

Volume

Key NC Statement

Calculate, estimate and compare volume of cubes and cuboids using standard units, including centimetre cubed (cm^3) and cubic metres (m^3), and extending to other units [for example mm^3 and km^3]

Recognise when it is possible to use formulae for area and volume of shapes

Related NC Statements

- recognise, describe and build simple 3-D shapes, including making nets
- compare and classify geometric shapes based on their properties and sizes and find unknown angles in any triangles, quadrilaterals, and regular polygons
- use, read, write and convert between standard units, converting measurements of length, mass, volume and time from a smaller unit of measure to a larger unit, and vice versa, using decimal notation to up to three decimal places
- use simple formulae
- express missing number problems algebraically
- find pairs of numbers that satisfy an equation with two unknowns
- perform mental calculations, including with mixed operations and large numbers
- solve problems involving addition, subtraction, multiplication and division

Key Concepts

This sequence builds upon 5LS21, in which pupils explored volume as the measure of the space taken up by a three-dimensional object and how this can be calculated for a cuboid using length x width x height. Pupils will already have considered volume measured in cm^3 blocks and started to develop their understanding of the standard units for volume and capacity (the space within a container).

In this sequence, pupils will also build upon their understanding of cube numbers. There will be opportunities to clarify understanding of the difference between cubes and cuboids and how the area of a face can be calculated using length x width. Pupils will consider how to visualise 3-D shapes and the dimensions needed to calculate the volume of a cuboid. The volume of cuboids will be measured in cubes first. Understanding of the calculation will then be applied to work out the volume of cuboids using standard units of measurement.

In this sequence, pupils will further develop their understanding of simple formulae and use this to calculate volumes and to calculate measures when the volume is known.

Finally, pupils will develop their estimation skills for volume through developing, identifying and using benchmarks and by making the link between cm^3 and ml.

Steps within the Learning Sequence

Step 1: Visualise and calculate the volume of cubes

Step 2: Calculate and compare volumes

Step 3: Estimate volume

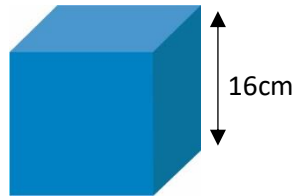
Destination Questions

1

Grace was building a cube.
She used 64 cubes for one layer.

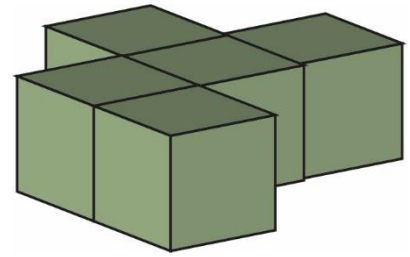
How many cubes did she use to build the whole shape?

2



What is the volume of the cube?

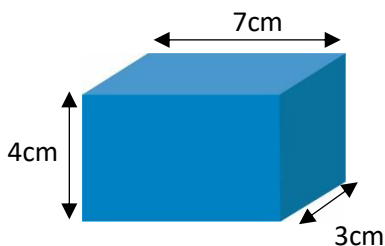
3



4 more cubes must be added to complete the first layer of this cube.

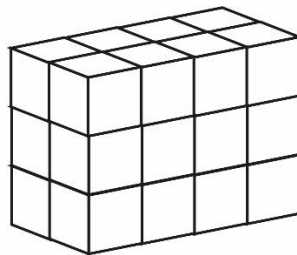
What will be its volume when complete?

4



What is the volume of this cuboid?

5



Another cuboid was made with the same number of cubes.
What could its dimensions be?

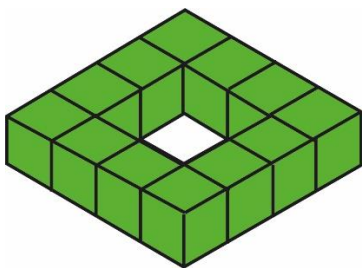
6

A cuboid has a volume of 40cm^3 .

It is 5cm long and 2cm wide.

What is its height?

7

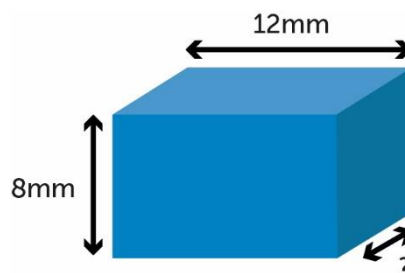


If this is the base, what would be the volume of the completed solid cube?

How many more cubes would be needed to build it?

8

The volume of the cuboid is 288mm^3 .
What is the missing measure?



9

Caitlin says her pencil case has a volume of 1m^3 .

What do you think?

Step one

Visualise and calculate the volume of cubes

During this step, there is an opportunity to check previous learning regarding the names of 3-D shapes, area, cube numbers and volume.

Using handout_6LS25_step1_starting_point, ask pupils to consider what they know and links they can make.

Can you use any of this vocabulary?

cube	face
cuboid	calculate
square	length
area	width
volume	height

Gather feedback and clarify:

- Cubes are a particular type of cuboid in which the length, width and height are all equal.
- Each cube has six square faces and the area of each face could be calculated using length x width.
- These shapes have been built from smaller cubes and you cannot see them all but you can visualise how many cubes would be needed to make them.

Ask pupils to build the shapes using interlocking cubes, using the diagram to help them.

What did you look at to be able to build the shapes?

I looked at the number of cubes in the length and width and then counted the number of layers needed.

I built a layer with 9 cubes because I can see 9 on the top of the shape. I made 3 layers the same.

Model how pupils can visualise the number of cubes in the shape, by looking for clues about the number of cubes in its length, width and height.

Notice that both shapes represent cube numbers drawing out the notation and associated calculations ($2^3 = 2 \times 2 \times 2 = 8$ and $3^3 = 3 \times 3 \times 3 = 27$).

Clarify that volume is a measure of the space taken up by an object and this can be measured using the number of cubes taken to build them. Ask pupils to build other cube numbers and to identify the calculation needed to work out the volume of the shapes, measured in cubes.

Clarify that the volume of a cube can be calculated using $a \times a \times a$ or a^3 where a is the measure of any side.

How else can volume be measured?

You can use m^3 and cm^3 .

If centicubes ($1cm^3$ cubes) have been used to build the shapes, this can be identified to support pupils in developing their sense of volume and benchmarks for estimation. Identify that the measure cm^3 is $cm \times cm \times cm$ and other measures of volume could include mm^3 and km^3 .

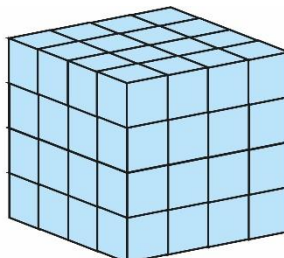
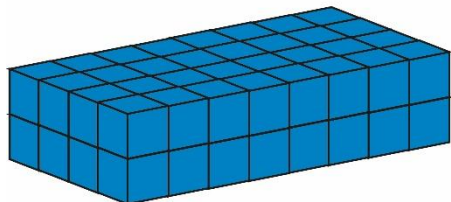
Provide pupils with opportunities to visualise and calculate the volume for a range of cubes.



Step two

Calculate and compare volumes

Building on the previous step, pupils will now clarify their understanding of the formulae to calculate the volume of any cuboid and then use this to calculate and compare volumes. Build the shapes below using cubes and / or show pupils the two images.



What is the same and what is different?

Identify similarities and differences including:

- Both shapes are cuboids, but only one is a cube.
- Both shapes have been built using the same number of cubes (64) and the volume of the shapes, therefore, is the same. This can be proved by rearranging one model to create the other one.
- The dimensions of the shapes are different ($2 \times 4 \times 8$ and $4 \times 4 \times 4$).

Record the dimensions and volume of the cuboids built.

Could you create another cuboid with same volume?

Clarify that volume can be calculated for any cuboid using length $\times$ width $\times$ height.

Allow pupils to investigate and calculate volumes through considering a statement or question. Pupils may wish to continue to use cubes to build the shapes to support their exploration.

Which volumes allow a large number of cuboids to be built? Why?

True or false: The largest number of different cuboids you can build that each have the same volume is five.

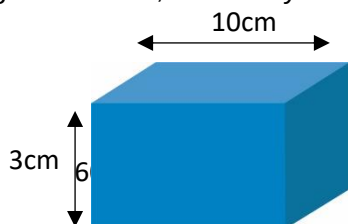
Support pupils to consider how they can work systematically and to use their understanding of factors to identify numbers which satisfy the formula $\square \times \square \times \square = \text{volume being investigated}$.

I know the volume needs to be 32 cubes.

I know $8 \times 4 = 32$.

I can use this to work out $4 \times 2 \times 4 = 32$ and $8 \times 2 \times 2 = 32$.

Provide pupils with opportunities to consider how they can apply this understanding, including through working backwards, to identify a dimension when the volume and other dimensions are known.



I know $10 \times 3 \times \square = 60$ so I know $30 \times \square = 60$
 $60 \div 30 = 2$ so the missing measure is 2cm.

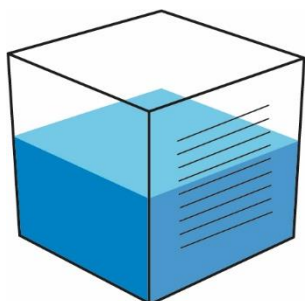


Step three



Estimate volume

In the final step in this sequence, pupils consider benchmarks for volumes to support being able to estimate. The link between cm^3 and ml can also be explored noting that 1cm^3 is equivalent to 1ml.



If you have a clear measuring cube and centicubes, use this to model the connection between cm^3 and ml.

How many centicubes do you think would fill the container to 100ml?

Establish that 100cm^3 is equivalent to 100ml. 1cm^3 is, therefore, equivalent to 1ml.

How many cm^3 is equivalent to 20ml...200ml...1 litre?

Ask pupils to consider the space taken up by different volumes and to identify relevant benchmarks, making links to real life experience wherever possible. Once benchmarks have been established, pupils can consider different items with a similar volume. The volume of cuboid shaped items can be calculated accurately by measuring the dimensions and rehearsing previous learning. Containers can also be filled with liquid and then emptied into a measuring jug to strengthen understanding of volume and capacity and the link between cm^3 and ml.

For example:

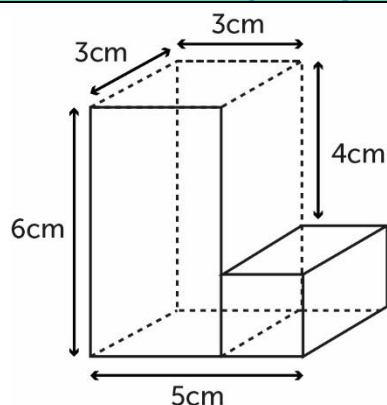
- Use metre sticks to create a cubic metre. How many people might fit inside?
- Find objects which are about 1cm^3 or 10cm^3 . Centicubes could be used to measure this.
- How small would 1mm^3 be?
- What do you think the volume of the base-10 equipment thousand block would be?

What might fit in that space?

Encourage pupils to record relevant benchmarks using drawings to show relative sizes.

9

Activities for exploring ideas at greater depth



Calculate the combined volume of the two cuboids.

Is there more than one way to do it?

Can you find an object or objects around you to approximately total the same volume?

BUFFER ZONE