

Josh's Jelly Beans' Box

Purpose:

The purpose of this activity is to engage students in using volume/capacity calculations to solve a problem.

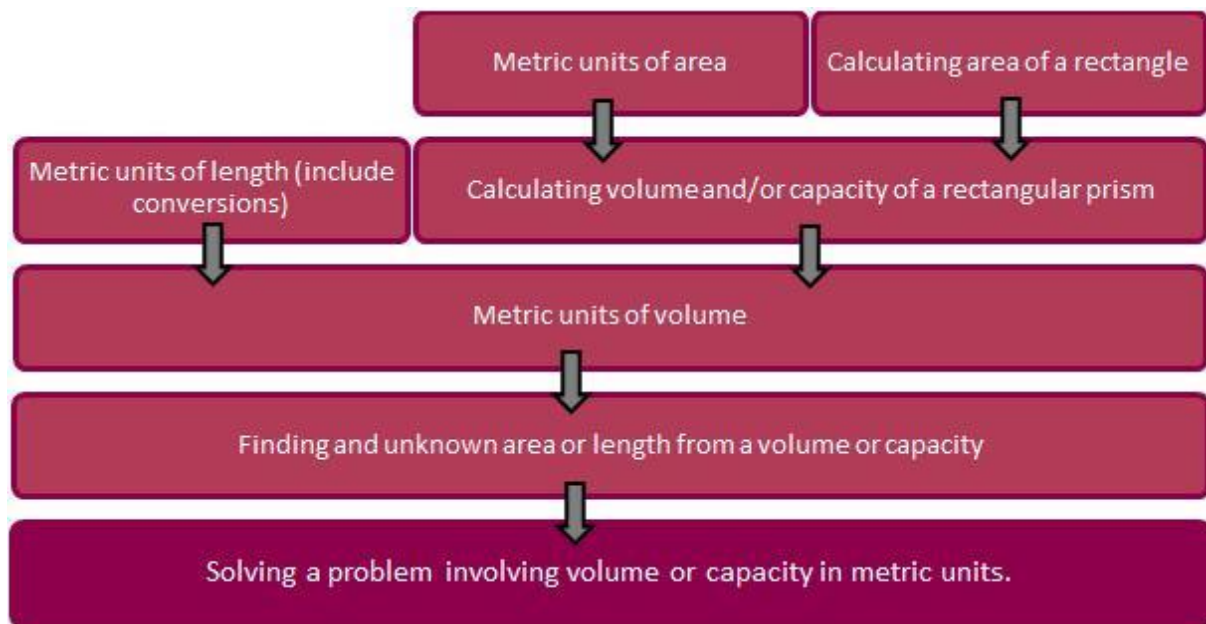
Achievement Objectives:

GM4-1: Use appropriate scales, devices, and metric units for length, area, volume and capacity, weight (mass), temperature, angle, and time.

NA4-1: Use a range of multiplicative strategies when operating on whole numbers.

Description of mathematics:

To solve this problem, the students will need to calculate the capacity of a box from the dimensions given and to use this in order to solve a problem. The dimensions have been given in cm, so it is expected that the capacity will be found in cm^3 . The activity ideally follows exploration and learning in the following areas.



Metric units of length (include conversions)

Joanna holds a block of wood against her ruler. The block starts on the 12mm mark and ends at 37mm. How long is the block in mm? In cm? In m?

Metric units of area

What is the area of a rectangle with a base of 5 cm and a height of 12 mm? In cm^2 , in mm^2 , in m^2 ? How many cm^2 are there in 1 m^2 ?

Calculating area of a rectangle

What is the area of a rectangle with a base of 7.1 and a height of 3.2?

Calculating volume and/or capacity of a rectangular prism

Find the volume of a rectangular block of wood that has width, depth and height of 5, 10 and 120 units respectively.

Find the capacity of a thin walled box that has width 3 units, depth 2 units and height 4 units.

Metric units of volume

Find the volume of a rectangular block of wood that is 5 cm x 10 cm x 1.2 m.

Finding and unknown area or length from a volume or capacity

A box has a height of 3 units and a capacity of 27 units³. Find the base area of the box.

Solving a problem involving volume or capacity in metric units.

A box has a height of 0.3 m and a capacity of 2 700 cm³. Find the base area of the box.

The activity should be sufficiently open ended to allow the students freedom of choice in their approach. It may be scaffolded with guidance that leads to a solution, and/or the students might be given the opportunity to solve the problem independently. The approach should be chosen in sympathy with their skills and preferred method of solution.

Activity:

Josh has a box with dimensions 40 cm x 30 cm x 30 cm full of jelly beans.

To hide them from his sister, he needs to put them in the back of a cupboard where there is a space with a base area of 25 cm x 35 cm.

If he is to make a new box to fit all the jelly beans in, to hide them in this space, what is the **minimum** height this box should be?



The arithmetic approach

The student is able to calculate the capacity of a box and to use this value to solve a problem to find an unknown height.

Prompts from the teacher could be:

1. Do we know the volume of the jelly beans or the capacity of the box they are in?
2. What is the base area of the new box?
3. What else do we know about the new box?
4. Do we have enough information to calculate the smallest height the new box could be?

The image shows a student's handwritten work on a grid background. On the left, there is a multiplication problem:
$$\begin{array}{r} 40 \\ \times 30 \\ \hline 1200 \\ \times 1200 \\ \hline 36000 \\ 36000 \text{ cm}^3 \end{array}$$

In the center, there is a division problem:
$$\begin{array}{r} 41 \\ \overline{) 36000} \\ 875 \\ \hline 41.14285714 \end{array}$$

Below the division problem, the student has written "Used calculator" with an arrow pointing to the result "41.14285714".

Two speech bubbles contain dialogues:

Speech bubble 1 (left):
S: I thought this number (36 000) was way too big. But then it kind of made sense that the sides are tens, the area is hundreds, and so the volume is thousands. It's big, but then the 41cm makes sense.

Speech bubble 2 (right):
T: I notice you said you've used a calculator.
S: I wanted to get the right answer.
T: Is 41.14285714 the best answer for this question about a box for jelly beans?
S: It's a bit too many decimals... oh, it's in centimetres so just 41 is ok.

The conceptual approach

The student is able to find a method of solution that will allow him/her to find an unknown dimension of a container, within the context and specifications given.

Prompts from the teacher could be:

1. What are you trying to find out?
2. What information do you have?
3. How accurate does your answer need to be? (ie 'To the nearest....?')

Student says volume, but means capacity

The volume of the box ① is 36000 cm³
 Box ② needs to have the same volume with base area 875 cm² so its height ~~36000 ÷ 875 =~~ 42 cm

T: Tell me about why you crossed out this part in the middle (3600 ÷ 875).

S: Well, I was going to do a division, but it was a bit hard. Then I realised that this is about a box and height to the nearest centimetre is good enough. So I just added up 875s until I got the box big enough.

40 × 30 × 30
 4 × 9 × 1000
 36000

25 × 35
 20 × 35 = 700
 5 × 35
 175
 1 × 350
 875

875
 × 4
 3500

8 × 4 = 32

40 × 875 = 35000
 41 too small 875
 42 too big will fit