10 000 Centicubes
Lesson 4: Defend

Australian Curriculum: Mathematics (Year 4)

ACMMG290: Compare objects using familiar metric units of area and volume
- Comparing areas using grid paper.
- Comparing volume using centicubes.

Lesson abstract

Groups prepare and present their justified solution to the inquiry question. Students examine the reasoning of other groups, and use calculators and rules to validate the solutions. Later, they act on feedback on their own presentations. Groups compare their container with one constructed by another group and record the similarities and differences. As an extension, students consider what reasonable mathematical adjustments might be made to the container if neat packing of cubes is not assumed.

Mathematical purpose (for students)

Mathematical evidence includes correct terminology, labeled diagrams, accurate calculations and measurements.

Mathematical purpose (for teachers)

The Inquiry solution needs to be accompanied with mathematical evidence linking the size of the base and the number of layers to the final total of 10 000 centicubes, and a justification of why the container is 'best'. Students' capacity to describe their solution and explain their reasoning is further developed, by firstly presenting an account of their own solution and justification, and then critiquing the solutions and justifications of others. Solutions have the potential to be refined and improved once feedback is evaluated and acted on. If desired, formal links to square centimetres and cubic centimetres can be made when area and volumes are compared using grid paper and centicubes.

At the end of the Defend phase, students will be able to:

- Justify that their container holds 10 000 centicubes using mathematical evidence, and validate the evidence using a ruler and a calculator.
- Explain the reasons why their container is 'best'.
- Provide constructive feedback to others; reflect on the effectiveness of their presentations using feedback given and by observing other presentations.

Lesson Length 90 - 120 minutes

Vocabulary Encountered
- similarities, differences
- area, volume (optional)
- square centimetre, cubic centimetre (optional)

Lesson Materials
- Sticky notes (about 6 per student)
- Rulers and calculators – one per student
- Student Sheet 1 – Presentation Planner (optional)
- Student Sheet 2 - Reviewing Feedback (1 per group)

We value your feedback after these lessons via https://www.surveymonkey.com/r/CV2TXTT

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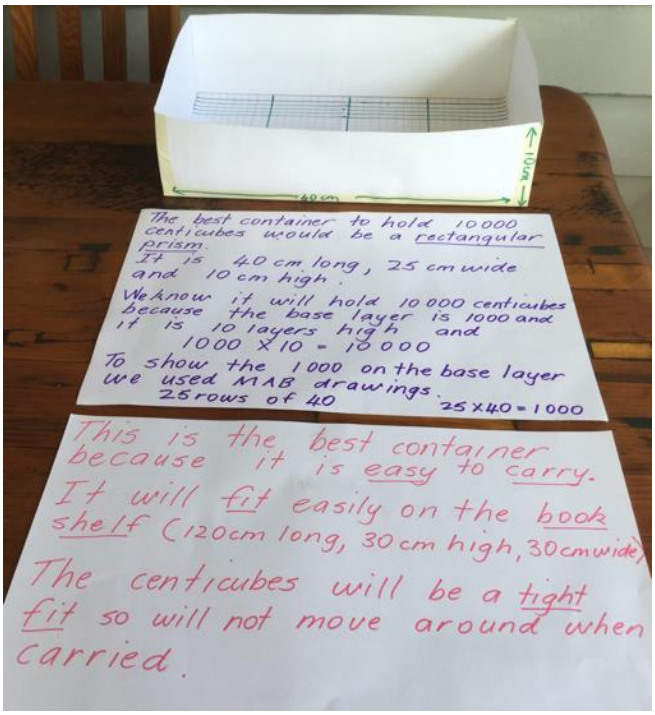
Presenting the Best Containers

1. Display the inquiry question: "*What is the best container to hold 10 000 centicubes?*"
   Inform students that in the Defend Phase the focus is on providing sufficient mathematical evidence to convince others that their container can hold 10 000 centicubes and that it is the 'best'.

2. If students are new to answering inquiry questions using mathematical evidence, provide a model and/or scaffold to assist them. Student Sheet 1 – Presentation Planner can be used for this.

Presentation scaffold	Justified student solution using scaffold as a guide
The best container to hold 10 000 centicubes is a _____ *(name of 3D object), that is* _____ *centimetres long,* _____ *centimetres wide and* _____ *centimetres high.* *These measurements will work because* _____ *Explain the mathematical thinking you used to decide on the base and the height (number of layers)* *This is the best container because*_____ _. *Give more than one reason if you can.*	

3. Allow students sufficient time to prepare and write their justified solution. Advise students that their solutions will be displayed and they will not be able to add any further clarification. Highlight the importance of clear information that provides enough mathematical detail to explain their solution and convince others they have designed and constructed the best container.

4. To help students justify why their shape is best, refer students back to the context as discussed in the end of the Develop Phase *(e.g. This container is 25 centimetres high so it would easily fit on the classroom shelves which are 30 centimetres apart)*.

5. Have groups set up a display on their table that presents their evidence, model and justification for their 'best' container.

Gallery Walk and Response to Feedback

6. Provide all students with about 6 sticky notes to use as they do a gallery walk to visit the displays. Instruct them to provide constructive feedback focusing on what mathematics was done well and what mathematics could have been improved. Have students focus on:
    - appropriate mathematical terminology (perhaps with formal metric terms for area and volume),
    - well labelled diagrams,
    - accurate calculations (check with a calculator)
    - accurate measurements (check with a ruler)
    - correctly shaped faces on the container,
    - clear mathematical thinking and
    - sensible justification of the attributes of the container that make it best for this purpose.

7. As students may not have time to visit every group, ask them to choose the displays they visit to ensure that all receive at least 5 sticky notes.
   After about 20 minutes, ask groups to return to their own display to read the feedback given.

8. Distribute Student Sheet 2 - Reviewing Feedback. Have groups decide which feedback they should address, before each student completes Q1 to report on what they did well and what they could do to improve their presentation and model.

9. Pair up groups and ask them to compare the similarities and differences between their containers. Have all students use mathematical language to complete Q2 on Student Sheet 2 - Reviewing Feedback.

Example:

SIMILARITIES	DIFFERENCES
Both can hold 10 000 centicubes	Different sized bases – one has a base of 1000 centicubes and the other base is 500 centicubes

Extension: Unpacked centicubes

10. Ask students to consider whether their containers are very practical for schools, where it will not always be sensible to spend time packing the centicubes neatly. Ask groups to consider the adjustments they should make to their container to ensure it would still hold the 10 000 centicubes once they had been unpacked and then just poured back into the container without organising them into layers.

Presentation Planner

Name: _____

The best container to hold 10 000 centicubes is a

_____ *(name of 3D object), that is*

_____ *centimetres long,*

_____ *centimetres wide and*

_____ *centimetres high.*

These measurements will work because: *(Explain the mathematical thinking you used to decide on the base measurements and the height)*

_____

_____

_____

_____

_____

_____.

We think that this is the best container because:

_____

_____

_____

_____

_____

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Reviewing Feedback

Name: _____

1. Use the feedback sticky notes and your observations of other presentations to help you **reflect** on your container and your presentation.

What did your group do well?

What could you do to improve your presentation and model?

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2. Compare your container with a container from another group. Record the similarities and differences.
   Remember to use mathematical words.

YOUR CONTAINER	OTHER CONTAINER
Describe the shape. Write the measurements. Draw it here.	Describe the shape. Write the measurements. Draw it here.

SIMILARITIES	DIFFERENCES