Ashbury Meadow Primary School

Policy for the Problem Solving Curriculum: Mathematics, Science, Computing and Design and Technology

Rationale and Aims

Solving problems is one of the core purposes of the study of mathematics, science, computing and design and technology (D&T) as children get opportunities to use and apply the skills, knowledge and understanding they have acquired in these subjects. A creative curriculum rich in engaging and stimulating problems can be highly effective in developing young mathematicians and scientists and children whose skills, knowledge and understanding in computing and D&T are developed through investigating, exploring and being inquisitive about the world around them. Through our creative curriculum we aim to stimulate our children's natural curiosity and to give them the confidence to be curious while motivating them to learn problem-solving subjects through a real sense of purpose linked to real life contexts.

What problem solving is and the approach to teaching problem solving

Problem solving can be defined as involving these core principles:

- analysing the components of a problem: identifying what is known and what needs to be found and making links between them
- exploring patterns or relationships
- formulating conjectures and testing them/developing a line of enquiry making references and deductions, for example, '*If I know this, then that could or must be true*'
- finding proofs and reasoning
- seeking solutions
- presenting, recording and communicating

In mathematics, science, computing and D&T teachers plan regular opportunities for children to practise these problem solving principles linked to their class theme work and in their weekly mathematics lessons. Children are taught essential skills and strategies for effective problem solving and understand how and when to use them in order to support them to become an efficient problem solver. When teaching problem solving, the teacher links problems to real life contexts, models how to use an appropriate problem solving strategy, gives children opportunities to solve problems with opportunities to review and evaluate. Teachers plan practical opportunities which are fundamental to a child's development in problem solving ensuring that children

have the pre-requisite learning and understanding to ensure that children can be successful.

Problem Solving strategies and Progression

These are eight problem solving strategies that will be taught progressively from Reception to Year 6. Some strategies are more appropriate to specific mathematical problems however at least one problem solving strategy in each year group can be used for problems in any subject. The tables presented are used by teachers for assessing children's problem solving abilities.

Reception / Year 1	Year 2	Year 3
Act it out / make a model: use various resources or equipment to act out the problem and aid the solution **Look for patterns**: identify things that happen again, repeating patterns or sequences **Trial and error**: least efficient strategy but a good starting point for some problems. Pick an idea and go **Trial and improvement** – a systematic approach: First estimate the starting point then refine the answer	**Act it out / make a model**: use various resources or equipment to act out the problem and aid the solution **Look for patterns**: identify things that happen again, repeating patterns or sequences **Trial and error**: least efficient strategy but a good starting point for some problems. Pick an idea and go **Trial and improvement** – a systematic approach: First estimate the starting point then refine the answer **Simplify the problem**: break down the problem into separate parts	**Act it out / make a model**: use various resources or equipment to act out the problem and aid the solution **Look for patterns**: identify things that happen again, repeating patterns or sequences **Trial and error**: least efficient strategy but a good starting point for some problems. Pick an idea and go **Trial and improvement** – a systematic approach: First estimate the starting point then refine the answer **Simplify the problem**: break down the problem into separate parts **Work backwards**: use inverse operations to solve

Year 4	Year 5	Year 6
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Deepening a problem:

The quality of the problems which children are given to solve is important; higher order problems with more depth allow children to draw on their conceptual understanding, make links, use reasoning and apply knowledge. Problems can be adapted by:

-removing intermediate steps
-making the problem more open
-asking why, so that pupils explain
-setting investigations
-reversing the problem
-asking for all possible solutions
-asking directly about a relationship or links

Problem Solving Days

The aim of a problem-solving day is to create a community of problem solvers with a common purpose and to promote excellence and enjoyment of problem solving for children whilst raising the profile of problem solving as a core component to learning. A problem solving day takes place each year in which the whole school is engaged in a variety of rich and engaging problems linked to mathematics, science, computing and D&T. During the morning, a whole school problem solving assembly takes place in which children learn about the context of the problems to be solved. Teachers provide opportunities to solve problems linked to the whole school given theme.

Recording Evidence of Problem Solving

Children demonstrate evidence of their specific problem solving learning in different ways: for example through pictures, systematic working etc and not always on pages in an exercise book but in photographs, posters, products and presentations; evidence is kept and all work is marked and used for assessment for future learning and to feedback to pupils about what they are doing well and what they need to improve. Evidence of problem solving is recorded in different curriculum books. Marking of problem solving work is linked to the effectiveness of strategies used and/or whether an alternative strategy would have been more efficient.

Planning

As well as the statutory programmes of study provided in the National Curriculum 2014 for mathematics, science, computing and D&T, support for planning is also provided in the school's Focus Education document which provides learning challenges in science and D&T linked to half termly themes for each year group. The Rising Stars sequences are used to breakdown the mathematics curriculum into manageable units of work. To support planning for computing, lesson plans from the Rising Stars scheme 'Switched on Computing' are used and annotated to tailor lessons for the needs of the cohort being taught. A comprehensive overview of planning for the school's creative curriculum approach is provided in the school's creative curriculum policy.

Weekly, short term plans are written for mathematics using the school's assessment software 'Alfie' and the Rising Stars sequences to inform planning units of work. A medium term plan is written for science and D&T on the school's foundation subject planner. All planning is evaluated and the key principles of assessment for learning outlined in the school's assessment policy are used to ensure that children progress through a unit of work.

Teacher's planning is prepared for a half term by the first Friday back in a half term and planning is posted onto the shared area in the folder 'Teacher Planning' so that planning can be monitored by curriculum teams and senior leaders at any time.

Planning is clearly differentiated by at least three levels: higher ability, middle ability and lower ability/SEN and differentiation is clearly evident through scrutiny planning and of children's work across the different ability groups in the class. This is an on-going monitoring focus.

Scrutiny of children's problem solving work across the curriculum and cross-curricular mathematical links in theme work shows that teachers have checked that the work set matches the children's mathematical attainment so that all pupils are challenged sufficiently, for example, a child who is working at secure Year 5 in mathematics is set mathematical problems at this level in their theme work. Able and talented pupils are challenged sufficiently to ensure that they are reaching their full potential.

Able and Talented Pupils

At Ashbury Meadow Primary School we are committed to providing high quality education for all our children. We endeavour to ensure that the children reach their potential intellectually, socially, creatively and personally. We believe a rich, challenging and stimulating curriculum enables children to develop depth and confidence.
By recognising and meeting the needs of able and talented pupils' expectations will rise and a culture where success is valued will be created. This will therefore raise standards throughout the school community.

Personalisation: from identification to practice

Personalised learning is about tailoring education to individual needs, interest and aptitude so as to ensure that every learner achieves and reaches their highest standards possible, notwithstanding their background or circumstances.

The following subject statements are taken from the National Curriculum 2014:

Mathematics

Purpose of study (National Curriculum 2014)

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

The national curriculum for mathematics aims 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 have conceptual understanding and are able to recall and apply their knowledge rapidly and accurately to problems
- **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.

Science

Purpose of study (National Curriculum 2014)

A high-quality science education provides the foundations for understanding the world through the specific disciplines of biology, chemistry and physics. Science has changed our lives and is vital to the world's future prosperity, and all pupils should be taught essential aspects of the knowledge, methods, processes and uses of science. Through building up a body of key foundational knowledge and concepts, pupils should be encouraged to recognise the power of rational explanation and develop a sense of excitement and curiosity about natural phenomena. They should be encouraged to understand how science can be used to explain what is occurring, predict how things will behave, and analyse causes.

Aims

The national curriculum for science aims to ensure that all pupils:

- develop **scientific knowledge and conceptual understanding** through the specific disciplines of biology, chemistry and physics
- develop understanding of the **nature, processes and methods of science** through different types of science enquiries that help them to answer scientific questions about the world around them
- are equipped with the scientific knowledge required to understand the **uses and implications** of science, today and for the future.

Computing

Purpose of study (National Curriculum 2014)

A high-quality computing education equips pupils to understand and change the world through logical thinking and creativity, including by making links with mathematics, science, and design and technology. The core of computing is computer science, in which pupils are taught the principles of information and computation, and how digital systems work. Computing equips pupils to use information technology to create programs, systems and a range of media. It also ensures that pupils become digitally literate – able to use, and express themselves and develop their ideas through, information and communication technology – at a level suitable for the future workplace and as active participants in a digital world.

Aims

The national curriculum for computing aims to ensure that all pupils:

- can understand and apply the fundamental principles and concepts of computer science, including abstraction, logic, algorithms and data representation
- can analyse problems in computational terms, and have repeated practical experience of writing computer programs in order to solve such problems
- can evaluate and apply information technology, including new or unfamiliar technologies, analytically to solve problems
- are responsible, competent, confident and creative users of information and communication technology.

Design and Technology

Purpose of study (National Curriculum 2014)

Design and technology is an inspiring, rigorous and practical subject. Using creativity and imagination, pupils design and make products that solve real and relevant problems within a variety of contexts, considering their own and others' needs, wants and values. They acquire a broad range of subject knowledge and draw on disciplines such as mathematics, science, engineering, computing and art. Pupils learn how to take risks, becoming resourceful, innovative, enterprising and capable citizens. Through the evaluation of past and present design and technology, they develop a critical understanding of its impact on daily life and the wider world. High-quality design and technology education makes an essential contribution to the creativity, culture, wealth and well-being of the nation.

Aims

The national curriculum for design and technology aims to ensure that all pupils:

- develop the creative, technical and practical expertise needed to perform everyday tasks confidently and to participate successfully in an increasingly technological world
- build and apply a repertoire of knowledge, understanding and skills in order to design and make high-quality prototypes and products for a wide range of users
- critique, evaluate and test their ideas and products and the work of others
- understand and apply the principles of nutrition and learn how to cook.