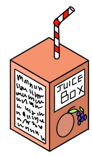
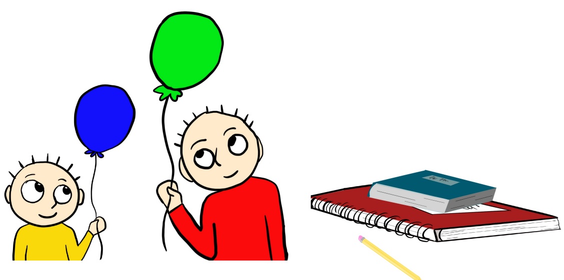


Lesson 3: Finding the Volume of Regularly-shaped Objects

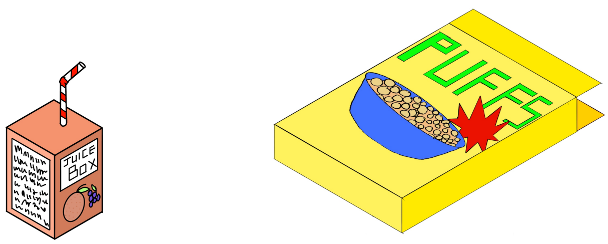
In Lesson 2, we introduced you to our first derived measurement which was surface area. Recall that with derived measurements, where we take two or more base measurements and, through the use of a math operation (adding, multiplying, dividing), we come up with a new meaningful measurement. In this lesson, we are going to introduce you to another derived measurement known as volume. By definition, volume is the amount of space something takes up. Objects in our world take up space. Your book and your pencil take up space. You and I take up space. Everything, even things that are liquids and gases, take up space and therefore have volume. The measure of how much space something takes up is its volume.



Everything in our world, whether it be a solid, liquid or gas takes up space and, therefore, has volume.

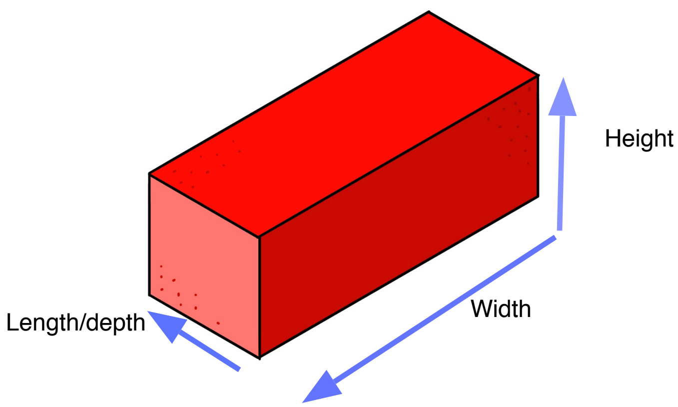
Recall from our discussion in lesson 2, we said that area was an amount of space measured in two dimensions. Volume is measured in three dimensions. Let's take a closer look by pretending you have a cardboard box and would like to know its volume.

Because boxes are usually made with flat surfaces that have measurable dimensions, we can find the volume of the box using derived measurements. We refer to these flat surfaces as being regular in shape. (In the next lesson, we'll look at techniques we can use to determine the volume of objects which do not have flat surfaces. These objects are referred to as having irregular surfaces.) While cardboard boxes are great examples of regularly-shaped objects, a rock or apple would be a good example of an irregularly-shaped object. Let's look first at the steps to find the volume of a regularly-shaped object.

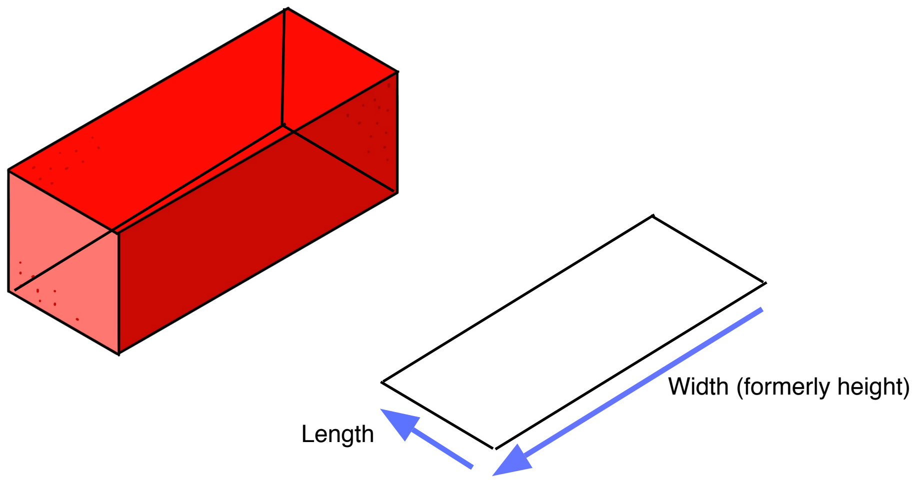


The boxes in which juice and cereal come are examples of regularly-shaped objects.

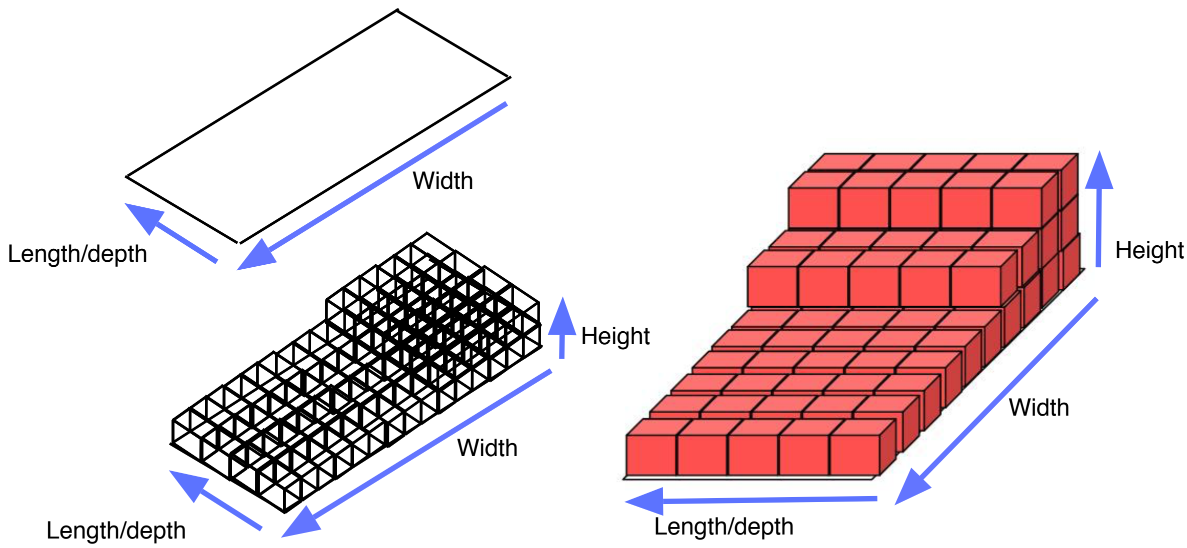
When we think about finding the volume of a regularly-shaped object, the first thing we must realize is that objects have three dimensions. These objects have the distance from left to right, front to back and then top to bottom. These measurements are conventionally identified as being the length, width and height of the object. The "length" measurement is also referred to as depth.



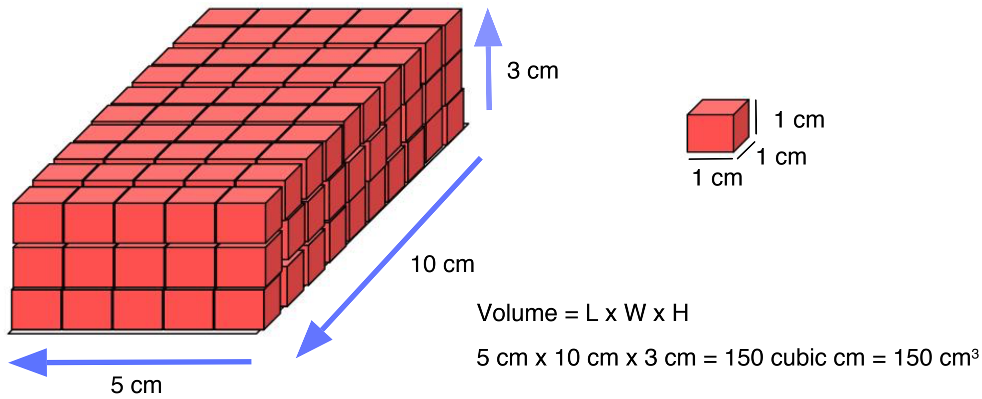
Let's focus first on the bottom or base of the box. Note that by multiplying the length by the width of the bottom of the object, we can get the area of the bottom of the object. In Lesson 2 we referred to these two measurements as the length and height of the shape. Let's rename "height" to "width" to reduce confusion.



Recall that this area would be presented in square units. If we use centimeters, these units would be a quantity of square centimeters. If we extend each of these squared units upward (the height of the object) we can essentially find out how many layers of cubic units exist in the object. Essentially, we are attempting to find out how many of these cubes, measured one unit on each edge, that can "fit" into our object. Look at this diagram to see how we can count these cubes.

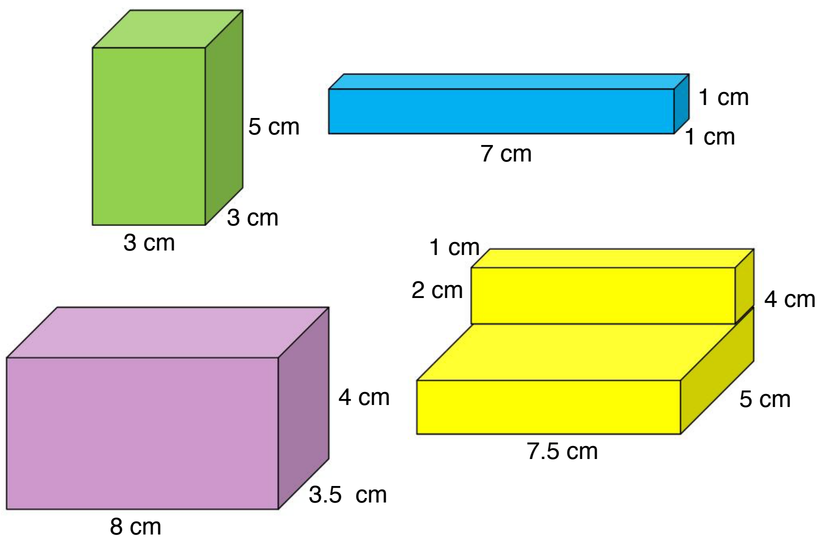


By combining these two steps (area of the bottom of the object and height of the object), we can find the volume of a regularly-shaped object. The area of the bottom (length x width) times the height of the object or L x W x H equals the volume of the object.



In this example we used centimeters as our units of length. We have the length in cm x width in cm and the height in cm. Multiplying these together we get cm^3 or cubic centimeters. So, our volume measurement is in cubic units. An object measured in inches would have a volume in cubic inches; in feet, the volume would be in cubic feet. Something very large might have its volume measured in cubic miles. The key here is that volume is measured in cubic units.

Let's practice this concept now. Look at the regularly-shaped objects below. Find the volume of each object. Remember, first find the area of the bottom of each object and then multiply that result by the height (number of layers of cubes) of the object.



Answers:

Green shape: 45 cubic cm or 45 cm^3

Blue shape: 7 cubic cm or 7 cm^3

Purple shape: 112 cubic cm or 112 cm^3

Yellow shape: Bottom portion = 75 cubic cm; top portion = 15 cubic cm; total volume = 90 cubic cm or 90 cm^3

Here are your design challenges for Lesson 3:

Challenge 1: Create a box which has a volume (when measuring outside dimensions) of 500 cubic centimeters. The box must have solid sides. Your box must be able to survive the crash test of 2 meters from a hard floor.

Challenge 2: Create a box with an **internal** volume of exactly 750 cubic centimeters. The box must have solid sides. Your box must include a lid which has functional hinges (a device which allows the lid to be affixed to the remainder of the box, yet allow the lid to open and close). The lid must also have a locking mechanism. Your box must be able to survive a crash test of 3 meters from point of release to the floor.