DISCOVERY COLLEGE
智新書院

# MATHEMATICS POLICY & SCOPE AND SEQUENCE

Developed Term 1 2009

Last updated: 4 January 2010

## Vision

It is our vision that the students of Discovery College will develop a positive attitude to Mathematics and be able to view the world mathematically.

## Goals

Our Mathematics curriculum aims to develop the following:

- Confidence and competence in dealing with Mathematics in everyday situations
- Thinking and acting as mathematicians
- Positive attitudes towards involvement in Mathematics
- The ability to use Mathematics to solve problems both independently and collaboratively, in groups or as a whole class
- The ability to communicate mathematically, through mathematical discourse and the recording of ideas in a variety of written formats
- The acquisition of strategies to solve mathematical problems
- An understanding that Mathematics is a language and a way of thinking not just a body of knowledge
- Exploration of techniques and tools, which reflect modern Mathematics
- An interactive process through which students validate the meaning they construct from their experiences with mathematical situations

## Definition

Mathematics is an area of the curriculum where students develop knowledge and understanding of:

- Measurement
- Shape and Space
- Pattern and Function
- Number
- Data Handling

Students are encouraged to explore relationships between these strands. Students learn ways of thinking and doing which enables the development of these ideas along with the application and communication of Mathematics in a wide range of contexts.

## Belief Statement

*We believe students learn Mathematics best when:*

***They are given the opportunity to construct meaning.***
Therefore we will:
- Find out students prior knowledge on topics
- Plan activities that allow students to build upon their prior knowledge
- Plan activities through which students construct meaning from direct experiences by using manipulatives and conversation
- Provide purposeful and relevant learning tasks, where possible authentically embedding Mathematics into the POI

***They are actively involved in their learning.***
Therefore we will:
- Provide concrete materials, student collections and purchased resources
- With the students identify things that they already know that might be relevant to an inquiry, what they want to know, what they need to know to answer their questions and how best they might find out
- Encourage students to make links to real life contexts
- Establish structures so that adults and students can give each other feedback

***They are able to progress at their own rate.***
Therefore we will:
- Provide open entry and open ended activities
- Be aware of individual capabilities and plan appropriate learning experiences and assessment strategies
- Be aware of individual interests and learning styles and plan appropriate learning experiences and assessment strategies to suit these
- Encourage students to set their own learning goals
- Use inquiry questions

***They are given the opportunity and time to explore and question.***
Therefore we will:
- Actively involve students in their learning
- Help students to develop effective questioning skills
- Provide opportunities for students to communicate mathematically, either through journal writing or whole class sharing
- Make the purpose of the activities clear to students
- Add a reflective layer to our units of work

***They are encouraged to take risks in their learning.***
Therefore we will:
- Provide students with a positive and secure environment
- Encourage students to build new understandings from their direct experiences, successful or not
- Encourage students to accept challenges
- Encourage students to take risks in their learning

***They are challenged within a supportive environment***.
Therefore we will:
- Provide a flexible classroom arrangement
- Value all ideas

- Ensure students have clear goals/roles
- Model appropriate skills when needed
- Allow students to work in groups, pairs or individually, while being responsible for the recording of their own ideas and thinking

***They have the opportunity to communicate mathematically***.
Therefore we will:
- Provide the symbols for the students for them to describe their understanding
- Provide opportunities for students to share and reflect their discoveries and challenges, (whole class, small group, paired sharing)
- Encourage students to write about their mathematical thinking through journal writing
- Provide students with written and oral feedback about their mathematical thinking

***They have the chance to inquire into topics of interest to them.***
Therefore we will:
- Provide 'front loading' time for students to become familiar with topics
- Provide a choice of open ended tasks or learning experiences for students
- Provide multiple resources for use in investigation of personal questions
- Encourage children to investigate their own questions

***Continuity of work is provided***.
Therefore we will:
- Keep records of student learning
- Use these records to inform teaching and learning
- Collaboratively plan units of work with year level teams

***Teachers continue to develop professionally.***
Therefore we will:
- Ensure all new staff have the opportunity to undertake PD in Mathematics through training with the PYP coordinator or PYP and Mathematics workshops
- Have staff meetings devoted to the teaching and learning of Mathematics
- Promote Maths professional development courses available to staff
- Promote the sharing of success and new knowledge acquired from Professional Development through staff meetings and ESF wide meetings

***Parents are involved in their learning.***
Therefore we will:
- Talk about Mathematics at Parent Information Nights
- Run parent workshops on a needs basis
- Invite parents to Student Led Conferences where the students are given the opportunity to share their mathematical learning
- Communicate with parents about the best ways to support their child's numeracy development

## Assessment

Assessment in the classroom is regular and ongoing and is used by teachers to plan their Mathematics curriculum and to monitor what the students have learnt.

## Classroom Assessment

Strategies include:

- Checklists
- Anecdotal records
- Work samples
- Self evaluation
- Peer evaluation

There should be ongoing formative assessments as well as summative. The activities used should be carefully planned; giving the students opportunities to self assess using a variety of methods.

EAL learners may require special attention in order to fully participate in the learning engagements. When assessing the understandings of the EAL learners, care must be taken not to underestimate the student's ability due to their lack of language proficiency.
Teachers, who are concerned about a particular student's Numeracy development, can refer them to the Learning Development team. Appropriate support strategies will be developed and implemented in collaboration with the classroom teacher.

# MATHEMATICS IN THE PRIMARY YEARS PROGRAMME

## Beliefs and values in Mathematics

All students deserve an opportunity to understand the power and beauty of Mathematics.

*Principles and standards for school Mathematics*
*National Council of Teachers of Mathematics (NCTM 2000)*

In the PYP, Mathematics is viewed primarily as a vehicle to support inquiry, providing a global language through which we make sense of the world around us. It is intended that students become competent users of the language of Mathematics, and can begin to use it as a way of thinking, rather than seeing it as a series of facts and equations to be memorized. The power of Mathematics for describing and analysing the world around us is such that it has become a highly effective tool for solving problems.

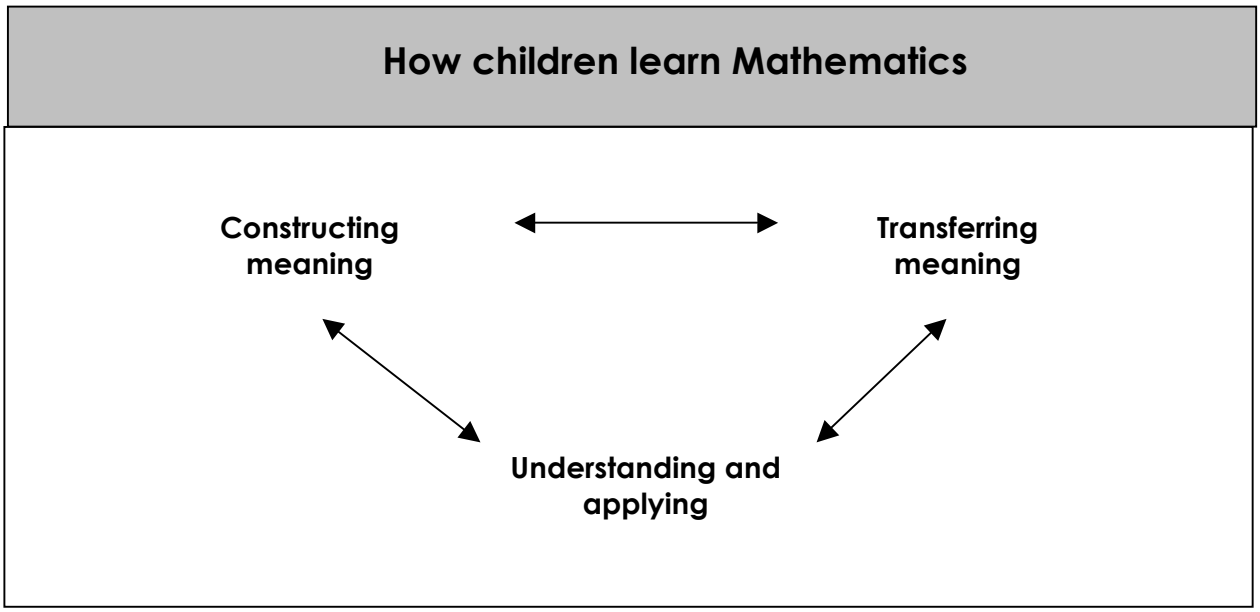
It is also recognized that students can appreciate the intrinsic fascination of Mathematics and explore the world through its unique perceptions.

It is important that students acquire mathematical understanding by constructing their own meaning, through ever-increasing levels of abstraction. Moreover, it is fundamental to the philosophy of the PYP that, since it is to be used in context, Mathematics needs to be taught in relevant, realistic contexts, rather than through an attempt to impart a fixed body of knowledge directly to students.

The IB learner profile is integral to teaching and learning Mathematics in the PYP because it represents the qualities of effective learners and internationally minded students. The learner profile, together with the five essential elements of the programme—knowledge, concepts, skills, attitudes and action—informs planning, teaching and assessing in Mathematics.

## Good Mathematics practice

Any development of mathematical understanding should start with students exploring their own personal experiences, understandings and knowledge. Schools that have local and/or national curriculum requirements should articulate how best these can be incorporated into their planning, teaching and assessing of Mathematics. An example of how children learn Mathematics is described in the following stages.




*It is useful to identify these stages when planning developmentally appropriate learning experiences at all ages.*

**Constructing meaning about mathematics**
Learners construct meaning based on their previous experiences and understanding, and by reflecting upon their interactions with objects and ideas. Therefore, involving learners in an active learning process, where they are provided with possibilities to interact with manipulatives and to engage in conversations with others, is paramount to this stage of learning mathematics.
When making sense of new ideas all learners either interpret these ideas to conform to their present understanding or they generate a new understanding that accounts for what they perceive to be occurring. This construct will continue to evolve as learners experience new situations and ideas, have an opportunity to reflect on their understandings and make connections about their learning.

**Transferring meaning into symbols**
Only when learners have constructed their ideas about a mathematical concept should they attempt to transfer this understanding into symbols. Symbolic notation can take the form of pictures, diagrams, modelling with concrete objects and mathematical notation. Learners should be given the opportunity to describe their understanding using their own method of symbolic notation, then learning to transfer them into conventional mathematical notation.

**Applying with understanding**
Applying with understanding can be viewed as the learners demonstrating and acting on their understanding. Through authentic activities, learners should independently select and use appropriate symbolic notation to process and record their thinking. These authentic activities should include a range of practical hands-on problem-solving activities and realistic situations that provide the opportunity to demonstrate mathematical thinking through presented or recorded formats. In this way, learners are able to apply their understanding of mathematical concepts as well as utilize mathematical skills and knowledge. As they work through these stages of learning, students and teachers use certain processes of mathematical reasoning.
- They use patterns and relationships to analyse the problem situations upon which they are working.
- They make and evaluate their own and each other's ideas.

• They use models, facts, properties and relationships to explain their thinking.
• They justify their answers and the processes by which they arrive at solutions.
In this way, students validate the meaning they construct from their experiences with mathematical situations. By explaining their ideas, theories and results, both orally and in writing, they invite constructive feedback and also lay out alternative models of thinking for the class. Consequently, all benefit from this interactive process.

## The role of Mathematics in the programme of inquiry

Wherever possible, Mathematics should be taught through the relevant, realistic context of the units of inquiry. The direct teaching of Mathematics in a unit of inquiry may not always be feasible but, where appropriate, prior learning or follow-up activities may be useful to help students make connections between the different aspects of the curriculum. Students also need opportunities to identify and reflect on "big ideas" within and between the different strands of Mathematics, the programme of inquiry and other subject areas.

Links to the transdisciplinary themes should be made explicitly, whether or not the Mathematics is being taught within the programme of inquiry. A developing understanding of these links will contribute to the students' understanding of Mathematics in the world. The role of inquiry in Mathematics is important, regardless of whether it is being taught inside or outside the programme of inquiry. However, it should also be recognized that there are occasions when it is preferable for students to be given a series of strategies for learning mathematical skills (including rote learning) in order to progress in their mathematical understanding rather than struggling to proceed.

## How Mathematics practices are changing

Structured, purposeful inquiry is the main approach to teaching and learning Mathematics in the PYP. However, it is recognized that many educational innovations (or, more accurately, educational re-workings) suffer from the advocacy of a narrow, exclusive approach. The PYP represents an approach to teaching that is broad and inclusive, in that it provides a context within which a wide variety of teaching strategies and styles can be accommodated, provided that they are driven by a spirit of inquiry and a clear sense of purpose.

The degree of change needed to teach Mathematics in this way will depend on the individual teacher. For those teachers who have grown weary of imposed change for which they see little point, it should be stressed that teachers are not expected to discard years of hard-earned skill and experience in favour of someone else's ideas on good teaching. It is suggested, rather, that teachers engage in reflection on their own practice, both individually and in collaboration with colleagues, with a view to sharing ideas and strengths, and with the primary aim of improving their teaching to improve student learning. In doing so, they will be modelling the skills and attitudes that have been identified as essential for students.

As an aid to reflection, the following set of subject-specific examples of good practice has been produced. It is believed that these examples are worthy of consideration by anyone committed to continuous improvement.

| How are Mathematics practices changing? | |
|---|---|
| ***Increased emphasis on:*** | ***Decreased emphasis on:*** |
| Connecting mathematical concepts and applications to learning | Treating Mathematics as isolated concepts and facts |
| Manipulatives, to make Mathematics understandable to students | Rote learning, memorization and symbol manipulation |
| Real-life problem solving using Mathematics | Word problems as problem solving |
| Instruction built on what students know, what they want to know, and how they best might find out | Instruction focused on what students do not know |
| A variety of strategies for possible multiple solutions – emphasis on process | One answer, one method, emphasis on answer |
| Students being encouraged to speculate and pursue hunches | The teacher as the sole authority for right answers |
| A broad range of topics regardless of computational skills | Computational mastery before moving on to other topics |
| Mathematics as a means to an end | Teaching Mathematics disconnected from other learning |
| The use of calculators and computers for appropriate purposes | A primary emphasis on pencil and paper computations |
| Programme of inquiry as the context for learning | Textbook as the context for learning |
| Students investigating, questioning, discussing, justifying and journaling their Mathematics | The use of worksheets |
| Students and teachers engaged in mathematical discourse | Teacher telling about Mathematics |

## Knowledge and skills in Mathematics

The Mathematics component of the curriculum of the PYP encompasses measurement, shape and number, and their many applications to students' everyday lives. Mathematics provides opportunities for students to engage in investigations into measurement, shape and number, and allows them to communicate in a language that is concise and unambiguous. Mathematics concepts and skills can also be applied to solve a variety of real-life problems. Students apply their mathematical reasoning to a number of situations in order to find an appropriate answer to the problems they wish to solve.

In the PYP, the Mathematics component of the curriculum should be driven by concepts and skills rather than by content. The key concepts identified in the "Concepts: what do we want students to understand?" section are inevitably influential in driving the curriculum, but there are many other related Mathematics concepts that provide further understanding of the subject area.

The Mathematics scope and sequence (2003) document identifies the expectations considered appropriate in the PYP. Within each of these interconnected strands, there should be a balance between the acquisition of knowledge and skills and the development of conceptual understanding. The Mathematics knowledge component is arranged into five strands: **data handling, measurement, shape and space, pattern and function** and **number**.

In the **number** and **pattern and function** strands, students and teachers inquire into number systems and their operations, patterns and functions. They become fluent users of the language of Mathematics as they learn to understand its meanings, symbols and conventions.

**Data handling, measurement** and **shape and space** are the areas of Mathematics that other disciplines use to research, describe, represent and understand aspects of their domain. Mathematics provides the models, systems and processes for handling data, making and comparing measurements, and solving spatial problems. These three strands are, therefore, best studied in authentic contexts provided by the transdisciplinary units of inquiry.

All curriculum areas provide an opportunity to utilize the transdisciplinary skills identified in figure 8 in the "Skills: what do we want students to be able to do?" section. The Mathematics component of the curriculum also provides opportunities for students to:

- count, sort, match and compare objects, shapes and numbers
- recognize and continue patterns (and relationships)
- use mathematical vocabulary and symbols (including informal Mathematics)
- develop and implement/trial strategies for investigating a range of mathematical questions or problems
- select and use appropriate Mathematics (operations, computations and units) to solve numerical and word problems
- make reasonable estimates
- analyse, make predictions and infer from data
- become confident and competent users of ICT in Mathematics learning.

## Mathematics strands

**What do we want students to know?**

**Data handling** Data handling allows us to make a summary of what we know about the world and to make inferences about what we do not know.

- Data can be recorded, organized, represented and summarized in a variety of ways to highlight similarities, differences and trends; the chosen format should illustrate the information without bias or distortion.
- Probability can be expressed qualitatively by using terms such as "unlikely", "certain" or "impossible". It can be expressed quantitatively on a numerical scale.

**Measurement** To measure is to attach a number to a quantity using a chosen unit. Since the attributes being measured are continuous, ways must be found to deal with quantities that fall between numbers. It is important to know how accurate a measurement needs to be or can ever be.

**Shape and space** The regions, paths and boundaries of natural space can be described by shape. An understanding of the interrelationships of shape allows us to interpret, understand and appreciate our two and three-dimensional world.

**Pattern and function** To identify pattern is to begin to understand how Mathematics applies to the world in which we live. The repetitive features of patterns can be identified and described as generalized rules called "functions". This builds a foundation for the later study of algebra.

**Number** Our number system is a language for describing quantities and the relationships between quantities. For example, the value attributed to a digit depends on its place within a base system. Numbers are used to interpret information, make decisions and solve problems. For example, the operations of addition, subtraction, multiplication and division are related to one another and are used to process information in order to solve problems. The degree of precision needed in calculating depends on how the result will be used.

**Related concepts:** There are many related concepts that could provide further links to the transdisciplinary programme of inquiry or further understanding of the subject area. Related concepts, such as pattern, boundaries and base systems, have been embedded into the descriptions for each of the strands above. Schools may choose to develop further related concepts.

## Key concepts in the PYP: what do we want students to understand about Mathematics?

Central to the philosophy of the PYP is the principle that purposeful, structured inquiry is a powerful vehicle for learning that promotes meaning and understanding, and challenges students to engage with significant ideas. Hence in the PYP there is also a commitment to a **concept-driven curriculum** as a means of supporting that inquiry. There are clusters of ideas that can usefully be grouped under a set of overarching concepts, each of which has major significance within and across disciplines, regardless of time or place.

These key concepts are one of the essential elements of the PYP framework. It is accepted that these are not, in any sense, the only concepts worth exploring. Taken together, they form a powerful curriculum component that drives the teacher- and/or student-constructed inquiries that lie at the heart of the PYP curriculum.

When viewed as a set of questions, the concepts form a research tool that is manageable, open-ended and more readily accessible to students. It is these questions, used flexibly by teachers and students when planning an inquiry-based unit, that shape that unit, giving it direction and purpose.

The following table explains each concept from both the generic perspective and the Mathematics perspective; a full explanation of the key concepts is found in the "Concepts: what do we want students to understand?" section.

| *Concept* | *Generic perspective* | *Mathematics perspective* |
|---|---|---|
| ***FORM***<br>*What is it like?* | Everything has a form with recognizable features that can be observed, identified, described and categorized. | The recognition, categorization and description of patterns throughout the curriculum. |
| ***FUNCTION***<br>*How does it work?* | Everything has a purpose, a role or a way of behaving that can be investigated. | The examination of systems, relationships, mechanics, components and patterns. |
| ***CAUSATION***<br>*Why is it like it is?* | Things do not just happen. There are causal relationships at work, and actions have consequences. | An examination of the mathematical concepts and processes that influence the way things are. |
| ***CHANGE***<br>*How is it changing?* | Change is the process of movement from one state to another. It is universal and inevitable. | Looking for evidence of change, analysing the evidence, drawing conclusions and making predictions. |
| ***CONNECTION***<br>*How is it connected to other things?* | We live in a world of interacting systems in which the actions of any individual element affect others. | The examination of systems and strategies to identify different kinds and levels of relationships, within and between different strands of Mathematics and beyond to other subject areas. |
| ***PERSPECTIVE***<br>*What are the points of view?* | Knowledge is moderated by perspectives. Different perspectives lead to different interpretations, understandings and findings. Perspectives may be individual, group, cultural or disciplinary. | The examination of different ways individuals and cultures use Mathematics to solve problems. Developing respect for varied interpretations, explanations, strategies and solutions. |
| ***RESPONSIBILITY***<br>*What is our responsibility?* | People make choices based on their understandings, and the actions they take as a result do make a difference. | Understanding the importance of communicating accurately and appreciating the obligation to apply Mathematics with honesty. |
| ***REFLECTION***<br>*How do we know?* | There are different ways of knowing. It is important to reflect on our conclusions, to consider our methods of reasoning, and the quality and reliability of the evidence we have considered. | Being able to communicate how we have come to understand an idea, concept or skill. Being able to evaluate the effectiveness of strategies and tools used in order to inform future learning. |

## Examples of questions that illustrate the key concepts

The following table provides sample teacher/student questions that illustrate the key concepts, which may help to structure or frame an inquiry. These examples demonstrate broad, open-ended questioning — requiring investigation, discussion, and a full and considered response—that is essential in an inquiry-led programme. Further examples can be found in the Mathematics scope and sequence (2003) document.

| *Concept* | *Sample teacher/student questions* |
|---|---|
| ***FORM***<br>*What is it like?* | • What is a pattern?<br>• How can we describe these shapes?<br>• What is a fraction?<br>• How can we describe time? |
| ***FUNCTION***<br>*How does it work?* | • How does the scale on a graph work?<br>• What happens if we keep adding?<br>• What is each shape being used for?<br>• How can we record time? |
| ***CAUSATION***<br>*Why is it like it is?* | • Why is a block the best shape for building a tower?<br>• Why do these calculations produce patterns?<br>• What prompted people to develop a place value system?<br>• Why was the data displayed in this form? |
| ***CHANGE***<br>*How is it changing?* | • How can we convert from the 12-hour clock to the 24-hour clock?<br>• How can you change one quadrilateral into another?<br>• What do all patterns have in common?<br>• What would happen to the area of something if…? |
| ***CONNECTION***<br>*How is it connected to other things?* | • How can you use fractions to explain musical notation?<br>• How are 4 + 3 and 3 + 4 connected?<br>• What do you already know that helps you to read and interpret this display of data?<br>• How is area connected to perimeter? |
| ***PERSPECTIVE***<br>*What are the points of view?* | • Are there some different ways of explaining this?<br>• Who might be interested in, or be able to use, the results of our survey?<br>• How do people calculate in different cultures?<br>• What would make this game fair to all players? |
| ***RESPONSIBILITY***<br>*What is our responsibility?* | • What makes your answer reasonable?<br>• Why does the measurement need to be accurate?<br>• How have you collected all the relevant data? |
| ***REFLECTION***<br>*How do we know?* | • How do you know that you are correct?<br>• Which way works the best? Why?<br>• What could you do differently if you repeated the survey?<br>• Why are our estimates realistic? |

# Overall expectations in Mathematics

## Data Handling
## Overall expectations

**Phase 1**

Learners will develop an understanding of how the collection and organization of information helps to make sense of the world. They will sort, describe and label objects by attributes and represent information in graphs including pictographs and tally marks. The learners will discuss chance in daily events.

**Phase 2**

Learners will understand how information can be expressed as organized and structured data and that this can occur in a range of ways. They will collect and represent data in different types of graphs, interpreting the resulting information for the purpose of answering questions. The learners will develop an understanding that some events in daily life are more likely to happen than others and they will identify and describe likelihood using appropriate vocabulary.

**Phase 3**

Learners will continue to collect, organize, display and analyse data, developing an understanding of how different graphs highlight different aspects of data more efficiently. They will understand that scale can represent different quantities in graphs and that mode can be used to summarize a set of data. The learners will make the connection that probability is based on experimental events and can be expressed numerically.

**Phase 4**

Learners will collect, organize and display data for the purposes of valid interpretation and communication. They will be able to use the mode, median, mean and range to summarize a set of data. They will create and manipulate an electronic database for their own purposes, including setting up spreadsheets and using simple formulas to create graphs. Learners will understand that probability can be expressed on a scale (0–1 or 0%–100%) and that the probability of an event can be predicted theoretically.

## Measurement
## Overall expectations

**Phase 1**

Learners will develop an understanding of how measurement involves the comparison of objects and the ordering and sequencing of events. They will be able to identify, compare and describe attributes of real objects as well as describe and sequence familiar events in their daily routine.

**Phase 2**

Learners will understand that standard units allow us to have a common language to measure and describe objects and events, and that while estimation is a strategy that can be applied for approximate measurements, particular tools allow us to measure and describe attributes of objects and events with more accuracy. Learners will develop these understandings in relation to measurement involving length, mass, capacity, money, temperature and time.

**Phase 3**

Learners will continue to use standard units to measure objects, in particular developing their understanding of measuring perimeter, area and volume. They will select and use appropriate tools and units of measurement, and will be able to describe measures that fall between two numbers on a scale. The learners will be given the opportunity to construct meaning about the concept of an angle as a measure of rotation.

**Phase 4**

Learners will understand that a range of procedures exists to measure different attributes of objects and events, for example, the use of formulas for finding area, perimeter and volume. They will be able to decide on the level of accuracy required for measuring and using decimal and fraction notation when precise measurements are necessary. To demonstrate their understanding of angles as a measure of rotation, the learners will be able to measure and construct angles.

## Shape and Space
## Overall expectations

**Phase 1**

Learners will understand that shapes have characteristics that can be described and compared. They will understand and use common language to describe paths, regions and boundaries of their immediate environment.

**Phase 2**

Learners will continue to work with 2D and 3D shapes, developing the understanding that shapes are classified and named according to their properties. They will understand that examples of symmetry and transformations can be found in their immediate environment. Learners will interpret, create and use simple directions and specific vocabulary to describe paths, regions, positions and boundaries of their immediate environment.

**Phase 3**

Learners will sort, describe and model regular and irregular polygons, developing an understanding of their properties. They will be able to describe and model congruency and similarity in 2D shapes. Learners will continue to develop their understanding of symmetry, in particular reflective and rotational symmetry. They will understand how geometric shapes and associated vocabulary are useful for representing and describing objects and events in real-world situations.

**Phase 4**

Learners will understand the properties of regular and irregular polyhedra. They will understand the properties of 2D shapes and understand that 2D representations of 3D objects can be used to visualize and solve problems in the real world, for example, through the use of drawing and modelling. Learners will develop their understanding of the use of scale (ratio) to enlarge and reduce shapes. They will apply the language and notation of bearing to describe direction and position.

## Pattern and Function
## Overall expectations

**Phase 1**

Learners will understand that patterns and sequences occur in everyday situations. They will be able to identify, describe, extend and create patterns in various ways.

**Phase 2**

Learners will understand that whole numbers exhibit patterns and relationships that can be observed and described, and that the patterns can be represented using numbers and other symbols. As a result, learners will understand the inverse relationship between addition and subtraction, and the associative and commutative properties of addition. They will be able to use their understanding of pattern to represent and make sense of real-life situations and, where appropriate, to solve problems involving addition and subtraction.

**Phase 3**

Learners will analyse patterns and identify rules for patterns, developing the understanding that functions describe the relationship or rules that uniquely associate members of one set with members of another set. They will understand the inverse relationship between multiplication and division, and the associative and commutative properties of multiplication. They will be able to use their understanding of pattern and function to represent and make sense of real-life situations and, where appropriate, to solve problems involving the four operations.

**Phase 4**

Learners will understand that patterns can be represented, analysed and generalized using algebraic expressions, equations or functions. They will use words, tables, graphs and, where possible, symbolic rules to analyse and represent patterns. They will develop an understanding of exponential notation as a way to express repeated products, and of the inverse relationship that exists between exponents and roots. The students will continue to use their understanding of pattern and function to represent and make sense of real-life situations and to solve problems involving the four operations.

# PYP Learner Profile

| *Students are:* | *In Mathematics* |
|---|---|
| **Inquirers** – Their natural curiosity has been nurtured. They have acquired the skills necessary to conduct purposeful, constructive research. They actively enjoy learning and this love of learning will be sustained throughout their lives. | They are fascinated by the world of patterns, shape and number and use the skills of Mathematics to conduct purposeful inquiry. |
| **Thinkers** – They exercise initiative in applying thinking skills critically and creatively to make sound decisions and solve complex problems. | They use Mathematics as an analytical tool across the curriculum. |
| **Communicators** – They receive and express ideas and information confidently in more than one language, including the language of mathematical symbol. | They use the language and symbols of Mathematics to receive and express ideas and information confidently, to understand the relationships between meanings and to engage in mathematical discourse at ever increasing levels of abstraction. |
| **Risk-takers** – They approach unfamiliar situations without anxiety and have the confidence and independence of spirit to explore new roles, ideas and strategies. They are courageous and articulate in defending those things in which they believe. | They are prepared to try out new approaches, suggest solutions to problems and respond to unfamiliar formats, even when they are not certain that they know the right way. |
| **Knowledgeable** – They have spent time in our schools exploring themes which have global relevance and importance. | They know about coherent body of interconnected mathematical understandings and the role of Mathematics in the development of science, technology and society in general. |
| **Principled** – They have a sound grasp of the principles of moral reasoning. They have sense of personal commitment to action and service. | They recognise the responsibility to be accurate and appreciate the obligations to gather interpret, report and apply data with honesty. |
| **Caring** – They show sensitivity towards the needs and feeling of others. They have a sense of personal commitment to action and service. | They recognise and value the power of Mathematics as a highly effective tool for understanding and solving problems and to show appreciation of the beauty and fascinations of the subject. |
| **Open-minded** – They respect the views, values and traditions of other individuals and cultures and are accustomed to seeking and considering a range of points of view. | They have an awareness of, and a respect for, varied interpretations and critically evaluate explanations, strategies and solutions. |
| **Balanced** – They understand the importance of physical and mental balance and personal well-being. | They understand the importance of being numerate in order to meet the demands of a technological age. |
| **Reflective** – They give thoughtful consideration to their own learning and analyse their personal strengths and weaknesses in a constructive manner. | They are accustomed to examining their own mathematical learning and analyse their strengths and weaknesses in a thoughtful, constructive manner. They reflect on their own mathematical conclusions and the processes they have use to arrive at these. |

**How to use this document for the planning of mathematics**

# How to use the PYP mathematics scope and Sequence

The following points should also be considered when using the IB PYP Scope and sequence

- Each learner is a unique individual with different life experiences and no two learning pathways are the same.
- Learners within the same age group will have different proficiency levels and needs; therefore, teachers should consider a range of phases when planning mathematics learning experiences for a class.
- Learners are likely to display understanding and skills from more than one of the phases at a time. Consequently, it is recognized that teachers will interpret this scope and sequence according to the needs of their students and their particular teaching situations.
- The continuums are not prescriptive tools that assume a learner must attain all the outcomes of a particular phase before moving on to the next phase, nor that the learner should be in the same phase for each strand.
- Each teacher needs to identify the extent to which these factors affect the learner. Plotting a mathematical profile for each student is a complex process for PYP teachers. Prior knowledge should therefore never be assumed before embarking on the presentation or introduction of a mathematical concept.