# Sample Unit – Mathematics Standard – Year 11

***Sample for implementation for Year 11 from 2018***

|  |  |  |  |
| --- | --- | --- | --- |
| **Unit title** | Perimeter, Area and Volume | **Duration** | 10 hours |
| **Topic** | Measurement | **Subtopic** | MS-M1: Applications of Measurement |
| **Subtopic focus**The principal focus of this subtopic is to develop an awareness of the inherent error in measurements and to become competent in solving practical problems involving energy, mass, perimeter, area, volume and capacity.Students develop knowledge of the concepts of measurement and demonstrate fluency with its application.Within this subtopic, schools have the opportunity to identify areas of Stage 5 content which may need to be reviewed to meet the needs of students. | **Resources**Drawing programs to create 2D drawings and to sketch solids, eg *Google Sketchup* for 3D design <http://www.sketchup.com/> or*Tinkercad* for 3D design and printing <https://www.tinkercad.com/>Measuring instruments: ruler, trundle wheel, tape measure, 1m wooden rulerAMSI Teacher resource on surface area and volume:<http://www.amsi.org.au/teacher_modules/Cones_Pyramids_and_Spheres.html>Note: Aspects of this topic can be taught in conjunction with the Year 11 Mathematics Standard Data Analysis topic (MS-S1). |

|  |  |
| --- | --- |
| **Outcomes** | **Assessment Strategies** |
| A student:* solves problems involving quantity measurement, including accuracy and the choice of relevant units MS11-3
* performs calculations in relation to two-dimensional and three-dimensional figures MS11-4
* uses appropriate technology to investigate, organise and interpret information in a range of contexts MS11-9
* justifies a response to a given problem using appropriate mathematical terminology and/or calculations MS11-10
 | Informal Assessment:* Students respond to prompts of key words related to the unit to establish what prior knowledge they have, either vocally as a class, as a class brainstorm, or in groups on paper. The ‘Chalk Talk’ Routine from ‘Visible Thinking’ is one method of doing this.
* Students read some questions on prior and early knowledge in the topic, and traffic light the questions as green (I understand), amber (I understand bits or I sort of understand) or red (I don’t understand). This can be done by showing a card of that colour, colouring in, or simply writing a G, A or R next to each question.
* Students respond to a class discussion, which informs the teacher of the learning required.
* Students work either individually or in small groups, to draw a mind map, poster or summary of their prior learning in the topic.
* The teacher starts each lesson with a number of brief questions that reviews the key concepts of previous lessons and/or key skills that will be required in the lesson that will follow.
* The teacher asks students to summarise the core ideas they have learnt as a plenary to a lesson, in their book, on a piece of paper to hand in, or orally.
* Students bring a question they were unable to answer to class and then work in groups to discuss the questions and share their ideas. The teacher emphasises that a minute of silence to consider each question is important, to establish that thinking time is necessary in mathematics.

Formal Assessment:An investigative task based on students using the knowledge, understanding and skills they have developed in this topic to design a practical space such as a car park for a community centre. |

|  |  |
| --- | --- |
| **Content** | **Teaching, learning and assessment activities** |
| **M1.1: Practicalities of measurement**Students:* review the use of different metric units of measurement including units of area, take measurements, and calculate conversions between common units of measurement, for example kilometres to metres or litres to millilitres ◊
* calculate the absolute error of a reported measurement using and state the corresponding limits of accuracy ◊
	+ find the limits of accuracy as given by:
	+ investigate types of errors, eg human error or device limitations Critical and creative thinking icon
	+ calculate the percentage error of a reported measurement using
* use standard form and standard metric prefixes in the context of measurement, with and without a required number of significant figures ◊  Information and communication technology capability icon
 | Students review the practical challenges of measuring accurately, selecting appropriate units of measure and converting one unit of measurement to another. For example a set of information sheets on measurement ideas and interactive revision quizzes are available at <http://www.bbc.co.uk/bitesize/ks3/maths/measures/use_of_measure/revision/1/> Students use square saws and domino games to review the conversion of units. The teacher introduces the concepts of error in measurement and the limits of accuracy through a practical activity: Students each measure the height, length and capacity of a set of physical objects and record their measurements in a combined class spreadsheet. After collating all measurements, the class explores the differences in the results and discusses the reasons why discrepancies may have occurred. Students explore the history of the metric system and the names and relationships of the prefixes using the internet. They prepare a summary of units of measurement and include examples of their use. Students are given a paragraph of text that includes a variety of different types of measurements, for example the specifications of a car, or scientific descriptions of planets or cells. They rewrite the measurements either by using a different unit of measurement and/or to a specific number of significant figures. Students convert between the different metric units for area, for example hectares to square metres.Students build the physical outline of a cube of side 1 m using lengths of 1 metre (for example metre rulers and string) to aid the visualisation of the number of cubes of side 1 cm that would fit inside it. They use this activity to establish the conversion: 1 m3 = 1 000 000 cm3. The class discusses the effect of conversion of units on the accuracy of the measurement. |
| **M1.2: Perimeter, area and volume**Students:* review and extend how to solve practical problems requiring the calculation of perimeters and areas of triangles, rectangles, parallelograms, trapezia, circles, sectors of circles and composite shapes ◊ Critical and creative thinking icon Literacy icon
	+ review the use of Pythagoras’ theorem to solve problems involving right-angled triangles
	+ review the use of a scale factor to find unknown lengths in similar figures
 | Students use interactive apps to explore the derivation of the formulae for perimeter and area. For example:for a parallelogram: <http://illuminations.nctm.org/ActivityDetail.aspx?id=47> or for a circle: <http://www.geogebratube.org/student/m279?mobile=true>Students explore visual derivations of Pythagoras’ theorem using online applets, for example <http://www.cut-the-knot.org/pythagoras/>. They then use Pythagoras’ theorem to solve problems involving perimeter and area.Students solve problems involving composite areas by either adding or subtracting the areas of known shapes. For example find the area of gold leaf that needs to be used in a logo. Students design a logo composed of three different shapes that share at least one edge, given the total area of the logo. For example using a square, triangle and a sector, design a logo that has a total area between 15 and 16 cm2 and fits within a square of side 5 cm.The teacher issues a formal investigative assessment task based on the considerations of designing a practical space such as a car park for a community centre. The teacher discusses the nature and scope of the task and the way in which the students can access feedback and support. The teacher provides students with an opportunity to ask questions about the task and seek clarification if necessary. |
| * solve problems involving surface area of solids including but not limited to prisms, cylinders, spheres and composite solids
* solve problems involving volume and capacity of solids including but not limited to prisms, cylinders, spheres, pyramids and composite solids
	+ convert between units of volume and capacity
 | Students explore the relationship between the volume of a pyramid or cone to the volume of the enclosing prism or cylinder using physical models filled with rice. Students watch a video to consolidate how formulae can be used to calculate volumes. For example: <http://splash.abc.net.au/home#!/media/1477961/> or <http://splash.abc.net.au/home#!/media/1477939/> or <http://splash.abc.net.au/home#!/media/1478027/>Students use drawing software to draw prisms, cylinders and pyramids and their nets. Use the net to calculate the surface area of the original solid.Students inflate a balloon, counting the number of full breaths they used. They then calculate the volume of their single exhale. |
| * calculate perimeters and areas of irregularly shaped blocks of land by dissection into regular shapes including triangles and trapezia **AAM** **Paperclip icon**
	+ derive the Trapezoidal rule for a single application,
	+ use the Trapezoidal rule to solve a variety of practical problems
	+ use the Trapezoidal rule to estimate the base area of a solid in a practical context, using technology, and then calculate its approximate volume, eg the volume of water in a swimming pool  Information and communication technology capability icon
 | The teacher marks out a large shape bound by straight edges on the school oval. Students decide on the measurements they need to take so that they can determine the perimeter and area of the shape.The teacher develops the Trapezoidal rule for a single application. Students use the rule to find:* the area of a block of land bound by a creek
* the volume of water flowing past a bridge.

Students determine the amount of soil that will need to be removed so that a backyard pool can be installed. They calculate the amount of paint required to resurface the interior of the pool, the capacity of water in the pool and the length of time taken for the pool to fill. Students could also determine associated costs.Students investigate the dimensions that maximise the area for a given shape and perimeter, such as in the design of paddocks and other irregular blocks of land. |
| * solve problems involving perimeters, area, surface area, volumes and capacity in a variety of contexts **AAM**
 | Students calculate the volume of water that can be collected from a roof, given the rainfall in millimetres and the roof area (plan view area) and hence determine the most suitable size tank for a given roof. They explore the monthly and annual rainfall patterns in their local area using the internet and calculate how much rain could be harvested from the roof for a specific month, or a year.Students log their personal water use over a one-week period and use this to: * estimate personal water usage and costs over a year
* determine the size of a cylindrical tank that could contain enough water for the entire class for a week.

Students design cost-effective packaging, eg groups of students are given four table-tennis balls and need to design two different boxes to package them. Students should then determine the better of the two designs in terms of minimisation of material used. Students explore other practical situations which could include:* A decorating or floor-tiling task: for example calculate the wallpaper required by working out the area of the walls.
* A gardening or agricultural task: for example determine the area for seeding, paths, chips or paving.

Students calculate associated costs and discuss the concept of tendering for a project. The teacher provides an opportunity for students to present their draft assignment for feedback. |
| **M1.3: Units of energy and mass**Students:* review the use of metric units of mass in solving problems, including grams, kilograms and tonnes, their abbreviations and how to convert between them Literacy icon
 | Students calculate the surface area and volume of sphere-shaped sweets or cylinder-shaped sweets, eg marshmallows. Combine class results to form a dataset for statistical analysis. Discussion could include:* What assumptions are being made about the shape of the sweet?
* How can a reasonably accurate measure for the radius be obtained?
* How accurate will the results be?
* Are the results normally distributed?
* What claims could the manufacturer make about the surface area and volume of that particular product?
 |
| * use metric units of energy to solve problems, including calories, kilocalories, joules and kilojoules, their abbreviations and how to convert between them
* use units of energy and mass to solve problems related to food and nutrition, including calories Personal and social capability icon
* use units of energy to solve problems involving the amount of energy expended in activities, for example kilojoules Personal and social capability icon
 | Students research: * the history of the measurement of calories and kilojoules and how they are measured
* the amount of energy expended in activities.

Students record their food consumption for a particular day. Using the food labels on packaging, students then calculate the number of calories/kilojoules consumed. Students record the number of steps they take during a typical school day or during a period of exercise. They determine the amount of energy consumed. Students explore the effect of the Heart Foundation’s recommendation that adults walk at least 10 000 steps per day on the amount of energy consumed.Students could investigate the amount of energy consumed by a Year 7 student participating in the ‘Jump Rope for Heart’. |
| * use units of energy to solve problems involving the consumption of electricity, for example kilowatt hours, and investigate common appliances in terms of their energy consumption **AAM** Sustainability icon Literacy icon
 | Students explore, compare and solve problems based on the consumption of household electricity such as:* interpret information about a household’s electricity usage, eg a household electricity bill
* rank common appliances and physical activities in terms of their energy consumption in watts
* calculate the cost of running different household appliances for various time periods, given the power rating, usage time, and cost of power
* perform calculations and conversions involving units related to power, eg watt, watt-hour
* interpret the energy rating of appliances and compare running costs of different models of the same type of appliance
* calculate the amount of electricity that could be saved by using energy-efficient devices and adopting energy-efficient strategies
* calculate the running costs of various home appliances.

Students use the internet to collect data in relation to worldwide electricity consumption. They extract data from tables or graphs and interpret this information in order to compare electricity consumption in different countries.Students submit their investigative task. |

|  |  |  |
| --- | --- | --- |
| **Prior knowledge** | **Questions and prompts for Working Mathematically** | **Summary of technology opportunities** |
|  | What would happen if …?What is the same and different about …?Explain why …How can we be sure that …?Of what is this a special case …?Give me an example of …What information has been lost?What else can be concluded? | Online apps Scientific calculatorGraphics calculatorSpreadsheetsOnline conversion calculatorsGoogle Earth |

|  |
| --- |
| **Reflection on learning and evaluation – to be completed by teacher during or after teaching the unit.** |