

Hydro and Wind Energy

The name hydro comes from the Greek word for water. Flowing or falling water carries energy that can be transformed into other forms of energy that are more useful to us. Water is in permanent motion due to the continuous natural water cycle and this means that the source of energy – flowing water – will not be depleted by its use to produce other forms of energy. Hence, hydro energy is a renewable energy.



Wind Energy refers to the energy harvested from the wind and, given that air is in constant motion due to atmospheric circulation, the source of energy – flowing air/wind – will not be depleted by its use to produce other forms of energy either. Wind energy is also a renewable energy.

Both hydro and wind energy can be transformed into motive power by turbines (either water or wind turbines). This energy can be used to produce electricity or other mechanical work, like lifting a weight for example, or for grinding grain as they did many years ago before we had electricity!

Combined Windmill and Watermill in Emsland, Germany

Experiment 1: Hydro Energy

In this experiment we will build a Pelton turbine, which will extract energy from the falling water from a tap. For this experiment you need:

- Plasticine
- 6-8 small plastic spoons (ice lolly sticks will also work)
- A disposable wooden chopstick/stick
- A piece of straw
- Lego
- A tap

The wooden stick will become the axis of the turbine. Attach a bit of plasticine to one of the ends of the wooden stick – try to keep the thickness of the plasticine around the axis constant so the turbine is well balanced. Insert the plastic spoons in the plasticine. The spoons should all have the same orientation and, for better results, place them evenly around the rim of plasticine. This will be the *runner* of our turbine.

To allow the free rotation of the axis, the wooden stick has been inserted into a piece of a plastic straw, which will act as a sleeve. Make sure the wooden stick can rotate freely inside the straw.



The tower to host the turbine has been made with Lego, but anything that can hold the plastic straw with the axis in will work. A small hole is left in the tower through which the axis can be inserted - in this example, plasticine is used on the inside of the hole to hold the straw in place while the wooden stick rotates freely inside it.

Place the turbine close to the tap so the falling water strikes on the concave side of the spoon and switch the tap on. The tangential strike will make the runner rotate.

The three different photos below show the turbine that transforms the energy of the falling water into the rotational motion of the runner. In a hydro power plant, this rotation will be converted into electricity using a generator connected to the electricity grid.

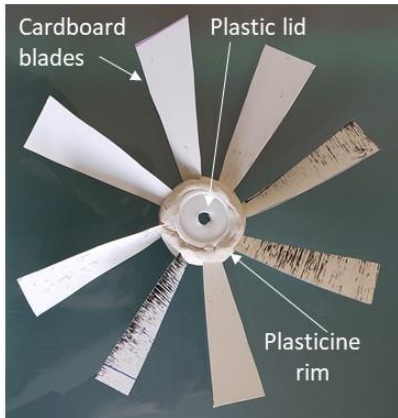


Experiment 2: Wind Energy

In this experiment we will build a wind turbine to understand how we harvest wind energy. For this experiment you need:

- A plastic lid
- Plasticine
- Cardboard
- A disposable wooden chopstick/stick
- A straw
- A hairdryer

First, make 8-10 blades with cardboard – a rectangular shape will work, or you can try tapered blades. A rectangular shape of 8 centimetres (cm) tall by 1.5cm wide is a good starting point. On the plastic lid make a hole big enough to get one end of the wooden stick through. A plastic lid is used as it is lighter than a full rim made of plasticine. Put a thin layer of plasticine around the lid and insert the cardboard blades in the plasticine layer forming an angle with the direction of the air. All blades should have the same orientation. See the rotor in the picture below for guidance.



The wooden stick is the axis of our wind turbine. Similarly to 'Experiment 1', the stick should rotate freely inside a plastic straw sleeve. We can use a Lego tower to hold the turbine axis, as before, or the plastic straw (with the wooden axis inside) could be placed inside a bit of plasticine, stuck to a corner of a table – like in the example below. Switch on the hairdryer, around 20 centimetres from the propeller, and point the air towards it.

Follow-on experiments

In both experiments you can tie a string at the end of the stick and add a mass at the end of the string to see how the rotational energy can be used to change the potential energy of the weight by lifting it to a height.

In the case of the wind turbine, shown below, we made a little basket from a plastic container so we could put Lego figurines or add objects to investigate how much weight the turbine can lift. Some hairdryers allow you to change the air speed – if you can do that, check what happens when you change the air speed and/or if you change the shape, size or orientation of the blades.

