



Road ruiners

A do-at-home civil engineering activity for ages 4-18.

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Irritating ICE

When civil engineers are building structures one of the things they consider heavily is how long they expect it to last! Lots of things – like the weather for example – can affect how long buildings last and one big enemy of civil engineers is something called freeze-thaw weathering.

When water freezes it expands by 10%. A small crack in a road surface will collect water and will freeze overnight repeatedly during the winter months. As it freezes and expands it pushes the material of the road starts to break it up. A few years of this can mean huge potholes can form in roads that are very expensive to fix.

This problem affects anywhere on a structure that water can collect and freeze – from roads to bridges and towers. (There is one type of civil engineering construction that doesn't have any problems with freeze-thaw weathering – can you guess what it is?)

This experiment shows the affect that freeze-thaw weathering can have on buildings.

What you'll need

- Some Lego
- A balloon
- Water
- A freezer
- A ruler
- For the 16-18s extension activity– salt, scale, a measuring tape



Activity instructions

Step 1: Fill up a balloon with water and tie it. If you can get it reasonably large that would help the experiment.

Step 2: Build a Lego house around your water balloon, making the walls as tight as possible around the water balloon, and make sure you include a floor and roof so that your balloon is completely enclosed. There is a large creative part to being a civil engineer so feel free to decorate your house with nice windows, a garden or any other features you like.

Step 3: Place your house in the freezer and leave overnight for the water to expand and freeze, in the morning very carefully remove the Lego house and see what damage the expanding ice has caused. Have a think about how you would plan to stop this happening if you were a civil engineer!

For 11-16 year olds

For a more dramatic effect see if you can build a house with multiple rooms and multiple water balloons, notice what happens if you place two balloons next to each other.

For 16-18 year olds

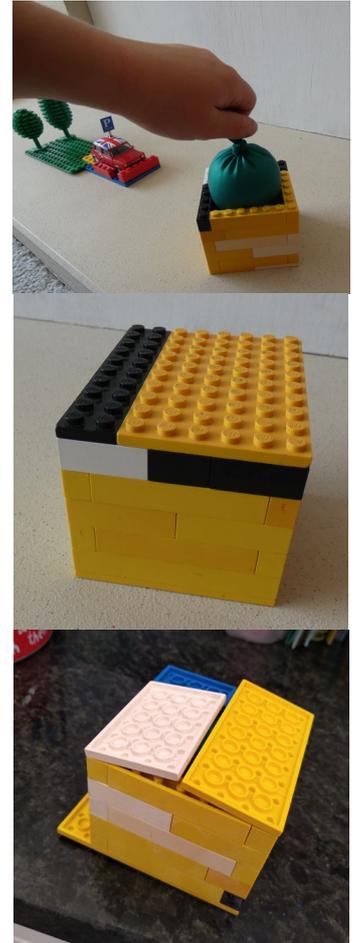
Adding salt to water will make it harder to freeze, this is why they pour a mix of salt and grit onto roads to provide grip but also to stop ice freezing in cracks in the road and breaking up the surface. Salt is also applied to areas on bridges and other structures that may be vulnerable to freeze-thaw weathering.

Your challenge here is to measure how much salt it takes to reduce the expansion or even formation of the ICE balloon and therefore save the house from damage (it is best to weigh out the salt first before adding it to the balloon, then add water).

Try the following solutions:

10 grams of salt for every 100 ml of water

20 grams of salt for every 100 ml of water



30 grams of salt for every 100 ml of water

See how much less damage each solution does to the house and measure the difference in circumference of the balloon.

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