Measurement: Calculating and Estimating Volume

Aim:	**Success Criteria:**	**Resources:**
I can calculate, estimate and compare volume of cubes and cuboids using standard units, including cubic centimetres and cubic metres, and extending to other units. I can estimate and calculate the volume of cubes and cuboids.	I can count cubes in a layer to help me estimate the volume of cubes and cuboids. I can use a formula to calculate volume of cubes and cuboids.	**Lesson Pack** Isometric paper Small cubes (interlocking if possible) Dice
	Key/New Words: Volume, cube, cuboid, cubic, centimetres, metres, feet.	**Preparation:** Differentiated **Calculating and Estimating Volume Activity Sheet** – one per child **Extra Challenge Activity Sheet** - as required

Prior Learning: It will be helpful if children have used small cubes to calculate volume.

Learning Sequence

	**Make the Shape:** In pairs, children roll a dice three times. They multiply the three numbers together. When they have created a number, they take this number of small cubes and create a 3D shape. They try to make a cube or cuboid.	
	**What Is Volume?** Children write a definition of 'volume'. Share the definition on the **Lesson Presentation**.	
	**Calculating Volume of Cubes and Cuboids:** Children are shown how to calculate the volume of cubes and cuboids by counting layers and by using a formula. They work through several examples.	
	**Estimating Volume of Cubes and Cuboids:** Use the **Lesson Presentation** to show how to estimate the volume of cubes and cuboids by using one cube as a measure to estimate how many in each layer and how many layers. Children estimate the volume of shapes on the **Lesson Presentation**.	
	**Calculating and Estimating Volume:** Children complete the differentiated **Calculating and Estimating Volume Activity Sheet**, calculating and estimating the volume of cubes and cuboids.  Children calculate the volume of cubes and cuboids, using cubic centimetres and cubic metres. They estimate the volume of cuboids, where one small square is marked. They find the dimension of a cuboid, given two of the dimensions. They choose which dimensions give a volume of 60cm^3.  Children calculate the volume of cubes and cuboids, using cubic centimetres and cubic metres. They calculate the volume of a composite shape made up of two cuboids. They estimate the volume of cuboids, where one small square is marked. They find the measurement of an unknown dimension of a cuboid, given the surface area of one face and the volume.  Children calculate the volume of cubes and cuboids, using cubic centimetres and cubic metres. Some of the dimensions have one decimal place. They calculate the volume of a composite shape made up of a cube and a cuboid. They find all the dimensions of a cuboid, given the volume and one dimension. An **Extra Challenge Activity Sheet** is also included.	

Diving into Mastery: Schools using a mastery approach may prefer to use the following as an alternative activity. These sheets might not necessarily be used in a linear way. Some children might begin at the 'Deeper' section and in fact, others may 'dive straight in' to the 'Deepest' section if they have already mastered the skill and are applying this to show their depth of understanding.

Children complete fluency problems which involve finding the volume of 3D shapes by counting cubes.

Children explore answering reasoning problems which involve finding the volume of 3D shapes and explaining reasoning to prove if the given statements are true or false.

Children use problem-solving skills in order to calculate answers to tasks that involve a greater depth of thinking and investigate finding all possible answers.

Draw That Shape: Children use isometric paper to draw a cube or cuboid which would have the volume 60cm^3.

Exploreit

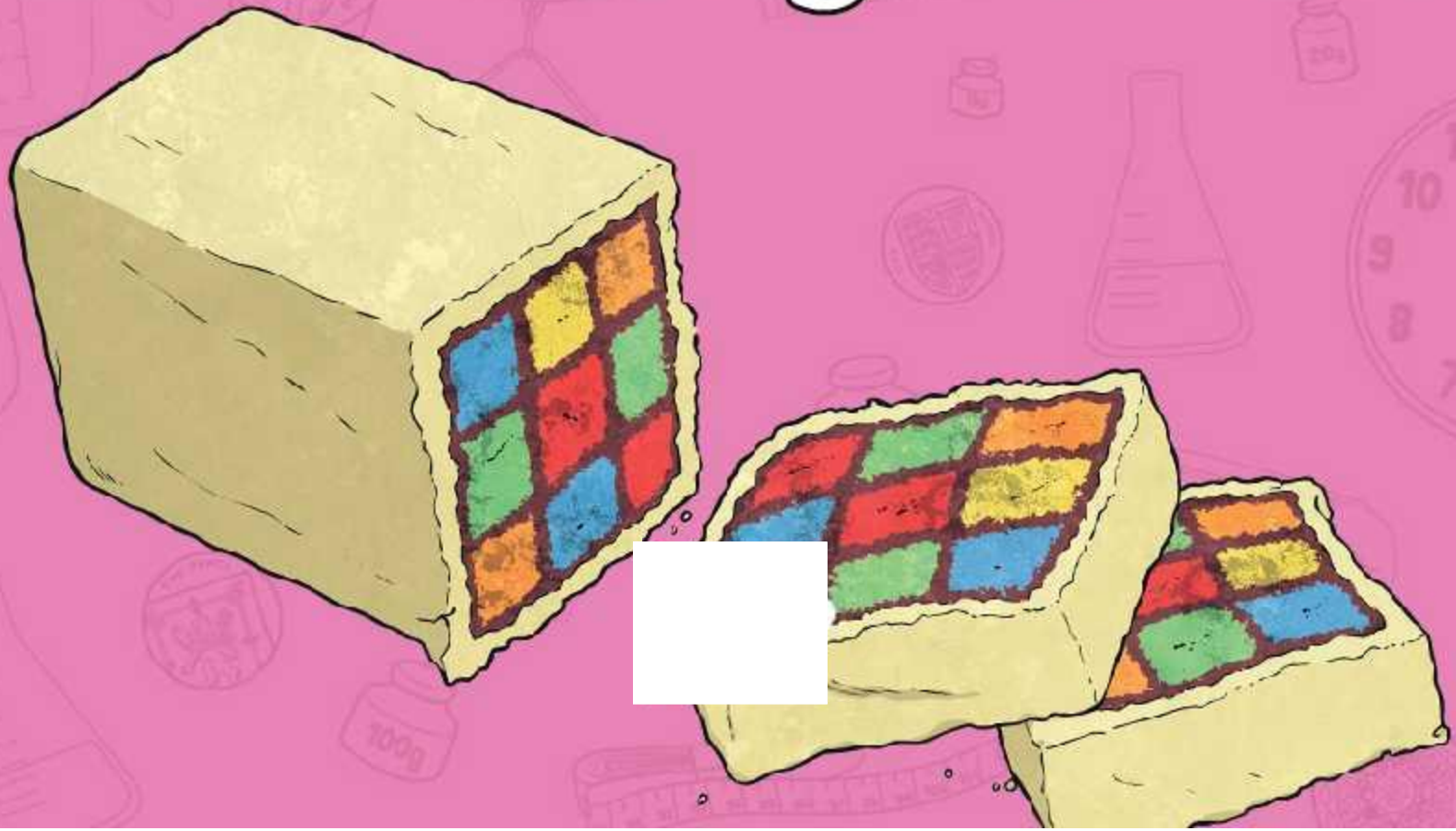
Estimateit: Children use small cubes to build a cube or cuboid. Partners estimate the volume (without counting). Children count the cubes to confirm the actual volume.

Boxit: Provide children with a range of empty boxes for them to estimate the volume. They then measure the length, width and height and calculate the actual volume.

Maths

Measurement

Calculating and Estimating Volume



Aim

- I can estimate and calculate the volume of cubes and cuboids.

Success Criteria

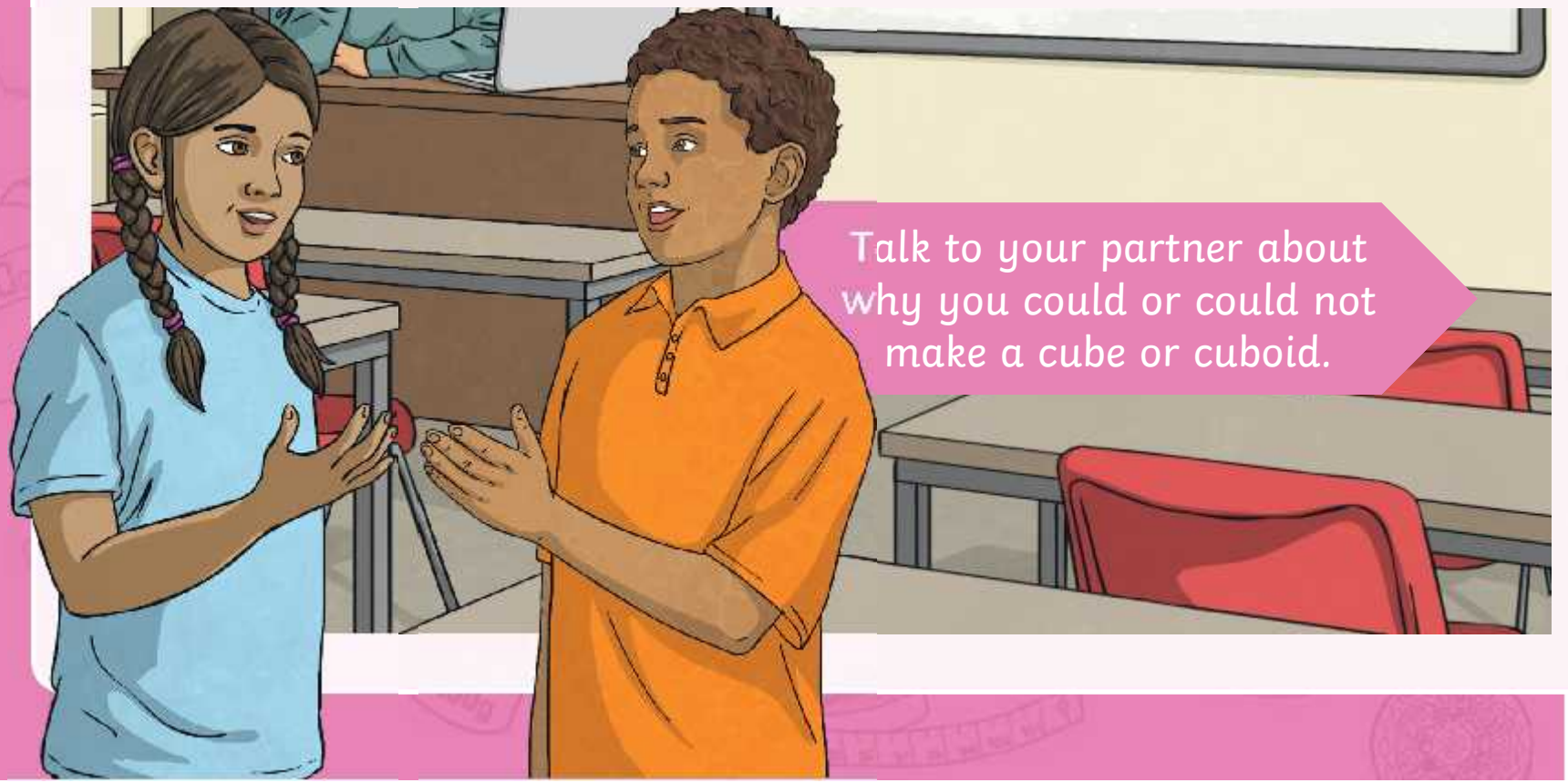
- I can count cubes in a layer to help me estimate the volume of cubes and cuboids.
- I can use a formula to calculate volume of cubes and cuboids.

Make the Shape

Roll a dice 3 times. Multiply the numbers you roll.
Make a 3D shape with this number of small cubes.

?

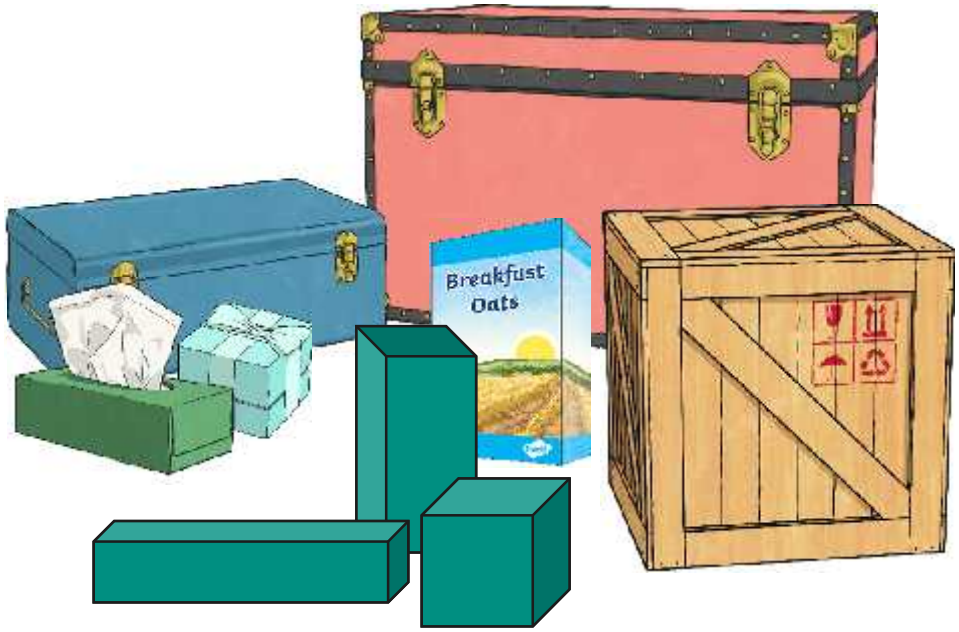
Were you able to make a cube or a cuboid?



What Is Volume?

With your partner, write a definition for volume.

Volume = the amount of 3D space taken up by something.

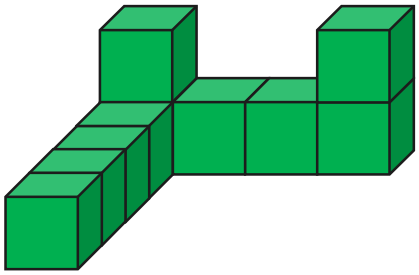


When measuring the volume of a fixed object (where the shape doesn't change), we use cubic units. Today we are going to use cubic centimetres and cubic metres to measure and estimate the volume of cubes and cuboids.

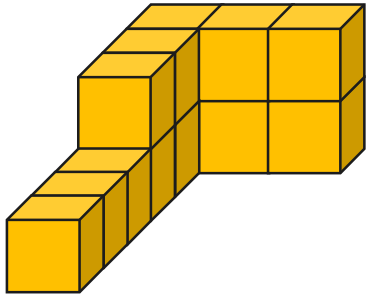
What Is Volume?

We can find the volume of these shapes made from $1cm^3$ multilink cubes by counting the number of $1cm^3$ cubes that make up each shape.

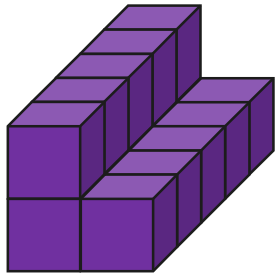
Remember that some shapes have cubes that are hidden from sight!



$10cm^3$



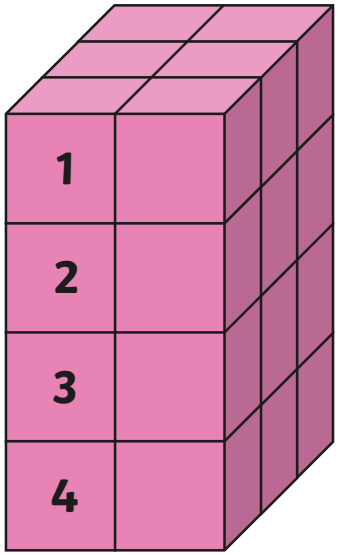
$13cm^3$



$15cm^3$

Calculating Volume of Cubes and Cuboids

We can calculate the volume of cubes and cuboids by counting cubes in layers:



In the top layer, there are 6 cubes (3 × 2).

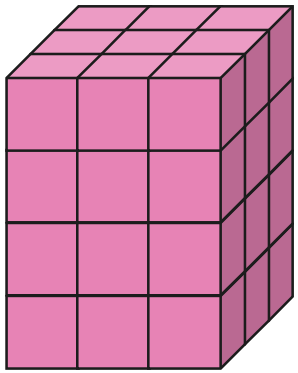
There are 4 layers.

$3 \times 2 \times 4 = 24$

If each cube were a cubic centimetre, this would be 24 cubic centimetres, which we could write as $24cm^3$.

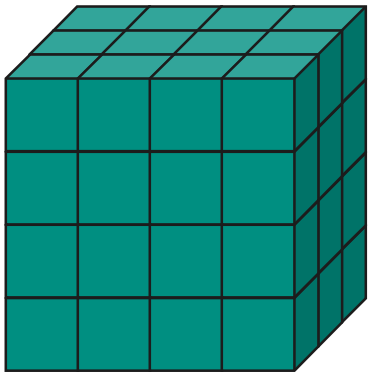
Calculating Volume of Cubes and Cuboids

Count the top layer of each shape and calculate the volume.
The unit measurement is shown underneath.



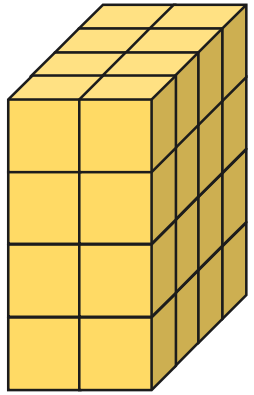
cubic centimetres

$36cm^3$



cubic metres

$48m^3$



cubic centimetres

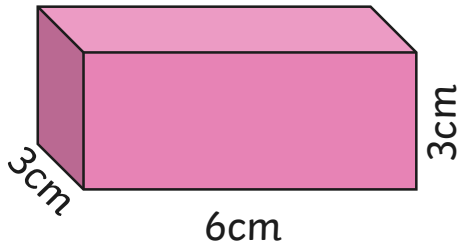
$32cm^3$

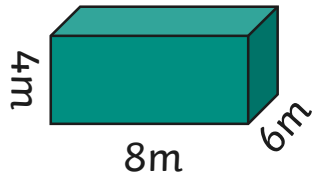
Calculating Volume of Cubes and Cuboids

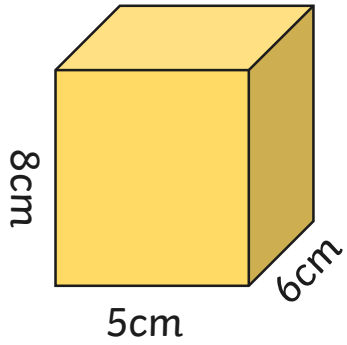
Do you know another way to calculate the volume of cubes

length × width × height

Use the formula to calculate the volume of the following shapes.







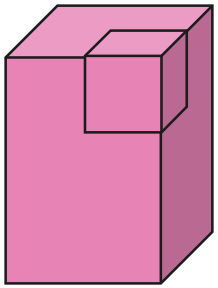
$54cm^3$

$192m^3$

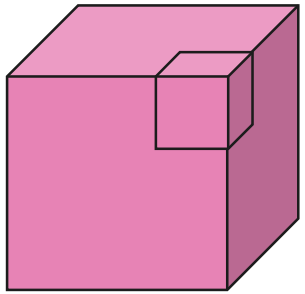
$240cm^3$

Calculating Volume of Cubes and Cuboids

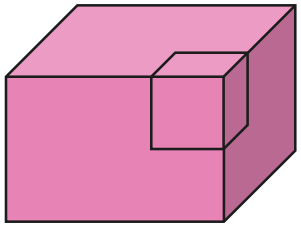
On these shapes, one cube has been drawn.
Each cube is a cubic centimetre. Estimate the volume.



$12cm^3$



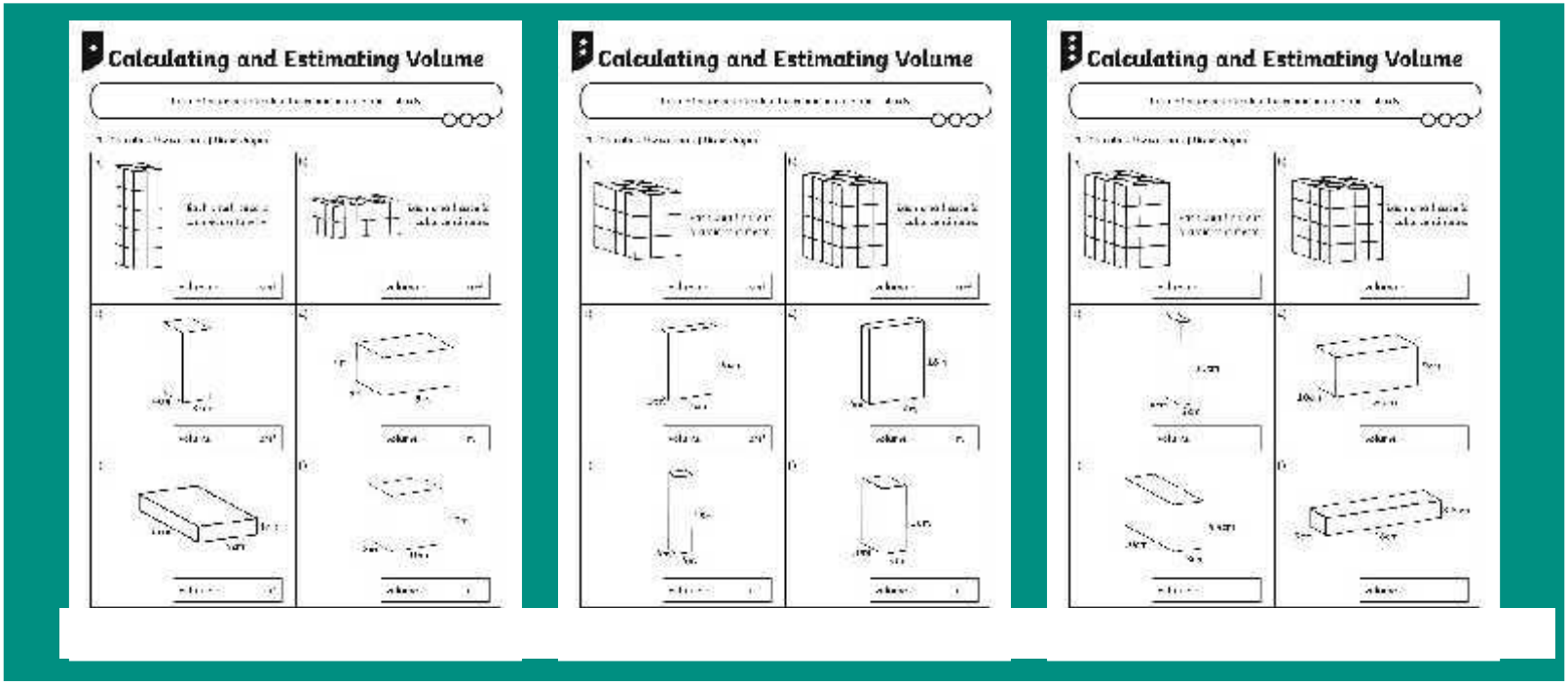
$27cm^3$



$18cm^3$

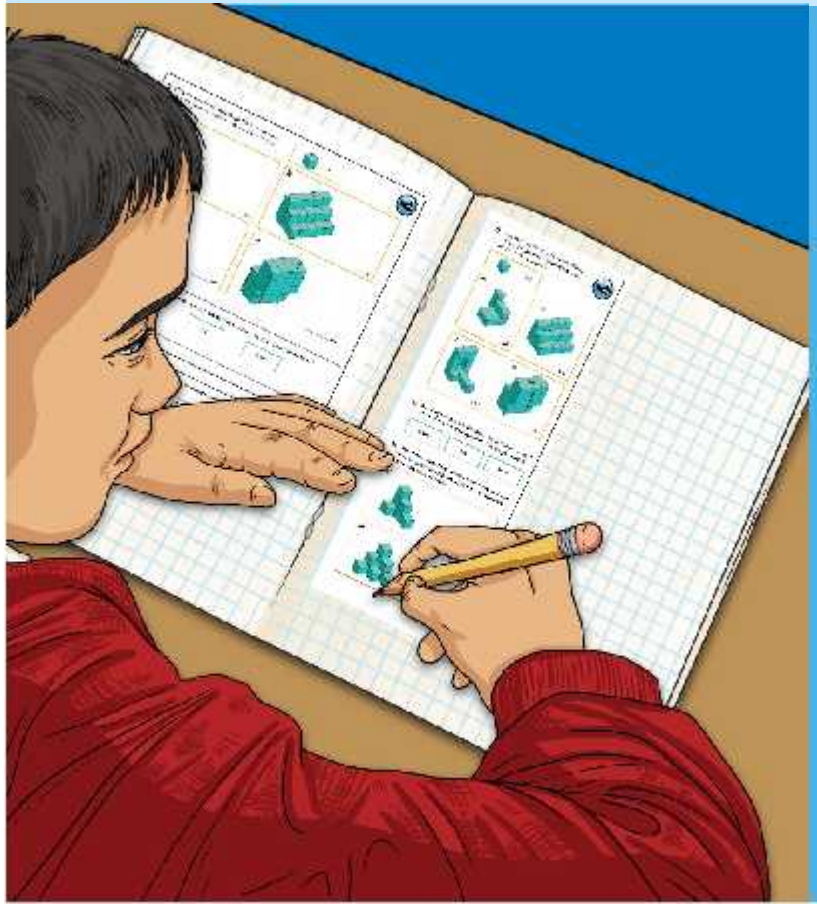
Calculating and Estimating Volume

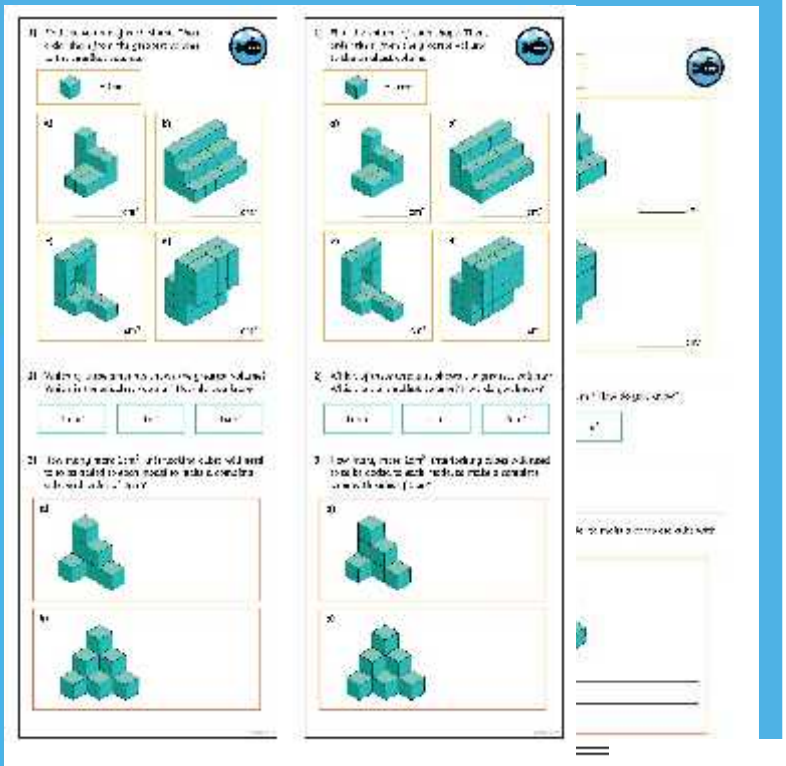
Use your fabulous calculation and estimation skills to complete these activity sheets.



Diving into Mastery

Dive in by completing your own activity!

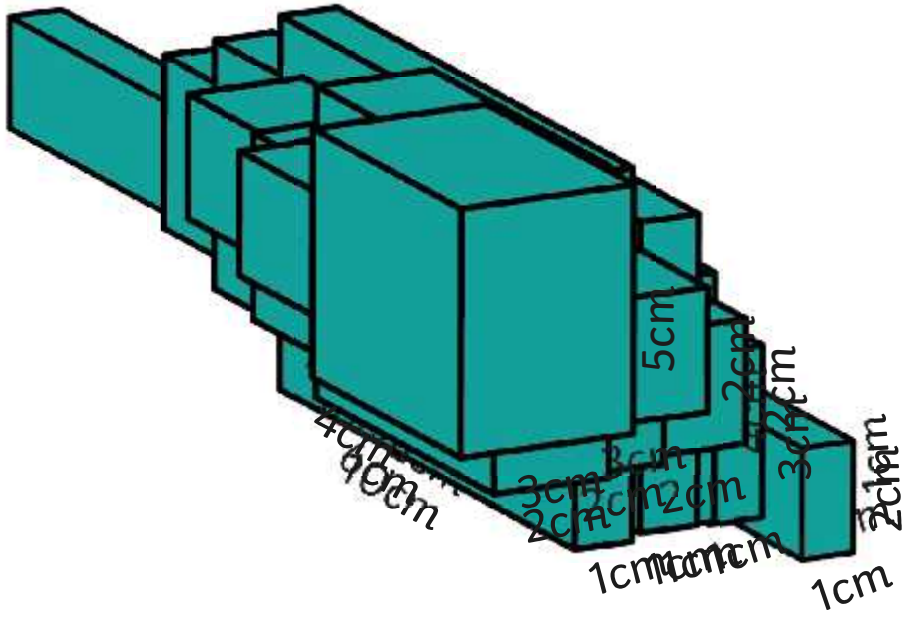




Draw That Shape!

Lewis has estimated that a shape has a volume of 60cm^3.
On your isometric paper, draw a cube or cuboid which would have a volume of 60cm^3.

There are many possible solutions.

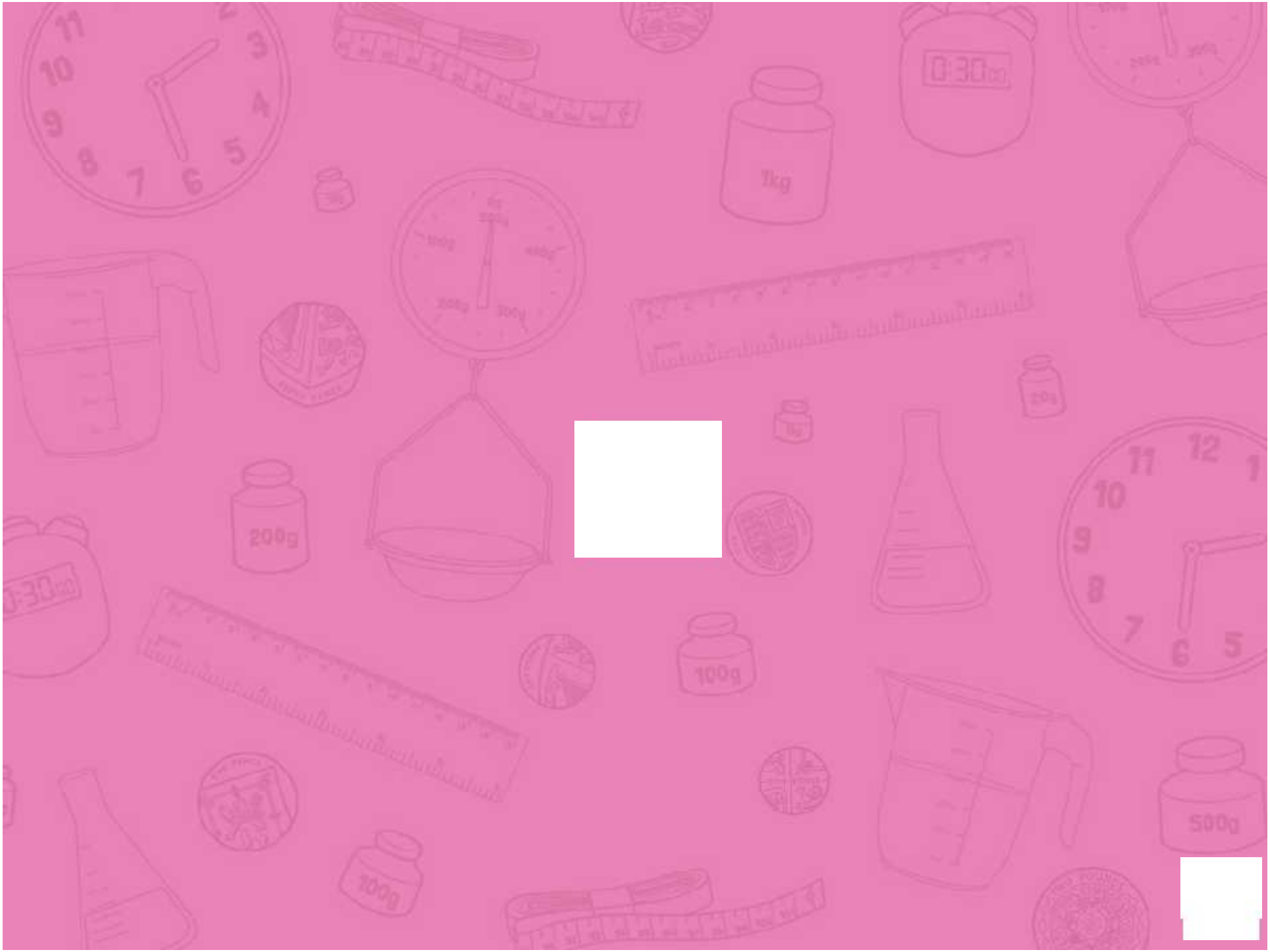


Aim

- I can estimate and calculate the volume of cubes and cuboids.

Success Criteria

- I can count cubes in a layer to help me estimate the volume of cubes and cuboids.
- I can use a formula to calculate volume of cubes and cuboids.



Aim: I can estimate and calculate the volume of cubes and cuboids.				**Date:**					
				Delivered By:			**Support:**		
Success Criteria	**Me**	**Friend**	**Teacher**	**T**	**PPA**	**S**	**I**	**AL**	**GP**
I can count in a layer to help me estimate the volume of cubes and cuboids.				**Notes/Evidence**					
I can use a formula to calculate the volume of cubes and cuboids.									

Next Steps

- _____
- _____

T	Teacher	**I**	Independent
PPA	Planning, Preparation and Assessment	**AL**	Adult Led
S	Supply	**GP**	Guided Practice

Aim: I can estimate and calculate the volume of cubes and cuboids.				**Date:**					
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Success Criteria	**Me**	**Friend**	**Teacher**	**T**	**PPA**	**S**	**I**	**AL**	**GP**
I can count in a layer to help me estimate the volume of cubes and cuboids.				**Notes/Evidence**					
I can use a formula to calculate the volume of cubes and cuboids.									

Next Steps

- _____
- _____

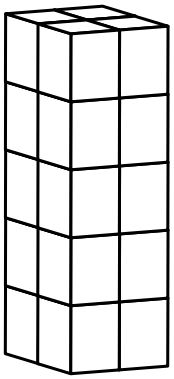
T	Teacher	**I**	Independent
PPA	Planning, Preparation and Assessment	**AL**	Adult Led
S	Supply	**GP**	Guided Practice

Calculating and Estimating Volume

I can estimate and calculate the volume of cubes and cuboids.

1. Calculate the volume of these shapes.

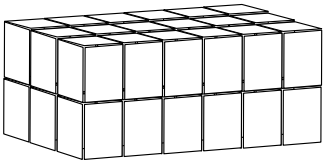
a)



Each small cube is a cubic centimetre.

volume = cm^3

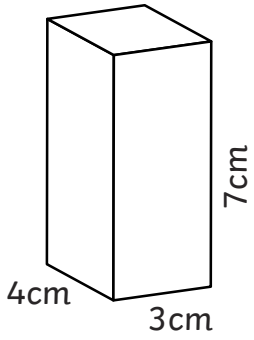
b)



Each small cube is a cubic metre.

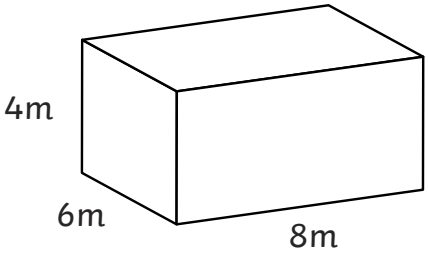
volume = m^3

c)



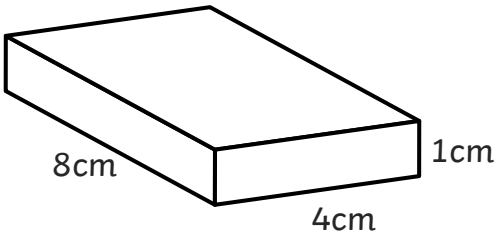
volume = cm^3

d)



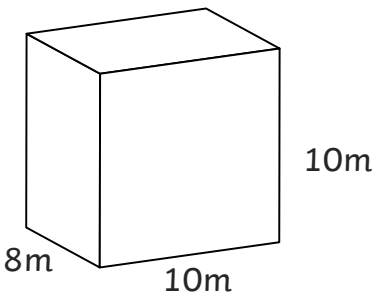
volume = m^3

e)



volume = cm^3

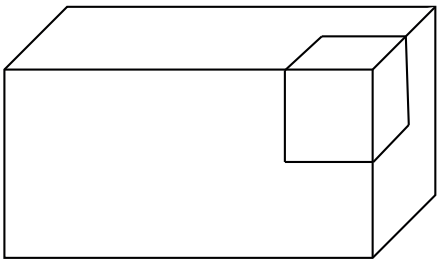
f)



volume = m^3

2. Estimate the volume of these shapes.

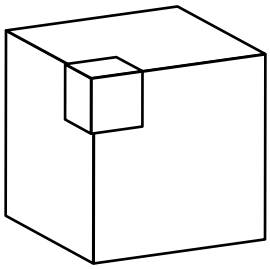
a)



Small cube = 1 cubic centimetre

Estimation =

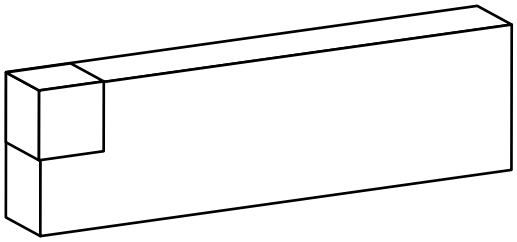
b)



Small cube = 1 cubic metre

Estimation =

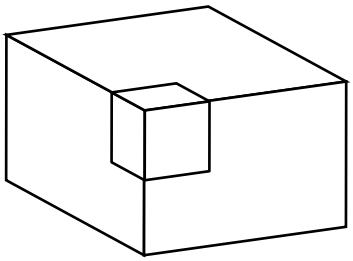
c)



Small cube = 1 cubic metre

Estimation =

d)



Small cube = 1 cubic metre

Estimation =

3. The volume of a cuboid is 36cm^3. The height of the cuboid is 6cm and the width is 2cm. What is the measurement of the other side?

4. A cuboid has a volume of 60cm^3. Place a tick by all the dimensions which the cuboid could be.

12cm × 3cm × 4cm		10cm × 3cm × 2cm	
20cm × 3cm × 1cm		5cm × 6cm × 2cm	
6cm × 2cm × 2cm		8cm × 3cm × 2cm	

Calculating and Estimating Volume **Answers**

1. Calculate the volume of these shapes.

   a. $20cm^3$ d. $192m^3$

   b. $36m^3$ e. $32cm^3$

   c. $84cm^3$ f. $800m^3$

2. Estimate the volume of these shapes.

   a. $16cm^3$

   b. $27m^3$

   c. $14cm^3$

   d. $24m^3$

3. The volume of a cuboid is $36cm^3$. The height of the cuboid is 6cm and the width is 2cm. What is the measurement of the other side?
   3cm

4. A cuboid has a volume of $60cm^3$. Place a tick by all the dimensions which the cuboid could be.

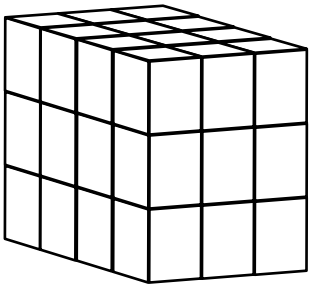
12cm × 3cm × 4cm		10cm × 3cm × 2cm	✓
20cm × 3cm × 1cm	✓	5cm × 6cm × 2cm	✓
6cm × 2cm × 2cm		8cm × 3cm × 2cm	

Calculating and Estimating Volume

I can estimate and calculate the volume of cubes and cuboids.

1. Calculate the volume of these shapes.

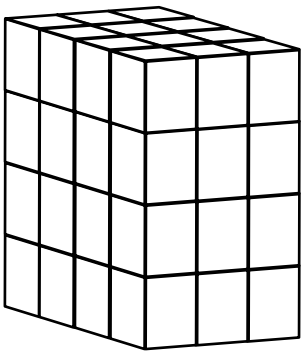
a)



Each small cube is a cubic centimetre.

volume = cm^3

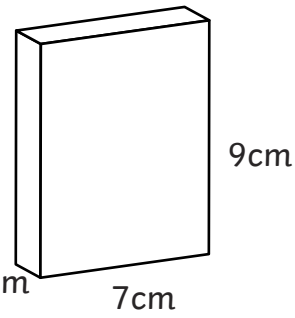
b)



Each small cube is a cubic metre.

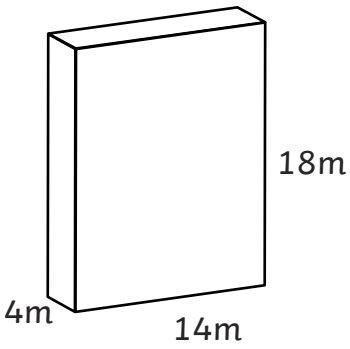
volume = m^3

c)



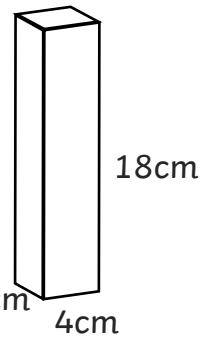
volume =

d)



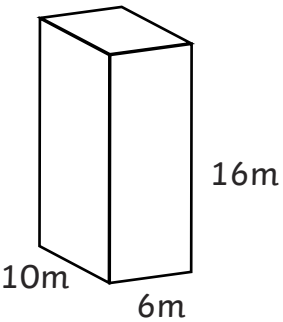
volume =

e)



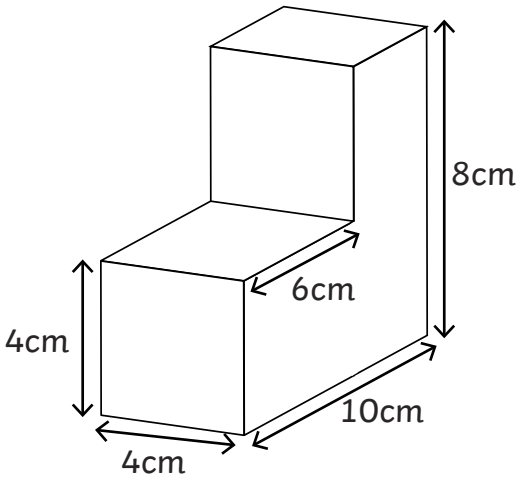
volume =

f)



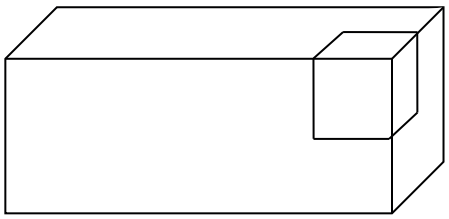
volume =

2. Calculate the area of this composite shape.



3. Estimate the volume of these shapes.

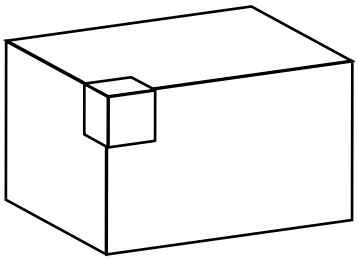
a)



Small cube = 1 cubic centimetre

Estimation =

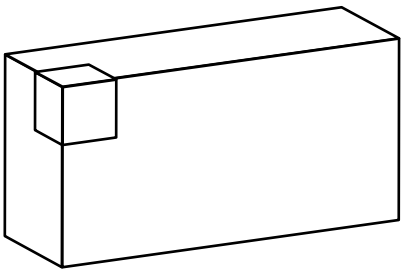
b)



Small cube = 1 cubic metre

Estimation =

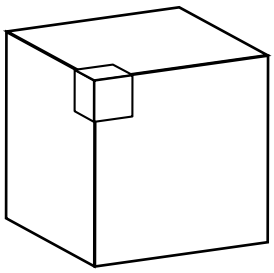
c)



Small cube = 1 cubic centimetre

Estimation =

d)



Small cube = 1 cubic metre

Estimation =

4. The volume of a cuboid is $72cm^3$. The area of the base is $9cm^2$. What is the height of the shape?

Calculating and Estimating Volume **Answers**

1. Calculate the volume of these shapes.

   a. $36cm^3$

   b. $48m^3$

   c. $126cm^3$

   d. $1008m^3$

   e. $288cm^3$

   f. $960m^3$

2. Calculate the area of this composite shape.
   $224cm^3$

3. Estimate the volume of these shapes.

   a. $20cm^3$

   b. $60m^3$

   c. $36m^3$

   d. $64m^3$

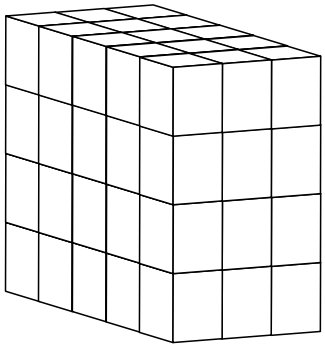
4. The volume of a cuboid is $72cm^3$. The area of the base is $9cm^2$. What is the height of the shape?
   $8cm$

Calculating and Estimating Volume

I can estimate and calculate the volume of cubes and cuboids.

1. Calculate the volume of these shapes.

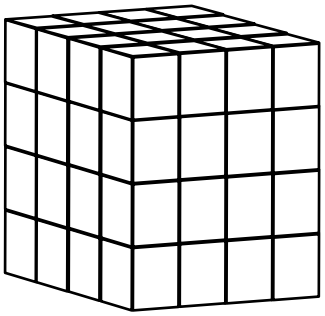
a)



Each small cube is a cubic centimetre.

volume =

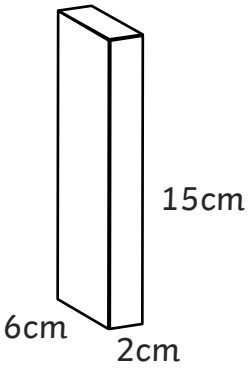
b)



Each small cube is a cubic metre.

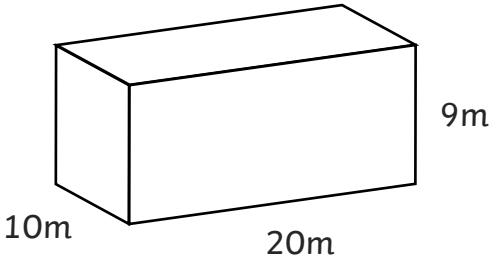
volume =

c)



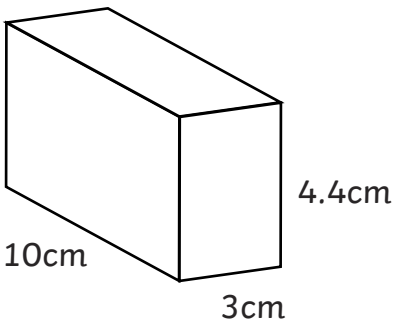
volume =

d)



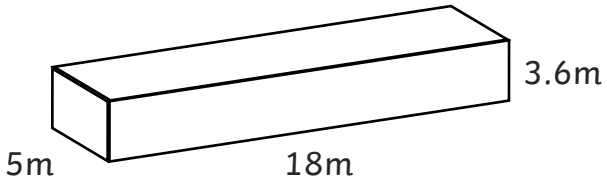
volume =

e)



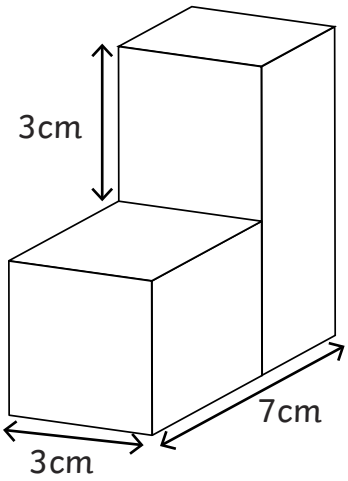
volume =

f)



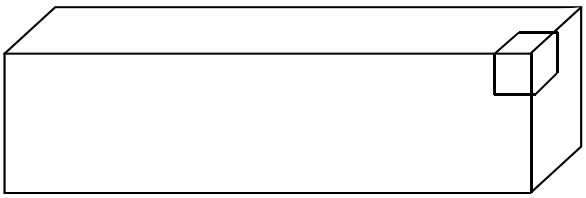
volume =

2. Calculate the area of this composite shape. The shape is made up of a cube and a cuboid.



3. Estimate the volume of these shapes.

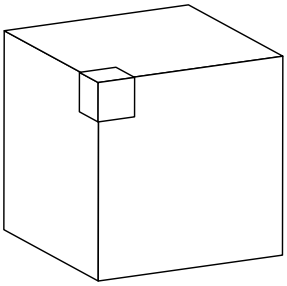
a)



Small cube = 1 cubic centimetre

Estimation =

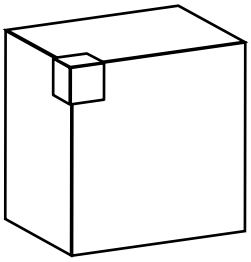
b)



Small cube = 1 cubic metre

Estimation =

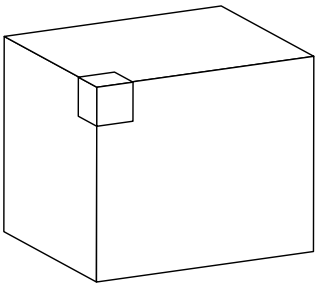
c)



Small cube = 1 cubic metre

Estimation =

d)



Small cube = 1 cubic metre

Estimation =

4. Find all the cuboids that have a volume of 96cm^3, where one of the dimensions is 8cm.

Calculating and Estimating Volume **Answers**

1. Calculate the volume of these shapes.

   a. $60cm^3$

   b. $64m^3$

   c. $180cm^3$

   d. $1800m^3$

   e. $132cm^3$

   f. $324m^3$

2. Calculate the area of this composite shape.
   $99cm^3$

3. Estimate the volume of these shapes.

   a. $72cm^3$

   b. $125m^3$

   c. $48m^3$

   d. $150m^3$

4. Find all the cuboids that have a volume of $96cm^3$, where one of the dimensions is 8cm.
   8cm × 12cm × 1cm
   8cm × 6cm × 2cm
   8cm × 4cm × 3cm

1) a) $11cm^3$

b) $30cm^3$

c) $14cm^3$

d) $44cm^3$

Order from greatest to smallest is d, b, c, a

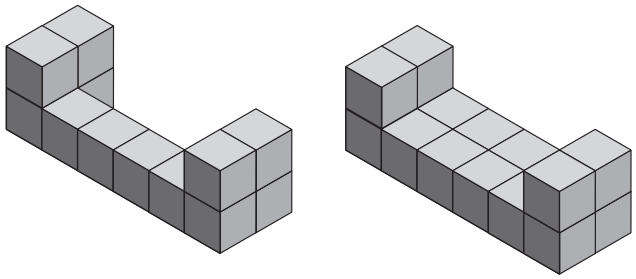
2) The greatest amount is $1m^3$.
The smallest amount is $1\ mm^3$.

We can use what we know about the relative size of millimetres, centimetres and metres to help us see that $1m^3 = 1m \times 1m \times 1m$ will be larger than $1cm \times 1cm \times 1cm$. This means that $1mm \times 1mm \times 1mm$ is the smallest volume.

3) a) $27cm^3 - 7cm^3 = 20cm^3$
20 more cubes will need to be added.

b) $27cm^3 - 10cm^3 = 17cm^3$
17 more cubes will need to be added.

1) Keeva is incorrect. The model could have a volume of $16cm^3$ or $12cm^3$.



2) Emily's cuboid has a volume of $48cm^3$.

The first shape has a volume of $25cm^3$.
The second shape has a volume of $21cm^3$.
The total volume of both shapes is $46cm^3$ not $48cm^3$ so Shen is incorrect.

1) a) $27cm^3 - 1cm^3 = 26cm^3$

b) $125cm^3 - 27cm^3 = 98cm^3$

2) a) $2cm \times 4cm \times 4cm$ cuboid $= 32cm^3$
$2cm \times 3cm \times 2cm$ cuboid $= 12cm^3$

b) After the two example cuboids are taken into account there are another 8 more different cuboids that can be made:

$3cm \times 3cm \times 3cm$ cuboid $= 27cm^3$

$4cm \times 4cm \times 4cm$ cuboid $= 64cm^3$

$2cm \times 2cm \times 2cm$ cuboid $= 8cm^3$

$3cm \times 4cm \times 4cm$ cuboid $= 48cm^3$

$3cm \times 4cm \times 3cm$ cuboid $= 36cm^3$

$2cm \times 4cm \times 2cm$ cuboid $= 16cm^3$

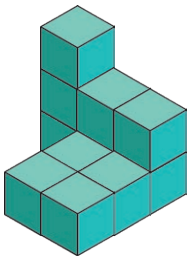
$2cm \times 3cm \times 3cm$ cuboid $= 18cm^3$

$2cm \times 3cm \times 4cm$ cuboid $= 24cm^3$

1) Find the volume of each shape. Then, order them from the greatest volume to the smallest volume.

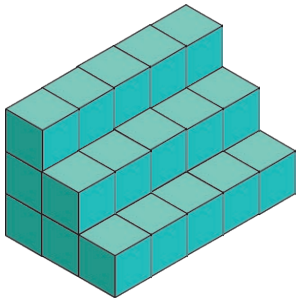
 = 1cm³

a)



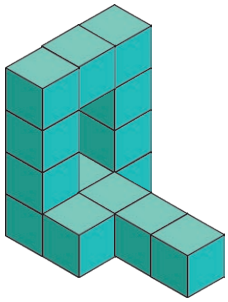
_____cm³

b)



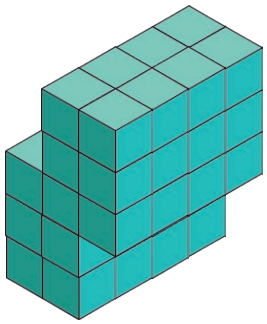
_____cm³

c)



_____cm³

d)



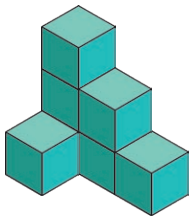
_____cm³

2) Which of these amounts shows the greatest volume? Which is the smallest volume? How do you know?

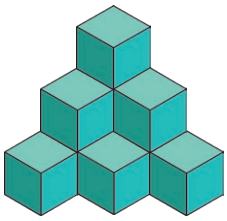
1mm³	1m³	1cm³

3) How many more 1cm³ interlocking cubes will need to to be added to each model to make a complete cube with sides of 3cm?

a)



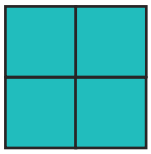
b)



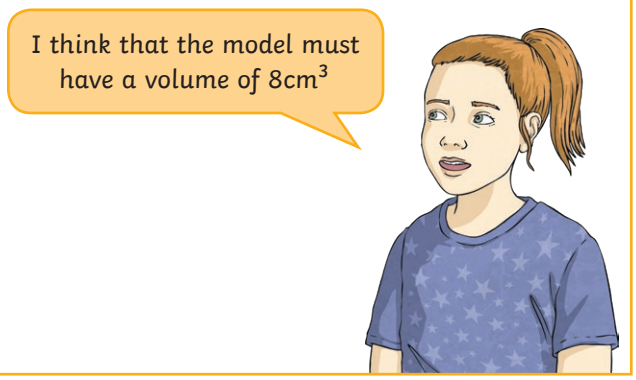
1) Joshua draws two different views of the model his friend has made out of $1cm^3$ interlocking cubes.

Keeva looks at Joshua's drawing.

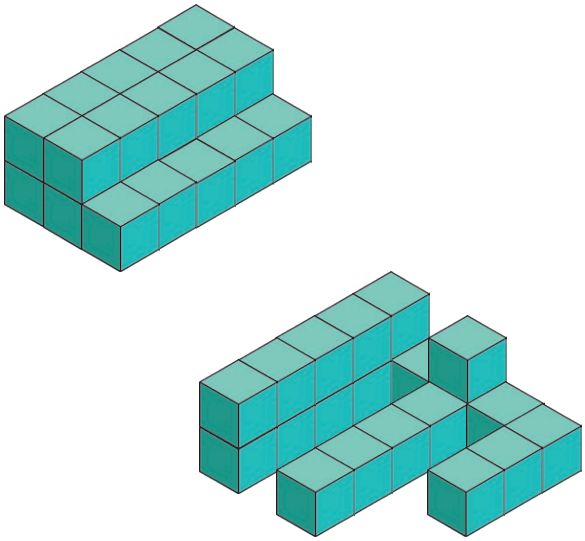
front view

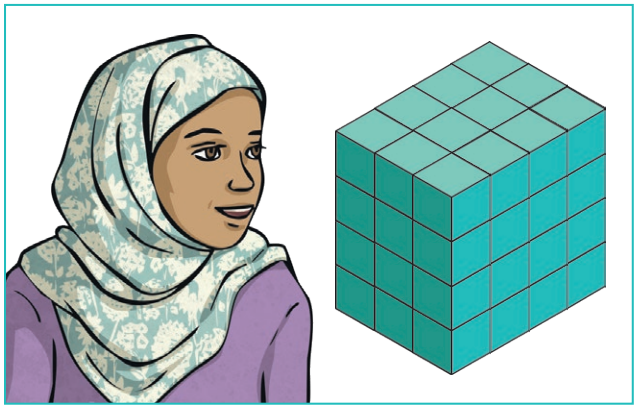


side view



2) Shen thinks that both of these shapes put together will have the same volume as Emily's cuboid.



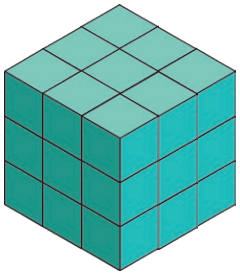


Is Shen correct? Prove it!

1) **a)** This cube is made from $1cm^3$ interlocking cubes.

Imagine that the cube has been made with a hollow centre so that only the faces are made from the interlocking cubes.

What is the volume of the cube?

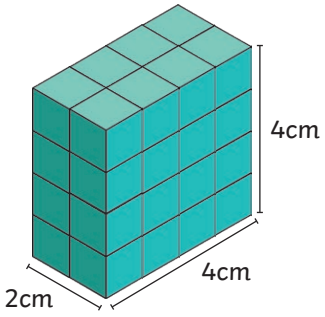


b) If another similar hollow cube was made that had the dimensions 5cm × 5cm × 5cm, what would the volume of the cube be?

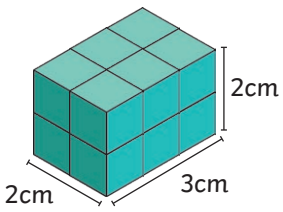
_____cm^3

2) I use $1cm^3$ interlocking cubes to make some different size cuboids. I make cuboids with different side lengths of 2cm, 3cm and 4cm.
Here are two of my cuboids:

a) What are the volumes of each cuboid?



_____cm^3



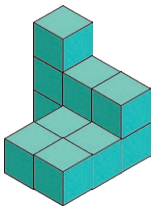
_____cm^3

b) How many more cuboids can I make which have side lengths of 2cm, 3cm and 4cm?
What is the volume of each different cuboid?

1) Find the volume of each shape. Then, order them from the greatest volume to the smallest volume.

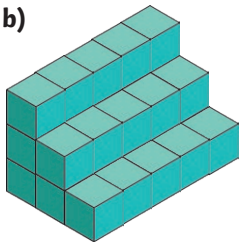
 = 1cm³

a)



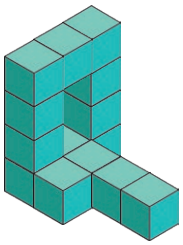
_____cm³

b)



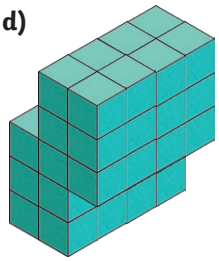
_____cm³

c)



_____cm³

d)



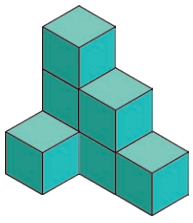
_____cm³

2) Which of these amounts shows the greatest volume? Which is the smallest volume? How do you know?

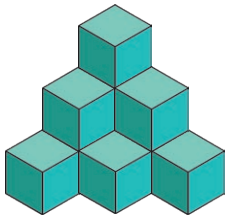
1mm³	1m³	1cm³

3) How many more 1cm³ interlocking cubes will need to to be added to each model to make a complete cube with sides of 3cm?

a)



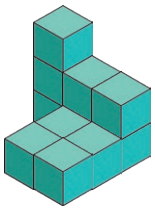
b)



1) Find the volume of each shape. Then, order them from the greatest volume to the smallest volume.

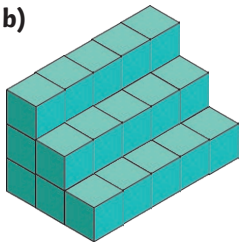
 = 1cm³

a)



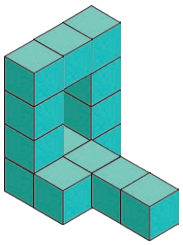
_____cm³

b)



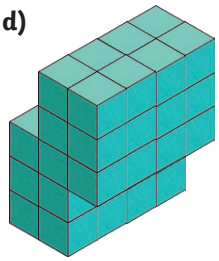
_____cm³

c)



_____cm³

d)



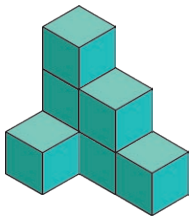
_____cm³

2) Which of these amounts shows the greatest volume? Which is the smallest volume? How do you know?

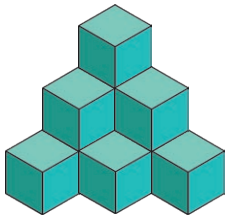
1mm³	1m³	1cm³

3) How many more 1cm³ interlocking cubes will need to to be added to each model to make a complete cube with sides of 3cm?

a)



b)



1) Joshua draws two different views of the model his friend has made out of $1cm^3$ interlocking cubes.

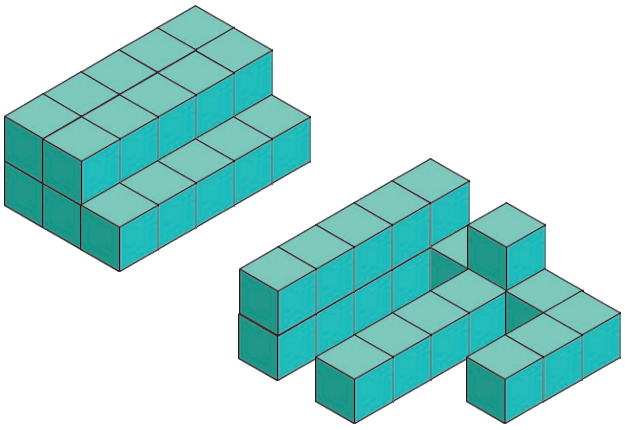
Keeva looks at Joshua's drawing.

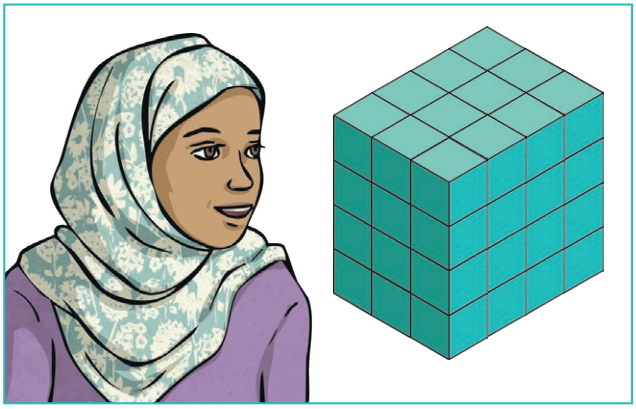
front view

side view

I think that the model must have a volume of $8cm^3$

2) Shen thinks that both of these shapes put together will have the same volume as Emily's cuboid.





Is Shen correct? Prove it!

1) Joshua draws two different views of the model his friend has made out of $1cm^3$ interlocking cubes.

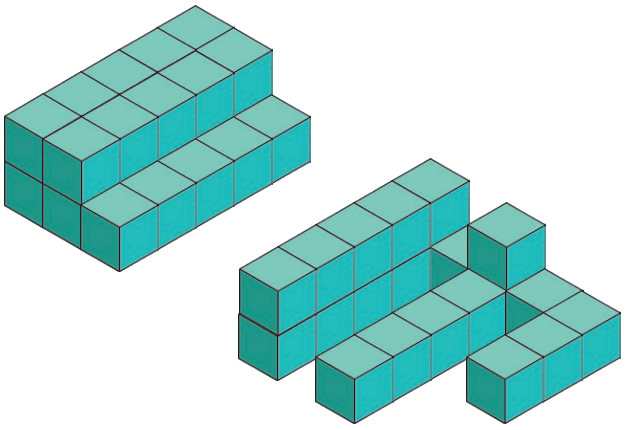
Keeva looks at Joshua's drawing.

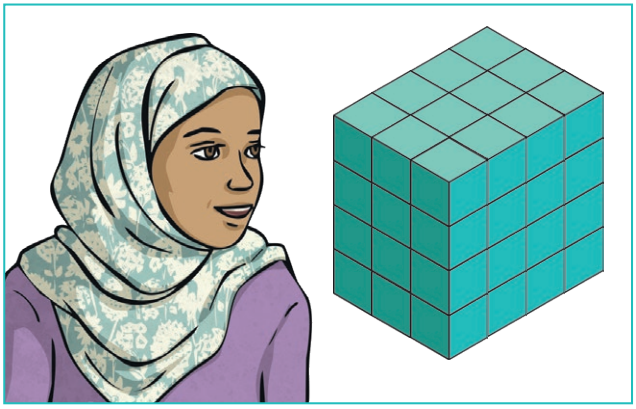
front view

side view

I think that the model must have a volume of $8cm^3$

2) Shen thinks that both of these shapes put together will have the same volume as Emily's cuboid.



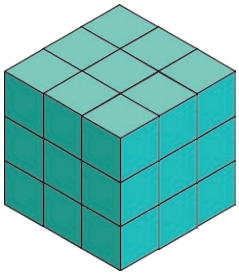


Is Shen correct? Prove it!

1) a) This cube is made from $1cm^3$ interlocking cubes.

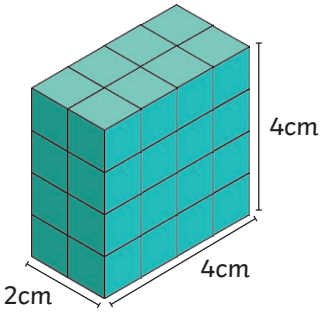
Imagine that the cube has been made with a hollow centre so that only the faces are made from the interlocking cubes.

What is the volume of the cube?

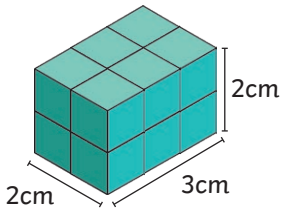


b) If another similar hollow cube was made that had the dimensions 5cm × 5cm × 5cm, what would the volume of the cube be?

2) I use $1cm^3$ interlocking cubes to make some different size cuboids. I make cuboids with different side lengths of 2cm, 3cm and 4cm. Here are two of my cuboids:



_____cm^3



_____cm^3

a) What are the volumes of each cuboid?

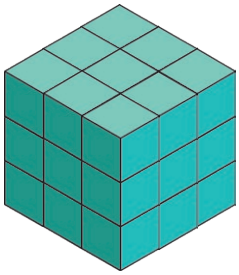
b) How many more cuboids can I make which have side lengths of 2cm, 3cm and 4cm?

What is the volume of each different cuboid?

1) a) This cube is made from $1cm^3$ interlocking cubes.

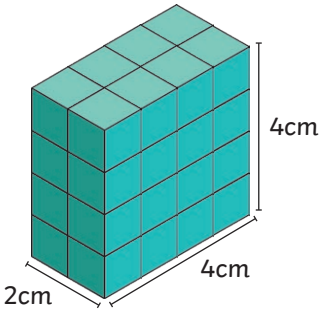
Imagine that the cube has been made with a hollow centre so that only the faces are made from the interlocking cubes.

What is the volume of the cube?

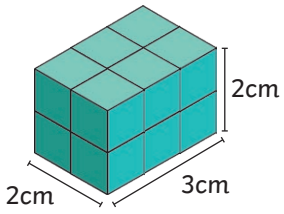


b) If another similar hollow cube was made that had the dimensions 5cm × 5cm × 5cm, what would the volume of the cube be?

2) I use $1cm^3$ interlocking cubes to make some different size cuboids. I make cuboids with different side lengths of 2cm, 3cm and 4cm. Here are two of my cuboids:



_____cm^3



_____cm^3

a) What are the volumes of each cuboid?

b) How many more cuboids can I make which have side lengths of 2cm, 3cm and 4cm?

What is the volume of each different cuboid?

Fill That Box

I can estimate and calculate the volume of cubes and cuboids.

A box is 1.5m long, 0.6m wide and 0.6m high.

Toy cars are in small boxes which are 15cm long, 10cm wide and 10cm high.

What is the largest number of cars that can be put into the larger box?

Show how you worked out the answer. You may want to draw pictures to help.

Fill that Box **Answer**

360 cars would fit into the larger box.

Measurement | Calculating and Estimating Volume

I can estimate and calculate the volume of cubes and cuboids.		
I can count in a layer to help me estimate the volume of cubes and cuboids.		
I can use a formula to calculate the volume of cubes and cuboids.		

Measurement | Calculating and Estimating Volume

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