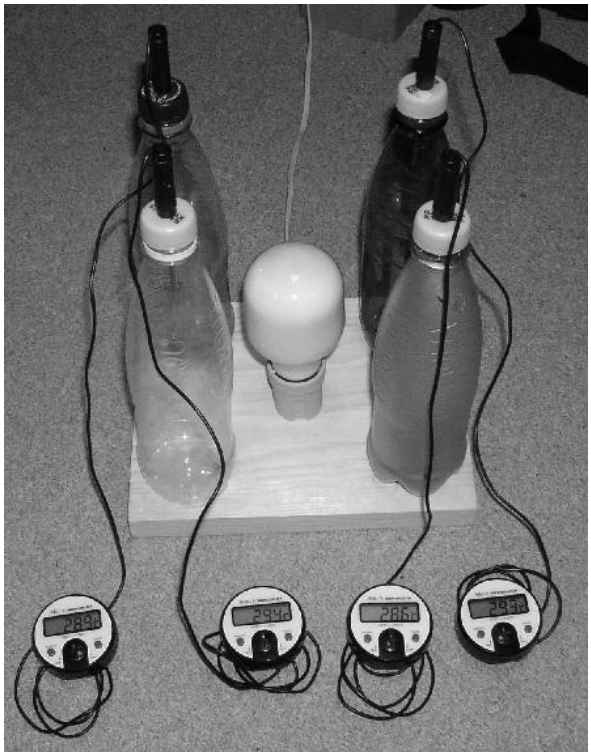


## 2) Spreading of heat by radiation

Get four small (0.5 litre) plastic bottles having same or similar shape but of different colours. I used one dark blue, one dark green, one transparent and sprayed one with a silver (zinc) colour. You will also need a wooden board, bulb socket, a wire with a standard plug, a 100 W light bulb, 20 W power-saving light bulb (the equivalent to standard 100 W), silicone sealant and four digital thermometers. *Remark:* Because the fibre in the light bulb is situated in its lower half, the bottles don't get heated uniformly. Therefore I recommend getting a milky glass light bulb where this effect is not so significant.

Cut the board to dimensions 20 cm × 20 cm at minimum and attach the socket to its centre. I have had good results with a ceramic socket that already has holes prepared for screwing it to the board. Fix the wire to the socket. Take care, this is 230 V voltage so you have to make sure everything is safe from fire or health risk. Glue all four bottles around the socket. Distances of the bottles from the socket should be all same. Drill thermometer-sized holes through the lids of the bottles.

This tool shows that different colours absorb different amount of incoming radiation. At the beginning, the air in all closed bottles is of same temperature. After turning on the bulb it takes just a few seconds and the air is being heated by the radiation. The highest increase of temperature emerges in the dark blue bottle, the lowest in the silver one.



It is also possible to study the final temperature inside the bottles and the time required to reach it.

If we use a power-saving light bulb in stead of a standard one, we find out that the rate of temperature increase is significantly lower.

Furthermore, it is possible to pour into all bottles same amount of hot water and observe the rate of decrease of temperature, drawing conclusions as to how colour affects heat radiation.

Finally, if you let the students to do these experiments, they will come out with their own ideas of what to study more.

## 3) Magnetic water propulsion

Students at school learn that when a conductor with an electric current is placed into a magnetic field, it is affected by a magnetic force. This force is that which moves the rotor in electric motors. Sometimes we show an experiment with a wire placed near a magnet: the wire moves slightly when it conducts electric current. However, a much

more exciting performance is when we replace the metal conductor with a liquid - an electrolyte. If we turn on the current, the liquid starts moving due to magnetic force. If the arrangement of the experiment is adequate, it can move continually around in closed space. Such experiment is illustrative and convinces pupils about the existence of a connection between magnetic an electric fields.

To make this tool you need two strong flat magnets that have magnetic poles on opposite flat sides (usual school magnets do not fit this requirement). You can get such magnets e.g. at www.rootra.com or you can use a vertically positioned coil which is able to make the magnetic field strong enough. Furthermore you need a can, a plastic lid of same or larger diameter than the can, an empty spray can (make sure there is no overpressure any more), wires and a switch.

Cut from the can a ring about 4 cm high. Solder one wire to the ring and glue it with a silicone sealant to the plastic lid. You have now the outer electrode. Make the second electrode from the spray can, solder another wire to it and glue it to the centre of the lid. After the silicone hardens put the lid onto the magnets, pour electrolyte between the electrodes and connect the wires to a 9 V power source. The electrolyte starts to move in direction of the magnetic force. To make the movement of the electrolyte more visible you can dust it with cork powder or poppy seed.