

Mathematics in the PYP

Students investigate the following 5 strands to enable them to develop their conceptual and practical understanding:

- Number
- Shape and space
- Pattern and function
- Measurement
- Data handling

Data handling

Students will discuss, compare and create sets that have subsets; design a survey; and process and interpret the data on a bar graph where the scale represents larger quantities. They will manipulate information in a database. They will find, describe and explain the mode in a set of data and will use probability to determine the outcome of mathematically fair and unfair games.

Measurement

Students will estimate, measure, label and compare length, mass, time and temperature using formal methods and standard units of measurement. They will determine appropriate tools and units of measurement including the use of small units of measurement for precision (cm, mm, °C). They will also estimate, measure, label and compare perimeter and area, using non-standard units of measurement. Students will model the addition and subtraction of money and be able to read and write time to the minute and second.

Shape and space

Students will sort, describe and model regular and irregular polygons, including identifying congruency in 2-D shapes. They will combine and transfer 2-D shapes to create another shape. They will identify lines and axes of reflective and rotational symmetry, understand angles as a measure of rotation and locate features on a grid using coordinates.

Pattern and function

Students will recognize, describe and analyze patterns in number systems. They will identify patterns and rules for multiplication and division, together with their relationship with addition and subtraction. They will model multiplication as an array and use number patterns to solve problems.

Number

Students will read, write, estimate, count, compare and order numbers to 1000, extending understanding of the base 10 system to the thousands. They will read, write and model multiplication and division problems. They will use and describe multiple strategies to solve addition, subtraction, multiplication and division problems, reasonably estimating the answers. They will compare fractions using manipulatives, and develop appropriate mathematical vocabulary.

Detailed below are skills developed by students. The phases usually cover two year group levels in recognition of the varying developmental rates of students. Teachers use differentiation in their teaching to ensure students can progress at their own rate.

Phase 1

Data handling: statistics

- sort and label objects into sets by one or more attributes
- collect, display and interpret data for the purpose of finding information
- understand the purpose of graphing data
- create a pictograph and simple bar graph from a graph of real objects

Measurement

- compare using nonstandard units of measurement: length, mass, time and temperature and use non-standard units to solve problems in real-life situations
- identify, compare and describe attributes of real objects, for example longer, shorter, heavier, empty, full, hotter, colder
- identify, describe and sequence events in their daily routine, for example before, after, bedtime, storytime, today, tomorrow

Shape and space

- understand that 2D and 3D shapes have characteristics that can be described and compared
- understand that common language can be used to describe position and direction, for example inside, outside, above, below, next to, behind, in front of, up down
- sort, describe and compare 3D shapes
create 2-D shapes

Pattern and function

- create, describe and extend patterns in various ways

Number

- count to determine the number of objects in a set
- use number words and numerals to represent quantities in real life situations
- use mathematical language to compare quantities, e.g. more, less, first, second
- use simple fraction names

Phase 2

Data handling: statistics

- discuss, compare and create sets from data that has subsets using tree, Carroll, Venn and other diagrams design a survey, process and interpret the data
- collect and display data in a bar graph, and interpret data by comparing quantities: more, fewer, less than, greater than
- use the scale on the vertical axis of a bar graph to represent large quantities
- understand the purpose of a database by manipulating the data to answer questions and solve problems.

- discuss, identify, predict and place outcomes in order of likelihood: impossible, unlikely, likely and certain.

Measurement

- understand why we use standard units of measurement to measure
- estimate, measure, label and compare using formal methods and standard units of measurement: length, mass, time and temperature
- model addition and subtraction using money
- read and write the time to the hour, half hour and quarter hour.
- use a calendar to determine the date, and to identify and sequence days of the week and months of the year
- estimate, identify and compare lengths of time: second, minute, hour, day, week, month

Shape and space

- use what they know about 3-D shapes to see and describe 2-D shapes
- sort and label 2-D and 3-D shapes using appropriate mathematical vocabulary: sides, corners, circle, sphere, square, cube
- combine and transform 2-D shapes to make another shape
- create symmetrical patterns, including tessellation
- identify lines and axes of reflective symmetry
- find and explain symmetry in their immediate environment
- create and explain simple symmetrical designs
- give and follow simple directions, describing paths, regions and boundaries of their immediate environment

Pattern and function

- recognize, describe and extend patterns in numbers: odd and even, skip counting, 2s, 5s and 10s
- identify patterns and rules for addition: $4 + 3 = 7$, $3 + 4 = 7$ (commutative property)
- identify patterns and rules for subtraction: $7 - 3 = 4$, $7 - 4 = 3$
- model, with manipulatives, the relationship between addition and subtraction: $3 + 4 = 7$, $7 - 3 = 4$.

Number

- read, write and model numbers, using the base 10 system, to 100
- count (in 1s, 2s, 5s and 10s), compare and order numbers to 100
- estimate quantities to 100
- use mathematical vocabulary and symbols of addition and subtraction: add, subtract, difference, sum, +, -
- read, write and model addition and subtraction to 20 (with and without regrouping)
- automatically recall addition and subtraction facts to 10
- describe the meaning and use of addition and subtraction

- explore and model multiplication and division using their own language/ methods
- use fraction names (half, quarter) to describe part and whole relationships
- estimate the reasonableness of answers
- select and explain an appropriate method for solving a problem.

Phase 3

Data handling: statistics

- design a survey and systematically collect, organize and record the data in displays: pictograph, bar graph, line graph
- create, interpret, discuss and compare data displays (pictograph, bar/line graph) including how well they communicate information
- find, describe and explain the mode in a set of data and its use
- use probability to determine mathematically fair and unfair games and to explain possible outcomes.

Measurement

- select and use appropriate standard units of measurement when estimating, describing, comparing and measuring
- use measuring tools, with simple scales, accurately
- understand that the accuracy of a measurement depends on the situation and the precision of the tools
- develop procedures for finding area, perimeter and volume
- determine the relationships between area and perimeter
- estimate, measure, label and compare, using formal methods and standard units of measurement, the dimensions of area, perimeter
 - understand that an angle is a measure of rotation
- describe measures that fall between numbers on a measure scale: $3\frac{1}{2}$ kg, between 4cm and 5cm
- read and write the time to the minute and second, using intervals of 10 minutes, 5 minutes and 1 minute, on 12-hour and 24- hour clocks.

Shape and space

- sort, describe and model regular and irregular polygons: triangles, hexagons, trapeziums
- identify, describe and model congruency in 2-D shapes
- understand an angle as a measure of rotation by comparing and describing rotations: whole turn; half turn; quarter turn; north, south, east and west on a compass
- locate features on a grid using coordinates.

Pattern and function

- analyse patterns in number systems to 100
- recognize, describe and extend more complex patterns in numbers
- identify patterns and rules for multiplication and division: $4 \times 3 = 12$, $3 \times 4 = 12$, $12 \div 3 = 4$, $12 \div 4 = 3$
- model, with manipulatives, the relationship between multiplication and division

- model, with manipulatives, the relationship between multiplication and addition (repeated addition)
- model, with manipulatives, the relationship between division and subtraction
- understand and use the relationship between multiplication and division (inverse function)
- understand and use the relationship between multiplication and addition
- understand and use the relationship between division and subtraction
- model and explain number patterns
- use real-life problems to create a number pattern, following a rule

Number

- read, write and model numbers, using the base 10 system, to 1000
- count, compare and order numbers to 1000
- estimate quantities to 1000
- count in 3s, 4s, 5s, and explore other numbers
- use number patterns to learn multiplication tables: 1s, 2s, 4s, 5s, 10s
- automatically recall basic addition and subtraction facts
- model addition and subtraction equations to 1000 (with and without regrouping)
- use mathematical vocabulary and symbols of multiplication and division: times, divide product, quotient, %, +
- use and describe multiple strategies to solve addition, subtraction, multiplication and division problems
- read, write and model multiplication and division problems
- compare fractions using manipulatives and using fractional notation
- model addition and subtraction of fractions with the same denominator
- use mathematical vocabulary and symbols of fractions: numerator, denominator, equivalence
- understand and model the concept of equivalence to 1: two halves = 1, three thirds = 1
- reasonably estimate answers: rounding and approximation
- select and explain an appropriate method for solving a problem.

Phase 4

Data handling: statistics

- design a survey and systematically collect, organize and record the data in displays: pictograph, bar graph, circle graph (pie chart), line graph
- create, interpret, discuss and compare data displays (pictograph, pie chart, bar/line graph) including how well they communicate information
- find, describe and explain the range, mode, median and mean in a set of data and understand their use
- create and manipulate an electronic database for their own purposes
- set up a spreadsheet, using simple formulas, to manipulate data and to create graphs
- use a numerical probability scale 0 to 1 or 0% to 100%

- determine the theoretical probability of an event and explain why it might differ from experimental probability

Measurement

- select and use appropriate tools and standard units of measurement when estimating, describing, comparing and measuring
- use measuring tools, with simple scales, accurately
- understand that the accuracy of a measurement depends on the situation and the precision of the tools
- develop procedures for finding area, perimeter and volume
- determine the relationships between area, perimeter and volume
- estimate, measure, label and compare, using formal methods and standard units of measurement, the dimensions of area, perimeter and volume
- use decimal notation in measurement: 3.2cm, 1.47kg
- understand that an angle is a measure of rotation
- measure and construct angles in degrees using a protractor
- use and construct timetables (12-hour and 24-hour) and time lines to determine times worldwide.

Shape and space

- use the geometric vocabulary of 2-D and 3-D shapes: parallel, edge, vertex
- classify, sort and label all types of triangles and quadrilaterals: scalene, isosceles, equilateral, right-angled, rhombus, trapezium, parallelogram, kite, square, rectangle
- understand and use the vocabulary of types of angle: obtuse, acute, straight, reflex
- understand and use geometric vocabulary for circles: diameter, radius, circumference
- use a pair of compasses
- understand and use the vocabulary of lines, rays and segments: parallel, perpendicular
- describe, classify and model 3-D shapes
- turn a 2-D net into a 3-D shape and vice versa
- find and use scale (ratios) to enlarge and reduce shapes
- use the language and notation of bearing to describe position
- read and plot coordinates in four quadrants.

Pattern and function

- understand and use the relationship between multiplication and addition
- understand and use the relationship between multiplication and division (inverse function)
- understand and use the relationship between division and subtraction
- model and explain number patterns
- use real-life problems to create a number pattern, following a rule
- develop, explain and model simple algebraic formulas in more complex equations: $x + 1 = y$, where y is any even whole number

- model exponents as repeated multiplication
- understand and use exponents and roots as inverse functions: 9^2 , $\sqrt{81}$.

Number

- read, write and model numbers, using the base 10 system, to millions and beyond; and to thousandths and beyond
- automatically recall and use basic number facts
- create and solve multiple digit multiplication and division problems
- read, write and model addition and subtraction of fractions with related denominators
- read, write and model improper fractions and mixed numbers
- compare and order fractions
- model equivalency of fractions: $\frac{2}{4} = \frac{1}{2}$
- simplify fractions
- use the mathematical vocabulary of fractions: improper, mixed numbers
- read, write and model the addition and subtraction of decimals to the thousandths
- read, write and model multiplication and division of decimals (with reference to money)
- round decimals to a given place or whole number
- read, write and model percentages
- interchange fractions, percentages and decimals
- find and use ratios
- read, write and model integers
- read, write and model addition and subtraction of integers (negative numbers)
- read, write and model exponential notation
- select and defend the most appropriate and efficient method of solving a problem: mental estimation, mental arithmetic, pencil and paper algorithm, calculator.