

The New Senior Secondary Curriculum for Sierra Leone

Subject syllabus for Mathematics in Other Disciplines

Subject stream: Mathematics and Numeracy



This subject syllabus is based on the National Curriculum Framework for Senior Secondary Education. It was prepared by national curriculum specialists and subject experts.





Curriculum Elements for Mathematics in Other Disciplines – an applied subject

Definition of Mathematics as an academic discipline or school subject

Mathematics is the study of how we manipulate numbers and symbols to deal with quantities, space, shapes, and change. It is a subject that helps us to understand and demonstrate relationships, order, structure, configurations, generalizations, and abstractions as we imagine and deal with everything we encounter in human activity and thought. It evolved from basic activities of counting and measuring things and describing shapes. It now involves abstract ways of using numbers and symbols to study changes in quantities and sets. Branches of mathematics include arithmetic, algebra, geometry, calculus, and statistics. When used on its own as an abstract way of understanding and predicting in the world we call it pure mathematics. When used to deal with real-life problems in various disciplines (e.g., engineering) we call it applied mathematics.

Rationale for introduction of Mathematics in other Disciplines in the Senior Secondary School Curriculum

Mathematics for other disciplines in the Senior Secondary School (SSS) curriculum, builds on mathematics already learned at JSS level. It is intended to equip students with basic tools for understanding and making change in the world. Such tools include logical reasoning and problem-solving skills. The skills acquired in mathematics can be transferred and applied in other areas or retained as a life-long skill. Skills like data analysis, organisation, critical thinking, time management. Communication and decision making can be applied to all career fields. Many roles in life require the basics of Mathematics that this course provides.

In Sierra Leone, pupils' experiences of mathematics are as diverse as their different abilities. Access to the Mathematics Curriculum has never been differentiated. Every student is taught all the topics without cognisance of their career path and are subjected to one untiered examination. The end result is the majority of students lose interest in mathematics and the subject is perceived one of the most difficult and boring subjects.

Mathematics for other disciplines attempt to address some of these issues. This mathematics programme is targeting students who may not be highly mathematically inclined but want to access the mathematics curriculum at their individual abilities. Some students may only need a grade C as a university requirement for their various courses. With this grade C, they will be able to meet the mathematical demands of their chosen courses of study.

This course has been tailored to include mainly the traditional grade B/ C topics and below. These are topics that can be easily accessed by students in other disciplines who may want to have an exciting, focused, and relevant mathematical experience. This is a three-year course and the logic is that more students will find success with Mathematics



General Learning Outcomes [Broad Goals]

The general aim of the course is to enable students to:

- Appreciate and enjoy the benefits of using mathematics in various areas.
- Improve their chances of becoming critical thinkers, problem solvers and independent thinkers.
- Develop improved communication skills through the practice of expressing ideas with mathematical precision
- Improve learning in general through logical thinking, analytical skills, and problem-solving approaches.
- Contribute to society with financial capability, enterprise/ entrepreneurship, work place competence and real-life problem-solving.

Content (Topics/ Themes) for the SSS Curriculum

	SSS 1	SSS 2	SSS 3
Term 1	Numbers and the Numbers System <ul style="list-style-type: none"> • Integers • Approximation/ Estimation • Fractions, Decimals and Percentages • Ratio, Proportion and Rates • Powers and Roots • Indices • Standard Form 	<ul style="list-style-type: none"> • Set Theory • Representation of Data: Pictogram, Bar charts, Pie charts • Grouping data • Statistical Measures <ul style="list-style-type: none"> ○ Estimate Mean from group data • Tabulation and Representation <ul style="list-style-type: none"> ○ Cumulative Frequency graphs 	<ul style="list-style-type: none"> • Angles of elevation/ depression • 3D shapes and Volumes
Term 2	Algebra <ul style="list-style-type: none"> • Algebraic Expressions • Equations <ul style="list-style-type: none"> ○ Linear, ○ Quadratic, ○ Simultaneous • Number Bases • Equations and Formulae <ul style="list-style-type: none"> ○ Change of subject ○ Substitution into formulae 	<ul style="list-style-type: none"> • Graphs of Linear and Quadratic functions. • Linear inequalities. • Relations Mapping • Sequence and Series 	<ul style="list-style-type: none"> • Transformation <ul style="list-style-type: none"> ○ Reflection ○ Rotation ○ Translation ○ Enlargement



	<ul style="list-style-type: none"> Undefined Algebraic Fractions 		
Term 3	<p>Statistics</p> <ul style="list-style-type: none"> Definition of Data and types of Data Statistical Measures Averages and their advantages & disadvantages Probability Language of Probability Probability Scale Probability of events happening Theoretical Probability/Experimental Probability Mutually exclusive events Expected Frequency 	<p>Shape, Space, Measure</p> <ul style="list-style-type: none"> Angles, Line and Triangles Polygons and Congruency Lines of Symmetry and rotational symmetry Construction Loci Circles Mensuration of 2D objects Pythagoras' Theorem Trigonometry in right angle triangle 	





Teaching Syllabus

Topic/ Theme/ Unit	Expected learning outcomes	Recommended teaching methods	Suggested resources	Assessment of learning outcomes
Numbers and the Numbers System <ul style="list-style-type: none"> Integers 	Students should be able to: <ul style="list-style-type: none"> understand and use integers understand Place Value. understand and use directed numbers in practical situations. use the four rules of addition, subtracting, multiplication and division. use order of operation [BIDMAS]. use the terms 'odd', 'even', Prime Numbers', 'factors', and multiples. identify prime factors, common factors, and common multiples. 	Teacher modelling and explanations. Examples: Find $\frac{2}{3}$ of 180 $= \frac{2}{3} \times 180$ $= 120$	Teacher Handbook, leaflets, magazines, newspapers, bank statements, newsletters etc. showing percentages, decimals, and fractions	Standard Questions from textbooks and past papers. Probing questions <ul style="list-style-type: none"> Which number up to 100 has the most factors? Which numbers less than 100 have exactly three factors? The sum of four even number is a multiple of 4. When is this statement true? When is it false? Can a Prime Number be multiple of 4? Why? Multiplication makes numbers higher. When is this statement true? When is it false?
<ul style="list-style-type: none"> Approximation/ Estimation 	Students will be able to: <ul style="list-style-type: none"> round numbers to a given number of decimal places or significant figures. identify and solve problems using Upper and Lower bounds where values are given to a degree of accuracy. 	Teacher modelling	Teacher Handbook	<ul style="list-style-type: none"> Standard questions are rounding to decimal places and significant figures. Questions on upper and lower bounds.



<ul style="list-style-type: none"> • Ratio, Proportion and Rates 	<p>Students will be able to:</p> <ul style="list-style-type: none"> ➤ Use ratio notation including reduction to its simplest form and its links to fraction notation. ➤ Divide any amount in any given ratio or ratios. ➤ Use the process of proportionality to calculate unknown quantities. ➤ Carry out calculations on direct inverse, partial and joint variations. ➤ Calculate rates of work, foreign exchange, density [including population density, speed, distance, and time. 	<p>Teacher modelling, incorporating real life examples. Example: It will take a certain number of workers to lay a certain number of building blocks. How many men will it take to lay a certain number of blocks?</p>	<p>Teacher Handbook</p>	<p>Students answer standard questions from textbooks and examination board past papers.</p>
<ul style="list-style-type: none"> • Powers and Roots 	<p>Students will be able to:</p> <ul style="list-style-type: none"> ➤ Identify square and cube numbers. ➤ Calculate square, square roots, cube and cube roots. ➤ Find Highest Common Factor [HCF] and Lowest Common Factor [LCF] 	<p>Teacher modelling</p>	<ul style="list-style-type: none"> • Teacher Handbook • Calculators 	<p>Standard questions on powers and roots.</p> <p>Probing questions Are the following statements Always, Sometimes or Never true?</p> <ul style="list-style-type: none"> • Cubing a number makes it bigger. • The square of any number is always positive. • You can find the square root of any number. • You can find the cube root of any number.



				Three security guards each flash their lights at intervals of 5 minutes, 10 minutes, and 15 minutes respectively. If they all flash their light at 9.00 p.m., when next will they all flash their lights at the same time?
<ul style="list-style-type: none"> Indices 	<p>Students will be able to:</p> <ul style="list-style-type: none"> Write an integer as a product of its prime factors in index form. Use index laws to simplify and evaluate numerical expressions involving integer fractional and negative powers. Solve indicial equations 	<p>Teacher modelling:</p> <p>Expressing a number as a product of its prime factors in index form.</p> <p>The rules of Indices</p> <p>Solving equations involving indices</p>	Teacher Handbook	<p>Students answer standard questions from past examination board papers.</p> <p>Probing questions</p> <ul style="list-style-type: none"> What is the value of c in the question? $48 \times 56 = 3 \times 7 \times 2c$ What does the index of $\frac{1}{2}$ represent?
<ul style="list-style-type: none"> Standard Form 	<p>Students will be able to:</p> <ul style="list-style-type: none"> Convert ordinary number to standard form. Convert standard form to ordinary number. Solve problems involving standard form. 	<p>Teacher modelling</p> <p>Writing ordinary numbers in standard form.</p> <p>Writing numbers in standard form as ordinary number.</p>	Teacher Handbook	<p>Standard questions on standard form from past exam papers</p> <p>Probing questions</p> <ul style="list-style-type: none"> What are the key conventions when using standard form? How do you go about expressing a very small number in standard form
<p>Algebra</p> <ul style="list-style-type: none"> Algebraic Expressions 	<p>Students will be able to:</p> <ul style="list-style-type: none"> Collect like terms Expand single brackets. Expand double brackets Factorise algebraic expressions by: 	<p>Teacher modelling</p> <p>When modelling, explain to students that factorisation can be viewed as a reverse process of expansion.</p>	Teacher Handbook	<p>Students answer standard questions especially those from past exam board papers.</p> <p>Probing questions</p>



	<ul style="list-style-type: none"> ○ Linear factorization ○ Difference of 2 squares ○ Quadratic factorisation ○ Solve word problems in context. 	<p>When factorizing simple quadratic expressions, get children to work in groups of 4 or 5.</p> <p>Recall the process of expanding double brackets and simplifying. Example:</p> $(x-3)(x+4)$ $x(x+4)-3(x+4)$ $x^2 + 4x - 3x - 12$ $x^2 + x - 12$ <p>Give students several quadratic expressions with coefficient of $x^2 = 1$ and ask them to work backwards and find the two brackets that were multiplied together to produce the quadratic expression given.</p> <p>When students think they have found their two brackets get them to expand their brackets and simplify to self-check if they are correct.</p> <p>Students need support with the manipulation of signs.</p> <p>Get pupils to clearly write down their rules and how they got their answers.</p>	<ul style="list-style-type: none"> ● What is a quadratic expression? ● How would you recognise a quadratic expression? ● Why is $(x + 5)(2x - 3)$ a quadratic expression? ● What is the difference between a quadratic expression and a cubic expression? ● Give students examples of multiplying out a bracket with errors. Ask them to identify and talk through the errors and how they should be corrected. <p>Example:</p> $4(b + 2) = 4b + 2$ $3(p - 4) = 3p - 7$ $-2(5 - b) = 10 - 2b$ $12 -(n - 3) = 9 - n$
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		Get pupils to do presentation to the class - clarify misunderstandings and misconceptions.		
Equations <ul style="list-style-type: none"> Linear 	Students will be able to: <ul style="list-style-type: none"> Solve linear equations including equations with brackets, equations with the unknown on both sides of the equals to sign, and equations with fractions. Construct and solve Linear Equations from Word problems and in context. Solve equations involving algebraic fractions, e.g. Solve $\frac{1}{x} + \frac{1}{2x+1} = \frac{7}{10}$ 	<p>Teacher modelling of various types of linear equations</p> <p>Examples Solve</p> <p>$3(x + 2) = 4$ [Expand]</p> <p>$3x + 6 = 4$ [Subtract 6 from both sides]</p> <p>$3x = -2$ [Divide by 3 on both sides] $x = -\frac{2}{3}$</p> <p>$\frac{1}{3}(x + 2) = \frac{2}{5}(x - 10)$ simplify</p> <p>To get rid of fractions, multiply by the LCM of the denominators which is 15.</p> <p>$15 \times \frac{1}{3}(x + 2) = 15 \times \frac{2}{5}(x - 10)$ $5(x + 2) = 6(x - 10)$ Expand $5x + 10 = 6x - 60$ Subtract 5x from both sides $10 = x - 60$ Add 60 to both sides $70 = x$ $x = 70$</p> <p>The cover method could also be used for simple examples.</p>	Teacher Handbook	<p>Standard questions on linear equations including from exam board past papers.</p> <p>Probing questions</p> <ul style="list-style-type: none"> Here is a list of given equations. <ul style="list-style-type: none"> Which one of these are easy to solve? Which ones are difficult and why? What strategies are important with the difficult ones? The length of a rectangle is three times its width. Its perimeter is 24cm. Find its area. In an ice cream shop, a large cone of ice cream costs 40p more than the small cone. The cost of 2 large cones is the same as 3 small cones. Find the cost of a large ice cream cone. Find the cost of the small ice cream cone. How do you construct equations from information given in a problem? How do you check whether the equations work?



<ul style="list-style-type: none"> • Quadratic 	<p>Students to be able to solve quadratic equations by:</p> <ul style="list-style-type: none"> ➤ Factorisation method ➤ Completing the square method. ➤ Formula method ➤ Forming quadratic equations with given roots. 	<p>Teacher modelling:</p> <p>Example: Solve by factorising $x^2 - 8x + 12 = 0$</p> <p>First factorise $x^2 - 8x + 12$ $(x - 6)(x-2)=0$</p> <p>This means that both or one of the brackets must be equal to zero because their product is zero.</p> <p>$x - 6 = 0$, $x=6$ and/ or $x-2 =0$, $x=2$ Therefore, two answers: $x = 6$ and $x = 2$</p>	<p>Teacher Handbook</p>	<p>Students to answer standard questions in solving quadratic equations including from exam board past papers.</p> <p>Probing questions What clues would you be looking for to warn you that a given quadratic equation cannot be solved by factorisation?</p>
<ul style="list-style-type: none"> • Simultaneous 	<p>Students will be able to:</p> <ul style="list-style-type: none"> ➤ Solve linear simultaneous equations ➤ Solve simultaneous equations from word problems. 	<p>Teacher modelling</p> <p>Model the solving of two linear simultaneous equations by method of elimination and method of substitution.</p>	<p>Teacher Handbook</p>	<p>Students answer standard questions on simultaneous equations.</p> <p>Probing questions</p> <ul style="list-style-type: none"> • How would you know that a problem given will need to be solved using simultaneous equations? • What is confusing when using the elimination method to solve simultaneous equation?



				<ul style="list-style-type: none"> • What is confusing when using substitution method to solve simultaneous equations. • Can you think of a better strategy to avoid such confusions? • A cycle shop has a total of 36 bikes [okada] and tricycles [kekeh] in stock. Altogether there are 80 wheels. How many bikes [okada] and how many tricycles [kekeh] are there?
<p>Equations and Formulae</p> <ul style="list-style-type: none"> • Change of subject 	<p>Students will be able to: rearrange a formula or equation to change the subject; including cases where the subject appears more than once or has powers.</p>	<p>Teacher modelling on rearranging formula.</p> <p>Explain that in a formula, a letter usually stands alone on one side of the equal sign whilst the other letters and/ or numbers are all on the opposite side. The letter that stands alone is called the subject of the equation.</p> <p>Example Make r the subject of $V = 4 \pi r^3$</p> <p>Make L the subject of $T = 2\pi \sqrt{L/G}$</p> <p>When modelling, explain to students that the process of changing the subject of a formula is</p>	<p>Teacher Handbook</p>	<p>Standard Questions on change of subject.</p> <p>Probing questions:</p> <ul style="list-style-type: none"> • What is meant by the subject of a formula? • How do you decide on the steps you need to take to rearrange a formula? What are the important conventions? • What strategies would you use to rearrange a formula where the required subject occurs twice? • What are the similarities and differences between rearranging a formula and solving an equation?



		similar to the process of solving equations. This is because when solving an equation in x for example, we end up with x on its own on one side of the equal sign.		
• Substitution into formulae	Students will be able to: evaluate a letter by substituting into a formula given the values of other letters	Model substitution into a formula.		What precautions would you take when substituting negative values into a formula?
• Undefined Algebraic Fractions	Students will be able to: ➤ know when an algebraic fraction is undefined ➤ find value(s) of x which makes a fraction undefined	Teacher modelling		Students to answer standard fractions on undefined fractions.
• Number Bases	Students will be able to: ➤ understand concept of number bases in counting systems. ➤ convert numbers from one base to another. ➤ perform basic operations on number bases. ➤ solving equations involving number bases.	Teacher modelling Explain the concept of number bases and the idea of counting in groups.	Teacher Handbook	Students answer standard questions on number bases. Probing questions • What will happen to the digits of a number in base two when it is: ○ multiplied by two ○ divided by two • How many different symbols exist in a base five system? What are they? • The Limbas and Sherbro people count in base five. Can you investigate what base is counting done in your language and any two other languages?



<p>Statistics</p> <ul style="list-style-type: none"> • Definition of data and types of data <ul style="list-style-type: none"> ○ Primary/ Secondary data, ○ Categorical/ Numerical data, ○ Discrete/ Continuous data. 	<p>Students to be able to</p> <ul style="list-style-type: none"> ➤ define data in their own words. ➤ distinguish between primary and secondary data. ➤ distinguish between categorical data and numerical data ➤ know that numerical data can be discrete or continuous and understand the usage of these words. 	<p>Open question to the class: “What is data?”</p> <p>Record pupils’ responses on the board with probing questions to clarify misconceptions and collectively answer the question ‘What is data?’</p> <p>Teacher modelling for primary/ secondary data, categorical/ numerical data, and discrete/ continuous data</p> <p>Display keywords around classroom (and corridor) or anywhere appropriate.</p>	<ul style="list-style-type: none"> • Teacher’s Handbook • Display of different types of data. • Measuring instruments: Ruler, Tape measures • Cards/ vanguard. 	<ul style="list-style-type: none"> • Students are asked to group given data into categorical or numerical and discrete or continuous using matching cards. • Students work in pairs or in groups to look around the classroom or local environment and produce: <ul style="list-style-type: none"> ○ 5 real-life examples each of categorical and numerical data. ○ 5 real-life examples each of measurements that will produce discrete and continuous data.
<ul style="list-style-type: none"> • Statistical Measures 	<p>Students will be able to:</p> <ul style="list-style-type: none"> ➤ understand concept of average for data in form of a list or a Frequency Table. ➤ calculate mean, median, mode and range for discrete data set. ➤ examine data and identify extreme values [outliers]. ➤ know the advantages and disadvantages of using Mean, Median and Mode. 	<p>Pre-lesson activity:</p> <ul style="list-style-type: none"> • -select seven volunteers to come to the front of the class. • -get the students to arrange themselves in ascending order of their heights. [from left to right facing the class] • -explain to the class that the student in the middle is said to have the median height. The student on the far left has the lowest height and the student on the far right has the highest height. 		<p>Standard questions on Mean, Median, Mode and Mode.</p> <p>Problem solving:</p> <ul style="list-style-type: none"> • Find a set of five positive whole numbers with: <ul style="list-style-type: none"> ○ Range 10 ○ Mode 4 ○ Median 6 ○ Mean 7 • Is there more than one possible set? • Repeat for a set of six numbers. Find as many possible answers as you can.



		<ul style="list-style-type: none">• -explain that heights range from the shortest to the tallest and the range can be calculated by subtracting the smallest height from the largest height. <p>Repeat this exercise for even number of students e.g 10 students.</p> <p>Ask students if they notice anything different about the Median. Accept different responses e.g., there are two students; it is between the two students.</p> <p>Discuss with students the best way of resolving the median height. i.e adding the 2 middle heights and dividing by 2.</p> <p>Get students into small groups. Give each group sets of numbers to arrange in order of size. Some sets of numbers should contain extremely high and low values.</p> <p>Students to discuss in their groups and talk about possible outliers and the median.</p>	<p>Probing questions</p> <ul style="list-style-type: none">• Is the Median the most appropriate average to calculate for this data set? Convince me.• Convince me that the Mean is the most appropriate average to calculate for this data set.• Convince me that the Mode is the most appropriate average to calculate for this data set.
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		<p>Model with whole group: calculation of Mean, Median, Mode and Range.</p> <p>Summarise advantages and disadvantages of using Mean, Median and Mode.</p>		
<p>Probability</p> <ul style="list-style-type: none"> • Language of Probability • Probability Scale • Probability of events happening 	<p>Students will be able to:</p> <ul style="list-style-type: none"> ➤ understand and use simple language of probability [certain, impossible, likely, unlikely, even chance, impossible, outcomes, equally likely] ➤ understand and use probability scale. ➤ calculate probability of events happening. ➤ draw a sample space diagram for given events. ➤ determine the probability of an event occurring from a sample space diagram. 	<p>Open discussion: - what is probability?</p> <ul style="list-style-type: none"> • -Is it a concept we use in everyday life? • Give me examples. <p>Teacher modelling of:</p> <ul style="list-style-type: none"> • Tossing a coin and probability of Tails. • Tossing a coin and probabilities of Heads • Probability of getting a '1' or '2' or '3' or '4' or '5' or '6' when a dice is thrown. <p>A sample space of all outcomes when two coins are spun together.</p>	<ul style="list-style-type: none"> • Coins • Dice • Counters 	<ul style="list-style-type: none"> • Standard questions on probability including probability scale. • Give three situations where probability is used in everyday life. • Write down or explain two situations where probability was used to make a decision in a real-life situation this week. • Give an example of what is meant by 'equally likely outcomes'? • The Probability of getting a '3' when a die is thrown is 1/6. Can you explain why? • When a coin is tossed, the probability of getting tails is $\frac{1}{2}$. Can you explain why? • Give me examples of probabilities for events that could be described using the following words: <ul style="list-style-type: none"> ○ Impossible ○ Certain ○ Unlikely ○ Even chance





				<ul style="list-style-type: none"> Show these on a Probability Scale.
<ul style="list-style-type: none"> Theoretical Probability/ Experimental Probability Mutually exclusive events Expected Frequency 	<p>Students will be able to:</p> <ul style="list-style-type: none"> understand the difference between theoretical probability and experimental probability / relative frequency understand the term 'mutually exclusive' and can find the probability of mutually exclusive events. use the fact that the sum of all mutually exclusive outcomes of an event is 1 use the addition rule of probability for mutually exclusive events, calculate expected frequency 	<p>Teacher modelling:</p> <p>Theoretical probability is calculated without doing an experiment, e.g., tossing a fair coin. The probability of tails is $\frac{1}{2}$ or 0.5 or 50%.</p> <p>Probability of getting a six when a dice is cast is $\frac{1}{6}$.</p> <p>Experimental probability is probability obtained by actually carrying out an experiment and involves a repetition of a large number of trials.</p>	<ul style="list-style-type: none"> Dice Matchboxes Coins 	<p>Students answer standard questions.</p> <p>Probing questions</p> <ul style="list-style-type: none"> A match box is to be used as a die. The two largest faces are each marked with 1 and with 6. The next two largest faces are marked with 2 and with 5 and the two smallest faces are each marked with 3 and with 4. <ul style="list-style-type: none"> What two faces will have the largest probability of facing up when the matchbox is thrown as a die? Explain why. -Explain how you would estimate the Probability of obtaining a '3' when the matchbox is thrown as a die. Design an experiment you will carry out to estimate the probability that the first car that goes past the school entrance after 8a.m. is a green car.
<ul style="list-style-type: none"> Set Theory 	<p>Students will be able to:</p> <ul style="list-style-type: none"> know what is a set know the types of sets know the language and notations of set. 	<p>Teacher modelling</p> <p>Introduce the topic of set.</p>	<p>Teacher Handbook</p>	<p>Answer standard questions on set theory from examination board past papers.</p>



	<ul style="list-style-type: none"> ➤ interpret, draw, and use Venn diagrams to solve problems. 	<p>Talk about language and notations of set e.g. members, cardinality, intersection, union, compliments.</p> <p>Talk about types e.g. universal, unit set, null set, sub set etc.</p> <p>Interpret and draw Venn diagrams.</p>		
<ul style="list-style-type: none"> • Representation of Data: <ul style="list-style-type: none"> ○ Pictogram, ○ Bar charts, ○ Pie charts 	<p>Students will be able to:</p> <ul style="list-style-type: none"> ➤ use appropriate methods of tabulation to enable the construct of statistical diagrams. ➤ interpret statistical diagrams ➤ recognise, construct and interpret pictograms, bar charts, [vertical, horizontal and composite] and pie chart. ➤ Use ICT [spreadsheets] to design charts. 	<p>Display various charts as seen in real life situations e.g., newspapers [Awoko business], adverts, magazines, websites.</p> <p>Get students to identify charts and discuss amongst themselves before asking them to share with the whole class their understanding of the charts and what information they can draw.</p>	<ul style="list-style-type: none"> • Newspapers, reports, advertisement, magazines. • Compasses and rulers • Secondary data 	<p>Students are given secondary data and asked to construct appropriate charts.</p> <p>Probing questions</p> <ul style="list-style-type: none"> • How did you decide on how to organize your table of results? • What made your chart easy or difficult to construct? • Which chart[s] is mainly used to represent categorical data?
<ul style="list-style-type: none"> • Grouping data 	<p>Students will be able to:</p> <ul style="list-style-type: none"> ➤ Construct grouped frequency table with equal class intervals and identify the modal class interval from grouped frequency table. ➤ Construct and interpret frequency diagram from group discrete data. ➤ Construct and interpret Histograms from grouped continuous data 	<p>Display the various charts as seen from real life examples from newspapers, adverts, text-books and Magazines.</p> <p>Give pupils opportunities to talk about charts/ diagrams/ graphs and their understanding of the charts.</p> <p>Model the construction of each chart.</p>	<ul style="list-style-type: none"> • Graph paper • Plain paper • Newspapers • Magazines • Coloured pencils 	<p>Pupils answer standard questions on constructing tables and drawing frequency diagrams, histograms, frequency Polygons.</p> <p>Probing questions:</p> <ul style="list-style-type: none"> • What difference[s] can you see between a frequency diagram and a histogram? • If you were to collect data to draw a histogram, what type of data



	<ul style="list-style-type: none"> ➤ Construct frequency polygons. 	<p>Ensure pupils understand scaling of axis.</p> <p>Pupils construct their own diagrams.</p> <p>Pupils' work put on display.</p>		<p>would you collect? Give examples of such data.</p> <ul style="list-style-type: none"> ● What is important when choosing the scale of your graphs.
<ul style="list-style-type: none"> ● Statistical Measures <ul style="list-style-type: none"> ○ Estimate Mean from group data 	<p>Students will be able to:</p> <ul style="list-style-type: none"> ➤ calculate an estimate of the mean from grouped data. ➤ identify the modal class interval and the class interval where the median of the data lies. 	<p>Review prior knowledge from SSS1 on mean, median, mode and range from a list. Also review mean from frequency table.</p> <p>Review tallying of data for frequency table.</p> <p>Use of the inequality sign when grouping data.</p> <p>Teacher models how to estimate mean for grouped data, and shows how this is almost similar to calculating mean from a frequency table.</p> <p>The concept of 'mid-point' should be carefully modelled and 'teased-out' from students by questioning and finally concluding that the mid-point is merely representing all the numbers within a class interval. Hence the mean becomes only an estimate.</p>		<p>Students answer standard questions.</p> <p>Probing questions</p> <ul style="list-style-type: none"> ● Why is it only possible to estimate the mean from grouped data? ● Why is the Mid-Point of the class interval used to calculate an estimated mean? ● Why not the end of the class interval? ● Write an essay on the steps you will take to estimate the mean from grouped data. ● How could you possibly use a grouped frequency table to estimate the range and the median.



		<p>Explain to students that by grouping the data, we have lost the frequency of the individual members of the class interval. We only have the total frequency of the class interval.</p> <p>Teacher Models how to identify the Modal class interval and the interval where the Median lies.</p>		
<ul style="list-style-type: none"> • Tabulation and Representation <ul style="list-style-type: none"> ○ Cumulative Frequency graphs 	<p>Students will be able to:</p> <ul style="list-style-type: none"> ➤ complete a cumulative frequency table and draw a cumulative frequency curve. ➤ use the cumulative frequency curve to estimate median, quartiles, interquartile range, and semi-interquartile range. 	<p>Teacher models completion of cumulative frequency table and drawing of cumulative frequency curve.</p>	<ul style="list-style-type: none"> • Graph Papers • Teacher Handbook 	<p>Students to answer standard questions on cumulative frequency.</p>
<ul style="list-style-type: none"> • Graphs of Linear and Quadratic functions. 	<p>Students will be able to:</p> <ul style="list-style-type: none"> ➤ fill table of values, plot co-ordinates and draw graphs of linear and quadratic functions. ➤ gradient of linear graphs ➤ obtain roots of quadratic functions from graph. ➤ determine the gradient at a point on the curve by drawing Tangents. 	<p>Teacher modelling</p> <p>Completing tables and plotting graphs</p>	<ul style="list-style-type: none"> • Teacher Handbook • Graph paper • Autograph software 	<ul style="list-style-type: none"> • Students answer standard questions on quadratic graphs including questions from past examination board papers. <p>Probing questions</p> <ul style="list-style-type: none"> • By inspecting a quadratic function, how can you tell it has got a maximum or minimum turning point? • How would you compare the gradient of a straight line and the gradient of a curve?



<ul style="list-style-type: none"> Linear inequalities. 	<p>Students will be able to:</p> <ul style="list-style-type: none"> understand what 'inequality' is and the signs associated with it. solve problems on linear inequalities and represent on a Number Line. 	<p>Teacher modelling</p> <p>Explain to students that the techniques used in solving equations is the same used in solving inequalities.</p> <p>Model solving an equation like $3x+2=10$ alongside and Inequality like $3x+2 > 10$.</p> <p>Model representation on a Number Line.</p>	<ul style="list-style-type: none"> Teacher Handbook Graph paper 	<p>Students to answer standard questions on linear inequality and linear programming.</p> <p>Probing questions</p> <ul style="list-style-type: none"> How did you find the solution set for this Inequality? What are the important conventions when representing the solution set on a Number Line? Why does the inequality sign change when you multiply or divide the inequality by a negative number?
<ul style="list-style-type: none"> Relations Mapping <ul style="list-style-type: none"> Functions and Function notations 	<p>Students will be able to:</p> <ul style="list-style-type: none"> distinguish between the various types of relations use function notation to describe simple functions [Mappings] find the range of a function for a given domain. 	<p>Teacher modelling and explanations.</p> <p>Discuss relations and explain the relations.</p> <ul style="list-style-type: none"> Many-to-many One-to-many Many-to-one One-to-one <p>Relate functions to a number machine with Input and Output.</p> <p>Input → multiply by 2 → add 5 → output</p>	<p>Teacher Handbook</p>	<p>Students to answer standard questions on functions</p>



		<p>For any input the instruction is to multiply that input by 2 first and then add 5.</p> <p>If the Input is x, then the output is $2x+5$. This number machine is an example of a function, which is a process that takes one number and turns it into [maps into] another number.</p> <p>We say x is mapped to $2x+5$.</p> <p>Functions are often given names such as f, g, h, and so on. The rule for the above function is written as: $F(x)=2x+5$ or $F:x \rightarrow 2x+5$ using arrows instead.</p> <p>Explain Domain and Co-domain</p>		
<ul style="list-style-type: none"> Sequence and Series 	<p>Students will be able to:</p> <ul style="list-style-type: none"> distinguish between a sequence and a series and be familiar with the language and symbols of sequences. be familiar with the sequence of odd number, even numbers, square numbers, cube numbers, triangular numbers, prime numbers, and continue a sequence with more terms. 	<p>Teacher modelling</p> <p>Explain sequence</p> <p>Explain series</p> <p>Explain the terminologies e.g., terms, difference, last term, number of terms, sum of term, first term, common ratio, sum of terms and their respective symbols.</p>	<ul style="list-style-type: none"> Teacher Handbook Multilink cubes Matchsticks Counters Matchboxes 	<p>Students answer standard Question on A.P and G.P including those from past exam board question papers.</p> <p>Probing questions</p> <ul style="list-style-type: none"> Can you find a quick way of adding up the numbers from 1 to 10 to give 55? [without calculator] What about adding up the numbers from 1 to 20?





	<ul style="list-style-type: none"> ➤ recognise an Arithmetic Program and find its general term and sum of terms. ➤ recognise a geometric progression and find its general term and sum of terms. 	<p>Explain how to use the common difference [d] and first term [a] in an arithmetic sequence. Eg given 2nd term is 7 and 5th term is 19, find a and d.</p> <p>Model the use of nth term = $a+(n-1)d$</p> <p>Model the use of sum of terms = $\frac{N}{2}(a+L)$ where L is the last term. = $\frac{N}{2}(2a+(N-1)d)$</p> <p>Model use of general term and sum of G.P</p> <p>Get pupils in groups and ask them to produce their own sequences from everyday objects. E.g., matchsticks, multilink cubes, matchboxes, counters, and present a formula for the general term of their sequence.</p>		<ul style="list-style-type: none"> • What about adding the numbers from 1 to 100? • What do you look for to decide whether a sequence is Linear or Quadratic?
<p>Shape, Space, Measure</p> <ul style="list-style-type: none"> • Angles, Line and Triangles 	<p>Students will be able to:</p> <ul style="list-style-type: none"> ➤ distinguish between acute obtuse reflex ➤ draw and measure angles and right angles. ➤ use angles related to intersecting lines and parallel lines. 	<p>Teacher modelling</p> <ul style="list-style-type: none"> ○ -Angles around a point ○ -Vertically opposite angles ○ -Alternate angles ○ -Corresponding angles ○ -Interior [allied] angles 	<ul style="list-style-type: none"> • Teacher Handbook • Protractors 	<p>Students answer standard questions on angles and parallel lines.</p> <p>Students to draw their angles and measure using protractor</p> <p>Ask students to also draw given angles.</p>



	<ul style="list-style-type: none"> ➤ understand the exterior angle of a triangle property and the sum angle of a triangle property. ➤ understand the terms 'isosceles', equilateral, 'scalene' and right-angled triangles' and their related properties. 	<p>Teacher to identify local resources as examples of the different triangles.</p> <p>Students to physically draw several angles and measure using protractor.</p>																						
<ul style="list-style-type: none"> • Polygons and Congruency 	<p>Students will be able to:</p> <ul style="list-style-type: none"> ➤ recognise and give the names of polygons. ➤ know angle sum of a quadrilateral, name all quadrilaterals and state their properties. ➤ know what a regular polygon is and calculate the interior and exterior angles of regular polygons. ➤ derive the sum of angles of a polygon, of n sides as $(N-2)180$. ➤ use formula exterior angle = $360 / \text{No of sides}$ ➤ know the meaning of congruent shapes 	<p>Teacher modelling</p> <p>When modelling sum of angles of a polygon, use an investigative approach. Students draw out triangles in quadrilaterals, pentagon, hexagon etc and fill a table similar to the one below</p> <table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th>No of sides</th> <th>Name</th> <th>Triangles</th> <th>Sum of angles</th> </tr> </thead> <tbody> <tr> <td>3</td> <td>Triangle</td> <td>1</td> <td>180</td> </tr> <tr> <td>4</td> <td>Quadrilateral</td> <td>2</td> <td>2 x 180</td> </tr> <tr> <td>5</td> <td>Pentagon</td> <td>3</td> <td>3 x 180</td> </tr> <tr> <td>6</td> <td>Hexagon</td> <td>6</td> <td>?</td> </tr> </tbody> </table> <p>Students to look for connection between the number of sides and the possible number of triangles in the shape and if 1 triangle has 180° then for any number of triangles, find the sum by multiplying by 180°</p>	No of sides	Name	Triangles	Sum of angles	3	Triangle	1	180	4	Quadrilateral	2	2 x 180	5	Pentagon	3	3 x 180	6	Hexagon	6	?	Teacher Handbook	
No of sides	Name	Triangles	Sum of angles																					
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4	Quadrilateral	2	2 x 180																					
5	Pentagon	3	3 x 180																					
6	Hexagon	6	?																					





<ul style="list-style-type: none"> • Lines of symmetry and rotational symmetry 	<p>Students will be able to:</p> <ul style="list-style-type: none"> ➤ Identify lines of symmetry and the order of rotational symmetry of a 2D figure 	<p>Teacher modelling:</p> <p>Rotational symmetry is when a shape can rotate and fits into itself as it is rotated.</p> <p>The number of times it will fit into itself before reaching its original position is called the order.</p>	<ul style="list-style-type: none"> • Car wheel covers • Car 'badges' 	<p>Students to answer standard questions</p>
<ul style="list-style-type: none"> • Construction 	<p>Students will be able to:</p> <ul style="list-style-type: none"> ➤ Construct: <ul style="list-style-type: none"> ○ angles bisectors and bisectors of line segment. ○ a perpendicular from a point to a line. ○ a perpendicular from a point on a line. ○ a line parallel to another line. ○ angles 90°, 60°, 45° and 30° ○ triangles and quadrilateral with enough information. 	<p>Teacher modelling</p> <p>Model the whole of construction to include angles 75°, 105°, and 135°</p>	<ul style="list-style-type: none"> • Teacher Handbook • Compasses and rulers. 	<p>Students to answer standard questions on construction including from past exam board papers.</p> <p>Probing questions</p> <ul style="list-style-type: none"> • How does knowledge of properties of a rhombus help with simple constructions like bisecting an angle? • For which constructions is it important to keep the same compass arc? Why? • The following are given as lengths of triangles which ones can never be triangles? Explain: [i] 5cm, 6cm, 8cm [ii] 8cm, 4cm, 13cm [iii] 9cm, 6cm, 15cm [iv] 7cm, 4cm, 5cm [v] 12cm, 8cm, 3cm
<ul style="list-style-type: none"> • Loci 	<p>Students will be able to:</p> <ul style="list-style-type: none"> ➤ understand the concept of loci 	<p>Teacher modelling</p>	<ul style="list-style-type: none"> • Compass • Pencils 	<p>Students to answer standard questions on loci</p>



	<ul style="list-style-type: none"> ➤ apply loci to real life situations. ➤ construct loci of: <ul style="list-style-type: none"> ○ points at a given distance from a given point [a circle] ○ Points equidistant from 2 given points [bisector of a line] ○ points equidistant from 2 given lines angle bisector] ○ points at a given distance from a given line [line parallel to another line] 	<p>Make connection between loci and construction.</p> <p>Example: A perpendicular bisector of a line AB is the loci of points equivalent from A and B</p>		
<ul style="list-style-type: none"> • Circles 	<p>Students will be able to:</p> <ul style="list-style-type: none"> ➤ recognise and know parts of a circle. E.g., centre, radius, diameter, circumference, tangent, arc, sector, segment, chord segment, ➤ calculate area and circumference of a circle, including compound shapes and semi circles. ➤ investigate the relationship between the circumference and diameter for various circles and obtain a value for 'pi'. 	<p>Teacher modelling</p> <p>Calculating area and circumference of circles, including compound shapes.</p> <p>Investigative approach to obtain value for Pi.</p> <p>Get students to measure the circumference and diameter of various round object or circles of different sizes and record results in table.</p> <p>Students to divide the circumference by the diameter. What conclusions can they draw?</p>	<ul style="list-style-type: none"> • Teacher Handbook • Various round objects, circles. • Measuring instruments e.g., calipers, ruler, tape measures • Strings, thread 	<p>Students answer standard questions on circles.</p> <p>Probing questions</p> <ul style="list-style-type: none"> • State one similarity and difference between a chord and a diameter.



<ul style="list-style-type: none"> • Mensuration of 2D objects 	<p>Students will be able to:</p> <ul style="list-style-type: none"> ➤ convert measurements within the metric system including Linear and area units. ➤ find area and triangles and rectangles including compound shapes. ➤ find area of parallelograms and trapezia. ➤ distinguish between Metric and Imperial units 	<p>This value is an estimate of the constant Pi.</p> <p>Teacher modelling</p> <p>Converting cm^2 to m^2 and vice versa.</p> <p>Opportunities for practical activities to be exploited. Example: students expected to measure and calculate areas and perimeter of accessible areas in the school environment eg doors, tables, surfaces, school playground.</p> <p>Identification of shapes from the local environment. E.g., paper currencies are rectangles.</p> <p>Clarify the misconception of base and height of a triangle by explanation and diagrams.</p>	<ul style="list-style-type: none"> • Teacher Handbook • Measuring Instruments • Trundle wheel • Measuring tapes 	<p>Students answer standard questions.</p> <p>Discussing with students during practical activities.</p> <p>Probing questions</p> <ul style="list-style-type: none"> • Yeabu said there can only be one triangle with an area of 12cm^2. Tommy disagrees. Explain why Tommy is right. • 'The base and height of a triangle are always at 900 to each other'. Is this statement always, sometimes, or never true? • 'If a rectangle has a larger perimeter than another one, then it will also have a larger area'. Is this statement always, sometimes, or never true?
<ul style="list-style-type: none"> • Pythagoras' Theorem • Trigonometry in right angle triangles 	<p>Students will be able to:</p> <ul style="list-style-type: none"> ➤ calculate in right angled triangles using Pythagoras ➤ use the trigonometric ratios to calculate lengths and angles in right angle triangles. 	<p>Teacher modelling</p> <p>Recap Pythagoras theorem.</p> <p>Do initial work on labelling of sides of right angle triangles with given angle.</p> <p>Students must be able to identify opposite, adjacent and hypotenuse before moving on to main task.</p>	<ul style="list-style-type: none"> • Teacher Handbook 	<p>Standard questions on Pythagoras and trigonometry.</p> <p>Probing questions</p> <ul style="list-style-type: none"> • How do you decide whether a problem requires use of a trigonometric relationship [sine, cosine or tangent] or Pythagoras theorem to solve it?



				<ul style="list-style-type: none"> • Why is it important to understand similar triangles when using trigonometric relationships? • ABCD is a square and X is a midpoint on AB. Calculate angle AXD
<ul style="list-style-type: none"> • Angles of elevation/ depression 	<p>Students will be able to:</p> <ul style="list-style-type: none"> ➤ calculate angles of elevation and depression and other related heights and distances. 	<p>Teacher modelling</p> <p>A practical approach is recommended for this lesson.</p> <p>Students can work outdoors using clinometers or improvised clinometers using protractors and paper tubes.</p>	<ul style="list-style-type: none"> • Clinometer • Improvised Clinometers 	<p>Students to answer standard questions on angles of elevation and depression.</p>
<ul style="list-style-type: none"> • 3D shapes and Volumes 	<p>Students will be able to:</p> <ul style="list-style-type: none"> ➤ recognise and name 3D solids ➤ understand the terms 'face' 'edge' and 'vertex' in the context of 3D solids. ➤ distinguish between Prism and non-Prisms [i.e. Prisms have a uniform cross-sectional area all along its length] ➤ find the volume of Prisms and non-Prisms like Cone, Pyramid and compound shapes. ➤ understand what total surface area is and calculate 	<p>Teacher modelling</p> <p>3D shapes to be displayed to include cube, cuboid. Prisms, pyramid, cylinder, sphere, hemisphere, cone,</p>	<ul style="list-style-type: none"> • Teacher Handbook • 3D sets of models including solids collected from the local environment. 	<p>Standard questions on 3D shapes and volumes.</p>





	<p>total surface area of 3D shapes,</p> <ul style="list-style-type: none"> ➤ convert between units of volume within the metric system i.e. cm^3 to m^3 and vice versa. $1 \text{ Litre} = 1000\text{cm}^3$ 			
<ul style="list-style-type: none"> • Transformation <ul style="list-style-type: none"> ○ Reflection ○ Rotation ○ Translation ○ Enlargement 	<p>Students will be able to:</p> <ul style="list-style-type: none"> ➤ reflect 2D shapes on graph paper given the equation of the line of reflection. ➤ rotate a shape on graph paper giving the centre of rotation and the angle and direction of rotation. ➤ translate a shape on graph paper given the Vector Translation. ➤ enlarge a shape given the centre of rotation and the scale factor. ➤ students to be able to describe transformation. 	<p>Teacher Modelling</p> <p>Model reflection along the x-axis, the y-axis, $x=2$ axis, and $y= x$ axis etc. Point out to students that the image and object will have the same distance from the line of reflection.</p> <p>Mirrors could be used to support understanding. When reflecting along a diagonal line [$y=x$ or $y=-x$], point out that you count the number of steps needed to get to the line from any point using the scale on the y-axis and when you reach the line you bend away from the line and count the same number of steps from the line to locate your point. Each point is done one at a time.</p> <p>When modelling notation explain what clockwise rotation is and use tracing paper to rotate the shape accordingly around the centre of rotation.</p>	<ul style="list-style-type: none"> • Teacher Handbook • Graph Paper • Mirrors 	<p>Standard questions on transformation</p> <p>Probing questions</p> <ul style="list-style-type: none"> • When describing a reflection what are the key elements that must be specified? • When describing a rotation what are the key elements that must be specified? • When describing a translation, what key elements must be specified? • When describing enlargement, what key elements must be specified? • A reflection in one axis followed by a reflection in the other axis is the same as a rotation. Decide whether this statement is sometimes, always, or never true. • When a shape is enlarged with a scale factor 3, what happens to its area?



		<p>When modelling transformation explain the column vector Notation. $[\begin{smallmatrix} x \\ y \end{smallmatrix}]$ e.g., when asked to translate a shape by vectors $[\begin{smallmatrix} 3 \\ 2 \end{smallmatrix}]$ It means move the shape 3 steps to the right along the x-axis and then 2 steps upwards along the y-axis.</p> <p>Similarly, a translation by Vector $[\begin{smallmatrix} -3 \\ -2 \end{smallmatrix}]$ means move the shape 3 steps to the left along the x-axis and then two steps downwards along the y-axis. Tracing paper can also be used to trace the shape and moved according to the required vector translation.</p> <p>When modelling enlargement make sure the centre of enlargement and the scale factor are included. The distance from the centre to each point on the shape is multiplied by the scale factor.</p>		
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Composite List of Suggested Resources for Mathematics in other Disciplines SSS Syllabus

- Measuring tapes
- Metre sticks
- Trundle wheels to measure long distances
- Masses (1kg, 2kg etc)
- Stop watches
- Vanguard
- Permanent markers (different colours)
- Classroom displays
- Class sets of rulers, protractors, compasses and pencils
- Glue sticks
- Sets of geometrical models (3-D shapes)
- Blue tac (to support classroom displays/ charts)
- Board rulers, protractors and compasses.
- Interactive whiteboards
- Playing cards
- Spinners (for probability)
- Tape measures
- Metre rule
- Height measures
- Weights
- Callipers
- 2D shape sets
- Assorted coloured dice
- Vanguard coloured cards
- Scale
- 3D translucent shapes
- Strings and threads
- Multilink cubes
- Centimetre squared paper
- Dotted isometric paper
- Tracing paper
- Clinometer [improvised clinometers]
- Graph paper
- Autograph software
- Matchsticks
- Counters
- Matchboxes
- Newspapers/ magazines/ leaflets
- Mathematical instruments [compasses, protractors, rulers etc]
- Car wheel covers