

PUMP IT UP

Challenge

A new village has just been built in the Welsh mountains. It has 140 houses, 1 school, 3 local shops and a garage. They all need electricity to run their lights, heating and TVs. The builders were worried about the environment and so decided to investigate how they could use renewable energy - like wind or water power - to make electricity to help power the village.

Before you start

Use your muscles, and see where the tubes go!

Think about...

Is storing energy a good idea?

Where is the energy coming from in this exhibit?

Can you make the light/TV stay on for a long time?

Your challenge is to work out how to get electricity from this exhibit.

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Most power stations work by burning a fuel to turn a wheel or turbine that rotates a generator just like the exhibit. A generator does just what it says— it generates electricity! Some power stations use steam to turn the turbine and some use water.

1. Can you name some things that use electricity?

2. Can you name some types of energy other than electricity?

3. Look at the picture of the exhibit.

Put the words into the boxes on the diagram.

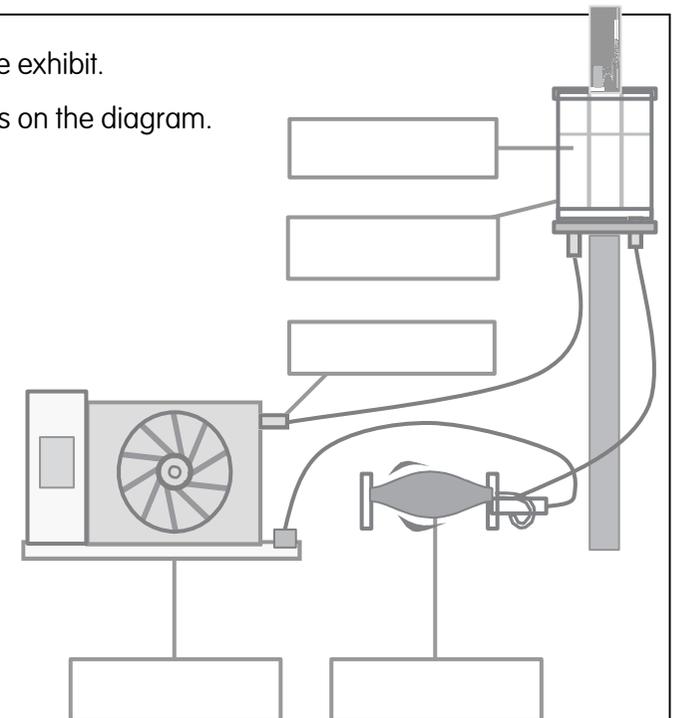
Hand pump

Water wheel

Top reservoir

Open/close valve

Water



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4. Can you explain what is happening to make the water wheel spin?

5. Experiment

1. Choose a position for the top reservoir and record the height in metres.
2. Turn the tap off.
3. Pump all of the water to the top of the reservoir.
4. Open the tap and let all the water run through the turbine.
5. The digital display shows the speed of the water in revolutions per minute (rpm)

a. Complete the table below for the rpm at 4 different heights.

	Height (m)	Revolutions per minute (rpm)
1		
2		
3		
4		

b. What pattern do you notice?

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6. Based on what you found, suggest why the Welsh mountains might be a good place for a hydroelectric power station

7. Supply and demand

The National Grid Company supplies all the electricity in the United Kingdom and need to try and predict the amount of electricity needed at certain times of the year. Look at the times and days below.

Decide if the demand for electricity would be high, medium or low at the times below. Give your reasons.

Time	Demand	Reason
August afternoon	<input type="checkbox"/> High <input type="checkbox"/> Medium <input type="checkbox"/> Low	
Christmas Day, 1pm	<input type="checkbox"/> High <input type="checkbox"/> Medium <input type="checkbox"/> Low	
Any Tuesday night just after EastEnders	<input type="checkbox"/> High <input type="checkbox"/> Medium <input type="checkbox"/> Low	
February midnight	<input type="checkbox"/> High <input type="checkbox"/> Medium <input type="checkbox"/> Low	
February evening	<input type="checkbox"/> High <input type="checkbox"/> Medium <input type="checkbox"/> Low	

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8. Sources of energy used for making electricity can be 'renewable' or 'non-renewable'. Renewable energy is replaced naturally, does not run out, and is generally less polluting. Give some examples below of each type of energy.

<p>Renewable Means you can use it again!</p>	<p>Non-renewable Means that once you have used it all up it is gone forever</p>

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9. How much energy?

Using the formula below, work out how much energy (in joules) is stored as **gravitational potential energy** once you have pumped it.

GPE = m x g x h, where:

GPE = gravitational potential energy in joules (J)

m = mass in kilogrammes (kg)

g = gravitational field strength (10 m/s²)

h = height in metres (m)

Total mass of water = 2kg

$$\text{GPE} = m \times g \times h$$

$$\text{GPE} = \quad \times \quad \times$$

$$\text{GPE} = \quad \text{J}$$

Notes:

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10. Energy transfers

Fill in the gaps with the words to describe energy transfers taking place in this exhibit.

Energy cannot be _____ or _____. Any process involves _____ energy from one form to another.

_____ energy from your food allows you to do _____ which in turn allows you to turn the pump.

The water gains _____ energy as it is pumped up to the top reservoir. When this water comes down the pipe it gains _____ energy.

The energy of the fast-moving water is transferred by the water turbine and generator into _____ energy. This energy could be used to supply different electrical items.

transferring

chemical

created

electrical

work

potential

destroyed

kinetic

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11. Power stations and their energy stores

Power stations use energy to generate electricity. During this process they deplete an energy store in order to generate the electricity.

Complete the table below.

Power station	Type of energy	What is used to turn the turbine in the generator?
Hydro-electric		
Tidal		
Wave		
Wind		
Solar		
Biofuels		
Coal fired	Chemical	Steam
Gas fired		
Geothermal		
Nuclear		
Oil fired		