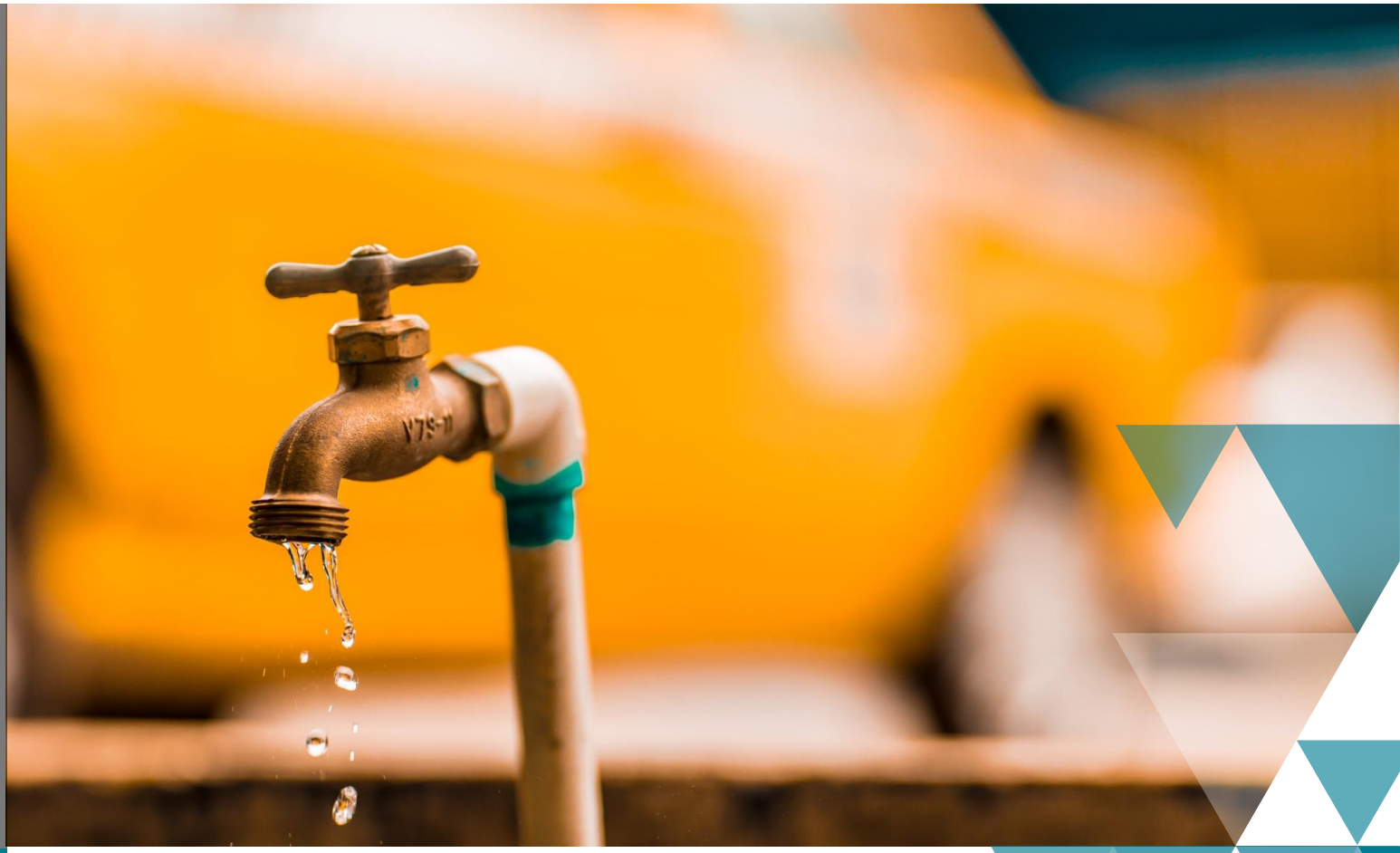

Water works

An ICE do-at-home activity for ages 4-18

E: **careers@ice.org.uk** W: **ice.org.uk/wice**

Background

How many people helped you brush your teeth this morning? Think you did it alone? Think again!

When you turn your taps on and the water comes out, this is because civil engineers have put together a complex network of pipes that water flows through.

The water that comes out of the tap is also clean, filtered by systems set up by civil engineers at special water treatment plants.

Your challenge today is going to be to make your own water treatment plant and pipe network using household items, copying what civil engineers do in real life.

To clean our water we will be using an empty two litre plastic bottle and filling it with different materials for the water to pass through. But please note that this is a just a demonstration to show how water is cleaned – do not drink the water at the end of the session!

We've adapted this activity to work for different age groups – 4-10s (primary), 11-16s (secondary) and 16-18s (sixth form) – to be completed in the home environment with minimal equipment. This activity uses 'dirty' water and so its best done outside or in a room with an easy to clean floor perhaps with cloths or newspaper at the ready to catch leaks.

Activity instructions

Materials needed

1 plastic 2 litre bottle

A spadeful each of larger (>1cm) and smaller (<1cm) pebbles, and/or other similar material (activated charcoal or coffee filters for example).

Several kitchen and toilet roll tubes (if you do happen to have any other plastic tubing between 1-4cm diameter handy you can use this)

About 50cm of string

Scissors and sellotape

Making the water filter

1.Take a plastic two litre bottle, make sure the bottle cap is screwed on and turn then it upside down and cut off the top of the bottle.

2. Give your pebbles a quick wash under your tap (making sure not to lose any down the sink!).

3. Pour your pebbles in fours layers around 5cm thick starting with the larger rocks (alternating smaller and larger) into the open end of the bottle (make sure the lid is screwed on when you do this). If you're using charcoal or a coffee filter then put this in the middle of your filter.

3. Repeat both these steps so you end up with four 5cm layers of rocks starting with small rocks then larger, then small again and one final layer or larger rocks.

4. Pierce two holes in the side of the water bottle near the original cut of end and put some string though it and hang it up.

This filter will clean water as it passes through the different layers of rock as particles (small chunks) of dirt will get trapped and left behind by the water as it flows though. The larger rocks help break up the filtration and allow the water to move a bit faster through them, so the water builds up a bit of flowing speed (water pressure) before going onto the next layer of smaller rocks to filter out any remaining dirt.

Here is an image of the finished filter without any rocks in it.

Making the pipeline

In real life civil engineers use sealed pipes and powerful pumps to move the water around but today we will just be using gravity so you will have to prop up the pipe with some (waterproof!) household items to support its weight.

1. Cut the tubes length-ways into two and use some strips of on the inside of the pipes to water proof them slightly.

2. Join your pipeline together to make your network (making sure the water is only travelling downwards throughout it's course). Tape the top end of the pipe so it hangs under the bottle cap (which will be removed when you pour the water into the filter).
3. Support your pie network as necessary and add a large volume container at the far end of the pipeline network to catch the 'clean' water.

Testing your water works

Your challenge is pour about 500ml of dirty water (not too fast!) into the top of your filter (you can make this by mixing your water with a small amount of soil or compost) and see how much you can catch at the end of the system. You can also judge how clean your water is (so how effective your filter has been!).

For 11-16 year olds

To make this activity more challenging your pipe has to navigate past two obstacles. One has to be passed on the right side and the other the left - you will have to plan this route carefully.

[For the Crossrail civil engineering project that will deliver a new tube line to London, civil engineers had to plan the route of a pipe/tunnel that was 7.1m wide though a gap only 8m wide which a 1,000 ton TBM (tunnel boring machine) would pass though. – they referred to this as 'threading the needle'.]

For 16-18 year olds

Fluid dynamics calculations are used by civil engineers to work out the capacity of pipelines.

The first step is to use a measuring tape to measure the length of the journey of the water from the start of the filter to the end point – accuracy is difficult so round up the nearest centimetre.

Using a stopwatch time how long it takes for 500ml of water to pass through the filter and the pipe system to the final container – once this is done use your measurements to figure out the flow rate of the pipe network.

How many millilitres (ml) per second flow through a 10cm segment of the pipe?

Tell us what you thought!

Email us at **careers@ice.org.uk** or write a comment or post on the ICE@schools Twitter.

More resources on civil engineering

Careers advice for becoming a civil engineer: **ice.org.uk/beacivilengineer**

Careers and activity resources on our website: **ice.org.uk/educationresources**

Civil engineering project case studies: **ice.org.uk/what-is-civil-engineering/what-do-civil-engineers-do**

Civil engineer (people) case studies: **ice.org.uk/what-is-civil-engineering/who-are-civil-engineers**

Info about all types of engineering careers (not just civil)**:** Tomorrow's Engineers **tomorrowsengineers.org.uk**