A CURRICULUM for EXCELLENCE

To really appreciate the benefits and power of learning contained within '**CARS MATHS IN MOTION'**, Scottish schools need look no further than the Mathematics Principles and Practice paper within the Scottish Curriculum for Excellence Guidelines.

http://www.ltscotland.org.uk/Images/mathematics_principles_practice_tcm4-540169.doc

'What can learning in mathematics enable children and young people to achieve?'

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.

Mathematics plays an important role in areas such as science or technologies, and is vital to research and development in fields such as engineering, computing science, medicine and finance. Learning mathematics gives children and young people access to the wider curriculum and the opportunity to pursue further studies and interests.

Because mathematics is rich and stimulating, it engages and fascinates learners of all ages, interests and abilities. Learning mathematics develops logical reasoning, analysis, problem-solving skills, creativity and the ability to think in abstract ways. It uses a universal language of numbers and symbols which allows us to communicate ideas in a concise, unambiguous and rigorous way.

To face the challenges of the 21st century, each young person needs to have confidence in using mathematical skills, and Scotland needs both specialist mathematicians and a highly numerate population.

Building the Curriculum 1

Mathematics equips us with many of the skills required for life, learning and work. Understanding the part that mathematics plays in almost all aspects of life is crucial. This reinforces the need for mathematics to play an integral part in lifelong learning and be appreciated for the richness it brings.'

'**CARS MATHS IN MOTION**' is engaging, motivational and, above all, develops deep and sustainable knowledge and understanding of the mathematics involved through its application in a relevant and exciting context.

'**CARS MATHS IN MOTION**' encompasses the principles and practice of effective learning and teaching as outlined in the guidelines:

'The experiences and outcomes encourage learning and teaching approaches that challenge and stimulate children and young people and promote their enjoyment of mathematics. To achieve this, teachers will use a skilful mix of approaches, including:

- *planned active learning which provides opportunities to observe, explore, investigate, experiment, play, discuss and reflect*
- *modelling and scaffolding the development of mathematical thinking skills*
- *learning collaboratively and independently*
- *opportunities for discussion, communication and explanation of thinking*
- *developing mental agility*
- *using relevant contexts and experiences, familiar to young people*
- *making links across the curriculum to show how mathematical concepts are applied in a wide range of contexts, such as those provided by science and social studies*
- *using technology in appropriate and effective ways*
- *building on the principles of Assessment is for Learning, ensuring that young people understand the purpose and relevance of what they are learning*
- *developing problem-solving capabilities and critical thinking skills.*

Mathematics is at its most powerful when the knowledge and understanding that have been developed are used to solve problems. Problem solving will be at the heart of all our learning and teaching. We should regularly encourage children and young people to explore different options: 'what would happen if...?' is the fundamental question for teachers and learners to ask as mathematical thinking develops.'

By using '**CARS MATHS IN MOTION**' teachers will ensure that they are helping to develop and educate young people investing in them to become:

- successful learners with enthusiasm and motivation for learning and openness to new ideas and determined to reach high standards of achievement.
- Confident individuals with physical, mental and emotional wellbeing and self respect and ambition.
- Responsible citizens with respect for others and a commitment to participate responsibly in political, economic, social and cultural life whilst developing a knowledge of the world and Scotland's place in it.
- Effective contributors with resilience and self-reliance, who can communicate, work in partnership and apply critical thinking, solve problems and be enterprising and creative.

Pupils involved in '**CARS MATHS IN MOTION**' soon develop these four capacities.

LINKS TO CURRICULUM EXPERIENCES AND OUTCOMES

This programme is designed to develop learning in and through mathematics and therefore this is the key area of the curriculum being addressed. It would be possible for other contexts for learning to be developed alongside the maths but teachers should be careful that this is not contrived and that the main motivation of winning a race is recognised as the key to this

programme's success. The use of technology is integral to the learning and is used as a tool rather than as a focus for learning.

Other learning could possibly develop through investigations into forces, friction and streamlining as part of science, research into the circuits, the countries and their culture to support work in social studies and health and wellbeing. The teacher's notes also provide many opportunities for close reading with a direct purpose and context for discussion.

Outcomes are shown for the second and third level of CFE. The main focus for learning will be within the second level, usually between P5-P7 but third level outcomes have been included (*in red italics*) as pupils working securely at the second level will be working independently at that level. They will also be secure in what they know and understand and will be beginning to develop and consolidate knowledge and understanding at the third level. It is very likely that many pupils will be working at this level in Primary. In fact, the programme encourages them to develop the necessary knowledge and understanding to achieve this without doubt.

Jane Craik, Headteacher, Tullynessle Primary School, Aberdeenshire

Activity/Context within 'Cars Maths in Motion'	Related CFE Outcomes	Vocabulary	Developing	Consolidating	Secure
Angle measurement: Estimating, measuring and categorising track angles.	I have investigated angles in the environment, and can discuss, describe and classify angles using appropriate mathematical vocabulary. MTH 2-17a I can accurately measure and draw angles using appropriate equipment, applying my skills to problems in context. MTH 2-17b I can use my knowledge of rounding to routinely estimate the answer to a problem then, after calculating, decide if my answer is reasonable, sharing my solution with others. MNU 2-01a	Acute Reflex Obtuse Right Degrees Protractor	Pupils use angle measurers to compare and contrast sizes of angles linked to track plans. They begin to relate these to the use of protractors and increased accuracy with measurements.	Continued development of accurate drawing and measuring of angles with an increased emphasis on accuracy of estimation to check answers.	Pupils apply their knowledge of measuring, drawing, categorising and estimation to decide on bend feature types of track.
The concept of scale: Estimating, measuring, calculating and then categorising the straight features.	I can use my knowledge of rounding to routinely estimate the answer to a problem then, after calculating, decide if my answer is reasonable, sharing my solution with others. MNU 2-01a I can use the common units of measure, convert between related units of the metric system and carry out calculations when solving problems. MNU 2-11b Having determined which calculations are needed, I can solve problems involving whole numbers using a range of methods, sharing my approaches and solutions with others. MNU 2-03a *I can use a variety of methods to solve number problems in familiar contexts, clearly communicating my processes and solutions.* *MNU 3-03a* *I can continue to recall number facts quickly and use them accurately when making calculations.* *MNU 3-03b* *I can show how quantities that are related can be increased or decreased proportionally and apply this to solve problems in everyday contexts.* *MNU 3-08a*	Scale Ratio T chart or ratio table Straight Curve Accuracy Measure Millimetre Centimetre Kilometre Metre	Pupils use and mark a paper measuring strip by comparing to a drawn scale and then using to measure both on diagrams, maps and then on track plan. Measure straight distances accurately using a ruler.	Measure the straight distances and develop calculations to use a T table or ratio table to help calculate. Some pupils using calculators as necessary.	Pupils calculate distances independently.
Measuring curved lines: Calculating the whole track distance.	I can use the common units of measure, convert between related units of the metric system and carry out calculations when solving problems. MNU 2-11b I can use my knowledge of rounding to routinely estimate the answer to a problem then, after calculating, decide if my answer is reasonable, sharing my solution with others. MNU 2-01a Having determined which calculations are needed, I can solve problems involving whole numbers using a range of methods, sharing my approaches and solutions with others. MNU 2-03a	Scale Ratio T chart or ratio table Straight Curve Accuracy Measure Millimetre Centimetre Kilometre Metre	Pupils measure small parts of the track and calculation of distance is scaffolded and modelled through teacher support.	Pupils calculate parts of track length with a partner or in a group and work how they are going to calculate whole track length. Either using t table and/or calculator.	Pupils measure whole track independently and calculate distance based on scale using mental and written methods.

	I can use a variety of methods to solve number problems in familiar contexts, clearly communicating my processes and solutions. *MNU 3-03a* *I can continue to recall number facts quickly and use them accurately when making calculations.* *MNU 3-03b* *I can show how quantities that are related can be increased or decreased proportionally and apply this to solve problems in everyday contexts.* *MNU 3-08a*				
Calculation of race distance: Using long multiplication or calculators to calculate the whole race distance and converting to/from metres to/from kilometres. Possible use of averages to ensure accuracy of track measurement.	I can use my knowledge of rounding to routinely estimate the answer to a problem then, after calculating, decide if my answer is reasonable, sharing my solution with others. MNU 2-01a Having determined which calculations are needed, I can solve problems involving whole numbers using a range of methods, sharing my approaches and solutions with others. MNU 2-03a I have explored the contexts in which problems involving decimal fractions occur and can solve related problems using a variety of methods. MNU 2-03b I can use the common units of measure, convert between related units of the metric system and carry out calculations when solving problems. MNU 2-11b *I can round a number using an appropriate degree of accuracy, having taken into account the context of the problem.* *MNU 3-01a* *I can use a variety of methods to solve number problems in familiar contexts, clearly communicating my processes and solutions.* *MNU 3-03a* *I can continue to recall number facts quickly and use them accurately when making calculations.* *MNU 3-03b* *I can show how quantities that are related can be increased or decreased proportionally and apply this to solve problems in everyday contexts.* *MNU 3-08a*	Round up Multiply Distance Convert	Pupils are supported to discuss and use ways of calculating the race distance. Scaffolded discussion can revolve around conversion of metres to kilomteres and kilometres to metres to make numbers 'friendly'. Pupils can be supported in discussing how to calculate the race length even though they may not yet have the skills to carry out the calculation. This can then be supported by the use of calculators and or modelled by the use of repeated addition. A t table could also be used to model the process.	Pupils can be encouraged to work more and more independently to calculate race distances. Pupils should be encouraged to become more secure with conversion of measurements. Calculators would still be used at this stage but there would be a greater emphasis on accurate recording of calculations and the process undertaken to achieve these.	When pupils are secure with this aspect of the programme they will work independently and record all steps accurately. They will use rounding to help their calculations in a way that is relevant to the problem. They may still be using calculators but by this time will have the understanding to be taught the formal algorithm for long multiplication. The accuracy of track measurements can be discussed as a class and this group of pupils can investigate how to find an average track distance and discuss the effect of this on their car adjustments.

Fuel consumption: Division or repeated addition used to calculate fuel needed. Identify and recognise relevance of always rounding up where fuel required is concerned.	I can use my knowledge of rounding to routinely estimate the answer to a problem then, after calculating, decide if my answer is reasonable, sharing my solution with others. MNU 2-01a Having determined which calculations are needed, I can solve problems involving whole numbers using a range of methods, sharing my approaches and solutions with others. MNU 2-03a I have explored the contexts in which problems involving decimal fractions occur and can solve related problems using a variety of methods. MNU 2-03b *I can round a number using an appropriate degree of accuracy, having taken into account the context of the problem.* *MNU 3-01a* *I can use a variety of methods to solve number problems in familiar contexts, clearly communicating my processes and solutions.* *MNU 3-03a* *I can continue to recall number facts quickly and use them accurately when making calculations.* *MNU 3-03b* *I can show how quantities that are related can be increased or decreased proportionally and apply this to solve problems in everyday contexts.* *MNU 3-08a*	Litres Consumption Ratio Division Half	For pupils at the developing stage they can be supported in creating a t table with fuel consumption related to various multiples and through investigation can explore how they can use calculators to work out fuel for various numbers of laps. This is also a great context for developing multiplying by ten and multiples of ten.	Pupils increasingly work independently on this and develop multiplicative strategies of their own looking for and developing increasingly efficient ways to calculate fuel. This in turn then gives teachers opportunities for assessing pupils' developing construction of understanding.	Pupils calculate the fuel required by dividing the distance by the fuel consumption. They can be challenged with more irregular fuel consumption than the usual 2km/l.
Percentages and Workshop adjustments: Investigate the effect of variables on performance, understand percentages as fractions and part whole relationship. Calculations using either a calculator or written methods using either decimals or percentages and known simple fractions.	I can use my knowledge of rounding to routinely estimate the answer to a problem then, after calculating, decide if my answer is reasonable, sharing my solution with others. MNU 2-01a Having determined which calculations are needed, I can solve problems involving whole numbers using a range of methods, sharing my approaches and solutions with others. MNU 2-03a I have explored the contexts in which problems involving decimal fractions occur and can solve related problems using a variety of methods. MNU 2-03b I have investigated the everyday contexts in which simple fractions, percentages or decimal fractions are used and can carry out the necessary calculations to solve related problems. MNU 2-07a I can show the equivalent forms of simple fractions, decimal fractions and percentages and can choose my preferred form when solving a problem, explaining my choice of method. MNU 2-07b *I can use a variety of methods to solve number problems in familiar contexts, clearly communicating my processes and solutions.* *MNU 3-03a* *I can continue to recall number facts quickly and use them accurately*	Percentage Fraction. Hundredths Tenth Part Whole	Very simply pupils can be taught what to do with a calculator to work out the answer but this does not develop any understanding. It is more important that pupils begin to construct an understanding of what is meant by a percentage. Again a t table linked to a pictorial representation could be used to scaffold and support children's learning.	Pupils begin to understand the part whole relationship between fractions, decimals and percentages as well as the distributive law of multiplication and division. Pupils can begin to look at the link between calculating e.g. 10 % and place value. At it's simplest level a percentage could be calculated using repeated additions of ten percent and 1 percent which are easily calculated if place value is understood.	If pupils are secure with the outcomes then they will be able to calculate percentage safe speeds using any of the previous methods and are also ready to learn how to use long multiplication but should always realise that this may not always be the most efficient or effective way of doing the calculation. Estimation is also essential to all these

	when making calculations. *MNU 3-03b* *I can solve problems by carrying out calculations with a wide range of fractions, decimal fractions and percentages, using my answers to make comparisons and informed choices for real-life situations.* *MNU 3-07a* *I can show how quantities that are related can be increased or decreased proportionally and apply this to solve problems in everyday contexts.* *MNU 3-08a*				calculations to ensure answers 'make sense'.
Probability, Mean speeds *Investigation and discussion into probability messages following practice laps:* Discuss and understand the concept of mean or average speed.	I can use my knowledge of rounding to routinely estimate the answer to a problem then, after calculating, decide if my answer is reasonable, sharing my solution with others. MNU 2-01a Having discussed the variety of ways and range of media used to present data, I can interpret and draw conclusions from the information displayed, recognising that the presentation may be misleading. MNU 2-20a I can conduct simple experiments involving chance and communicate my predictions and findings using the vocabulary of probability. MNU 2-22a *I can continue to recall number facts quickly and use them accurately when making calculations.* *MNU 3-03b* *I can show how quantities that are related can be increased or decreased proportionally and apply this to solve problems in everyday contexts.* *MNU 3-08a* *I can work collaboratively, making appropriate use of technology, to source information presented in a range of ways, interpret what it conveys and discuss whether I believe the information to be robust, vague or misleading.* *MNU 3-20a* *I can find the probability of a simple event happening and explain why the consequences of the event, as well as its probability, should be considered when making choices.* *MNU 3-22a*	Probablility Chance Mean average	At the simplest level pupils will begin to understand that the chance of something happening can be measured and they can be encouraged to 'play' with the settings to see if they can reduce the risks involved. There are great opportunities for looking at calculated risks but at this level perhaps getting a car around the track is the target to be aimed for.	The use of probability, chance and the meaning of averages can begin to be used to refine the pupils' calculations. Investigations can continue into cause and effect of alterations to speeds, workshop adjustments etc and discussion can take place as to why adjustments have the effect they do.	Pupils at this stage should be encouraged to use probability information as well as engine temperature percentage levels to help with development of their cars. It is essential at this stage that pupils are encouraged and helped to record details of their changes so that effects can be measured and monitored.
Race planning:	I can carry out practical tasks and investigations involving timed events and can explain which unit of time would be most appropriate to use. MNU 2-10b Using simple time periods, I can give a good estimate of how long a journey should take, based on my knowledge of the link between time, speed and distance. MNU 2-10c *I can round a number using an appropriate degree of accuracy, having taken into account the context of the problem.* *MNU 3-01a*	24 hour clock Seconds Minutes Proportion	Pupils at this level would be working with simple tracks with no requirement of a tyre change and could go round the whole race with one tank of petrol. They will very quickly realise the	At this level pupils will have to calculate when to change tyres and how much fuel to put in. This is probably the hardest part of the programme for most pupils and the teacher will have to give lots of support and break the tasks down into small achievable parts	Pupils who are secure with these calculations will still require support from time to time at second level unless they have fully grasped the concept of proportion in

	I can use a variety of methods to solve number problems in familiar contexts, clearly communicating my processes and solutions. *MNU 3-03a* *I can continue to recall number facts quickly and use them accurately when making calculations.* *MNU 3-03b* *I can solve problems by carrying out calculations with a wide range of fractions, decimal fractions and percentages, using my answers to make comparisons and informed choices for real-life situations.* *MNU 3-07a* *I can show how quantities that are related can be increased or decreased proportionally and apply this to solve problems in everyday contexts.* *MNU 3-08a* *I can work collaboratively, making appropriate use of technology, to source information presented in a range of ways, interpret what it conveys and discuss whether I believe the information to be robust, vague or misleading.* *MNU 3-20a* *I can find the probability of a simple event happening and explain why the consequences of the event, as well as its probability, should be considered when making choices.* *MNU 3-22a*		inefficiency of this and look for ways to improve their performance. These pupils can begin to work out the length of the race and how long that will be in seconds in preparation for when they have to calculate pit stops.	as the problem is too large for most pupils to grasp. The use of t tables is a great help here. Lots of work will also be done on calculating seconds from hours etc.	relation to calculations. There will also be great opportunities for discussing the effects of rounding up or down.
Post race analysis:	Having discussed the variety of ways and range of media used to present data, I can interpret and draw conclusions from the information displayed, recognising that the presentation may be misleading. MNU 2-20a *I can work collaboratively, making appropriate use of technology, to source information presented in a range of ways, interpret what it conveys and discuss whether I believe the information to be robust, vague or misleading.* *MNU 3-20a*	Data Graphs Bar charts Interpret Trends	At its simplest level pupils can look at graphs to see what data they can find on the graphs. At this stage they are really trying to successfully get a car round the track but this can begin to develop an understanding of the effect of variables on results. They will also suddenly begin to see the competitive nature of their calculations and be inspired to improve and find out more.	As the move into developing their understanding pupils will be supported to interpret race reports, race diagrams for race positions, mean lap speeds, weather conditions, fuel state, tyre wear etc as yet pupils are unlikely to use the date they see directly to influence their decisions.	At this level pupils are helped to use all possible data to develop their understanding of how to improve their car's efficiency. Discussion should be encouraged about cause and effect based on evidence. Pupils at this stage would also be encouraged to make notes and plan changes in an organised and planned way.