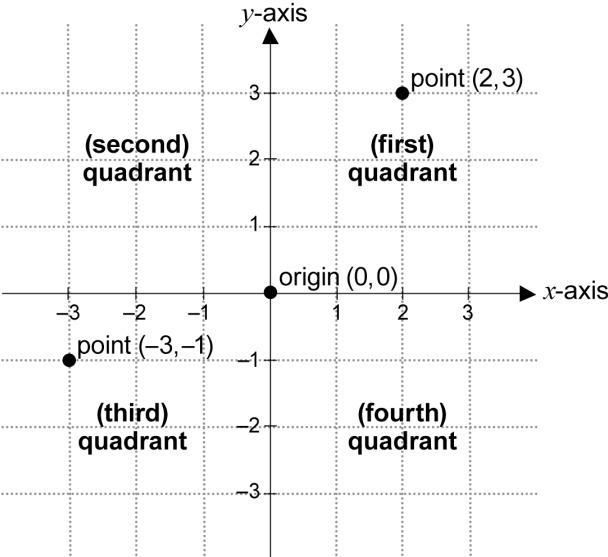




Scope and sequence summary	Duration: 1 week
Substrand: S3 NA Patterns and Algebra 2 (part)	Detail: 5 activities

Outcomes	Key considerations	Overview
<p>› describes and represents mathematical situations in a variety of ways using mathematical terminology and some conventions MA3-1WM</p> <p>› selects and applies appropriate problem-solving strategies, including the use of digital technologies, in undertaking investigations MA3-2WM</p> <p>› gives a valid reason for supporting one possible solution over another MA3-3WM</p> <p>› analyses and creates geometric and number patterns, constructs and completes number sentences, and locates points on the Cartesian plane MA3-8NA</p>	<p><i>Key ideas</i></p> <ul style="list-style-type: none"> Locate and record the coordinates of points in all four quadrants of the Cartesian plane <p><i>Language</i></p> <p>Students should be able to communicate using the following language: number plane (Cartesian plane), horizontal axis (x-axis), vertical axis (y-axis), axes, quadrant, intersect, point of intersection, right angles, origin, coordinates, point, plot.</p> <p><i>Adjustment</i></p> <p>A range of new mathematical terms is introduced in this unit of work. A ‘word wall’ of these terms could be developed if required.</p>	<p><i>This unit of work encompasses:</i></p> <ul style="list-style-type: none"> some of the content of S3 NA Patterns and Algebra 2 <p><i>Assumed knowledge</i></p> <ul style="list-style-type: none"> S3 Whole Number 2 (integers) <p><i>Links to learning across the curriculum</i></p> <p>Students’ literacy skills are developed as they describe the location of points on the Cartesian plane and use associated terminology.</p>

Content	Teaching, learning and assessment	Resources
<p>Introduce the Cartesian coordinate system using all four quadrants (ACMMG143)</p> <ul style="list-style-type: none"> recognise that the number plane (Cartesian plane) is a visual way of describing location on a grid recognise that the number plane consists of a horizontal axis (x-axis) and a vertical axis (y-axis), creating four quadrants  <ul style="list-style-type: none"> recognise that the horizontal axis and the vertical axis meet at right angles (Reasoning) identify the point of intersection of the two axes as the origin, having coordinates $(0, 0)$ 🎓 	<p>Activity 1: Creating a Colossal Cartesian Plane</p> <p>This activity is best completed on a large flat space, such as the floor of the school hall or a playground. A space that has a square-grid structure (eg the grout lines separating large square tiles) is preferable, if available. If the space to be used does not have a square-grid structure, the teacher should create a square grid of 30 units \times 30 units prior to the activity. In addition, construct a large-scale number line through the middle of the grid labelled from -15 to 15.</p> <ul style="list-style-type: none"> Review the concept of positive and negative numbers (integers) and model the placement of integers on the large-scale number line. Call out numbers from -15 to 15 and have each student, one by one, find the specified position on the number line. Continue until all students have a position on the number line. <p><i>Adjustment:</i> Reinforce associated terminology when discussing position on the number line through the use of 'left'/'negative' and 'right'/'positive'.</p> <ul style="list-style-type: none"> Explain that the number line allows us to identify a particular position on a single line using a number, but that this limits us to describing position only on the one line. Ask a few students to find a position nearby that is not on the line (include positions on both sides of the line). Generate discussion about how the position of someone who is not on the line could be described. Guide students to think of the important features needed to describe position accurately, such as: <ul style="list-style-type: none"> side of the line distance from the line. Guide student responses to the idea of two number lines placed at right angles to each other and intersecting at zero on each line. Use masking tape or chalk to construct the second number line on the ground from (roughly) -15 to 15 using the same scale as on the first line. Introduce the term 'number plane' and inform students that René Descartes was one of the first mathematicians to represent position in two dimensions using this method, hence the title 'Cartesian plane'. Introduce terminology associated with the Cartesian plane and use either large prepared labels or chalk to label these on the colossal Cartesian plane. It is important that students realise that, by convention, mathematicians refer to the horizontal axis as the 'x-axis', and the 	<p><i>Resources</i></p> <ul style="list-style-type: none"> Masking tape or chalk Labels of the features of a Cartesian plane For the teacher: www.shodor.org/interactive/discussions/IntroductionToTheCoo/ <p><i>Scoutle resources</i></p> <ul style="list-style-type: none"> M010539 Interactive animation introducing the first quadrant of the Cartesian plane before introducing the other three quadrants M010540 Explanation and short exercises on the first quadrant of the Cartesian plane before extending to the other three quadrants <p><i>Variations/Extensions</i></p> <ul style="list-style-type: none"> Students can be introduced to the convention of naming the quadrants, starting with the 'first quadrant', being that in which both the x- and y-coordinates are positive, and then moving in an anticlockwise direction around the Cartesian plane. This convention of

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	<p>vertical axis as the 'y-axis'. This allows a common understanding of the Cartesian plane in all parts of the world. Terminology to be introduced includes:</p> <ul style="list-style-type: none"> - 'horizontal axis' ('x-axis'), 'vertical axis' ('y-axis'), 'intersect': the number plane is created using two axes, the horizontal axis (<i>x</i>-axis) and the vertical axis (<i>y</i>-axis), which intersect at right angles - 'point of intersection', 'origin': the name given to the point of intersection of the axes of the Cartesian plane is the origin. Students should be made aware that, by convention, the origin is denoted by the capital letter <i>O</i> - 'quadrant': the axes divide the Cartesian plane into four quadrants (remind students of the word stem 'quad-', meaning 'four', and recall known words that use this stem, eg 'quadrilateral'). <ul style="list-style-type: none"> • With the aid of the labels, and later without, students practise responding to the terminology as the teacher asks all students (or a single student) to move to that feature of the Cartesian plane, eg 'Ali, go to the origin', 'Everyone stand on the <i>x</i>-axis', 'Tam, go to the point of intersection of the axes'. • Issue each student with a card marked with the coordinates of a point. The set of points used should include points in each quadrant, the origin, and points on the <i>x</i>-axis and <i>y</i>-axis, eg (2, 5), (7, 4), (-13, 1), (-6, 8), (5, -3), (12, -6), (-8, -10), (-1, -7), (0, 3), (0, -14), (12, 0), (-4, 0), (10, 12), (-10, 12), (-6, -6), (7, -12), (0, 2), (-10, 0), (10, -10), (8, 0), (-14, -8), (13, 8), (0, 12), (0, 0), (0, -3), (3, -8), (-11, 5), (-11, -5), (-4, -13), (-6, -2). • Explain the following: <ul style="list-style-type: none"> - Coordinates of the origin are (0, 0) and all other points are located by starting (originating) at the origin. - By convention, a 'point' on the Cartesian plane is recorded as a pair of numbers, separated by a comma, in parentheses (brackets). - By convention, the first number in parentheses always refers to the '<i>x</i>-coordinate' of the point and indicates the position that is moved to on the <i>x</i>-axis to the right (positive) or to the left (negative) of the origin, ie the position moved to horizontally starting from the origin. - The second number always refers to the '<i>y</i>-coordinate' of the point and indicates the position that is moved to up (positive) or down (negative) from the origin, ie the position moved to vertically. 	<p>naming the quadrants is important in the study of trigonometry in Stages 5 and 6.</p> <ul style="list-style-type: none"> • Some students may research the life and mathematical discoveries of René Descartes and create a book or display for the classroom.

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	<p>Note: a useful memory aid for the order of the coordinates is that x comes before y in the alphabet, and so the x-coordinate comes before the y-coordinate when we locate or record points on the Cartesian plane.</p> <p><i>Adjustment:</i> Some students may be provided with visual aids that include the coordinates of the given point and a description in words of the location of the point (incorporating the mathematical terms), eg $(2, -4)$ is '2 units to the right of the origin along the x-axis and 4 units down from the origin along the y-axis'.</p> <ul style="list-style-type: none"> • One by one, each student finds the point on the ground that corresponds to the point on his or her card and sits at that point. Each student must start at the origin and walk to the number corresponding to the x-coordinate on the x-axis BEFORE considering the y-coordinate. <p><i>Adjustment:</i> Some students may require modelling by the teacher and/or peers first, followed by guided practice with a teacher's assistant or peer. Some students may prefer to place an object rather than sit on the ground themselves.</p> <ul style="list-style-type: none"> • Once students are seated at their given points, the teacher gives instructions that re-affirm the terminology associated with the Cartesian plane, eg Stand up if your point is: <ul style="list-style-type: none"> – on an axis – on the x-axis (What do all of these points have in common?) – on the y-axis (What do all of these points have in common?) – at the origin – in a quadrant – a point with a y-coordinate of 12 – a point with an x-coordinate of 0 – a point with the same value for the x-coordinate and the y-coordinate – a point with a positive y-coordinate (Where are all of these points in relation to the axes?) – a point with a negative x-coordinate (Where are all of these points in relation to the axes?). <p><i>Adjustment:</i> Some students may require verbal prompting to ensure inclusivity.</p>	

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	<p><i>At the conclusion of the outdoor session or as review prior to Activity 2</i></p> <ul style="list-style-type: none"> • Students are given two sets of cards: <ul style="list-style-type: none"> – set A – 8 cards with terms that describe the features of the Cartesian plane – set B – 8 cards with diagrams indicating in colour the corresponding features of the Cartesian plane. • Students work in pairs to match the terms in set A with the corresponding diagrams in set B. • Provide each student with a list of terms and diagrams associated with the Cartesian plane. (This summary could be pasted into their workbooks.) 	
<ul style="list-style-type: none"> • plot and label points, given coordinates, in all four quadrants of the number plane  <ul style="list-style-type: none"> ▶ plot a sequence of coordinates to create a picture (Communicating)  • identify and record the coordinates of given points in all four quadrants of the number plane <ul style="list-style-type: none"> ▶ recognise that the order of coordinates is important when locating points on the number plane, eg (2, 3) is a location different from (3, 2) (Communicating) 	<p>Activity 2: Guess the Shape</p> <ul style="list-style-type: none"> • Give all students an empty grid. With teacher guidance, students construct an empty Cartesian plane by drawing the two axes with a ruler and labelling all important features, including the x-axis (horizontal axis), y-axis (vertical axis) and origin (O). <p><i>Adjustment:</i> Some students may require a larger grid and/or a grid on which the axes and the origin are already drawn and labelled, and/or the option to choose from a list of given labels.</p> <ul style="list-style-type: none"> • Students mark equal spaces on each axis from at least -5 to 5 and label each marker. (It does not matter in which quadrant the label O is written, but it is generally placed in the third quadrant, as close as possible to the origin.) <p><i>Adjustment:</i> Some students may need to be given scales to complete that have already been started, or they may be asked to fill in missing numbers.</p> <ul style="list-style-type: none"> • One by one, the teacher calls out the coordinates of a number of points that can be connected to form a shape. Start with a simple shape, such as a rectangle, that includes at least one point in each quadrant. Students plot and label these points with the correct coordinates, being careful to place the x- and y-coordinates in the correct order inside parentheses (brackets). Avoid using points in which the x- and y-coordinates have the same value, as this can cause confusion for students in the early stages of learning about the Cartesian plane. <p><i>Adjustment:</i> Some students could be provided with a procedural prompts sheet for plotting a point on the Cartesian plane.</p>	<p><i>Resources</i></p> <ul style="list-style-type: none"> • Interactive whiteboards usually have Cartesian plane templates readily accessible as drag and drop objects • Online Cartesian plane creator: select the 'graph paper' option and then 'rectangular grid' – this tool allows users to create Cartesian planes to their specifications and save them as pdf or jpeg files <p><i>EAL/D students</i></p> <ul style="list-style-type: none"> • Students with EAL/D or learning difficulties may require additional assistance due to the high literacy demands of this unit. These students could work in pairs, or a list of the points to be used could be given to them

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	<ul style="list-style-type: none"> Once all the points have been plotted, the teacher calls out the coordinates of the points in the order in which they should be connected, while the students use a ruler to connect them. The students can then name the shape formed. Repeat the activity with a new Cartesian plane (which includes a grid and scale) for each shape until proficiency is demonstrated. The shapes used can become progressively more complex by involving more points, including points on the x-axis and/or the y-axis. <p><i>Adjustment:</i> Some students might only perform the activity with familiar simple shapes.</p> <ul style="list-style-type: none"> The output of this activity can be collected and used to inform the teacher of the quality of the learning that has taken place before moving on to subsequent activities. The teacher may determine that some (or all) students require clarification and further practice of the concepts addressed before subsequent activities are attempted. 	<p>prior to the lesson.</p> <p><i>Adjustment</i></p> <ul style="list-style-type: none"> Procedural prompts sheet for plotting a point on the Cartesian plane.
	<p>Activity 3: Buried Treasure</p> <ul style="list-style-type: none"> Students work in pairs. Each student is given two identical Cartesian planes with axes from -4 to 4 only. Students may benefit from having the teacher model the process before they begin working in pairs. Individually, students plot a specified number of 'buried treasures' of different sizes on one of the Cartesian planes, eg 8 rubies (1 point (x, y)), 5 gold bars (an interval joining 2 points), 3 boxes of silver (a square 1 unit by 1 unit made by joining 4 points). The treasure must not touch or overlap. Students take turns guessing where the treasure is buried on their partner's Cartesian plane by calling out the coordinates of points: <ul style="list-style-type: none"> If the guess is correct, the partner must respond positively and indicate the type of treasure that has been hit, eg 'You've struck a gold bar'. If the guess is incorrect, the partner responds negatively, eg 'You missed'. Students record the hits and misses made by their partner on the grid that shows their own treasure, and record the hits and misses they have made to locate their partner's treasures on their second Cartesian plane. The first person to guess the location of all of his or her partner's treasure 	

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	<p>wins the game.</p> <p><i>Adjustment:</i> Some students may begin the activity using only three rubies and a small Cartesian plane, before attempting the activity with progressively more rubies, gold bars, boxes of silver and/or a larger Cartesian plane.</p>	
	<p>Activity 4: Mystery Picture</p> <ul style="list-style-type: none"> • Students work in pairs. One student is given a pre-plotted image constructed by joining coordinates on a Cartesian plane. The student keeps this hidden from his or her partner. The partner is given an empty Cartesian plane (which includes a grid and scale). • Using coordinates, the student with the pre-plotted image gives instructions to his or her partner on how to construct the image on the empty Cartesian plane. • Once completed, the students compare the two images. They discuss and correct any discrepancies. <p><i>Adjustment:</i> Students could be partnered with peers who are able to instruct and assist the students to complete the activity. The activity could be modelled if required. Images used should be simple and familiar. Some students could be provided with an image drawn wholly within the first quadrant.</p>	<p><i>Resources</i></p> <ul style="list-style-type: none"> • A number of pre-plotted images on the Cartesian plane • Empty Cartesian planes, eg Online Cartesian plane creator: select the 'graph paper' option and then 'rectangular grid' – this tool allows users to create Cartesian planes to their specifications and save them as pdf or jpeg files
	<p>Activity 5: Create Your Own Picture</p> <ul style="list-style-type: none"> • Students begin by plotting a picture on an empty Cartesian plane (which includes a grid and scale). Pictures can vary from basic shapes or symmetrical designs to more complex pictures, such as those of animals. Students may benefit from having the teacher model the process before they begin to work independently. • Students choose a starting point and write down the coordinates of the points in the order in which they must be connected to create the image. If the image has more than one part, students should write appropriate instructions to indicate this, eg using the words 'start at ...' and 'stop'. If desired, instructions can also be written for how each part is to be coloured. <p><i>Adjustment:</i> Some students could be assigned simple familiar shapes with as few points as possible, or be given a picture pre-drawn on a Cartesian plane, and start by drawing a coloured dot on top of the points used to create the picture. Some students could work wholly within the first quadrant.</p>	<p><i>Resources</i></p> <ul style="list-style-type: none"> • Empty Cartesian planes, eg Online Cartesian plane creator: select the 'graph paper' option and then 'rectangular grid' – this tool allows users to create Cartesian planes to their specifications and save them as pdf or jpeg files

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	<ul style="list-style-type: none"> • Copies of students' instructions can be made and given to other students to draw pictures on an empty Cartesian plane. This will allow students to check each other's work. • The teacher could keep some of these images to use for Activity 4 in the following year. <p><i>Adjustment:</i> Copies of images and instructions created by students in previous years could be used as models for students prior to commencing the activity.</p>	

Assessment overview
<ul style="list-style-type: none"> • Provide students with grid paper that has two axes drawn, is labelled with a scale, and has a small number of points plotted (in each of the four quadrants and on the axes), but without the origin, x-axis or y-axis labelled. Ask students to: <ul style="list-style-type: none"> – label the x-axis and y-axis and the origin, including writing the coordinates of the origin – shade a quadrant – label each of the given points with their correct coordinates – plot a series of points (provided both orally and in written form) and label them correctly, including points in all four quadrants and on the x- and y-axes. <p><i>Adjustment</i></p> <ul style="list-style-type: none"> • Some students could: <ul style="list-style-type: none"> – require larger grids – match a set of given labels to the corresponding features of the Cartesian plane – plot and label a limited number of points.