ISS
SINGAPORE CAMPUS

Realising Potential

MATHEMATICS

K-12 LEARNING OUTCOMES & BENCHMARKS

Learning Outcomes and Benchmarks

Below you will find the Learning Outcomes and Benchmarks for the International Baccalaureate Primary Years Programme, Middle Years Programme and Diploma Programme at ISS.
This document covers the Learning Outcomes and Benchmarks that will be covered from Kindergarten to Grade 12 at ISS.

It is an important document in ensuring that the students at ISS have a World Class education. An education that provides an ever deepening level of understanding of the world from when they join us to when they leave.

Explanation of terms:

Different curriculum use the terms Outcomes and Benchmarks in slightly different ways. At ISS we use the terms to mean:

Learning Outcomes: the concepts, skills, attributes and knowledge that a student in the relevant Grade Level is expected to understand, demonstrate and apply.

Learning outcomes complete the statement: students will be able to .....

Benchmarks: specific performance indicators for each grade level

Benchmarks complete the statement: students will be able to show their understanding by .....

It is important to note that a Learning Outcome is not a limitation. Through differentiated teaching teachers ensure that all students are given the maximum opportunity to reach the Learning Outcomes for their Grade Level and to extend those who are capable of surpassing the Learning Outcomes.

Learning Outcomes and Benchmarks

Subject : MATH
Strand : SPACE AND SHAPE (MS/HS Geometry/ Trigonometry)

Grade / Phase	Learning Outcome *Students will be able to...*	Benchmarks
Standard 11-12	**Vectors** : · Understand the definition and concept of a vector in the plane and in three dimension space · Understand that representation of vectors using directed line segments such as unit vectors; base vectors ***i***, ***j***, ***k***. · Show algebraic and geometric approaches to the following · the sum and difference of two vectors · the zero vector **0** , the vector −***v*** · multiplication by a scalar, *k**v*** ; parallel vectors · magnitude of a vector |**v**| · unit vectors and base vectors : ***i, j and k*** · position vectors · Calculate the angle between two vectors. · Identify perpendicular vectors and parallel vectors. · Calculate vector equation of a line in two and three dimensions: ***r*** = ***a*** +λ***b*** . · Calculate the angle between two lines. · Distinguish between coincident, parallel, intersecting and skew lines;	· Interpret the various forms of vectors both geometrically and analytically as used in physics · Perform operations of addition, subtraction, and scalar projection of vector onto another vector, and the cosine of the angle between vectors · Read, interpret, and solve applied problems using vectors as used in physics. · Use of the Pythagorean identity to illustrate the

	Trigonometry · Solve problems involving degree and radian measure of angles as they relate to circular models in the physical world · Define the sine, cosine, tangent functions of angles in terms of the unit circle · Sketch the graphs for the basic trigonometric functions and specify the intervals over which they increase or decrease · Identify and use the domain, range, amplitude, period and phase shift to graph trigonometric functions. · Solving trigonometric equations in a finite interval, both graphically and analytically. · Solve a right triangle using the definitions of sine, cosine and tangent · Calculate the area of the triangle using the sine rule.	double angle identities for sine and cosine. · Demonstrate understanding of the relationship between trigonometric ratios. · Read and interpret a word problem and apply the Law of Sines and Cosines · Read and interpret real world problems such as navigational (in 2 two and three dimensions) and including angles of elevation and depression.
10	· Calculate lengths in right-angled triangles using Pythagoras' theorem, including the use of Pythagorean triples. · Calculate lengths and angles of right-angled triangles using trigonometric ratios, including problems based on real-life situations. · Determine the exact values of sine, cosine and tangent for 30, 45, 60 using special triangles · Solve real life application problems involving bearings, angles of elevation and depression. · Solve simple three-dimensional problems requiring the use of	· Master understanding and use of Pythagorean's theorem and Pythagorean triples when solving right triangles. · Master the relationships between the sides and angles of right triangles using trigonometric relationships. · Master understanding of the relationships among the sides in 45-45-90 triangles and 30-60-90 triangles. · Master understanding of bearings, angles of elevation and angles of depression.

	trigonometry.	· Investigate the application of trigonometry to three-dimensional problems.
10 (extension)	· Choose appropriate formulae to calculate unknown sides and angles in non-right-angled triangles. · Use simple trigonometric identities to simplify expressions and solve equations where 0°≤θ≤360°. · Convert between degrees and radians. · Use radians to solve trigonometric problems. · Use the unit circle to find exact values of trigonometric functions of special angles. · Apply coordinate geometry methods to three-dimensional questions to calculate distances and midpoints. · Justify and provide proof of similarity and/or congruence using applicable theorems. · Add, subtract and multiply vectors (with scalars) both algebraically and graphically. · Calculate the dot product of two vectors.	· Develop understanding of the Law of Sines and the Law of Cosines; simple trigonometric identities ($sin\ \ ^2x + cos\ \ ^2x = 1, tanx = \frac{sinx}{cosx}$); radian measure; unit circle. · Investigate three-dimensional coordinate geometry; similarity and congruence in different shapes; and Vectors.
9	· Use the angle properties of triangles, quadrilaterals, circles and polygons to calculate unknown angles. · Calculate unknown angles in parallel lines. · Determine whether two triangles are similar, congruent or neither, giving proof.	· Master understanding of angles of a triangle, quadrilateral, circle, and polygon. · Review angle properties in parallel lines. · Master understanding of similarity and congruence.

	· Determine the lengths of sides and sizes of angles in two similar or congruent shapes, with emphasis on triangles. · Calculate the distance between two points using the distance formula. · Calculate the perpendicular distance between a point and a line. · Calculate a midpoint using the midpoint formula · Find sides and angles of right-angled triangles using trigonometric ratios. · Use translations, reflections, rotations and dilations to transform figures and shapes on the coordinate plane.	· Investigate and develop understanding of methods for finding the distance between two points, relating it to Pythagoras' theorem. · Investigate and develop understanding of methods for finding the distance between a point and a line. · Investigate and develop understanding of methods for finding the midpoint between two points. · Investigate the relationships between sides and angles in right-angled triangles. · Master understanding of transformations of figures and shapes on the coordinate plane.
8	**2-D and 3-D shapes** · Calculate unknown angles in parallel lines · Use the angle properties of triangles and quadrilaterals to calculate unknown angles. · Use properties of angles, triangles, quadrilaterals and regular polygons to find missing side lengths and/or angles · Identify quadrilaterals and differentiate between parallelograms · Calculate perimeter and area of triangles, quadrilaterals, and other irregularly shaped polygons and extend understanding to find perimeter and area of circles and composite figures · Calculate volume and surface area of basic prisms and pyramids	**2-D and 3-D shapes** · Students will be able to understand and analyse characteristics and properties of two- and three-dimensional geometric shapes and develop mathematical arguments about geometric relationships

	· Calculate area of polygons and circles, including sectors and composite shapes **Visualization & Spatial Reasoning** · Use Pythagorean's theorem and Pythagorean triples to solve for missing sides of right triangles · Apply loci to situations in everyday life · Draw networks for real-life situations	**Visualization & Spatial Reasoning** · Students will be able to use visualization, spatial reasoning, and properties and relationships of geometric figures to solve problems involving geometry and trigonometry including those in real life contexts
7	· Explain 3D shapes with respect to their 2-D shapes · Use nets of three-dimensional objects to visualize component shapes of 3-D shapes and develop and justify formulas for surface areas and volumes of prisms, pyramids, and cylinders · Apply the formulas for volume of any prism =Area of base x Height and any pyramid using the formula V= ⅓ (area of base)(height) · Solve problems that involve lengths of sides, areas and volumes including those where volume is given and it is necessary to find the lengths of the sides and/or surface area	**2D and 3D Shapes** · Understand and analyse characteristics and properties of two and three-dimensional geometric shapes with emphasis on similarity, and understand volume and surface area as attributes of three dimensional shapes.
6	**Coordinate Geometry** · Develop understanding of the different components of the Cartesian plane (origin, horizontal axis, vertical axis, quadrants, etc.) · Use Cartesian plane to plot points and draw graphs of patterns and relations in all four quadrants · Use Cartesian plane to plot points or simple figures and determine their image under translations and reflections · Determine reflection and rotation symmetries of a figure	**Coordinate Geometry** · Specify locations and describe spatial relationships using coordinate geometry and begin to apply transformations and use symmetry to analyse mathematics in the real world. **2-D Shapes** · Understand and analyse characteristics and properties of triangles, quadrilaterals, circles and other regular polygons including perimeter and

	· Use Cartesian plane to draw simple figures and determine simple lengths and areas related to **2-D Shapes** · Describe, classify, and understand relationships among types of angles, triangles, quadrilaterals and other regular polygons using their defining properties · Investigate and develop understanding of relationships among angles including vertically opposite angles, adjacent angles, complementary angles, supplementary angles, and angles on a straight line · Investigate and develop understanding of relationship among interior angles of a triangle, a quadrilateral and other regular-shaped polygons · Find unknown angles in geometric figures using properties of angles, triangles, quadrilaterals, etc. · Understand and describe defining properties of circles and identify parts of a circle including centre, radius, diameter and circumference · Select and apply techniques and tools to accurately find length, perimeter, area, and angle measures to appropriate levels of precision · Draw geometric objects with specified properties, such as side lengths or angle measures · Use formulas to determine perimeter, circumference and area of triangles, quadrilaterals, circles and other regularly and irregularly shaped polygons	understand perimeter and area as attributes of two dimensional shapes

	· Understand, select and use appropriate units to measure angles, perimeter and area · Understand that a square that is 1 unit on a side is the standard unit for measuring area.	
5	· Describe lines and angles using geometric language · Use 2D representations of 3D objects to visualise and solve problems · Create and model how a 2D net converts into a 3D shape and vice versa · Apply transformations and use symmetry and analyse mathematical situations · Apply the language and notation of bearing to describe direction and position	**2D and 3D Shapes** · Describe, identify parallel lines and perpendicular edges or faces · Identify 3D shapes from 2D drawings · Identify different nets for a closed 3D shape Symmetry · Represent and describe the results of reflection, rotation and translation on shapes or patterns Directions and mapping · Use real life resources to describe position using compass directions and grid lines
4	· Analyse and describe 2D and 3D shapes, including regular and irregular polygons, using geometrical vocabulary · Apply knowledge of transformations to problem solving situations · Apply the language and notation of bearing to describe direction and position	**2D and 3D Shapes** · Describe 2D and 3D shapes including regular and irregular polygons using geometrical vocabulary · Draw 2D representations showing different perspectives of a 3D object Symmetry · Identify lines and axis of reflective and rotational symmetry Directions and Mapping · Use real life resources to describe position using

		compass directions and grid lines
3	· Recognise and explain symmetrical patterns including tessellations, in the environment · Understand the common language used to describe 2D and 3D shapes · Identify, describe and model congruency and similarity in 2D shapes · Locate features on a grid using coordinates	**2D and 3D Shapes** · Identify patterns in the environment such as tessellations · Apply knowledge of 2D shapes to create and describe 3D shapes Symmetry · Predict and communicate the results of translations, reflections and rotations of simple 2D shapes Directions and Mapping · Provide directions for a pathway on a map using specific location and directional language
2	· Recognise the names and properties of 2D and 3D shapes. · Analyse and use what they know about 3D shapes to describe and work with 2D shapes · Apply knowledge of symmetry to problem-solving situations · Interpret and use simple directions, describing paths, regions and positions boundaries of their immediate environment	**2D and 3D shapes** · Describe the properties of common 2D and 3D shapes · Describe the relationship between 2D and 3D shapes Symmetry · Apply simple transformations to shapes Directions and Mapping · Interpret simple maps and give directions using coordinates and compass points
1	Sort, describe and label 2D and 3D shapes Understand that geometrical shapes are useful for representing real world situations	2D and 3D shapes · Identify, name and describe common 2D and 3D shapes

	Identify lines of symmetry Give and follow instructions using the language of position and direction	· Make connections between 2D and 3D shapes and the real world Symmetry · Identify reflective symmetry in shapes and draw lines of symmetry Directions and Mapping · Identify simple paths
K2	Sort, describe and compare 2D and 3D shapes Understand that 2D and 3D shapes have characteristics that can be described and compared Explore and describe the paths, regions and boundaries of their immediate environment and their position	2D and 3D shapes · Identify and compare common 2D and 3D shapes · Identify and use common 2D and 3D shapes to make pictures and models Directions and Mapping · Describe the location of one object to another using the language of position and direction
K1	Identify and name 2D shapes Explore simple symmetry and non-symmetry Describe position and direction	2D and 3D shapes · Select particular named 2D shapes Show an awareness of symmetry Directions and Mapping · Identify positional language through pla

Learning Outcomes and Benchmarks

Subject: MATH

Strand: DATA HANDLING (MS/HS Statistics and Probability)

Grade / Phase	Learning Outcome *Students will be able to...*	Benchmarks
Standard (11-12)	**Statistics** Classify data as discrete or continuous Construct frequency tables and histograms by using mid-interval values; upper and lower boundaries; Construct Box-and-whisker diagram by identifying the 5 number summary Identify measures of central tendency such as mean, median, mode for discrete data. Identify measures of central tendency by estimating the mean and modal class for continuous data Identify measures of dispersion such as range, interquartile range, variance and standard deviation Calculate and interpret the linear correlation of bivariate data Develop an understanding of the concept of linear correlation and regression by constructing and interpreting a scatter plot, by computing and interpreting a linear correlation coefficient, and by determining the simple linear regression equation and using it to make predictions.	Analyse and interpret relevant information Explain questions, problems, and/or issues Evaluate information to determine credibility of reasoning Use technology to help generate well-reasoned conclusions. Generate a research question and identify the population and sample to which it pertains. Design a survey/questionnaire for collecting data. and administer the survey and collect data for the Math Exploration or internal assessment (IA).

	Probability Identify basic concepts of set theory: elements $x \in A$, subsets $A \subset B$; intersection $A \cap B$; union A U B; complement A'. Construct Venn diagrams and simple applications by identifying sample space and its elements. Calculate the probability of an event, Probability of a complementary event. and the expected value. Compute probability of combined events, mutually exclusive events, and independent events. Construct tree diagrams, Venn diagrams, sample space diagrams and tables of outcomes. Determine the probability using with replacement and without replacement as a form of characterisation to determine independent events. Understand discrete random variables and their probability distribution. Understand the characteristics of the binomial distribution Calculate the mean and variance of the binomial distribution Understand the characteristics of the normal distribution and its curves. Use the features of the GDC to find the z-scores that gives you the standardized deviations from the mean.	Analyse data, interpret correlation coefficient and present other statistics which communicates the results of the IA. Define experiment, outcome, event, probability and equally likely. Restate the formula for finding the probability of an event. Determine the outcomes and probabilities for experiments. Distinguish between an event and an outcome for an experiment. Connect set theory and Venn diagrams with events that are mutually and non-mutually exclusive. Summarize the procedures for applying the addition rules to compute probabilities of events that mutually or non-mutually exclusive. Connect random variables to the real world applications. Develop problem-solving skills and apply these skills in Math Exploration (IA).

10 (Standard and Extended)	Define key terms including population, sample, random sample, census, survey, categorical data, numerical data, discrete data, continuous data Design a study, collect, organise, present and analyse data. Draw box-and-whisker plots, bar graphs, line graphs, stem-and-leaf plots, pie charts, histograms, and scatterplots. Interpret the data given on statistical graphs, including lines of best fit. Calculate mean, median and mode for data and grouped data and interpret the results (manually, using statistical software and/or GDC) Calculate range, inter-quartile range and standard deviation for data and grouped data (manually, using statistical package or GDC) and interpret the results. Describe distribution of data using terms such as symmetrical, positively skewed, negatively skewed, outliers.	Refine understanding of the statistical method and process; review appropriate graphical representations for discrete numerical data, grouped discrete numerical data and continuous data; master understanding of measures of central tendency; and dispersion.
9	Define key terms including impossible event, certain event, compound events, independent events, dependent events, mutually exclusive events. Collect real-life experimental data and calculate probabilities from it. Calculate event probabilities given theoretical situations. Count possible permutations from lists, tree diagrams, grids. Create tree diagrams for given data and use them to calculate probabilities for compound events, dependent or independent.	Master understanding of key probability terms; understand the concepts of experimental probability, and theoretical probability. Investigate and develop understanding of a variety of methods for counting possibilities. Understand how to organize information using tree diagrams, tables,

	Calculate probabilities for data given in set notation. Create and calculate probabilities from 2-circle Venn diagrams. Use 2-circle Venn diagrams to explore the union and intersections of sets as well as the compliment of sets. Calculate conditional probabilities using tree diagrams, tables and/or probability formulae. Convert written probability information into a Venn diagram with three or more sets, and vice versa.	Understand and use set notation. Organize and analyse information using 2-circle Venn diagrams; and 3-circle diagrams
8	**STATISTICS** Refine understanding of key terms including population, sample, random sample, census, survey, categorical data and numerical data Identifying graphs and data that don't follow standard conventions and discuss the possible reasons why Develop understanding of quantitative variable; quantitative discrete variable (counting) and quantitative continuous variable (measured) Design an investigation to collect, organize, present and analyse data Select, create, use and analyse appropriate graphical representations for discrete numerical data and grouped discrete numerical data including dot plot, stem-and-leaf plots, frequency tables Describe distribution of data using terms such as symmetrical, positively skewed, negatively skewed, outliers, etc.	**Statistics** Select and use appropriate statistical methods to collect, organize, display and analyse data

	Find the mean, median and mode of sets of data including grouped data and interpret the significance of the values Calculate measures of spread of data including range and interquartile range and interpret the significance of the value Use appropriate mathematical concepts and skills to solve problems involving statistics including those in real-life contexts and assess reasonableness of results **Sets** Develop understanding of networks and pathways and their use in addressing abstract and practical mathematical situations Develop understanding of loci and their applications in everyday life	**Sets** Students will be able to understand and apply the skills and concepts of sets, Venn diagrams and networks to analyse and address abstract and practical mathematical situations
7	**Probability** Develop understanding of key terms including chance, probability, outcome, event, frequency, relative frequency, sample space Determine the likelihood of events happening by investigating using dice, coins, spinners, cards, etc. Determine experimental probability using real-life data Develop understanding of theoretical probability as the theoretical chance of an event occurring Use lists, tree diagrams and grids to illustrate sample spaces and determine theoretical probabilities of given events Use appropriate mathematical concepts and skills to solve problems involving probabilities	**Probability** Understand and apply basic skills and concepts of probability

	Sets Refine understanding of sets and the terminology and symbols involved with sets and set operations Develop understanding of complement of a set and disjoint sets Develop understanding of Venn diagrams and their use in problem solving and finding probabilities	**Sets** Venn diagrams and networks to analyse and address abstract and practical mathematical situations
6	**Statistics** Define the key terms; population, sample, random sample, census, survey, categorical data and numerical data Formulate questions, design studies and collect data about characteristics shared by two populations or different characteristics within one population Select, create and use appropriate graphical representations for **categorical data** including dot plots, tally and frequency tables, column graphs, bar charts and pie charts Select, create and use appropriate graphical representations for **numerical data** including stem-and-leaf plots, frequency tables and bar graphs Find the mean, median, mode and range of a set of data and interpret the significance of the values Explain the correspondence between data sets and their graphical representations, especially histograms and stem-and-leaf plots Identify misleading graphs and statistics	**Statistics** Develop an understanding of the various statistical methods to collect, organize, display and analyse data and develop and evaluate inferences in order to make decisions and predictions based on the data

	Sets Define and record sets, subsets and empty sets Use terminology and symbols involved in sets Find intersection and union of two or more sets Use Venn Diagrams to represent sets and other relationships	**Sets** Understand and apply the skills and concepts of sets and Venn diagrams to represent and analyse abstract and practical mathematical situations
Grade 5	Design a survey and systematically collect record, organise and display the data in a bar graph, circle graph or line graph. Understand that different graphs have special purposes Determine the theoretical probability of an event and explain why it might differ from experimental probability	Collecting and organising data Design survey and systematically collect, organise and record data in displays Evaluate the effectiveness of different displays in representing data Chance and Probability Describe and predict outcomes from data using language of chance likelihood
Grade 4	Select appropriate graph forms to display data Interpret range and scale on graphs Select appropriate graph forms to display data Use probability to determine mathematically fair and unfair games and to explain possible outcomes	Collecting and organising data Construct, label and interpret tables and graphs that summarise a set of data Identify that scale can represent different quantities in graphs and tables Select appropriate graphs for data gathered Chance and Probability Plan and construct chance experiments

Grade 3	Collect, display and interpret data Select appropriate graph forms to display data Use probability to determine mathematically fair and unfair games and to explain possible outcomes	Collecting and organising data Interpret and summarise a set of data Select appropriate graphs for data gathered Chance and Probability Investigate simple situations that involve elements of chance, recognising equal and different likelihoods and acknowledging uncertainty.
Grade 2	Collect, display and interpret data for the purpose of answering questions Identify and describe chance in daily events	Collecting and organising data Collect and display data from a range of real life situations using pictographs, bar graphs and Venn diagrams Interpret data from graphs Chance and Probability Predict the outcome of chance events
Grade 1	Collect, display and interpret data for the purpose of answering questions Express the chance of an event happening using words or phrases	Collecting and organising data Collect and display data related to their own activities using pictographs and bar graphs Chance and Probability Use extended vocabulary to describe the likelihood of events

K2	Create and represent information about themselves through pictographs and tally marks Discuss chance in daily life	Collecting and organising data Collect and display data related to their own activities using pictographs Chance and Probability Investigate situations which involve elements of chance or possibility
K1	Sort and label real objects by attributes	Collecting and organising data Display data related to their own activities

Learning Outcomes and Benchmarks

Subject: MATH
Strand: MEASUREMENT

****Measurement is NOT a strand in the ISS/ IBO MYP curriculum. Topics that are somewhat related to Measurement are re-allotted to Strands in NUMBER and SHAPE AND SPACE.**

Grade /Phase	**Learning Outcomes** *Students will be able to …….*	**Benchmarks**
5	· Select and use standard units of measurement and the appropriate tools to solve problems. · Determine and discuss the relationship between area, perimeter, and volume. · Demonstrate their understanding of angles as a measure of rotation, by measuring and constructing angles. · Understand that a range of procedures exists to measure different attributes of objects and events, in finding area, perimeter and volume. · Use timetables and schedules in real life situations	· Length, weight, capacity, volume and temperature · Read, write and identify standard units of measure to two decimal places · Find the volume of rectangular prisms Angles · Classify angles as acute, right, obtuse and reflex Area and perimeter · Solve problems involving area and perimeter of rectangles, squares and composite figures · Estimate the area of an irregular shape by counting squares Time · Read, Use and compare 12 and 24 hour clocks (digital and analogue)

4	· Use and select standard units of measurement to solve problems · Understand and apply a range of procedures exists to find out the area, perimeter and volume of shapes. · Count up using minutes and hours in order to determine elapsed time. · Read and write digital and analogue time on 12 hour and 24 hour clocks	· Length, weight, capacity, volume and temperature · Identify the relationship between equivalent standard units Area and perimeter · Solve problems involving area and perimeter of rectangles and squares using formulas. Time · Identify the concept of elapsed time using seconds, minutes, hours, days and weeks. · Read and write the time to the minute and second using intervals of 1
3	· Select and use appropriate tools for measurement · Use standard units of measurement to solve problems in real-life situations involving perimeter and area. · Estimate and tell time using seconds, hours, and minutes in order to choose reasonable time estimates for given activities.	Length, weight, capacity, volume and temperature · Choose and use standard metric units and their abbreviations when estimating, measuring and recording length, weight, capacity and temperature. Area and perimeter · Find the area and perimeter of squares and rectangles drawn on a square grid by counting squares Time · Tell the time to the nearest minute using analogue and digital clocks · Choose units of time to measure time intervals
2	· Use non-standard units of measurement to solve problems. · Use measures of time to assist with problem solving	· Length, weight and capacity · Estimate, measure, label and compare using non-standard units of measurement; length, weight, capacity and temperature. Time · Tell the time to the hour, half hour and quarter hour and to the nearest 5 minutes using analogue and digital clocks.

1	· Use informal/non-standard units of measurement to solve problems. · Use measures of time to assist with problem solving.	Length, weight and capacity · Estimate, measure, label and compare using informal/non-standard units of measurement; length, weight and capacity Time · Tell and write time to the hour and half hour using digital and analogue clocks
K2	· Compare a group of objects and describe them by their length · Use /non-standard units of measurement to solve problems involving length, weight and capacity · Compare the duration of two events · Sequence events within a day, and name and order the days of the week	· Length, weight and capacity · Measure the length of an object by lining up multiple units · Make direct comparisons of length, weight and capacity using non-standard measurements Time · Identify the continuity of time such as day into night, night into day · Correctly sequencing days of the week
K1	· Compare a group of objects and describe them by their length and height. · Describe a duration of time	Length, weight and capacity · Order two items by length or height · Compare the length of an object by lining up multiple units Time · Identify the continuity of time such as day into night and night into day

Learning Outcomes and Benchmarks
Subject: MATHEMATICS
Strand: NUMBER

Grade / Phase	Learning Outcome *Students will be able to...*	Benchmarks
11-12 (Standard)	**Calculus (Differentiation**) · Grasp an informal idea of limit and convergence · Learn to use appropriate limit notation · Understand the definition of the first derivative using the limit of the difference quotient · Understand that the derivative is interpreted as the gradient function and as rate of change · Calculate the derivative of the power and trigonometric functions · Differentiate the sum and real multiple of these functions · Differentiate using the chain rule for composite functions · Differentiate using product and quotient rules · Calculate the second and higher order derivatives · Locate maximum and minimum points and testing the nature of these points for maximum and minimum by calculating the second derivatives · Understand the nature of inflexion points · Understand the behaviour of functions, including the relationship between ***f, f' and f''*** **Calculus (Integration)** · Understand that integration is equivalent to anti-differentiation	· Application of concepts of functions, graphs, limits, differentiation and integration to business applications such as optimization and in physics related problems such as kinematics. · Use the Fundamental Theorem of Calculus to calculate the value of the definite integral

	· Compute the integral of power functions and basic trigonometric functions · Integrate using inspection, or substitution methods. · Calculate the integral with a boundary condition to determine the constant term · Using analytical and the GDC approaches to define integrals. · Calculate the areas of the curves and the volumes of revolution about the x-axis. · Solve kinematic problems involving displacement ***s,*** velocity ***v*** , and acceleration ***a*** · Calculate the total distance travelled	· Application of Integrals to geometrical and physical problems
10 (standard)	· Classify numbers from a list, which includes radical numbers such as · $\sqrt{2}$, as rational or irrational. · Accurately add, subtract, multiply and divide radical numbers. · Convert accurately between root form and rational exponent form. · Estimate values of numbers with rational exponents. · Use radicals within computations, both in root form and with rational exponents. · Use multiplication principles to correctly rationalise denominators for monomial and binomial square root radicals. · Apply all the strategies learned to algebraic expressions which include real number terms. · Convert between negative rational exponents and their positive radical equivalent form.	· Investigate and demonstrate understanding of the meaning and development of irrational numbers and the relationship between irrational numbers and radicals such as $\sqrt{2}$. · Rationalize denominators for monomial and binomial square root radicals. · Master understanding of positive and negative rational exponents; and its laws.

	· Apply the laws of exponents to simplify expressions containing positive and negative integer and rational exponents.	
10 (extension)	· Accurately add, subtract, multiply and divide third and fourth root radicals. · Evaluate the logarithm of a number and simplify expressions with logarithms, including use of GDC. · Perform operations with alternative base systems.	· Use cube and fourth root radical expressions, develop understanding of logarithms, and alternative base systems.
9	· Recognize and classify numbers in different number systems including the set of positive integers and zero (N), integers (Z), rational numbers (Q), irrational numbers (Q') and real numbers (R) and show visually the relationships amongst the different sets. · Mark approximate locations of various types of real number on a number line. · Accurately add, subtract, multiply and divide numbers in scientific notation form, with and without a calculator. · Compute percentages and ratios of given quantities, and express a number as a percent or ratio of another. · Round numbers correctly to a specified number of significant figures. · Use rounding strategies to make reasonable estimates. · Accurately convert fractions to recurring decimal, using the correct form of = or≈. · Draw the solution sets of linear inequalities on a number line using different sets of numbers to define the domain.	· Compute, compare and order real numbers expressed in a variety of forms; and demonstrate the difference between exact and approximate values of equivalent forms of numbers. · Interpret the meaning of linear inequalities and their relationship to number lines.
8	**Number Skills** · Identify numbers as rational or irrational and provide appropriate justification · Find equivalent forms for rational numbers including integers, fractions, repeating and terminating decimals, exponents, scientific	**Number Skills** · Students will be able to understand rational numbers, make reasonable estimates, compute fluently and solve problems when working with rational numbers and begin to develop understanding of irrational numbers

	notation and square root radicals and convert from one form to another · Read, write, compare and order rational numbers written in any form and find their approximate locations on a number line · Accurately carry-out a combination of operations with rational numbers (BEDMAS/PEMDAS) · Make reasonable estimates when finding sums, differences, products and quotients of rational numbers and judge the reasonableness of estimates · Compute operations with percent, fractions, and decimals · Apply percent to solve problems involving application of simple interest, compound interest, and percent increase/decrease · Solve a variety of problems using rational numbers in both familiar and unfamiliar situations including those in authentic real-life contexts **Exponents/Indices** · Use exponential notation (index notation) to express and simplify powers of rational numbers expressed in any form including squares, cubes, square roots and cube roots · Investigate and develop conceptual understanding of negative and zero integer exponents and represent numbers using exponential form (index notation) · Apply the laws of exponents (multiplication law, division law, power of a power, power of a product, power of a quotient) to simplify expressions containing integer exponent · Convert between scientific and standard form · Round numbers to a certain number of significant figures when using	**Exponents** · Students will be able to understand positive and negative integer exponents, scientific notation, and exponent laws, make reasonable estimates, compute fluently and solve problems when working with exponents

	scientific notation · Apply laws of exponents to numbers written in scientific notation.	
7	**Integers and Decimals** · Compute with positive and negative integer numbers and the everyday contexts that can be described with them · Read, write, compare and order integers and fractions and find their approximate locations on a number line · Accurately carry-out combinations of integer operations (PEMDAS/BEDMAS) · Make reasonable estimates when finding sums, differences, products and quotients of integers · Add, subtract, multiply and divide rational numbers to solve problems · Apply basic rounding rules to solve simple problems in real-life contexts and assess reasonableness of results · **Exponents/Indices/Power** · Express an understanding of positive exponents · Use index notation to express and simplify powers of integers · Apply multiplication and division laws of exponents to simplify products and quotients of powers of integers · Convert between scientific and standard form · Use squares and cubes of integer numbers in computation and begin to use square roots in computation · Use index notation to express and simplify powers of rational numbers expressed in fractional form including squares, cubes, square roots and cube roots **Ratio, Rate, Percentage**	**Integers, Decimals, and Ratios** · Students will be able to understand integers, make reasonable estimates, compute fluently and solve problems when working with integers **Exponents** · Students will be able to understand positive and negative integer exponents, scientific notation, and exponent laws, make reasonable estimates, compute fluently and solve problems when working with exponents

	· Use ratio as a comparison of quantities of the same kind · Use rate as a comparison of quantities of different kinds · Use proportions as statements of equivalent ratios · Use percent as a comparison with the whole (100%) · Use fractions, decimals, and percent to make estimations and perform calculations · Compare and order fractions, decimals and percent · Find the ratio of two or more quantities · Recognize and use common measures of rate · Develop meaning for percent greater than 100 and less than 1 · Calculate a given percentage of a quantity and express one quantity as a percentage of another · Calculate the percent increases and decreases of a quantity · Develop, analyse and explain methods for solving proportions such as equivalent ratios, cross multiplication, scaling, etc. **Rational Numbers** · Use common divisibility rules, factors, multiples, and prime factorizations to solve problems including finding greatest common factor (GCF) and lowest common multiple (LCM) · Explain rational numbers as a quotient of two integers · Read, write, compare and order rational numbers written in any form and find their approximate locations on a number line · Add, subtract, multiply and divide rational numbers written in any form	**Ratio, Rate, Percentage** Students will be able to understand ratios, rates, percent and proportions and develop understanding and fluency when applying proportional thinking **Rational Numbers** Students will be able to develop an understanding of rational numbers and compute with rational numbers written in any form.

	· Make reasonable estimates when performing operations with rational numbers	
6	**Multiples and factors** · Use common divisibility rules, factors, multiples, and prime factorizations to solve problems including finding greatest common factor (GCF) and lowest common multiple (LCM) · **Order of Operations** · Accurately carry out combinations of integer operations (BEDMAS/PEMDAS) · **Fractions and Decimals** · Read, write, compare and order fractions, mixed numbers and decimals and find their approximate location on a number line · Demonstrate multiple ways to represent fractions and decimals (models) · Perform operations with decimals and fractions · Write fractions in simplest form · Convert fractions to decimals and vice versa · Develop and use strategies to make reasonable estimates of fraction and decimal sums, differences, products and quotients · Basic operations with fractions and decimals · Carry out combinations of operations (BEDMAS/PEMDAS) with decimals and fractions · **Exponents/indices/powers** · Use index notation to express powers and factored form of whole numbers · Identify the first 10 square numbers · Use index notation to write cubed numbers	**Multiples and factors** Identify factors and multiples **Order of Operations** Evaluate calculations with a number of operations **Fractions and Decimals** Understand relationship between decimals and fractions **Exponents/indices/powers** Convert from index form to expanded form to standard form fluently **Rounding** Round to a specific number of places and assess the reasonableness of their results **Percentages** Students will be able to understand percent.

	· Use square and cube numbers in computations · Multiply and divide by powers of 10 and by common fractions such as ½, 1/3, ¼, etc. · **Rounding** · Round decimal numbers to a specific number of decimal places · Use appropriate forms of rounding to estimate results · Apply basic rounding rules to solve simple problems in *authentic* real-life contexts and assess reasonableness of results · **Percentages** · Demonstrate percent as a comparison with the whole amount which is called 100% · Write percent as decimals and fractions and vice versa · Express one quantity as a fraction or a percent of another · Use percentages to solve a wide variety of simple problems and assess reasonableness of results	
5	· Read, write, order, and model numbers using the base 10 system to millions. · Read, write, and represent place value of 6 digit numbers using models and symbols · Develop and analyse strategies for adding and subtracting 5 digit numbers to 3 decimal places. · Link the pattern when counting in 10s 100s and 1000s and when multiplying and dividing	Identify, count, order and group numbers up to 999,999. Group 6 digit numbers into ten thousands, thousands, hundreds, tens and units in more than one way. Addition and Subtraction Use a variety of strategies to add and subtract five digit numbers to three decimal places. Multiplication and Division Multiply whole numbers by 10, 100 and 1,000 and divide by 10 and 100

	· Develop and analyse strategies for multiplying and dividing 5 digit numbers by up to 2 digits · Confidently use a range of part/whole strategies to solve problems involving the four operations. · Apply strategies to solve money related problems up to $10,000 · Convert improper fractions to mixed numbers and vice versa in real life situations. · Estimate and make approximations in real life situations involving fractions, decimals and percentages.	Use a variety of strategies to solve multiplication and division problems involving 5 digits numbers by up to 2 digits Problem Solving Use mathematical symbols and the appropriate operation when problem solving. Money Solve problems using money/coins up to $9,999. Fractions and decimals Convert improper fractions to mixed numbers and vice versa Identify the relationship between fractions, decimals and percentages
4	· Read, write, order, and model numbers using the base 10 system to hundred thousand. · Read, write, and represent the place value of 5 digit numbers using models and symbols · Develop and analyse strategies for adding and subtracting 4 digit numbers to 2 decimal places. · Link the pattern when counting in 10s 100s and 1000s and when multiplying and dividing · Develop and analyse strategies for multiplying and dividing 3 digit numbers by up to 2 digit numbers.	Numeration and Notation **I**dentify, count, order and group numbers up to 99,999. Group 5 digit numbers into ten thousands, thousands, hundreds, tens and units in more than one way. Addition and Subtraction Use a variety of strategies to solve addition and subtraction of four digit numbers. Add and subtract four digit numbers to two decimal places using mental, written and calculator methods. Multiplication and Division Multiply whole numbers by 10, 100 and 1,000 and divide by 10 and 100 Solve multiplication and Division operations involving 3 digits by 1 or 2 digit numbers. Fractions and Decimals

	· Add and subtract fractions with related denominators · Use decimal fractions in real life situations · Apply strategies to solve money related problems up to $1,000.	Add and subtract simple common fractions with like denominators Identify the tenths and hundredths place value of a decimal Money Solve problems using money/coins up to $999
3	· Read, describe and use whole numbers up to thousands · Select an efficient method to round numbers to the nearest 10 and 100 · Develop and analyse strategies for adding and subtracting 3 digit numbers . . Develop and analyse strategies for multiplying 2 digit numbers by 1 digit number · Link the pattern when counting in 10s and 100s when multiplying and dividing · Understand and describe fractions as parts of a whole · Apply strategies to solve money related problems up to $100	Numeration and Notation Identify, count, name and order numbers up to 9,999. Round numbers to the nearest 10 and 100. Addition and Subtraction Use a variety of strategies to solve addition and subtraction of three digit numbers. Multiplication and Division Solve multiplication operations involving 2 digits by 1 digit number using a variety of strategies. Multiply and divide whole numbers by 10 and 100. Fractions and Decimals Describe simple fractions of halves, thirds and quarters in terms of equal parts of a whole number Money Solve problems using money/coins up to $99

2	· Read, describe and use whole numbers up to a thousand · Select an efficient method to round numbers to the nearest 10 · Develop and analyse strategies for adding and subtracting 2 digit numbers · Identify, describe, extend, and create numeric patterns to count in 2's, 5's and 10's. · Link the pattern when counting in 10s and 100s both forwards and backwards to 900 · Describe fractions as parts of a whole · Apply strategies to solve money related problems up to $1	Numeration and Notation Identify, count, name and order numbers up to 999 Round numbers to the nearest 10 Addition and Subtraction Use a variety of strategies to add and subtract two digit numbers Multiplication and Division Skip count using 2's, 5's and 10's Count by 10's or 100's forwards or backwards to 900 Fractions and Decimals Describe simple fractions of halves, thirds and quarters in terms of equal parts of the whole Money Solve problems using money/coins up to $1
1	· Use whole numbers up to hundreds or beyond · Count forwards and backwards beginning from a given number · Use fast recall of addition and subtraction number facts up t0 10 · Use mental and written strategies for addition and subtraction of two digits	Numeration and Notation Identify, write and count numbers up to 100. Count forward and backwards using a 100 chart and count one, two and ten more than a given number. Addition and Subtraction Identify number bonds to 20

	· Classify numbers as odd and even · Use fractions in real life situations · Apply strategies to solve money related problems up to 99c	Count on or use decomposition to add two or more numbers up to 50. Multiplication and Division Classify odd and even Fractions Identify a fraction as part of a whole, with equal sized parts and use the language in a real life situation Money Solve problems using money/coins up to 99c
K2	· Recognize, count and write numbers up to 20. · Say the forwards and backwards number word sequences in the range 0–20. · Use number words and numerals to represent quantities · Recall addition and subtraction number facts up to 10	Identify, Write and Count numbers up to 20 Identify the forward and backward counting sequence of whole numbers up to 20 Use ordinal numbers to describe the position of objects or number in a set from 1st to 10th Identify number bonds to 10
K1	· Recognize, count and write numbers up to 10 · Name the number that comes before and after a given number from 0-9 · Use the language of mathematics to compare quantities	Identify, count and write numbers up to 10 Identify the number before and after a given number up to 9 Recognise the difference in quantities when comparing sets of objects

Learning Outcomes and Benchmarks

Subject : MATH
Strand : PATTERNS AND FUNCTIONS (MS/HS ALGEBRA)
Patterns, relationships and functions comprise one of the most important themes in the study of mathematics.

Grade/Phase	**Learning Outcome** ***Students will be able to...***	**Benchmarks**
Grade 11-12 Standard (Algebra)	**Sequence & Series :** Identify the Arithmetic sequences and series; Calculate the sums of finite, arithmetic series, geometric sequences and series and sums of finite and infinite geometric series. **Exponents & Logarithms** : To understand the elementary treatment of exponents and logarithms. To apply the laws of exponents; laws of logarithms. and the change of base. **The Binomial Theorem**, Calculate the binomial coefficients using Pascal's Triangle and nCr	Solve applications of these sequences and series and apply them in real life situations such as in computing the compound interest (finance) and the harmonic series (physics).

Standard (Functions)	**Functions** Identify concept of a function State the domain and range Construct composite functions and identify the domain and range Construct the inverse of a function and identify the domain and range Sketch the graph of basic functions by hand and to use the features of the GDC to sketch out complicated functions. Use the key features of graphs, such as maximum and minimum values, intercepts, horizontal and vertical asymptotes, symmetry and consideration for domain and range To manipulate basic functions of graphs and transform them to new functions by undergoing a series of transformations that include translation, reflection, stretching (horizontal and vertical) To understand the characteristics of the quadratic function and to be able to sketch the graph using the x-intercepts (if any), the y-intercept, the lines of symmetry and its vertex (maximum or minimum). To understand the characteristics of the reciprocal function and its self-inverse. To understand and sketch the rational function using its vertical and horizontal asymptotes, and the x and y intercepts.	Solve various functions using the analytic and graphical viewpoints and will be able to use them in real-life situations. Recognize and graph the various types of functions that include polynomials, rationals, exponential and logarithmic and state the domains and range

	To understand the characteristics of the exponential functions and their graphs. To understand the characteristics of the logarithmic functions and their graphs. To understand the relationships between the exponential and logarithmic functions as these are inverses of each other. Solving the various equations both graphically and analytically. To use the features of the GDC to solving a variety of equations including those where there is no appropriate algebraic approach. Solving the quadratic equations explicitly by using the quadratic formula Using the discriminant to determine the nature of roots of the quadratic equation if they exist	Solve applications of these functions such as exponential growth, decay, population growth, compound interest, compound interest, carbon-14 dating and interpret these results in context writing solutions using in both exact form and estimated (using GDC) formats.
Grade 10	Factorize linear and quadratic expressions. Graphing different types of functions and understanding the characteristics. Analyze quadratic functions of the form $y = (x-h)^2 + k$ determine the: • vertex • domain and range • direction of opening • axis of symmetry • x- and y-intercepts. Analyze quadratic functions of the form $y = ax^2 + bx + c$ to identify characteristics of the	Determine the basic properties of quadratic relations; relate transformations of the graph of $y = x^2$ to the algebraic representation $y = a(x - h)^2 + k$; solve quadratic equations and interpret the solutions with respect to the corresponding relations; and solve problems involving quadratic relations. Investigate the transformation (graphically) of $y = a\ sin\ b(x - c) + d$ from $y - sin(x)$.

	corresponding graph, including: • vertex • domain and range • direction of opening • axis of symmetry • x- and y-intercepts and to solve problems. Solve problems that involve quadratic equations. Solve, algebraically and graphically, problems that involve systems of linear-quadratic and quadratic-quadratic equations in two variables. Demonstrate an understanding of the effects of horizontal and vertical translations on the graphs of functions and their related equations. Demonstrate an understanding of the effects of horizontal and vertical stretches on the graphs of functions and their related equations. Apply translations and stretches to the graphs and equations of functions. Demonstrate an understanding of the effects of reflections on the graphs of functions and their related equations, including reflections through the: • x-axis • y-axis	
MYP 10 Extended	Further investigation of higher degree polynomials. Demonstrate an understanding of operations on, and compositions of functions. Demonstrate an understanding of inverses of relations. Demonstrate an understanding of logarithms.	Investigate and develop understanding of the relations and functions of higher order polynomials, logarithms; and exponential.

	Demonstrate an understanding of the product, quotient and power laws of logarithms. Graph and analyze exponential and logarithmic functions. Developed, and justified or proved, general rules/ formulae for sequences Finding the sum of the series, including infinite series.	Arithmetic and Geometric Sequence and Series
9	Write, interpret and use algebraic expressions to represent and analyze mathematical situations, including finding general rules/formulae for sequences. Give definitions of the following terms: variable, term, coefficient, like terms, constant, expression, simplify, polynomial, monomial, binomial, trinomial, degree of a term or of a polynomial, writing a polynomial in descending order. Simplify, add, subtract, multiply polynomials. Solve simple rational equations. Draw a graph given the linear equation, and vice versa. Interpret and explain the relationships among data, graphs and situations. Demonstrate an understanding of relations and functions. Demonstrate an understanding of slope with	Determine the relationship between the form of an equation and the shape of its graph with respect to linearity and non-linearity; determine, through investigation, the properties of the slope and y-intercept of a linear relation; and solve problems involving linear relations

	respect to: • rise and run • line segments and lines • rate of change • parallel lines • perpendicular lines. Describe and represent linear relations, using: • words • ordered pairs • tables of values • graphs • equations. Determine the characteristics of the graphs of linear relations, including the: • intercepts • slope Relate linear relations expressed in: • slope–intercept form ($y = mx + b$) • general form ($Ax + By + C = 0$) • slope–point form ($(y – y_1) = m(x – x_1)$) to their graphs. Determine the equation of a linear relation, given: • a graph • a point and the slope • two points • a point and the equation of a parallel or perpendicular line to solve problems. Represent a linear function, using function notation.	

	Solve problems that involve systems of linear equations in two variables, graphically and algebraically. Draw and shade a graph given the linear inequality, and vice versa.	
8	**Algebraic Expressions** Demonstrate understanding of the terms: variable, term, coefficient, like terms, constant, polynomial, monomial, binomial, trinomial, simplify, evaluate, expand, expression Write algebraic expressions to represent word phrases or simple real life situations Evaluate algebraic expressions and formulas which require the use of order of operations with rational numbers simplify expressions and understand equivalent forms of expressions Simplify algebraic expressions by collecting like terms Add and subtract algebraic expressions Apply laws of exponents to multiply and divide monomial expressions Understand and use the distributive property to multiply a monomial by a polynomial, two or more binomials or two or more polynomials Begin to develop understanding of factoring as the reverse of expanding and then factor simple algebraic expressions	**Algebraic Expressions** Students will be able to write, interpret and use algebraic expressions to represent and analyze mathematical situations and structures

	Simplify, multiply, divide, add and subtract simple algebraic fractions **Linear Equations/Inequalities and Systems** Master understanding of what an equation is (with emphasis on linear equation) and what it means to solve an equation Solve a variety of linear equations including those with parentheses, fractions, decimals and variables on both sides using a variety of methods including inspection, trial and error and undoing (with emphasis placed on undoing) Check the validity of a solution of an equation by substituting the solution back into the original equation Solve word problems using a variety of methods including translating into algebraic equations Develop understanding of what a "system of simultaneous linear equations" is and what it means to find the solution to a system of equations Solve a system of linear equations in two variables using: a) Graphing method; b) Substitution method; and c) Elimination method and relate the systems to pairs of lines that intersect, are parallel or are the same line **Linear Relationships** Understand that in a linear relationship the rate of change is described by the slope (***m***) of the line so that if the input, or x-coordinate, changes by a specific amount, ***a***, the output, or y-coordinate, changes by the amount ***ma***.	**Linear Equations/Inequalities and Systems** Write, interpret and use linear equations, inequalities and systems of linear equations to represent and analyze mathematical situations and structures and solve a variety of problems

	Understand that in a linear relationship the rate of change is constant whereas in non-linear relationships the rate of change varies Investigate and develop understanding of characteristics of relationships which are linear and describe how characteristics such as slope and y-intercept appear in different representations of linear relationships Investigate and develop understanding of relationship between the equation of a linear relationship and the graph of a line, paying particular attention to the meaning of intercept and slope Investigate and develop understanding of the meaning of slopes which are positive, negative, zero, and undefined Investigate and develop understanding of different techniques that can be used to draw the graph of a linear relation including: table of value and y=mx+b form Investigate and understand the characteristics of special lines including vertical, horizontal, parallel, perpendicular Determine whether a given point satisfies the equation of a line geometrically and algebraically Understand linear functions as tools for mathematical modeling and model and solve contextualized real-life problems that involve linear relationships	**Linear Relationships** Students will be able to understand, represent and analyze relationships and change with focus on linear functions

	Identify patterns and develop understanding of arithmetic sequences as linear functions whose inputs are counting numbers, predict the next term, and begin to develop the rules which describe them	
7	**Algebraic Expressions** Identify variables as representations of numbers whose exact values are not yet specified Write algebraic expressions to represent word phrases or simple real life situations Evaluate an expression and evaluate algebraic expressions and formulas for given values which require the use of order of operations with integers Simplify expressions and simplify simple algebraic expressions by applying associative and commutative properties to collect like terms Tell the different forms of expressions. Use the distributive property to expand numerical and algebraic expressions containing monomial times binomial Understand that factoring is the reverse of expanding. Factor algebraic expressions by removing the greatest common factor Begin to simplify, multiply, divide, add and subtract simple algebraic fractions **Linear Equations**	**Algebraic Expressions** Students will be able to write, interpret and use algebraic expressions to represent and analyze mathematical situations and structures

	Refine understanding of what an equation is and what it means to solve an equation Solve a variety of one step and multi-step equations including those which require use of distributive property and with variables on both sides using a variety of methods including inspection, trial and error, and undoing (with emphasis placed on undoing). Check the validity of a solution of an equation by substituting the solution back into the original equation Solve simple word problems using a variety of methods including translating into algebraic equations **Tables, Equations, and Graphs** Represent, analyze and generalize a variety of patterns and simple relationships using different forms of representation including words, tables, graphs, and where possible equations (i.e. symbolic rules) and compare the different forms Construct and analyze tables from simple equations and then draw the graphic representations of the relationships Write equations to describe simple relationships given a tables of values or a graph of the relationship Begin to describe relationships as linear or nonlinear and contrast their properties from tables, graphs or equations Identify patterns in a variety of number sequences including linear, quadratic, triangular and Fibonacci	**Linear Equations** Students will be able to write, interpret and use linear equations to represent and analyze mathematical situations and structures and solve simple problems **Tables, Equations, and Graphs** Students will be able to understand, represent and analyze patterns and relationships using tables, equations and graphs

	sequences, predict the next term, and begin to develop the rules which describe them Develop understanding of slope as a ratio which compares vertical change to horizontal change Calculate the measure of the slope of lines with positive and negative slopes Know the difference between an expression and an equation Solve an equation by inspection, trial-and-error, and undoing Be able to simplify an equation so that the solution to the new equation also solves the original one Solve simple linear equations written in fractional and/or decimal form Solve simple word problems using a variety of methods including translating into algebraic equations Understand the distributive property and expand expressions containing monomial X binomial Be able to solve multi-step equations with variables on both sides using distributive property Know how to check the validity of a solution by substitution Have clear understanding that variables represent numbers whose exact values are not	

	yet specified Be able to write equivalent expressions in different forms Be able to write algebraic expressions to represent word phrases or simple real life situations Be able to use proper order of operations in solving algebraic expressions and formulas Begin to simplify, multiply, divide, add and subtract simple algebraic fractions Be able to collect like terms to simplify algebraic expressions	
6	**Algebra** Know that variables represent numbers whose exact values are not yet specified Write algebraic expressions to represent word phrases or simple real life situations Evaluate algebraic expressions and formulas by substituting the variables with given values Simplify simple algebraic expressions by collecting like terms Understand that expressions in different forms are equivalent but some are more compact or	**Algebraic Expressions** Students will be able to write, interpret and use algebraic expressions to represent and analyze mathematical situations and structures

	feature different information Solve simple one step linear equations using a variety of strategies including inspection, trial and error, and undoing. **Coordinate Geometry** Know the different components of the Cartesian plane (origin, horizontal axis, vertical axis, quadrants, etc.) Plot points in all four quadrants of the Cartesian plane Draw graphs of patterns and relations in all four quadrants of the Cartesian plane Use the Cartesian plane to plot points or simple figures and determine their image under translations and reflections Recognize and determine the reflection and rotation symmetries of a figure Find the reflection line of a symmetrical shape of picture Determine the center and the order of rotation of a shape or picture Use the Cartesian plane to draw simple figures	**Coordinate Geometry** Specify locations and describe spatial relationships using coordinate geometry

	and determine simple lengths and areas related to them	
Grade 5	Select appropriate methods to analyse patterns and identify rules Write expressions and equations that correspond to given situations Use functions to solve problems	Describe and create a rule for numerical and geometrical patterns and the extend the patterns Solve algebraic expressions that represent simple solutions Problem solving Represent a problem situation using words, numbers, pictures, physical objects, graphs and symbols.
Grade 4	Select appropriate methods for representing patterns Perform calculations correctly to solve problems Use the properties and relationships of the four operations to solve problems Use functions to solve problems	Identify patterns and rules for inverse operations (addition, subtraction,multiplication and division) Identify how to use a calculator to solve simple problems Problem Solving Select from a variety of problem solving strategies and use one or more Represent a problem situation using words, numbers, pictures, physical objects, graphs and symbols.
Grade 3	Represent rules for patterns using words, symbols and tables.	Use mathematical symbols and vocabulary in problem solving

	Understand that multiplication is repeated addition and division is repeated subtraction Use the properties and relationships of the four operations to solve problems Identify and explain mathematical relationships using charts and diagrams to solve problems	Identify the inverse relationship of addition and subtraction Problem Solving Select from a variety of problem solving strategies and use one or more Identify and describe how a problem was solved (e.g. pictures, words, numbers, stories)
Grade 2	Use the properties and relationships of addition and subtraction to solve problems Use number patterns to represent and understand real life situations Use mathematical equations based on the information provided in the problem.	Identify patterns and rules for addition and subtraction. Demonstrate an understanding of pattern in real life situation using problem solving Problem Solving Identify the given information that can be used to solve a problem

Grade 1	Understand that patterns can be found in numbers Select one or more appropriate strategies to help resolve the problem.	Construct, extend and describe patterns Problem Solving Describe how a problem was solved using one or more strategies
K2	Extend and Create Patterns Identify and describe patterns in various ways	Copy, construct and extend simple patterns Compare two quantities up to 10 to see which is great than, less than or equal to
K1	Understand that patterns can be found in everyday situations Describe patterns in various ways	Explore with simple patterns Identify the unit of a repeating pattern