Mathematics Curriculum

MathematicsDepartment Statement of Intent

"Teach us to number our days, that we may gain a heart of wisdom." Psalm 90:12

Over the next three years the Mathematics department will strive to be the best it can possibly be, ensuring quality education at all levels for our young people. In addition to becoming fluent in the fundamentals of mathematics we aim to deepen understanding through the exploration of mathematical skills and processes and allow our young people, to not only develop contextual thinking, but endeavour to develop their problem solving and reasoning skills. We will work collaboratively to ensure the best provision for our learners, and hope to inspire the Mathematicians of the future, inclusive of all abilities. It will be a department that strives for academic excellence, by improving the P8 figure and allow our learners to exceed the grades of other students with similar starting points. Students will be challenged in their learning and through the high expectations will dream big and be encouraged to be the best they can be. It is important to ensure that with academic excellence comes the development of the child as a whole, to build life skills and equip them to celebrate successes along their journey into later life.

Aims of the Mathematics Department

Our aim is to provide a journey for our learners that is broad, coherent, satisfying and worthwhile. We want to encourage students to develop confidence in, and a positive attitude towards mathematics and to recognise its importance in their own lives and to society. We want to provide a firm mathematical foundation for any student who desires to study mathematics and a higher level and try to be the inspiration for them to do this.

Our main aims include:

- Develop fluent knowledge, skills and understanding of mathematical methods and concepts
- Acquire, select and apply mathematical techniques to solve problems
- Reason mathematically, make deductions and inferences and draw conclusions
- Comprehend, interpret and communicate mathematical information in a variety of forms appropriate to the information and context.

- **<u>SMSC, Gospel Values and British Values in Mathematics</u>**

It is important to us, as stated in out aims that students develop a positive attitude towards mathematics and to recognise its importance in their own lives and to society. With this in mind, we have created an approach that tries to cover the spiritual, moral, social and cultural development of the whole child, whilst combining this with our fundamental British values. Below are a few examples of how you would see this in the mathematics department and it is discussed on a topic by topic basis where appropriate.

Topic	Suggested questions
Introduction to algebra; cross-cultural language	How is algebra used in medicine and religious artwork?
Types of number	Primes in encryption / world security
Order of operations/negatives; taxes, investments, global warming.	Explain the relevance of Maths in Climate change.
Angle facts and properties/shapes	How and why are religious buildings designed in such a way? Reference symmetry in windows. Circles
Sequences	Explain the role of Fibonacci in nature.
Fractions/decimals/percentages	Should more be done to increase the survival rates in different countries? Research and describe the percentage earnings given to charity in Islam.
Measurements and units	Which is more useful…Metric or imperial? What role does Maths have in genetic engineering?
Solving equations	What does it mean to be equal?
Rounding and estimation	Deaths in WW2
Area and volume	Land area / capacity / resources of our Earth - Can we sustain the volume of people? Sustainability / deforestation / crops
Data handling	Reliability of data: nature vs nurture debate
Straight lines and reflections	Explain the significance of Rangoli patterns

As a Catholic school, Gospel Values are also embedded through the delivery of the wider SMSC topics.

The Gospel Values considered are:

Faithfulness and integrity, dignity and compassion, humility and gentleness, truth and justice, forgiveness and mercy, purity and holiness, tolerance and peace, service and sacrifice

Examples of some of the discussions and tasks that take place are shown in the following:

SMSC: Data

Link and Excite

We are often asked to comment upon the reliability of data in GCSE exams. Here are two pieces of data from experts in their respective fields and yet their research has drawn contrasting conclusions:

Robert Plomin is a geneticist who has spent over four decades researching genetics and says that our **mathematical ability is pre-determined by our genes.** His research has found that support and intervention from your parents and teachers has little impact on your mathematical ability.

Conversely, Rosenthal and Jacobson conducted educational research which has shown that if your **teachers have the highest expectation of you, this leads to pupils scoring higher marks,** even if you are a pupil who does not excel at Maths.

SMSC TASK: Nature vs Nurture!

Write a sentence or two explaining whether you feel nature or nurture will have the biggest impact on your Mathematics GCSE grade.

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SMSC: Solving Equations

Link and Excite

Being able to **solving equations** is a crucial skill in Maths which underpins our ability to work fluently across all our topics. If we take a moment to consider what equality really means, it will enhance our understanding of **equality in Mathematics** too.

The spider diagram below shows how **equality** forms the basis of democratic governments like we have here in Britain. Equality can be split into 5 main areas:

Discuss as a class which specific types of equality might be relevant to each of these 5 areas.

SMSC TASK: Draw a spider diagram showing how we champion equality and British & Gospel values at St Joseph's in our Mathematics classrooms. You might want to include our support systems:

Justice for all with our consequence system;
Epraise points;
Reward trips;
Positive praise;
Positive phone calls;
Seating plans;
Restorative conversations;
Consistency in teaching;
Your own experiences with us…

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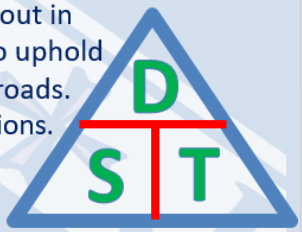
SMSC: Speed Distance Time Link and Excite

Being able to interpret **speed, distance and time graphs** that we learn about in **Mathematics** is crucial to us growing into responsible **British citizens** who uphold the **rule of law** regarding our own safety and the safety of others on the roads. The AA reports that speeding is still the biggest contributory factor in collisions.



Mathematics allows us to **calculate** how long journeys will take so we are not tempted to speed. The Department for Transport published some important **mathematical data** specifically about young drivers aged 17-24:

- 10% of all 17 year olds hold a full driving licence;
- Road collisions account for 15% of deaths for all young adults between 17-24;
- 79% of all young car drivers involved in fatal collisions are male;
- 23% of all young drivers crash within the first two years of passing their test;
- Not wearing seat belts and being distracted by mobile phones is more of a problem with young drivers than with older drivers.
- The road safety charity Brake says that every 24 seconds someone in the world is killed on a road.

SMSC Task: A UK study by Brake has predicted that young people would have 9% fewer accidents if they delayed learning to drive until aged 18 rather than 17. Write a few bullet points explaining your views on if the law should the law be changed. If so, what should the minimum age of drivers be and list 3 pieces of advice you would give to a young driver. Also consider, should the age at which we are allowed to drive be older for males given the mathematical data above?

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SMSC: Rounding & Estimation Link and Excite

In **Mathematics** we learn to **round** and **estimate** numbers. This skill is vitally important in our GCSE exams so we can make judgements about whether our answers are reasonable. In an everyday context, we round and estimate numbers to make them simpler to work with when an exact answer is either not required or not available. This is a life skill that we will need in situations including:

- Budgeting for weekly shopping and other bills;
- Socialising with friends / splitting costs;
- Quotations for building projects.

Estimation and rounding is used by historians when trying to calculate how many people were killed during the holocaust in WW2. There are no exact figures but experts believe that the number of people killed was about 10 000 000. This figure includes about 6 000 000 Jews, Soviet POWs and civilians, homosexuals and disabled people.

SMSC TASK: Efforts have been made to name the victims of the holocaust to restore the individuality and dignity their killers sought to destroy. Write bullet points explaining what can we do as individuals, as a Catholic school and as British Citizens to ensure that the horrors of the past are never repeated.

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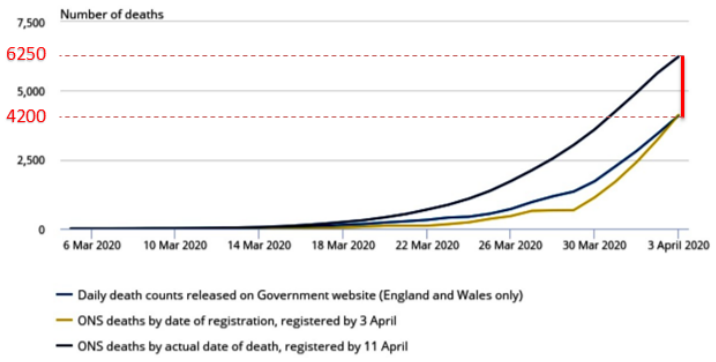
SMSC: Cumulative Frequency Link and Excite

In **Mathematics** lessons we learn about **cumulative frequency** which means adding up data as we go along. We can then use this **data** to make **estimates** to influence decisions that we make. **Cumulative frequency graphs** played a vital role in enhancing our understanding of the coronavirus outbreak in early 2019 and also brought British social, moral and cultural attitudes about our elderly population to the forefront of media scrutiny…

Figure 1: The cumulative number of deaths involving COVID-19 in England and Wales using different data sources, up to 3 April 2020

Cumulative number of deaths involving COVID-19 in England and Wales



The black line at the top shows the number of deaths reported by the Office for National Statistics which includes ALL deaths.

The blue line underneath shows the number of official deaths released by the government.

The vertical red line reveals a discrepancy of about 2050 deaths between the two sets of data as at April 3rd 2019. So who are all our missing dead and why were they not included in government data?

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SMSC: Cumulative Frequency Link and Excite

As **mathematicians**, using the **cumulative frequency graphs** on the previous slide, we can calculate that 33% of deaths that happened in care homes and hospices were omitted from government data. Is the implication of this decision to omit these people from our data that they simply do not matter? Lets watch this 2 minute video to reveal a real person who would have been in danger of being omitted from the statistics had he died during the coronavirus outbreak:

Not all our elderly population need our support. In fact, our elderly population support us by continuing to make vital and valued contributions to our society – even when they reach their 100th birthdays! By 25th April 2019, WW2 veteran Captain Tom Moore had raised over £20 million to support our NHS during the coronavirus pandemic.

There are, however, instances where we ALL need medical support – not just our elderly. This photograph is of three young care assistants from Liverpool who moved into a care home, leaving their own families, to look after the elderly during the coronavirus outbreak. The conditions their patients were suffering from included dementia, Alzeihmer's and Parkinson's. They exuded **Gospel and British values** by being a voice for the elderly when they were too weak and confused to speak for themselves.

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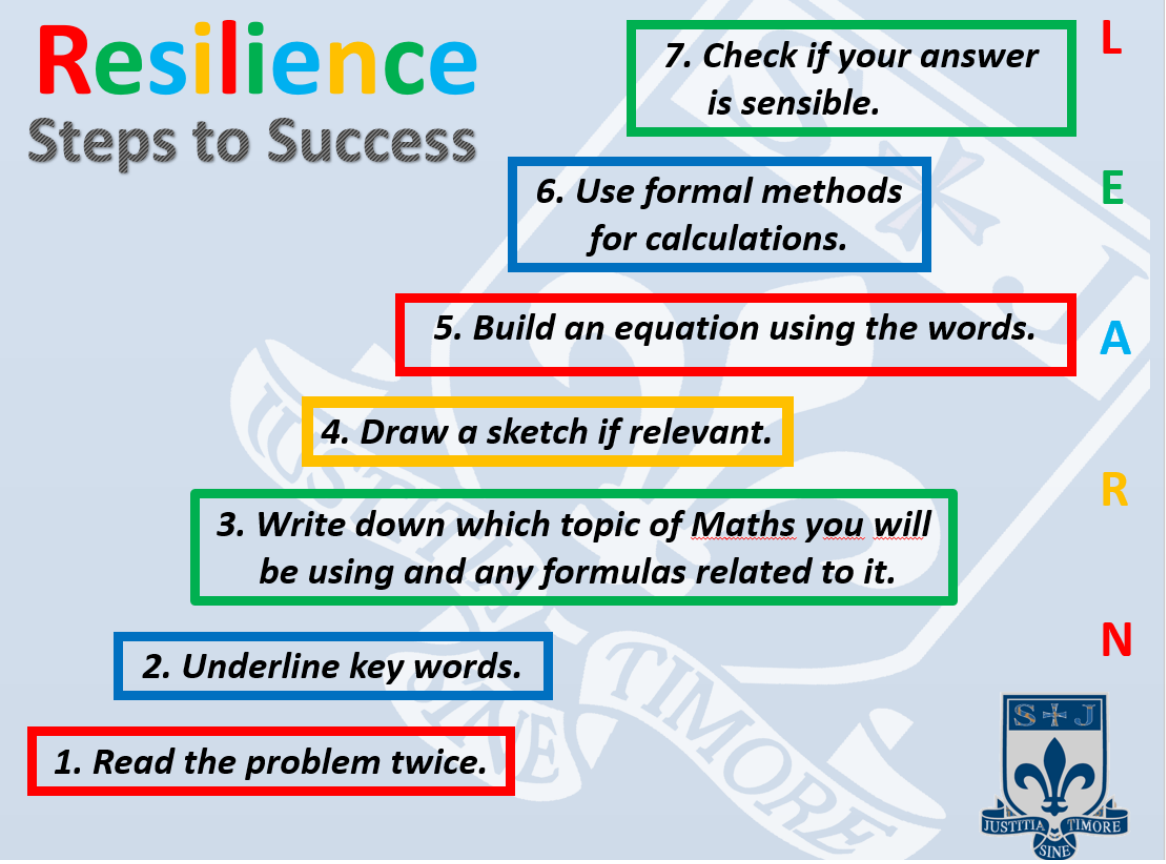
Literacy and Mathematics

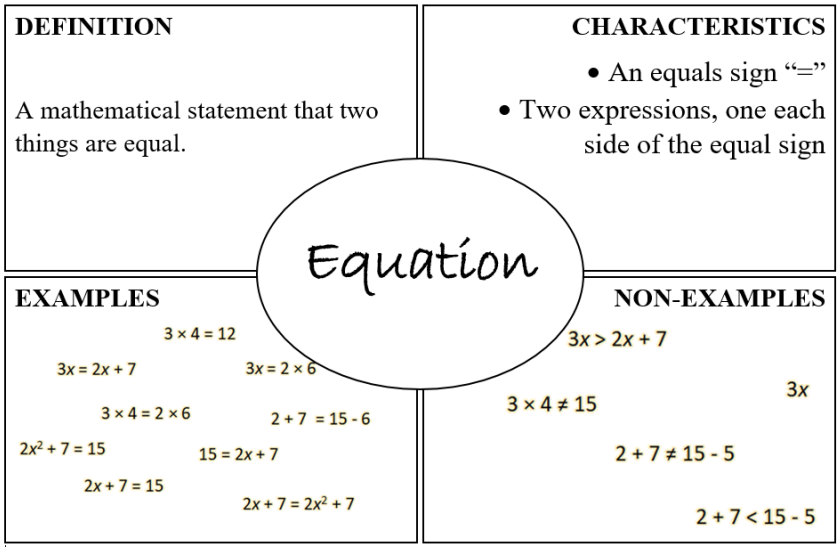
Literacy Strategies in Maths

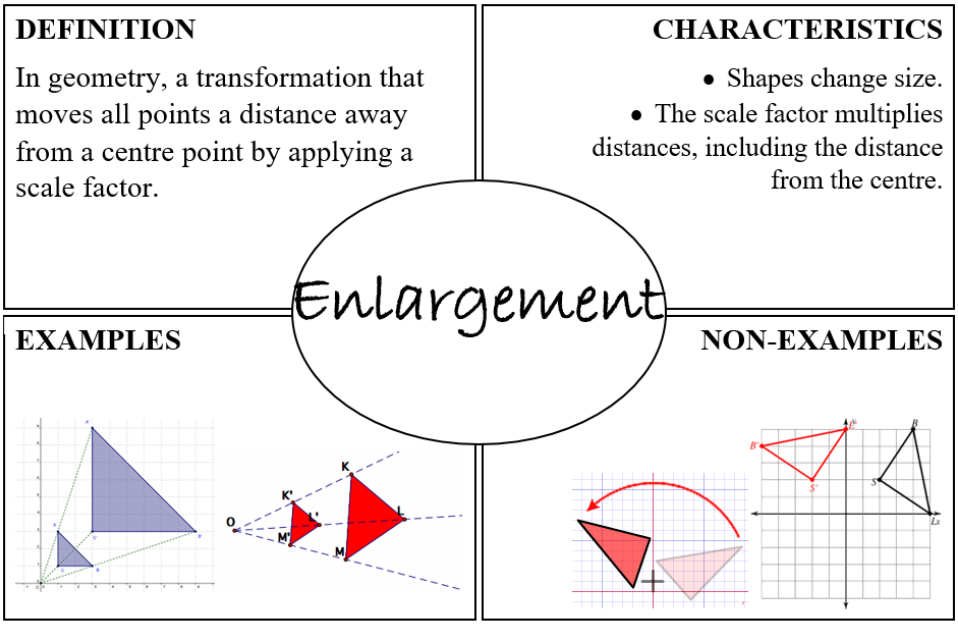
Literacy has been an area of focus that we continue to develop. In the guidance from the Mathematics GCSE Subject Content and Assessment Objectives the Department for Education states that GCSE mathematics examinations should enable students to "comprehend, interpret and communicate mathematical information in a variety of forms appropriate to the information and context." With this in mind and the huge focus on mathematical reasoning and problem solving style questions we ensure that literacy, particularly with key words and breaking down a problem, is a key feature from year 7. As part of our worked examples, displayed in each maths room, you will see evidence of this in using our steps to success to solve a problem. Underline key words is second, after reading the problem twice. This then enables students to identify which mathematical process is needed and go on to solve the problem. Our steps to success guidance is shown below:



As you can see from this literacy plays a very important role in our method to solve a problem and break it down into smaller steps.

Whenever it is appropriate literacy objectives should be built into the lesson along with mathematicalspecific objectives. Literacy can be developed in every lesson through a variety of activities such as emphasis on word work during questioning and mental start-up activities at the start of each lesson. Some topics will lend themselves more easily to literacy development than others. Our learning plans have links to the Frayer models, which are extremely useful in the understanding of key mathematical terms. A few examples of these are below:





It is intended that some of these are used as examples with the students and to develop further understanding, where suitable, students can design their own.

Key Areas of Literacy

Key issues	Overcoming these
Vocabulary Technical and specialist words Appropriate usage Correct spelling Understanding meaning and linking in with correct command.	Use of these words correctly by staff and students alike. Repetition of these along with recap when appropriate. Try to link in, where possible, to words in real life (only where this wouldn't cause conflict) Use pictures where possible to help and non-examples, which can help students to identify common misconceptions where required. (See Frayer models, particularly ones with diagram representations)
Oracy Using the key terms precisely	Good use of language by staff Use a range of questioning techniques. Build an environment from the beginning so that students feel safe to contribute without fear of 'getting it wrong' Think pair share where appropriate to allow students to discuss key concepts. (Often used when introducing a new topic.)
Reading Reading for understanding Drawing out key words Understanding the command/ identifying the correct area of Maths needed to complete the problem.	Use of steps to success to help structure a problem. Sometimes done more formally in lower school and we see that students adapt to using this model into GCSE. They do get prompted but they are generally used to it. Constant reminders of what key terms would link into what command. Other key terms in the question emphasised (other than the mathematical key terms) to lead students into the correct steps to solve the problem.
Writing No extended writing to think of in Maths but students are now expected to reason and problem solve and draw conclusions. Sometimes students lose marks because they cannot be specific with their mathematical reasoning or do not write what their working out deduces in the end.	This is overcome by completing as many reasoning and problem solving questions as we can. There are sections in the scheme of work that link directly to some problem solving questions, which we complete alongside any problem solving that is topic based. This allows repetition of some topics, when they are not currently being covered and also exposes all students to similar questions. A big focus throughout the Maths department has been on the consistency of learning and teaching and allowing all students to get the same 'diet' when it comes to questions.

Mathematics Structure

TheMathematics department is made up of:

Miss R Finch Head of Mathematics
Mrs A Halliday Assistant Head of Mathematics
Mrs Y Taylor Teacher of Mathematics
Mrs J Anderton Teacher of Mathematics (Part time 0.8)
Mr T Hodgson Teacher of Mathematics / Assistant Head of Year 7
Mr Y Ali Laljee Teacher of Mathematics (Part time 0.8)
Miss S Airey Teacher of Mathematics
Mrs C Fitzpatrick Teacher of Mathematics (Part time 0.2)
Mrs N Walmsley Teacher of Mathematics
Miss M Clayton Clarke Teacher of Mathematics
Mrs R Asal HLTA Mathematics

Curriculum Structure

Students in Year 7 and Year 8 are follow a programme of study which aligns to the National Curriculum for Mathematics

Each unit of work is set out as follows:

Year 7:

Term	1	2
Autumn	Introduction to Algebra Number Facts Calculations	Rules of Mathematics Angles and Geometrical Shapes Sequences
Spring	Fractions, Decimals and Percentages 2D and 3D shapes Conversions and measurement Fractions	Percentages Further Algebra Estimations
Summer	Area and perimeter of 2D shapes Volume Problem Solving	Statistical graphs and Measures Coordinates Transformations

Year 8

Working towards

Term	1	2
Autumn	Explore primes HCF problem solving Powers and roots Number patterns Linear graphs LCM problem solving	Probability Linear equations Explore ratio Fractions and percentages
Spring	Revisit and recall understanding of perimeter Develop a knowledge of area Surface area Explore Volume Sequences	Recall multiplication and division of fractions Percentage increase/decrease and change Algebra including simplifying, expanding brackets, substitution, factorising Addition and subtraction of fractions
Summer	Develop a knowledge of angles Averages Summarising and Analysing Data.	Types of data Graphs Constructions

Working at and above

Term	1	2
Autumn	Prime factorisation Approximation Standard form Linear graphs Quadratic graphs Real life graphs	Probability Linear equations Explore ratio and proportion Fractions, decimals and percentages
Spring	Circles Area and perimeter 2D shapes including compound with circles Volume of prisms and cylinders Explore sequences Extension: Fibonacci numbers and sequences Geometric sequences Investigate quadratic sequences	Recall fractions and percentage work Percentage change and reverse percentages Simple and compound interest Algebra including factorising, laws of indices, formulae, substitution and rearranging. Possible Extension: • *Expand the product of two or more binomials* • *factorise a quadratic expression of the form $x^2 + bx + c$*
Summer	Angles including polygons and parallel lines	Introduction to histograms Scatter diagrams

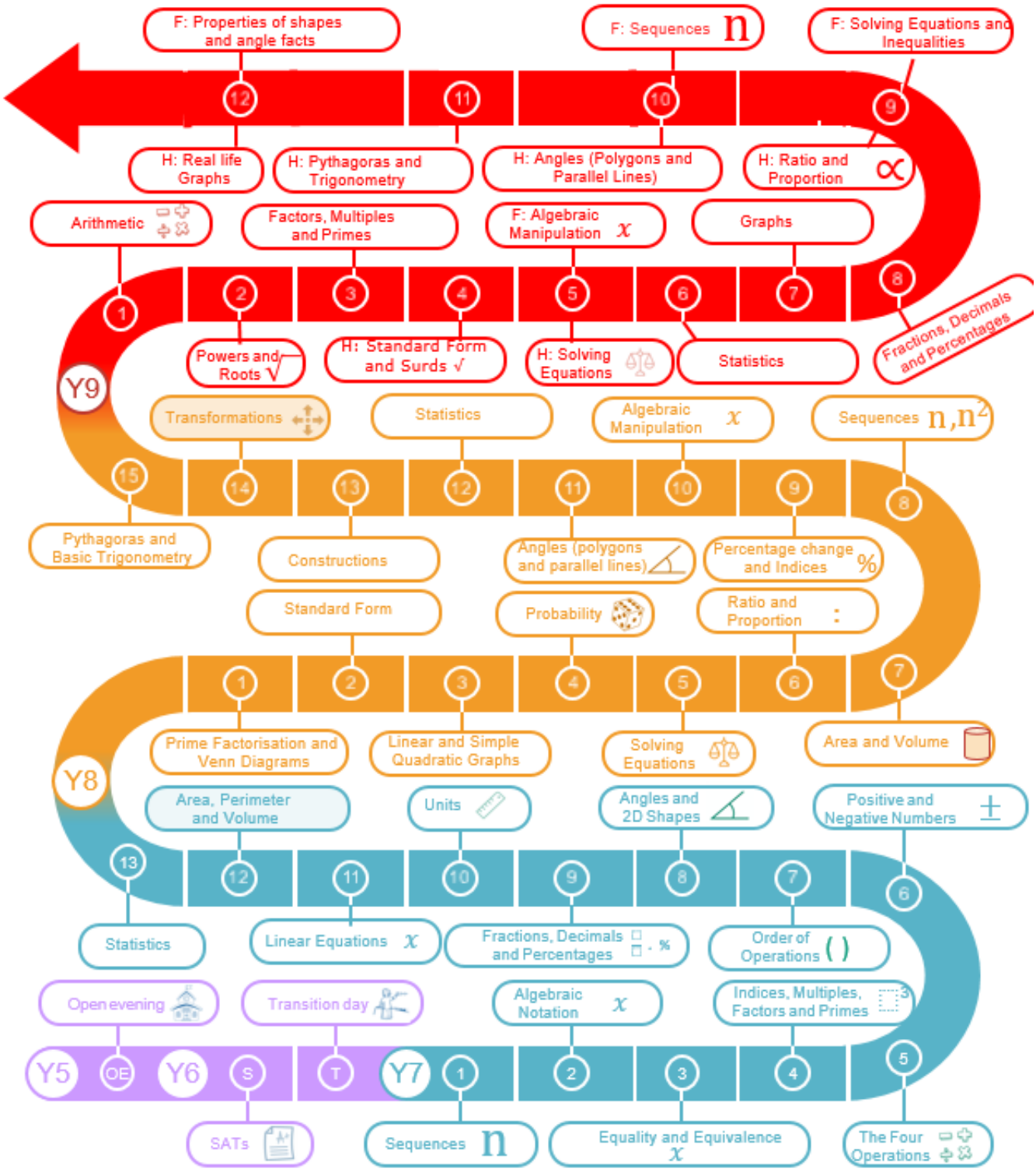
Investigate averages Summarising, analysing and comparing data **Possible Extension:** • *Observe and use Pythagoras'Theorem*	Enlargement 2D shapes Scale diagrams Representing 3D shapes Pythagoras Investigate similar triangles and observe the connection with trigonometric ratios. Constructions **Possible Extension:** • *Investigate congruent and/or similar shapes*

In Year 9 to 11 students study Mathematics from the Edexcelspecification of GCSE qualifications. Students will either follow the higher or foundation programme of study and the overview of the topics are shown in the tables below:

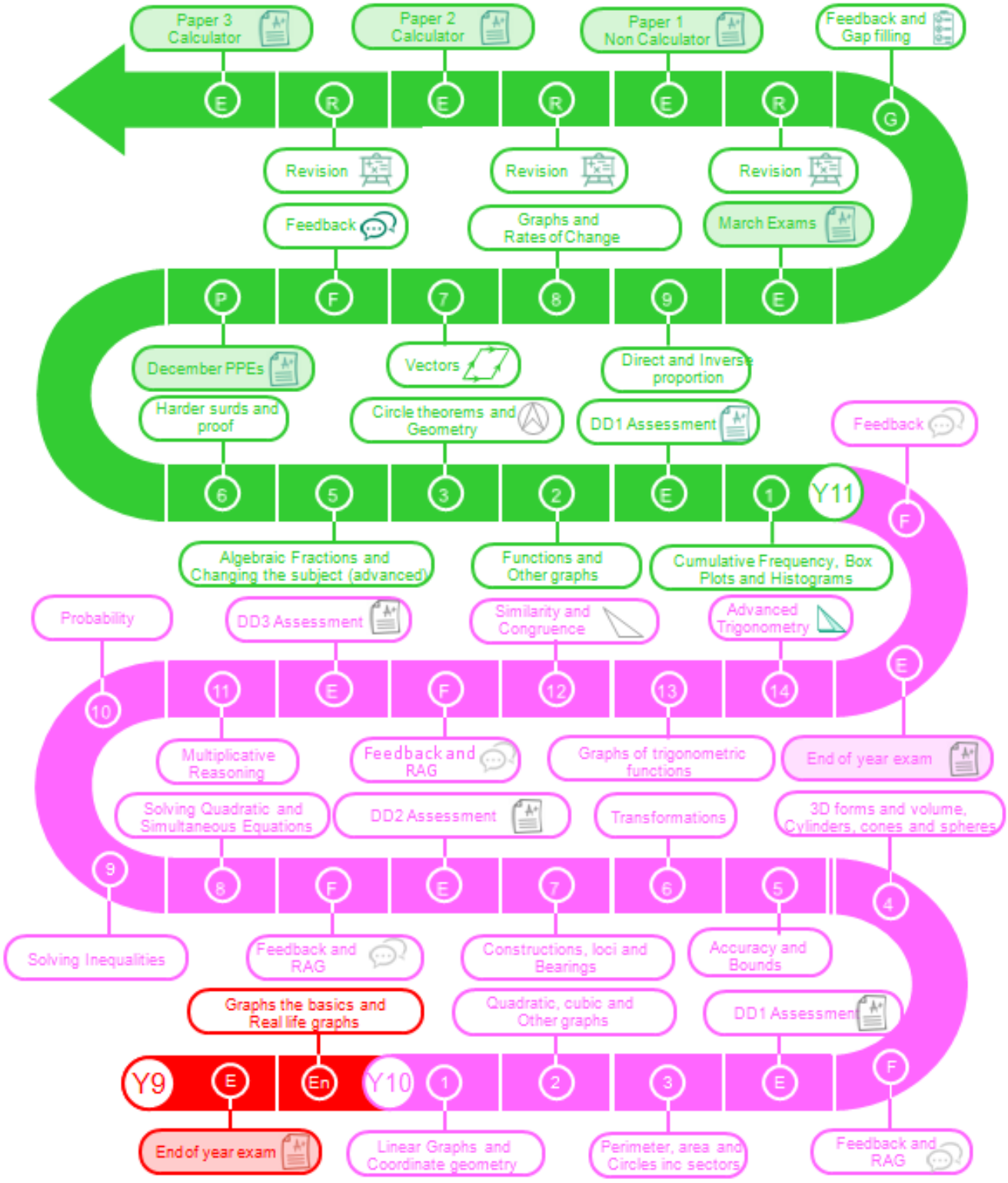
Unit		Foundation: Title
1	a	Integers and place value
	b	Decimals
	c	Indices, powers and roots
	d	Factors, multiples and primes
2	a	Algebra: the basics
	b	Expanding and factorising single brackets
	c	Expressions and substitution into formulae
3	a	Tables
	b	Charts and graphs
	c	Pie charts
	d	Scatter graphs
4	a	Fractions
	b	Fractions, decimals and percentages
	c	Percentages
5	a	Equations
	b	Inequalities
	c	Sequences
6	a	Properties of shapes, parallel lines and angle facts
	b	Interior and exterior angles of polygons
7	a	Statistics and sampling
	b	The averages
8	a	Perimeter and area
	b	3D forms and volume
9	a	Real-life graphs
	b	Straight-line graphs
10	a	Transformations I: translations, rotations and reflections
	b	Transformations II: enlargements and combinations
11	a	Ratio
	b	Proportion
12		Right-angled triangles: Pythagoras and trigonometry
13	a	Probability I
	b	Probability II
14		Multiplicative reasoning
15	a	Plans and elevations
	b	Constructions, loci and bearings
16	a	Quadratic equations: expanding and factorising
	b	Quadratic equations: graphs
17		Circles, cylinders, cones and spheres
18	a	Fractions and reciprocals
	b	Indices and standard form
19	a	Similarity and congruence in 2D
	b	Vectors
20		Rearranging equations, graphs of cubic and reciprocal functions and simultaneous equations

Unit		Higher: Title
1	a	Calculations, checking and rounding
	b	Indices, roots, reciprocals and hierarchy of operations
	c	Factors, multiples and primes
	d	Standard form and surds
2	a	Algebra: the basics
	b	Setting up, rearranging and solving equations
	c	Sequences
3	a	Averages and range
	b	Representing and interpreting data
	c	Scatter graphs
4	a	Fractions
	b	Percentages
	c	Ratio and proportion
5	a	Polygons, angles and parallel lines
	b	Pythagoras' Theorem and trigonometry
6	a	Graphs: the basics and real-life graphs
	b	Linear graphs and coordinate geometry
	c	Quadratic, cubic and other graphs
7	a	Perimeter, area and circles
	b	3D forms and volume, cylinders, cones and spheres
	c	Accuracy and bounds
8	a	Transformations
	b	Constructions, loci and bearings
9	a	Solving quadratic and simultaneous equations
	b	Inequalities
10		Probability
11		Multiplicative reasoning
12		Similarity and congruence in 2D and 3D
13	a	Graphs of trigonometric functions
	b	Further trigonometry
14	a	Collecting data
	b	Cumulative frequency, box plots and histograms
15		Quadratics, expanding more than two brackets, sketching graphs, graphs of circles, cubes and quadratics
16	a	Circle theorems
	b	Circle geometry
17		Changing the subject of formulae (more complex), algebraic fractions, solving equations arising from algebraic fractions, rationalising surds, proof
18		Vectors and geometric proof
19	a	Reciprocal and exponential graphs; Gradient and area under graphs
	b	Direct and inverse proportion

Curriculum Map – Years 7 to 9



Learning Journey – Years 10 and 11 Higher



St Joseph's Mathematics Department

Progression Scales

Steps 1 to 8 used in Y7 and 8

All used in Y9 to 11



12	Independently and confidently apply comprehensive knowledge and solve increasingly complex problems to including negative and fractional indices, quadratic and simultaneous equations, transformations, exponential functions which evidence a capacity for deep mathematical thinking.
11	Demonstrate and effectively apply comprehensive knowledge and understanding of problems, with reasoning, involving accuracy and bounds, rearranging complex formulae, quadratic inequalities, quadratic sequences and histograms.
10	Demonstrate fluency in the following areas by simplifying surd expressions, using function notation, simplifying algebraic fractions, completing the square, examine perpendicular lines, apply Pythagoras to 3D problems, know and apply the sine and cosine rule to find unknown lengths and sides in any triangle, identify and use rules of circle theorems and calculate the resultant of two vectors.
9	Demonstrate and apply wide-ranging knowledge and understanding, whilst embedding proficiency, in index laws, including negative and fractional, expanding double brackets, using tree diagrams for dependant events and calculating angles of elevation and depression, forming and solving simultaneous equations, calculating with standard form, using set notation.
8	Demonstrate and apply accurate and appropriate knowledge and understanding in solving quadratic equations algebraically, identifying key points of quadratic functions, using tree diagrams confidently to calculate the probabilities of independent events, understand the language planes (3D shapes), use and apply Pythagoras to solve 2D problems, use trigonometry to find the lengths of unknown sides or angles in right angled triangles, add and subtract column vectors, use equations for direct proportion.
7	Prove increasing competence by working with reciprocals, prime factorisation, solving more complex equations including the use of trial and improvement, simple quadratic functions, calculating the gradient of a straight line and relating this to real life problems, loci, transformations, vector notation, direct and indirect proportion and compound interest. Evaluate the relationship from a scatter diagram. Demonstrate understanding on transformations and examine the effect of enlargement on 2D shapes.
6	Extend understanding on index laws to examine that any number to the power of zero is 1. Plot the graphs of simple linear functions. Identify possible sources of bias and plan to minimise it. Understand what is meant by a sample and a population. Implement the formulae associated with angles in polygons. Execute the formulae associated with circles. Identify congruent shapes. Use a multiplier to increase or decrease by a percentage.
5	Develop and apply accurate knowledge when adding and subtracting simple fractions with denominators of any size, using division to convert a fraction to a decimal and knowing all the squares of numbers less than 16 and be able to know the square root given the square number. Solve simple two-step linear equations, generate coordinate pairs of simple linear functions, implement probability diagrams for two successive events and write probabilities in words, fractions, decimals and percentages. Construct frequency tables for continuous data, use straight edge and compasses to construct the midpoint and perpendicular bisector of a line segment and convert one metric unit to another.
4	Develop and apply more detailed knowledge on complex order of operations, using inverse operations and begin to understand fractions by simplifying and ordering fractions, decimals and percentages. Explain by rounding the solution to a calculation. Simplify algebraic expressions by collecting like terms and from here identify expressions from worded sources. Use the vocabulary of probability and understand that probabilities sum to 1. Calculate probabilities based on equally likely outcomes and be able to form simple diagrams that demonstrate this. Group data where appropriate in equal class intervals and interpret simple diagrams and charts including pie charts and two-way tables. Use the basic congruence criteria for triangles (SSS, SAS, ASA, RHS). Find a percentage of a quantity using a multiplier and use ratio notation.
3	Identify and explain essential knowledge on how to use the order of operations, round numbers to decimal places, begin to use multiples and factors, draw, label and scale axes, gather real information from and input information to create basic line and bar graphs, recognise and describe sequences, evaluate probability using a mathematical scale, become familiar with the median, mode, mean and range of data, distinguish acute, obtuse, and reflex angles and be able to work out the area of a rectangle or square using the correct formula.
2	Recognise and apply basic knowledge on reading coordinates, identifying parallel lines, labelling lines with correct notation, ordering decimals, measuring lines and angles, recalling basic angle facts, calculating simple perimeters and recognising where a shape will be after a translation or reflection.
1	Add, subtract, multiply and divide positive and negative integers. Identify common solids and name them and the faces, edges and vertices. Record readings with some accuracy. Begin to use scale. Use the words associated with translations.

Assessment Principles

The following assessment objectives are in relation to the GCSE specification but these are used throughout Y7 to 11 when considering assessments.

Assessment Objectives		Weighting	
		Higher	**Foundation**
AO1	**Use and apply standard techniques** Students should be able to: • accurately recall facts, terminology and definitions • use and interpret notation correctly • accurately carry out routine procedures or set tasks requiring multi-step solutions	40%	50%
AO2	**Reason, interpret and communicate mathematically** Students should be able to: • make deductions, inferences and draw conclusions from mathematical information • construct chains of reasoning to achieve a given result • interpret and communicate information accurately • present arguments and proofs • assess the validity of an argument and critically evaluate a given way of presenting information Where problems require candidates to 'use and apply standard techniques' or to independently 'solve problems' a proportion of those marks should be attributed to the corresponding Assessment Objective	30%	25%
AO3	**Solve problems within mathematics and in other contexts** Students should be able to: • translate problems in mathematical or non-mathematical contexts into a process or a series of mathematical processes • make and use connections between different parts of mathematics • interpret results in the context of the given problem • evaluate methods used and results obtained • evaluate solutions to identify how they may have been affected by assumptions made Where problems require candidates to 'use and apply standard techniques' or to 'reason, interpret and communicate mathematically' a proportion of those marks should be attributed to the corresponding Assessment Objective	30%	25%

Enrichment and Extra-Curricular

The Mathematics department offers weekly enrichment during P6 and also other activities and trips/visits as they arise from external providers. We are looking to increase the external maths challenges again to further raise the profile of Mathematics.