Pyramids in a Box
Lesson 4: Defend Phase

Australian Curriculum: Mathematics (Year 6)

ACMMG140: Construct simple prisms and pyramids.

- Constructing prisms and pyramids from nets and skeletal models.

ACMMG141: Investigate, with and without digital technologies, angles on a straight line, angles at a point and vertically opposite angles. Use results to find unknown angles.

Lesson abstract

Students prepare and present their justified solution to the inquiry question. They provide feedback on others' presentations, focusing on the mathematical evidence used. Students reflect on the feedback given to determine what they did well and what they could do to improve their solution, models and presentation.

Mathematical purpose (for students)

The solution to an inquiry question needs to be justified with appropriate mathematical evidence.

Mathematical purpose (for teachers)

To effectively communicate their inquiry solution, groups are required to answer clarification questions, provide labelled nets and models of their three-dimensional objects, and display clear mathematical working of the iterations considered.The feedback session provides an opportunity for teachers to monitor how well students present the mathematical evidence,seek clarification or question the validity of evidence.

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

- Provide mathematical evidence to describe the best box, and explain their reasoning why their box is best;
- Provide feedback to others on the strengths and weaknesses of their mathematical evidence;
- Reflect on the effectiveness of their presentations using feedback given and by observing other presentations.

Lesson Length 60 minutes

Vocabulary Encountered

Lesson Materials

- Student workbooks
- Constructions from previous lessons
- Class poster on meaning of 'best' box (from Devise phase)
- Class poster of evidence (from Develop phase)
- Evidence Triangle (optional, from Develop phase)

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

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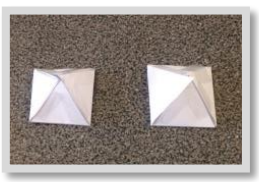
What is the "Best" Box?

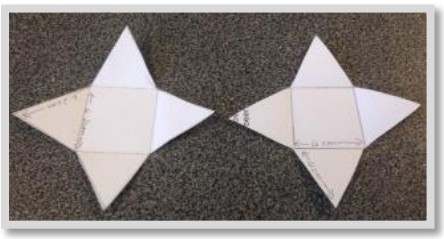
Preparing evidence

1. Inform students in the Defend Phase they will be collating their evidence gathered in the Devise and Develop Phases and preparing their justification for why their final choice is the best box to hold their two different sized pyramids. Have them add the title DEFEND after the previous lesson's ideas and representations.
2. Allow groups twenty minutes to prepare their presentation. The expectation is for groups to present:
    - A clear description of the two pyramids that the group has selected to be packed.
    - A statement that answers the Inquiry question (*The best box to hold our two pyramids would be …*).
    - A clear mathematical solution that is backed up with evidence of the mathematical thinking used. Refer students back to the evidence poster constructed in the Develop Phase to ensure they include sufficient evidence to ensure others can easily follow the thinking and processes used to determine the dimensions for their pyramids and best box. The Evidence Triangle may assist.
    - Justification as to why their box is the best box for the pyramids to minimise the amount of left over space. Refer students back to the class poster on the meaning of 'best' made in the Devise Phase for further ideas to include in their justification.

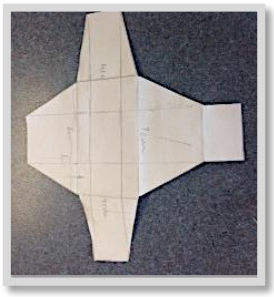
Presentations

3. Prior to presentations, remind non-presenting groups to actively listen and analyse each presentation, checking that groups have used appropriate mathematical terminology and give sufficient evidence to support their solution. Inform non-presenting groups they should provide feedback on the strengths and weaknesses of the mathematics used as evidence.
4. Have groups present their evidence, models and justification. Use the presentations as an opportunity to:
    - Ensure the inquiry question has been answered.
    - Reiterate the use of appropriate mathematical terminology (e.g., *You are using the term triangle but referring to a three-dimensional object. What name should you be using when referring to this object?* OR *On your net you have recorded the dimension as 6, what unit of measure should you have included?*)
    - Highlight the importance of having both the three dimensional models and labelled nets to use as evidence. For example:
      T: Are your pyramids really different sizes? Even when I put them together they look very similar in size and shape.
      S: Here are the nets and you can see that their dimensions are actually different. The smallest pyramid has a square base with 4 cm sides and the larger one has a square base with 4.2 cm sides.
      T: Thanks for clarifying this. The models, together with the labelled nets were useful evidence to convince me that your pyramids were different sizes. However, are these different enough to be visibly different?





    - Deepen the understanding of the different types and names of polyhedra (e.g. *Can you name the box you have used*?)

 	Students: We made a design so the sides have a slope to fit and lock the pyramids. We constructed a polyhedron made up of 4 trapeziums and 2 rectangles. The bottom was 7 cm wide and the top was 3 cm and the 2 sides were 4 centimetres. Teacher: What type of polyhedron have you made? Student: We don't know, but it can't be a trapezium based prism because there are four trapezium side faces and they all slope in so they are not parallel. Teacher: Where did you get the idea for this shape? Student: We were positioning pyramids in a box. We thought our box should be shaped like a pyramid with the top cut off. Teacher: Cutting off part of an object is called truncating it. Do you think the shape you have made could possibly be a truncated pyramid? Student: No, because we do not think these sloping faces will meet at one point, as the faces of a pyramid must do. Teacher: I agree. These sloping faces would meet along a short line, like the ridge line of a house roof.

- Strengthen the mathematics in the evidence.

  Students: First we constructed a triangular prism and two square based pyramids. Then we realised that we needed to make the box's height bigger and the length shorter so the box could close and there was less space left.

  Teacher: Can you tell us how much you needed to increase the height by so your box would close and how much shorter you made the box to reduce the amount of left over space?

Reflection

5. Have students spend ten minutes reflecting in their journals on what they did well and what they would do differently to improve their presentation and model if they had the opportunity to repeat the task. Encourage them to consider any feedback addressed to them and particularly good ideas other groups used. Remind students their reflections should focus on mathematics (e.g., *It was hard for people to visualise all the manipulations we used to come up with the least amount of space. Next time we will take photos of all the positions we try.)* and not the asthetics of their box (e.g., *Our box would look better if we created it with origami paper.)*.

Extension

- Has anyone seen a product packaged in a hexagonal pyramid?
- Would it be practical for manufacturers to package their products as hexagonal pyramids?
- Explain why or why not. Use findings from yours and other group presentations to guide your thinking.