KS3 THURSDAY



CIVIL ENGINEERING



In this activity, students will take on the role of Civil Engineers and learn about the importance of structures and foundations, before trying to build their own bridge structure out of coins.



Help! A bridge has collapsed in your local town and now no one can cross to the other side.

The local mayor has called upon you, a budding young Civil Engineer, to help fix the bridge!



Image: https://www.clipartkey.com/view/Jwwbb_broken-bridge-clipart/



What does it mean to be an Engineer?

An Engineer is someone who wants to know how and why things work, and they use their special scientific knowledge to design and build solutions for specific problems - they're basically brainy problem-solvers! Everything you see around you was designed and built thanks to the help of Engineers to solve a problem that people faced....

- "I want to keep my food cold and stop it from going mouldy... how can I do that??" An Engineer designed and built the refrigerator (or fridge) to keep your food cold!
- "How can I travel around quickly but also cheaply?" An Engineer designed and built cars!
- "There's a river in our way and we can't cross it!" An Engineer designed and built a bridge!

Question: Think about a mechanical or electrical object you use regularly in your house, like your microwave! What problem was the microwave a solution to? What about other objects in your house; what problem do they solve?

Answer: To heat up cold food quickly!





🥑 esurreyoutreach o esurreyuniwpo **#SurreyWPOatHome**



KS3 THURSDAY



CIVIL ENGINEERING





But what is Civil Engineering?

Civil Engineers design and construct infrastructure (buildings and structures), like skyscrapers and bridges, and often

work closely with architects (building designers). They are involved in all stages of Engineering projects, from the initial planning and designing of the structure, to its construction, and then its continuous maintenance and even its demolition!

Challenge: Look out of your window, how many things can you see that were constructed by civil engineers?



What do you think are the most important parts of a bridge?

Foundations are very important to ensuring the bridge stays up and doesn't

collapse.

Foundations are the base or support on which other structures are built; often in Engineering, these are concrete or metal supports dug into the ground so that the structure on top doesn't move around.

Without them, a structure like a bridge won't be able to support its own weight and might fall apart in the middle! Worse yet, what if that happened when someone was crossing! This is why the job of a Civil Engineer is so important, it's not only about building a good solution, but also making it safe!







What is it like to study Civil Engineering?

Watch the video and find out about Lily's & Mike's experience of studying Civil Engineering.

 Civil Engineering | University of Surrey https://www.youtube.com/watch? v=hLWn fJNELU



esurreyoutreach
 esurreyuniwpo

#SurreyWPOatHome



WIDENING

PARTICIPATION



CIVIL ENGINEERING



KS3

THURSDAY



Did you know? - The Wobbly Millennium Bridge

The Millennium Bridge in London is a 320 metre long suspension bridge over the River Thames that was opened in June 2000. It was praised by Engineers for being one of the most modern and sleek bridges ever, comparing it to a "blade of light", and with its opening, thousands of pedestrians walked across it. At first, the bridge was still and worked amazing! But then it began to sway, just slightly... and as more people walked across it, the wobble intensified! As the wobbling got worse, the pedestrians began to sway with the bridge to keep their balance. Left, right, left, right in rhythm with the wobble of the bridge. But this just made it worse and turned a £26 million bridge into a dangerous Engineering disaster!

In physics, there's something called oscillations which are rhythmic wobbles, or like swinging backwards and forwards on a swing. If you get pushed occasionally on a swing, you'll just keep swinging, and if you get pushed a bit harder, you swing more and quicker! This is what happens to a bridge when someone walks across it. The weight of a person stepping is like a little push downwards on the bridge, so if enough people stepped at the same time, the "push" would be stronger and, if everyone kept doing it in a rhythm, it would make the whole bridge wobble up and down! Now, we've known about this for a long time. In wartime, the army would always "break step" and stop marching left, right, left, right to make sure they didn't cause any oscillations when they crossed a bridge – the signs are still there on some bridges like here at the Albert Bridge in London!

Now, for the Millennium Bridge, the Engineers knew about this so put vertical dampers in place, and they stop these up and down oscillations. But when people swayed, that "push" is also felt sideways (like being pushed from the side on a swing, you'd wobble sideways too!). As everyone was unintentionally walking together in the same left, right, left, right rhythm, the bridge began to also wobble left, right, left, right! Now that's a big problem the bridge, so if enough people stepped at the same time, the "push" would be stronger and, if everyone kept doing it in a rhythm, it would make the whole bridge wobble up and down! Now, we've known about this for a long time. In wartime, the army would always "break step" and stop marching left, right, left, right to make sure they didn't cause any oscillations when they crossed a bridge - the signs are still there on some bridges like here at the Albert Bridge in London!

The bridge was closed for being too dangerous, and another £7.2 million was spent adding in more dampers, but this time horizontally. For an Engineer, you've always got to do your research and safety is always a key factor!!





esurreyoutreach
 esurreyuniwpo

#SurreyWPOatHome







CIVIL ENGINEERING





What about our local town?!? We still need to build a bridge!

So now we know that as a Civil Engineer, you're a really clever problem-solver, we know the importance of foundations and also how we've got to make it safe for everyone. Now it's time to try making some bridges ourselves.

To start off with you're going to need:

- As many coins as you can find (preferably 1p and 2p pieces)
- A ruler
- Your clever Engineer brains!

Place the ruler down on a flat surface... now that's your river! You need to find a way to build a bridge that will be able to span the river and support people crossing it, but all you've got is slabs of concrete (your coins). The locals have told you it must be a minimum of 30m high (3cm) and span the entire river, without touching the water.

It must remain freestanding for a minimum of a minute... can you do it??

Remember what you've learnt! All good structures have solid foundations, and for a bridge that will be the supports at each side of the river....

Here's some inspiration of what other Engineers have built:





Things to consider & extra challenges:

- Why does it keep falling inwards? What could you do to stop it from collapsing?
- Can it support if someone, like Batman, tries to walk across it?
- But if that's too easy, perhaps try making the river even wider or the bridge taller! What's the biggest bridge you can make? Is it easier when the foundation supports either side are taller or shorter?
- What other objects do you have in the house you can use? Could you build a bridge out of books? If you lie down, could you even get it to span the width of your body?



esurreyoutreach
 esurreyuniwpo

#SurreyWPOatHome







<u>@</u>

CIVIL ENGINEERING



Other types of Engineering:

When studying to go into Engineering, Engineers will often specialise in different areas – and there's so many areas to choose from! There's Mechanical (machines), Aerospace (planes and spacecraft), Automotive (cars and engines) and Civil (buildings and structures) but the list goes on!

Match up some other Engineering areas with their descriptions:

1 . Looking at chemical reactions and processes to solve all sorts of problems, from cosmetics to cleaning products to medicine!	A. Electrical Engineering
2 . Looking at the environment and ensuring that factors re- garding location, design, construction, operation and mainte- nance of Engineering projects don't cause the environment too much damage	B. Sustainability Design Engineering
3. Applying knowledge of Engineering to the development of ocean technologies, such as pontoons and power generation on ships, and developing new forms of energy using the ocean	C. Petroleum Engineering
4. Looking at the extraction of oil and gas from beneath the earth, and developing greener and less environmentally damaging ways to get to the fuel underground	D. Materials Engineering E. Geological Engineering
5. A combination of medicine and biology looking at advanced healthcare treatment technology, prosthetics and medical equipment	E. Marina Engineering
6. The study of energy and electricity, looking at computers, power generators and batteries	F. Marine Engineering
7. The study into environmental, social and economic impacts of Engineering and how to make the life cycle of a product better for the environment	G. Chemical Engineering
8. Looking at what things are made out of, and looking into what's best to make objects and structures out of ("Should I build my house out of feathers, chocolate or bricks?")	H. Biomedical Engineering



Want to learn more about Engineering?

<u>https://www.prospects.ac.uk/jobs-and-work-experience/job-sectors/engineering-and-manufacturing</u>

Remember to send us a photo of your bridge!





esurreyoutreach
 esurreyuniwpo

#SurreyWPOatHome

