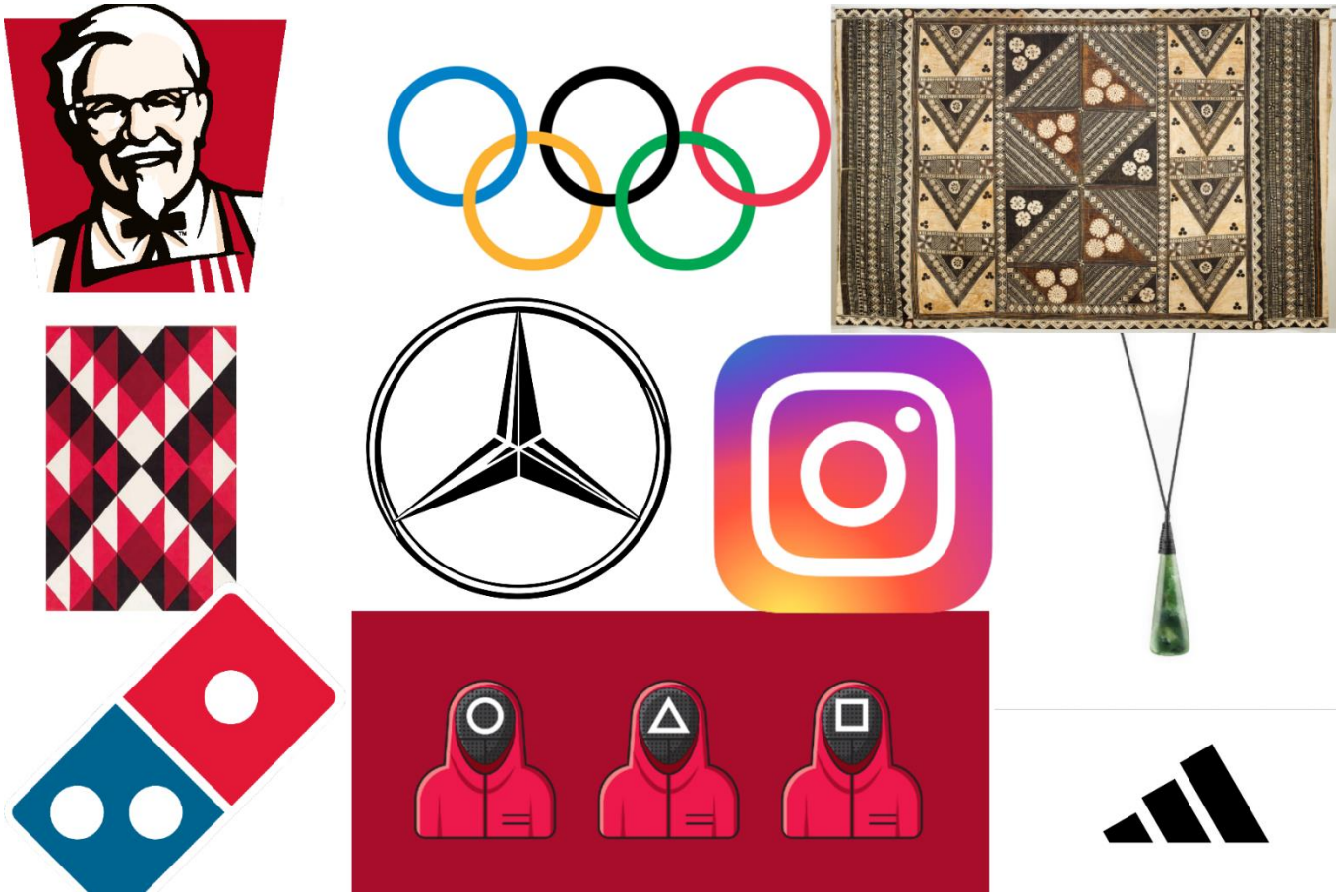
Ako Mātātupu
Teach First NZ

Shapes as Icons

OVERVIEW



Subject: Mathematics and Statistics: Shape
Level: Year 10
Duration: 6 weeks
Number of lessons: 24 Lessons (4 lessons per week)
Kaiako: Daniel Beetham

Unit introduction:
The *Shapes as Icons* unit weaves art and design with mathematics. Using culturally appropriate (including pop culture) art, we will explore shape, by identifying various shapes and volumes and calculating perimeter and area of triangles, most quadrilaterals and circles. We will also calculate the volume of cuboids and identify prisms by their cross section. It will cover parts of Level 3,4 and 5 in the **Geometry and Measurement** in the New Zealand Curriculum (Ministry of Education, 2007; Te Kete Ipurangi, n.d.-c, n.d.-b, n.d.-a). It is assumed this will be run after a unit on the measurement (*units/distance etc*) achievement objectives, although it is not strictly necessary.

Connection to New Zealand curriculum:
Principles
High expectations: By working across curriculum levels, I am ensuring that students' learning is gently pushing them towards high levels of achievement and deeper levels of understanding, thus pursuing excellence for each student can look different, but is catered for in this standard.

Community Engagement: I am asking whānau to speak with their taitamaiti about their culture and whānau background. I am also hoping to directly get whānau involved in the classroom, to explain to the class a significant shape. This allows space for other cultures in the classroom.

Key Competencies
Using language, symbols and texts: Tauira will be required to make meaning in mathematical language and symbols. I will give word questions as well as questions with mathematical symbols to help tauira with mathematical literacy.

Thinking: Students will be encouraged to take charge of their own learning through the pre-test feedforward session. By including some learning that is 'beyond the curriculum', such as discussing the

Connection to Tātaiako & Tapasā:
Tātaiako
Whanaungatanga: *Actively engages in respectful working relationships with Māori learners, parents and whānau, hapū, iwi and the Māori community.* Sending a message home to whānau will help to build connections outside of the school. I am also attempting to get a whānau member into class to discuss the cultural significance of a shape, whether it be through ta moko or carving, or anything else that is significant to the whānau.

Wānanga: *Participates with learners and communities in robust dialogue for the benefit of Māori learners' achievement* This is acheived by allowing Māori parents to discuss their own culture and shapes that are significant to them. This acknowledges and uses the expertise of "Māori parents, whānau, hapū and iwi" (p. 4)

Tangata whenuatanga: *Arms Māori learners as Māori – provides contexts for learning where the identity, language and culture (cultural locatedness) of Māori learners and their whānau is armed.* By allowing tauira to bring their knowledge into the classroom, I am "harnessing the rich cultural capital [of] Māori learners" (p 10). This means that tauira will feel that their identity, language and culture matter. I will use correct pronunciation with Māori tauira and their whānau.

irrationality of pi and by doing physical proofs (such as the area of a triangle).

Participating and Contributing: I am asking tauira to bring themselves their whānau and their culture to the classroom. I hope to get the students discussing shapes that are important to them.

(Ministry of Education, 2007)

Level 3

"Classify plane shapes and prisms by their spatial features" – Tauira will be able to identify quadrilaterals, triangles, and circles, and describe them with correct terminology.

"Find areas of rectangles and volumes of cuboids by applying multiplication" – Tauira will be able to calculate the area of rectangles, and the volume of cuboids when displayed with unit squares/cubes.

(Te Kete Ipurangi, n.d.-c)

Level 4

"Use side or edge lengths to find the perimeters and areas of rectangles, parallelograms, and triangles and the volumes of cuboids." Tauira will be able to calculate area for parallelograms, rectangles and triangles using correct symbols/units.

"Identify classes of two- and three-dimensional shapes by their geometric properties." Tauira will be able to:

- Identify and use correct terminology with polygons with 3,4,5,6 and 8 sides.
- Identify and use correct terminology with various 3-D shapes
- Understand that circles relate to spheres by rotation

Ako: *Takes responsibility for their own learning and that of Māori learners.* I have high expectations of all learners, including Māori tauira. I demonstrate this by expecting students to learn about pi, and irrational numbers, as well as thinking about square numbers. I will be flexible in my teaching approach, and I will also learn as I go, both in terms of the culture students bring to my classroom as well as their subject knowledge.

(Education Council New Zealand & Ministry of Education, 2011)

Tapasā

Turu 1: *Identities, languages and cultures.* I am hoping that my tauira are able to ask their whānau about shapes that are important to their culture or whānau and bring that back with them to the classroom.

Turu 2: *Collaborative and respectful relationships and professional behaviours.* I will send an email home to all parents to ask them to help their taitamaiti discover how shapes are used in their culture and what the signify. I would also love to invite whānau into a class to explain their significance of the shapes of their culture, which will only be possible if I have a good relationship with whānau.

Turu 3: *Effective Pacific pedagogies.* Allowing my Pacific tauira to bring their culture into the classroom should help Pacific learners understand they are equal partners together with their whānau in learning that takes place within the classroom.

(Ministry of Education, 2018)

- Understand that shapes can be included within shapes (in 2-D).

(Te Kete Ipurangi, n.d.-b)

Level 5

“Deduce and use formulas to find the perimeters and areas of polygons and the volumes of prisms.” – Tauira will be able to write and apply formulas using multiplicative strategies.

“Find the perimeters and areas of circles and composite shapes and the volumes of prisms, including cylinders.” Tauira will:

- Understand the terminology of circles and be able to relate the various parts of a circle using formulae.
- Be able to deduce and use the formula for the area of a circle.
- Be able to calculate the area of composite shapes
- Be able to calculate the volume of prisms by multiplying their cross section by the length.

(Te Kete Ipurangi, n.d.-a)

Real world connections, community links & rationale:

Real world Connections

Shapes will be introduced through art and design. This will be through many different forms such as tauira describing a shape that is significant to their whanau, having a whanau member come into the classroom to discuss an important cultural shape. I hope to have a whanau member come into the class – I am hoping they will establish how the shape is used in cultural practice within their culture.

Community Links

Firstly, I will establish a connect at the beginning of the unit to ask parents and whānau to help with having a conversation with their taitamaiti to talk about shapes and art that are significant to their whānau or culture. Secondly, I will try to get a member of whānau to come and explain a significant shape to their culture to the whole class. Which gives the class and myself a chance to showcase a different culture, and also offers tauira the chance to see that other cultures and teaching styles are normalised in the classroom.

Rationale

Ako Philosophy: My ideal of education is similar to **ako** (Bishop & Berryman, 2009). My metaphor for teaching is that we are explorers on a journey together. I am as much a learner as the tauira, and they are as much a teacher as me. I feel that I am a beginner, and that we are exploring a mathematical landscape together. Bishop and Berryman (2009) suggest that Ako is “teaching learning practice that involves teachers and students learning in interactive, dialogic relationships ... [and] the co-construction of knowledge” (p. 31). This is how I see the explorer model. That the student and I are on a journey to discovery and through discussion and learning together we can find a discovery together.

The second philosophy I feel aligns with me is **kotahitanga** (Bishop & Berryman, 2009). I will strive to give tauira as much information about their learning as they want, but to make that feedforward and feedback effective. I value individual and whānau agency in making decisions, and to make an adequate decision about their learning they need the right information at the right time. Bishop and Berryman (2009) suggested that students want to be “let in on the secret” (p. 31) which indicates that they would like feedback and feedforward so they can be in charge of their own learning.

Pedagogy: I will use group work wherever possible. There is strong evidence to suggest that cooperative learning helps tauira both academically and socially (Gillies, 2016; Slavin, 1989). Students in groups are contributing more readily than if they were in a full classroom setting. However, it is not always enough to put students into groups and expect them to be able to work constructively (Gillies, 2016). Gillies (2016) argues that tauira may need modelling with how to work in a group. One such model that would work with maths is Hunter at al's (2018) Developing Mathematical Inquiry Communities. This may be a challenge for tauira, but as the teacher I aim to create a safe space where we can openly discuss and challenge in a wānaga style environment.

I hope to use **formative assessment** to see where the students are tracking, and how I need to shift any instruction to meet their needs. I also hope to feed forward to the students in order that they understand what their next steps are in the unit of study. This will happen explicitly with the pre-test, which I have planned to mark quickly straight after work, and hand back to them the next day. Instead of focusing on a deficit approach, I will give three items that they can work on during the unit that will be covered. I have also outlined other more informal ways to assess how students are going during the class, specifically the Hei Mahi questions will be related to work they have already studied in the unit (or before the unit for this first lesson) (Black & Wiliam, 2010). Therefore, Hei Mahi activities will also be used as formative assessment opportunities (Ginsburg, 2011).

Unit Timeline: Week 1: Introduction to Unit, Pre-test and Feedback, Share your culture's/whānau's shapes Week 2: Identifying quadrilaterals, Triangles (and area of these shapes) Week 3: Learning about circles (and area of these shapes) Week 4: Perimeter/Circumference of shapes, and area and perimeter of composite shapes Week 5: Identifying and calculating the volume of 3D shapes. Week 6: 3D shapes (cont), revision and post-test.	**Keywords:** New Zealand Curriculum, quadrilateral, triangle, square, rectangle, circle, pi, π, circumference Icons, art, shape, area, perimeter, volume, prism, Level 3, Level 4, Level 5.

Differentiation overview:

All students will: Be able to identify various triangles and quadrilaterals. Be able to calculate the perimeter and area of Squares and Rectangles.

Most students will: Be able to calculate the perimeter and area of triangles and parallelograms. Be able to calculate the volume of cuboids.

Some students will: Be able to calculate the perimeter (circumference) and area of composite shapes and circles. Have a good understanding of volume and be able to calculate the volume of prisms where the cross section is a previously studied polygon or circle.

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LESSON OVERVIEW

Curriculum Links Key:

- **GM3-2:** Find areas of rectangles and volumes of cuboids by applying multiplication.
- **GM3-3:** Classify plane shapes and prisms by their spatial features.
- **GM4-3:** Use side or edge lengths to find the perimeters and areas of rectangles, parallelograms, and triangles and the volumes of cuboids.
- **GM4-5:** Identify classes of two- and three-dimensional shapes by their geometric properties.
- **GM5-3:** Deduce and use formulas to find the perimeters and areas of polygons and the volumes of prisms.
- **GM5-4:** Find the perimeters and areas of circles and composite shapes and the volumes of prisms, including cylinders.

Timescale	Learning Objectives	Learning Activities	Assessment opportunities	Links to curriculum	Resources
1 Lesson 0.25 weeks	To become familiar with the unit's content and structure. To recall prior knowledge before the pre-test	Introduce The unit to students Students discuss prior knowledge in groups. Each group gets a provocation (with an 'icon') to jog their memory Let students know about the upcoming test, and what to expect for the next few weeks. Ask students to have a conversation with their parents, and to create a poster either on Google Classroom or a physical copy ready for lesson 4. Email home to let whānau to ask them to discuss shapes and patterns that are special to their whānau or culture.	Go around the groups to see what different groups can remember about shape. Get a handle on what people know.	GM3-2, GM3-3, GM4-3, GM4-5, GM5-3, GM5-4	3-4 sheets of paper per group. Devices
2 Lessons 0.5 weeks	To understand the feedback from the pre-test Understand my next steps in relation to this unit of study	**Pre-test** **Pre-test Feedback Session**	Pretest with a dedicated feedforward session. Give two or three areas where students can work on. Students are able to assess themselves and their next steps.	GM3-2, GM3-3, GM4-3, GM4-5, GM5-3, GM5-4	Test, pens, calculators (for the circles questions).
1 Lesson 0.25 weeks	To learn about the shapes that are important to other cultures	Hei Mahi: What's one culture you don't know much about but would like to learn more about? Students will present a shape on their poster that is special to their whānau or culture and explain any links to maths that they can think of.	Able to see how curious and engaged students are. Assess their ability to link art to mathematics, artistic ability and ability to present to a classroom.	GM3-3, GM4-5	Devices

2 Lessons 0.5 weeks	To be able to identify quadrilaterals To be able to calculate the area of Squares, Rectangles and Parallelograms	Hei Mahi: Revision - What do units like cm, mm, km mean? Use a ruler/measuring tape to measure some shapes and calculate areas of rectangles, squares around the school.	Opportunity to check understanding of prior units such as measurement and number.	GM3-3, GM4-3	Rulers/Measuring tape, pens, books.
2 Lessons 0.5 weeks	To be able to identify different triangles To be able to calculate the area of a triangle	Hei mahi: Identifying various quadrilaterals and calculating what their area is. Using Pacific Art to look at triangles, what they represent to that culture. Ideally, we'd have a member of the class community come in to speak to their shape and why it's important. Guided physical proof of the area of a triangle is $A = \frac{1}{2} \times b \times h$ Questions from the book - in pairs or threes	Opportunity to check that students have made progress from the previous two weeks of learning. Able to check any misunderstandings at this point. Walk around the room and check in individually to make sure students understand the questions.	GM3-3, GM4-3	Community member/Whānau member or a Youtube video. Pre cut triangles (or ask students to cut their own), Scissors, rulers
4 Lessons 1 week	To become familiar with the language of circles. Circumference, Radius and Diameter To become familiar with pi (π) and understand that it is irrational To be able to use the x^2 and π on the calculator To be able to calculate the area of a circle	Hei Mahi: Checking that students know how to calculate the area of a triangle. Pi art – Do some pi art individually or coordinate with a group to write out the first 50 digits of pi. Artwork will be displayed in the room. Physically getting out calculators and putting some equations into them. Checking to see which calculators students have an adapting the instructions for that calculator	Opportunity to check that students have made progress from the previous two weeks of learning. Able to check any misunderstandings at this point. Discussions with students may elucidate how well they are finding the content. Ask students to calculate some values to check they are able to use their calculators correctly.	GM4-5, GM5-4 New Zealand Curriculum: Pursuing Excellence and Curiosity (exploration of irrational numbers)	Class set of Calculators
4 Lessons 1 week	To be familiar with the terms perimeter and circumference and to understand what they mean	Hei mahi: Checking students understood the last week of work, gradually moving into perimeter	Check that students have made progress in the past week. Able to address any misunderstandings at this point.	GM4-3	

	To be able to calculate the perimeters of all quadrilaterals and triangles To be able to calculate the perimeter and area of composite shapes and the circumference of a circle	questions as well as circle. Extension: Perimeter = area rectangles in groups of two.	Able to see algebraic ability.	GM4-3 GM5-3, GM5-4	
5 Lessons 1.25 weeks	To become familiar with the types of 3-D shapes. To be able to calculate volumes of cuboids with and without using unit squares and unit cubes. To be able to identify prisms and to calculate their volume	Hei mahi: Checking students understood the last week of work, gradually moving into my volumes and cuboids. Perspective Picasso – Session 1 – Activity 1 and 2 Video Introduction to Pablo Picasso Perspective Picasso – Session 3 (Cubism)	Opportunity to check that students have made progress from the previous two weeks of learning. Able to check any misunderstandings at this point. Walk around and review groups; work	GM3-3, GM4-5 GM3-2 (with squares or cubes), GM4-3 (without squares) GM5-3, GM5-4	Picasso Artwork – search on Te Kete Ipurangi (n.d.-d)
2 Lessons 0.5 weeks	To revise all the material in the unit.	Hei Mahi: Questions that cover the whole unit Students to get pretests back to review, and are able to go to different teacher sessions available over the two lessons as well as pointing them to online resources for them to revise. Tauira and Kaiako to wānanga about what they enjoyed, challenged them, and what they would change about the unit.	Opportunity to check that students have made progress over the course of the unit. Able to address any misunderstanding at this point. A chance for tauira to share feedback with me about how they think the course went.		Pre-test from week 1. Devices
1 Lesson 0.25 weeks	To see how much I've learnt	**Post-Test**	Post-Test	GM3-2, GM3-3, GM4-3, GM4-5, GM5-3, GM5-4	Test Class set of calculators

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REFLECTION

Evaluation and department review plan:

1. This plan will need to be checked by the HOD, Mathematics at MRGS to ensure that it is fit for purpose, allows enough time for outside of classroom activities and that pretesting and post-testing is completed on time.
2. This plan may need to be adjusted based on the pre-test results of students. This plan has been designed with learners from Levels 3 through to 5 in mind. This is usually the levels we find in a Y10 classroom at Mount Roskill Grammar School. This may need to be changed to just level 4 and 5.
3. This plan may not meet the mathematics department's requirements for which Assessment Objectives (AOs) should be in the school's Y10 'shape' unit. This may need to be rewritten to include different AOs.
4. I have chosen to introduce quadrilaterals and to calculate their area prior to introducing triangles, this is in order that we can do a physical proof that a triangle's area (A) is: $A = \frac{1}{2} \times b \times h$. I have left teaching the perimeter of a circle until after introducing the circle because all perimeter measurement is starting at a point and 'walking around the shape'. However, it may be easier to introduce perimeter earlier of quadrilaterals and triangles and the circumference of circles when discussing them and spending more time focusing on calculating the perimeter and area of composite shapes.
5. I have not left time for a summative test for the unit, because it may be dependant on when the school requires a

Teacher reflection:

[Filled out during and after the unit]

Changes for next time:

[Filled out after the unit]

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