Introduction

At Carolside Primary we follow East Renfrewshire's Numeracy and Mathematics Framework as well as being guided by best practice identified in the National Numeracy and Mathematics Progression Framework.

Rationale

Mathematics is important in our everyday life, allowing us to make sense of the world around us and to manage our lives. Using mathematics enables us to model real-life situations and make connections and informed predictions. It equips us with the skills we need to interpret and analyse information, simplify and solve problems, assess risk and make informed decisions.

Numeracy and Maths Principles and Practice Paper

The National Numeracy and Mathematics Progression Framework is arranged by the Curriculum for Excellence organisers:

- Estimation and rounding;
- Data and analysis;
- Fractions;
- Decimal fractions and percentages;
- Ideas of chance and uncertainty;
- Measurement;
- Time;
- Number and number processes.

East Renfrewshire's Numeracy and Mathematics Framework offers a progressive programme building on pupils' prior knowledge. The framework is used to capture forward planning and to assess learning, annotated as groups or individuals progress through the programme. The Numeracy and Mathematics Framework is passed on to new teachers to ensure progression.

Learning and teaching in Numeracy and Mathematics here at Carolside is motivating and meaningful. The design principles are used to plan rich and engaging learning experiences where children and young people experience success in numeracy and mathematics. Our classroom environments encourage children and young people to face challenge and develop confidence to take risks without the fear of being wrong. Through effective questioning and discussions, mistakes and misconceptions are used as opportunities to discuss solutions, different methods of working and therefore deepen understanding.

Aims

In Carolside we aim to:

- Ensure that all children, irrespective of gender, race and culture have access to a wide range of stimulating problems and activities
- Build on each child's early experiences at home and from Early Learning and Childcare

- Equip pupils with competence and confidence in mathematical knowledge, concepts and skills
- Meet the needs of all of our children and young people through effective differentiation, flexible grouping and challenge
- Provide opportunities for pupils to work through structured whole class, group and individual teaching strategies
- Give children the ability to solve real life problems in a meaningful context
- Provide opportunities for children to use technology to support their mathematical work.
- Encourage pupils to work both independently and in cooperation with others.

Learning, Teaching and Assessment

The following regular practices underpin high quality learning and teaching in Numeracy and Mathematics:

Planning and Assessment

Beginning with the Experiences and Outcomes of Curriculum for Excellence and the design principles, teachers plan rich and meaningful learning experiences. Learning is made relevant to children through real-life links wherever possible. Links are be made to the world of work through questioning e.g. 'How could this mathematics be useful in the world beyond the classroom?' 'Who might use these maths processes in their daily work or lives?

Assessment is a collection of tools brought together in a toolkit. Approaches to assessment identify the extent to which children and young people can apply their skills in their learning, in their daily lives and in preparing for the world of work. Teachers use data from daily formative assessment strategies to plan next steps in children's learning. A range of AifL strategies are embedded in our classroom pedagogy and practice.

Mental Maths Warm up Activities

Each lesson begins with a short warm up activity which helps children and young people to begin to think mathematically, develop 'number sense' and encourage flexibility of thinking. Warm up activities are accessible for all learners, can be used to introduce a new skill or concept; bridging into the main teaching of the lesson or can be a way of keeping skills sharp with our learners.

Learning Intentions and Success Criteria

Learning intentions clearly state what the learner should know, understand and be able to do by the end of the learning experience. They should link closely to, and reflect, the standards embedded in the chosen Es and Os. In each lesson learning intentions are shared. Success criteria are clear, relevant and measurable. Success criteria are often negotiated with the learners where appropriate.

Concrete, Pictorial, Abstract (CPA)

The CPA approach builds on children's existing knowledge by introducing abstract concepts in a concrete and tangible way. It involves moving from concrete materials, to

pictorial representations, to abstract symbols and problems. This approach permeates all numeracy and mathematics learning and teaching across all stages of the school.

Differentiation and Flexible Groupings

In Carolside we are flexible in our approaches to learning, teaching and assessment in order to meet the needs of all of our children and young people. Aspects of learning such as content, process, product and learning environment can be modified. Children and young people are 'flexibly grouped' in Mathematics allowing class teachers to use data from on-going formative assessments to plan next steps in each child's learning. We acknowledge that children's confidence and performance varies across the organisers of Curriculum for Excellence and flexible grouping allows for staff autonomy when making 'in the moment' decisions around differentiation in order to meet the needs of all learners.

Plenary

A plenary is used at the end of a lesson in order to discuss and reflect upon the key learning of the lesson, share methods and procedures and deepen children's understanding.

Effective Questioning

Teachers use effective questioning techniques and approaches to guide the children through investigations while stimulating their mathematical thinking and gathering information about their knowledge and strategies. (See Appendix 1)

Maths Journals

Maths Journals are a working document used within a lesson to exemplify understanding in additional ways, record thinking or ask questions. They are also used as a way of assessing pupils' prior knowledge and understanding when introducing a new topic, throughout the lesson or when reflecting on learning. Children are sometimes asked to record one thing they have discovered, or note a mathematical question to be considered later in discussion.

Appendix 1

Effective Questioning

Within the context of open-ended mathematical tasks, it is useful to group questions into four main categories (Badham, 1994). These questions can be used be the teacher to guide the children through investigations while stimulating their mathematical thinking and gathering information about their knowledge and strategies.
Teachers use a variety of higher order questioning in maths such as

1. *Starter questions*
These take the form of open-ended questions which focus the children's thinking in a general direction and give them a starting point. Examples:
How could you sort these.....?
How many ways can you find to ..... ?
What happens when we ..... ?
What can be made from....?
How many different ..... can be found?

2. *Questions to stimulate mathematical thinking*
These questions assist children to focus on particular strategies and help them to see patterns and relationships. This aids the formation of a strong conceptual network. The questions can serve as a prompt when children become 'stuck'. (Teachers are often tempted to turn these questions into instructions, which is far less likely to stimulate thinking and removes responsibility for the investigation from the child).
Examples:
What is the same?
What is different?
Can you group these ..... in some way?
Can you see a pattern?
How can this pattern help you find an answer?
What do think comes next? Why?
Is there a way to record what you've found that might help us see more patterns?
What would happen if....?

3. *Assessment questions*
Questions such as these ask children to explain what they are doing or how they arrived at a solution. They allow the teacher to see how the children are thinking, what they understand and what level they are operating at. Obviously they are best asked after the children have had time to make progress with the problem, to record some findings and perhaps achieved at least one solution.
Examples:
What have you discovered?
How did you find that out?
Why do you think that?
What made you decide to do it that way?

4. *Final discussion questions*
These questions draw together the efforts of the class and prompt sharing and comparison of strategies and solutions. This is a vital phase in the mathematical thinking processes. It provides further opportunity for reflection and realisation of mathematical ideas and relationships. It encourages children to evaluate their work.
Examples:
Who has the same answer/ pattern/ grouping as this?
Who has a different solution?
Are everybody's results the same?
Why/why not?
Have we found all the possibilities?
How do we know?
Have you thought of another way this could be done?
Do you think we have found the best solution?

Levels of Mathematical Thinking
Another way to categorise questions is according to the level of thinking they are likely to stimulate, using a hierarchy such as Bloom's taxonomy (Bloom, 1956). Bloom classified thinking into six levels: Memory (the least rigorous), Comprehension, Application, Analysis, Synthesis and Evaluation (requiring the highest level of thinking). Sanders (1966) separated the Comprehension level into two categories, Translation and Interpretation, to create a seven level taxonomy which is quite useful in mathematics. As you will see as you read through the summary below, this hierarchy is compatible with the four categories of questions already discussed.

1. *Memory:* The student recalls or memorises information
2. *Translation:* The student changes information into a different symbolic form or language
3. *Interpretation:* The student discovers relationships among facts, generalisations, definitions, values and skills
4. *Application:* The student solves a life-like problem that requires identification of the issue and selection and use of appropriate generalisations and skills
5. *Analysis:* The student solves a problem in the light of conscious knowledge of the parts of the form of thinking.
6. *Synthesis:* The student solves a problem that requires original, creative thinking
7. *Evaluation:* The student makes a judgement of good or bad, right or wrong, according to the standards he values.

References

Badham, V. (1994) What's the Question?. Pamphlet 23. Primary Association for Mathematics (Australia)

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Bloom, B. (1956). Taxonomy of Educational Objectives Handbook 1: Cognitive Domain. New York: David Mackay

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