

MATHEMATICS



Solid figures

SEQUENCE 1

Age group	10-12 y.o.
Prior knowledge	None
Material needed	The Solid figures box, a ruler
Subjects	Perimeter & area of solid shapes
Skills involved	Geometry, algebra
Time to carry out the sequence	2h

Step 1: Before the storytelling

Let your pupils discover the contents of the box, including the solid figure templates.

Ask your pupils what shapes they expect to create from the box.

Calculating the perimeter of a shape

To calculate the perimeter of a shape, add the lengths of the sides of the figures. Ask your pupils to use their rulers to find out the actual length of each side before calculating the perimeter.

/!\ Be careful not to give too much information to your pupils: only show them the formula to calculate the perimeter of a shape, but it is important that they try and perhaps do not find the “right” result. For example, the tongues of the templates should not be taken into account when calculating the perimeter of the figure since they will be hidden after construction.

Calculating the area of a shape

Here are the formulae to calculate the area of various shapes. In the following, h stands for “height”, l stands for “length”, and s stands for “side”.



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The area of a square is s^2 (or $s*s$ if your pupils are not familiar with the “square” notion”)

The area of a triangle is $(l*h)/2$

A less direct methodology will allow your pupils to calculate the area of other regular polygons (polygons that are made of sides of the same length and angles of the same size). In order to do so, they need to divide the polygon into triangles of the same size, calculate the area of each triangle and add them.

Creating same-size triangles:

- For polygons that have an even number of sides

Draw a line between two opposite angles. Repeat for each angle of the polygon

- For polygons that have an odd number of sides

Calculate the middle of each side. Then, draw a line between the middle of each side and the opposing angle.

Step 2: Creation of the boxes

Now is the time for your pupils to create their boxes. Do not forget about the storytelling resources to make the box more engaging!

Step 3: Conclusions from the box creation

What happened to the perimeter and area of the shapes? Did they change or remain the same? Are there some hidden parts? Some parts that have merged?

Potential points of difficulty that may require explanations during step 3:



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- The “tongues” (the additional pieces of paper that are used to glue the solid figure) are not to be taken into account when calculating the perimeter and area of the solid figure: they will remain hidden beneath the faces of the platonic solid.
- The perimeter of the solid figure will be smaller than the perimeter of the template since some of the sides will be glued together and, therefore, only count as 1 side instead of 2.

To go further

Although the templates for these figures are not part of this box, you may introduce your pupils to the perimeter and area of a rectangular cuboid or even to the area of a sphere, cone or cylinder.

This sequence can also be used as an introduction or a reminder before starting the next one.



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SEQUENCE 2

Age group	10-12 y.o.
Prior knowledge	None
Material needed	The Solid figures box, a ruler
Subjects	Volume of solid shapes
Skills involved	Geometry, algebra
Time to carry out the sequence	2h

Step 1: Creation of the boxes

Show your pupils how to build solid figures from the templates and use the storytelling resources to animate the activity.

Step 2: Discovery of the notion of volume

The volume of a solid figure corresponds to what is “inside” it. What data would your pupils need to find out the volume of a solid figure? Guide them through the process of finding the three dimensions: height, width and depth. You may use the material from the box to do so.

Step 3: Calculating the volume of simple solid figures

Take the cube out of the rest of the platonic solids from the box. Use it to show your pupils how this concept is applied: the volume of a cube is obtained by multiplying the height by the width by the depth of the cube. The same is true for rectangular cuboids, although there is none in the box: you may create one in order to show the class.



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Step 4: The volume of two other figures in the box

You may use the following formulae with your class if your pupils are confident enough: depending on which country you live in, these may be slightly out of the programme for primary-school pupils, but with the right tools in hand, they can achieve these tasks! Remember to use the box materials each time; giving a visual representation of the solids will help pupils with learning disabilities.

A. The tetrahedron

The volume of a tetrahedron is equal to the area of one of the triangles (written “a” in the following formula) times the height “h” of the solid, divided by 3.

The formula would be: $(a \cdot h)/3$

On a side note, the formula for a pyramid (with a square base) would be the same, except the area of the square would be used in the calculation.

B. The octahedron

Calculating the volume of an octahedron is actually quite simple! If you look at this platonic solid, you will notice that it can be divided into two pyramids. Calculate the volume of a pyramid and multiply it by two to discover the volume of the octahedron.

Therefore, its volume is equal to $2 \cdot ((a \cdot h)/3)$

Calculating the volume of the dodecahedron and icosahedron is too difficult for children this age, so we will not mention the formulae in this sequence.

However, for a bit more challenge – and even though they do not appear in the box – you can ask your pupils to calculate the volume of a ball or a cone!



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The formula for a ball's volume is $(4\pi r)/3$, where “r” corresponds to its radius.

The formula for the volume of a cone is close to the one of a pyramid: multiply the area of the base (which is a circle in this case) by the height of the solid figure.

Now that your pupils are able to calculate most of the traditional shapes, you may send them around the school and have them calculate different parts of the classroom, schoolyard or cafeteria!



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