

TUNNELWORKS

KS2 MATHS LESSON 1

LESSON PLAN

Introduction

If the children haven't seen it already, play the 'You Poo Too' introductory video which explains the background of the Thames Tideway Tunnel. Before watching the video, it would be useful to have a short discussion with the children about what sewage and waste water is.

Explain to the children that large barges are going to be used on the River Thames to transport spoil that has been dug out of the new tunnel downstream to be recycled. Spoil is the excavated material that is removed from the ground and is mostly rocks and earth. They are going to be helping to plan some of this work, and to do this they will be working out the volume of the barges.

Slide one

Show the video to the children, they will meet Michael Brown who will:

- Explain the way barges are going to be used to move excavated spoil from the construction sites downstream to be recycled.
- Set the children a challenge, which is to help work out how much spoil each barge can carry.
- Explain that this means they need to work out the volume of the hold of a barge – and they are going to start off by practicing on something rather big and familiar to them. In fact they are sitting in it right now!

Slide two

Ask the children to investigate how much space they think is inside their classroom. Explain to pupils that they are using the rectangular classroom as an example to measure volume, as it is a similar shape to a barge hold. Ask children to discuss in pairs how they think they would calculate the volume of their classroom, then have a short discussion as a class. Agree a strategy as a class for measuring the room.

Key questions

- How could you measure the room if you had no rulers/metre sticks or tape measures? E.g. If they stood on each other's shoulders, how many children would be needed to measure the height of the room?
- How could you use smaller 3D shapes, e.g. boxes to measure the volume of the room?
- Why do you think the Thames Tideway Tunnel team need to measure how much volume there is on a barge?

Slide three

Open slide 3 to reveal an image of a storage box. Ask children to discuss in pairs what they think is the best way to measure the volume of this object, what equipment would they use (e.g. tape measure, rulers) and what would be the suitable unit of measurement.

Key questions

- What do we mean by volume?
 - How would you measure the volume of a shape?
 - What equipment would we need?
 - Why are some objects more difficult to measure volume than others?
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Slide four and five

Slide 4 shows that one cube = 1m^3 and will help children with their calculations. Talk the children through slides 5.1 – 5.6 which explain how to work out the volume of a cuboid. Children measure volume of cuboids by working out how many cubes can fit into the shape. They use the formula $L \times W \times H$ to work out the total amount of cubes, starting with the length and width, then adding the height to complete the calculation.

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Slide six

Now the children put their learning into action by measuring their classroom. You may also like to ask small groups of children to explore other areas in the school, such as the other classrooms to discover which teacher has the biggest classroom! Or measure small spaces within the classroom, for example a cupboard or reading area. They measure the length, width and height and multiply the three values together. You may want to round up the numbers to make the calculations easier.

Ask the children to discuss and agree in their groups what they think the best way to record their measurements is, before they start.

When they have completed their measurement tasks, bring the results together on the whiteboard. Ask the groups to discuss how accurate they think their measurements are. Were there any problems in getting the measurements and which was the most difficult measurement to obtain? Have they had to estimate any measurements?

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Slide seven

Now the children have practised with their classroom, they are going to help work out how much spoil some barges can carry.

Explain to the children that barge holds are rectangular shapes, like their classroom and that engineers use just the same calculations to work out how much spoil from the tunnel construction can be loaded onto a barge. Take the children through slides 7.1 to 7.3 so they can see how to transfer their learning into another situation by measuring the volume of a barge hold.

Hand out worksheet one which has a range of different sized barge holds for the children to work out, plus two additional questions which ask them to consider the weight of the spoil as well as the cube. Children who finish early can use squared paper to draw their own different sized barge holds and then swap with a partner to calculate the volume of each one.

Slide eight

Show the second video of Michael Brown, who goes through the answers to the worksheet. He will then challenge children to work out the volume of other shapes. This is the extension activity on slide 9.

Differentiation

To make it more difficult	To make it easier
Ask children to convert between measurements of volume. For example, if they have worked out the volume of a cuboid in cubic metres, ask them to work out the volume in cubic centimetres or convert to litres/millilitres etc.	For children who are finding this a difficult concept or to reinforce learning for all children, physically demonstrate capacity by putting blocks into rectangular containers or pour water into different shaped containers. Ask children to find the volume of simple cuboid shapes around the classroom.

Plenary

Ask children to think of an item in the home or classroom that they could measure the volume of, and explain why they might need to measure its volume. For example, a bath or sink, a car boot, or a lunchbox. Children discuss the most effective way to measure the volume of these items and estimate what they think the volume could be.

Children complete a self-assessment of the lesson through a smiley face system.

Extension activities

Slide nine

To extend the learning, ask children to consider what would happen if they needed to measure the volume of other shapes. Slide nine shows some more challenging shapes to measure. Ask if the cubes would fit in perfectly to measure the volume. How could they measure the capacity to ensure it is more accurate? Explain how liquid can be used as an alternative measurement of capacity. This can link to an additional volume lesson using measuring jugs and millilitres or litres to measure capacity.

As a comparison to a large space like the tunnel, ask the children to estimate and then measure their school corridor using appropriate units of measurement. Ask children to consider how accurate their results are and then compare with measuring the capacity of a tunnel. Ensure children recognise that the tunnel is a cylinder shape and that it is more difficult to measure the capacity of a cylinder in comparison to a rectangular shape. Demonstrate this concept on a smaller scale by pouring water into a measuring cylinder.

Investigate with the children how you can use measuring jugs to measure the capacity using liquid. Use a rectangular container to compare how to use cubes or water to measure volume. The children discover that it is still the same volume, but represented in a different way, for example, one litre of water will equal 1000cm^3 .