Unit Overview: Pyramids in a Box

Summary of learning goals

What is the best box to hold 2 different sized items that are packaged as pyramids? This unit uses content in measurement to deepen students' understanding of and confidence working with solids and their nets. The lessons provide opportunities for students to work flexibly as they construct simple prisms and pyramids from nets they have created. Students record their mathematical thinking as they work through iterations to refine a box that has the least amount of left over space.

Students work systematically and record or photograph their progress through each of the Phases. They will see the importance of collecting evidence, especially accurately labelled nets, and organising this evidence to show how they have packaged their two different sized pyramids in a box (prism) with minimal left-over space.

Students justify their solution to the inquiry question using evidence that shows the mathematical thinking and reasoning used to determine the best box shape and dimensions.

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.

Summary of lessons

Who Is This Unit For?

This sequence of lessons is for students in who are building an understanding of constructing three-dimensional objects (prisms and pyramids) from nets and skeletal models and vice versa. Earlier they will have had experience connecting three-dimensional objects with their nets and other two-dimensional representations and naming two dimensional figures. They will also be able to reliably measure lengths and angles.

Lesson 1: Discover

Students are introduced to the challenge of designing the best box to hold two different sized pyramids. The teacher reviews and extends prior knowledge of pyramids and prisms. Students manipulate, three dimensional objects and geometric construction materials to draw nets, making the connection between the shapes and positions of the faces on the object and in the net. They explore the different nets that can make one three-dimensional object.

Lesson 2: Devise

Students make a plan to answer the Inquiry question. They determine what 'best' means in this context, acknowledging that having a small amount of unused space in the box is a key consideration. Students draw nets and construct their two pyramids to be packaged, before sharing their initial ideas for constructing their best box.

Lesson 3: Develop

Students check and refine plans before implementing them to construct their box. They gather mathematical evidence as they work through iterations to reduce the amount of left over space in their box.

Lesson 4: Defend

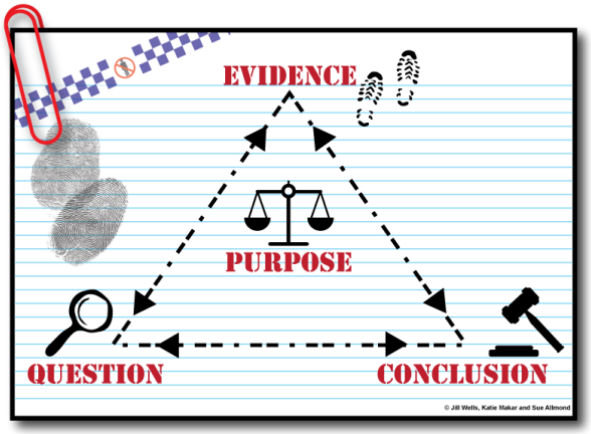
Students prepare and present their justified solution to the inquiry question. They provide feedback on others' presentations, focusing on the mathematical evidence used. Students reflect on the feedback given to determine what they did well and what they could do to improve their solution, models and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

Reflection on this sequence

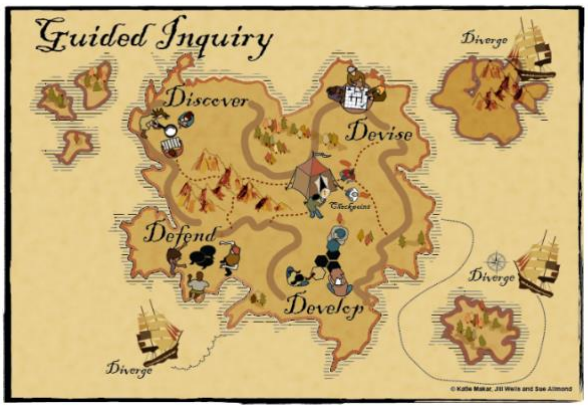
Rationale

This unit has been developed around the '4D Guided Inquiry model' with four phases—*Discover, Devise, Develop and Defend*. The unit aims to develop content knowledge as well as assisting students to understand the process of inquiry. The unit is driven by the inquiry question: *What is the best box to hold 2 different sized items that are packaged as pyramids?* The task is quite open; it contains ambiguities in the question and the method of solution that require negotiation; and mathematical evidence is required to justify a proposed solution. In the Discover phase, begin to connect the inquiry context with their prior knowledge. In the Devise phase, students make a plan and deliberate on the evidence they will need. They put this plan into practice in the Develop phase and prepare and present their solution in the *Defend* phase. They use the evidence they have gathered to support, justify and convince their peers that their conclusion answers the inquiry question. All the lessons stress the need to gather mathematical evidence and the importance of explicitly connecting the inquiry question, the evidence and the conclusion, as shown in the Evidence Triangle below. The 4D Guided Inquiry model requires the teacher to support and scaffold students through each phase.

Further information is given in the *Mathematical Inquiry into Authentic Problems Teachers' Guide*.



The Evidence Triangle



4D Guided Inquiry map

reSolve Mathematics is Purposeful

Understanding: Students use the connection between the shape and number of faces and their relative positions to construct nets. They identify the commonalities and differences of three-dimensional shapes.

Fluency: Students accurately measure net and solid dimensions using appropriate metric units.

Problem Solving: Students use an inquiry approach and mathematical modelling to solve a real-life problem.

Reasoning: The unit provides extensive opportunities for students to demonstrate their mathematical reasoning, as they communicate their thinking and pathways used to reach a solution Students provide sufficient, appropriate evidence to convince others that they have a good solution. They analyse the reasoning of others, seek clarification where required and explain their thinking when challenging the ideas or mathematics used.

reSolve Tasks are Challenging Yet Accessible

This unit offers a context for inquiry that students are familiar with, including links made to real-life packaging and the constraints associated with designing packaging. Students can work collaboratively (mixed ability groups) to construct prisms and pyramids beginning with their existing geometry knowledge. The expectation that all group members will contribute in some way to preparing and sharing the solution provides each student with the opportunity to use peers as resources. Students can develop their skills in reasoning and justification and build conceptual understanding with their group. Regular Checkpoints allow groups to share their progress, any challenges they are facing and to see how others are working on the problem. Sharing helps groups to move forward with ideas to use or build on. Teachers can use the opportunities presented in Checkpoints to focus students on the need for quality evidence and consider more complex options to further refine the solution. As groups work towards a solution, teacher prompting, through open questioning can support groups to embrace setbacks as challenges that can be overcome and question their mathematical thinking.

reSolve Classrooms Have a Knowledge Building Culture

The inquiry addresses a knowledge building culture through requiring students to take on many roles usually undertaken by the teacher. In their groups, students collaboratively plan the pathway they will use to answer the inquiry question and negotiate between their own ideas and understandings and those of others. During the Devise Phase, students acknowledge that all ideas, including those that are unformed and un-evidenced, can be improved on through the giving and receiving of feedback. Expecting all students to be active listeners and contributors who share ideas, build on others' ideas, seek clarification where required, and question or challenge ideas respectfully, ensures all students contribute towards the advancement of knowledge in the classroom and provides opportunities for them to build, reconceptualise, recreate and extend mathematical concepts.