AFRICAN INSTITUTE FOR MATHEMATICAL SCIENCES
SCHOOLS ENRICHMENT CENTRE (AIMSSEC)
AIMING HIGH

METRE AND CENTIMETRE CUBES Inclusion and Home Learning Guide

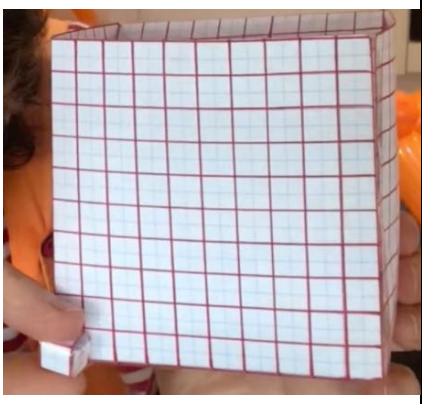
is part of a Learning Pack downloadable from the AIMING HIGH website
https://aiminghigh.aimssec.ac.za
It provides related activities for home learning for all ages and learning stages from pre-school to school-leaving, together with guidance for home-learning and also for inclusion in school lessons, all on the **Common Theme of SCALE.**
Guidance for school lessons is given in the separate Notes for Teachers documents.
Choose what seems suitable for the age or attainment level of your learners.

METRE AND CENTIMETRE CUBES

Watch the video about the Metre Cube and Scale.

How many children can fit inside a metre cube (1 metre by 1 metre by 1 metre)? How many adults?

How many cubic centimetres (1 centimetre by 1 centimetre by 1 centimetre) can fit inside a metre cube?



The cubes pictured here are made from centimetre squared paper. The bigger one measures 10 centimetres by 10 centimetres by 10 centimetres and the smaller one measures 1 centimetre by 1 centimetre by 1 centimetre.

1. What is the edge length of the 10 by 10 by 10 cube?

2. You can see how many square centimetres there are on each face. What is the surface area of the whole 10 by 10 by 10 cube?

3. What is it's volume?

4. What is the linear scale factor from the 1 by 1 by 1 cube to the 10 by 10 by 10 cube?

5. What is the area scale factor?

6. What is the volume scale factor?

7. How many of the smaller 1 by 1 by 1 (1 cubic centimetre) cubes can you pack into the 10 by 10 by 10 cube?

8. How many of the 1 by 1 by 1 cubes can you pack into a metre cube?

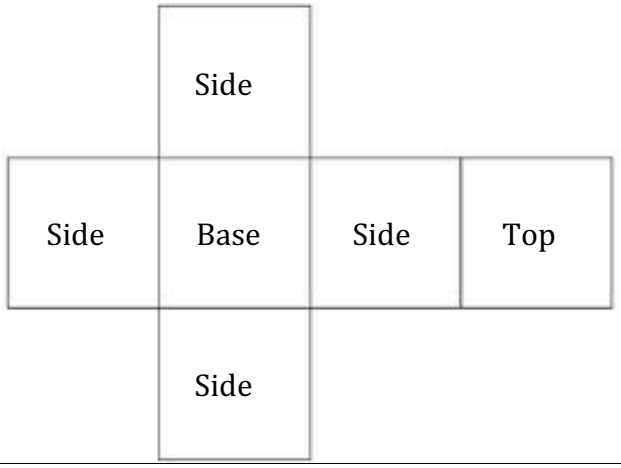
9. What is the surface area of the metre cube?

10. What is the linear scale factor comparing the metre cube (100 by 100 by 100) to the 10 by 10 by 10 cube and to the 1 by 1 by 1 cube?

11. What is the area scale factor comparing the metre cube (100 by 100 by 100) to the 10 by 10 by 10 cube and to the 1 by 1 by 1 cube?

12. What is the volume scale factor comparing the metre cube (100 by 100 by 100) to the 10 by 10 by 10 cube and to the 1 by 1 by 1 cube.

HELP



Make your own 1 by 1 by 1 (1 cubic centimetre) cube and 10 by 10 by 10 cube from squared paper marked in square centimetres (see page 3).

Cut out a net for the cube or cut out the faces separately and fix them together with sticky tape.

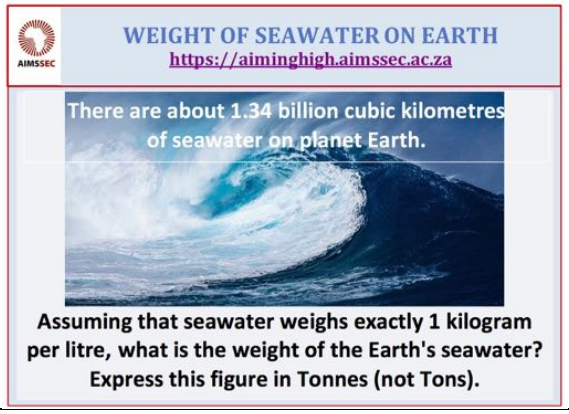
NEXT

Investigate the connection between cubic centimetres and millilitres and how these measures are used in practice (for example in doses of medicine).

Investigate the capacity of a medicine spoon in relation to the volume inside a cubic centimetre.

How many US pints make 1 litre? The Imperial pint used in the UK, as in this measuring jug, is 20 fluid ounces. The US Customary pint is 16 fluid ounces.

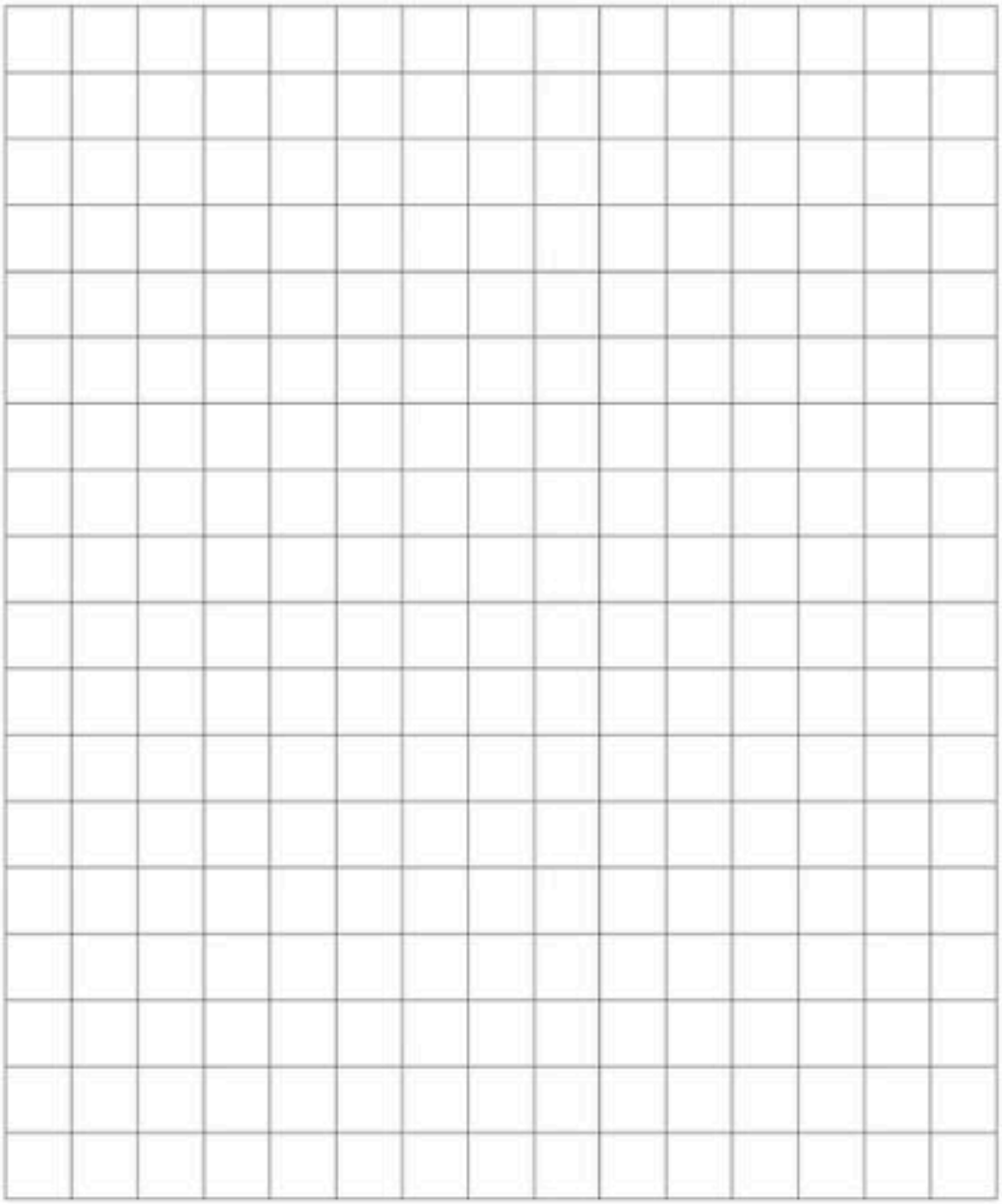
Investigate the connection between millilitres and milligrams and how these are used in practice (for example in cooking).



No calculators are needed here, just big numbers and powers of 10.

Take 1 billion to be 10^9 .

Warning: it is generally best to use powers of 10, and not words like billion and trillion, because these words have different meanings in different countries.



INCLUSION AND HOME LEARNING GUIDE
THEME: SCALE

Early Years - Make a Den

Resources: String, metre ruler or measuring tape, large cardboard boxes.

Talk about this picture.
Ask what the children notice in it. Explain that the children are inside a cube made from 12 blue balloons that are one metre long like the green balloon that Bubblz is holding.

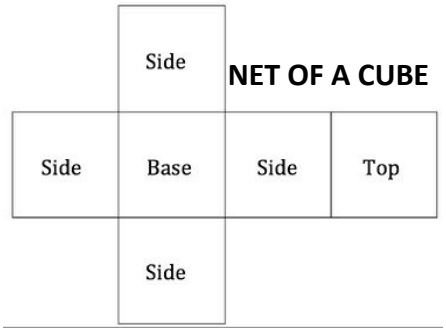
Show the children how you measure one metre lengths of string using a ruler or tape measure. Give each child a piece of string exactly 1 metre long. Ask them to walk around and show you some objects that are about a metre long that they have measured with their string. Help them to measure their heights and to measure the length and breadth of the room you are in.

Improvise a play-den that is approximately 1 metre by 1 metre by 1 metre. It could be under a table or between some furniture and you can use waste cardboard and/or an old sheet or blanket. For safety reasons do not use plastic. The purpose of this activity is for the children to learn about metres and about the properties of a cube.

Make the play-den as close to a metre cube in size and shape as you can get it. Talk about how close it is to a metre cube and what the differences are.

Lower Primary – Investigating litres and millilitres

Resources: A cube made from scrap cardboard measuring 10 centimetres by 10 centimetres by 10 centimetres. String. Newspaper stick one metre long. Metre rule or measuring tape. A measuring jug showing litres and millilitres or a plastic milk carton that holds 1 litre. Water and sand or rice or gravel or other granular material. A selection of containers such as cups, mugs and bottles.



NET OF A CUBE

MAKE A METRE STICK FROM ROLLED NEWSPAPER

Tightly roll 8 large sheets of newspaper, 4 and 4 placed as in the photograph, so that the length of the stick when the paper is rolled up is 1 metre. Mark it into 10 centimetre lengths.

See https://aiminghigh.aimssec.ac.za/years-3-7-metre-measures/

Do some of the activities described in the Early Years section. Give each pair of learners a 1 metre long paper stick or a piece of string exactly 1 metre long. Ask them to walk around and look for objects that are about a metre long and measure them. Help them to measure their heights and to measure the length and breadth of the room you are in.

Compare the lengths of 1 centimetre, 10 centimetres and 1 metre.

Make a cube from scrap cardboard measuring 10 centimetres by 10 centimetres by 10 centimetres. Fill your cube with sand, rice, gravel or other granular material and compare it with the measuring jug. Point out the 1 litre or 1000 millilitre line on the measuring jug and ask the learners what they think would happen if you poured the sand from the cube into the jug? Would it fill up to the 1 litre level or be lower or higher? Let the learners do this for themselves. They should be convinced that the 10 by 10 by 10 cube holds 1 litre.

Ask the learners what order they would put your containers in to arrange them in order from smallest capacity to largest capacity. Test out how much each container holds by filling it with water and using the measuring jug.

See https://aiminghigh.aimssec.ac.za/years-4-7-bottles-and-capacity/
and https://aiminghigh.aimssec.ac.za/years-5-7-cups-and-capacity/

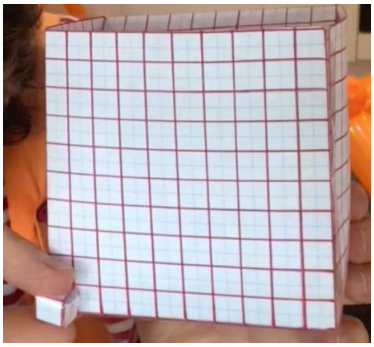
Upper Primary and Lower Secondary (Years 4 – 10)

Resources: Metre rule or piece of string 1 metre long. Models of a centimetre cube and a 10cm by 10 cm by 10 cm cube (see instructions in HELP section, page 2) or squared paper, scissors and sticky tape for the students to make their own models.

Watch the video with the class if possible. Then show your class a metre rule or a piece of string 1 metre long. Draw a line 1 metre long on the board. Show them that a metre is made up of 100 centimetres and 1000 millimetres. Ask them how many metres they think there are in a kilometre and, if their answers are wrong, don't tell them so. Name a few places that they will know about that are approximately one kilometre or two kilometres from the school, for example you might name a church, a shop, a taxi rank or train station or some other local places. Your aim here is to help the learners to develop the ability to judge distances.

Show the class the pictures of Bubblz with a metre rule holding a centimetre cube and of Bubblz inside a metre cube, and ask how many children could fit inside a metre cube.

Show them these two pictures of children in a metre cube and ask why there are more children in the pink metre cube than there are in the blue metre cube.



Either (1) organise the class into small groups, give out squared paper, scissors and sticky tape, show them the instructions in the HELP section on page 2 and tell each group to make a 10 cm by 10 cm by 10 cm cube and a 1 cm by 1 cm by 1 cm

Or (2) simply show the models that you have made in advance to the class and hand them around for the students to handle and look at closely.
Give out copies of the Worksheet (page 1) or write the questions on the board. You could use the One-Two-Four-More strategy where students work individually, then in pairs then in fours with the pair in from or behind them, and then there is a whole class discussion to end the lesson.

As homework, or if there is time in the lesson, or as a follow up lesson, guide the students to investigate and to discuss the use of millilitres and milligrams in doses of medicine and the link to the capacity of a 1 cubic centimetre cube (One cubic centimetre corresponds to a volume of one millilitre. The mass of one cubic centimetre of water at 3.98 °C, which is the temperature at which it attains its maximum density, is equal to one gram.)

Key questions

- How many of the 1 centimetre cubes go along an edge of the 10 by 10 by 10 cube?
- Put a 1 centimetre cube in the bottom of a 10 by 10 by 10 cube or imagine it. How many 1 centimetre cubes could you fit in the bottom layer in the 10 by 10 by 10 box.
- Imagine a 10 by 10 by 10 cube on the bottom of a metre cube. How many 10 by 10 by 10 cubes could you fit in the bottom layer inside a metre cube.

Upper Secondary

You should aim to know all about millimetres, centimetres, metres and kilometres and to be able to judge distances and volumes. You should also aim to understand the connection between millilitres, cubic centimetres and milligrams.

Work through the questions on pages 1, 2 and 3 and check your answers with the solutions on page 8.

To past the driving test in some countries you must demonstrate that you can read a clean car number plate from a minimum distance of 20.5 metres. How accurately can you judge that distance? How many car lengths do you think it is?

SOLUTION

1. What is the edge length of the 10 by 10 by 10 cube?

10 centimetres

2. You can see how many square centimetres there are on each face. What is the surface area of the whole 10 by 10 by 10 cube?

600 square centimetres

3. What is it's volume?

1000 cubic centimetres

4. What is the linear scale factor from the 1 by 1 by 1 cube to the 10 by 10 by 10 cube?

Linear scale factor 10

5. What is the area scale factor?

Area scale factor 100

6. What is the volume scale factor?

Volume scale factor 1000

7. How many of the smaller 1 by 1 by 1 (1 cubic centimetre) cubes can you pack into the 10 by 10 by 10 cube?

1000

8. How many of the 1 by 1 by 1 cubes can you pack into a metre cube?

1 million

9. What is the surface area of the metre cube?

10,000 square centimetres or 1 square metre

10. What is the linear scale factor comparing the metre cube (100 by 100 by 100) to the 10 by 10 by 10 cube and to the 1 by 1 by 1 cube?

Linear scale factor $\frac{1}{10}$

11. What is the area scale factor comparing the metre cube (100 by 100 by 100) to the 10 by 10 by 10 cube and to the 1 by 1 by 1 cube?

Area scale factor $\frac{1}{100}$

12. What is the volume scale factor comparing the metre cube (100 by 100 by 100) to the 10 by 10 by 10 cube and to the 1 by 1 by 1 cube?

Volume scale factor $\frac{1}{1000}$

NEXT SOLUTION

There are 1.34 billion billion tonnes of seawater on Earth. (134 with 16 zeros after it.)

VOLUME	CAPACITY	MASS
1 cubic centimetre (1 cc)	1 millilitre (1 ml)	1 gram (mg)
1 cubic metre (10^3 cc)	1 litre (l)	1 kilogram (1 kg)
1 cubic kilometre (10^9 cubic metres)	10^9 litres (10^9 l)	10^9 kilograms (10^9 kg)

Why do this activity?

Scale is one of the most important themes in mathematics and it's applications. Students need to have a good understanding of scale if they are to be well equipped for adult life and the world of work.

Learning objectives

In doing this activity students will have an opportunity to:

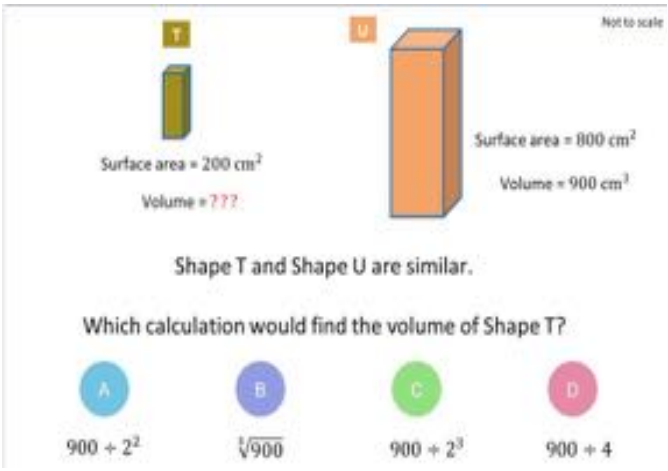
- learn about linear, area, volume and capacity measures in the metric system;
- develop an intuitive understanding of measures and the ability to estimate length, area and volume;
- develop an understanding of length, area and volume scale factors.

Generic competences

In doing this activity students will have an opportunity to develop a good understanding of scale that they can apply in many contexts.

DIAGNOSTIC ASSESSMENT This should take about 5–10 minutes.
Write the question on the board, say to the class:
"Put up 1 finger if you think the answer is A, 2 fingers for B, 3 fingers for C and 4 fingers for D".

1. Notice how the learners respond. Ask a learner who gave answer A to explain why he or she gave that answer. DO NOT say whether it is right or wrong but simply thank the learner for giving the answer.
2. It is important for learners to explain the reasons for their answers. Putting thoughts into words may help them to gain better understanding and improve their communication skills.
3. Then do the same for answers B, C and D. Try to make sure that learners listen to these reasons and try to decide if their own answer was right or wrong.



4. Ask the class to vote for the right answer by putting up 1, 2, 3 or 4 fingers. Notice if there is a change and who gave right and wrong answers.
5. If the concept is needed for the lesson to follow, explain the right answer or give a remedial task.

The correct answer is: C The area scale factor to get from Shape T to Shape U is 800/200 = 4.
This means that the corresponding linear scale factor is 2. To find the volume scale factor of Shape T to Shape U, the linear scale factor is cubed, giving 2 × 2 × 2 = 8. This means that the volume of Shape T is multiplied by 8 to give the volume of Shape U; however, we are working the other way, so the volume of Shape U is divided by 8 to give the volume of Shape T, so $900 \div 2^3$, answer C.

Possible misconceptions:
A. The student may think you square the area SF to get the volume SF
B. The student may be confused with thinking you need to cube root the volume.
D. The student has assumed the area SF and volume SF are the same.

Follow up

Metre Measures https://aiminghigh.aimssec.ac.za/years-3-7-metre-measures/
Bottles and Capacity https://aiminghigh.aimssec.ac.za/years-4-7-bottles-and-capacity/
Cups and Capacity https://aiminghigh.aimssec.ac.za/years-5-7-cups-and-capacity/
Scale Paper Airplanes
https://aiminghigh.aimssec.ac.za/years-4-12-scale-paper-airplanes/
Sierpinski Number and Shape Patterns
https://aiminghigh.aimssec.ac.za/grades-6-12-sierpinski-number-and-shape-patterns/

Go to the **AIMSSEC AIMING HIGH** website for lesson ideas, solutions and curriculum links: http://aiminghigh.aimssec.ac.za
Subscribe to the **MATHS TOYS YouTube Channel**
https://www.youtube.com/c/mathstoys
Download the whole AIMSSEC collection of resources to use offline with the AIMSSEC App see https://aimssec.app Find the App on Google Play.

Note: The Grades or School Years specified on the AIMING HIGH Website correspond to Grades 4 to 12 in South Africa and the USA, to Years 4 to 12 in the UK and school years up to Secondary 5 in East Africa.
New material will be added for Secondary 6.
For resources for teaching A level mathematics (Years 12 and 13) see https://nrich.maths.org/12339
Mathematics taught in Year 13 (UK) & Secondary 6 (East Africa) is beyond the SA CAPS curriculum for Grade 12

	Lower Primary Approx. Age 5 to 8	Upper Primary Age 8 to 11	Lower Secondary Age 11 to 15	Upper Secondary Age 15+
South Africa	Grades R and 1 to 3	Grades 4 to 6	Grades 7 to 9	Grades 10 to 12
East Africa	Nursery and Primary 1 to 3	Primary 4 to 6	Secondary 1 to 3	Secondary 4 to 6
USA	Kindergarten and G1 to 3	Grades 4 to 6	Grades 7 to 9	Grades 10 to 12
UK	Reception and Years 1 to 3	Years 4 to 6	Years 7 to 9	Years 10 to 13