Using Key Stage 3 to build towards GCSE

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List of resources

1. *Preparing for the new 2015 Mathematics curriculum: KS4 needs and KS3 implications*
   Department review and discussion template, with a list of KS4 needs and the respective questions to ask about their KS3 implications. A way of analysing the department's current KS3 offer and how to adapt it to meet the new KS4 demands.

2. *KS3 Mathematics scheme of work*
   Sample KS3 scheme of work (perimeter and area), including sections relevant to the new requirements for GCSE Maths 2015: past paper links; content not previously covered; and applications to real-life and unfamiliar contexts.

3. *My progress tracker*
   Grid for tracking student progress from Year 7 (National Curriculum levels) to Year 11 (GCSE grades). It can be used to select the right GCSE questions for use at KS3 to give students early exposure to KS4.

4. *National curriculum changes in Mathematics 2014–15*
   Table listing the changes to the KS2, KS3 and KS4 curricula, detailing skills, knowledge and general conclusions. It can help Maths departments to map their KS3 provision.
   NB print out on A3 paper.

Randall has been teaching Mathematics for 10 years, in which time he has mentored dozens of colleagues, many of whom have gone on to run their own successful departments. He is currently Deputy Head Teacher at Milton Cross, where Maths results have risen over 20% in the last 3 years, having been Assistant Head beforehand, and was also a Maths AST and county lead practitioner. He has written innovative curricula which have been published by the then National Strategies, and has also run workshops at the International ICT in Maths conference.

Department review and discussion

Preparing for the new 2015 Mathematics curriculum: KS4 needs and KS3 implications

KS4 need	Students will need to recall even more formulae now, the most common being: area and circumference of a circle, the quadratic formula, the formulae associated with trigonometry, the area of a trapezium, stratified samples, percentage change.
KS3 implications	*Does our curriculum teach the access and recall to several formulae at an early stage?* *How do we help students remember and recall these formulae?*

KS4 need	There is an increased content of knowledge, with many new topics at both Foundation and Higher tier. The most able students will now be expected to be competent in content previously 'beyond GCSE'.
KS3 implications	*Does the KS3 curriculum have the right amount of teaching time allocated?* *Does the curriculum teach higher-ability topics to all students?* *Are there opportunities to develop units of knowledge to be taught at KS3 to ease the burden at KS4?*

KS4 need	The Foundation tier has an increased proportion of algebra.
KS3 implications	*Does the KS3 curriculum, taught to the lower-ability classes, have the correct weighting across the four key areas of Mathematical knowledge?* *Does the KS3 curriculum build upon the improved numerical understanding from KS2?*

KS4 need	An increased importance of the correct use of Mathematical language, both spoken and written.
KS3 implications	*Do we teach key words and terms explicitly and ensure students can recall and use them in the correct context?* *Do our students understand the language of geometry, including angles and sides?* *Do our students form reasoned arguments, particularly algebraically, with the use of correct notation, including ≠?*

KS4 need	An increased proportion of the mark weighting is given to problem solving and application of knowledge to real world and unfamiliar problems. An increased proportion of the mark weighting is given to reasoning and justification.
KS3 implications	*Does our KS3 curriculum link to real world problems and scenarios?* *Do we provide our students with access to application of knowledge to functional situations?* *Does our curriculum look familiar with topics taught through repetition?* *Do we make our students justify their answers and prove their work?* *Do we hide the Maths?*

KS3 Mathematics Scheme of Work

Unit title: Area and perimeter	**Teaching hours**: 4

Knowledge Objectives:

1. Derive and apply formulae to calculate and solve problems involving perimeter and area of triangles, parallelograms and trapezia.
2. Calculate and solve problems involving perimeter of 2D shapes (including circles), areas of circles and composite shapes.

Skill objectives:

1. Select and use appropriate calculation strategies to solve increasingly complex problems.
2. Substitute values into expressions.
3. Use language and properties precisely.
4. Begin to reason deductively in geometry.
5. Develop mathematical knowledge, in part through solving problems and evaluating the outcomes.
6. Develop the use of formal mathematical knowledge.

KS4 links:

Geometry and measures:

2. Derive and apply formulae to calculate:
   - perimeter and area of triangles, parallelograms, trapezia, circles, and composite shapes.

14. Calculate arc lengths, angles and areas of sectors.

KS4 past paper links:

Edexcel GCSE, Higher tier:

- June 2012, calc, Q5
- June 2012, non-calc, Q2
- November 2012, non-calc, Q7, Q12
- March 2013, calc, Q5
- June 2013, calc, Q8

Previously untaught content to prepare for KS4:

1. Learning to recall the area of trapezia.
2. Using calculations of circles keeping the answer in terms of π.
3. Calculate arc lengths and areas of sectors.

Application of learning for fluency, reasoning, and problem solving:

1. Which is better value – two 6” pizzas for £6.99, or a 12” pizza for £8.99?
2. How much should a 60° slice cost from each pizza?
3. What percentage of land is lost by irrigating using circular systems in Texas?
4. How far does each car travel on the London Eye?

My progress tracker

KS2 LEVEL	YEAR 7			YEAR 8			YEAR 9			YEAR 10			YEAR 11		
	AP1	AP2	AP3	AP1	AP2	AP3	AP1	AP2	AP3	AP1	AP2	AP3	AP1	AP2	AP3
										A*	A*	A*	A*	A*	A*
										A	A	A	A	A	A
	8a	8a	8a	8a	8a	8a	8a	8a	8a	B	B	B	B	B	B
	8b	8b	8b	8b	8b	8b	8b	8b	8b	B	B	B	B	B	B
	8c	8c	8c	8c	8c	8c	8c	8c	8c	B	B	B	B	B	B
	7a	7a	7a	7a	7a	7a	7a	7a	7a	C	C	C	C	C	C
	7b	7b	7b	7b	7b	7b	7b	7b	7b	C	C	C	C	C	C
	7c	7c	7c	7c	7c	7c	7c	7c	7c	C	C	C	C	C	C
	6a	6a	6a	6a	6a	6a	6a	6a	6a	D	D	D	D	D	D
	6b	6b	6b	6b	6b	6b	6b	6b	6b	D	D	D	D	D	D
	6c	6c	6c	6c	6c	6c	6c	6c	6c	D	D	D	D	D	D
5a	5a	5a	5a	5a	5a	5a	5a	5a	5a	E	E	E	E	E	E
5b	5b	5b	5b	5b	5b	5b	5b	5b	5b	E	E	E	E	E	E
5c	5c	5c	5c	5c	5c	5c	5c	5c	5c	E	E	E	E	E	E
4a	4a	4a	4a	4a	4a	4a	4a	4a	4a	F	F	F	F	F	F
4b	4b	4b	4b	4b	4b	4b	4b	4b	4b	F	F	F	F	F	F
4c	4c	4c	4c	4c	4c	4c	4c	4c	4c	F	F	F	F	F	F
3a	3a	3a	3a	3a	3a	3a	3a	3a	3a	G	G	G	G	G	G
3b	3b	3b	3b	3b	3b	3b	3b	3b	3b	G	G	G	G	G	G
3c	3c	3c	3c	3c	3c	3c	3c	3c	3c	G	G	G	G	G	G
2a	2a	2a	2a	2a	2a	2a	2a	2a	2a						
2b	2b	2b	2b	2b	2b	2b	2b	2b	2b						
2c	2c	2c	2c	2c	2c	2c	2c	2c	2c						

1. In the first column circle the level that you achieved when you finished Primary school and joined us.
2. Now follow that colour across the grid – that is what you should be doing ***as a minimum***.
3. Each time you have an assessment point, circle your new working level.

National curriculum changes in Mathematics 2014–15

Changes to the KS2 curriculum

Skills

- A detailed conceptual development of number, particularly in relation to proportionality.
- A discouraged acceleration in place of building concrete foundations.
- Content has moved to earlier years with higher expectations for age-related content.
- Increased requirement for proportional reasoning.
- Financial education – money, percentages and essential numeracy skills emphasised.
- Use of calculators discouraged.

Knowledge

Most of the knowledge content has moved from older years to younger, including some from KS3:

- Using imperial units.
- Working with circles.
- Reflections and translations, in all 4 quadrants.
- Straight-line geometry facts and application.
- Long and short division.
- Mixed and improper fractions.
- Express problems algebraically.
- Generate and describe linear sequences.
- Use simple formulae, especially area and volume.

General conclusions

KS2 has less content, covered at a deeper level, with topics being accessed by earlier year groups than previously. This means that the content is more difficult at all year levels compared to the old programme of study, including some prior KS3 content that is now KS2.

Additionally, there is an increased emphasis on numerical proficiency, particularly the recall of multiplication tables and the use of proportionality in questions (the bar method?).

Algebra and fluency in the language is now increased; conversely there is less content in geometry and statistics, including the removal of probability altogether.

In terms of implications for KS3, while this promises to deliver greater numeric and mental proficiency, students will have less knowledge of geometry and statistics than previously, and will have less reliance and understanding of the use of a calculator.

Changes to the KS3 curriculum

Skills

- The ‘aims’ now place an emphasis on students becoming fluent through varied and frequent practice.
- They are also required to solve problems which are both non-routine and increasingly sophisticated.
- There has been the removal of levels and attainment descriptors.
- A move from the use of ‘calculating devices’ to ‘calculating strategies’ – an emphasis on mental fluency.
- More emphasis on using ‘precise language’.
- The use of ‘formal mathematical representations and knowledge’.
- Use of ‘multi-step’ and ‘increasingly sophisticated’ statements.

Knowledge

Much of this was previously listed under ‘exceptional performance’ and was Level 8 and beyond; this now sits in the body of the main curriculum:

- Surds.
- Rearrange and simplify expressions.
- An increased importance in moving freely between numeric, algebraic and graphical representations.
- Use of efficient written methods for the four arithmetic operations.
- Interpret and compare numbers in standard form.
- Use of roots and reciprocals.
- Use of direct and inverse proportion.
- Transformations on plain paper.
- More explicit reference to higher-ability topics such as exponential graphs and also ‘piece-wise linear’ language.
- Multiplicative reasoning.
- Use of concrete and digital (ICT) instruments to measure.
- Loci and bearings gone?
- Enumerate sets and combinations of sets systematically using tabular, grid and Venn diagrams.
- An increased emphasis on probability, which has moved from KS2.

General conclusions

Increased importance of varied and frequent practice, the access to multi-stage and more sophisticated problems, the links between number, algebra and geometry and fluency between them. Mathematical reasoning is now very important, as this work towards the three aims, including fluency.

Also, increased importance on the use of language and terminology, using terms such as ‘formal’ and ‘precise’, as well as mental mathematics, as both KS2 and KS3 have moved away from the use of calculating devices.

Much of the content of the higher-ability topics has moved from ‘exceptional objectives’ under the old programme of study into the main body of the curriculum: topics such as surds, standard form, factorising, proof and alternative representations are now expected to be taught at KS3 to most students.

The content is seen as a positive step towards reinforcing and preparing students for the rigours of KS4 and GCSE assessment, including the increased use of more calculations and the need to be fluent, rather than learning by rote.

There is now the increased opportunity to develop a syllabus which can build more cohesively across the Key Stages, and in particular the five years at secondary school. Given a much deeper curriculum at all levels, the need will be to balance procedural fluency with conceptual understanding.

Changes to the KS4 curriculum

Skills

- No grade descriptors, but content to be covered.
- The new numbered 1–9 system doesn't yet correlate with where a C/D borderline student should be attaining.
- An increased emphasis on problem solving through the weighting of marks for each Assessment Objective.
- 40% on Higher and 50% on Foundation is awarded for factual recall; the rest is for communicating, reasoning and solving.
- Many formulae now removed (trapezium, quadratic formula, trigonometry rules).

  Many traditionally Higher tier topics are now to be taught to Foundation students.
- Material previously beyond GCSE now appears on the Higher tier.

Knowledge

New Foundation content:

- Calculate exactly with multiples of π • Use standard form • Round to any number of significant figures (currently 1 s.f. only)
- Expand double brackets • Factorise quadratics including the difference of two squares • Solve quadratic equations by factorising
- Use $y = mx + c$ to identify parallel lines • Sketch quadratic, cubic and reciprocal functions • Problems involving compound interest
- Derive simultaneous equations from real-life situations • Solve linear simultaneous equations algebraically and graphically
- Perform calculations with density, mass and volume • Solve problems involving percentage change and reverse percentages
- Use direct and inverse proportion graphically and algebraically • Find corresponding lengths in similar shapes
- Use the congruence criteria for triangles (SSS, SAS, ASA) • Enlarge shapes with fractional scale factors
- Find the areas and perimeters of compound shapes involving circles, and calculate arc lengths and areas of sectors
- Use the sin, cos and tan trigonometric ratios for right-angled triangles • Use tree diagrams to solve probability questions
- Infer properties of a population from a sample, while knowing the limitations of sampling

New skills assessed at Foundation and Higher:

- Find the equation of a line through two points or through one point with given gradient
- Recognise and use sequences of triangular, square and cube numbers, Fibonacci type sequences, quadratic sequences and geometric sequences
- Calculate compound measures including pressure in numerical and algebraic contexts • Use Venn diagrams
- Express a multiplicative relationship between two quantities as a ratio or a fraction • Write a ratio as a linear function
- Set up, solve and interpret growth and decay problems • Use inequality notation to specify error intervals due to rounding
- Understand the ≠ symbol (not equal) • Use the standard convention for labelling sides and angles of polygons
- Derive the sum of angles in a triangle • Know the exact values of sin, cos and tan at key angles (0, 30, 45, 60, 90 degrees)
- Consider outliers when calculating the range of a distribution • Know that correlation does not imply causation

New skills assessed at Higher only:

- Find the equation of a tangent to a circle at a given point, using the fact that it is perpendicular to the radius
- Find approximate solutions using iteration • Solve quadratic inequalities
- Find the nth term of a quadratic sequence • Recognise and use geometric sequences where the common ratio may be a surd
- Apply the concepts of instantaneous and average rates of change by looking at the gradients of tangents and chords to a curve
- Prove the circle theorems • Find inverse and composite functions • Sketch $y = \tan x$ (in addition to sin and cos)
- Locate turning points of quadratic functions by completing the square
- Interpret areas under graphs and gradients of graphs in real-life contexts (e.g. recognise that the area under a velocity-time graph represents displacement)

Skills no longer required:

- Design a survey question and identify bias • Convert between metric and imperial units • Draw/interpret frequency polygons and stem & leaf diagrams

General conclusions

For first teaching from 2015 (current Year 8). More curriculum time will need to be given to cover the content and skills adequately. The Foundation tier will cover grades 1–5; Higher will cover 4–9. Given that the current grading system will be replaced with this numeric one, there will need to be some consideration over which tier students are now entered for: the profile of students for each tier may now change.

The depth of Mathematical understanding at all levels is now much greater, as is the need to be fluent and proficient in the language and correct written conventions. There is an even greater emphasis on the need to problem solve and reason, with a smaller percentage available than before for factual recall. This places a greater importance at KS3 to introduce higher-level Maths earlier, and to provide access to increasingly unfamiliar contexts and scenarios, so that application can be developed and confidence built. A previous criticism of the curriculum was that you could be successful in doing without understanding – this is now not the case.