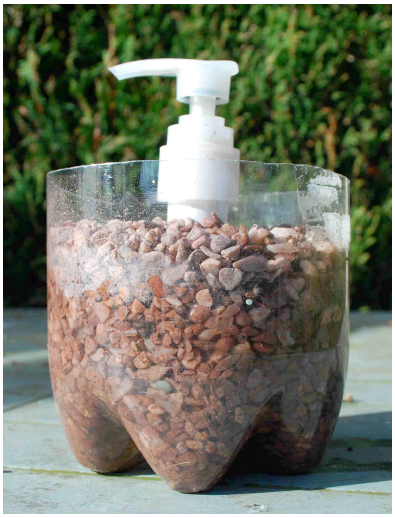
Well, well, well!
Making a working model of a well

Many pupils think that water from wells comes up from great underground lakes, rather than from the pore spaces and natural fractures within the rocks. To help them to understand what really happens, set up one of the two model wells described here.

a) The simple version: Take the pump from an old 'squirty' bottle of hand-wash or similar liquid and stand it in a clear plastic container, such as the base cut from a 2 litre drinks bottle, as shown in the photo. Trickle in gravel or coarse sand to nearly fill the container. Imitate rainfall by gently pouring water from a watering can until the level rises to about three quarters full. Ask the pupils what they can see through the sides of the container. Then use the pump action to pump water up out of the well into a cup, and ask the pupils to see if the water level in the gravel/sand has gone down. After abstracting some of the water (abstraction is the term used for extracting groundwater), mark the position of the water table on the plastic of the container, using a felt tipped pen. Ask the pupils what they think the term 'water table' means (*the top surface of the zone in the rock which is saturated with water. i.e. water which is still trickling down is not included*).

b) The elaborate version: Build up the model in a bucket, as shown in the pictures, and as described under "Resources". Pour water slowly onto the surface of the sand, using the roof over the well, to ensure that water does not go down the tube itself. If using dry sand in a 5 litre bucket, 1 litre of water will probably be enough. Take off the roof and ask pupils to check when they can see water rising at the bottom of the well, which will probably take about 10 minutes. They can then lower the bottle top, weighted with a coin, to see if they can bring up some water.

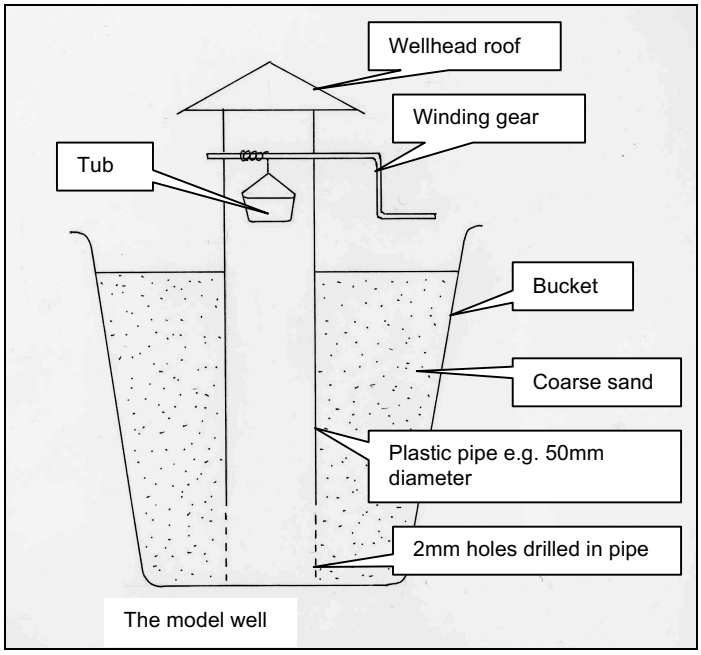


The simple version

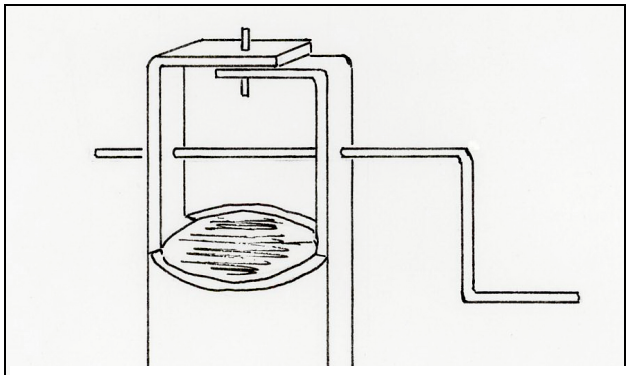
Showing a piece of perforated pipe around the pipe of the pump, to prevent clogging (see "Resources")

For either model, ask the pupils:

- Is there is an underground lake in the model (*no*).
- Where is the water, then? (*it occurs within the pore spaces between the grains of sand)*
- What is needed to maintain the supply of water? (*rainfall*).
- Could the well be pumped dry? (*yes, if it is not replenished by more rainfall*).
- Are wells used to supply water in all countries or just some countries? *(groundwater supplies are important in nearly every country – in the UK they provide an important part of the water supply, even though the UK is a relatively wet country).*



The model well



The wellhead –made by cutting out part of the top of the pipe to leave two uprights. These are bent over and held together with glue, or with a small bolt. The uprights are drilled to take the winding rod.

Well in a bucket showing winding gear and the well roof

Well in a bucket without its roof
(*All photographs: Peter Kennett*)

The back up

Title: Well, well, well

Subtitle: Making a working model of a well

Topic: Choose one version of the model to make, depending on the time and equipment available, and use it to demonstrate how water percolates through the spaces between the grains of a sediment or rock to accumulate at the bottom of a well.

Age range of pupils: 5 – 14 years

Time needed to complete activity: 15 minutes, plus 5 minutes to make the simple model, or about 45 minutes to make the more elaborate one.

Pupil learning outcomes: Pupils can:

- observe what happens when water is added to a porous and permeable 'rock';
- describe the meaning of the term 'water table';
- appreciate that most water derived from groundwater comes from within the pore spaces and other fractures of the rock and does not usually occur as underground lakes;
- understand that a reliable supply of water depends on rainfall and that a well may run dry.

Context: The activity is simple enough to be understood by children of all ages, and can be used in any lesson, e.g. in geography or science where water supply is being taught, or where renewable and non-renewable resources are featured.

Following up the activity:

- Ask pupils to predict how much water they think the model can absorb before it becomes saturated, and standing water appears on the surface. Then test their predictions.
- The bucket model can be left outside for a week and inspected every day to see by how much the water level has varied, owing to rainfall, or to evaporation.
- Pupils could undertake a web search on water supply, or could collect press reports of drought, or flood, depending on the weather. This could be done for their own country, or for overseas.

Underlying principles: Rocks which are good for holding water must be both porous and permeable.

- Porosity is the percentage of pore space in a material, which is not being directly considered in this activity (rocks which are good for holding water often have around 15% or more porosity).
- These rocks must also let fluids flow through – be permeable. Permeability is measured as a

volume of flow per second through a fixed area of rock.
- Water rarely occurs as large underground lakes; instead it is held in the pore spaces between the grains of the rock, or occurs in joints and faults which cut the rock.

Thinking skill development:
Cognitive conflict may arise if the pupils have already acquired the misconception that water supplies come from underground lakes. (This is perpetuated in the hydrocarbon industry by use of the term 'reservoir' for underground resources of oil and gas). Bridging is involved when pupils make the link between the models and a real well.

Resource list:
For the simple model:
- an old 'squirter' pump from a hand-wash liquid bottle, or similar bottle
- the base cut from a clear plastic drinks bottle, e.g. 2 litre
- optional – a piece of narrow plastic pipe with some holes drilled near the base, to prevent clogging of the base of the 'squirter', and to provide an analogue for a well casing
- some coarse dry sand or gravel (horticultural grit is shown in the photograph)
- water in a small watering can.
- cup to collect the water

For the elaborate model:
- a bucket, e.g. 5 litre
- a length of plastic drain pipe, with a lot of 2mm holes drilled into the lowest 8 cm or so
- enough dry coarse sand or gravel to nearly fill the bucket ('sharp' sand from a builders' yard is shown in the bucket in the photographs)
- a piece of wire bent to make a winding handle
- some thin string
- a 'tub' for hauling the water, made from a bottle top, weighted with a coin or two
- a small piece of cardboard or hardboard, bent to make a roof for the well
- a small bolt, or some adhesive to hold the wellhead struts together
- water, in a small watering can with a rose

Useful links: Try the Earthlearningidea activities **'**Modelling for rocks: what's hidden inside': and 'The space within: the porosity of rocks'.
http://www.nationalstemcentre.org.uk/elibrary/collection/215/earth-science-teachers-association-resources 'Science of the Earth 11 – 14, Water overground and underground'
Find out more about groundwater at:
http://www.groundwateruk.org/

Source: The well in a bucket model is adapted from an article by P. Deacon and R. Mayhew (1980), *Geology Teaching* 5.4 p140.
The simple version with the 'squirty' pump was devised by the Primary Group of the Earth Science Teachers' Association in *Teaching Primary Earth Science: Groundwater; the water cycle Part 2 1999 Issue 2.*