Elmfield Rudolf Steiner School Numeracy Curriculum 2018-2019

Sources

This Numeracy Curriculum Framework is based on the extensive indications given by Rudolf Steiner as expressed in the *Educational Tasks and Content of the Steiner Waldorf Curriculum* (SWSF), the National Curriculum, the SWSF Embedded Curriculum, the EYFS and other curriculum resource materials developed by teachers in Steiner Schools internationally.

Purpose of study

Mathematics is a creative and highly inter-connected discipline that has been developed over centuries, providing the solution to some of history's most intriguing problems. It is essential to everyday life, critical to science, technology and engineering, and necessary for financial literacy and most forms of employment. A high-quality mathematics education therefore provides a foundation for understanding the world, the ability to reason mathematically, an appreciation of the beauty and power of mathematics, and a sense of enjoyment and curiosity about the subject.

Aims

At Elmfield Rudolf Steiner School the Numeracy curriculum aims to ensure that all students:

- 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

Mathematics is an interconnected subject in which pupils need to be able to move fluently between representations of mathematical ideas. The programmes of study are, by necessity, organised into apparently distinct domains, but pupils should make rich connections across mathematical ideas to develop fluency, mathematical reasoning and competence in solving increasingly sophisticated problems. They should also apply their mathematical knowledge to science and other subjects. The expectation is that the majority of pupils will move through the programmes of study at broadly the same pace. However, decisions about when to progress should always be based on the security of pupils' understanding and their readiness to progress to the next stage. Pupils who grasp concepts rapidly should be challenged through being offered rich and sophisticated problems before any acceleration through new content. Those who are not sufficiently fluent with earlier material should consolidate their understanding, including through additional practice, before moving on.

Method

"Mathematics in the Waldorf School is divided into three stages. In the first stage, which covers the first five classes, Mathematics is developed as an activity intimately connected to the life process of the child, and progresses from the internal towards the external. In the second stage, covering Classes 6-8, the main emphasis is on the practical… The ninth year onwards is characterised by a transfer to a rational point of view." (H. von Baravalle)

At Elmfield, we avoid confronting young children with abstract logical structures, preferring to immerse their whole capacity for physical experience in Mathematics. The rule 'from hand, through heart to head' makes it possible for the children to bring their own capacities into play. The children explore the quality of numbers as well as the element of quantity. Through the experience of number qualities, the children experience trust and security: number, world and human being belong together.

By beginning with the concrete qualities of number, and by working with the properties of movement in counting and calculating, children develop a kind of intelligence which seeks and finds the way to reality.

Calculation is not possible without regular practice, which makes it an excellent medium for developing the will, and we build daily practice into many main lessons. Geometry begins in the middle school and is taught in separate main lessons. One of the principle intentions is to develop and nurture the ability to visualise space.

As the children approach puberty, their feeling life expands in all ways. Mathematics can offer an important support in this stage of life. If the pupils manage to become confident and secure with Mathematical laws, they learn self-confidence. Algebra and Business Mathematics are introduced at this stage.

From Class 9 onwards, pupils are prepared for Mathematics GCSE, which they take at the end of Class 10, with two opportunities to retake in Class 11 if necessary.

Outcomes

Transition

Pupils will be able to:

- Count with ease and accuracy
- Understand the meaning of numbers, including half and quarter
- Carry out basic addition and subtraction
- Understand the use of number in daily activity
- Recognise some numerals, e.g. those with personal significance
- Understand the concept of time, including past, present and future, and words such as before, after, early, late

- Use causal thinking (i.e. if I do this, that will happen)
- Comprehend the order and sequence of events
- Recognise and use language such as long/short, heavy/light, full/empty, quick/slow
- Understand the concept of monetary value
- Understand positional language e.g. behind/in front

Class 1

Pupils will be able to:

- Demonstrate an appreciation of number qualities, 1-10 or 1-12
- Count accurately to 100 (and more) and count from 100-0 (reverse sequence)
- Associate number with relevant quality
- Demonstrate whole numbers (e.g. 10) in various arrangements of parts (9+1; 2+8)
- Identify quantity through direct recognition and pattern (e.g. patterns used on a die or playing cards)
- Recognise numbers shown by hand (including variations, e.g. 7 with 5 on the left hand and 2 on the right, then 4 on the left and 3 on the right)
- Show a working knowledge of add, subtract, divide and multiply as process and symbol in verbal and written forms
- Confidently count in twos, threes, fives and tens
- Know what follows 99, 999, 9999, etc.
- Add and subtract facts by heart in the region of twenty (number bonds)
- Do simple mental arithmetic in narrative form
- Do freehand drawings of common geometric forms (as a dynamic drawing rather than precise forms)
- Draw symmetrical forms on upright axis and horizontal reflections
- Solve and record 1-digit number sums
- Understand odd and even numbers through physical enactment, visual clustering with pebbles, shells etc.
- Read out sums using mathematical language
- Represent number bonds of 6, 7, 8 and 9 physically with fingers, counters and on paper as abstract number sequences

Class 2

Pupils will be able to:

- Analyse numbers up to 1000
- Write number dictations up to 1000
- Count to 1000 and count forwards or backwards from any number up to 100
- Spell and read numbers up to 10
- Recall the doubles of numbers up to 10
- Add a 2-digit number and a 1-digit number
- Subtract a 1-digit number from a 2-digit number

- Subtract a 2-digit number from a 2-digit number where the answer is a 1-digit number
- Count in 4s, 6s, 7s, 12s, 11s and 7s
- Recite addition and subtraction facts in the region of 20 (number bonds) by heart
- Understand and demonstrate the difference between odd and even numbers
- Understand multiplication 1-10 at least (both in order and out of sequence) and understand these as division
- Use abacus and cuisenaire rods to understand place value
- Use place value in the range of 4 places correctly, i.e. show practical understanding that the 1 in 1, 12 and 138 has different values
- 'Carry' numbers (i.e. proper use of place value) for addition (e.g. 19 + 2) and multiplication (e.g. 74 x 2)
- Tell the time, at least hours, half past and quarter past
- Use money correctly for simple bills and calculating change
- Recite as a group the 1, 2, 5 and 10 times tables in order of sequence
- Represent the times tables in a 100 square
- Recognise patterns in the times tables
- Recognise the geometrical patterns that arise from times tables and the circle
- Recall the addition and subtraction bonds up to 24
- Estimate numbers of objects up to 24
- Use the 4 processes without help
- Explain a sum in their own words

Class 3

Pupils will be able to:
- Appreciate patterns of 10 times table
- Count to 1000, and in reverse
- Calculate simple 'pre-area' sums such as how many milk bottles will be in a crate of bottles holding six by six using simple calculations, or size of wall or floor on basis of number of bricks or tiles
- Do simple mental arithmetic in narrative form
- Solve sums up to 1100
- Recall the times tables up to 12 out of order and up to 15 in order
- Recall the 10 times table up to 900
- Work with times tables in division sums
- Solve simple sums in measurement of length and weight
- Use kitchen equipment for measurement and cooking/baking
- Follow a recipe, using kitchen scales and kitchen measurements when needed (e.g. a cup, a teaspoon, grams)
- Recognise and use British coins and notes
- Do vertical multiplication (using up to 2 place values) and vertical division (using units as divisor)

- Recall square numbers (e.g. 2x2=4, 3x3=9)
- Tell the time on an analogue or digital clock to the minute

Class 4

Pupils will be able to:
- Carry out all four processes of number confidently and in other number bases
- Read and analyse numbers up to and beyond six figures
- Answer more complex mental arithmetic questions involving a mix or processes, both in narrative form and as 'number gym'
- Find factors of a given number
- Find lowest common denominator of highest common factor of a group of numbers or more
- Record information such as heights, weights etc.
- Calculate long multiplication and division sums with numbers up to 100 as multiple or divisor, and check by the reverse process
- Estimate approximate answers (as needed for long division especially)
- Estimate measurement
- Produce freehand geometry with reasonable accuracy
- Recognise a number can be broken into smaller parts called fractions
- Apply the four processes with fractions, including mixed numbers
- Recognise common fractions as parts of an object or shape, or as part of a quantity
- Count in fractions
- Use fraction notation e.g. ½

Class 5

Pupils will be able to:
- Add whole numbers with more than four digits
- Subtract whole numbers with more than four digits
- Calculate long multiplication and division
- Calculate short and long division number sequences
- Carry out multi-step problems
- Carry out inverse operations
- Understand the concept of squared numbers
- Read and analyse decimal fractions, i.e., 0.1, 0.01, 0.001, etc.
- Use the 'rule of three' (e.g. if it costs £2.50 to buy 10 pencils, how much would it cost for 8?)
- Recognise and analyse numbers involving decimals
- Carry out the four processes with decimals (addition and subtraction observing decimal point, and multiplication and division where multiplier and divisor is a whole number)
- Record information including measurement using decimals
- Record fractions and decimals pictorially
- Match fractions to decimals (e.g. 0.1=1/10)
- Estimate answers using rounding up and down using whole numbers

- Round numbers to the nearest 10, 100, 10th and 100th
- Answer more complex arithmetic questions
- Solve conversion problems (e.g. how many centimetres in 2.5 metres?)
- Solve money and other measurement problems involving the four processes (e.g. 2.34+2.99=)
- Calculate area of squares, rectangles, triangles and irregular forms by resolving them into simple shapes
- Measure and calculate the perimeter of shapes
- Understand time, including 24-hour clock and processes in time, e.g. miles per hour
- Use ruler and compass accurately
- Draw, recognise and name different common geometrical shapes
- Draw polygons using freehand, or approximate divisions of the circle

Class 6

Pupils will be able to:
- Apply all four processes to fractions including mixed operations (vulgar and mixed numbers)
- Convert fractions to decimals, percentages, and vice versa
- Estimate results prior to accurate calculation
- Apply 'speed maths' and short-cut methods appropriately
- Understand the powers of numbers
- Read balance sheets (e.g. book keeping for a class outing) and use other 'business' maths (e.g. profit and loss, discounts, commission, VAT)
- Work out averages including speed
- Make time and speed calculations
- Work out ration and scale
- Present information via pictograms, pie charts, bar graphs, linear graphs
- Read co-ordinates
- Work out simple and compound interest
- Use algebra for general solutions to specific problems
- Apply the principle of substitution
- Make precise use of compass, ruler, set squares, protractor, dividers and other geometrical instruments
- Understand the theorem of Pythagoras and its applications
- Construct major regular geometric figures
- Understand graphs and be able to plot coordinates
- Understand the metamorphosis of form, including circles, triangles and quadrilaterals
- Understand how to divide a circle in order to create forms
- Understand how to create spiral forms arising from arithmetic and geometric progressions
- Understand the construction and measurement of polygons
- Understand the concept of, and calculations of, percentages
- Understand interest, discount and profit
- Understand the equivalent percentages/fractions/decimals

- Understand the use of symbols
- Work with number sentences – true or false; lesser, greater and equals
- Solve simple equations
- Simplify expression (extension)

Class 7

Pupils will be able to:
- Calculate and approximate square roots
- Use negative and positive integers
- Understand properties of triangles
- Divide a circle using a radius
- Divide circles into 4, 8, 16, 6, 12 or 24 parts, deriving polygons from them
- Construct geometrical forms with compasses, rulers and set squares
- Intersect and divide with compasses
- Measure angles with a protractor
- Bisect angles in a circle
- Find the area of a circle
- Find the area of geometrical shapes through construction and calculation
- Calculate the area of figures bounded by straight lines and circular arcs
- Make and transform formulae
- Understand and work with ratio and proportion
- Understand types of quadrilateral and their symmetries
- Understand the use of brackets
- Understand recurring decimals, including pi
- Understand decimal places and significant figures

Class 8

Pupils will be able to:
- Multiply and divide using decimals
- Apply the rules for order of operations
- Add, subtract, multiply and divide using negative numbers
- Understand algebraic substitution
- Understand how to collect like terms
- Understand simple factorisation
- Solve linear equations
- Calculate the perimeter and area of a rectangle, triangle, parallelogram and trapezium
- Calculate the circumference and area of a circle
- Calculate angles on a straight line
- Calculate angles at a point
- Calculate angles between parallel lines and a transverse line

- Calculate mean, mode, median and range
- Calculate percentage increase and decrease
- Understand calculations involving profit and loss
- Draw and interpret straight line graphs
- Draw and interpret bar charts and histograms
- Understand reflection and rotational symmetry
- Work out basic probabilities
- Accurately draw, construct and build basic 3D shapes, including cube, cuboid and prism
- Draw nets of 3D shapes
- Calculate areas and volumes of 3D shapes

Class 9
Taught though a main lesson, pupils will be able to:
- Understand and use various ciphers
- Understand the main elements of coding and decoding
- Understand binary and other number bases and be able to perform simple tasks
- Understand the relevance of prime numbers in our digital security
- Work out basic permutations and combinations

Pupils will also start their preparation for GCSE Maths (AQA syllabus 8300), which they will sit at the end of Class 10.

Class 10
Pupils will continue their preparation for GCSE Maths (AQA syllabus 8300), which they will sit at the end of Class 10.

Class 11
Those pupils who have not yet achieved a GCSE grade 4 or above will receive extra lessons and will have two opportunities to retake their Maths GCSE during Class 11, in November and in May/June.

Assessment
By the end of each class, pupils are expected to know, apply and understand the matters, skills and processes specified for the class.