

**Water Cleaning Exploring Engineering Challenge**

**The Structure of the Tasks**

**Overview of the whole challenge**

1. Introduction

What is Civil Engineering? How does it make a difference (including Civil Engineering roles)?

How engineers design and model things that help balance forces.

1. Pre-task 1

Explore how to effectively join materials while considering how to make them stronger, bearing in mind the forces at work around them.

1. Pre-task 2

Learn how engineers design ways to clean water; experiment and predict using a simple water filtering system.

1. Challenge

Apply everything discovered so far to design and model a water filtering system to fit on a simple test rig, which transports the water to another place for testing.

**Pre-task Guidance**

Most of the guidance you need can be found on the notes section under each PowerPoint slide, which can be printed.

Pre-task 1 – Learning to Join Materials

The main focus here is helping the children experiment with joining materials together with cable ties, string, elastic bands and double sided tape, while making a tower. The experimentation is more important than the outcome. This is especially important if those you are working with have not had much experience of making and junk-modelling.

Do demonstrate how to use double sided tape by joining materials together inside a join rather than around the outside. It is unlikely the children will have had the opportunity to use double sided tape before.

Explain that later in the day, they will gain extra points for using double-sided tape correctly.

Pre-task 2 - Water Clarity Testing

In this experiment the children can work out for themselves how much of each material (sand, grit, stones) to use in their filter. For example, if they have more stones it could flow more quickly, but not clean so well. If they have more sand it might clean better, but take longer.

This experiment will help them start to decide for themselves how much of each material to use.

*Testing the filters*

To help keep the potential mess with water and soil contained, it’s worth following these steps. It also helps having two adults run tests at the same time, for example, you and a teaching assistant**.** To test the filters:

1. use washing up bowl testing areas at the front of the classroom;
2. for each test, mix 2 dessert spoons of soil into 100ml water, in a plastic pint glass. This mixture will be poured through each team’s filter funnel;
3. for each team, put an Opalometer into the bottom of a cereal bowl and place into the washing up bowl, situated in the testing area;
4. an adult will pour the 100ml soil-mixed water through the filter and set the timer for 90 secs to allow for filtering;
5. after 90 secs of the water dripping through, put the filter into a plastic pint glass so it stays upright and collects the drips. You could ask a child to oversee the timing with a stop watch;
6. lay out the bowls across the front of the table in team order, from team 1-8, so they can be compared at the end;
7. look through the water in the cereal bowl to the Opalometer at the bottom to check the water clarity. You could do an overall comparison between bowls and draw a general conclusion about which team’s quantities seemed to work best. If you have more time, you could use the ‘Water Cleaning Challenge Measuring Clarity Table.doc’ to ascertain whether the clarity is poor, average or very good. (Read ‘Water Cleaning Challenge opal-water-survey-opalometer.pdf’ for guidance on how the Opalometer can be used in other settings);
8. record the results for each team on a copy of ‘Water Cleaning Challenge Pretask 1 log.doc’

*Summarising findings*

This is a time to encourage the children to think about which filter with the different quantities worked best in terms of water clarity and speed. NB: in trials, it seemed the filters with equal amounts of each material cleaned best.

In terms of speed, you can compare how much water there is in each bowl at the end of 90 seconds. The bowl with the most water filtered most quickly.

You can also ask the children whether we have filtered enough to make the water drinkable. This might make them laugh and get them quite engaged. Encourage them to think of contaminants that you can’t see as well as those you can. Ask them what else has to happen in a real water treatment works before water can be drunk again.

**Challenge Guidance**

The children have now been given enough information which they can apply to the Challenge.

Introducing the Challenge

Below you will find details of how to introduce the Challenge:

1. if in a hall, gather the children around the front and sit them on the floor;
2. explain where things are in the room which they will need, i.e.,
* a table for each team;
* a copy of the Challenge details on their tables ‘Water Cleaning Challenge The Challenge.doc’; and
* testing tables with test rigs at the front
1. use the ‘Water Engineering Challenge.ppt’ to introduce the Challenge;
2. explain the following Health & Safety rules:
* not to run in the hall;
* to pick things up off the floor that people might slip on;
* to tie back long hair;
* show the children how to hold scissors safely and instruct them not walk around the hall with them.

*Using Test Rigs*

Explain that the children are allowed to come up in teams to explore and measure the test rig, but only a few minutes at a time. NB: if they don’t have a whole test rig each, then it is easier to ration the time and it is also easier to ensure they design something that is fitted not fixed.

*Questions from Children*

When the children ask for help, you can prompt them with things they have learned in the pre tasks, or refer to ‘Water Cleaning Challenge The Challenge.doc’ sheet on their tables.

*Structuring the Challenge* *Time*

The groups are likely to need a reminder every 10-15 mins what they should be doing to keep them on task. This can include reminding them about:

* comparing ideas and combining the best parts of each person’s design into a final design;
* having everyone involved, if you don’t have a job to do you can be designing the decoration as that has points in the testing;
* remind them how much time they have left;
* give them a last 5 minutes warning at the end;
* at the end, tools are to be put down and tidied away into packs, scraps to be put in the bin and, finally, to sit down ready for testing.

These reminders can also help you as the teacher, keep on track with the time, **make sure you leave 40 minutes for testing and awarding certificates and prizes.**

*Challenge Testing*

Challenge Testing is similar to the morning with 2 dsp soil mixed in 100ml water and 90 secs on the clock each time. However, the children’s structures need to come and be fitted to hold the funnels in place over the left side of the guttering and the collection bowl with the Opalometer at the end of the right side of the guttering.

It’s worth inviting two teams up at a time to fit their structure and then ask them to sit down while the testing happens. This will help all the children sit down, be able to see and be calmer while testing happens.

While the water is dripping through the filters, you can ask the teams:

* what surprised you as you worked together?
* what do you know now that you did not know before?

The ‘Water Cleaning Challenge Test Log.doc’ provides you with the six tests and space to log results for each team.

Each test is worth 0, 1 or 2 points:

0= doesn’t do this

1= does this somewhat or just about

2= yes, does this.

NB: for most of the tests, it will be obvious if the criterion has been met. We are trying to give points to the teams rather than trying to penalise them during each test.

When testing this design challenge, some structures did not hold the filters in the correct place, so we held them manually. This meant the team got zero points for tests 1 and 2, but it could still be tested for the effectiveness of tests 3 and 4. The logos had to be seen from the front of the room to be able to get points for test 5.

Use the pint glasses again to hold the dripping funnels after testing (perhaps somewhere behind/out of the way is best so they don’t get knocked over) and the bowls of filtered water can be lined up along the front in case you want to compare them as part of the plenary.

*Plenary of the Learning*

The beginning and end of the event will be most memorable to the children, so do help them to summarise what they have learnt today. You may need to draw out the learning while the water is filtering rather than at the end if time is getting tight.

Simple certificates have been provided if you want to use them ‘Water Cleaning Challenge Certificate.pdf’. The children will be very excited by simple prizes like lollies or erasers (in the trials, we gave everyone a poop emoji eraser).

**And finally, enjoy this! It’s easy to get started, with just one class.**

Enjoy!