

Primary Mathematics Curriculum

DRAFT SPECIFICATION

JUNIOR INFANTS TO SECOND CLASS

FOR CONSULTATION



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I. Introduction

I. Introduction

About the Primary Mathematics Curriculum

Who is the Primary Mathematics Curriculum for?

The Primary Mathematics Curriculum is for teachers of all children in all school contexts. The first four sections—Introduction, Rationale, Aims, and Strands and Elements—are for teachers of children in all eight primary years. Sections 5 and 6—Overview of learning outcomes and labels, and Progression Continua—are for teachers of children in the junior primary years, that is, stage 1 which refers to junior and senior infant classes and stage 2 which refers to first and second classes.

Why is there a new Primary Mathematics Curriculum?

Since the implementation of the 1999 Primary School Curriculum, reviews, evaluations and research have highlighted a number of strengths and challenges. Findings have indicated the need for a new Primary Mathematics Curriculum which

- is coherent in terms of aims, goals (relating to both processes and content), and pedagogy; particularly in acknowledging and building on the pedagogical emphases in *Aistear*
- foregrounds the processes of mathematisation, that is, communicating, reasoning, argumentation, justifying, generalising, representing, problem-solving, and connecting, as central to the mathematical experiences of all children
- draws on current research in highlighting the principles and features of good mathematics pedagogy, including overarching meta-practices and the ways in which they permeate learning activities
- supports teachers to design and develop rich and challenging mathematical tasks that are appropriate to their children's learning needs
- explicates the critical ideas in each of the content domains— Algebra, Data and Chance, Measures, Number, Algebra, and Shape and Space.
- presents learning paths which indicate shifts in children's mathematical learning, and which serve as reference points for planning and assessment

- promotes the principles of equity and access for all children, ensuring that supports enable children with developmental delays and those with exceptional talent, children in culturally-diverse contexts and children in disadvantaged circumstances to experience rich and engaging mathematics.

Moreover, teachers have called for a less crowded curriculum with a greater emphasis on practice and on supporting progression in children's mathematical learning and development. Research reports that inform and support curriculum development are published at www.ncca.ie/primarymathematics.

How is the new Primary Mathematics Curriculum different?

Table 1: Primary Mathematics Curriculum, 1999 and 2018

Primary School Mathematics Curriculum (1999)	New Primary Mathematics Curriculum (2018)
Strands: Algebra, Data and Chance, Measures, Number, Shape and Space	
Strand units	Learning Outcome Labels
Mathematical Skills List of six mathematical processes at the beginning of each Strand	Elements Four Elements integrated into the Progression Continua describing learning experiences for children across all Strands and Learning Outcomes.
Content objectives (junior infants to second class) – 201	Learning outcomes – 27

What are the Strands of the Primary Mathematics Curriculum?

The Strands represent the main areas or domains of learning in mathematics. The Primary Mathematics Curriculum has five Strands: Algebra, Data and Chance, Measures, Number, Shape and Space. The Strands are not discrete domains of learning; rather, they interact and connect in the learning experience of the child. It is important that teachers understand the interconnected nature of the Strands to support children to make sense of their learning.

What are the Elements of the Primary Mathematics Curriculum (2018)?

Elements describe essential mathematical learning in terms of the processes that are central to this learning. Children develop their mathematical proficiency through engaging with processes such as connecting, communicating, reasoning, argumentation, justifying, representing, problem-solving and generalising. In the new Primary Mathematics Curriculum, for ease of reference, there are four Elements—Understanding and Connecting; Communicating; Reasoning; Applying and Problem Solving.

How is the Primary Mathematics Curriculum structured and presented?

The Primary Mathematics Curriculum and the companion Primary Mathematics Toolkit will include the following.

Table 2: Contents of the Primary Mathematics Curriculum and Toolkit

Introduction	What are the key messages in the new Primary Mathematics Curriculum?
Rationale	Why is mathematical learning and development important in primary school?
Aims	What do we value in children's mathematical learning and development in primary school?
Strands and Elements	What concepts, dispositions and skills are important in children's mathematical learning and development?
Planning, teaching and assessing for learning	<p>What are the key components of the curriculum and how do these work together?</p> <ul style="list-style-type: none"> ▪ Learning Outcomes ▪ Progression Continua ▪ Examples of children's learning and development* ▪ Support Materials for teachers*
Glossary	Definitions and explanations of important terms used to describe concepts, dispositions and skills in children's mathematical learning and development.**

*These will be published in the Primary Mathematics Toolkit at www.curriculumonline.ie when ready.

**This will be developed and included in the Primary Mathematics Curriculum prior to publication.

How does the Primary Mathematics Curriculum connect with Aistear?

The draft Primary Mathematics Curriculum builds upon the principles of *Aistear, the Early Childhood Curriculum Framework* (NCCA, 2009). These principles highlight the importance of adult-child relationships, and playful and meaningful experiences for children’s learning and development. *Literacy and Numeracy for Learning and Life, the National Strategy to Improve Literacy and Numeracy for Children and Young People 2011 – 2020* (DES, 2011) identified the pedagogical approaches highlighted in *Aistear* as a particular focus for a redeveloped curriculum for infant classes. These approaches are described in *Aistear’s Guidelines for Good Practice*. Against this background ‘*Through appropriately playful learning experiences, children should be able to...*’ is the stem used for the Learning Outcomes in the Primary Language Curriculum (DES, 2015), and in the new draft Primary Mathematics Curriculum. In recognition of the importance of the pedagogical approaches used to provide appropriate learning experiences for young children in school, the Primary Language Curriculum includes a range of Support Material for Teachers that focuses on play and playful teaching and learning. Similar support material will be made available in the new Primary Mathematics Curriculum, as well as examples of children’s learning and development.

Both *Aistear* and the draft Primary Mathematics Curriculum promote positive learning dispositions. *Aistear* defines dispositions as the ‘*tendency to respond to situations in characteristic ways*’ (NCCA, 2009, p.54) and advocates the nurturing of dispositions like independence, curiosity, playfulness, perseverance, confidence, resilience and resourcefulness. These support the development of productive disposition, an aspect of mathematical proficiency (see p.21): ‘*In early childhood, productive disposition begins with the fostering of a positive disposition towards the mathematics they encounter in their everyday life*’ (Dooley et al., 2014, p.40). Positive interactions between, and among, adults and children, in conjunction with play and playful teaching and learning experiences will be an important contributor to children’s development as mathematicians.

How does the new Primary Mathematics Curriculum support children with complex needs?

Milestone a is designed to facilitate the inclusive teaching and learning of children with severe and profound learning difficulties. Children with moderate learning difficulties may

be between Milestone a and c/d. Through the open nature of the language, Milestone a aims to encompass a range of learning opportunities that will arise for these children. The challenge for teachers is to identify when a child is 'merely present' or is experiencing the stimulus or activity taking place. Insofar as possible, activities to demonstrate learning outcomes should be deliberately planned. Any signs of 'noticing' should be noted and used to inform planning for future experiences and activities.

The Support Material, Special Educational Needs (SEN) Pathways is an additional help for teachers who have children with complex needs in their classroom¹. The Support Material describes seven SEN paths. These paths can be used together with the Primary Mathematics Progression Continua to support teachers in recognising and supporting such children's progress within a milestone or a progression step.

How does the new Primary Mathematics Curriculum support computational, creative and flexible thinking skills and coding?

There has been much public interest in the question of the place of coding in the primary curriculum and of the relationship between the wide range of coding initiatives currently in primary schools and the curriculum, particularly the mathematics curriculum. Following a request from the Minister in July 2016, NCCA undertook to clarify, tease out and explain, through its planned development of a new mathematics curriculum, the relationship between coding and mathematics at this level of children's education. Essentially, primary mathematics lays some of the foundations of coding through its emphasis on computational, creative and flexible thinking skills. Mathematical experiences and activities designed to develop these skills involve children solving complex problems, in which they are encouraged to break the problem down into steps, analyse the parts of the problem, prioritise relevant information and drawing on existing understandings, reason their ideas and evaluate their solution.

¹ *Special Educational Needs (SEN) Pathways* is a support designed for the Primary Language Curriculum and can be accessed on:

https://ncca.sharepoint.com/nccateams/Primary/lang/Shared%20Documents/Tigh%20Nan%20Dooley_Special%20School/Special-Educational-Needs-Pathways.pdf

Similar Support Material will be developed for the new Primary Mathematics Curriculum.

Through playful, collaborative and engaging learning experiences, the new Primary Mathematics Curriculum provides opportunities for children to develop computational, flexible and creative thinking skills as they learn across the strands of Algebra, Data and Chance, Measures, Number, and Shape and Space. In this way, the new mathematics curriculum contributes to the foundations of coding.

In exploring coding in the wider primary curriculum, the NCCA has identified a number of approaches used internationally. These include locating coding within a broader curriculum area such as computing or computer science; integrating some of the fundamental underpinnings of coding within subjects such as mathematics and science; developing it across the curriculum, for example, as a key skill. The NCCA will work with a network of schools during this school year to explore these different approaches to integrating coding in the primary curriculum. This work will help to inform the redevelopment of the primary curriculum beyond mathematics.

Using the Curriculum and Toolkit

What are Learning Outcomes?

Learning Outcomes are used to describe the expected mathematical learning and development for children at the end of a two-year period. They replace the content objectives in the 1999 curriculum. In mainstream settings, Stage 1 Learning Outcomes refer to junior and senior infant classes and Stage 2 Learning Outcomes are for first and second classes. Reflecting *Aistear's* Learning Goals, the phrase 'Through appropriately playful learning experiences, children should be able to' introduces all stage 1 Learning Outcomes. Children's progress towards Learning Outcomes will be influenced by their varying circumstances, experiences and abilities. Given the diversity in children's mathematical learning and development across any class group, learning is described on a continuum. The Progression Continua support teachers to create appropriately challenging and playful learning experiences for children, and work with children whose learning and development may progress at a different level or rate to their peers.

What are the Progression Continua and how do they work?

The Progression Continua reflect the reality that children come to school with different experiences of mathematics, are at different places in their mathematical learning journey,

and develop at different rates, particularly children with special educational needs and children in the early years of primary school. The Progression Continua support teachers to use their own judgement and experience to identify where children are in their mathematical learning journey.

There is one Progression Continuum for each Learning Outcome Label. The Progression Continua describe, in broad terms, children’s mathematical learning and development for Stages 1 and 2. Each Learning Outcome Label currently has seven progression milestones (a-g)². All four Elements—Understanding and Connection; Communicating; Reasoning; Applying and Problem Solving—are described within each Progression Continuum. Thus, each child’s journey, from junior infants to second class, can be in one of the seven milestones. There are currently two Learning Outcomes for each Label³.

How do teachers begin to use this curriculum?

While the mathematical experiences of children, teachers and schools vary greatly across different school contexts, all teachers will begin with the same starting points by asking – *Where are the children at? Where are they going in their learning and development? And what mathematical experiences do I, as a teacher, need to plan and provide to help them make this progress?* (Discussions at recent Development Group and Board meetings highlighted a need to adjust former graphic to reflect multiple access points for schools in using the new Primary Mathematics Curriculum. This graphic will be updated following the consultation process which will involve working closely with a number of schools).

Teachers can begin to answer these questions by looking at the Learning Outcomes for the relevant stage and the Progression Continua linked to these Learning Outcomes. When ready, teachers will be able to refer to Examples of children’s learning for evidence of children’s mathematical learning and development at similar stages, as well as for ideas to support the creation of appropriately challenging and playful learning experiences to support these Learning Outcomes. The Support Material for teachers will also provide teachers with additional ideas for practice.

² It is anticipated that there will be up to ten or eleven milestones when the curriculum is completed from infants to 6th class. This correlates with the number of milestones anticipated for the full primary language curriculum – junior infants to 6th class.

³ It is anticipated that there will be up to four learning outcomes per label when the curriculum is completed from infants to 6th class.

Development and publication

Where can I find out about the research that underpins the Primary Mathematics Curriculum?

Two research reports underpin the Primary Mathematics Curriculum. The first report discusses the themes of definitions, theories, development and progression (Dunphy *et al*, 2014). The second research report focuses on mathematical teaching and learning (Dooley *et al*, 2014). These full reports, their executive summaries and podcasts are published on the review and research webpage at www.ncca.ie/primarymathematics. In addition, there are other relevant research and development publications at this weblink, including the Background Paper and Brief for the development of the new Primary Mathematics Curriculum. Following consultation in the autumn, a report on the findings and implications for the draft curriculum specification, will also be published at www.ncca.ie/primarymathematics.



2. Rationale

2. Rationale

The rationale for the new Primary Mathematics Curriculum addresses the importance of mathematics in children's lives. The rationale describes mathematics in the context of children's learning and development and the implications of same for the provision of education to children in the primary school. Key messages highlighted in the draft rationale are as follows.

Primary Mathematics

Mathematics is the study of the relationships, connections and patterns that surround us and is thus intrinsic to our concept of the world. Mathematics greatly enhances our capacity to understand and engage fully with the world around us.

Every child is a mathematician

Every child has an innate, intuitive and instinctive sense of mathematics. Every child is capable of engaging with mathematical concepts and ideas from birth, and deepening and developing their learning over time.

Primary mathematics education should evoke children's innate ability to think and communicate mathematically, to solve problems and to make sense of the world using mathematics. Children should be encouraged to have a positive disposition to mathematics and to develop their mathematical understanding, language, communication skills, perseverance and resilience, interactions and expressions. Enabling children as mathematicians lays the foundations for children to become confident and life-long learners.

Mathematics is both a human and social phenomenon

Mathematics learning is dependent on social and cultural experiences as well as on the internal learning processes of each child.

Primary mathematics education should provide children with learning experiences that give rise to mathematical thinking, such as modelling, thinking aloud and ‘maths talk’. It should also provide opportunities for children to collaborate, communicate mathematical thinking, and express their understanding in multiple ways and in various contexts.

Mathematics is a tool that helps us to make sense of our world

Mathematics is used to think about, see and organise our everyday lives and the world.

Primary mathematics education should enable children to communicate and solve real-world problems in mathematical terms. It is also essential to support children to develop the language of mathematics. Thus, mathematical thinking should be promoted, and ‘maths talk’ should be integral to the teaching and learning process.

Maths is beautiful and worthy of pursuit in its own right

Through playful and creative learning opportunities, children can experience the beauty and power of mathematics. It is important that children have the opportunity to engage with mathematics as a discipline in its own right and to explore its many intriguing aspects.

Primary mathematics education should foster a love of mathematics. It should provide children with the opportunity to explore, discover and refine their ideas. Children should also be supported to think critically and flexibly, and to be creative and innovative in their approach to learning mathematics.

Mathematics is everywhere and for everyone

Mathematics is a human activity that develops in response to everyday problems and interactions.

Primary mathematics education should provide children with opportunities to engage with deep, meaningful and challenging mathematics in educational settings, including social and familial settings. Such engagement will result in children co-constructing knowledge and skills as they interact and collaborate to solve complex and real problems.

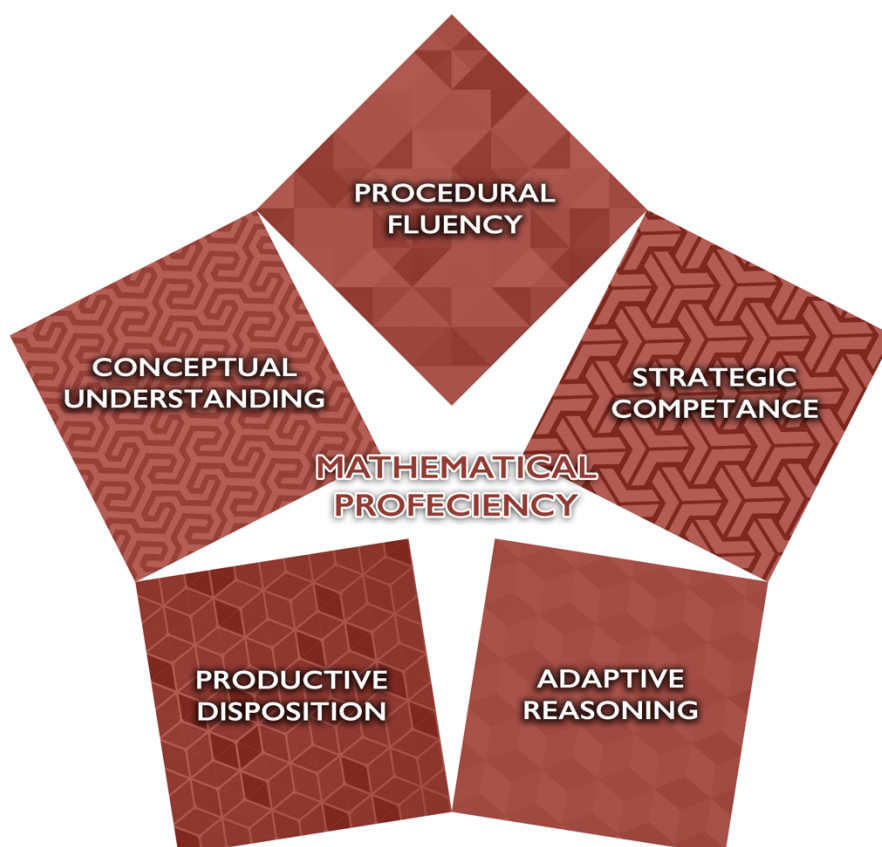


3. Aims

3. Aims

The over-arching aim of the Primary Mathematics Curriculum is the development of mathematical proficiency. Mathematical proficiency encompasses conceptual understanding, procedural fluency, adaptive reasoning, strategic competence, and productive disposition (see Figure 1 below). Critically, all five aspects are interwoven and interdependent. As children develop proficiency in one aspect, there are developments in other aspects too. Mathematical proficiency becomes progressively more developed in children as their mathematical experiences become increasingly sophisticated and as they are exposed to good pedagogy. The curriculum supports teaching, learning and assessment that is congruent with this aim.

Figure 1: Five aspects of Mathematical Proficiency



Each of the five aspects of Mathematical Proficiency is described below.

Conceptual Understanding⁴

The curriculum aims to help children to understand why mathematics ideas are important and the different ways they can use and apply these ideas.

The curriculum aims to help children build on what they already know and to connect this with their new learning. This should make it easier for children to use their learning in different ways for different situations.

As well as supporting children to use mathematics in different ways, teachers should support children to represent how they understand mathematics in lots of different ways, such as using pictures or objects or by modelling, explaining and demonstrating it for their classmates. Having the opportunity to explore maths with others provides children with the opportunity to share and connect what they have learned, how they learned, and the different ways their learning can be useful.

Procedural Fluency

The curriculum aims to provide children with opportunities to create their own informal strategies and to integrate new concepts and procedures as they build on these strategies. It aims to support children to justify the use of commonly used mathematical procedures and informal strategies, and through this, to strengthen their understanding and skills.

Children should be encouraged to apply procedures accurately, efficiently and flexibly; to transfer procedures to different problems and contexts; to build or modify procedures from other procedures; and to recognise when one strategy or procedure is more appropriate to apply than another.

⁴ It is envisaged that commentary, by children and adults, on the aspects of mathematical proficiency will be included in this section in the form of 'speech bubbles'. The commentary will be identified during the consultation with schools.

Strategic Competence

The curriculum aims to support children to become proficient problem solvers. Children should have the opportunity to formulate mathematical problems, represent them, and solve them in a variety of ways.

As well as needing a repertoire of solution strategies, children should be facilitated in generating problem models where they first understand the problem or situation and its key features, and then framing or representing the problem mathematically.

Children should detect mathematical relationships and devise mental representations of problems by building mental images of the essential components of the problem (variables and relations) using a number of tools such as numbers, concrete materials, manipulatives, symbols, words or graphics.

Children should also be encouraged to demonstrate flexibility throughout the problem-solving process and broaden their knowledge through solving meaningful, real-life problems and through creating or adjusting appropriate methods to fit the requirements of unfamiliar situations.

Adaptive Reasoning

The curriculum aims to support children's capacity for logical thought, reflection, explanation, and justification. Through collaboration and a talk-friendly environment, teachers should equip children with tools to reflect and navigate through the many concepts, solution methods, facts, and procedures they encounter so that they can see how mathematics fits together and makes sense.

Children should be encouraged to clarify and determine the legitimacy of their reasoning by discussing concepts and procedures; by representing problems, solutions and their understanding of mathematics in multiple ways; and by offering good reasons for the procedures and strategies they employ.

Productive Disposition

The *Primary Language Curriculum (2015)* emphasises the importance of supporting children to develop positive dispositions towards language and literacy. *Aistear: the Early Childhood Curriculum Framework (2009)* as a curriculum structure refers to a range of positive learning dispositions, including perseverance and resilience in learning. Consistent with these views of positive learning dispositions, the new primary mathematics curriculum aims to encourage children to be confident in their mathematical knowledge and ability. It aims to support them to see, through appropriately challenging and engaging experiences and work over time, that mathematics is practical and enjoyable, and has relevance in their everyday lives.

With lots of opportunities to make sense of mathematics, to recognise the benefits of perseverance and to experience success in their learning, children should see that mathematics is really useful, engaging and motivating, and they should enjoy sharing their mathematical ideas with friends, family, teachers and others.



4. Strands and Elements

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Curriculum Strands

The Curriculum Strands outline the conceptual domains or content areas of primary mathematics for junior infants to second class. Each strand has a set of Learning Outcome Labels.

Table 3: Overview of Curriculum Strands and Learning Outcome Labels

Algebra	<ul style="list-style-type: none"> 1. Number Patterns, Sequences and Relationships 2. Patterns, Structure and Rules
Data and Chance	<ul style="list-style-type: none"> 3. Data
Measures	<ul style="list-style-type: none"> 4. Measuring 5. Time 6. Money
Number	<ul style="list-style-type: none"> 7. Uses of Number 8. Place Value 9. Numeration and Counting 10. Operations 11. Fractions
Shape and Space	<ul style="list-style-type: none"> 12. Spatial Awareness and Location 13. Shape 14. Transformation

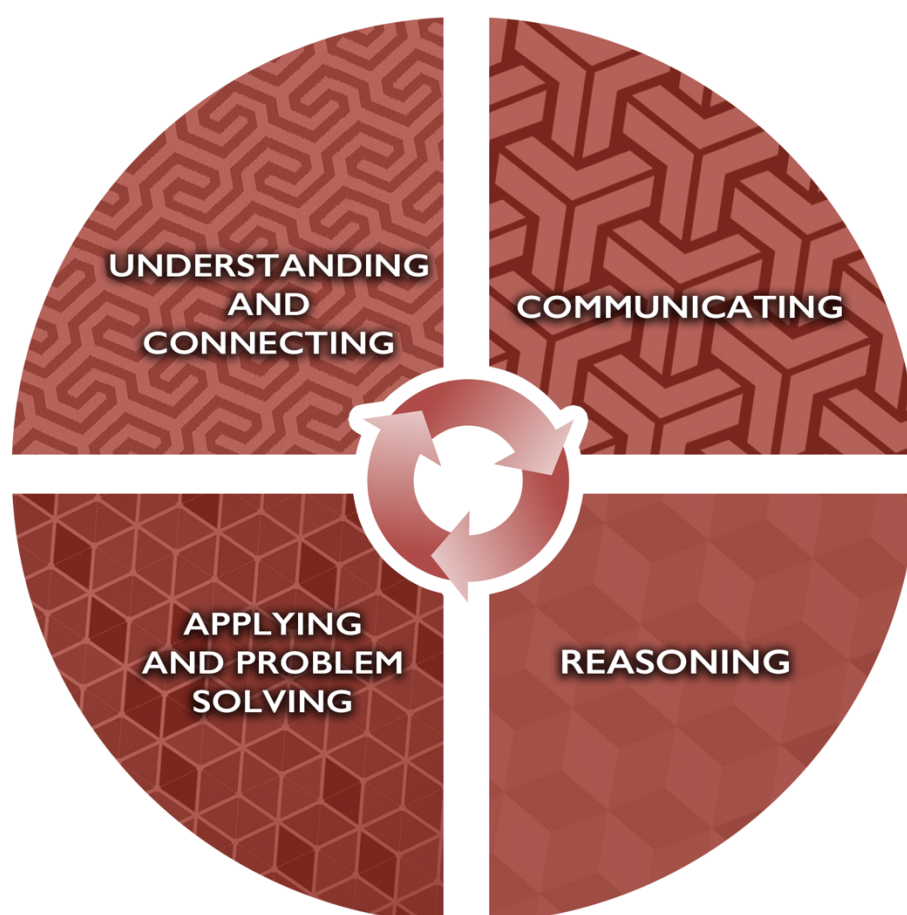
Further Learning Outcome Labels may be added to this list when the curriculum is developed for third to sixth class; for example, related to Chance. The interconnectivity between Strands will be highlighted. The website www.curriculumonline.ie, where the final version of the new Primary Mathematics Curriculum will be published, offers a great opportunity to create links between Strands and Learning Outcomes Labels.

Curriculum Elements

Children develop their mathematical proficiency through engaging with processes such as connecting, communicating, reasoning, argumentation, justifying, representing, problem solving, and generalising. The Elements or key mathematical processes are organised in four categories: Understanding and Connecting; Communicating; Reasoning; Applying and Problem solving. These categories are derived from the literature on mathematical proficiency and mathematisation and are also informed by the list of mathematical skills in the Primary School Mathematics Curriculum (1999).

The Elements of mathematical learning across each of the Strands are set out in Figure 2 below.

Figure 2: The elements of primary mathematics



Element 1: *Understanding and Connecting*

Children should make connections between related concepts and procedures—the ‘why’ and the ‘how’ of mathematics—and between new and prior knowledge, in order to make sense of what they are learning. They should apply and connect their understanding to contexts within mathematics, with other areas of learning, and with the real world.

Element 2: *Communicating*

Children should use appropriate means of communication and a variety of representations and conventions to convey thinking, ideas, relationships and logical arguments. They should improve and refine their thinking and communication through engaging in inquiry-based learning and social learning environments.

Element 3: *Reasoning*

Children should develop and apply reasoning to make, assess and justify ideas and conjectures. They should engage in logical thought and actions such as analysing, proving, inferring and generalising. They should plan and construct solid arguments to justify their explanations, proofs and decision making.

Element 4: *Applying and Problem Solving*

Children should investigate, develop, select, apply, interpret, model and compare a variety of problem-solving situations and strategies as they explore mathematics and deepen their mathematical understanding. They should apply their mathematical knowledge and skills in flexible, efficient and creative ways to solve problems, conduct investigations and develop their computational thinking.



5. Overview of Learning Outcomes

5. Overview of Learning Outcomes

As noted previously, Parts 5 and 6 of the specification refer specifically to junior infants to second class.

Learning Outcomes describe the expected mathematical learning and development for children at the end of a two-year period, when due account is taken of individual abilities and varying circumstances. Learning Outcomes help teachers to

1. plan, teach and reflect on their use of appropriate methods for teaching and learning
2. use appropriate assessment methods to gather evidence of children's mathematical thinking
3. provide focused feedback to children and parents.

The following tables provide an overview of the Learning Outcomes and Labels for each Strand.

Table 4: Algebra: Learning Outcomes and Labels

Strand: Algebra			
Elements	Learning Outcome Labels	Learning Outcomes	
		Stage 1: Junior and senior infants Through appropriately playful learning experiences, children should be able to*	Stage 2: First and second classes Children should be able to* ⁵
Understanding and connecting; Communicating; Reasoning; Applying and Problem-Solving	1. Number patterns, sequences and relationships	<i>Explore, recognise and use number patterns and sequences</i>	<i>Understand and use the commutative properties and relationships between addition and subtraction</i>
	2. Patterns, structure and rules	<i>Explore and search for patterns, structures and relationships in physical, geometric and eventually numerical forms</i>	<i>Identify the rules that govern sequences and patterns; make predictions and generalise to other situations</i>

*When due account is taken of individual abilities and varying circumstances.

Table 5: Data and Chance: Learning Outcomes and Labels

Strand: Data and Chance			
Elements	Learning Outcome Label	Learning Outcomes	
		Stage 1: Junior and senior infants Through appropriately playful learning experiences, children should be able to*	Stage 2: First and second classes Children should be able to* ⁵
Understanding and connecting; Communicating; Reasoning; Applying and Problem-Solving	3. Data	<i>Explore data in a variety of ways for a variety of purposes</i>	<i>Use data as evidence to tell stories about questions of interest</i>

*When due account is taken of individual abilities and varying circumstances.

⁵ Discussions at recent Development Group, Board and Council meetings indicated support for the Stage 1 Learning Outcome stem of 'Through appropriately playful learning experiences, children should be able to...' to be applied to the Stage 2 Learning Outcomes. The relevance and usefulness of this stem will be considered and explored with teachers during the consultation.

Table 6: Measures: Learning Outcomes and Labels

Strand: Measures			
Elements	Learning Outcome Labels	Learning Outcomes	
		Stage 1: Junior and senior infants Through appropriately playful learning experiences, children should be able to*	Stage 2: First and second classes Children should be able to* ⁵
Understanding and connecting; Communicating; Reasoning; Applying and Problem-Solving	4. Measuring	<i>Develop awareness of measuring (length, weight, capacity and area) in meaningful contexts</i>	<i>Estimate, measure and record length, weight (mass), capacity and area using appropriate instruments and units</i>
	5. Time	<i>Develop awareness and understanding of the concept of time</i>	<i>Recognise, read and record elements of time using both analogue and digital representations</i>
	6. Money	<i>Develop awareness of money and how money is used</i>	<i>Recognise the value of money and use money in a range of meaningful contexts</i>

*When due account is taken of individual abilities and varying circumstances.

Table 7: Number: Learning Outcomes and Labels

Strand: Number			
Elements	Learning Outcome Labels	Learning Outcomes	
		Stage 1: Junior and senior infants Through appropriately playful learning experiences, children should be able to*	Stage 2: First and second classes Children should be able to* ⁵
Understanding and connecting; Communicating; Reasoning; Applying and Problem-Solving	7. Uses of number	<i>Develop an awareness that numbers can be used to</i> <ul style="list-style-type: none"> • <i>tell how many</i> • <i>describe (label)</i> • <i>order</i> 	
	8. Place value	<i>Develop a sense of ten as the foundation for place value and counting</i>	<i>Understand that digits can have different values; the value of a digit in a written numeral depends on its place or position in that numeral</i>
	9. Numeration and Counting	<i>Develop an awareness that the purpose of counting is to quantify</i>	<i>Demonstrate fluency in using and applying different counting strategies</i>
	10. Operations	<i>Combine and partition quantities</i>	<i>Use addition and subtraction to solve real world situations and problems, making use of a range of strategies</i>
	11. Fractions	<i>Understand whole number(s) in the context of part-whole relationships</i>	<i>Explore, (model, express and represent) mathematical relationships between part-whole quantities</i>

*When due account is taken of individual abilities and varying circumstances.

Table 8: Shape and Space: Learning Outcomes and Labels

Strand: Shape and Space			
Elements	Learning Outcome Labels	Learning Outcomes	
		Stage 1: Junior and senior infants Through appropriately playful learning experiences, children should be able to*	Stage 2: First and second classes Children should be able to* ⁵
Understanding and connecting; Communicating; Reasoning; Applying and Problem-Solving	12. Spatial Awareness and Location	<i>Develop a sense of spatial awareness and reasoning</i>	<i>Develop spatial reasoning and visualise and model location using symbolic co-ordinates</i>
	13. Shape	<i>Visualise and model 2D and 3D shapes and describe their properties</i>	<i>Visualise and model 2D and 3D shapes and analyse their properties</i>
	14. Transformation	<i>Explore and describe the effects of shape movements</i>	<i>Visualise and show the effects of transformations on shapes</i>

*When due account is taken of individual abilities and varying circumstances.



6. Progression Continua



6. Progression Continua

Children come to school with different experiences and are at different places in their early learning and development. They also learn and develop at different rates, especially in the early years of primary school. Some children beginning junior infants and having experienced pre-school education guided by Aistear, may be at Progression Milestone d in the first Learning Outcome Label; Number Patterns, Sequences and Relationships, while other children with a similar experience may be at Milestone b. The new Primary Mathematics Curriculum uses Progression Continua to help teachers in all school contexts to make professional judgements about where children are in their mathematical learning journey and to plan the next steps for their learning in mathematics. With the Progression Continua, teachers can locate the majority of children in the class on the appropriate Progression Milestone, and orientate children who are at an earlier or later point in their learning and development. Moreover, the Progression Continua provide practical support and ideas to teachers in building rich mathematical learning experiences for children.

The Progression Continua describe, in broad terms, children's mathematical learning and development for Stages 1 and 2. There is one Progression Continuum for each Learning Outcome Label, 14 Progression Continua in total. Seven Progression Milestones (a-g)⁶ are set out for each Learning Outcome Label. These describe the journey children make from junior infants to second class and each child's journey can be located in one of these seven milestones. The descriptions of the progression milestones are directly related to the four Elements of Primary Mathematics — Understanding and Connecting; Communicating; Reasoning; Applying and Problem-Solving.

Each Progression Continuum describes the types of learning experiences that a child needs, articulated in terms of both content and mathematical processes, in order to achieve the Learning Outcomes in question. The milestones describe what children's learning and development might look like as they move along the continuum towards achieving the Learning Outcomes. Examples of children's mathematical work will further illustrate this learning.

⁶ It is anticipated that there will be up to ten or eleven milestones when the curriculum is completed from infants to 6th class. This correlates with the number of milestones anticipated for the full primary language curriculum – junior infants to 6th class.

The Progression Continua show progression from junior infants to second class and support children with a wide range of abilities. Some children may take considerable time to progress from one milestone to the next, to make progress within one milestone and/or within one progression step. The continua support teachers to use their judgement about the most appropriate mathematical experiences for children at a given point in time.

Table 9: Overview of Progression Continua

Overview of Progression Continua in the Primary Mathematics Curriculum		
Strand	Learning Outcome Label	Pages
Algebra	1. Number patterns, sequences and relationships	40-41
	2. Patterns, structure and rules	42-43
Data and Chance	3. Data	44-45
Measures	4. Measuring	46-47
	5. Time	48-49
	6. Money	50-51
Number	7. Uses of number	52-53
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Algebra 1 - Number patterns, sequences and relationships

* Children should be given opportunities to demonstrate how the knowledge and skills gained in this strand can be used to link, reinforce and progress learning across the other four interconnected strands.

Learning Outcome - Stage 1: Through appropriately playful learning experiences, children should be able to explore, recognise and use number patterns and sequences

Learning Outcome - Stage 2: Children should be able to understand and use the commutative properties and relationships between addition and subtraction

	a The child	b The child	c The child	d The child	e The child	f The child	g The child
Elements	Learning Outcome Label						
	Number patterns, sequences and relationships						
Understanding and Connecting	Is present at, exposed to and experiences a range of appropriately rich matching and corresponding activities, songs, rhymes, stories and real-life situations e.g. row of houses	Matches sets and pairs of identical objects in one-to-one correspondence. Matches equivalent and non-equivalent sets of objects in one-to-one correspondence Describes equivalence and non-equivalence: the same number, the same as, as many as, equals, more than, less than	Compares, differentiates, matches, and orders sets and objects according to quantity by counting.	Identifies numbers in the context of a sequence, forward number word sequences– one, two, three... backward number word sequences – ten, nine, eight... Notices patterns that make up the sum of 5, 10. Describes equivalence between combinations.	Explores patterns and numerical relationships in addition and subtractions facts up to 5, 10. In a strategic manner, finds all sets of two numbers that make up 5/10 including zero. Extension: all sets of numbers. Represents relationships as number sentences. Explores equals sign as relational rather than operational.	Explores and uses patterns in addition and subtraction facts to at least 20 Explores multiple structures for number sentences: $c=a+b$. . . $a+b=c$. . . $a+b=c+d$. . .	Considers multiplication as repeated addition, zero property, and commutative property.
Communicating	Is present at, exposed to and experiences a variety of number rhymes, games and role play situations involving number patterns and sequences e.g. five little monkeys	Participates in number rhymes, games and role play situations involving number patterns and sequences e.g. 1, 2, 3, 4, 5, once I caught... Listens to and retells stories involving number patterns and sequences	Describes similarities and differences between sets in terms of quantity using appropriate vocabulary e.g. more than, less than, the same amount. Explores number word sequences	Describes similarities and differences between e.g. one more than, two more than, etc. Appreciates and argues the zero principles of addition facts e.g. $3+4=4+3$ and justifies with proofs.	Appreciates and argues the commutative principles of addition facts e.g. $3+4=4+3$ and justifies with proofs. Also describes properties of odd/even numbers, patterns that emerge in the addition, subtraction of odd/even numbers.	Translates verbal problems into written number sentences, and vice versa, including a broad range of number sentence structures.	Translates verbal problems into written number sentences, and vice versa, including unknown elements, or expressions of generality, e.g. My age+2=Paul's age

<p>Reasoning</p>	<p>Is present at, exposed to and experiences a range of activities involving number patterns, sequences and the identification of number relationships e.g. the child in a line.</p>	<p>Recognises and sequences numerals through rote counting from 1-10.</p> <p>Recognises that counting tells how many objects are in the set irrespective of how they are arranged or the order in which they are counted.</p> <p>Explores relationship between adding one more to a set and the next counting number.</p>	<p>Recognises number patterns and predict subsequent numbers in a sequence.</p> <p>Explores the numbers that come before or after or between numbers in a sequence.</p> <p>Identifies 10 as a number of significance.</p> <p>Explores the zero property of addition and generalise for all numbers.</p>	<p>Recognises number patterns, including odd and even numbers e.g. in a hundred square and predict subsequent numbers.</p> <p>Explores relationships between numbers and their position in the sequence. Draws diagrams and uses concrete manipulatives to explore the structure of the sequences, and how the terms change.</p> <p>Identifies the meaning of number names, e.g. thirteen means three plus ten, forty means four tens.</p>	<p>Explores patterns in number tables including the one hundred square.</p> <p>Counts in twos, fives and tens forwards and backwards and notice patterns.</p> <p>Generalises number patterns to numbers beyond the visible range presented, e.g. what is $1470+5$?</p>	<p>Reasons the use of a symbol or variable to represent an unknown number e.g. $4 + \square = 10$.</p> <p>Rather than a frame, a letter chosen by a child may be preferable here, as using one symbol leads to a very challenging misconception that one symbol can stand for two entities.</p> <p>Describes a number sequence by drawing a relationship between numbers and their position. Describes verbally, written form in words, written form using symbols.</p>	<p>Describes a number sequence by drawing a relationship between numbers and their position.</p> <p>Describes verbally, written form in words, written form using symbols.</p> <p>Describes a functional relationship between two sets of numbers, and applies the function to find further outputs/inputs.</p>
<p>Applying and Problem-Solving</p>	<p>Is present at, exposed to and experiences a range of activities involving number patterns, sequences and the identification of number relationships in real life meaningful contexts, e.g. numbered and/or sequenced tasks, first-then schedules.</p>	<p>Identifies and conveys understanding of number patterns and sequences in pictures and stories.</p>	<p>Explores patterns in number – arrange objects in groups or sets of 2, 3, 4, 5</p>	<p>Explores and identifies different arrays of the same quantity using concrete materials</p>	<p>Investigates and applies functions to a sequence of numbers e.g. add 1, 2 and identifies patterns emerging.</p>	<p>Uses multiple strategies to add and subtract multi-digit numbers. Describes strategies, compares and justifies choices made.</p> <p>Describes and justifies a general rule for the addition and subtraction of combinations of odd and even numbers.</p> <p>Applies such general rules to problem solving situations</p>	<p>Writes equations with variables, in order to arrive at a solution to a problem.</p> <p>Solves a range of problems with an unknown quantity</p>

Algebra 2 - Patterns, structure and rules

* Children should be given opportunities to demonstrate how the knowledge and skills gained in this strand can be used to link, reinforce and progress learning across the other four interconnected strands.

Learning Outcome – Stage 1: Through appropriately playful learning experiences, children should be able to explore and search for patterns, structures and relationships in physical, geometric and eventually numerical forms

Learning Outcome – Stage 2: Children should be able to identify the rules that govern sequences and patterns; make predictions and generalise to other situations

	a The child	b The child	c The child	d The child	e The child	f The child	g The child
Elements	Learning Outcome Label						
	Patterns, structure and rules						
Understanding and Connecting	Is present at, exposed to and experiences a range of repeated visual stimuli, sounds, actions and movements denoting patterns.	Attends to and responds to repeated sounds, actions and movements. Discovers and explores patterns in the environment e.g. wall tiles, leaves, butterfly wings. [Avoid over-emphasis on symmetry, and ensure that nothing with random elements is presented as a pattern] Is aware of pattern as containing a unit of repeat.	Identifies a unit of repeat within a repeating pattern.	Recognises, compares, differentiates and matches sets and objects according to different attributes Identifies a unit of repeat within a complex repeating pattern. Describes repeating patterns as repetitions of this unit. Begins to describe the structure of growing patterns.	Identifies the rules that govern a range of patterns, complex repeating and growing. Identifies relationships between terms +3, -2, etc. and between terms and their position in the pattern, e.g. The 1 st term is 2, the 2 nd term is 3, so the 10 th term is 11. Breaks pattern terms into component parts, and compares how they change as the pattern progresses.	Uses the rules of patterns to make reasonable predictions. [In F, children should build upon E with greater fluency. Children with tendencies to only compare consecutive terms should be encouraged to observe other structures within the pattern. Children who focus completely on numerical aspects should be encouraged to incorporate figural and vice versa.]	Represents a variety of patterns, in a variety of modes, such as verbal, pictorial, diagrammatic and symbolic. Extends thinking from one situation to another.
Communicating	Is present at, exposed to and experiences appropriate means of communication and representations where attributes are distinguished and/or described.	Demonstrates awareness of vocabulary to describe attributes – e.g. big, blue, round – and sequences – e.g. First, next, last. Explores why an item should come next in a pattern/sequence.	Talks about patterns in school, home and wider environment involving objects and shapes and numbers Demonstrates understanding of similarities and differences between sets in terms of attributes e.g. size, shape, and colour using appropriate modes of communication.	Attends to the appropriate use of language when describing patterns e.g. before, after, follow, next, start, finish, between, copy, same, different, middle, again, repeat, repeating unit, unit of repeat, structure, random.	Explains the rule used to generate a sequence or pattern and applies it to extend or create repeated and simple growing patterns. Describes and extends linear shape patterns to subsequent and preceding terms.	Represents and records algebraic patterns, structures and rules in a variety of ways e.g. each term has two extra match-sticks; rule: +2; each term has double the position number in match-sticks: Number of match-sticks=term number+term number	Identifies key patterns, structures and rules in rich problems and establishes how to present the problem in diagrams, with concrete materials, verbally, and abstract language of mathematics.

Reasoning	Is present at, exposed to and experiences sequencing activities and pattern work.	Creates a simple repeating pattern beginning with two objects and becoming more complex as appropriate. Demonstrates the sequence of steps in everyday routines, e.g. washing hands, eating lunch.	Describes, creates, copies, and extends simple and more complex repeating patterns. Makes predictions about what comes before/next in a sequence of objects, sounds or movements?	Finds the missing element in repeating patterns. Identifies and correctly sequences patterns in daily routines. Predicts succeeding and preceding terms in repeating patterns beyond the next term.	Present an argument to support the rules identified in patterns or sequences Proves or justifies the argument. Compares alternative perspectives on patterns e.g. focus on shape, quantity of elements, relationships between consecutive terms, or between terms and their position number.	Describes and justifies within a pattern what is changing and what is staying the same. Compares varying perspectives on the structure of patterns. Compiles a table of values for elements of pattern. Uses table to describe and extend patterns.	Recognises the characteristics of an acceptable argument to justify patterns, structures and rules. Describes rules for the general case underlying functions e.g. function machines. Connect functions with pattern structures.
Applying and Problem-Solving	Is present at, exposed to and experiences patterns, structures and rules in everyday routines and daily sequences.	Follows the correct sequence in carrying out activity. Correctly sequences pictures that depict familiar / regular routines. Copies simple repeating patterns.	Copies and extends increasingly complex patterns using a range of concrete materials and/or pictures / symbols. Applies understanding of a routine to predict what will happen next, in story, poems and everyday activities.	Duplicates patterns by attending to model patterns; in immediate and removed contexts. Represents daily/fictional routines in diagrams or with concrete materials – describe, and predict future events.	Applies rules for generating patterns to a variety of contexts or by creating new models. Creates complex repeating and growing patterns through construction, drawing, and with focus on shape and quantity of elements, with and without an adherence to a context e.g. Tom gets €2 pocket-money every week and he puts it into his piggy bank; show how much he will have saved in total at the end of each week.	Takes problems involving patterns of appropriate complexity and breaks structure into smaller units. Extends patterns to next, near and further terms both subsequent and preceding. Given a suggested n^{th} term for a pattern, states whether the term fits within the pattern, and corresponds to the suggested term number.	Expresses a general term for a growing pattern of appropriate complexity verbally, in short verbal form as a mathematical algorithm but with words rather than letter symbols; in abstract notation. Expresses a function as a pattern in shape, movement, or context and vice versa.

Data and Chance 3 – Data

* Children should be given opportunities to demonstrate how the knowledge and skills gained in this strand can be used to link, reinforce and progress learning across the other four interconnected strands.

Learning Outcome – Stage 1: Through appropriately playful learning experiences, children should be able to explore data in a variety of ways for a variety of purposes

Learning Outcome – Stage 2: Children should be able to use data as evidence to tell stories about questions of interest

	a The child	b The child	c The child	d The child	e The child	f The child	g The child
Elements	Learning Outcome Label						
	Data						
Understanding and Connecting	Through multi-sensory learning experiences, begins to develop an awareness of attributes and characteristics.		Reads, understands and explains the information conveyed in various categorical and numerical displays.	Explores and formulates possible research topics and questions for data collection relevant to themselves or their surroundings e.g. hair colour, pets, etc.	Explores and recognises the relationship between different modes of representing data.	Represents the same data using multiple modes of representation e.g. tables, charts and graphs.	Deduces and infers a range of information, including patterns of data, when presented with increasingly complex data displays.
Communicating	Is present at, exposed to and experiences appropriate modes of communication where attributes and characteristics are conveyed and/or represented.	Uses appropriate modes of communication to describe and/or label the attributes of different objects and sets. Responds to questions and problems of appropriate complexity to demonstrate understanding of attributes.	Discusses opportunities for collecting data. Uses different organisational modes when sorting and identifying negations/complements e.g. children themselves, sorting boxes, Venn/Carroll diagrams.	Represents and displays data gathered using objects, pictures or simple graphs. Explains and makes simple inferences based on data gathered.	Reads, interprets and talks about data displays such as tables; charts e.g. pictograms; and graphs e.g. block graphs.	Represents and interprets data using tables; charts e.g. block and bar charts, simple pie charts; and graphs e.g. line plots numerical data plotted as x.	Uses data as evidence to support ideas, arguments, decisions and conclusions drawn. Uses data displays to generate new hypotheses and questions for investigation.
Reasoning	Is present at, exposed to and experiences a range of appropriate sorting and classifying activities.	Compares and classifies objects according to at least one attribute. Justifies classifications.	Classifies and sorts objects and sets according to multiple attributes. Re-sorts data sets according to different attributes and justifies.	Explores the potential for data displays to convey large volumes of information. Explores and devises questions and statements based on data displays.	Differentiates information as useful or surplus to address questions of interest. Listens to others' interpretations of statistical investigations and compare with own interpretations.	Checks and evaluates the accuracy and reasonableness of own data collection methods and representations in different scenarios. Refines own methods.	Confirms or refutes whether the statements made by others about data displays are consistent with the display and/or evidence.

Applying and Problem-Solving

Is present at, exposed to and experiences a range of appropriate sorting and classifying activities, in real life context.

Sorts, interprets and matches related data sets e.g. teddy bears clothes, setting a table.

Through play, discussion, questioning and story-telling and everyday scenarios, explores the attributes of range of objects and/or sets e.g. size, shape, colour, characteristics etc....

Collects data by asking simple questions of each other and gathering responses.

Uses concrete graphs to display and contrasts data sets.

Applies an investigation cycle of problem-posing, planning, data gathering, representation, analysis and conclusion.

Works with information collected about themselves or peers as a data sample.

Selects and applies appropriate methods of data collection and recording in different problem-solving scenarios.

Applies an investigation cycle of problem-posing, planning, data gathering, representation, analysis and conclusion.

Compares two data samples e.g. themselves vs others; others vs others.

Collects, interprets, uses and analyses data to efficiently solve rich problems set in everyday life.

Measures 4 - Measuring

* Children should be given opportunities to demonstrate how the knowledge and skills gained in this strand can be used to link, reinforce and progress learning across the other four interconnected strands.

Learning Outcome – Stage 1: Through appropriately playful learning experiences, children should be able to develop awareness of measuring (length, weight, capacity and area) in meaningful contexts

Learning Outcome – Stage 2: Children should be able to estimate, measure and record length, weight (mass), capacity and area using appropriate instruments and units

	a The child	b The child	c The child	d The child	e The child	f The child	g The child
Elements	Learning Outcome Label						
	Measuring– length, weight, capacity, area						
Understanding and Connecting	Is present at, exposed to and experiences direct comparisons of everyday objects and items from the environment.	Makes direct comparisons of objects, containers or surfaces to compare measurable attributes and develop an understanding of same. Explores how measures help us to make sense of our world through play, role-play, and real-life situations.	Compares and orders e.g. -Objects according to length -Containers and volumes according to capacity -Surfaces and shapes according to area Understands and identifies the different attributes that can be measured on a single object e.g. Length- Long/Short Weight – heavy/light Capacity – full/empty	Selects appropriate non-standard units for measurement tasks. Length – straws, books, hands; Weight – marbles, cubes; Capacity – cups, jugs; Area – shapes, books, postcards. Use standard units as appropriate Use repetitions of the same sized unit to measure. Understands that to be accurate, measurements must be fair.	Identifies commonalities and differences between measurable attributes and the needs for standard units of measurements. Identifies the appropriate measurement instruments and units for a given situation (must be appropriate for attribute and level of accuracy needed)	Identifies meaningful benchmarks for standard units Length – m, cm Weight – kg, g Capacity – l, ml Areas – standard square units; and appropriate fractional quantities of same. Understands and explains how to read a simple scale and how to use conventional measuring instruments.	Understands and explains the relationship between the metric units associated with an attribute e.g., how centimetres relate to metres. Chooses appropriately sized standard units to measure.
Communicating	Is present at, exposed to and experiences measurable attributes through appropriate multi-modal communication.	Understands and uses appropriate, descriptive comparative and superlative language associated with a range of measurable attributes. Listens to a range of stories involving concepts of measurement.	Describes and discriminates between items using appropriate comparative language. Records comparisons and measurement activities using informal modes.	Discusses and compares estimates and measures. Records estimates and measures concretely, pictorially and orally. Understands that quantifying a measurement helps us describe and compare more precisely.	Understands that standard units can simplify communication about measurement Collects and records measurement data in systematic ways e.g., lists, tables etc. and compares results.	Discusses and records estimates and measurements using appropriate standard units and symbols including fractional quantities as appropriate; using appropriate instruments of measurement.	Expresses measurements in appropriate units and move flexibly between standard units. Makes and discusses estimations before engaging in measuring or indirect measuring tasks.

Reasoning	Is present at, exposed to and experiences a range of appropriate learning situations where measurable attributes are explored.	Predicts how measurable attributes of objects will compare to each other e.g., make conjectures about items and then check by direct comparison.	Recognises that if different attributes are used to order objects, the order may be different. Investigates and explains such cases. e.g., the tallest glass may not hold the most. Recognises the need for units of measurement to measure length, weight and capacity.	Makes numerical estimates of measure based on units that can be seen or handled. Explores the conservations of length, weight, capacity and area through practical investigations e.g. does the volume of water changed when it is transferred to another container; does the weight of playdough change when manipulated? Assesses reasonableness of estimations and measures.	Explains and justifies the necessity of selecting the same unit when comparing two things. Refines estimations based on known measurements. Assesses reasonableness of measurements with reference to estimations and personal benchmarks.	Estimates using standard units with increasing accuracy. Evaluates the reasonableness of measurements with reference to estimations and personal benchmarks. Explores patterns in the relationships between measurable units.	Recognises that different units will provide different measurement results for the same object and the numerical result is related to the size of the unit e.g., the door is 2m but 200cm because m are longer than cm. Evaluates the reasonableness of measurements and numerical calculations of measurements.
Applying and Problem-Solving	Is present at, exposed to and experiences a range of appropriate learning activities involving measurable attributes in meaningful contexts.	Explores various materials and equipment used to measure attributes of length, weight, capacity and area. Solves simple measurement problems in play, role play and real-life situations e.g., explores which object is heavier and which container holds more/ less in sand and water play.	Explores the procedural requirements of measurement by making direct comparisons of measurements in meaningful contexts Compares and orders objects, containers and surfaces according to appropriate measurable attributes.	Estimates and measures the attributes of a range of items in purposeful or problem-solving contexts using non-standard units/standard as appropriate. Devises strategies to measure indirectly where necessary e.g., find the length of a curved line	Identifies the appropriate attribute to measure for a given problem situation. Selects and uses appropriate procedures, measures and equipment to measure attributes of length, weight, capacity and area. Estimates and measures in standard units with a reasonable degree of accuracy.	Uses standard units and instruments to solve rich practical tasks and problems involving measurement. Measures with increasing accuracy e.g., use smaller units or fractional pieces of standard units.	Selects and uses instruments, reading and interpreting them with reasonable accuracy. Solves context-rich practical tasks and problems involving measurement and devise strategies to calculate measures where necessary e.g., adding or subtracting measurements.

Measures 5 – Time

* Children should be given opportunities to demonstrate how the knowledge and skills gained in this strand can be used to link, reinforce and progress learning across the other four interconnected strands.

Learning Outcome – Stage 1: Through appropriately playful learning experiences, children should be able to develop awareness and understanding of the concept of time

Learning Outcome – Stage 2: Children should be able to recognise, read and record elements of time using both analogue and digital representations

	a The child	b The child	c The child	d The child	e The child	f The child	g The child
Elements	Learning Outcome Label						
	Time						
Understanding and Connecting	<p>Is present at, exposed to and experiences a sense of time through experiencing the structure of daily routines at home and at school.</p> <p>Is present at, exposed to and experiences the order of a typical day e.g. school routine – bus journeys, break times, music, home time, etc.</p>	<p>Recognises personally meaningful times of the day and week e.g. dinner, music time, bedtime, yesterday, the weekend</p>	<p>Identifies the present time, things that happened in the (recent and distant) past, and events that will happen in the (near and distant) future.</p> <p>Explores different devices available to determine time e.g. analogue /digital clocks, watches, or computer applications.</p>	<p>Explores calendar patterns such as days of the week, months, seasons, celebrations, cultural events important to the school community, etc.</p>	<p>Reads and identifies day, date and month using the calendar. Identifies the seasons from calendar readings.</p> <p>Recognises and identifies the time of significant daily events represented on analogue and digital clock e.g. start of school, break time, home time, after-school activities</p>	<p>Identifies patterns, commonalities and differences between 12-hour and 24-hour digital devices.</p> <p>Understands and explains the relationship between units of time e.g. minute/hour, hour/day, day/week/fortnight, month/year.</p>	<p>Demonstrates understanding of connections between different modes of representing and displaying time e.g. am and pm. Represent using familiar examples.</p>
Communicating	<p>Is present at, exposed to and experiences a sense of time through exposure to teacher directed instruction and incidental opportunities for describing time and events.</p>	<p>Uses and responds to simple language associated with time.</p> <p>Conveys understanding of language associated with time e.g. nearly, now, soon, just past, later, morning, evening, night, before, after, today, yesterday, tomorrow, day and night.</p>	<p>Discusses and identifies days of the week, months, and seasons and makes connections with real-life events.</p> <p>Becomes familiar with the movements of analogue clock hands and uses on-the-hour times as key points of reference for these movements.</p>	<p>Uses the language/vocabulary of time to discuss and sequence events, days of the week, months of the year and seasons.</p> <p>Describes time passing and durations of time in informal ways e.g. describes a journey as long or short.</p> <p>Reads time in one-hour intervals.</p>	<p>Reads and record time in one-hour and half hour intervals on analogue and digital clock.</p> <p>Investigates and discusses calendar patterns and characteristics of months and seasons.</p>	<p>Reads and records time in one-hour, half-hour and quarter-hour intervals on analogue and digital clocks.</p>	<p>Expresses digital time as analogue time and vice versa.</p> <p>Makes and discusses estimations before engaging in numerical calculations involving time.</p>

			Records sequencing activities using informal modes.	Recognises that standard approaches to reading time can simplify communication.			
Reasoning	<p>Is present at, exposed to and experiences an appropriate variety of routines and activities on a daily basis.</p> <p>Is present at, exposed to and experiences the celebration of events of significance e.g. Christmas, birthdays, national holidays such as St. Patricks Day etc....</p>	<p>Recognises predictable patterns of time e.g. daily routines and durations of time / time passing e.g. seasons, festivals.</p> <p>Predicts events in the immediate future based on familiar patterns of events e.g. we will play after our snack, I read before bedtime.</p>	<p>Discusses and sequences daily and weekly events or stages in a story or real-life situations.</p> <p>Makes predictions based on familiar patterns of events in daily or weekly routines.</p> <p>Identifies errors in chronological sequences of events.</p>	<p>Identifies things that happened in the recent past and shows an understanding that things and events will happen in the future e.g. birthdays, Christmas, summer holidays.</p> <p>Identifies meaningful benchmarks for key time intervals e.g. lunch time is half an hour.</p>	<p>Discusses and investigates patterns and characteristics of seasons, days of the week, months of the year.</p> <p>Determines and makes reasonable estimations of time.</p> <p>Makes approximations of the present time or the time shown on analogue clocks using appropriate language e.g. about, almost, nearly, just past</p>	<p>Makes plausible predictions of time, generalisations of future times and events and justifies these explanations. Checks and evaluates accuracy of these ideas.</p> <p>Matches, sorts and sequences time represented on analogue and digital clocks.</p>	<p>Analyses and evaluates the ideas of other children in determining time or making predictions of time.</p> <p>Evaluates the reasonableness of predictions and numerical calculations involving time.</p>
Applying and Problem-Solving	<p>Is present at, exposed to and experiences visual timetables or scheduling boards that convey daily routines and patterns.</p>	<p>Identifies instruments which tell the time and recognises changes in time throughout everyday experience.</p> <p>Through everyday events and games, notices changes and differences in time.</p>	<p>Asks questions that are useful to acquire a clearer understanding of time.</p> <p>Analyses and sorts events according to when they occur e.g. night time vs day time activities.</p>	<p>Recognises special times on the clock face e.g. lunch or home time.</p> <p>Sequences time given on analogue clocks.</p> <p>Sequences events, days of the week, months of the year and seasons.</p>	<p>Experiments with and records time passing using a variety of modes; simple devices and/or methods e.g. egg timers</p> <p>Refines hypotheses based on evidence generated.</p> <p>Predicts and models how the face of an analogue clock will change over a specified time.</p>	<p>Explores different ways of presenting time.</p> <p>Converts minutes as hours and hours as minutes.</p> <p>Analyses and creates simple timetables and calendars.</p>	<p>Solves and completes rich practical tasks and problems involving time and dates.</p> <p>Estimates and measures, where possible, time taken for familiar activities or events.</p>

Measures 6 – Money

* Children should be given opportunities to demonstrate how the knowledge and skills gained in this strand can be used to link, reinforce and progress learning across the other four interconnected strands.

Learning Outcome – Stage 1: Through appropriately playful learning experiences, children should be able to develop awareness of money and how money is used

Learning Outcome – Stage 2: Children should be able to recognise the value of money and use money in a range of meaningful contexts

	a The child	b The child	c The child	d The child	e The child	f The child	g The child
Elements	Learning Outcome Label Money						
Understanding and Connecting	Is present at, exposed to and experiences using money in meaningful ways.	Recognises that money has a purpose. Begins to develop an appreciation and value of money relative to significant objects e.g. car, house, bar of chocolate.	Recognises and understands the relative value of coins up to the value of at least 20c. Understands and demonstrates that lower value coins can be combined to equal the value of a higher value coin.	Recognises and understands the relative value of coins, up to the value of at least 50c. Explores the concept of value for money and better value.	Recognises and understands the relative value of coins, up to the value of at least €1.	Recognises and understands the relative value of Euro coins. Identifies different ways of combining coins to make particular sums.	Recognises and understands the relative value Euro coins and notes. Identifies different ways of combining notes and coins to make particular sums.
Communicating	Is present at, exposed to and experiences money transactions.	Talks about transactions involving money in informal ways – e.g. pay, cost, dear, cheap, etc. Discusses the different ways that money can be generated. Discusses the different goods and services we can pay for with money.	Uses number words and comparative language to discuss coin values. Reads the number symbols on coins and records activities concretely, pictorially, and orally Uses appropriate language when buying and selling items in real-life and/or role play situations, including language of cashless transactions e.g. enter your pin, pay with card, cashback, contactless, swipe, etc.	Uses appropriate vocabulary to describe money transactions and problem-solving strategies. Records concretely, pictorially, and orally or with simple number sentences as appropriate.	Discusses and compares mental strategies used to make calculations. Selects from a variety of modes to support and record calculations e.g., concretely, empty number lines, number sentences, invented methods etc.	Discusses strategies used and evaluates the ideas of peers. Selects from a variety of written modes to support and record calculations e.g., empty number lines, formal addition or subtraction algorithms Records amounts using the decimal point and euro symbol and renames such amounts in cent.	Discusses strategies used and evaluates the ideas of peers. Selects appropriate forms of recording. Shares ideas on different ways to spend and save money e.g. pocket money gift vouchers, etc.
Reasoning	Is present at, exposed to and experiences the different forms that money comes in e.g.	Understands that some items will cost more than other items; and	Identifies and justifies which coin or collection of coins has the greatest value.	Judges whether there is enough money to buy an item of a particular value	Analyses different ways of combining coins to make particular sums and make and justify	Makes and justifies conjectures about combinations of coins.	Makes and justifies conjectures about combinations of coins and notes.

	coins, notes, debit cards, loans, etc....	<p>that some coins are worth more than others.</p> <p>Recognises that money is necessary to pay or exchange for goods and services,</p>	<p>Explains why having the most coins does not necessarily mean having the most money.</p> <p>Recognises, sorts and matches coins.</p>	and/ or whether change should be expected	<p>conjectures about combinations. e.g., using the least amount of coins, if it's possible to make using an even number of coins, etc.</p> <p>Estimates amounts of money and calculations involving money.</p>	<p>Selects appropriate mental strategies for calculation and estimation depending on context e.g., identifies whether it is more efficient to count on or count back to find change etc.</p> <p>Compares and analyses strategies used for calculation and selects efficient strategies for a given context.</p>	<p>Estimates and investigates amounts of money over €2 using specific numbers of coins and notes or the least number of coins and notes.</p> <p>Uses estimates to assess reasonableness of calculations.</p>
Applying and Problem-Solving	<p>Is present at, exposed to and experiences the transaction of money for goods or services in meaningful contexts.</p> <p>Is present at, exposed to and experiences the uses of money for social purposes.</p>	Explores money transactions in role-play and/or everyday situations.	Selects and exchanges appropriate coins in real life or role play contexts.	<p>Selects and uses suitable mental strategies to tender appropriate coins and calculates change in problem contexts.</p> <p>Investigates different ways to find and express the value of a group of coins; investigates different ways of making particular sums up to at least 50c.</p>	Selects and uses a range of mental strategies to identify the coins that are needed and/or calculates amounts of money and change in problem-solving contexts.	<p>Calculates simple bills and the number of items that can be bought with a given sum.</p> <p>Exchanges money for goods / items in real-life or role play contexts.</p>	Solves increasingly complex context-rich and/or open-ended problems involving money which require spending specific amounts and giving change.

Number 7 - Uses of number⁷

* Children should be given opportunities to demonstrate how the knowledge and skills gained in this strand can be used to link, reinforce and progress learning across the other four interconnected strands.

Learning Outcome – Stage 1: Through appropriately playful learning experiences, children should be able to develop an awareness that numbers can be used to: tell how many, describe (label) and order

	a The child	b The child	c The child	d The child
Elements	Learning Outcome Label			
	Uses of number			
Understanding and Connecting	<p>Use senses to playfully explore numerals in 3-D form. (Foam numerals, playdoh, forming numbers in sand, jigsaws)</p> <p>Is present at, exposed to and experiences numerals in the environment.</p> <p>Develops an awareness of numerals of significance or importance to the child e.g. age, address.</p>	<p>Recognises numerals in the immediate environment.</p> <p>Develops an awareness of number and number word sequencing through song, stories, rhymes and games.</p> <p>Uses senses to playfully explore numerals in 2-D form.</p> <p>Attends to numerals of significance or importance to the child e.g. age, address.</p>	<p>Recognises that objects and symbols can represent number e.g. dots on a dice</p> <p>Orders numerals. up to at least 10</p> <p>Notices and recognises the use of numerals as labels in the context of home, the classroom and school environment.</p> <p>Makes connections between numerals of significance in their lives and the role of these numbers e.g. age, bus route.</p> <p>Recognises the use of ordinal numbers first, second, third, last in everyday life contexts;</p>	<p>Recognises numerals to at least 20.</p> <p>Reads, writes and orders numerals up to at least 20.</p> <p>Recalls the number sequence forwards and backwards, from zero to at least 20, from any given number.</p> <p>Discusses and explores the use of number for a variety of purposes e.g. to quantify cardinality, to order/rank ordinality and to name or label nominality.</p>
Communicating	<p>Is present at, exposed to and experiences sensory activities that include number</p>	<p>Participates in sensory activities that include number e.g. tapping feet, clapping hands, banging drums.</p>	<p>Represents numbers using informal symbols e.g. fingers, tallies of marks and pictures and gradually introduces numerals as symbols.</p> <p>Explains ordinality using the language of after, before and in-between.</p>	<p>Creates a book or display of 6, 7, 8, 9, 10 to convey the different uses and application of numerals - to represent 'how many', order/rank, label.</p>

⁷ This Progression Continuum refers only to a Learning Outcome for Stage 1 and hence, has only four Milestones.

			Creates a book or display of 0, 1 2, 3, 4, 5, to convey the different uses and application of numerals - to represent 'how many', order/rank, label.	
Reasoning	Begins to experience a numeral rich, high quality, appropriate, learning environment,	Distinguishes numerals from letters and other symbols.	Talks about the personal significance of numerals e.g. birthdays, addresses and phone numbers. Understands that quantity, order and labels can be represented by a number.	Distinguishes between cardinal quantity, ordinal order/rank in a list and nominal name/label not denoting value or position numbers using everyday examples.
Applying and Problem-Solving	Is present at, exposed to and experiences a range of activities and games that involve number. Is present at, exposed to and experiences everyday routines and activities that involve number.	Explores the use of number in their environment. Plays games to raise awareness of number in their environment. Sorts sets of symbols into numerals and letters.	Matches numerals to sets and to other numerals in a variety of contexts.	Uses the calendar to apply ordinality of numbers to dates of upcoming events.

Number 8 - Place value

* Children should be given opportunities to demonstrate how the knowledge and skills gained in this strand can be used to link, reinforce and progress learning across the other four interconnected strands.

Learning Outcome – Stage 1: Through appropriately playful learning experiences, children should be able to develop a sense of ten as the foundation for place value and counting

Learning Outcome – Stage 2: Children should be able to understand that digits can have different values; the value of a digit in a written numeral depends on its place or position in that numeral

	a The child	b The child	c The child	d The child	e The child	f The child	g The child
Elements	Learning Outcome Label						
	Place value						
Understanding and Connecting	Is present at, exposed to and experiences grouping activities i.e. classifying, matching sorting, ordering	Shows an understanding of differences in value such as 'one', 'a lot', 'some', 'more'.	Explores the relationship between numbers 1-9 as units in themselves and also their association with 10. Understands that the quantity of a set is represented by a last number count. Uses concrete materials to demonstrate equivalence between the numeral and quantity of 10.	Understands that 2-digit numbers represent amounts of tens and ones. Explores the structure of numbers 11-20 in terms of tens and units. Appreciates that the position of a digit indicates its value – that digits to the left have the greatest value, digits to the right have the least.	Explores and identifies place value in whole numbers 0-99 Compares two 2-digit numbers and represent relationship between numbers using <, >, and =	Explores and identifies place value in whole numbers 0-199. Compares two 3-digit numbers up to at least 199, and represents relationship between numbers using <, >, and =	Explores and identifies place value in whole numbers 0-999. Compares numbers up to at least 999, and represents relationship between numbers using <, >, and =
Communicating	Is present at, exposed to and experiences the terminology of 'one', 'a lot', 'some', 'more'. Is present at, exposed to and experiences a variety of number rhymes, finger rhymes, stories and games.	Engages in number rhymes, finger rhymes, stories and games. Engages in grouping activities i.e. classifying, matching, sorting, ordering through appropriate modes of communication.	Develops the language of grouping and exchanging/swapping. Talks about numbers of personal significance such as age and compares with other familiar people. Discusses the grouping and swapping of materials.	Explores appropriate mathematical representations to communicate ideas of tens and ones. Records using materials or pictorially.	Uses appropriate materials to compose and decompose 2-digit numbers into tens and units. Uses appropriate language to describe a range of ways to describe 2-digit numbers e.g., 23 = 23 ones; 2 tens and 3 ones or 1 ten and 13 ones.	Uses appropriate materials to compose and decompose 3-digit numbers up to at least 199, into a hundred, tens and units. Uses appropriate language to describe a range of ways to communicate about 3-digit numbers up to at least 199 e.g., 123 = 123 ones; 1 hundred 2 tens and 3 ones.	Uses appropriate materials to compose and decompose numbers, up to at least 999, into hundreds, tens and units. Uses correct language to describe 3-digit numbers in a range of ways, e.g., 423 = 423 ones; 4 hundreds, 2 tens and 3 ones.
Reasoning	Explores various ways to group and exchange materials.	Shows awareness of the concept of grouping and swapping/exchanging	Explores various arrangements of manipulatives on a five	Composes and decomposes numbers 11-20 into tens and ones	Rounds numbers to the nearest ten and uses this skill routinely to estimate	Rounds numbers to the nearest ten or hundred.	Rounds numbers to the nearest ten or hundred.

		<p>using random materials e.g. token economy activities or reward system</p>	<p>frame to prompt different mental images of numbers and different mental strategies for manipulating these numbers</p> <p>Orders and compares numbers with each other.</p>	<p>using appropriate materials.</p> <p>Explores various arrangements of counters on a ten frame to prompt different mental images of numbers and different mental strategies for manipulating these numbers.</p>	<p>and check the reasonableness of a solution.</p> <p>Orders 2-digit numbers to 99 in terms of their value from least to most, most to least</p>	<p>Orders 3-digit numbers up to 199 in terms of their value from least to most, most to least.</p>	<p>Uses this skill routinely to estimate and check the reasonableness of a solution.</p> <p>Orders 3-digit numbers up to 999 in terms of their value from least to most, most to least.</p>
<p>Applying and Problem-Solving</p>	<p>Participates in appropriately rich and challenging tasks and activities to the level of the child's ability.</p>	<p>Sorts, groups and arranges materials according to specified or non-specified criteria.</p>	<p>Participates in grouping and swapping activities involving quantities up to 5 and beyond using lollipop sticks, counters.</p> <p>Solves problems through play involving grouping and swapping around 5.</p>	<p>Participates in grouping and swapping activities involving tens and ones; using concrete and base ten materials.</p> <p>Solves problems through play involving grouping and swapping around 10.</p>	<p>Explores a range of ways to describe 2-digit numbers e.g., 23 = 23 ones; 2 tens and 3 ones; or 1 ten and 13 ones.</p> <p>Compares the cost price of a range of objects using everyday contexts and examples e.g. shop</p>	<p>Compares the cost value price of a range of objects using everyday contexts and examples e.g. shop</p>	<p>Determines and employs robust means of solving problems involving place value.</p> <p>Applies learning to other areas of the curriculum e.g. measures, money.</p>

Number 9 - Numeration and counting

* Children should be given opportunities to demonstrate how the knowledge and skills gained in this strand can be used to link, reinforce and progress learning across the other four interconnected strands.

Learning Outcome – Stage 1: Through appropriately playful learning experiences, children should be able to develop an awareness that the purpose of counting is to quantify

Learning Outcome – Stage 2: Children should be able to demonstrate fluency in using and applying different counting strategies

	a The child	b The child	c The child	d The child	e The child	f The child	g The child
Elements	Numeration and counting						
Learning Outcome Label	Numeration and counting						
Understanding and Connecting	<p>Is present at, exposed to and experiences counting in play and in a variety of learning contexts using objects, sounds, movements, items that can be moved and not moved.</p>	<p>Understands that numbers are used for counting and that the last number in the count indicates the quantity or order of objects in a set.</p> <p>Recognises numerals, initially within 10.</p> <p>Recites forward to at least 10.</p> <p>Engages in counting of concrete objects in their environment.</p>	<p>Develops an understanding of the conservation of number (1-10) and understands that the appearance of the group has no effect on the overall total.</p> <p>Recites backwards from at least 10.</p> <p>Identifies the empty set and the numeral zero.</p> <p>Demonstrates a growing understanding of the five principles of counting 1:1, stable order, cardinal, order relevance, abstraction</p> <p>Connects numerals to counted objects.</p> <p>Explores relationship between oral counting of concrete materials or pictorial representations and numerals.</p>	<p>Develops an understanding of the conservation of number (11-20) and understands that the appearance of the group has no effect on the overall total.</p> <p>Talks about and links relationship between the numbers 11-20 and prior knowledge of 1-10.</p> <p>Counts forwards and backwards from 20 starting at any given number using verbal, concrete and pictorial supports.</p>	<p>Skip counts numbers within 50/100 using twos, fives, and tens from a given number using verbal, concrete and pictorial supports.</p> <p>Counts by ones to 100 and beyond, counting fluently across decades e.g. 39 to 40</p> <p>Counts forwards and backwards in tens from any given number to at least 100 using verbal, concrete and pictorial supports.</p> <p>Explores a range of approaches to support calculation strategies e.g., doubles, near doubles.</p>	<p>Counts combinations of wholes and parts e.g. 3 wholes and 4 halves make 5.</p> <p>Demonstrates ability to count forward and backwards in 100s to/from at least 1100.</p> <p>Uses a variety of strategies to add and subtract tens and hundreds to any whole number up to at least 1100.</p>	<p>Explores and counts numbers to 1000 and beyond, recognising patterns of ones, tens and hundreds.</p> <p>Represents understanding of numbers up to 1000 at least using different models.</p> <p>Uses splitting, jumping and other strategies to undertake calculations involving large numbers.</p>
Communicating	<p>Is present at, exposed to and experiences number rhymes, songs, jingles and stories.</p>	<p>Counts objects or people by touching, gesture or verbalisation from 1.</p> <p>Begins to use a variety of modes to communicate ideas about number and quantity.</p>	<p>Talks about, draws and writes representations of numbers 1-10, using concrete materials or relate to real life.</p> <p>Keeps track of counting acts by using numerical patterns such as tapping or fingers and records</p>	<p>Talks about, draws and writes representations of numbers up to at least 20.</p> <p>Counts mentally 2, 3, 4, and 5 more than/less than a given number.</p>	<p>Talks about and records solutions and strategies using non-standard written approaches.</p> <p>Explains and justifies choices of strategies used and compares with the choices of others.</p>	<p>Represents understanding of numbers up to at least 100 using different models e.g. physical models, diagrams and number expressions.</p> <p>Explains strategies used. Listens to other solutions and strategies.</p>	<p>Explains and justifies strategies used.</p> <p>Verifies and justifies solutions.</p> <p>Records solutions and strategic approaches.</p>

		<p>Begins to recognise and use numerals in personally meaningful contexts e.g. making a birthday card for a friend.</p> <p>Participates in counting acts using personal modes e.g. body movements.</p>	<p>pictorially, using concrete materials or in written form.</p> <p>Makes numerals in sand, using playdoh.</p> <p>Counts forwards and backwards from different starting points, using numbers appropriate to the children.</p>	<p>Justifies solutions and strategies used.</p> <p>Records solutions and strategies using materials, pictorial representations or symbols.</p>		<p>Justifies solutions.</p> <p>Records solutions strategies using non-formal or conventional approaches.</p> <p>Describes mental strategies used or 'how' came to</p>	
Reasoning	<p>Is present at, exposed to and experiences the concept of zero, none, empty, all gone.</p> <p>Is exposed to, through the immediate environment, a variety of opportunities to quantify and subitise.</p>	<p>Understands that zero, as a numeral, represents nothing/none in terms of quantity.</p> <p>Subitises, and counts the number of objects in sets up to at least 3.</p> <p>Orders and distinguishes between sets without counting (subitising)</p>	<p>Orders sets without counting, tests and proves hypothesis by counting.</p> <p>Subitises, and counts the number of objects in a set 1-10.</p> <p>Recognises that each subsequent number in a sequence is one more than the one that precedes it and one smaller than the one that comes after it.</p> <p>Develops a growing ability to talk about counting processes.</p>	<p>Estimates and counts the number of objects in a set 1-20. Uses this information to estimate the number of objects in a larger group.</p> <p>Checks and justifies estimates by counting.</p> <p>Subitises 'how many' in regular and irregular dot patterns, arrays, five frames and ten frames and dice without having to count.</p> <p>Determines the number immediately before or after another number without having to start at one.</p>	<p>Uses knowledge of doubling to develop further calculation strategies e.g. near doubling, bridging through 5 and 10, compensation, add 1 to develop increasingly complex strategies.</p> <p>Checks the reasonableness of calculations by comparing the final solution with the estimate.</p> <p>Explores, talks about and investigates mathematical patterns and relationships involving 2s, 5s, and 10.</p>	<p>Uses mental strategies to add/subtract and estimate quantities within at least 100.</p> <p>Uses knowledge of mental strategies to solve various calculations.</p> <p>Uses known facts and strategies to solve problems.</p>	<p>Uses knowledge of mental strategies to solve various calculations.</p> <p>Uses known facts and strategies to solve problems.</p>
Applying and Problem-Solving	<p>Is present at, exposed to and experiences counting in functional or play situations.</p> <p>Explores a range of manipulatives in play and how counting is applied in their personal lives.</p> <p>Is exposed to appropriately rich learning activities involving subitising and quantifying.</p>	<p>Investigates the role of quantifying in real life situations.</p> <p>Explores how counting can be used to solve problems related to everyday life.</p> <p>Undertakes tasks involving counting in other areas of learning.</p>	<p>Estimates and counts the number of objects in a set, up to 10</p> <p>Begins to use simple number lines for counting all, counting on and counting back, as appropriate.</p> <p>Asks questions around estimation activities.</p> <p>Selects and uses appropriate materials to make a variety of sets for a given number up to 10 and beyond.</p>	<p>Selects and uses appropriate materials to make a variety of sets for a given number up to 20 and beyond.</p> <p>Draws from a range of counting strategies to determine quantities.</p>	<p>Selects and uses a range of mental strategies to solve problems.</p> <p>Uses skip counting to extend number patterns.</p>	<p>Selects and uses a range of mental strategies to solve problems.</p> <p>Explores a variety of ways of counting and estimation strategies to support calculation.</p> <p>Uses number lines, significant benchmarks e.g. 5, 10, 100, patterns and later mental strategies to add and subtract.</p>	<p>Selects and uses a range of mental strategies to solve problems.</p> <p>Analyses and evaluates solutions to problems involving estimation and/or calculation.</p>

Number 10 – Operations

* Children should be given opportunities to demonstrate how the knowledge and skills gained in this strand can be used to link, reinforce and progress learning across the other four interconnected strands.

Learning Outcome – Stage 1: Through appropriately playful learning experiences, children should be able to combine and partition quantities

Learning Outcome – Stage 2: Children should be able to use addition and subtraction to solve real world situations and problems, making use of a range of strategies

	a The child	b The child	c The child	d The child	e The child	f The child	g The child
Elements	Learning Outcome Label						
	Operations						
Understanding and Connecting	<p>Is present at, exposed to and experiences situations where quantities are combined or increased and partitioned or decreased.</p> <p>Is present at, exposed to and experiences a range of appropriate matching, classifying, and one-to-one corresponding activities.</p>	<p>Sorts a variety of random materials into a set according to a single criterion/property.</p> <p>Subitises the number of objects in a set.</p> <p>Identifies the empty set – recognises zero.</p> <p>Matches pairs of identical objects in one-to-one correspondence.</p> <p>Matches equivalent and non-equivalent sets using one-to-one correspondence.</p>	<p>Sorts a variety of materials into a set according to various criteria/properties.</p> <p>Matches numerals to sets up to at least 5.</p> <p>Combines sets of objects up to at least 5.</p> <p>Partitions sets of 2 or more.</p> <p>Compares equivalent and non-equivalent sets from 1 up to at least 5 by matching without using symbols more/less than.</p> <p>Orders sets of objects by number up to at least 5.</p> <p>Accurately counts two sets and determine which set has more.</p>	<p>Combines sets of objects up to at least 10 including empty set/zero.</p> <p>Partitions sets of objects (2 to at least 10) using concrete materials.</p> <p>Makes sets from 6 to at least 10 and describes the sets, identifying which part has more, less or the same.</p> <p>Counts on and back in ones to complete addition and subtraction.</p> <p>Links number families when explaining mental strategies for addition and subtraction e.g. $2+4=6$; $4+2=6$; $6-2=4$; $6-4=2$</p> <p>Compares equivalent and non-equivalent sets (1 to at least 10) by matching without using symbols more/less than.</p> <p>Orders sets of objects by number (1 to at least 10).</p> <p>Matches numerals to sets up to 10 and beyond.</p>	<p>Combines sets of objects up to 20.</p> <p>Partitions sets of objects (0-20) using concrete materials. Demonstrates knowledge of addition and subtraction facts to 20 at least.</p> <p>Partitions whole numbers with at least two digits into component parts to aid mental calculation e.g. $19 = 10 + 9$.</p> <p>Compares equivalent and non-equivalent sets 0-20.</p> <p>Adds within 100 including adding a 2-digit number and a 1-digit number; a 2 digit and a 2-digit; a 2 digit and a multiple of 10.</p> <p>Subtracts number within 99 without renaming.</p> <p>Understands and uses the zero property to support calculations.</p> <p>Adds and subtracts using partitioning</p>	<p>Explores repeated addition and group or skip counting.</p> <p>Recognises, explains and uses the connections between addition and subtraction to complete mental and written calculations.</p> <p>Checks answers routinely using inverse operations e.g. $6 \times 4 = 24$, $24 \div 4 = 6$</p> <p>Subtracts number within 199 and beyond with renaming.</p> <p>Explores addition and subtraction within 199 and beyond.</p> <p>Establishes and identifies half and quarters of sets up to 20.</p> <p>Understands and uses the associative property to support addition.</p>	<p>Adds and subtracts within 999.</p> <p>Recognises, explains and uses the connections between addition and subtraction to complete mental and written calculations.</p> <p>Checks answers routinely using inverse operations</p>

Communicating	<p>Is present at, exposed to and experiences stories, songs, rhymes and activities that encourage comparisons of sets, such as The Very Hungry Caterpillar.</p> <p>Is present where terminology of early operations is modelled and scaffolded.</p>	<p>Talks about the process of sorting and justifies the use of attributes/property used in forming sets.</p> <p>Represents a verbal number sentence using concrete objects.</p> <p>Uses appropriate gestures and words to convey and make comparisons.</p>	<p>Talks about the process of sorting and the attributes/property used in forming sets.</p> <p>Records a number sentence pictorially or in jumps forward / backwards on number line.</p> <p>Uses comparative language, e.g. more, less, same, to compare sets up to 10 and beyond by counting using objects of different sizes.</p>	<p>Determines 'how many more' or 'how many less' by addition or subtraction in comparing sets</p>	<p>Selects and shares mental strategies for addition and subtraction facts within 20</p> <p>Uses symbols +, -, = to convey addition and subtraction facts</p> <p>Records equivalent and non-equivalent sets 0-20 using <, > and =</p>	<p>Describes and records mental strategies for addition within 99</p> <p>Uses symbols +, -, =, < and > to convey addition and subtraction facts</p>	<p>Recalls addition and subtraction facts to 20 least.</p>
Reasoning	<p>Is present at, exposed to and experiences a variety of rich learning opportunities where the concept of 'more' or 'less' is explored, in the real-life context and/or play; e.g. Comparing sets of objects same objects and different objects.</p>	<p>Classifies objects into sets.</p> <p>Combines sets of objects together when requested</p> <p>Partitions sets of objects when requested to e.g. 5 ducks in a picture, 3 ducks in the water and 2 ducks on the grass. $3+2=5$</p> <p>Identifies, recognises and estimates 'more' or 'less' in the real-life context and/or play; comparing sets of objects same objects and different objects.</p>	<p>Develops understanding of addition as combining, subtraction as deducting difference, and complementing.</p> <p>Accurately counts two collections and identifies which collection has more.</p>	<p>Partitions numbers 1-10 numbers into two or more parts and recognises that this does not affect the total e.g. $2+4=6$ and $1+2+2+1=6$.</p> <p>Demonstrates understanding of all possible partitions of numbers to at least 10.</p> <p>Use knowledge of addition to develop understanding of subtraction e.g., $2 + 4 = 6$ so $6 - 4 = 2$...</p>	<p>Uses knowledge of addition and subtraction facts to at least 20.</p> <p>Appreciates and argues the commutative property in relation to addition facts e.g. $3+4=4+3$ and justifies with proofs.</p> <p>Applies the zero property to support calculations and justifies with proofs.</p> <p>Estimates differences within 99.</p>	<p>Uses rounding and other estimation strategies, clustering, front-end, routinely to estimate and checks the reasonableness of a solution.</p> <p>Analyses different estimation strategies in solution contexts.</p> <p>Applies the associative and zero properties to support calculations and justifies with proofs.</p>	<p>Analyses and evaluates other strategies and proofs.</p> <p>Explores alternative solution strategies to addition and subtraction tasks.</p> <p>Recognises when estimation alone may not fully suffice and where other approaches to calculations may be more appropriate.</p>
Applying and Problem-Solving	<p>Is present at, exposed to and experiences number stories, songs, rhymes and activities where objects are added or taken away, e.g. during daily routines.</p>	<p>Plays games and participates in singing games and rhymes where objects are added or taken away</p>	<p>Combines sets of objects using appropriate strategies to find out how many</p>	<p>Uses a range of strategies to add and subtract mentally to at least 10.</p> <p>Uses symbols +, - and = appropriately to construct number sentences involving addition and subtraction.</p>	<p>Constructs number sentences and number stories; solves problems involving addition within 20/99?</p>	<p>Constructs number sentences and number stories; solves problems involving addition within 199</p>	<p>Solves word problems and real-life problems involving addition and subtraction.</p> <p>Applies a range of strategies to solve addition and subtraction problems with at least digit whole numbers and justifies choice of strategy.</p>

Number 11 - Fractions

* Children should be given opportunities to demonstrate how the knowledge and skills gained in this strand can be used to link, reinforce and progress learning across the other four interconnected strands.

Learning Outcome – Stage 1: Through appropriately playful learning experiences, children should be able to understand whole number(s) in the context of part-whole relationships

Learning Outcome – Stage 2: Children should be able to explore, (model, express and represent) mathematical relationships between part-whole quantities

	a The child	b The child	c The child	d The child	e The child	f The child	g The child
Elements	Learning Outcome Label Fractions						
Understanding and Connecting	Is present at, exposed to and experiences corresponding activities and the comparison of objects and sets of objects.	Matches and sorts objects with corresponding parts in everyday and interactive activities e.g. fork and knife Recognises and identifies relationships between matched pairs.	Uses materials to explore how a whole object or set can be built up from or broken down into subsets, often in different ways. Partitions objects and shapes into two equal shares and describes the whole and parts by the number of shares/parts. Compares sets of objects.	Explores the composition of a whole by decomposing single and discrete sets of objects into equal parts. Establishes and identifies half of sets to 10 and beyond.	Explores the concept of equivalence of fractions, Partitions objects and expresses as unit fractions. Establishes and identifies quarters of sets.	Connects eighths, fifths, and tenths to prior knowledge of fractions. Compares fractions in terms of size and place fractions in order on a number line. Establishes and identifies eighths, fifths and tenths of sets to 20 and beyond. Represents fractions using manipulatives to demonstrate relationships and equivalence.	Explores, compares and orders fractions and identifies equivalent forms of fractions with denominators 2-12. Establishes and identifies unit fraction of various amounts.
Communicating	Is present at, exposed to and experiences appropriate modes of communication, describing the combination and partitioning of objects and sets in a variety of appropriately rich contexts.	Uses appropriate gestures or language to communicate about matching, sorting and classifying experiences. Listens to and uses appropriate language to describe combining and partitioning in a variety of appropriately rich contexts.	Discusses combining and partitioning of sets and wholes using appropriate language to describe and justify solution. Records number sentences to represent the relationship between the set and the subset. Combines and partitions objects and sets and describes in terms of bigger, more, smaller, less than, the same as...	Uses appropriate vocabulary to describe equal parts of a whole - e.g. half, quarter. Records relationships between parts using concrete materials, pictorially or using symbols.	Explains understanding of unit fractions using concrete materials, pictorial representations and appropriate mathematical vocabulary.	Discusses and explains relationship between halves, quarters and other unit fractions. Uses correct notation for simple fractions, up to at least tenths, e.g. $\frac{1}{2}$, $\frac{3}{4}$, $\frac{5}{8}$	Establishes equivalence between fractions of denominators 2-12 using concrete materials and number lines.

Reasoning	Is present at, exposed to and experiences activities involving partitioning and combining sets of objects.	Classifies objects and/or pictures according to categories of objects, e.g. transport. Sorts materials in an undirected manner i.e. according to self-selected criteria.	Identifies patterns emerging from partitioning a set into subsets or from combining two subsets. Explores the differences between partitioning a whole and a set of discrete items.	Partitions objects and shapes into two and four equal shares and describes the whole and parts by the number of shares. Determines that equal shares of identical wholes need not have the same shape.	Demonstrates understanding that the greater the number of portions of a whole, the smaller the size of each equal share. Recognises that equal shares of identical numbers have the same value; and that comparisons are only valid when referring to the same unit/whole	Investigates relationships between halves, quarters and other unit fractions using for example paper folding, concrete materials and/or pictorial representations.	Explores patterns in respect of equivalent fractions. Explains the role of the numerator and denominator.
Applying and Problem-Solving	Is present at, exposed to and experiences a range of matching, sorting and classifying tasks.	Explores open-ended investigations in relation to matching, sorting and classifying objects. Applies idea of fair sharing among peers by partitioning whole sets of objects or spaces such as food, toys e.g. Lego and use of skipping rope.	Explores a range of ways in which sets can be divided into subsets. Explores the composition of sets 2-5 by combining and partitioning.	Splits a whole into smaller parts and explain that 'equal parts' are the same size. Divides or shares out groups of objects equally into smaller groups Investigates halves and quarters of different shapes.	Explores and solves a range of everyday problems involving partitioning. Develops awareness of everyday applications of fractions e.g., recipes, sport.	Explores different models to demonstrate understanding of simple equivalent fractions e.g. $\frac{1}{2} = \frac{2}{4} = \frac{3}{6}$ using concrete materials, paper folding and pictorial representations and other models	Manipulates equivalent forms of fractions for specific purposes.

Shape and Space 12 - Spatial Awareness and Location

* Children should be given opportunities to demonstrate how the knowledge and skills gained in this strand can be used to link, reinforce and progress learning across the other four interconnected strands.

Learning Outcome – Stage 1: Through appropriately playful learning experiences, children should be able to develop a sense of spatial awareness and reasoning

Learning Outcome – Stage 2: Children should be able to develop spatial reasoning and visualise and model location using symbolic co-ordinates

	a The child	b The child	c The child	d The child	e The child	f The child	g The child
Elements	Learning Outcome Label						
	Spatial awareness and location						
Understanding and Connecting	<p>Is present at, exposed to and experiences arrange of appropriate learning activities involving location/position in familiar environments.</p> <p>Begins to develop an awareness of the position of their body in space, through multi-sensory approaches.</p> <p>Begins to explore the movements of different parts of the body and/or the ways in which the body can move, or be moved, in space, relative to their level of mobility.</p>	<p>Describes the position or location of objects.</p> <p>Explores and discusses the environment of the classroom, school and other familiar settings.</p>	<p>Describes the location and relative proximity of objects using appropriate language e.g., far away, further away, closest to.</p>	<p>Recognises and describes the position of objects on simple maps and plans.</p> <p>Explores different modes of representing spatial concepts and relationships.</p>	<p>Gives and follows directions involving half and quarter turns in the context of personal movement, simple plans or grids.</p> <p>Identifies the position and orientation of objects with increasing accuracy e.g., facing the door, to the left of, using compass directions.</p>	<p>Devises and describes routes on maps, plans and grids.</p> <p>Describes and models rotational movements/angles in a variety of ways and identifies benchmark angles e.g. quarter and half turns, using arms, legs or straws to model angles.</p> <p>Investigates the effect of making a half turn clockwise or half turn anticlockwise.</p>	<p>Describes location or gives directions with attention to both distance and direction using appropriate mathematical language and concepts e.g., incorporation of compass directions, distances in metres, turns in terms of angles etc.</p>
Communicating	<p>Is present at, exposed to and experiences situations where movement and positionality are used and highlighted through varied multi-modal approaches.</p>	<p>Gives and follows simple instructions related to movement and positioning.</p> <p>Uses and responds to language that describes simple movements.</p> <p>Moves objects around and describes in terms of spatial relationships.</p>	<p>Communicates position or location through a range of modes such as physical, written, verbal, visual, augmentative e.g., makes simple models or drawings to show the position of objects - teddy between the car and the book.</p>	<p>Creates and discusses representations of familiar or imagined spaces e.g., bedroom, school yard or story setting in a variety of modes.</p> <p>Recognises and uses directions 'right' and 'left' in real situations and communicates positions and directions with increasing precision.</p>	<p>Describes and records the steps in a series of directions using appropriate vocabulary and representations.</p> <p>Asks questions to clarify directions.</p> <p>Represents spatial concepts and relationships from different vantage points and perspectives.</p>	<p>Interprets maps/plans of familiar locations.</p> <p>Analyses and evaluates representations for accuracy.</p> <p>Discusses and compares alternate routes on maps and plans.</p>	<p>Discusses mathematical features of conventional maps and digital maps or route-planning tools e.g., scale, how relative distance between locations is preserved; route planner on Google Maps.</p>

Reasoning	Is present at, exposed to and experiences activities where objects and/or people are placed in familiar positions or moved to random positions e.g. where is teddy gone?	Determines the location of an object by listening to descriptions of position or location. Evaluates statements about position or location in the environment e.g. determine if it is correct to say, 'the teddy is under the chair'.	Justifies statements about position and location of objects with reference to simple representations where appropriate.	Evaluates and refines self-created maps or plans. Explores spatial relationships in number lines to conjecture and predict approximate location of numbers.	Visualises the result of following a sequence of directions on a map/plan. Deduces and identifies where, in a series of steps, the wrong direction may have been taken.	Recognises the relationship between different modes of representing position and location e.g., birds-eye view vs. street view, 3-D model of bedroom vs. 2-D plan etc. Evaluates directions or instructions for movement and refines for clarity.	Uses maps or plans to visualise routes. Makes and justifies conjectures about position and location and evaluates the statements of others.
Applying and Problem-Solving	Is present at, exposed to and experiences a range of contexts where movement and positionality are explored, e.g. a range of physical activities, transitions and spatial games such as blocks and jigsaws.	Solves problems involving location/position in familiar and new environments e.g., where is the best place to plant a tree/store new toys etc.	Describes simple paths through familiar environments and traces paths on simple maps, plans or grids. Builds and creates structures using a range of strategies and materials e.g. blocks.	Solves problems involving simple maps, plans or grids e.g., barrier games; including maps and images from various angles and/or perspectives/vantage points.	Creates a set of instructions to direct movement for a given purpose e.g., directs partner to walk around a square, programme simple 'robots'.	Devises and analyses routes on maps, plans or grids that satisfy certain constraints e.g., the shortest route, a route that does not involve backtracking, devises a route for robot who can only turn clockwise etc.	Uses maps or plans to solve rich problems with connections to real-life. Uses formal spatial and measurement conventions to create a set of instructions to direct movement e.g., Scratch programming.

Shape and Space 13 – Shape

* Children should be given opportunities to demonstrate how the knowledge and skills gained in this strand can be used to link, reinforce and progress learning across the other four interconnected strands.

Learning Outcome – Stage 1: Through appropriately playful learning experiences, children should be able to visualise and model 2D and 3D shapes and describe their properties

Learning Outcome – Stage 2: Children should be able to visualise and model 2D and 3D shapes and analyse their properties

	a The child	b The child	c The child	d The child	e The child	f The child	g The child
Elements	Learning Outcome Label						
	Shape						
Understanding and Connecting	Is present at, exposed to and experiences shapes in the environment.	Identifies and recognises shapes in the environment.	Uses mathematical terminology to name 2-D and 3-D shapes. Recognises a range of geometric shapes in different orientations and sizes.	Identifies and describes simple properties of some shapes e.g., no. of faces on a 3- D shape or no. of sides and corners on a 2-D shape Identifies 2-D shapes as the faces of 3-d solids.	Identifies and describes properties of shapes using appropriate mathematical vocabulary e.g., uses the terms faces, vertices and edges to describe 3-D shapes.	Identifies and describes more complex shape properties e.g., symmetry, parallel or perpendicular lines, angles & use properties to sort shapes. Recognises an angle as the corner of a 2-D shape	Uses standard mathematical terminology to describe and analyse 2-D and 3-D shapes.
Communicating	Is present at, exposed to and experiences appropriate language to describe the properties and appearance of shapes and objects.	Understands and uses language to describe shape and shape functions e.g., curved, straight, roll, stack	Represents shapes in various ways e.g., make simple models or drawings with reasonable accuracy. Discusses similarities and differences between shapes.	Compares and discusses representations of shapes e.g., self-made and formal representations; 2-d representations of 3-D shapes; orientations and sizes more generally. Asks questions about the properties of shapes to determine the identity of same.	Discusses and records in various ways the results of shape sorting activities e.g., pictorial, use concrete objects in sorting hoops, etc. Makes and discusses simple representations of 2-D and 3-D shapes using appropriate materials.	Uses a variety of tools, including tables and diagrams to analyse and sort shapes e.g., simple two-way tables, Venn and Carroll diagrams. Discusses the criteria used for sorting.	Designs and makes accurate models of 2-D and 3-D shapes using a variety of materials. Extends, refines and records sorting and categorisation of shapes e.g., 4- way Carroll diagrams etc.
Reasoning	Is present at, exposed to and experiences through meaningful contexts, appropriate activities where objects and shapes are compared and examined.	Discriminates between shapes. Identifies and explains when one shape is similar or different to another. Identifies when an object or set of objects is different or does not	Explains how shapes have been sorted. Justifies why shapes belong or do not belong to certain sets. Selects appropriate criteria for shape sorting	Discriminates between examples and non-examples of a shape with reference to properties.	Justifies why shapes belong or do not belong to certain categories.	Visualises and describes how 3-D solids will look when deconstructed into nets. Justifies conjectures about whether a shape	Makes conjectures and evaluate claims about shape properties and categories of shape see examples below Devise nets for simple 3-D shapes.

		belong to a familiar category (negation/complement).				belongs to a given category.	
Applying and Problem-Solving	Is present at, exposed to and experiences a range of appropriate learning activities involving shapes.	Selects appropriate shapes for a purpose e.g., a circle to represent a wheel	Sorts, compares and classifies 2D and 3D objects into logical categories according to their attributes e.g., colour, size and geometric properties e.g., no. of sides, 2D or 3-D etc. Builds and creates structures using solid shapes – describe.	Classifies shapes into categories based on mathematical properties. Selects appropriate materials to represent shapes e.g., lollipop sticks for straight edges and string for curved edges.	Creates, compares and contrasts shapes with a specified property e.g., creates a collection of different 4-sided shapes on a geoboard and discuss Formulates property lists to describe individual shapes or collections of shapes.	Solves rich problems with connections to real-life e.g., design packaging to satisfy certain constraints	Analyses the relationships between shape properties and categories of shapes e.g., explore if all isosceles triangles are symmetrical or all regular shapes tessellate; discuss the relationship between rectangles and parallelograms.

Shape and Space 14 – Transformation

* Children should be given opportunities to demonstrate how the knowledge and skills gained in this strand can be used to link, reinforce and progress learning across the other four interconnected strands.

Learning Outcome – Stage 1: Through appropriately playful learning experiences, children should be able to explore and describe the effects of shape movements

Learning Outcome – Stage 2: Children should be able to visualise and show the effects of transformations on shapes

	a The child	b The child	c The child	d The child	e The child	f The child	g The child
Elements	Transformation						
Understanding and Connecting	Is present at, exposed to and experiences play situations involving shapes and construction.	Recognises that a shape may appear different when moved in some way.	Identifies shapes in a variety of different orientations.	Recognises and identifies the component parts of composite shapes e.g. shapes that combine to make a house.	Recognises and describes simple transformations e.g., identifies when the same shape is repeated, rotated or reflected e.g. on wall paper.	Recognises and creates simple tessellations.	Understands and describe features of reflective and rotational symmetry Identifies shapes and combinations of shapes which tessellate.
Communicating	Is present at, exposed to and experiences appropriate modes of communication to describe the movement and manipulation of shapes.	Discusses movement and manipulation of shapes using informal language.	Uses appropriate language to describe movement and comparison of shapes e.g., <i>turn, flip, slide, match, and fit.</i>	Models and describes composite shapes using appropriate language. Gives and follows instructions relating to the movement of shapes.	Identifies lines of symmetry and records lines of symmetry in a range of modes. Understands and uses formal mathematical language to describe some transformations e.g., reflection, rotation	Creates representations which illustrate transformations e.g., arrows to show direction of a shape's rotation or translation, pictures with line of symmetry highlighted Understands and follows instructions to transform shapes.	Understands and uses formal mathematical language and concepts to describe transformations e.g., specifies accurately the angle of rotation, the distance to the line of symmetry etc. Records transformations and directions for transformations in a variety of modes e.g. using Scratch
Reasoning	Experiences shapes moving.	Visualises how a shape will look when moved.	Makes and justifies predictions about shape movements and shape matching e.g., <i>will it fit if I turn it this way? Will it match if I turn it over?</i>	Makes and tests predictions about composite shapes and the movement of individual shapes	Visualises then tests the effect of simple transformations. Predicts and justifies whether a shape has reflective symmetry	Visualises the effect of transformations e.g. Predicts how an object will look when rotated through a quarter turn. Selects shapes to create tessellating patterns and justifies choice.	Makes, justifies and evaluates conjectures about transformations and tessellations.

Applying and Problem-Solving

Is present at, exposed to and experiences constructing and manipulating shapes in meaningful contexts.

Solves and discusses simple spatial puzzles such as jigsaws or shape sorters

Selects and manipulates shapes to copy a pattern or structure.

Engages in spatial puzzles or construction activities which involve moving, comparing or combining shapes e.g., tangrams puzzles, block play.

Undertakes and describes simple transformations in various contexts e.g. printing in art, barrier games; paper folding for symmetry

Designs and creates tessellating patterns and identifies simple transformations

Solves rich problems involving transformations using models or materials e.g., pentominoes, tangrams

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Appendix I: Overview of development of specification

Key milestones for specification development

In Autumn 2014, the NCCA published two mathematics research reports (Dunphy *et al.*, 2014; Dooley *et al.*, 2014) at a conference in Dublin Castle titled *Maths is surprisingly important and cognitively fundamental*. In addition to these reports, the NCCA also published a commissioned audit of mathematics curriculum policy across 12 jurisdictions. Building on this work, Autumn 2016 saw the publication of a background paper and brief to support the development of the new Primary Mathematics Curriculum. The research reports, audit, background paper and brief can be found on the website at www.ncca.ie/primarydevelopments.

In July 2016, the Minister wrote to the NCCA requesting that, in the context of the Council's work on primary mathematics, particular consideration would be given to ensuring that every child has an opportunity to develop the computational, and flexible and creative thinking skills that are the basis of computer science and coding. He also expressed hope that it would be possible to use some of the learning from the CoderDojo project and similar initiatives in considering approaches to integrating coding into the primary curriculum. In responding to the request, the NCCA completed an initial desktop audit of coding in the primary curriculum in 22 jurisdictions. The audit showed that, increasingly, computer science and coding are being included in curriculum policy at primary level, albeit that this trend is very much at an early stage. The audit further showed that a number of different approaches are used—developing a specific course or subject specification, integrating into other subjects such as mathematics and/or science, or embedding across the curriculum, for example, as part of a key competency in ICT. In light of the audit findings and findings more generally about overload and competing priorities in the current curriculum, the Council recommended that the *how*, *where* and *when* decisions about coding as an integral part of the primary curriculum should be made during, and as part of, the wider review of the primary curriculum in 2017 and 2018, since this review will determine decisions about the purpose, structure, stages, time allocations, and content of a redeveloped curriculum. In the meantime, we can embed the basis of coding—computational thinking, and flexible and creative thinking skills—in the new curriculum specification for mathematics currently under development.

In September 2016, a new Early Childhood and Primary Mathematics Development Group was convened. An induction meeting was organised for members on September 29th, 2016. The Maths Development Group has, to date, met on nine occasions:

- 2016 – September 29th, October 20th, December 1st
- 2017 - February 9th, March 23rd, April 27th, May 18th, June 21st, September 6th.

These meetings were supported by a roundtable meeting of academics and researchers in early childhood and primary mathematics education held in January 2017 which explored the most recent research pertaining to primary mathematics. The Development Group has formulated a vision for the presentation of the components of the new Primary Mathematics Curriculum that is consistent with the structure of the Primary Language Curriculum, with which primary teachers are becoming increasingly familiar, emphasising the potential for integration between both curricula while, simultaneously, holding the integrity of mathematics as a discipline.

Drafting and reviewing curriculum drafts

Initial specification work focused on clarifying and expanding the curriculum goals and aims as outlined in the *Background Paper and Brief for the Development of the New Primary Mathematics Curriculum* (NCCA, 2016). Informed by these, the Curriculum Rationale and Aims were drafted and the roles of the curriculum components were defined (See Table 2). Each component underwent several iterations and was presented to the Board at the March and May meetings. In addition to the Rationale and Aims, an overview of the Learning Outcomes and Learning Outcome Labels was devised to offer the ‘big picture’ of learning across the curriculum strands. An elements framework was then devised as a development tool to support drafting of Progression Continua for each Learning Outcome Label. With this groundwork in place, initial drafts of Progression Continua were written. Each draft has now undergone an iterative process of review and refinement involving:

- Development Group members
- commissioned experts from the field⁸

⁸ A commissioned expert is a member of the academic community with a wide research base and knowledge of the mathematical domain under review.

- a consultative group of teachers and principals representing special school settings— mild/moderate and severe/profound
- NCCA Early Childhood and Primary Mathematics Team.

Commissioned experts were asked to review drafts in terms of mathematical accuracy, plausibility and coherence across the continua. Following this, further revisions were made and then presented to the Development Group for further discussion. Development Group members conducted collective and individual reviews of each draft Progression Continuum and its associated Learning Outcomes. In reviewing the drafts, members checked for coherence with the brief and the curriculum's Rationale and Aims, and they reviewed the suitability and clarity of Learning Outcomes for teachers, learners and parents.

More recently, two consultative workshops were held in Scoil Chormaic in Cashel with a group of teachers and school leaders from Scoil Chormaic and Scoil Aonghusa. These teachers represented children in special school settings catering for children with a range of learning disabilities from mild to severe/profound. This consultative group was asked to conduct a specific review of the drafts to further improve the inclusivity of the specification. A review of the language register, specifically of terminology in the Learning Outcomes and Progression Continua, was conducted by a commissioned expert during Summer 2017.

Appendix 2: Suggested examples of children’s learning

The Primary Mathematics Toolkit will include a range of Examples of children’s learning and development. These Examples will illustrate how individual learning events and tasks can provide teachers with rich information about children’s mathematical learning, and can support them in planning for meaningful pedagogical experiences.

For the consultation draft of the specification, a number of ideas for children’s learning are presented here to support teachers as they use the curriculum to plan for, teach and assess children’s learning.

These examples have been generated by curriculum development group members who have extensive experience in mathematics teaching and learning. Examples are referenced according to their correlation on the Progression Continua⁹.

For example, **8.R.c** pertains to

Learning Outcome 8 - Spatial Awareness and Location

Element – Reasoning

Progression Milestone - c

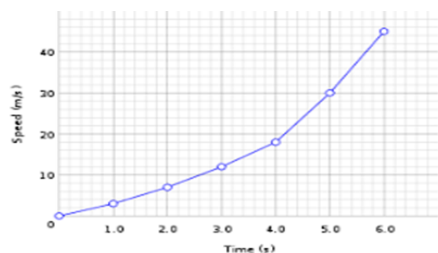
3. Data

3.C.c Examples of organisational modes can include Carroll diagram, Venn diagram, the children themselves and sorting boxes. Children could sort a range of pictures and items of negation, for example animal/not animal, straight line/non-straight line.

3.C.e Children work with data that is relevant to them, that is, school data where children generate questions based on the data. Data does not always have to be numerical. A visual schedule of their school day can be used.

3.C.f Example can include a line plot

⁹This reference functions to support teachers as they navigate Examples of children’s learning during the consultation phase. In the final publication of the Primary Mathematics Curriculum, Examples will be hyperlinked to the relevant Progression Continua for ease of use.



3.UC.f Examples can include children bird-watching and representing the data in multiple modes. Further examples can include spots, hobbies, television programmes, and food.

3.APS.d Examples can include comparison of a data sample with another data sample. How the children in the class travel to school: the data will be the modes of transport and can be represented through pictograms, bar chart, line plot, etc.

7. Uses of Number

7.APS.b Video example of a 'number hunt' in the classroom and local environment.

7.UC.b Role play in a print rich, high quality, number environment.

7.UC.c Video example of point 4 as cross-curricular to data, geography, SPHE

8. Place Value

8.UC.e/f Video example of children playing the nice/nasty place value game. Number of cards showing 1-10 turned upside down: children pick 3 numbers and facilitator decides if it's a nice (high value) or nasty (low value) game. Whoever gets the highest (nice) or lowest(nasty) number is the winner.

8.C.c Video of a shop where children are swapping money for goods.

8.R.c Video of children ordering playing cards, human number line. PDF download of five frame, ten frame.

9. Numeration and Counting

9.C.b Examples of drawings where children communicate their ideas about number and quantity using different modes; for example, Child A uses tally marks or dots, child B draws representative images of 5 circles for 5 frogs, child C uses fingers, child D uses everyday objects.

10. Operations

10.UC.b Video showing children identifying the empty set; for example, Which Teddy has no cup?

11. Fractions

11.R.e Video of sharing a pizza/bar of chocolate (whole) and sharing a bag of marbles (set).

11.APS.e Video of a cooking lesson using fractions.

Appendix 3: Meta-practices

Extract from Research Report No. 18 (p.9)

Good mathematics pedagogy incorporates a number of meta-practices (i.e., overarching practices) including the promotion of math talk, the development of a productive disposition, an emphasis on mathematical modelling, the use of cognitively challenging tasks, and formative assessment. The literature offers a range of perspectives, and advice, as to the issues for educators in integrating these elements into their practices. In doing so, the vision of ‘mathematics for all’ is supported. Good mathematics pedagogy can be enacted when educators engage children in a variety of mathematically-related activities across different areas of learning. The activities should arise from children’s interests, questions, concerns and everyday experiences. A deep understanding of the features of good pedagogy should inform the ways in which educators engage children in mathematically-related activities such as play, story/picture-book reading, project work, the arts and physical education. The potential of these activities for developing mathematical proficiency can best be realised when educators focus on children’s mathematical sense-making. In addition, educators need to maximise the opportunities afforded by a range of tools, including digital tools, to mediate learning.

More information on good pedagogy to support mathematical learning can be found at:

Dooley, T., Dunphy, E, & Shiel, G. (2014). Mathematics in Early Childhood and Primary Education. Research Report 18, National Council for Curriculum and Assessment, Report, Dublin. Accessed at http://ncca.ie/en/Publications/Reports/NCCA_Research_Report_18.pdf

Five overarching meta-practices that are essential in promoting mathematical thinking and understanding, and that are important in helping children towards achieving the overall aim of mathematical proficiency are highlighted in this research report, namely

- play
- story/picture-book reading
- project work

- learning through the arts, drama and physical education
- the use and integration of tools including digital technologies.

These meta-practices should permeate all learning activities if optimal mathematical learning and development are to be promoted.

