Transfer of Water to Point of Use - Teacher's Notes

Water has to be transferred from the source reservoir to the point of use. The easiest way of doing this is when the source lies uphill from the point of use. This is known as gravity feed. Most towns have their reservoirs uphill. All pipes are laid on a very gentle slope leading downhill to the user.

If a dam is uphill or upslope from the place where the water will be used, water can flow downhill. If, however, the water has to flow uphill or travel a long way across country, it needs to be pumped to encourage it to flow. Often, we need more water pressure to raise water from our underground mains to the taps and showerheads in our houses and schools.

Gravity Feed - Discussion

Gravity feed water tank that increases water pressure for the Perth suburb of Coolbellup.

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Transfer of Water to Point of Use - Teacher's Notes

If the point of use is downhill from the source, water will naturally flow downhill. This is known as ***gravity feed*** (see earlier activities). The Ancient Greeks and Romans transferred water from rivers and springs to towns by canals, aqueducts, and clay pipes. The Romans sometimes used lead pipes which contaminated water. If water is needed for showers or machinery, water pressure may need to be increased by pumping water into a header tank at the point of use. Many towns, small settlements and schools have header tanks uphill or on the roof to maintain "mains pressure". Suburban water supplies have small pumping stations to maintain water pressure.

Small pumping station in South Fremantle (built 1934 – now unused)

When C. Y. O'Connor built the Perth to Kalgoorlie water pipeline, 1896-1903, water had to be pumped uphill and over 557 kilometres. It needed eight huge wood fired steam driven pump stations along its length to keep the water running. Twenty small modern pumps have replaced the original ones.

When water is raised to a great height, it picks up energy (potential energy). Water pumped from underground can be stored in header tanks to pressurise water in underground mains to rise upwards for domestic use.

Transfer of Water to Point of Use - Teacher's Notes

Gravity Feed - Teacher Demonstration

This activity should be carried out outside.

Materials

- A funnel.
- A length of tubing/garden hose about 2m long.
- A small bucket of water.

Method

1. Fix the funnel into the end of the tubing.
2. Arrange for the funnel end always to be highest.
3. Ask a student to pour water into the funnel whilst you stop the flow with the pad at the base of your thumb.
4. Ensure all students stand back and that the bottom end is pointing away from your feet.
5. Holding the funnel end as high as you can, release your thumb and observe. If you can organise one student to stand on a veranda or steps and then have another student who is much lower hold the lower end and direct the water away from themselves and others.
6. Repeat at half the original height and then with funnel and exit at the same level.

The water will flow strongly and even rise above the lower hose end when the funnel is much higher than the outlet.
When funnel and outlet are at the same level little pressure can be observed once water level has been equalised.

Transfer of Water to Point of Use - Teacher's Notes

Height Increases Water Pressure/Rate of Flow – Teacher Demonstration

This activity is best performed over the sink or outside.

Materials

- An empty plastic cool drink bottle
- A thumb tack or sharp nail
- Blu-tack to seal holes
- Water

Method

1. Push the nail or tack into the wall of the bottle to make two holes. One should be near the middle of the bottle and the other near the bottom.
2. Seal the holes with blobs of Blu-tack to help when filling the bottle.
3. Ensuring the holes are pointed away from you, quickly remove the Blu-tack and ask students to observe the two different flows of water and how they change as the water level in the bottle drops.

When the bottle is filled with water the pressure from above causes the lower hole to release water at greater pressure than the one above, causing the water to push out further horizontally. As the water level lowers, the horizontal arc of the flow from the top hole will reduce and very careful observers may see the flow from the second hole temporarily stretch out further as the water level drops below the first hole and pressure increases on the second hole.

Transfer of Water to Point of Use - Teacher's Notes

Ancient builders in China and Greece made sure that water collected from the roof was not directly allowed to fall to the cellars where the high pressure would cause erosion, like it does at the bottom of some downpipes. It was brought down in stages along curved channels to reduce damage.

Modern cities and towns have water mains that run below the roads and into houses. In this case the water must be pressurized to move upwards into the house. Pumping stations along the water mains maintain water pressure.

Height Affects Water Flow - Student Activity

This activity is best performed over the sink or outside. If it is performed in the sandpit students may notice that the holes drilled into sand become deeper as the height above ground increases. If it is performed on cement or tarmac, students may notice how much more water from the top container splashes. Remember to repeat to confirm observations.

Materials

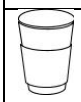
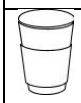
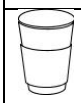
- 3 Paper cups (or three zip-lock sandwich bags) the same size
- 3 students to hold the cups (or bags) and 3 students to test the strength of water flow.
- A large nail or scissors
- Optional – plasticine

Method

1. Make a hole near the base of each cup or corner of each bag and ask students to seal it with their finger/s or with a piece of plasticine.
2. Fill each cup or bag with the same amount of water.

Transfer of Water to Point of Use - Teacher's Notes

3. Ask the first student to hold their water container at head height, the second to hold theirs at waist height and the third at knee height.
4. Making sure that the containers are held with the hole pointing away from the student, ask students to remove their fingers or the plasticine stopper.
5. Ask students to rate which flow was strongest, medium or weakest.
6. Observe the difference that height of source makes on water flow and what happens when it hits the ground. Draw or write the observations into the table below.

	Strength of flow	Depth of hole in sand/amount of splash
 Head height	(strong)	(deep) (lots)
 Waist height	(medium)	(medium) (moderate amount)
 Knee height	(weak)	(shallow) (least amount)

When the cup is high the water pressure is MORE / LESS

Emergency Services suggest that in the warning of any on-coming natural disaster, it is a good idea to have containers (including the bath!) filled with water in case electricity is cut and water cannot be pumped to your house. Earthquakes and fires also damage pipes.

To detect a water leak – turn off all taps and listen to the water meter. If it continues to tick there is a leak in the pipes underground. Would you expect a damp soggy spot to form on the ground? No. Water does not usually move uphill unless it is forced to.