

“Without mathematics, there’s nothing you can do. Everything around you is mathematics. Everything around you is number.” – Shakuntala Devi

“The only way to learn mathematics is to do mathematics” – Paul Halmos

Rationale

This policy outlines our aims for all children’s mathematical education. It outlines the planning, delivery and assessment of the mathematics curriculum. It is based on the recommendations and guidance contained in the following DfE documents:

- i) Birth to Five Matters
- ii) The National Curriculum 2014

1.0 Aims and objectives

1.1 Mathematics teaches us how to make sense of the world around us. Through developing a child’s ability to calculate, reason and to solve problems, they are empowered to understand and appreciate relationships and pattern, in both number and space in their everyday lives. Through their growing knowledge and developing understanding, children learn to appreciate the beauty, power and creativity of mathematics. We aim to develop in children a curiosity about the discipline and the contribution made by many cultures to the development and application of mathematics.

1.2 As outlined in the National Curriculum (2014), our principal aim in Mathematics are to ensure that all pupils:

- **become fluent** in the fundamentals of mathematics, including through varied and frequent practice with increasingly complex problems over time, so that pupils develop conceptual understanding and the ability to recall and apply knowledge rapidly and accurately.
- **reason mathematically** by following a line of enquiry, conjecturing relationships and generalisations, and developing an argument, justification or proof using mathematical language
- **can solve problems** by applying their mathematics to a variety of routine and non-routine problems with increasing sophistication, including breaking down problems into a series of simpler steps and persevering in seeking solutions.

We also believe that strong, meaningful links should be formed from this highly inter-connected discipline, and as such mathematics features across our curriculum.

We do this through:

- promoting enjoyment and enthusiasm for learning through practical activity, exploration and discussion;
 - promoting confidence and competence with numbers and the number system;
 - developing the ability to solve problems through decision-making and reasoning in a range of contexts;
 - developing a practical understanding of the ways in which information is gathered and presented;
 - exploring features of shape and space, and develop measuring skills in a range of contexts;
 - understanding the importance of mathematics in everyday life.
 - developing a variety of other skills, including those of enquiry, problem solving, ICT, investigation and how to present their conclusions in the most appropriate way.
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2.0 Mathematics curriculum planning

2.1 Mathematics is a core subject in the National Curriculum and we use this document as the basis for implementing the statutory requirements of the programme of study for mathematics.

2.2 Our curriculum planning in mathematics is in three phases: long-term, medium-term and short-term. The National Curriculum for Teaching (2014) gives a detailed outline of the objectives we teach in the long term.

2.3 Our medium-term mathematics plans, which are adopted from the National Curriculum (2014) define what we teach. They ensure an appropriate balance and distribution of work across each term. Our curriculum is spiral in nature, based on research and theory by Bruner, where subjects are revisited at intervals and at more sophisticated levels. This enables children to revisit areas of mathematics and mathematical concepts within and across year groups. A concept is first represented with concrete materials, then by models, or pictures, and finally by abstract notation, following Bruner's CPA (concrete, pictorial, abstract) model. As of November 2021, we have adopted the Maths – No Problem! curriculum planning structure, which allows children to meet each area of mathematics twice in each year group.

2.4 Each class teacher creates the weekly lesson plans for the teaching of mathematics. These weekly plans list the specific learning objectives for each lesson and give details of how the lessons are to be taught and the outcomes expected from each lesson. The class teacher keeps these individual plans.

3.0 Teaching and learning style

St John Vianney uses a variety of teaching and learning styles in mathematics lessons.

We do this through a daily Maths lesson that incorporates high quality whole class and group teaching. During these lessons we encourage children to ask as well as answer mathematical questions. They have the opportunity to use a wide range of resources to support their mathematical development. Children use ICT in mathematics lessons where it will enhance their learning, as in modelling ideas and methods.

The children are given the opportunity to engage in a wide variety of problem-solving and reasoning activities. Wherever possible, we encourage the children to use and apply their learning in everyday situations. Arithmetic thinking is at the core of what we teach and all pupils are encouraged to develop the computational links between different aspects of their mathematical learning.

3.1 A Spiral Curriculum

At St John Vianney, we believe that education should facilitate children to ***know more and remember more***. With this principle in mind, we have adopted a curriculum that is spiral in nature. The spiral curriculum is defined as a curriculum that returns to the same topics over time, in this case within an academic year. It is juxtaposed to methods that involve learning something then moving on, perhaps never to engage with it again, which can be seen in popular mathematics schemes. When children re-engage with a topic repeatedly, they both consolidate prior knowledge in their long-term memory and build on it over time. As children return to an area of study, teachers activate their prior knowledge and build on these foundations to revisit the topic in more depth. This approach to mathematical learning is underpinned by Jerome Bruner's pedagogy and research (1960). To support the retention of children's prior learning to their long-term memory, we also provide children with 'Maths Blast' activities three times weekly. These activities allow children to revisit learning from their last mathematics lesson, last week's mathematics learning, last topic's mathematical learning and last year's mathematical learning. In this way, children are continually revisiting prior learning and teachers are able to consolidate learning and identify gaps and misconceptions for future learning.

3.2 Fluency and Varied Fluency

Mathematical fluency is the ability to quickly and accurately recall mathematical facts and concepts. Fluency is not limited to number and calculation, but is needed across the primary curriculum. Dowker (1992) wrote that 'to the person without number sense, arithmetic is a bewildering territory in which any deviation from the known path may rapidly lead to being totally lost.' It is crucial that children are both **procedurally** and **conceptually** fluent - they need to know both *how* and *why*. Children who engage in a lot of practice without understanding what they are doing often forget, or remember incorrectly, procedures. Further, there is growing evidence that once students have

memorised and practised procedures without understanding, they have difficulty learning later to bring meaning to their work (Hiebert, 1999).

The use of concrete, manipulative resources and visual, pictorial representations is essential in ensuring conceptual fluency in children. It is only then that children are ready to move onto abstract notations and strategies, thereby ensuring procedural fluency.

Moreover, it is not enough to present fluency questions in the same way repeatedly: children need to apply their knowledge and skills to a range of varied fluency question types.

Fluency forms a key element of our daily mathematics lessons at St John Vianney, ensuring that children are procedurally and conceptually secure before moving onto reasoning and problem solving.

All children from Year 2 to Year 6 practise their arithmetic skills weekly in an arithmetic test. Teachers then unpick misconceptions and reinforce methods and strategies in this weekly session. As such, this provides another opportunity to activate prior learning and promote procedural and conceptual fluency.

We also prioritise mathematics at St John Vianney, as recognise that short daily sessions of maths, over time, accumulate into a significant amount of time weekly, termly and yearly. From Year 2 - Year 6, children take part in a daily 'Tough Ten' mathematics activity – ten arithmetic questions completed at the start of each school day. This task may be recorded on whiteboards or completed as a whole class in KS1, and then in arithmetic books in KS2.

At St John Vianney, we know that multiplication facts and derived division facts (known as times tables) are crucial to children's understanding of more complex areas of mathematics. The KS2 Multiplication Tables Check is now a statutory assessment for children in Year 4. All children are provided with a log in to 'Times Tables Rockstars', where they practice times table facts at their level in an engaging and fun way. As part of their homework, children are encouraged to spend time on the website daily.

3.3 Reasoning

Reasoning in maths is the process of applying logical and critical thinking to a mathematical problem in order to work out the correct strategy to use (and just as importantly, not to use) in reaching a solution. Reasoning can be seen as a crucial linking bridge between a child's fluency in mathematics and their ability to problem solve. It provides children with an unfamiliar context within which to use their mathematical skills. Reasoning forms a key part of national assessments at the end of KS1 and KS2 (SATS).

Children are supported by concrete and pictorial representations when reasoning, in every year group. Reasoning in mathematics at St John Vianney is also underpinned by mathematical talk and listening, as outlined below. Children are challenged in lessons to explain their thinking, whether that is with concrete resources, visual representations, calculations or mathematical talk.

We ensure all children are exposed to mathematical reasoning activities at their level, in all lessons. In KS1, this may be completed orally, on whiteboards, in groups or as a whole class. In KS2, children are encouraged to work collaboratively in all lessons to answer reasoning problems that stretch and challenge.

Children are supported by reasoning sentence stems which allow them to express themselves mathematically when reasoning. Stems are displayed in all classrooms, and kept in children's books so as to be readily available. These sentence stems are different for KS1 and KS2.

3.4 Problem Solving

Problem solving can be viewed as the end goal towards which we teach mathematics. Armed with procedural and conceptual fluency, and an ability to reason about maths, children are able to tackle unfamiliar problems.

There are various types of mathematical problems which we aim to expose children to, including: word problems, logic problems, finding all possibilities, visual problems and rules and patterns problems.

When problem solving, we encourage children to follow four key steps:

1. Read and think - Look at the problem you are trying to solve. Read it more than once. What information do you have? Underline it! What information are you missing? Note that down too! What are you trying to work out? See if your partner agrees.

2. Pictures/ representations - How can you visualise your problem using a picture, a diagram or using Maths equipment? You could use: a bar model, a part-part-whole model, a number line, cubes, counters or Numicon. Draw or show your thinking using the method of your choice.

3. Operations - Which operations will you use to solve the problem? Addition? Subtraction? Multiplication? Division? Use your chosen strategy to work out your answer. How does it look? Read the question again. Is it a sensible answer?

4. Check and Explain - Check your answer. Work out the answer again to be sure your answer is correct. Can you use the inverse operation to check your answer is correct? Now explain your strategy: why did you choose to work it out this way? Prove that your answer is correct. Could you have used a different method to find your answer?

These steps are displayed in all classrooms from Year 2 to Year 6 to support children's problem solving skills.

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3.5 Concrete, Pictorial, Abstract

Often mathematics is regarded as inaccessible as it is very abstract in nature. First developed by Jerome Bruner, the CPA approach (concrete, pictorial, abstract) moves learners through mathematical concepts by first meeting concrete resources, then visual representations before finally, abstract methods. At St John Vianney, we believe that all learners, of all ages and abilities, should experience all steps of the CPA approach.

The concrete step is the “doing” stage. It allows students to use concrete resources to model and solve problems. It is this step that often brings mathematical concepts to life for children.

The pictorial step is the “seeing” stage. Visual representations are used to model problems. It provides a crucial link between the physical experiences of the concrete step and the abstract process. It helps visualise abstract concepts and as such, aids children’s understanding.

The abstract step is the “symbolic” stage. Children are ready to access this stage of learning once they have grasped concepts in the concrete and pictorial stages. This stage uses only abstract notations and symbols.

3.6 Bar Modelling

Although teachers will use a range of concrete and pictorial resources to support learning, a notable pictorial representations which children are exposed to in all year groups is bar modelling. Based on Singapore maths teaching, and featuring heavily in Maths – No Problem! resources, bar modelling is a strategy that we have adopted in KS1 and KS2. Bar modelling is used to visualise problems and in turn solve them and it can be applied to a variety of mathematical areas of learning.

3.7 Maths Talk

At St John Vianney, we recognise how important mathematical talk is in ensuring children’s understanding. Mathematical talk can be heard in all lessons, in a variety of ways: teachers set high expectations for mathematical talk and vocabulary in whole class teaching; the frequent use of talk partners to allow children to unpick their thinking at key moments in lessons; when reasoning about mathematics; when solving problems in pairs or groups; when explaining how children came to an answer. Teachers use open-ended, targeted questioning in lessons to extend children’s understanding, support and consolidate learning and as formative assessment for learning.

In order to close the vocabulary gap in mathematics, teachers expose children to key vocabulary as they meet it, to ensure all children can access the lesson.

Children are supported by reasoning sentence stems which allow them to express themselves mathematically when reasoning. Stems are displayed in all classrooms, and kept in children’s books so as to be readily available. These sentence stems are different for KS1 and KS2.

3.8 Differentiation

As a school, we recognise that children come to school and into each class with different starting points. St. John Vianney school facilitates mixed ability teaching through a range of strategies including:

- using differentiated group work;
- setting tasks of increasing difficulty;

- organising the children to work in pairs on open-ended problems or games;
- providing resources of different complexity according to the ability of the child;
- using classroom assistants to support the work of individual children or groups of children.
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4.0 Early Years

4.1 We teach mathematics in Nursery and Reception classes. As the Nursery and Reception classes are part of the Early Years Foundation Stage of the National curriculum, we relate the mathematical aspects of the children's work to the objectives set out in the Birth to 5 Matters 'Problem, Solving Reasoning and Numeracy'. We give all the children ample opportunity to develop their understanding of number, measurement, pattern, shape and space through varied activities that allow them to enjoy, explore, practise and talk confidently about mathematics.

5.0 The contribution of mathematics to the broad and balanced wider curriculum

5.1 English

Mathematics contributes significantly to the teaching of English in our school by actively promoting the skills of reading, writing, speaking and listening. For example, we encourage children to read and interpret problems in order to identify the mathematics involved. The children explain and present their work to others. Children enjoy stories and rhyme that rely on counting and sequencing, they encounter mathematical vocabulary, graphs and charts when using non-fiction texts and are supported when using sentence starter prompts to explain the reasoning strategies they have used when problem solving.

5.2 Science

Science is integral to our pupils' ability to demonstrate their knowledge and understanding of maths in the real world. It actively promotes the skills of reasoning and problem solving, including the understanding of data within scientific investigations.

5.3 History

Understanding of the chronology of events is crucial in the teaching of History, both within and era as well as in understanding where a period of history fits within a wider timeline. History lessons involve the sequencing of events.

5.4 Geography

Map work, including with coordinate grids and ordnance survey maps, involves the use of various maths skills, including using coordinates and recognising symbols. Atlases used in Geography lessons include scaled representations of geographical areas, which allows children to explore scaling and ratio. Geography

lessons allow children to explore the points of a compass and position and direction.

5.5 Computing

Children use and apply mathematics in a variety of ways when solving problems using ICT. Pupils are able to use software to communicate results and produce graphs/tables when explaining their results or when creating repeating patterns, such as tessellations. When working on control, children use standard and non-standard measures for distance and angle. They use simulations to identify patterns and relationships. Children are encouraged to present their work through a range of computing medium and the use of visualizers greatly enhance pupils teaching and learning experiences across the curriculum.

5.6 Art

Some aspects of Art teaching allow children to explore the use of shape, space and pattern, such as using tessellation in artwork.

5.7 Design Technology

Within DT, children are encouraged to apply mathematical skills where possible – such as when measuring materials. Within food technology, children may use measurement skills, such as counting or weighing ingredients; food technology also introduces children to the concept of scaling recipes up and down.

6.0 Teaching mathematics to children with special educational needs

6.1 Mathematics forms part of the school curriculum; it provides a broad and balanced education to all children. Through our mathematics teaching we provide learning opportunities that match the needs of each individual child. Teachers provide learning opportunities matched to the needs of each individual child, work in Maths takes into account the targets set in their SEN Support Plans.

6.2 Intervention

At St John Vianney, we believe that all children should be exposed to high quality first teaching in mathematics lessons. This provides children of all lessons the opportunity to hear and absorb high level mathematical talk and discussion, as well as working collaboratively alongside their peers. Class teaching assistants are skilfully employed to support targeted groups of children within mathematics learning.

However, there are incidences in which children benefit from targeted intervention. As far as possible, this intervention takes place outside of mathematics curriculum time, usually in the afternoon. Children work in small groups as directed by the class teacher. Interventions may be used to address misconceptions from previously taught lessons, or may comprise of ‘pre-teaching’ of concepts to activate prior learning, allowing children to access upcoming maths lessons.

In some year groups, it is appropriate to deliver small group intervention, where there are skilled teachers to lead these interventions. This may be appropriate in year groups as they prepare for end of key stage assessments.

7.0 Assessment and recording

7.1 We assess the children's work in mathematics from three aspects (long-term, short-term and medium-term). We make short-term formative assessments, which we use to help us adjust our daily plans, including highlighting the objective in KS1 and ticking the objective in KS2. These short-term assessments are closely matched to the teaching objectives.

7.2 Teachers make medium-term assessments to measure progress against the key objectives, and to help us plan the next phase of learning. Termly assessments in Mathematics comprise of Rising Stars PUMA assessments, matched to national curriculum objectives covered in the term that they assess.

7.3 Teachers assess children's progress termly using the TIPPS assessment framework. This data enables teachers and senior leaders to set SMART targets and plan intervention. Children also undertake the national SATS tests in Year 2 and Year 6, as well as the Multiplication Tables Check in Year 4.

7.4 Moderation in **Mathematics** is carried out by the subject leader who oversees the regular moderation of work through phase meetings, book scrutiny and lesson observations, carried out at key points in the year. Mathematics is moderated internally within phase groups, which ensures that teachers' judgements are accurate and robust; this process also encourages a dialogue between teachers in different year groups about the progression of mathematics across the school. These internal moderation systems are further enhanced through external moderation through the Catholic family of schools each term.

8.0 Resources

8.1 Audits of resources are conducted at yearly intervals and the needs of the subject are met accordingly to facilitate the teaching and learning of mathematics as outlined above. This is additionally incorporated into the school development plan and thereby remains a key priority throughout the year.

8.2 In November 2021, the maths leads started to work with the NE1 Great North Maths Mastery Hub and the NCTEM to introduce a maths mastery approach to teaching and learning to support the spiral curriculum.

9.0 Monitoring and review

9.1 Teaching and learning is monitored through lesson observations, learning walks, regular drop in sessions by the senior team and book and planning scrutinies carried out at regular intervals throughout the school year.

Review Date: April 2022