YuMi Deadly Maths

Year 5 Teacher Resource:

MG – Packaging

Prepared by the YuMi Deadly Centre
Faculty of Education, QUT

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ACKNOWLEDGEMENT

We acknowledge the traditional owners and custodians of the lands
in which the mathematics ideas for this resource were developed,
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Year 5 Measurement and Geometry

Packaging

Learning goal Students will use the features and properties of three-dimensional (3D) objects to identify and create nets of 3D objects.

Content description Measurement and Geometry – Shape

- Connect three-dimensional objects with their nets and other two-dimensional representations (ACMMG111)

Big idea Geometry – interpretation vs construction

Resources Shopping items, Maths Mat, elastics; nets of the following 3D shapes: rectangular prism, cube, triangular-based prism, square-based pyramid, pentagonal-based pyramid, cylinder; template of nets (see Teacher's notes), scissors, tape, ruler, compasses; Zaks, Polydrons, construct-o-straws, other commercial materials; waste paper basket

Reality

Local knowledge Ask students to think of and describe all the differently shaped packages they see in their local environment and when they go shopping. Show a long-life milk carton, a Toblerone box, a cylinder of Pringles, a tissue box in the shape of a cube, a candy pyramid box, a cone-shaped gift box.

Prior experience Discuss properties of 3D shapes (open and closed): face, base, edge, vertex (corner). Check understanding that 3D shapes have three dimensions (length, width, height), that solid shapes have faces which are plane shapes and that 2D and 3D shapes are related through the faces of 3D shapes. Check understanding of congruence (same size and same shape).

Kinaesthetic Students look at different types of cardboard solids and, taking each solid one at a time, discuss how they think the shape was made. If the solid was to be cut out along its edges, what do they think the net of each solid may look like? Cut up the solids to show the nets. Compare the features of the solid and its net. *Where in the solid's net is the base or bases of the solid? Where are its corresponding faces? What do you notice about the number of bases and the number of faces in the solid compared with those in the net?* Repeat process for all types of prisms and pyramids.

Abstraction

Body Maths Mat and elastics: Use the first elastic band and have three/four students sit on the mat and hold corners to construct a 2D base on the mat (triangle, square, rectangle, etc.).

Use other students and other bands to build a prism or pyramid on the base (students who have made the base have to sit and hold more than one band at a vertex). After making a rectangle or square base, make a pyramid by adding two elastics, one to each of two opposite edges while another student stands in the centre, grasps the centre of the extra two elastics that have been added, and pulls them together into the centre turning the shape into a pyramid. Then add three more students so that the four students stand at each of the four corners. The two new elastics may be picked up from the base and held to make two opposite faces. Use another elastic that is held at the top, turning the shape into a prism. Make these shapes higher, lower, by raising/lowering the vertical edges. For every shape that is made, talk about the kind of base that describes the shape whether it is a prism or pyramid (e.g. triangular, rectangular, square bases), point out the faces and count how many faces, run a finger around each edge and count how many edges, point to and count the number of vertices (corners). *Prisms have rectangular or square faces with two congruent bases; pyramids have triangular faces with one base and faces converging to a point or vertex. What shapes will be seen if the solid is cut out and made into a net?*

In groups, students cut up cardboard solids to show the nets. *Are all nets of the same solid*

exactly the same shape? Compare the features of the solid and its net. *Where in the solid's net are the bases of the solid? Where are its corresponding faces? Why are some students' nets different from the nets of other students when everyone started with the same solid?* Discuss the different ways in which the solids were cut to give a net. In each of the different nets, identify the two bases and corresponding faces in prisms and the base and faces in pyramids. Repeat process for all types of prisms and pyramids.

Give more complex shapes to make (e.g. a trapezium prism on its side – like a folder box). Count edges, faces and vertices (and discover Euler's formula – edges + 2 = faces + vertices) – note how the vertices equal (in number) the people holding the bands in the shapes made with elastics on the mat.

Hand Reverse: Construct nets, using Zaks, Polydrons, construct-o-straws, other commercial materials, for 3D shapes, e.g. rectangular, triangular, square-based prisms and pyramids, cube, cylinder and cones.

Mind *Close your eyes and think of a die. What would be one way a net could be made? Can you think of other possibilities the die could be opened out to form its net?*

Creativity *Create as many different solid shapes as you can. Think about what you would call your shape and how you would describe it to someone else.*

Mathematics

Language/ symbols face, edge, vertex, vertices, surface, apex, 3D object, properties, congruent, prism, pyramid, cone, cylinder, curved, rectangular, cube, net, dimensional, viewpoint

Practice

1. Students are given a sheet with drawings of solids and, at the bottom, nets in a mixed order that correspond to the solids above. Students match the solid to its net.
2. Students are given various solids to cut out, draw the net and describe to a partner the features of the solid and its corresponding features in the net they have cut/drawn. Compare the nets. Draw other possible nets that would make that solid. *What nets wouldn't work to make the solid?*

Connections Relate to measurement, transformations, symmetry and similarity.

Reflection

Validation Students check where nets of solids are seen in the real world, e.g. shells of buildings, empty cake tins, buckets and sand toys at the beach.

Application/ problems Provide applications and problems for students to apply to different real-world contexts independently; e.g. *Clever Cubes: Shade in all eleven nets on the sheet that could be folded to construct a solid cube* (Appendix).

Extension

Flexibility. Show different ways of presenting 3D shapes (standing the shape on different faces) and thus also relate the different ways the solid's nets may be drawn. *What determines the name of the shape?* [its base – two faces in a prism and one in a pyramid; and the shape of its faces – rectangular faces in a prism and triangular faces in a pyramid].

Reversing. Students are able to move from the solid to identifying its net/s and from given nets to naming the corresponding solid.

Generalising. *Regular 3D shapes are constructed by joining congruent surfaces of 2D shapes around the perimeter of a 2D base. The shape is named in terms of its base and faces; rectangular faces are prisms and triangular faces are pyramids. Euler's formula states that the number of edges + 2 = the number of faces + the number of vertices.*

Changing parameters. Challenge: Make a net into a solid and place symbols/pictures on each side of the solid. Ask the students to make an identical net and then place the same symbols/pictures on their nets before folding them so that when folded, the resulting solid has symbols/pictures the same as the original (very hard).

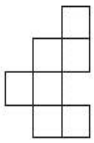
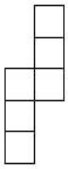
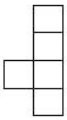
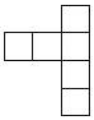
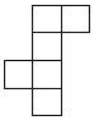
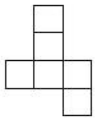
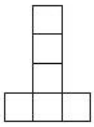
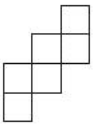
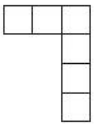
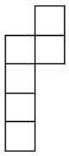
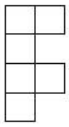
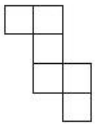
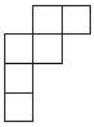
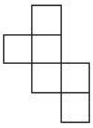
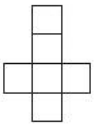
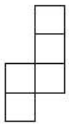
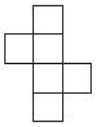
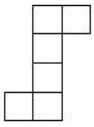
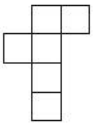
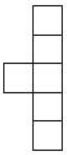
Teacher's notes

- Ensure that students have a sound understanding of the properties of 3D shapes before proceeding on to nets of solids.
- Template of nets for *Clever Cubes* activity on following page.
- Students need to be taught the skill of visualising: closing their eyes and seeing pictures in their minds, making mental images; e.g. show a picture of a shape, students look at it, remove the picture, students then close their eyes and see the shape in their mind; then make a mental picture of a different shape.
- Suggestions in Local Knowledge are only a guide. It is very important that examples in Reality are taken from the local environment that have significance to the local culture and come from the students' experience of their local environment.
- Useful websites for resources: www.rrr.edu.au; https://www.qcaa.qld.edu.au/3035.html
- Explicit teaching that **aligns with students' understanding** is part of every section of the RAMR cycle and has particular emphasis in the Mathematics section. The RAMR cycle is not always linear but may necessitate revisiting the previous stage/s at any given point.
- Reflection on the concept may happen at any stage of the RAMR cycle to reinforce the concept being taught. Validation, Application, and the last two parts of Extension should not be undertaken until students have mastered the mathematical concept as students need the foundation in order to be able to validate, apply, generalise and change parameters.

Appendix

Clever Cubes

Which of the nets below can be folded into a cube? If in doubt, use the plastic square polydrons to make the nets and then clip together to construct a cube. Keep a record of the numbers that make a cube. We've ticked one for you.

 1.	 2.	 3.	 4.	 5.	 6.
 7.	 8.	 9.	 10.	 11.	 12.
 13.	 14.	 15.	 16. ✓	 17.	 18.
 19.	 20.	 21.	 22.	 23.	 24.