



MINISTRY
OF
EDUCATION, YOUTH & INFORMATION
Every Child Can Learn, Every Child Must Learn

NATIONAL STANDARDS CURRICULUM

MATHEMATICS

GRADES 7-9 APSE1



NATIONAL STANDARDS CURRICULUM GUIDE

GRADES 7-9

MATHEMATICS

A C K N O W L E D G E M E N T

Our connection with each other is unquestionable and so at the end of this arduous yet rewarding journey, the Ministry of Education, Youth and Information gratefully acknowledges the contributions of the following individuals and institutions who generously gave of their time and resources in the planning and development of the National Standards Curriculum (NSC):

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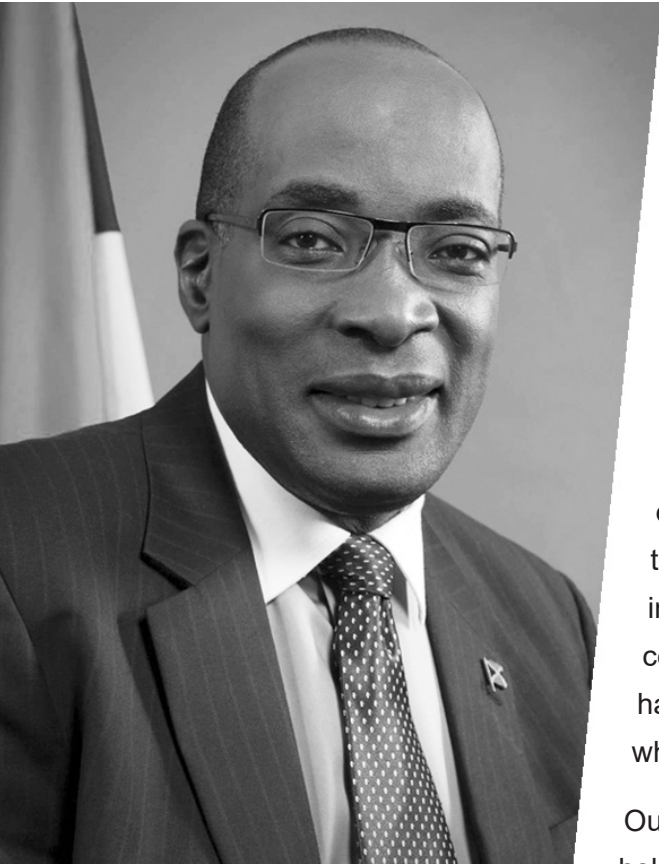
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Education has always been pivotal to societal and economic development. It is for this reason that Jamaica remains unshaken and hopeful of a realized vision to be “the place of choice to live, work, raise families and do business.” The assurance of the possibility of all that such a vision entails comes from the recognition that Jamaica is endowed with tremendous God-given talent and creative potential and as a people of strong faith in spiritual principles and resilience; we are able to harness our capabilities, to make significant influence on the world. It is through this new National Standards Curriculum (NSC) that we hope to propel this vision of the education system whilst becoming more relevant, current and dynamic.

The team at the Ministry of Education, Youth and Information is cognizant of the fact that the curriculum is the heart and mind of education and remains the most powerful means by which any country can develop and be sustainable. It is for this reason that the NSC has been designed with the understanding that people, learning and national development are at the core of our existence in a time of rapid change in the physical, social, economic and other dimensions of the global landscape. As a consequence, we celebrate the wisdom of the developers who through the engagement of numerous stakeholder groups, have responded favourably to the need for that kind of education that prepares our young people for life; while challenging our more mature to join in this lifelong journey of learning to learn.

Our commitment to the development of each learner and our support and appreciation of the various stakeholder groups that are partnering with us in providing quality education, remain at the forefront of our efforts in ensuring that this journey transforms education. This commitment is conveyed through our adoption of a Pathway Approach to learning that demands of us to provide customized programmes, differentiated learning experiences and specialized support for our learners. Our actions have been fruitful as is evident by the systems and conditions we have put in place for successful implementation.

Like the rest of Jamaica, I look forward to the testimonials of students, parents, teachers and other stakeholders of the empowering effect of this learner- centred curriculum and remain confident that it will contribute to make Jamaica renown.

The Honourable, Senator Ruel Reid, CD

Minister of Education, Youth & Information



Building a modern society where young people can prosper and achieve their aspirations is paramount on the Ministry of Education, Youth and Information's (MoEYI) agenda. In its bid to advance this agenda the team at the MoEYI has developed the National Standards Curriculum (NSC) on a clear set of values that will permeate learning and become embedded in young people's approach to life. Young people need to be clear about their Jamaican identity. Justice, democracy, tolerance and respect need to be more than mere words; they need to become an essential part of people's lives. Young people's understanding of, and commitment to, sustainable development is critical to the future of Jamaica and of the world. These values that permeate the new curriculum and more importantly, will by its use, be ingrained in the fabric of the Jamaican society.

The development of a new curriculum is a major achievement in the life of any country. It is even more noteworthy because this curriculum embodies the set of knowledge, skills, values and attitudes that our country deems relevant at this particular time. It is intended that these attributes be conveyed to the next generation as a means of cultural continuity in preparation to cope with the future, both nationally and individually.

I am particularly excited about the prospects of the NSC honing key twenty-first century skills such as communication, collaboration, critical thinking and creativity in our youth as they prepare to take on their roles as global citizens. I encourage parents, students, teachers and indeed the community to partner with us as we prepare our young people not just for today, but for the rapidly changing times ahead.

The Honourable, Floyd Green, MP

State Minister in the Ministry of Education, Youth & Information



In responding to the challenges confronting education in Jamaica, The Ministry of Education, Youth and Information has taken strategic measures to address the need for a national curriculum that is relevant for the 21st century, the dynamics of the Jamaican context and the profile of the learners at the pre-primary, primary and secondary levels. One major output of these strategic actions is the National Standards Curriculum. This curriculum is intended to be one of the means by which the Jamaican child is able to gain access to the kind of education that is based on developmentally-appropriate practice and the supporting systems and conditions that are associated with high quality education.

This curriculum has the potential to inspire and provide challenges in the form of problem situations that all our learners can handle in ways that are developmentally appropriate. It compels us to move beyond the traditional functional perspectives of being literate to a focus on the physical and physiological as well as the ethical, social and spiritual.

I invite all our stakeholders to fully embrace this new curriculum which promises to excite imaginations, raise aspirations and widen horizons. Learners will become critical and creative thinkers with the mindset required for them to be confident and productive Jamaicans who are able to thrive in global settings as they take their place in the world of uninhibited change.

Mr. Dean Roy Bernard

Permanent Secretary, Ministry of Education, Youth & Information



It was the mandate of the Curriculum Units of the Ministry of Education, Youth and Information (MoEYI) to spearhead the crafting of a new curriculum for the nation, in keeping with international standards, global trends in the educational landscape and societal goals and aspirations. The mandate had several facets: to establish clear standards for each grade, thereby establishing a smooth line of progression between Grades 1 and 9; to reduce the scope, complexity and amount of content; to build in generic competencies such as critical thinking across the subjects; to ensure that the curriculum is rooted in Jamaica's heritage and culture; to make the primary curriculum more relevant and more focused on skills development, and to ensure articulation between primary and secondary curricula, especially between Grades 6 and 7. To achieve this, the MoEYI embarked on an extensive process of panel evaluations of the existing curricula, consultation with stakeholders, (re)writing where necessary and external reviews of the end products.

Today, we are indeed proud that, the curriculum development teams have succeeded in crafting a curriculum which has met these expectations. Under the National Standards Curriculum (NSC) focus will be given to project-based and problem-solving learning, with an integration of Science, Technology, Engineering and Mathematics/Science, Technology, Engineering, Arts and Mathematics (STEM/STEAM) methodologies across the system. Learners will benefit from more hands-on experiences which should enhance the overall learning experience and cater to the different kinds of learners in our classroom. In addition, they will be exposed to work-based learning opportunities that will help them become productive citizens of Jamaica and the world at large.

It is anticipated that as school administrators and teachers system-wide implement the National Standards Curriculum that improvements will be evident in the general academic performance, attitude and behaviour of our students.

We anticipate the participation of all our stakeholders in this process as we work together to improve the quality of life and prospects for all the children of Jamaica and to realize our mantra that *every child can learn, every child must, learn.*

Dr. Grace McLean

Chief Education Officer, Ministry of Education, Youth & Information



The Ministry of Education, Youth and Information (MoEYI) is committed to providing high quality education to all Jamaican children. We have heard the cries from the various sectors of the Jamaican society about the level of preparedness/readiness of our students for life in the 21st century; and we are taking the necessary steps to ensure that our students graduate with marketable skills. The MoEYI has reviewed and redesigned the Grades 1-9 curricula around the principles of Vision 2030 Goal number one; “Jamaicans are empowered to achieve their fullest potential”.

The National Standards Curriculum (NSC) will lay the foundation for students by preparing them for working lives that may span a range of occupations, many of which do not currently exist. This has been done by way of designers carefully integrating the theoretical principles of Science, Technology, Engineering and Mathematics/Science, Technology, Engineering, Arts and Mathematics (STEM/STEAM) methodologies into the curricula at all grade levels. The NSC illustrates that in order to make education effective for our 21st century children; we need to change how we teach, and what we teach.

We are satisfied that the curriculum designers and writers have produced a curriculum that is indeed fitting for the 21st century. The NSC was designed to develop students’ understandings of subject matter and their ability to apply what is learnt; it fosters their ability to communicate and solve problems collaboratively, think critically and create novel solutions.

The success of our children is dependent on the participation of all stakeholders in the learning process. We encourage you all to be our committed partners in education as the true impact of this curriculum will only be

felt when we have all hands on board. I am indeed proud to be associated with the development and implementation of this curriculum. It will inspire hope in our nation and future generations; kudos to the various teams that contributed to its development.

Mrs. Lena Buckle Scott

Deputy Chief Education Officer,

Curriculum and Support Services, Ministry of Education, Youth & Information



The National Standards Curriculum (NSC) rests on the belief that all learners are endowed with the capabilities, gifts and talents to fulfil their divine purpose. These attributes are to be further enhanced or improved in a nurturing, inspiring and inclusive environment; one that caters to the whole person (soul, spirit and body - spiritual, emotional, social, physical and mental). As learners assume their roles and responsibilities individually and as communities of learning in such an environment, they become critical-reflexive thinkers, creative problem solvers, effective communicators and natural collaborators.

A curriculum design of this nature, calls for transformative change at the societal level (Elkind, 2004)¹ and not just at the school and classroom levels. This is a call for all stakeholders, as users of the curriculum, to adopt a critical-reflective and reflexive stance and join learners in the quest for meaning, purpose and stability as they help to shape the world. By integrating principles from various disciplines and their related methodologies, learners who interact with the curriculum are provided with enriching experiences, opportunities for creative expressions and authentic exploration of problems from a classical standpoint as well as in the context of workplace learning. This is due to the fact that the NSC recognizes the importance of each discipline in the problem solving process and in development.

Assessment as an element of the curriculum becomes primarily a learning process for charting progress through self-corrective measures that are informed by feedback from peers and teacher-facilitator. By providing assessment criteria statements in the curriculum, teachers are encouraged to facilitate learners functioning as self and peer assessors. This approach should see the learner developing self-direction with

the support of mentors and coaches and forming an intrinsic desire to succeed. These attributes prepare them to face high stakes assessment as problems to be confronted with courage, a sense of readiness, insight and creative prowess.

These features of the NSC have the potential to influence learners' profile as Jamaicans who are gratified by an identity of cultural excellence that embodies moral obligations, intellectual rigour, innovativeness, environmental stewardship and productivity. The curriculum echoes the sentiments of our National Anthem, National Song and Pledge and serves as rich and credible source of the values and virtues that are woven together to convey the Jamaican identity. I wish for our school administrators, teachers, students and other stakeholders much success as they work with the document.

Dr Clover Hamilton Flowers

Assistant Chief Education Officer, Core Curriculum Unit, Ministry of Education, Youth & Information

¹ Elkind, D. (2004). The problem with constructivism. *The Educational Forum*, 68(4), 306–12.

TERMS	DEFINITIONS/MEANINGS
Range of Content	Provides an overview of the concepts, knowledge, skills and attitudes that will be developed in a unit of study.
About the Unit	Gives a brief overview of the content, skills that are covered in the unit and the methodologies that are used. As well as the attitudes to be developed.
Standards	Statements that explain what all students are expected to know and be able to do in different content areas by the end of a course of study e.g. by the end of period spanning grades 4 – 9.
Attainment Targets	An attainment target is a desired or expected level of performance at the end of a course of work, within a given/specified teaching-learning period. Attainment targets identify the knowledge, skills and understanding which students of different abilities and maturities are expected to have by the end of each Grade. It is the standard that we expect the majority of children to achieve by the end of the grade.
Benchmarks	Behaviours students are expected to exhibit at different stages of development and age/grade levels.
Theme/Strands	Unifying idea that recurs throughout a course of study and around which content, concepts and skills are developed.
Prior Learning	It is what students are expected to already know through learning and experience about a topic or a kind of text.
Specific Objectives	Specific objectives state what the student is expected to know or understand as a result of the learning experience. The specific objective is usually framed in the areas of the knowledge, skills and attitudes that the students are expected to achieve. Specific objectives tell us what the children will learn or will be taught.

TERMS	DEFINITIONS/MEANINGS
Suggested Teaching/Learning Activities	A teaching/learning activity is an organised way of doing things towards achieving the stated objectives. They are suggested activities that are crafted in a way to be an efficient vehicle which can move the student between what is to be learnt (objective) and what the student is to become (outcome).
Key Skills	Gives a brief overview of the content, skills that are covered in the unit and the methodologies that are used as well as the attitudes to be developed.
Assessment	<p>An assessment is a determination of whether intended results have been achieved. This section of the curriculum speaks to both the product that will be judged as well as the criteria against which it will be judged. It must be noted that this section does not introduce new activities. Instead, it speaks to the judging of the suggested teaching and learning activities.</p> <p>Formal assessment may be conducted with the aid of instruments (e.g. via written test, portfolio) or by requiring students to complete assigned tasks (e.g. performance), and is usually recorded against a predetermined scale of grading. Informal assessment (e.g. via observation or spontaneous student expression) may also reveal important evidence of learning.</p>
Points to Note	This section provides technical information that must be considered in delivering the unit. It may also include information that provides additional explanation of key concepts that may be unfamiliar to the teacher as well as suggestions for infusion within the unit.
Extended Learning	Additional opportunities for students to utilise the knowledge and skills they would have acquired in the unit in authentic situations/experiences.
Learning Outcomes	A learning outcome is a demonstration/ behavioural evidence that an intended result has been achieved at the end of a course of study. The learning outcome tells us if pupils have understood and grasped what they have been learning.
Links to other Subjects	Suggests opportunities for integration and transfer of learning across and within different subject areas.
Key Vocabulary	This section consists of a number of words/phrases that addresses the skills, topics and content that must be covered in the unit.

- Internet access has so changed the information landscape, and technological developments have so revolutionized the means available to either create or solve problems, that mathematical literacy is today as important as the ability to read text. All students must possess understanding of basic computation, statistics and geometry in order to make an informed response to the global environment of the twenty first century in which they live.
- Mathematics contributes to the process of inquiry as a means of solving problems. It provides the opportunity for learners to be creative and inventive and in doing so, empowers them to construct their own mathematical knowledge to make sense of the physical, social, technological aspects of their environment.
- The Mathematics Curriculum serves as a real life context for learners and teachers to engage in meaningful activities that are relevant to life, including their languages, cultures and everyday experiences beyond the walls of school. The Mathematics Curriculum from Grades 1-9 challenges and inspires learners to:
 - a) Use mathematical concepts and processes to interpret the world
 - b) Make connection between their previous mathematical knowledge to new situations
 - c) Communicate mathematical ideas and processes that have helped them to understand their experiences and refine their problem solving skills
 - d) Explore in a variety of ways, the application of mathematics to problems in their everyday life
 - e) Reflect on their experiences and decisions and make adjustments to their prior conceptions or meanings of situations
 - f) Develop attitudes such as perseverance, honesty and courage as they manipulate mathematical concepts and skills and engage in critical reflective thought

TERM 1**Unit 1****Numbers**

Real numbers
Indices
Bases

Unit 2**Measurement**

Measuring Concepts
Relationships between Parts of the Circle
Area and Circumference of Various Parts of the Circle
Arc Length

Unit 3**Geometry**

Solids
Transformations
Constructions
Trigonometry

Unit 4**Algebra**

Formulae
Linear Inequalities
Distributive Properties
Laws of Indices
Algebraic Fractions
Factorizations
Simultaneous Equations

TERM 2**Unit 1****Numbers**

Properties of Arithmetic
Ratio
Consumer Arithmetic
Sets

Unit 2**Measurement**

Formulae for finding Areas of Polygons
Surface Areas of Solids
Conversions within Units
Volume and Capacity of Solids and Composite Objects

Unit 3**Geometry**

Properties of Polygons
Sum of Interior Angles of Polygons
Transformations
Calculation of Unknown Angles
Constructions
Pythagoras' Theorem

Unit 4**Algebra**

Making Rules
Equations & Inequalities
Simplification

TERM 3**Unit 1****Numbers**

Sets & Logic
Consumer Arithmetic
Matrices

Unit 2**Measurement****Unit 3****Geometry**

Constructions

Unit 4**Algebra**

Vectors
Relations
Functions
Graphs

TERM 1**TERM 2****Unit 5****Statistics and Probability**

Measures of Central Tendency

Measures of Dispersion

Presentation of Data

Fractions and Percentages as Probability

Range

TERM 3**Unit 5****Statistics and Probability**

Central Tendencies

Range of Data

Frequency Tables

Graphs

Data Collection

Simple Experiments

Simple Probability

There are five Strands for Grades 7 through 9.

	Strand: Number	Strand: Measurement	Strand: Geometry	Strand: Algebra	Strand: Statistics & Probability
Standard	Use the basic operations, number relationships, patterns, number facts, calculators and software to compute and estimate in order to solve real world problems involving fractions, percentages and decimals.	Use the correct units, tools and attributes to estimate, compare and carry out the processes of measurement to given degree of accuracy.	Explore paths, geometric shapes and space and make generalization about geometric relationships within the environment.	Employ algebraic reasoning through the use of expressions, equations and formulae to interpret, model and solve problems involving unknown quantities.	Collect, organize, interpret and represent data and make inferences by applying knowledge of statistics and probability.

STANDARD	STRAND: NUMBER		
	GRADE 7	GRADE 8	GRADE 9
Use the basic operations, number relationships, patterns, number facts, calculators and software to compute and estimate in order to solve real-world problems involving fractions,	<ol style="list-style-type: none"> Describe different types of numbers in the real number system (Natural, Whole, Integer, Rational, Irrational) Compare and order a set of numbers. Perform the four basic operations, including multiple operations, on real numbers, mentally, using paper and pencil, and in problem situations. Give reasonable estimates of the results of operations on numbers. By rounding off, approximate a given number to the nearest thousandths, hundredths, tenths, tens, hundreds, thousands, etc. 	<ol style="list-style-type: none"> State the meaning of a^m, where a and m are whole numbers. Evaluate the expressions: a^m, $a^m \times b^n$ and a^m/b^n where a, b, m, n, are whole numbers. Write numbers greater than or equal to 10 in standard form. Write a number to a given number of decimal places and significant figures. Express place values of digits in all bases including base 10. Add, subtract and multiply numbers written in base n, (where $1 < n < 10$). Convert numbers written in base n, (where $1 < n < 10$) to base 10 and vice versa. 	<ol style="list-style-type: none"> State the meaning of a^m, where a and m are rational numbers. Simplify expressions using the laws of indices. Evaluate expressions a^m and $a^m \times b^n$ where a, b, m, n, are whole numbers, integers, fractions. Write numbers less than, greater than or equal to 10 in standard form. Identify the order of a matrix. Perform scalar multiplication. Perform calculations to illustrate the commutativity and distributivity of matrices under addition.

STANDARD	STRAND: NUMBER		
	GRADE 7	GRADE 8	GRADE 9
	<p>6. Identify, without calculation, whole numbers divisible by 2, 3, 5, 6 and 9 (Divisibility rules).</p> <p>7. Identify and use the following properties of arithmetic:</p> <ol style="list-style-type: none"> Commutative Associative Distributive <p>8. Identify and use the following concepts:</p> <ol style="list-style-type: none"> Identity Inverses <p>9. Use the language of sets (including disjoint, null, complement and subsets).</p> <p>10. Identify and give examples of well-defined sets.</p> <p>11. Illustrate data using Venn diagrams (at most two intersecting sets within the universal set).</p> <p>12. Obtain and interpret information from Venn Diagrams.</p> <p>13. Write a fraction as a ratio and vice versa.</p> <p>14. Compare two quantities using ratios.</p> <p>15. Divide a quantity in a given ratio.</p> <p>16. Identify quantities in proportion.</p> <p>17. Compute the total price given quantity and unit price.</p> <p>18. Compute unit price given the quantity and total price.</p> <p>19. Compute quantity given the total price and the unit price.</p> <p>20. Identify 'best buys' and bargains by comparison of unit costs.</p>	<p>8. Identify and use the following concepts:</p> <ol style="list-style-type: none"> Closure Reflexive property Symmetry property Transitive property Trichotomy Law <p>9. Determine the number of subsets of a given set.</p> <p>10. List all the possible subsets of a given set, where the number of elements in the given set is no more than 4.</p> <p>11. Solve simple problems involving, at most, two subsets of the universal set</p> <p>12. Understand the concept of proposition and use the language of logic (negation, conjunction, disjunction, if...then, equivalence).</p> <p>13. Identify and differentiate between simple and compound propositions</p> <p>14. Express simple and compound propositions algebraically using appropriate terminology and vice versa</p> <p>15. Solve simple problems involving ratio and proportion.</p> <p>16. Identify different types of bank accounts with their characteristic features.</p> <p>17. Complete withdrawal and deposit forms when banking and know how to write a cheque.</p> <p>18. Use simple proportions of principal, rate and time to develop the Simple Interest.</p>	<p>8. Solve simple problems involving, at most, three subsets of the universal set (with at most two intersecting).</p> <p>9. Establish the truth value of compound propositions using truth tables.</p> <p>10. Use truth tables to determine if two propositions are logically equivalent.</p> <p>11. Define an argument</p> <p>12. Differentiate between valid argument and valid conclusion</p> <p>13. Apply deductive reasoning to determine the validity of arguments</p> <p>14. Solve more complex problems involving ratio and proportion.</p> <p>15. Calculate the total utility bill to be paid from given instructions.</p> <p>16. Explain and use in the proper context terms relating to the computation of wages and salaries (wages, salaries, bonuses, commissions, basic pay, overtime pay, gross pay, net pay, statutory and non-statutory deductions, taxable income, tax allowance).</p> <p>17. Calculate the wage and/or salary of an employee from given instructions.</p>

STANDARD	STRAND: NUMBER		
	GRADE 7	GRADE 8	GRADE 9
	20. Calculate profit and loss in monetary and percentage terms. 21. Convert Jamaican dollars to other currencies and vice versa.	19. Calculate simple interest on loans and deposits. 20. Calculate compounded interest using a calculator (using a recursive method). 21. Calculate total cost in a hire purchase agreement and compare Hire Purchase Price and Cost Price. 22. Calculate discounts and taxes from given instructions.	

STANDARD	STRAND: MEASUREMENT		
	GRADE 7	GRADE 8	GRADE 9
Use the correct units, tools and attributes to estimate, compare and carry out the processes of measurement to given degree of accuracy.	1. Measure length, mass, time, temperature, volume, capacity using appropriate instruments. 2. Perform conversions within units and across related units (up to square units). 3. Find the perimeter of plane composite figures. 4. Find the area of plane composite figures.	1. Derive and use the formulae for the area of: a. parallelograms, b. triangles ($\frac{1}{2}(bh)$), c. trapezia. 2. Compute the total surface area of cubes, cuboids, cylinders and triangular prisms (using only triangles where the area can be calculated using $\frac{1}{2}(bh)$ for the triangular prism). 3. Perform conversion within units up to cubed units. 4. Establish formulas and, estimate and calculate the volume and capacity of cubes, cuboids, prisms, cylinders, and composite objects.	1. Investigate and use the relationship between the radius and the area of a circle $A = \pi r^2$. 2. Investigate and use the relationships between the radius, diameter, circumference, and pi. 3. Calculate the area and circumference of a circle. 4. Identify the arc, sector, and segment of a circle. 5. Find the area of a sector, segment or parts thereof of a circle with the use of angles. 6. Find arc length.

STRAND: GEOMETRY

STANDARD

GRADE 7

GRADE 8

GRADE 9

Explore paths, geometric shapes, and space and make a generalization about geometric relationships within the environment.

1. Identify and draw nets of solids.
2. Construct solids from nets.
3. State the relationships between an object and its image in a plane when it undergoes a translation in that plane
4. State the relationships between an object and its image in a plane when it is reflected in a line in that plane.
5. State the relationships between an object and its image in a plane when it is rotated about a point (the center of rotation), through a given angle, in that plane.
6. Identify and use angle, side and symmetry properties of triangles and quadrilaterals.
7. Construct, using appropriate geometric instruments, a circle of a given radius.
8. Construct, using ruler and compasses only:
 - a. line segments
 - b. perpendicular and parallel lines
 - c. line bisectors

1. Investigate the relationship among angles formed by:
 - a. A transversal and two or more parallel lines;
 - b. Intersecting non-perpendicular lines.
2. Sketch different views (top, side, etc.) of solids making use of dotted lines to represent unseen lines.
3. Perform translations and identify images of objects, where the translation vector is given.
4. Find the translation vector given the object and its image.
5. Perform reflections and identify images of objects, where the mirror lines are the x or y-axes.
6. Perform rotations of 90° , 180° , 270° about the origin.
7. Determine the properties of n-sided polygons, where $3 \leq n \leq 10$.
8. Find the angle sum (sum of the interior angles) of polygons with n interior angles ($3 \leq n \leq 10$).
9. Construct, using appropriate geometric instruments:
 - a. angle bisectors
 - b. angles of 90° , 45° , 60° , 30°
 - c. triangles

1. State the relationships between an object and its image in a plane when it is enlarged from a point (center of enlargement), with given scale factor, in that plane.
2. Perform enlargements with the center at the origin with scale factor k.
3. Perform reflections and identify images of objects where the mirror line is any given line in the plane.
4. Use trigonometric ratios to find unknown quantities in right-angled triangles only.
5. Use trigonometric ratios to solve problems related to angles of elevation and depression.
6. Calculate unknown angles in given diagrams and word problems.
7. Prove Pythagoras' Theorem by a suitable method (for example by the area method).
8. Use the Pythagoras' Theorem to solve right-angled triangle problems.

STRAND: ALGEBRA

STANDARD

GRADE 7

GRADE 8

GRADE 9

Employ algebraic reasoning through the use of expressions, equations and formulae to interpret, model and solve problems involving unknown quantities.

1. Formulate rules from their knowledge of arithmetic properties.
2. Define and identify variables, terms, constant, coefficient, expression, equation and operations.
3. Identify, add and subtract like and unlike terms.
4. Use symbols to represent quantities which vary.
5. Write equations to illustrate word problems.
6. Solve simple linear equations using:
 - a. flow diagrams
 - b. the balancing method
7. Simplify algebraic expressions by grouping like terms.
8. Write coordinates of points as ordered pairs.
9. Plot ordered pairs of numbers on the Cartesian plane.
10. Read and identify points on the Cartesian plane.
11. Connect points on the Cartesian plane to form patterns.
12. Represent a mapping by (a) a mapping rule, (b) a mapping diagram, (c) as a set of ordered pairs.
13. Recognize and give examples of each of the following type of mapping:
 - a. one-to-one
 - b. one-to-many
 - c. many-to-one
 - d. many-to-many

1. Change the subject of a simple formula. e.g., $C = \pi r^2$ making r the subject gives
$$r = \frac{C}{2\pi}$$
2. Write inequalities to illustrate word problems.
3. Illustrate inequalities on a number line.
4. Solve simple linear inequalities and represent the solution on a number line.
5. Plot the ordered pairs of a mapping as a graph.
6. Draw straight line graphs of the form $y = mx + c$ by
 - a. plotting points,
 - b. using the gradient and intercept.
7. Determine gradients and intercepts of straight line graphs.
8. Relate gradient of a graph to the rate of change of quantities.
9. Find the equation of straight line graphs.
10. Plot two linear equations on the same pair of axes and interpret the point(s) of intersection (if any).
11. Graph linear inequalities on the coordinate plane and identify regions on the graph.

1. Use the distributive property to simplify expressions including the laws of indices.
2. Apply the distributive property to multiply two binomial expressions.
3. Add and subtract simple algebraic fractions.
4. Multiply and divide simple algebraic fractions.
5. Factorize simple algebraic expressions where there is a simple algebraic common factor other than
6. Solve simultaneous equations by the method:
 - a. Substitution
 - b. Elimination
7. Define a vector as the sum total of horizontal and vertical displacement.
8. Write vectors in column format.
9. Define and position vectors given two points.
10. Use the grid to locate and draw, position and relative position vectors.
11. Draw a right-angled triangle representing a vector.
12. Use Pythagoras' theorem to find the length of a vector.
13. Write the reverse vector ($-x$) given a vector x (multiply a vector by -1).
14. Find the relative position vector of collinear vectors given a ratio of division.

STRAND: ALGEBRA

STANDARD

GRADE 7

GRADE 8

GRADE 9

15. Use the properties of an appropriate polygon to find the relative position vector of parallel and non-collinear vectors.
16. Define a function as a many-to-one or one-to-one relation.
17. Distinguish between the graph of a relation and the graph of a function.
18. Use the functional notations, for example, $f:x \rightarrow 2x+1$, $y= f(x)$
19. Determine the range value that corresponds to a given domain value by evaluating the function at the stated domain value;
20. State the domain and range of a given function;
21. Distinguish between functions defined for different domains by the same formula;
22. Write a quadratic mapping as a set of ordered pairs;
23. Plot the ordered pairs of a quadratic mapping as a graph
24. Interpret the points of intersection of a quadratic graph with the axes

STRAND: STATISTICS & PROBABILITY

STANDARD

GRADE 7

GRADE 8

GRADE 9

Collect, organize, interpret and represent data and make inferences by applying knowledge of statistics and probability.

1. Find the mode, median and mean from raw data.
2. Calculate the range of a data set (from raw data or from a frequency table)
3. Construct and interpret simple frequency tables from a set of data

1. Determine the mode, median and mean from a frequency table.
2. Use the mode, median and mean to interpret information.
3. Read, interpret and construct pictographs, bar charts, pie charts and line graphs.

1. Design and conduct simple experiments, to collect data, determine simple probabilities and draw appropriate conclusions.
2. Use fractions and percentages to describe probability.
3. Interpret a probability given as a fraction or percentage.

A 3D rendering of a room with a grid floor and walls. In the foreground, there are three dark gray geometric shapes: a sphere, a cylinder, and a cone. The walls are made of a grid of light gray cubes. The text 'NSC' is in the top left, 'MATHEMATICS' is in a white banner across the middle, and 'GRADE 7 UNITS' is in the bottom left.

NSC

MATHEMATICS

GRADE 7 UNITS

Range of Content

Students will:

- Compute with different types of numbers accurately and fluently; use these skills to find answers in realistic problem situations;
- Compute with indices accurately and fluently; convert to different number bases accurately and fluently. Use these skills to find answers in realistic problem situations;
- Use the properties of arithmetic accurately and fluently;
- Identify members of a set and compute using the properties of sets;
- Use ratio and proportion in problem solving and decision making;
- Use consumer arithmetic to solve real-life problems;
- Use formulae to solve for perimeter and area; convert between units; use appropriate instruments to measure accurately;
- Use formulae of triangles, quadrilaterals and solids to solve for area, surface area and volume; convert between units; use angle properties to find unknown angles;
- Compute accurately length, circumference, and area of a circle and its relevant parts; identify parts of a circle correctly;
- Identify properties of solids;
- Perform transformations accurately;
- Use properties of polygons to solve problems accurately and fluently;
- Perform trigonometric calculations accurately;
- Perform constructions accurately and fluently;
- Use appropriate instruments to construct shapes;
- Compute accurately using Pythagoras' Theorem;
- Use algebraic properties accurately and fluently;
- Perform algebraic calculations accurately;
- Use algebraic properties to accurately solve problems;
- Use algebraic properties to solve linear inequalities accurately and fluently;
- Use algebraic properties to solve systems of linear equations; solve accurately problems involving vectors;
- Read and plot points in the Cartesian plane;
- Distinguish between types of mappings;
- Plot linear equations and inequalities; find linear equations; find gradients and intercepts;
- Define domain and range for functions; distinguish between relations and functions;
- Plot and interpret quadratic functions;
- Compute measures of central tendency and ranges accurately and fluently;

Students will:

- Find simple probabilities; plot and read points on the Cartesian plane;
- Solve problems related to frequency tables;
- Solve problems related to various types of charts and graphs;
- Engage cooperatively in problem solving activities that foster critical and creative thinking;
- Willingly participate in group discussions and activities.

Guidance for the Teacher

Considering this unit, teachers must plan accordingly through effective and relevant research; on-going self-reflection; and making reference to Mathematics resources – be it resource centers, textbooks, technology, resource personnel, and more importantly, the environment. Even more, teachers must be guided by Education policies; National Curricula; current trends in Mathematics teaching and learning; and what is being taught in relation to this topic in the Sciences, Social Studies, Geography, Physical Education, Visual Arts, Information and Communication Technology, and Technical and Vocational subjects. As well, teachers ought to bear in mind the need for sensitivity to the personal circumstances of every pupil during the teaching and learning experience of each concept in Mathematics.

Consequently, the intention to educate students in the learning of Mathematical concepts and its related attributes is to help and support young people to be: critical thinkers; effective users and creators of Mathematics; fluent in the language of Mathematics; successful lifelong learners; confident and productive individuals; and proud citizens of Jamaica. Ultimately, young people will learn to foster and demonstrate respect for self and others as they move with confidence from childhood through adolescence and into adulthood.

MATHEMATICS AND THE CURRICULUM**The Role of Mathematics in the Curriculum**

Students at the secondary level must continue to develop the necessary mathematical competence to function in society. The knowledge and skills garnered at the primary level must assist them in learning and appreciating the subject at this level. They must be given opportunities to: understand and use the language of Mathematics; apply number concepts and theories; engage in meaningful measurement activities; handle data efficiently as well as examine and understand the relationships of one mathematical concept with another. In so doing, they should improve their ability to think and work confidently.

Students at this level should also be able to: conceptualize spatial properties; observe geometric phenomena; and show appreciation of the aesthetic nature of the subject. Students should be given the chance to: communicate freely and effectively using the language of mathematics; make mathematical connections to their daily lives; use models to express their thoughts and ideas; use critical thinking, reasoning, and proof to process their thinking and understandings. These students must be given opportunities through problem solving to foster skills of creativity, enquiry, conjecturing, testing, analyzing and generalizing.

Contribution to the competencies

Mathematics contributes to all three of the Framework competencies. This subject is an ideal vehicle for the development of critical thinking and problem-solving skills, and for making judgments. It is also the subject that can be used as a tool for learning other disciplines such as: Geography, Physics, Resource and Technology and Chemistry etc. It provides opportunities for students to work independently and cooperatively.

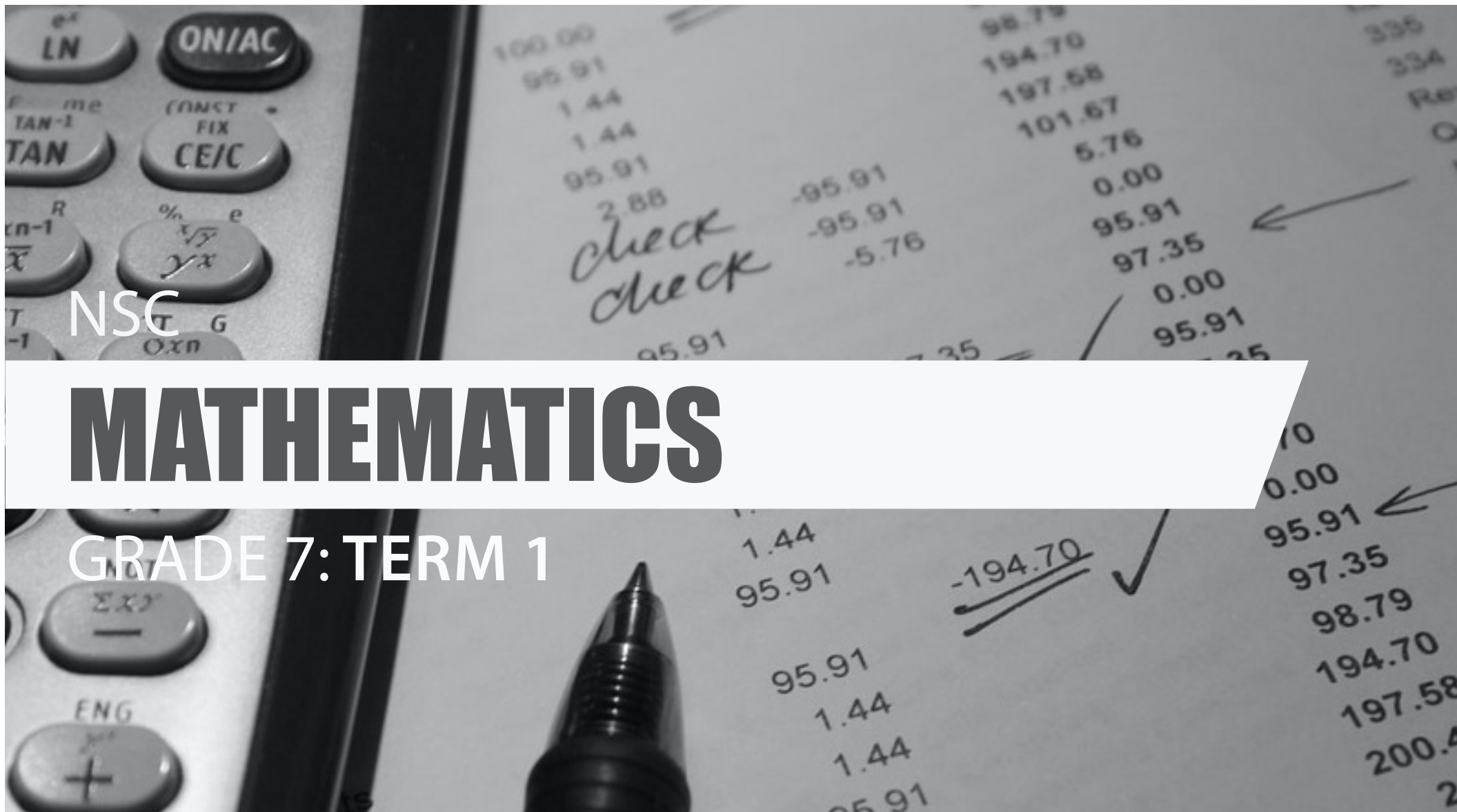
Range of activities

Students should be involved in a range of practical activities through which they can explore mathematical properties and relationships. They plan their own investigations and explore different ways of solving problems. By learning mathematics in a practical way, they should be able to relate its principles and theories to real life situations. Wherever possible, students should explore the mathematical uses of a range of ICT equipment as a tool as well as a discipline.

NSC

MATHEMATICS

GRADE 7: TERM 1



About the Unit

In this unit students will learn about/to:

- The differences between sets of real numbers;
- Work effectively during group discussions and activities;
- Order real numbers;
- The Sieve of Eratosthenes;
- The classification of real numbers;
- Approximations;
- Conduct investigation using digital content

Prior Learning

Check that students can:

- List the set of factors of sets of whole numbers;
- Compute the HCF and LCM of whole numbers;
- State the place value of a digit in a whole number or decimal fraction.

NUMBERS: OPERATIONS ON REAL NUMBERS**Standard**

Use the basic operations, number relationships, patterns, number facts, calculators and software to compute and estimate in order to solve real-world problems involving fractions, percentages, and decimals.

Objectives**Students will be able to:**

- Describe different types of numbers in the real number system (Natural, Whole, Integer, Rational, Irrational);
- Compare and order a set of numbers;
- Perform the four basic operations, including multiple operations, on real numbers, mentally, using paper and pencil, and in problem situations;
- Give reasonable estimates of the results of operations on numbers;
- By rounding off, approximate a given number to the nearest thousandths, hundredths, tenths, tens, hundreds, thousands, etc.);
- Identify, without calculation, whole numbers divisible by 2, 3, 5, 6 and 9 (Divisibility rules).

Suggested Teaching and Learning Activities

Key Skills

Assessment Criteria

Students will:

Explore addition and subtraction of whole numbers using Geogebra resources located at on the portal – www.moeschools.edu.jm
Explore divisibility rules from the website: <http://www.vectorkids.com/vkdivisible.htm>

- classify
- order
- describe
- calculate
- compare
- share findings
- work in groups
- solve problems
- represent fractions
- investigate fractions
- draw diagrams
- investigate real numbers
- classify real numbers
- share and compare
- discuss
- approximate numbers
- explore “rules of divisibility”
- navigate digital content.

Students are able to:

- Ability to recognize the differences between sets of real numbers
- Ordering of real numbers
- Round off numbers
- Estimate results from operations performed
- Determine factors

Learning Outcomes

Students will be able to:

- ✓ Accurately recognize the differences between sets of real numbers;
- ✓ Order real numbers correctly;
- ✓ Apply divisibility rules correctly;
- ✓ Perform the 4 basic operations correctly;
- ✓ Safely conduct investigation using digital content.

Points to Note

- Open the relevant site:
<https://drive.google.com/drive/u/1/folders/0B85w38KXTa7HaW8td0VSWEFvZms>
and access resources for Directed numbers, Rounding Numbers.
- Ensure that Geogebra is already installed on the devices that are to be used.

Extended Learning

- Use the Sieve of Eratosthenes to find prime numbers between 1 and 2000.
- Investigate the different types of prime numbers.
- Investigate perfect numbers.
- Investigate real numbers like π and (or any square root of a prime number).

RESOURCES

Computers/smartphones/tablets, Geogebra software, Geogebra files

Online resources:

<http://www.mathsisfun.com/numbers/golden-ratio.html>
http://en.wikipedia.org/wiki/List_of_types_of_numbers

KEY VOCABULARY

Natural numbers, whole numbers, Integers, rational numbers, irrational numbers, real numbers, approximate, Sieve of Eratosthenes, rounding off, additive inverse, divisibility, multiplicative inverse, commutativity, identity, reflexive property, transitive property.

LINKS TO OTHER SUBJECTS

Technical and vocational:

- Attainment Target 1: creativity and innovation: explore a range of problem-solving contexts and develop ideas for solutions utilizing new technologies;
- Attainment Target 2: explore methods and procedures: use resources efficiently and use appropriate techniques in the execution of tasks
- Attainment Target 3: apply solutions: use the design process in planning the execution of solution for an identified problem;

Science:

- Analyse experimental data and allow for anomalies. Carry out multi-step calculations.

Physical Education:

- Attainment Target: games and sports: exhibit the capacity to cope with new and varied skill difficulties and to cooperate with others in regular practice in order to refine technique;
- Attainment Target: team tactics: demonstrate advanced strategies and tactics in competitive play and undertake the role/roles of player, coach or spectator.

About the Unit

In this unit students will learn about/to:

- Instruments used to demonstrate a variety of measuring attributes;
- Participate in group activities and discussions;
- Problem solve situations involving measurement;
- Conduct research on measurement;
- Find area and perimeter of shapes;
- Modeling area and perimeter using software;
- ICT tools used to investigate measurement

Prior Learning

Check that students can:

- Differentiate between the units of the Metric System in measurement situations;
- Know and use relationships between units of the Metric System in measurement situation;
- Calculate the perimeter of irregular polygons and regular polygons by means of the appropriate formula;
- Find the length of one side of a polygon given the perimeter and the lengths of the other sides;
- Explore the tiling of a plane using different shapes;
- Identify shapes which will cover a plane exactly and those that will not;
- Differentiate between the size and use of the following units: square centimetre, square metre, hectare and square kilometre;
- Name and measure regions, compute the area of regions shaped as rectangles and right-angled triangles individually; in combination or as the surfaces of three-dimensional objects;
- Solve problems involving area measures.

MEASUREMENT: MEASURING CONCEPTS**Standard**

Use correct units, tools and attributes to estimate, compare and carry out the processes of measurement to given degree of accuracy.

Objectives

Students will be able to:

- Measure length, mass, time, temperature, volume, capacity using appropriate instruments;
- Perform conversions within units and across related units. (up to square units);
- Find the perimeter of composite figures in a plane;
- Find the area of composite figures in a plane.

Suggested Teaching and Learning Activities

Key Skills

Assessment Criteria

Students will:

Investigate ways of measuring body temperature. Research steps that are to be taken in the event a person's temperature is too high or low.

Estimate various masses and input these estimates in the table provided. Using an appropriate scale, measure the actual mass of each item and input into the correct column. Use the conversion program located at

<http://joshmadison.com/convert-for-windows/>

to convert each mass to the other units in the table in Appendix A.

- Investigate
- Measure
- Observe
- Share
- Compare
- Estimate
- Record information
- Listen carefully
- Make measuring instruments
- Work in groups
- Problem-solve
- Tabulate data
- Model area and perimeter
- Insert illustrations
- Navigate digital content

Students are able to:

- Group participation
- Engagement in problem-solving situations
- Completed tables with correct information on measurement
- Accurately completed table with measures of area and perimeter of objects
- Models of areas and perimeters using software.

Learning Outcomes

Students will be able to:

- ✓ Engage in problem solving situations involving measurement;
- ✓ Complete tables with researched information on aspects of measurement;
- ✓ Complete table with measures of area and perimeter of objects;
- ✓ Model areas and perimeters using software;
- ✓ Use ICT tools to investigate measurement.

Points to Note

Have professional users of other measuring instruments come in to assist with the correct use of instruments and to demonstrate how these instruments are used in their jobs. These professionals can be medical personnel, woodwork teachers/carpenters, plumbers, chefs/home economics teacher, industrial arts teacher, manufacturers of containers to explain volume and capacity.

Ensure that students get adequate time to practice with the various instruments.

Generate/Print requisite tables students will need to use. Download and install the conversion software from this site prior to each lesson that needs conversions done: <http://joshmadison.com/convert-for-windows/>. Some conversions will have small and large numbers that can be written in standard form (scientific notation). The following can be used to assist students in ensuring they have done so correctly:

- http://www.aaamath.com/nam-g6_71fx1.htm
- <http://www.mathportal.org/calculators/numbers-calculators/scientific-notation-calculator.php>
- <http://www.csgnetwork.com/directroundsimple.html>

Extended Learning

- Investigate the history of measuring and measuring instruments. Identify archaic and corresponding modern day instruments, and, new and emerging measuring instruments.
- Research on instruments used to measure small items (e.g. thickness of a sheet of paper or diameter of a copper wire or a strand of their hair).
- Measure and mark out a square or rectangular space on the playing field or any appropriate space available. Describe the method, instruments, units and any other attributes used to arrive at their results in their journals.

RESOURCES

Measuring tape, Scales (for body mass and kitchen scale), Teacher generated tables, Internet/Computer/tablets/smartphones, 3d design software (SketchUp, sweet home 3d)

KEY VOCABULARY

Measurement, Metric, Length, Mass, Capacity, Volume, Temperature, Time, Thermometer, Metre, Litre, Gram, Milli-, Centi-, Kilo-, Deci-, Celsius, Surface Fahrenheit, Perimeter, Area, Kelvin, Rankine

LINKS TO OTHER SUBJECTS

Technical and vocational:

- Attainment Target 1: creativity and innovation: explore a range of problem-solving contexts and develop ideas for solutions utilizing new technologies;
- Attainment Target 2: Explore methods and procedures: use resources efficiently and use appropriate techniques in the execution of tasks;
- Attainment Target 3: apply solutions: use the design process in planning the execution of solution for an identified problem.

Science:

- Appreciate the importance of scientific methods and be aware of safety procedures to be taken when using equipment and materials;
- Analyze experimental data and allow for anomalies. Carry out multi-step calculations;
- Use scientific knowledge to select appropriate experimental methods;
- Understand the relationships between forces and motion and illustrate these relationships in the environment and living things.

Physical Education:

- Attainment Target: games and sports: exhibit the capacity to cope with new and varied skill difficulties and to cooperate with others in regular practice in order to refine technique;
 - Attainment Target: team tactics: Demonstrate advanced strategies and tactics in competitive play and undertake the role/roles of player, coach or spectator.
-

About the Unit

In this unit students will learn about/to:

- Complete tables on solid shapes;
- Participate in group activities and discussions;
- Classify solids;
- Nets of solids from items used in everyday life;
- Sketch/draw solids;
- Problem-solving situations involving solids

Prior Learning

Check that students can:

- Recognize faces, edges, vertices of a solid and classify solids according to the number and shape of their faces;
- Represent and solve problems using geometrical models;
- Describe the physical world in terms of geometric concepts and talk about mathematical findings.

GEOMETRY: SOLIDS**Standard**

Explore paths, geometric shapes, and space and make generalizations about geometric relationships within the environment.

Objectives

Students will be able to:

- Identify and draw nets of solids;
- Construct solids from nets.

Suggested Teaching and Learning Activities

Students will:

Explore the properties of various solids with respect to the number of faces, edges and vertices to arrive at Euler's Formula. Complete the table as shown in Appendix B. Identify the pattern that exists between faces, edges, and vertices.

Key Skills

- Identify solids
- Work in groups
- Classify solids
- Tabulate information
- Determine criteria
- Name solids from supplied net
- Sketch solids
- Problem solve

Assessment Criteria

- Completed tables on solid shapes
- Group participation and discussions
- Correct classification of solids
- Solids sketched correctly
- Problems solved using appropriate techniques

Learning Outcomes

Students will be able to:

- ✓ Complete tables on solids correctly;
- ✓ Sketch solids accurately.
- ✓ Find Euler's Formula

Points to Note

Provide as many solids as possible including cylinders. Highlight the difference with a cylinder as against the other solids.

Extended Learning

- Research complex solid shapes such as tetrahedron, dodecahedron, icosahedrons etc.
- Design packages using design packaging software.
- Research the life of Leonard Euler and his contributions to mathematics and other areas. Publish their findings on a blog.

RESOURCES

Nets of solids (access from this site:
<http://www.senteacher.org/worksheet/12/NetsPolyhedra.html>),
Internet, Computer/tablet/smartphone, Supply of various solids such as boxes, cylinders, etc

KEY VOCABULARY

Geometry, Solids, Transformation, Similar, Congruent, Constructions, Nets of solids, Cubes, Cuboids, Prism, Pyramid, Euler

LINKS TO OTHER SUBJECTS

Technical and vocational:

- Attainment Target 1: creativity and innovation: explore a range of problem-solving contexts and develop ideas for solutions utilizing new technologies;
- Attainment Target 2: explore methods and procedures: use resources efficiently and use appropriate techniques in the execution of tasks;
- Attainment Target 3: apply solutions: use the design process in planning the execution of solution for an identified problem.

Science:

- Appreciate the importance of scientific methods and be aware of safety procedures to be taken when using equipment and materials;
- Analyze experimental data and allow for anomalies. Carry out multi-step calculations;
- Use scientific knowledge to select appropriate experimental methods;
- Understand the relationships between forces and motion, and illustrate these relationships in the environment and living things.

Physical Education:

- Attainment Target: games and sports: exhibit the capacity to cope with new and varied skill difficulties and to cooperate with others in regular practice in order to refine technique;
 - Attainment Target: team tactics: Demonstrate advanced strategies and tactics in competitive play and undertake the role/roles of player, coach or spectator.
-

About the Unit

In this unit students will learn about/to:

- Being involved in group activities and discussions;
- Transformations of shapes;
- Engage in problem-solving situations.

Prior Learning

Check that students can:

- Recognize faces, edges, vertices of a solid and classify solids according to the number and shape of their faces;
- Represent and solve problems using geometrical models;
- Describe the physical world in terms of geometric concepts and talk about mathematical findings.

GEOMETRY: TRANSFORMATIONS**Standard**

Explore paths, geometric shapes, and space and make generalizations about geometric relationships within the environment.

Objectives**Students will be able to:**

- State the relationships between an object and its image in a plane when it undergoes a translation in that plane;
- State the relationships between an object and its image in a plane when it is reflected in a line in that plane;
- State the relationships between an object and its image in a plane when it is rotated about a point (the center of rotation) in that plane;
- Identify and use angle, side and symmetry properties of triangles and quadrilaterals;

Suggested Teaching and Learning Activities

Key Skills

Assessment Criteria

Students will:

Explore transformations using geogebra files of Translations, rotations and reflections.

- Work in groups
- Record findings
- Engage in discussions
- Describe transformation
- Problem-solve
- Manipulate software.

- Group participation and discussions
- Images are correctly identified
- Type of transformation correctly identified
- Coordinates of object and image correctly identified.
- Problems solved using appropriate techniques

Learning Outcomes

Students will be able to:

- ✓ Get involved in group activities and discussions;
- ✓ Engage in problem-solving situations.
- ✓ Manipulate software

Points to Note

- Ensure that the Geogebra is installed on devices to be used.
- Access the geogebra files from <https://drive.google.com/drive/u/1/folders/0B85w38KXTa7HaW8td0VSWEFvZms>
- Install these files on the devices.
- Emphasize the difference between similarity and congruence
- Highlight that orientation is different when a reflection is done.
- Ensure translations are (i) only horizontal (left and right) (ii) only vertical (up and down) (iii) slant (horizontal followed by vertical).

Extended Learning

- Research on various designs and decorations by different civilizations and eras. Present findings in any format desired.
- Research tessellations. Design their own tessellations.
- Observe the image of objects when reflected in these mirrors. Place the two mirrors in front of each other (parallel to each other, perpendicular to each other or slant) and observe the reflection of the object in the two mirrors. Predict what would happen if three mirrors are used.
- Use GeoGebra software to carry out the same experiments.

RESOURCES

The Internet, Computer/tablet/smartphone, software (Geogebra)

KEY VOCABULARY

Geometry, Transformation, Image, Object, Plane, Reflection, Translation, Rotation, Angle, Symmetry, Triangles, Quadrilaterals, Line, segment, Perpendicular, Parallel, Bisectors, Similar, Congruent.

LINKS TO OTHER SUBJECTS

Technical and vocational:

- Attainment Target 1: creativity and innovation: explore a range of problem-solving contexts and develop ideas for solutions utilizing new technologies;
- Attainment Target 2: explore methods and procedures: use resources efficiently and use appropriate techniques in the execution of tasks;
- Attainment Target 3: apply solutions: use the design process in planning the execution of solution for an identified problem.

Science:

- Appreciate the importance of scientific methods and be aware of safety procedures to be taken when using equipment and materials;
- Analyze experimental data and allow for anomalies. Carry out multi-step calculations;
- Use scientific knowledge to select appropriate experimental methods;
- Understand the relationships between forces and motion and illustrate these relationships in the environment and living things.

Physical Education:

- Attainment Target: games and sports: exhibit the capacity to cope with new and varied skill difficulties and to cooperate with others in regular practice in order to refine technique;
 - Attainment Target: team tactics: Demonstrate advanced strategies and tactics in competitive play and undertake the role/roles of player, coach or spectator.
-

About the Unit

In this unit students will learn about/to:

- Get involved in group activities and discussions;
- Engage in problem-solving situations;
- Constructions of lines;
- Use geometric instruments.

Prior Learning

Check that students can:

- Use the compass to draw circles to create designs;
- Draw and measure angles using the protractor;
- Describe the physical world in terms of geometric concepts and talk about mathematical findings.

GEOMETRY: GEOMETRIC CONSTRUCTION**Standard**

Explore paths, geometric shapes, and space and make generalizations about geometric relationships within the environment.

Objectives**Students will be able to:**

- State the relationships between an object and its image in a plane when it undergoes a translation in that plane;
- Construct, using appropriate geometric instruments, a circle of a given radius;
- Construct, using ruler and compasses only:
 - a) line segments;
 - b) Perpendicular and parallel lines;
 - c) Line bisectors.

Suggested Teaching and Learning Activities

Key Skills

Assessment Criteria

Students will:

Follow instructions to carry out constructions required from the following site or printed instructions: Page, John D. "Math Open Reference" www.mathopenref.com
<http://www.mathopenref.com/tocs/constructionstoc.html>

- Construct lines
- Manipulate geometric instruments
- Navigate digital content

Lines constructed accurately

Learning Outcomes

Students will be able to:

- ✓ Engage in problem-solving situations;
- ✓ Construct sets of lines accurately with the aid of geometric instruments.

Key Skills

- Ensure there is internet connection in order to use the site and have it loaded before the lesson starts:
<http://www.athopenref.com/tocs/constructionstoc.html>
- The website can be supplied to students to use on their own after school or at their convenience.
- If there is no internet connection, download the relevant printed instructions from the site and provide it to students.
- Invite architect/draughtsman/engineer/relevant industrial arts teacher to demonstrate drawing software such AutoCAD. Have the engineer explain the benefits of certain solids that are shaped as they are, for example, the arch in building bridges.
- Visit the website
<http://www.pbs.org/wgbh/buildingbig/lab/forces.html>
for students to experiment with shapes/solids and forces.

Extended Learning

Take pictures of interesting architectural designs and make a presentation showing these designs along with any other pertinent information regarding the designs. These designs are not restricted to buildings.

RESOURCES

<http://www.mathopenref.com/tocs/constructionstoc.html>
<http://www.pbs.org/wgbh/buildingbig/lab/forces.html>
Internet, Computer/tablet/smartphone, Geometric instruments.

KEY VOCABULARY

Geometry, Constructions, Plane, Angle, Triangles, Quadrilaterals, Radius, Circle, Ruler, Compass, Line segment, Perpendicular, Parallel, Bisectors

LINKS TO OTHER SUBJECTS

Technical and vocational:

- Attainment Target 1: creativity and innovation: explore a range of problem-solving contexts and develop ideas for solutions utilizing new technologies;
- Attainment Target 2: explore methods and procedures: use resources efficiently and use appropriate techniques in the execution of tasks;
- Attainment Target 3: apply solutions: use the design process in planning the execution of solution for an identified problem.

Science:

- Appreciate the importance of scientific methods and be aware of safety procedures to be taken when using equipment and materials;
- Analyze experimental data and allow for anomalies. Carry out multi-step calculations;
- Use scientific knowledge to select appropriate experimental methods;
- Understand the relationships between forces and motion and illustrate these relationships in the environment and living things.

Physical Education:

- Attainment Target: games and sports: exhibit the capacity to cope with new and varied skill difficulties and to cooperate with others in regular practice in order to refine technique;
 - Attainment Target: team tactics: demonstrate advanced strategies and tactics in competitive play and undertake the role/roles of player, coach or spectator.
-

NSC

MATHEMATICS

GRADE 7: TERM 2

About the Unit

In this unit students will learn about/to:

- Model arithmetic properties;
- Engage in problem-solving situations;
- Quantities related to ratio and proportion;
- Convert ratios to fractions and vice versa;
- Perform operations relating to ratios and proportions;
- Give clear discourse and come to their own conclusions as a group.

Prior Learning

Check that students can:

- Represent and solve problems using geometrical models;
- Describe the physical world in terms of geometric concepts and talk about mathematical findings;
- Identify and count the number of lines of symmetry in more compound plane figures;
- Demonstrate a knowledge and understanding of congruence in two and three dimensions.

NUMBERS: PROPERTIES OF ARITHMETIC, RATIO, AND PROPORTION**Standard**

Use the basic operations, number relationships, patterns, number facts, calculators and software to compute and estimate in order to solve real world problems involving fractions, percentages and decimals.

Objectives**Students will be able to:**

- Identify and use the following properties of arithmetic:
 - a) Commutative;
 - b) Associative;
 - c) Distributive.
- Identify and use the following concepts:
 - a) Identity;
 - b) Inverses.
- Write a fraction as a ratio and vice versa;
- Compare two quantities using ratios;
- Divide a quantity in a given ratio;
- Identify quantities in proportion.

Students will:

Explore arithmetic properties from supplied Geogebra files.

- Discuss
- Draw conclusions
- Investigate
- Work in groups
- Model addition/multiplication
- Solve problems
- Identify properties
- Discover properties
- Compare quantities
- Divide quantities
- create
- estimate, measure
- investigate
- design
- model
- connect
- apply concepts
- calculate
- analyze
- compare
- make observations

- Models of arithmetic properties
- Engagement in problem-solving situations
- Comparison of quantities
- Ability to convert ratios as fractions and vice versa

Learning Outcomes

Students will be able to:

- ✓ Model arithmetic properties accurately;
- ✓ Engage in problem-solving situations;
- ✓ Compare quantities related to ratio and proportion;
- ✓ Convert ratios to fractions and vice versa;

Points to Note

Ensure Geogebra is installed on devices to be used. Access the Geogebra files at <https://drive.google.com/drive/u/1/folders/0B85w38KXTa7HaW8td0VSWEFvZms>

Extended Learning

Create their own ingredients for condiments/beverages/jewellery/etc.

RESOURCES

Teacher-generated worksheet, Computers/tablets/smartphones, Internet access, Copies of the tables needed for each activity, Geogebra files on portal @ <https://drive.google.com/drive/u/1/folders/0B85w38KXTa7HaW8td0VSWEFvZms>

KEY VOCABULARY

Commutative, Associative, Distributive, Inverse, Identity, Reciprocal, Proportion, Quantity, Ratio, Fractions, Property, Sharing

LINKS TO OTHER SUBJECTS

Technical and vocational:

- Attainment Target 1: creativity and innovation: explore a range of problem-solving contexts and develop ideas for solutions utilizing new technologies;
- Attainment Target 3: apply solutions: use the design process in planning the execution of solution for an identified problem;
- Attainment Target 2: explore methods and procedures: use resources efficiently and use appropriate techniques in the execution of tasks.

Science:

- Analyze experimental data and allow for anomalies. Carry out multi-step calculations.

Physical Education:

- Attainment Target: games and sports: exhibit the capacity to cope with new and varied skill difficulties and to cooperate with others in regular practice in order to refine technique;
- Attainment Target: team tactics: demonstrate advanced strategies and tactics in competitive play and undertake the role/roles of player, coach or spectator.

About the Unit

In this unit students will learn about/to:

- Central Tendencies;
- Tables presenting data;
- Problem-solving situations;
- Classify data;
- Define and discuss key terms;
- Estimate data;
- Engage in group activities and discussions.

STATISTICS: MEASURES OF CENTRAL TENDENCY, MEASURES OF DISPERSION AND PRESENTATION OF DATA**Standard**

Collect, organize, interpret and represent data and make inferences by applying knowledge of statistics and probability.

Objectives**Students will be able to:**

- Find the mode, median and mean from raw data;
- Calculate the range of a data set (from raw data or from a frequency table);
- Construct and interpret simple frequency tables from a set of data.

Students will:

Measure the height and weight of each member of the class. Record the information in the spreadsheet supplied. The spreadsheet will calculate the BMI of each class member. Design diet and exercise regimen for persons in the various BMI categories. Find the mean height and weight of the class.

- Estimate
- participate
- draw conclusion
- make observation
- calculate
- measure
- record information
- collect data
- convert
- make decision
- Work in groups
- Calculate mean and median of sets of data
- Collect data
- Observe
- Read for information
- Discuss, Problem-solve
- Classify data

- Accurate recording of data collected
- Cooperation among team members
- Safe manipulation of resources
- Accurate calculations of Central Tendencies and probabilities
- Conclusion drawn based on observations

Learning Outcomes

Students will be able to:

- ✓ Accurately record data collected;
- ✓ Safely manipulate a variety of resources;
- ✓ Accurately calculate Central Tendencies and probabilities;
- ✓ Draw conclusions based on observations;
- ✓ Engage in group activities and discussions cooperatively;

Points to Note

- Work with the HFLE teacher to start this lesson as it will impact students who are conscious about their weight and height.
- Access the spreadsheet on the portal at <https://drive.google.com/drive/u/1/folders/0B85w38KXTa7HaW8td0VSWEFvZms>
- Have it installed on a computer for students to enter information.
- Students are to research about BMI, diets and exercises. Ratio and Proportion are to come out as well as finding probability.
- The spreadsheet already calculates the BMI.
- For greater interest, use the online BMI calculator www.smartbmiccalculator.com

Extended Learning

Investigate the correlation between height and weight

RESOURCES

bathroom scale, Internet, Computer/tablets/smartphone, spreadsheet on <https://drive.google.com/drive/u/1/folders/0B85w38KXTa7HaW8td0VSWEFvZms>

KEY VOCABULARY

Measuring, estimating, converting, weight, strength, probability, mean, median, range, Central Tendencies, Statistics, Mean, Mode, Median, Range, Low, High, Dispersion, Average, Central Tendencies, Data, Information, Collect, Record, Sort, Count,

LINKS TO OTHER SUBJECTS

Science:

- Analyze experimental data and allow for anomalies. Carry out multi-step calculations.

Technical and vocational:

- Attainment Target 1: creativity and innovation: explore a range of problem-solving contexts and develop ideas for solutions utilizing new technologies;
- Attainment Target 2: explore methods and procedures: use resources efficiently and use appropriate techniques in the execution of tasks;
- Attainment Target 3: apply solutions: use the design process in planning the execution of solution for an identified problem;

Physical Education:

- Attainment Target: games and sports: exhibit the capacity to cope with new and varied skill difficulties and to cooperate with others in regular practice in order to refine technique
- Attainment Target: team tactics: demonstrate advanced strategies and tactics in competitive play and undertake the role/roles of player, coach or spectator.

About the Unit

In this unit students will learn about/to:

- Participate in group discussions and activities;
- Engage in problem-solving situations;
- Define key terms;
- Expressions and equations;
- Formulate rules based on prior knowledge;
- Simplify expressions with like and unlike terms;
- Solve equations;
- Simplify expressions.

Prior Learning

Check that students can:

- Perform the four operations on integers;
- Compute using fractions.

ALGEBRA: MAKING RULES, EQUATIONS & INEQUALITIES, SIMPLIFICATION**Standard**

Employ algebraic reasoning through the use of expressions, equations and formulae to interpret, model and solve problems involving unknown quantities.

Objectives**Students will be able to:**

- Formulate rules from their knowledge of arithmetic properties;
- Define and identify variables, terms, constant, coefficient, expression, equation, and operations;
- Identify, add and subtract like and unlike terms;
- Use symbols to represent quantities which vary;
- Write equations to illustrate word problems;
- Solve simple linear equations using:
 - I. flow diagrams;
 - II. the balancing method;
- Simplify algebraic expressions by grouping like terms.

Students will:

As a school project, gather all that is needed to prepare for a disaster . Determine how many of each item would serve for a household and express the information gathered using algebraic expressions and equations.

- Work in groups
- Problem-solve
- use key terms correctly
- determine methods
- Model expressions
- Model equations
- Simplify expressions

- Active participation in group discussions and activities
- Definition of key terms
- Modelled expressions and equations
- Rules formulated
- Distinguish between equations and expressions
- Equations solved correctly

Learning Outcomes

Students will be able to:

- ✓ Participate in group discussions and activities cooperatively;
- ✓ Accurately model expressions and equations;
- ✓ Formulate rules based on prior knowledge;
- ✓ Correctly complete simplification of like and unlike terms;
- ✓ Write equations and expressions using appropriate symbols;
- ✓ Demonstrate the ability to solve equations correctly;

Points to Note

- Invite representatives of ODPEM, RED CROSS, etc. to guide students with this activity.
- Ensure students identify all the basic resources needed to prepare a location as a shelter.

Extended Learning

- Research Algebra's use in various careers.
- Research the use, history, and development of the speedometer.

RESOURCES

Resource Personnel, the Internet, computers/tablets/smartphones.

KEY VOCABULARY

Algebra, Constant, Variable, Equation, Terms, Coefficient, Expression, Operations, Simplify, Substitute, disaster, preparedness, population, data, information, formulate

LINKS TO OTHER SUBJECTS

Technical and Vocational:

- Attainment Target 1: creativity and innovation: explore a range of problem-solving contexts and develop ideas for solutions utilizing new technologies;
- Attainment Target 2: explore methods and procedures: use resources efficiently and use appropriate techniques in the execution of tasks;
- Attainment Target 3: apply solutions: use the design process in planning the execution of solution for an identified problem.

Science:

- Appreciate the importance of scientific methods and be aware of safety procedures to be taken when using equipment and materials;
- Appreciate the importance of healthy lifestyle through the study of STDs, STIs and drug abuse;
- Analyze experimental data and allow for anomalies. Carry out multi-step calculations.

Physical Education:

- Attainment Target: games and sports: exhibit the capacity to cope with new and varied skill difficulties and to cooperate with others in regular practice to refine technique;
- Attainment Target: team tactics: demonstrate advanced strategies and tactics in competitive play and undertake the role/roles of player, coach or spectator.

Social studies:

- Attainment Target: present global information from maps, graphs, and pictures.

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MATHEMATICS

GRADE 7: TERM 3

About the Unit

In this unit students will learn about/to:

- Participate in group discussions;
- Tabulate data collected and classified;
- Draw Venn diagrams depicting data collected;
- Use key terms accurately

Prior Learning

Check that students can:

- Identify members of a set, equivalent sets, finite and infinite sets;
- Associate the number of members in a set with the properties of that set;
- Name and list members in the intersection or union of two sets;
- Draw Venn diagrams to show the intersection or union of two sets;
- Use the symbols associated with set operations – intersection and union.

NUMBERS: SETS**Standard**

Number operation and application

Use the basic operations, number relationships, patterns, number facts, calculators and software to compute and estimate in order to solve real world problems involving fractions, percentages and decimals.

Objectives**Students will be able to:**

- Use the language of sets (including disjoint, null, complement and subsets);
- Identify and give examples of well-defined sets;
- Illustrate data using Venn diagrams (at most two intersecting sets within the universal set);
- Obtain and interpret information from Venn Diagrams.

Suggested Teaching and Learning Activities

Key Skills

Assessment Criteria

Students will:

Conduct research on (i) classifications of living things; (ii) classification of types of computer games; (iii) types of numbers

- Work in groups
- illustrate information
- analyse information
- Define key terms
- Draw Venn diagrams

- Active participation in group discussions and activities
- Participation in group discussions and activities.
- Venn diagrams depicting information.
- Subsets, disjoint, complement and universal sets correctly identified

Learning Outcomes

Students will be able to:

- ✓ Tabulate information;
- ✓ Draw Venn diagrams correctly;
- ✓ Engage in problem-solving situations;
- ✓ Define key terms

Points to Note

- Ensure that composite, prime, odd, even numbers are clearly identified.
- Draw Venn diagram to show the uniqueness of 2 as prime and even and place the other numbers in their correct set. One Venn diagram can show the set of Natural numbers as the universal set with the subsets (i) Prime and Even; (ii) Prime and odd.
- Ensure the numbers that do not fit in either set is correctly identified in the complement. For example, for part (i) above, 9 is not prime or even so belongs in the complement.
- Ensure that all types of numbers are used, for example, show that there is the set of irrational numbers that are disjoint from the other types, but which belong to the set of real numbers.
- Have the students research the value of some irrational numbers such as pi, and the golden ratio.

Extended Learning

Research on John Venn, Evariste Galois and other contributors to Set Theory.

RESOURCES

Internet, Computer/tablet/smartphones

KEY VOCABULARY

Venn diagram, Sets, Null/empty, Intersecting, Universal, Disjoint, Subsets, Complement, finite, infinite

LINKS TO OTHER SUBJECTS

Technical and vocational:

- Attainment Target 1: creativity and innovation: explore a range of problem-solving contexts and develop ideas for solutions utilizing new technologies;
- Attainment Target 3: apply solutions: use the design process in planning the execution of solution for an identified problem;
- Attainment Target 2: explore methods and procedures: use resources efficiently and use appropriate techniques in the execution of tasks;
- Attainment Target 3: apply solutions: manage resources with the aid of appropriate technologies in the execution of tasks.

Science:

- Analyze experimental data and allow for anomalies. Carry out multi-step calculations;
- Use scientific knowledge to select appropriate experimental methods.

Physical Education:

- Attainment Target: games and sports: exhibit the capacity to cope with new and varied skill difficulties and to cooperate with others in regular practice in order to refine technique;
 - Attainment Target: team tactics: demonstrate advanced strategies and tactics in competitive play and undertake the role/roles of player, coach or spectator.
-

About the Unit

In this unit students will learn about/to:

- Conversion of currencies;
- Problem-solve situations;
- Engage in group discussions and activities;
- Computations of profit, loss and percentage amounts

NUMBERS: CONSUMER ARITHMETIC**Standard****Number Operation and Application:**

Use the basic operations, number relationships, patterns, number facts, calculators and software to compute and estimate in order to solve real world problems involving fractions, percentages and decimals.

Objectives**Students will be able to:**

- Compute the total price given quantity and unit price;
- Compute a unit price given the quantity and total price;
- Compute the quantity given the total price and the unit price;
- Identify 'best buys' and bargains by comparison of unit costs;
- Calculate profit and loss in monetary and percentage terms;
- Convert Jamaican dollars to other currencies and vice versa.

Suggested Teaching and Learning Activities

Key Skills

Assessment Criteria

Students will:

Engage in class discussions on how they use money. Discuss

The difference between total price and unit price:

- Will the quantity of an item determine the total price and unit price?
- How is a profit made on an item?
- How is a loss made on an item?
- List all the currencies used in our country.

- Work in groups
- Solve problems
- Discuss
- Compute accurately
- Convert currencies
- Use calculator/App/Software
- Critique constructively
- Observe
- Make presentation
- Navigate digital content

- Conversions of currencies
- Problem-solving situations
- Engagement in group discussions cooperatively
- Completed computations involving profit, loss and percentage amounts

Learning Outcomes

Students will be able to:

- ✓ Convert various currencies correctly;
- ✓ Problem-solve situations effectively;
- ✓ Engage in group discussions and activities cooperatively;
- ✓ Complete computations involving profit, loss, and percentage amounts accurately;
- ✓ Use selected ICT tools to investigate, explore and demonstrate profit and loss.

Points to Note

- Aspects of consumer arithmetic can be linked with how money is used in areas of Social Studies, Business Basics, and Home & Family i.e. fiscal budget, shopping lists, price lists in stores etc.
- Use online shopping where currency conversion has to be done and make informed decisions if it is better to purchase an item online as against purchasing locally. Highlight where it is advantageous or not and why.
- Identify apps in Google Playstore that do Percentage Profit and Loss and incorporate these apps in discussions.

Extended Learning

- Participate in a debate on the topic: "Should all currencies be of equal value?"
- Research the "Barter System" which was in place before the use of money.
- Research the 'Silk Road' trade route.
- Design other means of exchange/paying for services instead of using money

RESOURCES

The Internet, Computer/tablets/smartphones, Accessories, Journals, Magazines/Newspapers, Business journals, Calculator, Apps on profit and Loss, Currency Conversion.

KEY VOCABULARY

Money, Percentage, Profit, Loss, Unit Price/unit cost, Total cost, Currencies, Foreign Exchange, Trade (import/export), Conversion

LINKS TO OTHER SUBJECTS

Technical and vocational:

- Attainment Target 1: creativity and innovation: explore a range of problem solving contexts and develop ideas for solutions utilizing new technologies;
- Attainment Target 2: explore methods and procedures: use resources efficiently and use appropriate techniques in the execution of tasks;
- Attainment Target 3: apply solutions: use the design process in planning the execution of solution for an identified problem.

Science:

- Appreciate the importance of scientific methods and be aware of safety procedures to be taken when using equipment and materials;
- Appreciate the importance of healthy lifestyle through the study of STDs, STIs and drug abuse.

Physical Education:

- Attainment Target: games and sports: exhibit the capacity to cope with new and varied skill difficulties and to cooperate with others in regular practice in order to refine technique;
 - Attainment Target: team tactics: demonstrate advanced strategies and tactics in competitive play and undertake the role/roles of player, coach or spectator;
 - Use scientific knowledge to select appropriate experimental methods;
 - Understand the relationships between forces and motion, and illustrate these relationships in the environment and living things;
 - Analyze experimental data and allow for anomalies. Carry out multi-step calculations.
-

About the Unit

In this unit students will learn about/to:

- Participate in group activities and discussions;
- Construct diagrams;
- Identify patterns in relations;
- Draw graphs using various media;
- Predict outcomes;
- Draw conclusions based on graphs showing relations;
- Coordinates on a plane;
- Use Geometry software to explore coordinates.

Prior Learning

Check that students can:

- Identify the 'hidden question' in a two-step problem;
- Write and solve mathematical sentences for a two-step problem;
- Generate number patterns and identify their rules using algebra;
- Solve word problems using algebraic expressions and formulae;
- Use the symbols $>$, $<$, $=$, \neq , \geq , \leq to make a true mathematical sentence;
- Substitute in simple inequalities to make statements true;
- Substitute in algebraic expressions with up to two variables.

ALGEBRA: RELATIONS, FUNCTIONS & GRAPHS**Standard**

Employ algebraic reasoning through the use of expressions, equations and formulae to interpret, model and solve problems involving unknown quantities.

Objectives**Students will be able to:**

- Write coordinates of points as ordered pairs;
- Plot ordered pairs of numbers on the Cartesian plane;
- Read and identify points on the Cartesian plane;
- Connect points on the Cartesian plane to form patterns;
- Represent a mapping by (a) rule, (b) diagram, (c) a set of ordered pairs;
- Recognize and give examples of each of the following type of mapping:
 - I. one-to-one;
 - II. one-to-many;
 - III. many-to-one;
 - IV. many-to-many.

Suggested Teaching and Learning Activities

Key Skills

Assessment Criteria

Students will:

Access relevant Geogebra files to investigate properties of the Cartesian plane (including domain, range, ordered pair, plotting points, reading points, quadrants, etc)

- Engage in discussions
- Construct diagrams
- Make observations
- Problem-solve
- Identify patterns
- Draw graphs
- Predict outcomes
- Model patterns
- Deduce relations
- Draw conclusions
- Complete tables accurately
- Locate coordinates
- Manipulate digital content

- Diagrams correctly constructed
- Written descriptions of patterns identified
- Predictions made based on patterns
- Conclusions are drawn based on graph showing relations
- Completed tables depicting relations
- Coordinates accurately located on plane

Learning Outcomes

Students will be able to:

- ✓ Actively and cooperatively participate in group activities and discussions;
- ✓ Construct diagrams accurately;
- ✓ Predict outcomes based on patterns observed;
- ✓ Draw conclusions based on graph showing relations;
- ✓ Accurately locate coordinates on a plane;
- ✓ Use appropriate software to explore coordinates.

Points to Note

- Ensure students have access to the files at <https://drive.google.com/drive/u/1/folders/0B85w38KXTa7HaW8td0VSWEFvZms>
- Project to the whole class or have students use on their individual devices where possible.
- Design questions to go with each activity. Ensure the questions are open-ended.

Extended Learning

- Research Rene Descartes and his contribution to the coordinate system.
- Compare this system to lines of latitude and longitude and their use in everyday life.

RESOURCES

Teacher-generated tables and worksheets, the Internet, Computer/tablets/smartphones

KEY VOCABULARY

Functions, Relations/relationships, Graphs, Data, Coordinates, Mappings, Points, Ordered pairs, Cartesian plane, Patterns, One-to-one, One-to-many, Many-to-one, Many-to-many, domain, range, independent, dependent, variable

LINKS TO OTHER SUBJECTS

Technical and vocational:

- Attainment Target 1: creativity and innovation: explore a range of problem solving contexts and develop ideas for solutions utilizing new technologies;
- Attainment Target 2: explore methods and procedures: use resources efficiently and use appropriate techniques in the execution of tasks;
- Attainment Target 3: apply solutions: use the design process in planning the execution of solution for an identified problem.

Science:

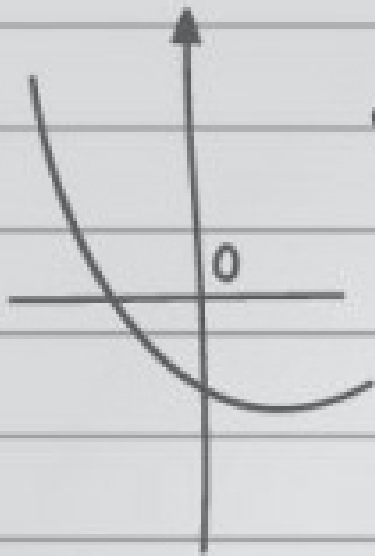
- Appreciate the importance of scientific methods and be aware of safety procedures to be taken when using equipment and materials;
- Appreciate the importance of healthy lifestyle through the study of STDs, STIs, and drug abuse;
- Analyze experimental data and allow for anomalies. Carry out multi-step calculations.

Physical Education:

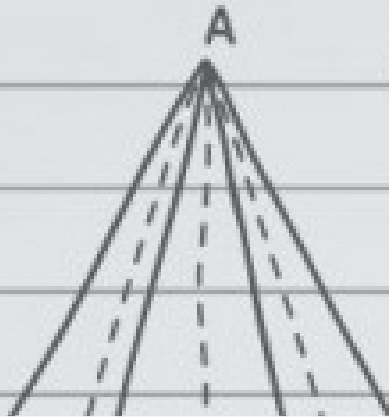
- Attainment Target: games and sports: exhibit the capacity to cope with new and varied skill difficulties and to cooperate with others in regular practice in order to refine technique;
- Attainment Target: team tactics: demonstrate advanced strategies and tactics in competitive play and undertake the role/roles of player, coach or spectator.

Social studies:

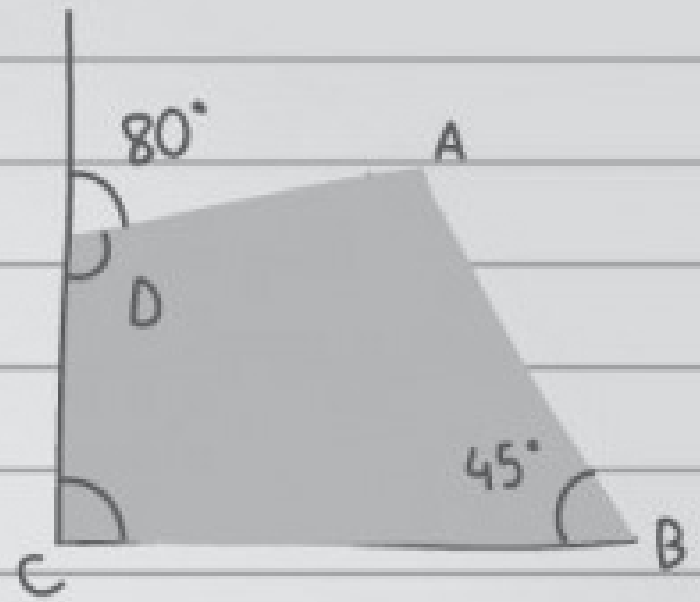
- Attainment Target: present global information from maps, graphs, and pictures.
-



$$ax^2 + bx + c = 0$$



$$\sqrt{\frac{a}{x}}$$

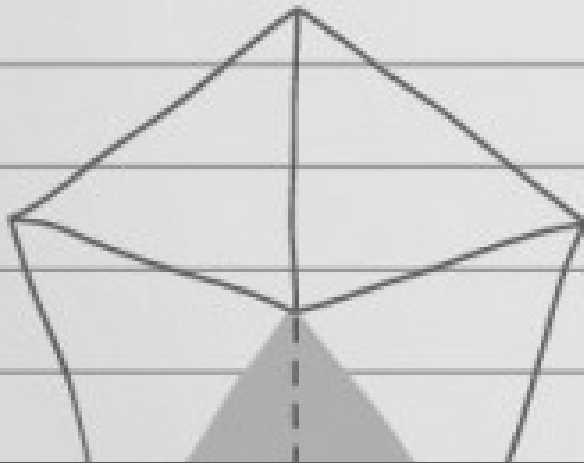


$$\angle A + \angle B + \angle C + \angle D = 360^\circ$$

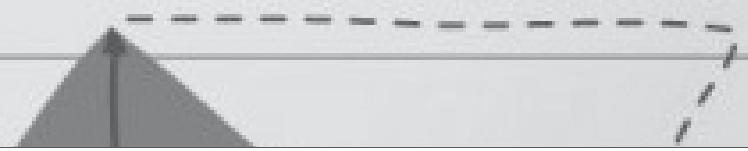
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MATHEMATICS

GRADE 8 UNITS



$$y = \left(\frac{b+ a}{2} \right) - h$$



TERM 1**Unit 1****Numbers**

Real numbers
Indices
Bases

Unit 2**Measurement**

Measuring Concepts
Relationships between Parts of the Circle
Area and Circumference of Various Parts of the Circle
Arc Length

Unit 3**Geometry**

Solids
Transformations
Constructions
Trigonometry

Unit 4**Algebra**

Formulae
Linear Inequalities
Distributive Properties
Laws of Indices
Algebraic Fractions
Factorizations
Simultaneous Equations

TERM 2**Unit 1****Numbers**

Properties of Arithmetic
Ratio
Consumer Arithmetic
Sets

Unit 2**Measurement**

Formulae for finding Areas of Polygons
Surface Areas of Solids
Conversions within Units
Volume and Capacity of Solids and Composite Objects

Unit 3**Geometry**

Properties of Polygons
Sum of Interior Angles of Polygons
Transformations
Calculation of Unknown Angles
Constructions
Pythagoras' Theorem

Unit 4**Algebra**

Making Rules
Equations & Inequalities
Simplification

TERM 3**Unit 1****Numbers**

Sets & Logic
Consumer Arithmetic
Matrices

Unit 2**Measurement****Unit 3****Geometry**

Constructions

Unit 4**Algebra**

Vectors
Relations
Functions
Graphs

TERM 1**TERM 2****Unit 5****Statistics and Probability**

Measures of Central Tendency

Measures of Dispersion

Presentation of Data

Fractions and Percentages as Probability

Range

TERM 3**Unit 5****Statistics and Probability**

Central Tendencies

Range of Data

Frequency Tables

Graphs

Data Collection

Simple Experiments

Simple Probability



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MATHEMATICS

GRADE 8: TERM 1

About the Unit

In this unit students will learn about/to:

- Express products using indices and vice versa;
- Multiplication and division of indices with different bases;
- Place values of bases other than of base 10;
- Convert between bases;
- Operations with bases other than base 10;
- Write numbers in standard form;
- Write integers in standard form;
- Round numbers to given number of decimal places;
- Properties of: closure, reflexive, symmetric, transitive properties and trichotomy;
- Articulate and contribute towards group discussions.

Prior Learning

Check that students can:

- Perform the four basic operations on numbers;
- Distinguish between the types of numbers;

NUMBERS: INDICES, BASES & ESTIMATIONS

Standard

Use the basic operations, number relationships, patterns, number facts, calculators and software to compute and estimate in order to solve real world problems involving fractions, percentages and decimals.

Objectives

Students will be able to:

- State the meaning of a^m , where a and m are whole numbers;
- Evaluate the expressions a^m , $a^m \times b^n$ and $\frac{a^m}{b^n}$ where a, b, m, n , are whole numbers;
- Write numbers greater than or equal to 10 in standard form;
- Write a number to a given number of decimal places and significant figures;
- Express place values of digits in all bases including base 10;
- Add, subtract and multiply numbers written in base n , (where $1 < n < 10$);
- Convert numbers written in base n , (where $1 < n < 10$) to base 10 and vice versa.

Students will:

Investigate indices, by modeling the spread of a contagious epidemic such as Influenza.

Equipment required: people (about 40). Start with everyone sitting down.

- The first person to be infected stands up – choose someone. This is step 0
- They infect two more people – choose them. They also stand up. This is step 1.
- They each infect two more people – choose them from amongst those still sitting. This is step 2.
- Continue until everyone is infected, keeping count of how many steps there are in the epidemic.
- participate in a discussion where the concept of indices and bases will be generated.

Copy and complete the table in Appendix C, for each step.

- Sequence
- Identify patterns
- Compute
- Investigate
- Make observations
- Research
- Present
- Review
- Convert
- Estimate

- Formulation and use of function to represent multiplication of numbers of the same base
- Conclusions made, and application of any number raised to the power of zero is one
- Ability to represent numbers in different bases
- Ability to carry out research independently on given topic
- Expressing integers in standard form and vice versa

Learning Outcomes**Students will be able to:**

- ✓ Express products using indices and vice versa;
- ✓ Simplify multiplication and division of indices with different bases;
- ✓ Know the place values of bases other than of base 10;
- ✓ Convert between bases;
- ✓ Perform operations with bases other than base 10;
- ✓ Write numbers in standard form;
- ✓ Round a number to a given number of decimal places.

Points to Note

- If an STI is used, involve the HFLE teacher/guidance counselor in discussions.
- Each person is only allowed to infect two persons.
- Repeat investigations for cases where each person is only allowed to infect 3, 4.... persons.
- Allow students to report findings.
- Have the students design a strategy to combat the spread of the epidemic, such as designing sanitation spots.
- Discuss the types of pathogens (virus, bacteria, etc) which would be the cause of such epidemic.
- Explore the use of numbers expressed in standard form to describe the size of pathogens.

Extended Learning

- Students should investigate other diseases, and how they are spread.
- Investigate distances of planets from earth.

RESOURCES

Activity instruction sheet, internet, laptop/tablet/smartphone

KEY VOCABULARY

Base, powers, epidemic, contagious, infection, infected, population, disease, Pathogens,

LINKS TO OTHER SUBJECTS

Technical and Vocational Attainment Targets

- creativity and innovation: explore a range of problem solving contexts and develop ideas for solutions utilizing new technologies; apply solutions: use the design process in planning the execution of solution for an identified problem; explore methods and procedures: use resources efficiently and use appropriate techniques in the execution of tasks.

Science:

- investigate the spread of diseases
- design approaches to reduce the spread of diseases.

Physical Education Attainment Targets:

- games and sports: exhibit the capacity to cope with new and varied skill difficulties and to cooperate with others in regular practice in order to refine technique;
 - Attainment Target: team tactics: Demonstrate advanced strategies and tactics in competitive play and undertake the role/roles of player, coach or spectator.
-

About the Unit

In this unit students will learn about/to:

- Properties of: closure, reflexive, symmetric, transitive properties and trichotomy;
- Articulate and contribute towards group discussions.

Prior Learning

Check that students can:

- Perform the four basic operations on numbers;
- Distinguish between types of numbers.

NUMBERS: ARITHMETIC PROPERTIES**Standard**

Use the basic operations, number relationships, patterns, number facts, calculators and software to compute and estimate in order to solve real world problems involving fractions, percentages and decimals.

Objectives**Students will be able to:**

Identify and use the following concepts:

- Closure;
- Reflexive property;
- Symmetry property;
- Transitive property;
- Trichotomy Law.

Suggested Teaching and Learning Activities

Key Skills

Assessment Criteria

Students will:

Research arithmetic properties of real numbers.

- Discover
- Construct
- State
- represent
- Apply.

Apply the properties in solving arithmetic computations.

Learning Outcomes

Students will be able to:

Identify the following concepts:

- ✓ Closure;
- ✓ Reflexive property;
- ✓ Symmetry property;
- ✓ Transitive property;
- ✓ Trichotomy Law.

Points to Note

Ensure that the four basic operations are used to demonstrate the arithmetic properties. For example, under addition on the set of natural numbers, $3 + 4 =$ (another natural number) 7, but, under subtraction in the set of natural numbers $3 - 4$ does not give another natural number, so subtraction on the natural numbers is not closed.

Extended Learning

Research the different types of mathematical properties and their importance to real life.

RESOURCES

Computers/smart devices, Internet

KEY VOCABULARY

Closure, trichotomy, transitive, symmetry, reflexive.

LINKS TO OTHER SUBJECTS

Technical and Vocational Attainment Targets:

- creativity and innovation: explore a range of problem solving contexts and develop ideas for solutions utilizing new technologies;
- apply solutions: use the design process in planning the execution of solution for an identified problem;
- methods and procedures: use resources efficiently and use appropriate techniques in the execution of tasks.

Science:

- analyze experimental data and allow for anomalies. Carry out multi-step calculations.

Physical Education Attainment Targets

- games and sports: exhibit the capacity to cope with new and varied skill difficulties and to cooperate with others in regular practice in order to refine technique;
 - demonstrate advanced strategies and tactics in competitive play and undertake the role/roles of player, coach or spectator.
-

About the Unit

In this unit students will learn about/to:

- Engage in group discussions and activities;
- Problem-solving situations;
- Changing subject of formulae;
- Equations and inequalities;
- Represent inequalities on number lines;
- Making algebraic rules;
- Simplification;
- Solve linear inequalities.

Prior Learning

Check that students can:

- Formulate rules from their knowledge of arithmetic properties;
- Define and identify variables, terms, constant, coefficient, expression, equation and operations;
- Identify, add and subtract like and unlike terms.

ALGEBRA: MAKING RULES, EQUATIONS & INEQUALITIES, SIMPLIFICATION**Standard**

Employ algebraic reasoning through the use of expressions, equations and formulae to interpret, model and solve problems involving unknown quantities.

Objectives**Students will be able to:**

Identify and use the following concepts:

- Change the subject of a simple formula e.g., $C=2\pi r$, making r the subject gives $r = \frac{C}{2\pi}$;
- Write inequalities to illustrate word problems;
- Illustrate inequalities on a number line;
- Solve simple linear inequalities and represent the solution on a number line.

Suggested Teaching and Learning Activities

Key Skills

Assessment Criteria

Students will:

Use the geogebra file Inequality_2 located at <https://drive.google.com/drive/u/1/folders/0B85w38KXTa7HaW8td0VSWEFvZms> to investigate inequalities

- Engage in activities
- Problem-solve
- Write inequalities
- Represent inequalities on number lines
- Solve linear inequalities
- Represent solutions on number lines

- Solution sets correctly identified
- Inequalities correctly entered
- Properties of inequalities correctly identified

Learning Outcomes

Students will be able to:

- ✓ Actively engage in group discussions and activities;
- ✓ Engage in problem solving situations;
- ✓ Complete list of inequalities accurately;
- ✓ Solve linear inequalities correctly;

Points to Note

Download the Geogebra file from the location <https://drive.google.com/drive/u/1/folders/0B85w38KXTa7HaW8td0VSWEFvZms>.

The name of the file is inequality_2. The file allows the user to enter their inequalities. Ask questions to have them find the properties of inequalities.

Extended Learning

Investigate linear programming

RESOURCES

Computers/smart devices, Internet access, Teacher generated tables needed for each activity

KEY VOCABULARY

Algebra, Inequalities, Linear, Formulae, Solution, Equation, Simplification

LINKS TO OTHER SUBJECTS

Technical and Vocational Attainment Targets:

- creativity and innovation: explore a range of problem solving contexts and develop ideas for solutions utilizing new technologies;
- apply solutions: use the design process in planning the execution of solution for an identified problem;
- explore methods and procedures: use resources efficiently and use appropriate techniques in the execution of tasks.

Science:

- analyze experimental data and allow for anomalies. Carry out multi-step calculations.

Physical Education Attainment Targets:

- games and sports: exhibit the capacity to cope with new and varied skill difficulties and to cooperate with others in regular practice in order to refine technique;
 - demonstrate advanced strategies and tactics in competitive play and undertake the role/roles of player, coach or spectator.
-

About the Unit

In this unit students will learn about/to:

- Angles formed from transversal and parallel lines;
- Apply angle properties formed from transversal and parallel lines to find missing angles;
- Movements of shapes/objects;
- Translate objects to its image and vice versa with given movement and direction;
- Movement and direction of an object and its image;
- Use real numbers to represent horizontal and vertical movements and their direction;
- Reflect an object in the x-axis or y-axis;
- Rotate objects 90° , 180° and 270° .

Prior Learning

Check that students can:

- Identify and use angle, side and symmetry properties of triangles and quadrilaterals.

GEOMETRY:**Standard**

Explore paths, geometric shapes, and space and make generalization about geometric relationships within the environment.

Objectives**Students will be able to:**

Identify and use the following concepts:

- Investigate the relationship among angles formed by:
 - a. a transversal and two or more parallel lines;
 - b. intersecting non-parallel lines;
- Sketch different views (top, side, etc.) of solids making use of unseen (dotted) lines;
- Perform translations and identify images of objects, where the translation vector is given;
- Find the translation vector given the object and its image;
- Perform reflections and identify images of objects, where the mirror lines are the x or y-axes;
- Perform rotations of 90° , 180° , 270° about the origin.

Students will:

Use GeoGebra to investigate Translation, Reflection, and rotation and participate in a discussion about the transformations from the site:

<https://drive.google.com/drive/u/1/folders/0B85w38KXTa7HaW8td0VSWEFvZms>

- Draw lines
- Measure angles
- Observe relationships between angles
- Describe relationships
- Translate
- Arrange
- Rotate
- Collect
- Sketch
- Reflect
- use software to carry out transformations

- Translations of objects to its image and vice versa with given movement and direction
- Ability to determine the movement and direction given an object and its image
- Use of real numbers to represent horizontal and vertical movements and their direction
- Ability to reflect an object in the x-axis or y-axis
- Rotation of objects 90° , 180° and 270°

Learning Outcomes**Students will be able to:**

- ✓ Apply angle properties formed from transversal and parallel lines to find missing angles;
- ✓ Describe movements of shapes/objects;
- ✓ Translate objects to its image and vice versa with given movement and direction;
- ✓ Determine the movement and direction given an object and its image;
- ✓ Use real numbers to represent horizontal and vertical movements and their direction;
- ✓ Reflect an object in the x-axis or y-axis;
- ✓ Rotate objects 90° , 180° and 270° .

Points to Note

- Use GeoGebra to demonstrate Translation, Reflection, and rotation.
- Ensure that the files are already downloaded and that Geogebra is already installed on the devices to be used.
- This can be a whole class activity with the requisite file projected to the whole class if devices are not available.
- Make sure to ask open-ended questions
- Geogebra can be used to find lengths of sides and size of angles. Ensure that these skills are already known before the class starts.

Extended Learning

- Investigate the use of transformations in computer graphics/games
- Create designs using a combination of 2 transformations only.

RESOURCES

Computers/smart devices, Internet access, Copies of the tables needed for each activity, Geogebra files (<https://drive.google.com/drive/u/1/folders/0B85w38KXTa7HaW8td0VSWEFvZms>)

KEY VOCABULARY

Transformations, Translate, Rotate, Reflect, Transversal, Cartesian plane, Parallel, Non-parallel, Intersecting, Solids, Image, Object, Vector, Mirror line, x-, y-axis, Origin, symmetry, similarity, congruence.

LINKS TO OTHER SUBJECTS

Technical and Vocational Attainment Targets:

- creativity and innovation: explore a range of problem solving contexts and develop ideas for solutions utilizing new technologies;
- apply solutions: use the design process in planning the execution of solution for an identified problem;
- explore methods and procedures: use resources efficiently and use appropriate techniques in the execution of tasks.

Science:

- analyze experimental data and allow for anomalies. Carry out multi-step calculations.

Physical Education Attainment Targets:

- games and sports: exhibit the capacity to cope with new and varied skill difficulties and to cooperate with others in regular practice in order to refine technique;
 - team tactics: demonstrate advanced strategies and tactics in competitive play and undertake the role/roles of player, coach or spectator.
-



NSC

MATHEMATICS

GRADE 8: TERM 2

About the Unit

In this unit students will learn about/to:

- Properties of n-sided polygons where $3 \leq n \leq 10$;
- The sum of interior angles of an n-sided polygon;
- Use formula to calculate the sum of the interior angles of an n-sided polygon.

Prior Learning

Check that students can:

- Identify angles in polygons;
- Calculate to find unknown angles in polygons

GEOMETRY: MAKING RULES, EQUATIONS & INEQUALITIES, SIMPLIFICATION**Standard**

Explore paths, geometric shapes, and space and make generalizations about geometric relationships within the environment.

Objectives**Students will be able to:**

- Determine the properties of n-sided polygons, where $3 \leq n \leq 10$;
- Find the angle sum (*sum of the interior angles*) of polygons with n interior angles ($3 \leq n \leq 10$).

Suggested Teaching and Learning Activities

Key Skills

Assessment Criteria

Students will:

Use their electronic devices to create movies about polygons in their environment. This movie should include scenes or photos of students identifying polygons and measuring the length their sides and size of their angles.

- Connect vertices
- Record
- Derive formula
- Use formula
- Recall

- Identification of properties of n-sided polygons where $3 \leq n \leq 10$
- Formula derived for the sum of interior angles of an n-sided polygon
- Use of formula to calculate the sum of interior angles of an n-sided polygon

Learning Outcomes

Students will be able to:

- ✓ Identify properties of n-sided polygons where $3 \leq n \leq 10$;
- ✓ Derive formula for the sum of interior angles of an n-sided polygon;
- ✓ Use formula to calculate the sum of the interior angles of an n-sided polygon.

Points to Note

- Students should be able to identify polygons.
- The teacher should differentiate between regular and irregular polygons.
- The teacher should have students download application softwares such as “auto distance” and “protractor master” to measure length and angles from a distance.
- Identify margin of error

Extended Learning

- Investigate the sum of interior angles of polygons of up to 20 sides. Tabulate findings.
- Research the various uses of angles in the construction industry.

RESOURCES

Computers/smart devices, Internet access, Geometry software, auto distance and protractor master apps from Google Playstore.

KEY VOCABULARY

Polygons, Angle, Interior, Properties, vertices, Formula, Regular polygon, irregular polygon

LINKS TO OTHER SUBJECTS

Technical and Vocational Attainment Targets:

- Attainment Target 1: creativity and innovation: explore a range of problem solving contexts and develop ideas for solutions utilizing new technologies;
- Attainment Target 3: apply solutions: use the design process in planning the execution of solution for an identified problem;
- Attainment Target 2: Explore methods and procedures: use resources efficiently and use appropriate techniques in the execution of tasks.

Science:

- Analyze experimental data and allow for anomalies. Carry out multi step calculations.

Physical Education:

- Attainment Target: games and sports: exhibit the capacity to cope with new and varied skill difficulties and to cooperate with others in regular practice in order to refine technique;
 - Attainment Target: team tactics: Demonstrate advanced strategies and tactics in competitive play and undertake the role/roles of player, coach or spectator.
-

About the Unit

In this unit students will learn about/to:

- Interpret graphs;
- Conduct research;
- Key terms in Statistics;
- Use tables to represent data;
- Mean of sets of data;
- Median of sets of data;
- Mode of a set of data

Prior Learning

Check that students can:

- Create a frequency table from a raw data;
- Analyze information in a frequency table;
- Find mean, mode and median from given data.

STATISTICS: STATISTICS AND PROBABILITY**Standard**

Collect, organize, interpret and represent data and make inferences by applying knowledge of statistics and probability.

Objectives**Students will be able to:**

- Determine the mode, median and mean from a frequency table;
- Use the mode, median and mean to interpret information;
- Read, interpret and construct pictographs, bar charts, pie charts and line graphs.

Students will:

Use <http://m.shoesize.com/measure/> to measure their shoe sizes

Complete the frequency table by filling in the shoe sizes measured. Form groups according their shoe sizes and answer questions such as;

- What do you think is the most popular size?
- How would this size be determined?
- Is this what we would call the typical size?
- Etc.

Calculate the mean of the collected data, Identify the mode and median of the collected data, Decide on the best graph to show the information.

- Review data
- Construct chart
- Work in groups
- Discuss and define key terms
- Arrange numbers
- Derive ideas
- Analyze data
- Record data
- Research information
- Construct table
- Represent data

- Active involvement in group discussions and activities
- Definition of terms
- Completed tables
- Calculation of measures of central tendencies.

Learning Outcomes**Students will be able to:**

- ✓ Interpret graphs;
- ✓ Conduct research;
- ✓ Engage in problem solving situations;
- ✓ Define key terms;
- ✓ Complete tables;
- ✓ Calculate measures of central tendencies,
- ✓ use software efficiently.

Points to Note

- There can be two groups: Separate males from females and complete separate frequency tables for each
- Do a whole group frequency table as well.
- Generate the graph for each group including the whole group.
- Find the measures of central tendency for all 3 groups and discuss findings
- Have the Information Technology teacher assist in designing a spreadsheet for the data to be inputted and for the graphs to be generated.
- Use the following apps from the google Playstore to assist with calculations: Mean Median Mode Statistics Calculator

Extended Learning

Investigate the composition of clean air

RESOURCES

Computers/smart devices, Internet access

KEY VOCABULARY

Mean, Mode, Median, Statistics, Average, Frequency, Data, Distribution, Information

LINKS TO OTHER SUBJECTS

Technical and Vocational Attainment Targets:

- Attainment Target 1: creativity and innovation: explore a range of problem solving contexts and develop ideas for solutions utilizing new technologies;
- Attainment Target 3: apply solutions: use the design process in planning the execution of solution for an identified problem;
- Attainment Target 2: Explore methods and procedures: use resources efficiently and use appropriate techniques in the execution of tasks.

Science:

- Analyze experimental data and allow for anomalies. Carry out multi step calculations.

Physical Education:

- Attainment Target: games and sports: exhibit the capacity to cope with new and varied skill difficulties and to cooperate with others in regular practice in order to refine technique;
 - Attainment Target: team tactics: Demonstrate advanced strategies and tactics in competitive play and undertake the role/roles of player, coach or spectator.
-

About the Unit

In this unit students will learn about/to:

- Use ratio ideas to find unknown quantities;
- Sharing proportionally using ratios;
- Simple equations and ratios.

Prior Learning

Check that students can:

- Perform the four basic operations on numbers;
- Express fractions as ratio and vice versa.

NUMBERS: RATIO AND PROPORTION**Standard**

Use the basic operations, number relationships, patterns, number facts, calculators and software to compute and estimate in order to solve real world problems involving fractions, percentages and decimals.

Objectives**Students will be able to:**

Solve simple problems involving ratio and proportion

Suggested Teaching and Learning Activities

Key Skills

Assessment Criteria

Students will:

Design moisturizers using natural resources such as papaya, sugar, coconut oil, etc. The moisturizers are to be tested and presentations made. Business models are to be provided for these moisturizers. Design the packages for these moisturizers.

- Identify
- Apply concepts
- Analyze
- Compare
- Investigate
- Measure
- Infer
- Solve
- design
- research

- Engagement in group activities
- Design of packages and moisturizers
- Design of business models
- Design of proportions list

Learning Outcomes

Students will be able to:

- ✓ Use ratio ideas to find unknown quantities;
- ✓ Describe sharing proportionally using ratios;
- ✓ Formulate and solve simple equations using ratios and proportions

Points to Note

Provide as many of the resources/ingredients as possible such as cornmeal, oats, honey, oil, lime/lemon, aloe vera and any other that students suggest. Research has to be done to know the proportions to be used and why. Design software for the packaging can be used to design the packages for the moisturizers. This designing will take in nets of solids. Work with the business department to assist students in making their business models, marketing strategies and advertising. Consumer arithmetic is also present here with cost price, selling price, profit and loss.

Have students give instructions on proportions to be used to make the moisturizers in the event customers want to blend for themselves. Measurement will also come out here such as grams so ensure correct scales are used.

Extended Learning

Design diet drinks

RESOURCES

Computers/tablets/smartphones, Internet access, Ingredients, Design software, Kitchen scale

KEY VOCABULARY

Ratio, proportion, profit, loss, business model, moisturize, gram, kilogram

LINKS TO OTHER SUBJECTS

Technical and vocational:

- Attainment Target 1 creativity and innovation: explore a range of problem solving contexts and develop ideas for solutions utilizing new technologies;
- Attainment Target 3: apply solutions: use the design process in planning the execution of solution for an identified problem;
- Attainment Target 2 Explore methods and procedures: use resources efficiently and use appropriate techniques in the execution of tasks.

Science:

- Analyze experimental data and allow for anomalies. Carry out multi step calculations.

Physical Education:

- Attainment Target: games and sports: exhibit the capacity to cope with new and varied skill difficulties and to cooperate with others in regular practice in order to refine technique;
 - Attainment Target: team tactics: Demonstrate advanced strategies and tactics in competitive play and undertake the role/roles of player, coach or spectator.
-

About the Unit

In this unit students will learn about/to:

- Find simple and compound interest;
- Hire Purchase
- Different types of bank accounts
- Complete accurately information on a cheque leaf
- Calculate discounts and taxes

Prior Learning

Check that students can:

- Perform the four basic operations on numbers;
- Estimate and approximate to the nearest hundredths, tenths, etc.

NUMBERS: CONSUMER ARITHMETIC**Standard**

Use the basic operations, number relationships, patterns, number facts, calculators and software to compute and estimate in order to solve real world problems involving fractions, percentages and decimals.

Objectives**Students will be able to:**

- Identify different types of bank accounts with their characteristic features;
- Complete withdrawal and deposit forms
- Complete accurately information on a cheque leaf;
- Use simple proportions of principal, rate and time to develop the Simple Interest;
- Calculate simple interest on loans and deposits;
- Calculate compounded interest using a calculator (using a recursive method);
- Calculate total cost in a hire purchase agreement and compare Hire Purchase Price and Cost Price;
- Calculate discounts and taxes from given instructions.

Suggested Teaching and Learning Activities

Key Skills

Assessment Criteria

Students will:

In groups, operate their own bank or business. Each group should offer a different service such as saving, chequing/business accounts, loans or hire purchase. They should be given different roles such as customer service, teller, manager...

Create vouchers required for their own business. As business owners, calculate the interest that should be charged to get maximum but reasonable profits.

Cut-out and/or collect advertisement with hire purchases, sales, discounts, loans, taxes, etc. Use advertisements to compute appropriate calculations.

- Observe
- calculate
- analyse
- compare
- select
- advise
- create
- share
- discuss
- evaluate

- Demonstration and understanding of money by creating and/or explaining the process
- Operating a business
- Correct completion of forms associated with banking
- Justify the need for charging interest rates
- Calculating interest on principal
- Ability to make wise financial decisions

Learning Outcomes

Students will be able to:

- ✓ Identify different bank accounts by their characteristic features;
- ✓ Complete withdrawal and deposit forms
- ✓ Complete accurately information on a cheque leaf;
- ✓ Calculate Simple Interest on loans and deposits (SI);
- ✓ Use calculator to find compound interest;
- ✓ Determine total cost in hire purchase agreements and make comparisons between cash price and hire purchase prices;
- ✓ Find discounts and associated tax from given scenarios.

Points to Note

Invite a bank representative to make presentations to the class. Ask the rep to provide samples of deposit and withdrawal slips and to assist in filling out these slips.

Have students discuss why they can't charge too much or too little of interest. Ensure that profit and loss are discussed as well and that taxes and other deductions are to be made.

Ensure that the following apps are downloaded from the google Playstore to assist: Discount calculator

Extended Learning

- Research the development of the banking system.
- Research security in the financial sector

RESOURCES

Computers/smartdevices, Internet access, Websites to generate charts and templates -

<https://www.easycalculation.com/unit-conversion/index.php> -

Financial Periodicals, Newspapers, Samples of banking documents, Apps from google Playstore (discount calculator)

KEY VOCABULARY

Bank accounts, Withdrawal, Deposit, Cheque, Proportions, Principal, Rate, Time, Simple Interest, Loans, Compound Interest, Cost Price, Hire Purchase, Discounts, Taxes

LINKS TO OTHER SUBJECTS

Technical and vocational:

- Attainment Target 1 creativity and innovation: explore a range of problem solving contexts and develop ideas for solutions utilizing new technologies;
- Attainment Target 3: apply solutions: use the design process in planning the execution of solution for an identified problem;
- Attainment Target 2 Explore methods and procedures: use resources efficiently and use appropriate techniques in the execution of tasks.

Science:

- Analyze experimental data and allow for anomalies. Carry out multi step calculations.

Physical Education:

- Attainment Target: games and sports: exhibit the capacity to cope with new and varied skill difficulties and to cooperate with others in regular practice in order to refine technique;
 - Attainment Target: team tactics: Demonstrate advanced strategies and tactics in competitive play and undertake the role/roles of player, coach or spectator.
-

About the Unit

In this unit students will learn about/to:

- Derive formulae;
- Area of triangles, parallelograms and trapezia;
- Total surface area of solids;
- Volume of prisms (cubes, cuboids, cylinders and triangular prisms with known altitude);
- Use formulae to solve problems involving area, total surface area and volume of prisms (cubes, cuboids, cylinders and triangular prisms with known altitude);
- Differentiate between capacity and volume;
- Convert between units of measure up to cubic units.

Prior Learning

Check that students can:

- Perform the four basic operations on numbers;
- Apply the properties of solids;
- Apply the properties of triangles and quadrilaterals to solve problems.

MEASUREMENT: AREAS, VOLUMES, CAPACITY**Standard**

Use the correct units, tools and attributes to estimate, compare and carry out the processes of measurement to given degree of accuracy.

Objectives**Students will be able to:**

- Derive and use the formulae for the area of (a) parallelograms, (b) triangles ($\frac{1}{2}bh$), (c) trapezia;
- Compute the total surface area of cubes, cuboids, cylinders and triangular prisms (using only triangles where the area can be calculated using $\frac{1}{2}bh$ for the triangular prism);
- Perform conversion within units up to cubed units;
- Establish formulas and,
- Estimate and calculate the volume and capacity of cubes, cuboids, prisms, cylinders, and composite objects.

Suggested Teaching and Learning Activities

Key Skills

Assessment Criteria

Students will:

Design a model water tank system for their school or home.

- Draw diagrams
- Construct shapes
- Draw conclusions
- Apply formulae
- Create

- Volumes of various solids found
- Cost of building the tank calculated
- Wages for workers calculated
- Optimal volume worked out that will serve the school for a week

Learning Outcomes

Students will be able to:

- ✓ Derive formulae for calculating:
 - Area of triangles, parallelograms and trapezia;
 - Total surface area of solids;
 - Volume of prisms (cubes, cuboids, cylinders and triangular prisms with known altitude);
- ✓ Use formulae to solve problems involving area, total surface area and volume of prisms (cubes, cuboids, cylinders and triangular prisms with known altitude);
- ✓ Differentiate between capacity and volume;
- ✓ Convert between units of measure up to cubic units;

Points to Note

- Students must establish the volume of water that should serve the school for a week at least.
- Work out the cost of building the tank from materials to be used and payment for workmen.
- Decide on the best shape for the tank in order to maximise volume.
- Advise or develop model on how to conserve water so that it lasts more than a week.

Extended Learning

Research the implications of lack of water on the school environment.

RESOURCES

Computers/tablets/smart phones, Internet access, Copies of the tables needed for each activity, Websites to generate charts and templates (<https://www.easycalculation.com/unit-conversion/index.php>), Software to design tanks

KEY VOCABULARY

Trapezia, trapezium, cylinder, volume, capacity, prism, cubic units, surface area, tank, drought.

LINKS TO OTHER SUBJECTS

Technical and vocational:

- Attainment Target 1 creativity and innovation: explore a range of problem solving contexts and develop ideas for solutions utilizing new technologies;
- Attainment Target 3: apply solutions: use the design process in planning the execution of solution for an identified problem;
- Attainment Target 2 Explore methods and procedures: use resources efficiently and use appropriate techniques in the execution of tasks.

Science:

- Analyze experimental data and allow for anomalies. Carry out multi step calculations.

Physical Education:

- Attainment Target: games and sports: exhibit the capacity to cope with new and varied skill difficulties and to cooperate with others in regular practice in order to refine technique;
 - Attainment Target: team tactics: Demonstrate advanced strategies and tactics in competitive play and undertake the role/roles of player, coach or spectator.
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NSC

MATHEMATICS

GRADE 8: TERM 3

About the Unit

In this unit students will learn about/to:

- Grid with points plotted;
- Plot lines on grids;
- Identify and write coordinates;
- Real-life problem situations;
- Share and compare results;
- Calculation gradients of given lines;
- Y – Intercepts;
- Linear inequalities;
- Represent pairs of linear equations on graph paper.

Prior Learning

Check that students can:

- Perform the four basic operations on numbers;
- Identify the 4 quadrants
- Plot points

ALGEBRA: RELATIONS, FUNCTIONS & GRAPHS**Standard**

Employ algebraic reasoning through the use of expressions, equations and formulae to interpret, model and solve problems involving unknown quantities.

Objectives**Students will be able to:**

- Plot the ordered pairs of a mapping as a graph;
- Draw straight line graphs of the form by
 - a. plotting points
 - b. using the gradient and intercept;
- Determine gradients and intercepts of straight line graphs;
- Relate gradient of a graph to the rate of change of quantities;
- Find the equation of any straight line;
- Plot two linear equations on the same pair of axes and interpret the point(s) of intersection (if any);
- Graph linear inequalities on the coordinate plane and identify regions on the graph.

Suggested Teaching and Learning Activities

Key Skills

Assessment Criteria

Students will:

Use the supplied Geogebra files to interpret point of intersection and graphing of linear equalities.

- Calculate gradients
- plot points correctly
- identify intercepts
- interpret graphs
- navigate digital content.

- Identify y – intercepts correctly
- Identify point of intersection between two straight lines
- Identify that this point is the solution to the system of simultaneous equations.
- Identify that two lines have the same gradient when they are parallel
- Identify that when the product of two straight lines is -1 then the lines meet at 90°

Learning Outcomes

Students will be able to:

- ✓ Cooperatively engage in group participation, discussions and activities;
- ✓ Identify point of intersection between two straight lines;
- ✓ Identify that two lines are parallel lines because their gradients are the same;
- ✓ Identify that two lines are perpendicular lines by the product of their gradients being -1 ;
- ✓ Correctly identify y – intercepts;
- ✓ Identify the solution of linear inequalities ;

Points to Note

- For intersection of two linear functions:
<https://drive.google.com/drive/u/1/folders/0B85w38KXTa7HNi00cE9pTI92d1U>
- For inequalities:
<https://drive.google.com/drive/u/1/folders/0B85w38KXTa7HNi00cE9pTI92d1U>
- Ensure that the correct files are identified and opened for students to use. The files can also be used on smart devices.

Extended Learning

Investigate the importance of gradients in building roads, ramps, staircases, etc.

RESOURCES

Computers/tablets/smart phones, Internet access, GeoGebra software

KEY VOCABULARY

Coordinates, Points, Relation, Function, Graph, Axes, Gradient, Intercept, Quantity, Equation, inequality, 'less than or equal to', 'greater than or equal to'

LINKS TO OTHER SUBJECTS

Technical and vocational:

- Attainment Target 1 creativity and innovation: explore a range of problem solving contexts and develop ideas for solutions utilizing new technologies;
- Attainment Target 3: apply solutions: use the design process in planning the execution of solution for an identified problem;
- Attainment Target 2 Explore methods and procedures: use resources efficiently and use appropriate techniques in the execution of tasks.

Science:

- Analyze experimental data and allow for anomalies. Carry out multi step calculations.

Physical Education:

- Attainment Target: games and sports: exhibit the capacity to cope with new and varied skill difficulties and to cooperate with others in regular practice in order to refine technique;
 - Attainment Target: team tactics: Demonstrate advanced strategies and tactics in competitive play and undertake the role/roles of player, coach or spectator.
-

About the Unit

In this unit students will learn about/to:

- Constructions of given angles;
- Geometric instruments used during various constructions;
- Use bisector to divide angles.

Check that students can:

- Use geometric instruments

GEOMETRY: CONSTRUCTIONS**Standard**

Explore paths, geometric shapes and space and make generalization about geometric relationships within the environment.

Objectives**Students will be able to:**

Construct, using appropriate geometric instruments:

- Angle bisectors;
- Angles of 90° , 45° , 60° , 30°
- Triangles.

Suggested Teaching and Learning Activities

Key Skills

Assessment Criteria

Students will:

- | | | |
|--|--|--|
| <ul style="list-style-type: none">• View presentation on constructing angles at http://www.mathopenref.com/constangle30.html• Design the front view of a house using the 90, 45, 60, 30-degree angles. | <ul style="list-style-type: none">• Construct angles• lines and triangles• Bisect angles and lines | <ul style="list-style-type: none">• Angles constructed• Correct use of appropriate geometric instruments• Accurate use of angle bisector |
|--|--|--|

Learning Outcomes

Students will be able to:

- ✓ Construct angles accurately;
- ✓ Use appropriate geometric instruments during various constructions;
- ✓ Use bisector correctly to divide angles evenly.

Points to Note

- In the absence of internet, the teacher should use screen capture software to record the videos.
- Students should be exposed to tools used by professionals to bisect angles. For example, the Carpenter's square.

Extended Learning

Investigate architecture and engineering drawing

RESOURCES

Geometric instruments, Internet, Computer, Journals, suggested website in points to note above

KEY VOCABULARY

Angles, Construct, Triangle, Bisector, Degrees

LINKS TO OTHER SUBJECTS

Science:

- Analyze experimental data and allow for anomalies. Carry out multi step calculations.

Technical and vocational:

- Attainment Target 1 creativity and innovation: explore a range of problem solving contexts and develop ideas for solutions utilizing new technologies;
- Attainment Target 2 Explore methods and procedures: use resources efficiently and use appropriate techniques in the execution of tasks;
- Attainment Target 3: apply solutions: use the design process in planning the execution of solution for an identified problem;
- Attainment Target 2: explore methods and procedures: make informed decisions in the selection of materials, tools and equipment and demonstrate increasing skill in the execution of tasks;
- Attainment Target 3 Apply solutions: manage resources with the aid of appropriate technologies in the execution of tasks;
- Attainment Target 3: apply solutions: build practical skills and the technical competencies necessary for effecting a solution/outcome.

Physical Education:

- Attainment Target: games and sports: exhibit the capacity to cope with new and varied skill difficulties and to cooperate with others in regular practice in order to refine technique
 - Attainment Target: team tactics: Demonstrate advanced strategies and tactics in competitive play and undertake the role/roles of player, coach or spectator.
-

About the Unit

In this unit students will learn about/to:

- Subsets of given sets;
- Determine the number of possible subsets of a given set;
- Analyze information from a Venn diagram;
- The intersection of sets;
- Elements of given sets.

Prior Learning

Check that students can:

- Identify subsets of a set
- List the elements of a set
- State the number of elements in a set

NUMBERS 3: SETS**Standard**

Use the basic operations, number relationships, patterns, number facts, calculators and software to compute and estimate in order to solve real world problems involving fractions, percentages and decimals.

Objectives**Students will be able to:**

- Determine the number of subsets of a given set;
- List all the possible subsets of a given set (number of elements in the given set should not exceed 4);
- Solve simple problems involving, at most, two subsets of the universal set.
- Understand the concept of proposition and use the language of logic (negation, conjunction, disjunction, if...then, equivalence)
- Identify and differentiate between simple and compound propositions
- Express simple and compound propositions algebraically using appropriate terminology and vice versa

Students will:

LOGIC ACTIVITY

This is a group activity or entire class activity.

Have students collect information on how many of them, in the class, have a DVD player at home and how many have computers at home. The results should be recorded in the table below.

	DVD player	No DVD player
Computer		
No computer		

a. Have students provide answers to the following questions. Let p and q represent the following simple propositions:

p : I have a computer

q : I have a DVD player

Write each of the following propositions in symbolic form.

i. I do not have a computer

ii. I have a computer and a DVD player

iii. I do not have a DVD player nor a computer

iv. I do not have a computer but I have a DVD player

v. It is not true that I have a computer and a DVD player

- Explore
- Deduce
- Record
- Arrange
- Select
- Simulate
- Analyse
- Observe
- Categorize

Accurate analyses of information illustrated in Venn diagrams.

- b. Represent each of the following symbolic propositions in words.
- $\sim p \wedge q$
 - $p \vee \sim q$
 - $p \rightarrow \sim q$
 - $\sim(p \wedge q)$
 - $\sim(p \vee q)$
 - $\sim p \wedge \sim q$
- c. Use a Venn diagram to represent the information given in the table and answer the following questions.
- How many children did not have a DVD player at home?
 - How many children had a computer at home?
 - How many children did not have a computer or a DVD player at home?
 - How many children were in the class?
 - What is the probability that a student is chosen at random
 - Had a computer at home?
 - Had a computer or a DVD player at home?
 - Had neither a computer nor a DVD player at home?

Learning Outcomes

Students will be able to:

- ✓ List subsets of a given set;
- ✓ Use formula to determine the number of possible subsets of a given set;
- ✓ Analyze information from a Venn diagram, involving the intersection of at most two sets;
- ✓ List elements of simple set problems.
- ✓ Write simple and compound propositions in algebraic form
- ✓ Convert simple and compound propositions from algebraic form to English-like form and vice versa

Points to Note

- Aspects of logic ought to be linked with other areas in mathematics i.e. statistics, sets, algebra. Have students collect the information before the actual lesson so that they will have the data to work with. The activity is not restricted to the two items used in the suggested activity.
- The students could be given a matching exercise to express the worded propositions symbolically and vice versa.
- Students should be able to construct a Venn diagram or shade the region(s) of a Venn diagram that corresponds with each proposition (negation, conjunction, disjunction, implication)

Extended Learning

- Students should examine their solar system and compare each planet's distance from the sun. Calculate the time it would take to travel from earth to each planet and identify the fastest mode of travel. Distance should be stated in standard form. Students should also calculate how old they would be on arrival to the named planet.
- Research the composition of clean air.

RESOURCES

Assortment of objects, Worksheets, Internet, Computer, Accessories

KEY VOCABULARY

Sets, Subsets, Universal sets, Complement, Null/empty, Venn Diagram, truth table, implication, proposition, equivalence, disjunction, conjunction, negation, compound proposition, simple proposition, logic

LINKS TO OTHER SUBJECTS

Science:

- Analyze experimental data and allow for anomalies. Carry out multi step calculations.

Technical and vocational:

- Attainment Target 1: Creativity and innovation: Explore a range of problem solving contexts and develop ideas for solutions utilizing new technologies;
- Attainment Target 2: Explore methods and procedures: Use resources efficiently and use appropriate techniques in the execution of tasks;
- Attainment Target 3: Apply solutions: Use the design process in planning the execution of solution for an identified problem;
- Attainment Target 2: Explore methods and procedures: Make informed decisions in the selection of materials, tools and equipment and demonstrate increasing skill in the execution of tasks;
- Attainment Target 3 Apply solutions: Manage resources with the aid of appropriate technologies in the execution of tasks;
- Attainment Target 3: Apply solutions: Build practical skills and the technical competencies necessary for effecting a solution/outcome.

Physical Education:

- Attainment Target: Games and sports: Exhibit the capacity to cope with new and varied skill difficulties and to cooperate with others in regular practice in order to refine technique;
- Attainment Target: Team tactics: Demonstrate advanced strategies and tactics in competitive play and undertake the role/roles of player, coach or spectator.



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MATHEMATICS

GRADE 9 UNITS

TERM 1**Unit 1****Numbers**

Real numbers
Indices
Bases

Unit 2**Measurement**

Measuring Concepts
Relationships between Parts of the Circle
Area and Circumference of Various Parts of the Circle
Arc Length

Unit 3**Geometry**

Solids
Transformations
Constructions
Trigonometry

Unit 4**Algebra**

Formulae
Linear Inequalities
Distributive Properties
Laws of Indices
Algebraic Fractions
Factorizations
Simultaneous Equations

TERM 2**Unit 1****Numbers**

Properties of Arithmetic
Ratio
Consumer Arithmetic
Sets

Unit 2**Measurement**

Formulae for finding Areas of Polygons
Surface Areas of Solids
Conversions within Units
Volume and Capacity of Solids and Composite Objects

Unit 3**Geometry**

Properties of Polygons
Sum of Interior Angles of Polygons
Transformations
Calculation of Unknown Angles
Constructions
Pythagoras' Theorem

Unit 4**Algebra**

Making Rules
Equations & Inequalities
Simplification

TERM 3**Unit 1****Numbers**

Sets & Logic
Consumer Arithmetic
Matrices

Unit 2**Measurement****Unit 3****Geometry**

Constructions

Unit 4**Algebra**

Vectors
Relations
Functions
Graphs

TERM 1**TERM 2****Unit 5****Statistics and Probability**

Measures of Central Tendency

Measures of Dispersion

Presentation of Data

Fractions and Percentages as Probability

Range

TERM 3**Unit 5****Statistics and Probability**

Central Tendencies

Range of Data

Frequency Tables

Graphs

Data Collection

Simple Experiments

Simple Probability



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MATHEMATICS



GRADE 9: TERM 1

About the Unit

In this unit students will learn about/to:

- Factorize algebraic expressions;
- Simplify algebraic fractions;
- The distributive property;
- Simultaneous equations;
- Methods of substitution and elimination to solve simultaneous equations;
- Participation in group discussions and activities.

Prior Learning

Check that students can:

- Identify, add and subtract like and unlike terms
- Use the laws of indices
- Solve simple linear equations

ALGEBRA: DISTRIBUTIVE PROPERTY, ALGEBRAIC FRACTIONS, FACTORIZATION & SIMULTANEOUS EQUATIONS**Standard**

Employ algebraic reasoning through the use of expressions, equations and formulae to interpret, model and solve problems involving unknown quantities.

Objectives**Students will be able to:**

- Use the distributive property to simplify expressions including the laws of indices;
- Apply the distributive property to multiply two binomial expressions;
- Add and subtract simple algebraic fractions;
- Multiply and divide simple algebraic fractions;
- Factorize simple algebraic expressions where there is a simple algebraic common factor other than 1;
- Solve simultaneous linear equations by the methods
 1. Substitution;
 2. Elimination.

Suggested Teaching and Learning Activities

Key Skills

Assessment Criteria

Students will:

Use the geogebra file to factorize simple linear expressions located at:

<https://drive.google.com/drive/u/1/folders/0B85w38KXTa7HN0NUV1JGTIVOc1U>

- Apply distributive property
- Group like terms
- Simplify like terms
- Expand binomial expressions
- Work in groups
- Engage in class discussion

- Expressions correctly simplified using the distributive property.
- Factorization of simple algebraic expressions.

Learning Outcomes

Students will be able to:

- ✓ Factorize algebraic expressions accurately;
- ✓ Accurately simplify algebraic fractions;
- ✓ Apply the distributive property correctly;
- ✓ Solve simultaneous equations using the method of substitution or elimination correctly;
- ✓ Participate in group discussions and activities.

Points to Note

- Ensure that the Geogebra file is supplied to the students from the location
<https://drive.google.com/drive/u/1/folders/0B85w38KXTa7HN0NUV1JGTIVOc1U>
- This program generates questions and provides some scaffolding for students.

Extended Learning

- Conduct research on the relevance of simultaneous linear equations in real life situations.
- Conduct research Emmy Noether.

RESOURCES

Algebra tiles, Geogebra software, Teacher-generated tables, Internet, Computer/tablets/smartphones

KEY VOCABULARY

Binomial, Factorize, Substitution, Elimination, Distributive property, Algebraic expression, Laws of Indices, Simultaneous equations, coefficient, constant, variable

LINKS TO OTHER SUBJECTS

Technical and vocational:

- Attainment Target 1 creativity and innovation: explore a range of problem solving contexts and develop ideas for solutions utilizing new technologies;
- Attainment Target 2 Explore methods and procedures: use resources efficiently and use appropriate techniques in the execution of tasks;
- Attainment Target 3: apply solutions: use the design process in planning the execution of solution for an identified problem.

Science:

- Appreciate the importance of scientific methods and be aware of safety procedures to be taken when using equipment and materials;
 - Use scientific knowledge to select appropriate experimental methods;
 - Analyze experimental data and allow for anomalies. Carry out multi step calculations;
 - Understand the relationships between forces and motion, and illustrate these relationships in the environment and living things;
 - Understand the relationships between forces and motion, and illustrate these relationships in the environment and living things.
-

About the Unit

In this unit students will learn about/to:

- Depicting areas of squares in indices;
- The uses of exponents in real life situations;
- Volumes of cubes in indices;
- Complete activities in groups;
- Safely use instruments to present data;
- Engage in meaningful group discussions;
- Make brief entries in journals on their experiences gained from indices;
- Participate in the solving of real life problems.

Prior Learning

Check that students can:

- Write a number to a given number of decimal places and significant figures;
- Express place values of digits in all bases including base 10;
- Add, subtract and multiply numbers written in base n , (where $1 < n < 10$);
- Convert numbers written in base n , (where $1 < n < 10$) to base 10, and, vice versa.

NUMBERS: INDICES**Standard**

Use the basic operations, number relationships, patterns, number facts, calculators and software to compute and estimate in order to solve real world problems involving fractions, percentages and decimals.

Objectives**Students will be able to:**

- State the meaning of a^m , where a and m are rational numbers;
- Simplify expressions using the laws of indices;
- Evaluate expressions a^m and $a^m \times b^n$ where a, b, m, n , are whole numbers, integers, fractions;
- Write numbers less than, greater than or equal to 10 in standard form.

Students will:

Use the Geogebra files on Indices at:

<https://drive.google.com/drive/u/1/folders/0B85w38KXTa7HN0NUV1JGTIVOc1U>

- Record data
- make observations
- Draw conclusions
- Analyze information
- Research
- Solve real life situations

- Digital content navigated
- Expressions simplified
- Expressions evaluated.

Learning Outcomes**Students will be able to:**

- ✓ Make presentations on the uses of exponents in real life situations;
- ✓ Safely navigate digital content
- ✓ Simplify expressions correctly
- ✓ Evaluate expressions correctly

Points to Note

- There are four files on Indices: Indices_meaning, Indices_Multiplication, Indices_Division, Indices_Powerofpower.
- Ensure that these are opened for students to use on their smart devices.
- Geogebra should already be installed. The download file is at www.geogebra.org
- Let students experiment with their own ideas. Ensure that properties such as any number to the power of zero is equal to one is highlighted.

Extended Learning

- Research very extreme quantities such as planetary bodies.
- Tabulate data.

RESOURCES

Internet, smart devices, geogebra files

KEY VOCABULARY

Indices, Rational, Laws of Indices, Expressions, Whole numbers, Exponents, Standard form, Index, Integers, Powers, Fractions

LINKS TO OTHER SUBJECTS

Technical and vocational:

- Attainment Target 1 creativity and innovation: explore a range of problem solving contexts and develop ideas for solutions utilizing new technologies;
- Attainment Target 3: apply solutions: use the design process in planning the execution of solution for an identified problem.

Science:

- Analyze experimental data and allow for anomalies. Carry out multi step calculations.

About the Unit

In this Unit students will learn about/ to:

- Find the length of the hypotenuse using Pythagoras' theorem;
- Angles of elevation and depression;
- Use trigonometric ratios to find angles;
- Actively engage in group activities and discussions;
- Combine Pythagoras' Theorem and Trigonometric Ratios to solve problems.

Prior Learning

Check that students can:

- Identify a right-angled triangle and its properties.
- Measure angles.
- Construct triangles using geometric instruments.

GEOMETRY: TRIGONOMETRY**Standard**

Explore paths, geometric shapes and space and make generalization about geometric relationships within the environment

Objectives**Students will be able to:**

- Prove Pythagoras' Theorem by a suitable method (for example by the area method);
- Use Pythagoras Theorem to solve right – angled triangle problems;
- Use trigonometric ratios to find unknown quantities in right-angled triangles only;
- Use trigonometric ratios to solve problems related to angles of elevation and depression;
- Calculate unknown angles in given diagrams and word problems.

Suggested Teaching and Learning Activities

Use several books, a metre rule and a clinometer/protractor app from Google Playstore to investigate the angle of elevation.

See the lesson plan supplied on the portal at <https://drive.google.com/drive/u/1/folders/0B85w38KXTa7HaW8td0VSWEFvZms>

Key Skills

- Investigate shapes
- Construct triangles
- Proof
- Identify
- Explore trigonometric ratios
- Analyse information
- Apply concepts
- Use appropriate instrument
- Work in groups
- Measure distances
- Record information
- Discuss
- Compute distances
- Sketch diagrams.

Assessment Criteria

- Correct identification of the hypotenuse in right-angled triangles
- Correct use of Pythagoras' theorem to solve problems relating to right-angled triangles
- App correctly used to measure angles
- Use of trigonometric ratios to determine unknown measures in a right-angled triangle
- Solving of problems involving angles of elevation and depression

Learning Outcomes

Students will be able to:

- ✓ Find the length of the hypotenuse using Pythagoras' Theorem;
- ✓ Solve problems involving angles of elevation and depression;
- ✓ Use Trigonometric Ratios correctly to find angles;
- ✓ Use the combination of Pythagoras' Theorem and Trigonometric Ratios to solve problems.

Ensure that a suitable clinometer or protractor is downloaded from the Google Playstore. The books are to simulate buildings of varying heights and the metre rule represents the hypotenuse of the right-angled triangles formed. The app is to be placed on the metre rule to find the angle (if a clinometer is used) or a picture of the angle taken with the protractor app and measured. Students are to work in groups of minimum 3 per group. Ensure that each diagram is drawn and correctly labelled.

- Investigate and explain the relationship between the lengths of the sides of triangles that are not right angled and determine the criteria for the measures of the lengths of lines needed to form a triangle.
- Research the practical uses of trigonometry.

RESOURCES

Worksheet with pictures of right angled triangles, 1 cm grid paper/graph paper, Clinometer, Ministry of Education supplied DVD "Seeing is Believing"

KEY VOCABULARY

Pythagoras' Theorem, Opposite, Adjacent, Hypotenuse, Line of sight, Elevation, Depression, Alternate, Clinometer, Sine, Cosine, Tangent

LINKS TO OTHER SUBJECTS

Technical and vocational:

- Attainment Target 1 creativity and innovation: explore a range of problem solving contexts and develop ideas for solutions utilizing new technologies;
- Attainment Target 2 Explore methods and procedures: use resources efficiently and use appropriate techniques in the execution of tasks;
- Attainment Target 3: apply solutions: use the design process in planning the execution of solution for an identified problem.

Science:

- Appreciate the importance of scientific methods and be aware of safety procedures to be taken when using equipment and materials;
- Analyze experimental data and allow for anomalies. Carry out multi step calculations;
- Use scientific knowledge to select appropriate experimental methods;
- Understand the relationships between forces and motion and illustrate these relationships in the environment and living things.

About the Unit

In this unit students will learn about/to:

- Finding the diameter of a circle given the circumference of the circle;
- Cooperatively engage in class discussions and activities;
- Finding the circumference of a circle given its diameter;
- Finding the area of a circle given its diameter;
- The arc length of a circle;
- The formula for the arc length of a circle.

Prior Learning

Check that students can:

- Identify the circumference, diameter and radius of the circle;
- Perform operations with fractions;
- Use the concept of ratio and proportion.

MEASUREMENT: CIRCLES**Standard**

Use the correct units, tools and attributes to estimate, compare and carry out the processes of measurement to given degree of accuracy.

Objectives**Students will be able to:**

- Investigate and use the relationships between the radius, diameter, circumference and pi;
- Investigate and use the relationship between the radius and the area of a circle $A = \pi r^2$;
- Calculate the area and circumference of a circle;
- Identify the arc, sector and segment of a circle;
- Find arc length;
- Find the area of a sector, segment or parts thereof of a circle with the use of angles.

Suggested Teaching and Learning Activities

Use online programs or apps to investigate various properties of a circle such as:

- <http://www.calculatorsoup.com/calculators/geometry-plane/circle.php>
- <http://www.miniwebtool.com/area-of-a-sector-calculator/?n1=3&n2=75>
- <http://www.1728.org/circsect.htm>

Key Skills

- Recall parts of a circle
- Investigate circles
- Interpret information
- Investigate formulae of any circle (arc length, etc)

Assessment Criteria

- Participation in class discussions and activities
- Accurate calculations of the areas and circumferences of circles
- Calculated areas of sectors and other parts of circles using angles
- Table depicting the relationships between various parts of circles

Learning Outcomes

Students will be able to:

- ✓ Find the diameter of a circle given the circumference of the circle;
- ✓ Find the circumference of a circle given its diameter;
- ✓ Find the area of a circle given its diameter;
- ✓ Find the arc length of a circle;
- ✓ Derive the formula for the arc length of a circle.

Points to Note

Ensure that websites are available for students use. Or, download the appropriate app to calculate circle lengths.

- <http://www.calculatorsoup.com/calculators/geometry-plane/circle.php>
- <http://www.1728.org/circsect.htm>
- <http://www.miniwebtool.com/area-of-a-sector-calculator/?n1=3&n2=75>

Extended Learning

Investigate tyre codes and to find the code that gives the circumference of tyres for various vehicles (including planes, bicycles, and motorbikes) and why that particular circumference is used for each type of vehicle.

RESOURCES

Computer/Smart devices, tyres, Apps (Circle Formulas, ArcCalc

KEY VOCABULARY

Pi, Sector, Chord, Minor arc, Major arc, Segment, Diameter, Radius, Circumference

LINKS TO OTHER SUBJECTS

Technical and vocational:

- Attainment Target 1 creativity and innovation: explore a range of problem solving contexts and develop ideas for solutions utilizing new technologies;
- Attainment Target 2 Explore methods and procedures: use resources efficiently and use appropriate techniques in the execution of tasks
- Attainment Target 3: apply solutions: use the design process in planning the execution of solution for an identified problem;

Science:

- Analyze experimental data and allow for anomalies. Carry out multi step calculations.

Physical Education:

- Attainment Target: games and sports: exhibit the capacity to cope with new and varied skill difficulties and to cooperate with others in regular practice in order to refine technique;
 - Attainment Target: team tactics: Demonstrate advanced strategies and tactics in competitive play and undertake the role/roles of player, coach or spectator.
-



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MATHEMATICS

GRADE 9: TERM 2

About the Unit

In this unit students will learn about/to:

- Create artwork using colour theory
- Tally data collected from experiments;
- Calculate probabilities using formula;
- Demonstrate cooperation throughout group activities;
- Compose songs/poems with key terms/words in journals;
- Formulate questions to help gather data;
- Key terms and words noted throughout activities;
- Design worthwhile experiments on probabilities;
- Create graphs from website with data collected;
- Determine probabilities based on events;
- Solving real world problems involving probabilities;
- Use fractions and percentage to describe probabilities;
- Conduct fair experiments involving probabilities;
- Manipulate apparatus during experiments.

Prior Learning

Check that students can:

- Determine the mode, median and mean from a frequency table;
- Use the mode, median and mean to interpret information;
- Read, interpret and construct pictographs, bar charts, pie charts and line graphs.

STATISTICS: SIMPLE EXPERIMENTS, DATA COLLECTION & SIMPLE PROBABILITIES**Standard**

Collect, organize, interpret and represent data and make inferences by applying knowledge of statistics and probability.

Objectives**Students will be able to:**

- Design and conduct simple experiments, to collect data;
- Determine simple probabilities and draw appropriate conclusions;
- Use fractions and percentages to describe probability;
- Interpret a probability given as a fraction or percentage.

Students will:

- | | | |
|---|--|---|
| <ul style="list-style-type: none"> • Then collect and interpret data, make predictions, and draw conclusions. • Take pulse rates and enter them on the activity sheet, Beat Heart_EveryBeat, below:
https://drive.google.com/drive/u/1/folders/0B85w38KXTa7HN0NUV1JGTIVOc1U | <ul style="list-style-type: none"> • Analyze • collect data • investigate • interpret • experiment • represent • develop logical argument • design • analyze • draw conclusions • make observations • graph • apply concepts • simulate • determine probabilities of events • interpret probabilities • think critically • apply formulae • manipulate equipment during experiments | <ul style="list-style-type: none"> • Completed worksheets on: “Every Beat of Your Heart” • Tally tables completed with data collected from experiments • Accurate calculations of probabilities using formula • Questions formulated to help gather data • Graphs accurately created with data collected • Probabilities correctly determined based on events • Appropriate uses of fractions and percentage to describe probabilities • Experiments conducted safely and willingly • Safe manipulation of apparatus during experiments/investigations |
|---|--|---|

Learning Outcomes**Students will be able to:**

- ✓ Complete tables with tally from data collected from experiments;
- ✓ Accurately calculate probabilities using formula;
- ✓ Define correctly key terms and words noted throughout activities;
- ✓ Accurately create graphs with data collected;
- ✓ Correctly determine probabilities based on events;

Points to Note

Have the school nurse demonstrate how to take the pulse. As the students work individually or in small groups, have them take their resting pulse for one minute. Note that students who are asthmatic or have heart conditions should not take part in the running aspect of the activity based on heart beat.

Have students download a stopwatch app to their device. Distribute a copy of the activity sheet to each student from here <https://drive.google.com/drive/u/1/folders/0B85w38KXTa7HN0NUV1JGTIVOc1U>.

Before beginning the exercises on the activity sheet, students should predict which activity will result in the greatest pulse:

- Being at rest
- Stepping up and down
- Walking
- Running in place

Students should explain their predictions.

Next have the students step up and down on a stair, or just march, for one minute. Have the same students determine their one-minute heart rates after running in place for one minute and after walking for one minute. Students should record their results on question 1 of the activity sheet located here:

<http://illuminations.nctm.org/uploadedFiles/Content/Lessons/Resources/3-5/BeatHeart-AS-EveryBeat.pdf>.

Have the students complete the remaining questions (2-6) on the activity sheet and discuss the responses. Download the answer sheet here:

<https://drive.google.com/drive/u/1/folders/0B85w38KXTa7HN0NUV1JGTIVOc1U>

Have students represent, analyze, interpret and draw conclusions of data collected in tables and on graphs e.g. line, bar etc. A spreadsheet can be used for this.

Extended Learning

Research how exercise affects heart beat during various activities e.g. sports, watching a scary movie etc.

RESOURCES

stop watch app, smart devices resource personnel e.g. nurse, doctor,
Website:
<http://illuminations.nctm.org/uploadedFiles/Content/Lessons/Resources/3-5/BeatHeart-AS-EveryBeat.pdf>.
Website for “Heart Rate App.:

KEY VOCABULARY

Data, exercise, heartbeat, collect, interpret, analyze information, predict, conclude, stop watch, Probability, chance/tries, likely, outcome, possible/possibility, Survey, Questionnaire, Observation, Interview schedule, Experiment, Sample, Population, Fair, Percentage, Fraction, Sample space, Event, Certain, Likelihood, Impossible.

LINKS TO OTHER SUBJECTS

Science:

- Analyze experimental data and allow for anomalies. Carry out multi step calculations.

Technical and vocational:

- Attainment Target 1 creativity and innovation: explore a range of problem solving contexts and develop ideas for solutions utilizing new technologies.
- Attainment Target 2 Explore methods and procedures: use resources efficiently and use appropriate techniques in the execution of tasks.
- Attainment Target 3: apply solutions: use the design process in planning the execution of solution for an identified problem.
- Attainment Target 2: explore methods and procedures: make informed decisions in the selection of materials, tools and equipment and demonstrate increasing skill in the execution of tasks.
- Attainment Target 3 Apply solutions: manage resources with the aid of appropriate technologies in the execution of tasks
- Attainment Target 3: apply solutions: build practical skills and the technical competencies necessary for effecting a solution/outcome.

Physical Education:

- Attainment Target: games and sports: exhibit the capacity to cope with new and varied skill difficulties and to cooperate with others in regular practice in order to refine technique
 - Attainment Target: team tactics: Demonstrate advanced strategies and tactics in competitive play and undertake the role/roles of player, coach or spectator.
-

About the Unit

In this unit students will learn about/to:

- Complete tables on functions;
- Use apparatus throughout experiment;
- Generate bar graph from the Internet;
- Write poems/songs on functions and relations;
- Engage in group discussions and activities;
- Participate in real life situations involving functions and relations;
- Determine the inputs and the outputs of functions;
- Define and note key terms with examples.

Prior Learning

Check that students can:

- Plot the ordered pairs of a mapping as a graph;
- Draw straight line graphs of the form $y = mx + c$ by (a) plotting, (b) using the gradient and intercept;
- Determine gradients and intercepts of straight line graphs;
- Relate gradient of a graph to the rate of change of quantities;
- Find the equation of straight line graphs;
- Plot two linear equations on the same pair of axes and interpret the point(s) of intersection (if any);
- Graph linear inequalities on the coordinate plane and identify regions on the graph.

ALGEBRA: RELATIONS, FUNCTIONS & GRAPHS

Standard

Employ algebraic reasoning through the use of expressions, equations and Formulae to interpret, model and solve problems involving unknown quantities.

Objectives

Students will be able to:

- Define a function as a many-to-one or one-to-one relation;
- Distinguish between the graph of a relation and the graph of a function;
- Use the functional notations, for example , $f:x \rightarrow 2x+1$, $f(x)=2x+1$, $y=f(x)$;
- Determine the range value that corresponds to a given domain value by evaluating the function at the stated domain value;
- State the domain and range of a given function;
- Distinguish between functions defined for different domains by the same formula.

Suggested Teaching and Learning Activities

1. Identify real world functions and classify them as one-to-one or many-to-one. Functions may include but is not limited to
 - Students to an Identification Number
 - Customer to a bank card
 - Students to a class
2. Students will Illustrate the function as
 - Mapping diagrams
 - Ordered pairs

Key Skills

- conduct experiment
- make observations
- measure heights
- utilize apparatus
- determine the input and output in a function
- solve real life problems
- participate in discussions
- work in groups
- analyze information
- draw conclusions
- interpret information
- make predictions
- complete tables
- present information graphically
- discuss observations
- identify patterns
- share and compare information/findings
- determine the differences between a function and a relation
- apply concepts
- design experiments.

Assessment Criteria

Learning Outcomes

Students will be able to:

- ✓ Complete tables on functions correctly;
- ✓ Safely use apparatus throughout experiment;
- ✓ Accurately generate bar graph from the Internet depicting the relationship between the age and height of a seedling;
- ✓ engage in group discussions and activities;
- ✓ Correctly arrive at inputs and outputs in sets of functions;
- ✓ Define and note key terms relating to functions and relations.

Points to Note

Activities Suggested in under Suggested Teaching and Learning Activities are introductory activities. Tangible real world functions may include but is not limited to:

- Efficiency of a car expressed as kilometers per liter. Define a function $D: g \rightarrow ag + b$, where D give the distance a car will travel.
 - E.g. If a car's efficiency is given as 8 km per liter, it means that for every liter the car actually uses, the car will go 8 kilometers. So, the distance a car will travel with this fuel efficiency is given by $D(g) = 29g$
- Wages can be expressed as a function of time.
 - E.g. 1. A laborer is paid \$2000 per Hour. His wage may be given by the function $W(t) = 2000(t)$ where t is given is hours.
 - E.g. 2. A part-time employee is paid \$1400 per week for traveling, \$3000 weekly in lunch allowances, \$2500 for every hour worked but pays \$1200 to health insurance. The part-time worker's weekly net wage may be given by $W(t) = \$2500t + \3200 .

Note also all functions must be well defined.

Extended Learning

Use Geogebra or any other dynamic geometry software to investigate functions and non-functions. Document their observations about the differences between these two types of relations and highlight the significant feature that makes a relation a function.

RESOURCES

Internet, Computer, Graph paper/grids, Apparatus for experiment (i.e. seeds, containers, water, newspaper, tissue paper), Ruler, Teacher-generated tables

KEY VOCABULARY

Functions, Relations, Graphs, Functional notations, Range, Domain, Formulae, information, data

LINKS TO OTHER SUBJECTS

Science:

- Analyze experimental data and allow for anomalies. Carry out multi step calculations.

Technical and vocational:

- Attainment Target 1 creativity and innovation: explore a range of problem solving contexts and develop ideas for solutions utilizing new technologies;
- Attainment Target 2 Explore methods and procedures: use resources efficiently and use appropriate techniques in the execution of tasks;
- Attainment Target 3: apply solutions: use the design process in planning the execution of solution for an identified problem;
- Attainment Target 2: explore methods and procedures: make informed decisions in the selection of materials, tools and equipment and demonstrate increasing skill in the execution of tasks;
- Attainment Target 3 Apply solutions: manage resources with the aid of appropriate technologies in the execution of tasks;
- Attainment Target 3: apply solutions: build practical skills and the technical competencies necessary for effecting a solution/outcome.

Physical Education:

- Attainment Target: games and sports: exhibit the capacity to cope with new and varied skill difficulties and to cooperate with others in regular practice in order to refine technique;
 - Attainment Target: team tactics: Demonstrate advanced strategies and tactics in competitive play and undertake the role/roles of player, coach or spectator.
-

About the Unit

In this unit students will learn about/to:

- Complete tables on functions;
- Create and solve real life situations;
- Model ratios;
- Participate in group discussions and activities;
- Ratios represented in the form of fractions and decimals;
- Calculations of problems involving ratios and proportions;
- Scale drawings used to represent actual objects;
- Calculate scale drawings;
- Calculate total utility bill;
- Calculate salaries and wages.
- Engagement in group discussions and activities;
- Solving real world situations.

Prior Learning

Check that students can:

- Perform operations with fractions;
- Use the concept of ratio and proportion.

NUMBERS: RATIO & PROPORTION**Standard**

Use the basic operations, number relationships, patterns, number facts, calculators and software to compute and estimate in order to solve real world problems involving fractions, percentages and decimals.

Objectives**Students will be able to:**

Solve more complex problems involving ratio and proportion.

Suggested Teaching and Learning Activities

Use the Geogebra files to investigate ratio and proportion located at
<https://drive.google.com/drive/u/1/folders/0B85w38KXTa7HN0NUV1JGTIVOc1U>

Key Skills

- Recall information
- Solve real life situations
- Interpret data
- Model ratios
- Record data
- Measure heights/ widths
- Reduce ratios
- Work in groups
- Draw conclusions
- Make observations
- Engage in meaningful discussions
- Share and compare findings
- Use fractions/ decimals to represent ratios
- Manipulate measuring instruments
- Calculate ratios/ proportions.

Assessment Criteria

- Solving of real life situations
- Ratios modelled correctly
- Tables with ratios written correctly
- Ratios represented in the form of fractions and decimals
- Accurate calculations of problems involving ratios and proportions

Learning Outcomes

Students will be able to:

- ✓ Solve real life situations
- ✓ Model ratios correctly;
- ✓ Complete tables with ratios correctly;
- ✓ Represent ratios in the form of fractions and decimals;
- ✓ Accurately calculate problems involving ratios and proportions;
- ✓ Correctly use scale drawings to represent actual objects;
- ✓ Calculate scale drawings accurately.

Ensure that the geogebra files are given to the students. They can work in pairs. The files are located at <https://drive.google.com/drive/u/1/folders/0B85w38KXTa7HN0NUV1JGTIVOc1U>.

They are: Equivalent ratios, proportion practice, proportions, similar triangles with missing lengths, simplifying ratios, the meaning of similar figures.

RESOURCES

Smart devices/ laptops Teacher-generated worksheets/tables, Measuring tape.

KEY VOCABULARY

Ratio, Proportion, Scale, Interpret, Model, Equivalent, Scale drawing, Observation

LINKS TO OTHER SUBJECTS

Technical and vocational:

- Attainment Target 1 creativity and innovation: explore a range of problem solving contexts and develop ideas for solutions utilizing new technologies;
- Attainment Target 3: apply solutions: use the design process in planning the execution of solution for an identified problem.

Science:

- Analyze experimental data and allow for anomalies. Carry out multi step calculations.
-

NUMBERS: CONSUMER ARITHMETIC**Standard**

Number Operation and Application Use the basic operations, number relationships, patterns, number facts, calculators and software to compute and estimate in order to solve real world problems involving fractions, percentages and decimals.

Objectives**Students will be able to:**

- Use consumer arithmetic to solve real life problems;
- Calculate the total utility bill to be paid from given instructions;
- Explain and use in the proper context terms relating to the computation of wages and salaries (wages, salaries, bonuses, commissions, basic pay, overtime pay, gross pay, net pay, statutory and non-statutory deductions, taxable income, tax allowance);
- Calculate the wage and/ or salary of an employee from given instructions.

Suggested Teaching and Learning Activities

Key Skills

Assessment Criteria

Students will:

Set up a business, such as growing and selling exotic flowers. The flowers are to be sold locally and abroad. Salaries are to be calculated. Investments are to be done such as how much money is required to purchase materials to grow the flowers. Marketing and advertising is also to be done. Calculations are to be done as well for profits to be realised and how much the produce will have to be sold for overseas, considering the various taxes, shipping and handling, etc. Utility bills are to be included such as water and light where applicable.

- Recall information
- Solve real life situations
- Interpret information
- Work in groups
- Calculate wages accurately
- marketing and advertising done

- Salaries correctly calculated.
- Utility bills correctly calculated

Learning Outcomes

Students will be able to:

- ✓ Calculate the total utility bill to be paid from given instructions;
- ✓ Accurately calculate salaries and wages from given instructions;
- ✓ Engage in group discussions and activities

Points to Note

- This can be a whole class activity with students doing the parts that interest them.
- Include the teachers/experts from Business, agriculture, banks, trade board, etc.
- Ensure that salaries are calculated with the help of the business department with all statutory deductions identified.

Extended Learning

Design an online business

RESOURCES

Internet, smart devices, Calculator, financial app, materials to grow flowers.

KEY VOCABULARY

Utility bill, consumer, discount, sales, overtime, profit, loss, Wages, Salaries, Bonuses, Commissions, Basic pay, Overtime pay, Gross pay, Net pay, Statutory and non-statutory deductions, Taxable income, Tax allowance

LINKS TO OTHER SUBJECTS

Technical and vocational:

- Attainment Target 1 creativity and innovation: explore a range of problem solving contexts and develop ideas for solutions utilizing new technologies;
- Attainment Target 3: apply solutions: use the design process in planning the execution of solution for an identified problem.

Science:

- Analyze experimental data and allow for anomalies. Carry out multi step calculations.

About the Unit

In this unit students will learn about/to:

- Enlargement of objects about a given centre and scale factor;
- Reflection of objects given the mirror line;
- Plotting points on a graph;
- Read coordinates of points;
- Centre of enlargement given an object and its image;
- Find the mirror line given an object and its image;
- Engage in class discussions and group activities;
- Characteristics of quadrilaterals;
- Construct quadrilaterals.

Prior Learning

Check that students can:

- Plot points on a Cartesian plane;
- Accurately measure line segments;
- Explain congruence, similarity and symmetry.

GEOMETRY: TRANSFORMATION - ENLARGEMENT AND REFLECTION**Standard**

Explore paths, geometric shapes and space and make generalization about geometric relationships within the environment.

Objectives**Students will be able to:**

- State the relationships between an object and its image in a plane when it is enlarged from a point (centre of enlargement) in that plane;
- Perform enlargements with the centre at the origin with scale factor k , $k \in \mathbb{N}$;
- Perform reflections and identify images of objects where the mirror line is any given line in the plane.

Students will:

Use Geogebra software to explore enlargements and reflections using resources at the site:

<https://drive.google.com/drive/u/1/folders/0B85w38KXTa7HaW8td0VSWEFvZms>

- Design
- Create
- Apply concepts
- Discover
- Analyze
- Draw
- Work cooperatively
- Draw conclusions
- Read coordinates correctly
- Identify centres of enlargement
- Identify mirror lines.

- Engagement in class/groups discussions and activities
- Mirror lines identified given an object and its image
- Centers of enlargement identified given object and its image.
- Identify coordinates of images given object, mirror lines/centers of enlargement.

Learning Outcomes**Students will be able to:**

- ✓ Enlarge an object about a given centre and scale factor;
- ✓ Reflect an object given the mirror line;
- ✓ Plot points on graph paper correctly;
- ✓ Read coordinates of points correctly;
- ✓ Find the centre of enlargement given an object and its image;
- ✓ Create items using patterns/designs;
- ✓ Engage in class discussions and activities;
- ✓ Find the mirror line given an object and its image.

Points to Note

- Make sure the relevant Geogebra files are open for students to use. Ask open ended questions for them to investigate the properties of the transformations.
- Install Geogebra from www.geogebra.org - <https://drive.google.com/drive/u/1/folders/0B85w38KXTa7HaW8td0VSWEFvZms>
- Have students identify and discuss the properties of reflection/enlargement using questions.

Extended Learning

Allow students to research how Tessellations/designs are used in real life.

RESOURCES

Smart devices/ laptop, Teacher-generated tables, geogebra files and program

KEY VOCABULARY

Reflection, enlargement, transformation, design, mirror line, line symmetry/axis symmetry, scale factor, origin, image, object, pattern, movements, motif, Centre of enlargement, Congruent, Orientation, Similar.

LINKS TO OTHER SUBJECTS

Technical and vocational:

- Attainment Target 1 creativity and innovation: explore a range of problem solving contexts and develop ideas for solutions utilizing new technologies;
- Attainment Target 2 Explore methods and procedures: use resources efficiently and use appropriate techniques in the execution of tasks;
- Attainment Target 3: apply solutions: use the design process in planning the execution of solution for an identified problem.

Science:

- Appreciate the importance of scientific methods and be aware of safety procedures to be taken when using equipment and materials;
- Analyze experimental data and allow for anomalies. Carry out multi step calculations;
- Use scientific knowledge to select appropriate experimental methods;
- Understand the relationships between forces and motion, and illustrate these relationships in the environment and living things.

Social studies:

- Attainment Target: present global information from maps, graphs and pictures.
-

Prior Learning

Check that students can:

- Accurately construct angles of 90° , 45° , 60° , 30° , 120° , 135° , 150° ;
- Construct triangles.

GEOMETRY: CONSTRUCTIONS**Standard**

Explore paths, geometric shapes and space and make generalization about geometric relationships within the environment.

Objective**Students will be able to:**

Construct quadrilaterals using appropriate geometric instruments.

Suggested Teaching and Learning Activities

Use the site <https://www.mathopenref.com/constsquare.html> to construct quadrilaterals.

Key Skills

- Investigate shapes
- Engage in discussions and group activities
- Construct quadrilaterals
- Safely manipulate geometric instruments.

Assessment Criteria

Quadrilaterals constructed accurately

Learning Outcomes

Students will be able to:

- ✓ Engage in class discussions and group activities;
- ✓ Construct quadrilaterals accurately.

Points to Note

Ensure the website is opened prior to the start of the lesson if one computer is being used. Otherwise, give the students the site to be used on their smart devices.

Extended Learning

- Explore the Golden Ratio/Triangle
- Construct a rectangle using Fibonacci Sequence.

RESOURCES

<https://www.mathopenref.com/constsquare.html>, smart devices, laptop, Geometric instruments, Internet.

KEY VOCABULARY

Quadrilaterals, Construction, Patterns, Angles, Parallel, Perpendicular, Bisector, Dimensions, Line segments

LINKS TO OTHER SUBJECTS

Technical and vocational:

- Attainment Target 1 creativity and innovation: explore a range of problem solving contexts and develop ideas for solutions utilizing new technologies;
- Attainment Target 2 Explore methods and procedures: use resources efficiently and use appropriate techniques in the execution of tasks;
- Attainment Target 3: apply solutions: use the design process in planning the execution of solution for an identified problem.

Science:

- Appreciate the importance of scientific methods and be aware of safety procedures to be taken when using equipment and materials;
- Analyze experimental data and allow for anomalies. Carry out multi step calculations;
- Use scientific knowledge to select appropriate experimental methods;
- Understand the relationships between forces and motion, and illustrate these relationships in the environment and living things.



NSC

MATHEMATICS

GRADE 9: TERM 3

About the Unit

In this unit students will learn about/to:

- Solve simple problems involving, at most, three subsets of the universal set (with at most two intersecting);
- Use set language;
- Description of a set;
- Representing sets using Venn diagram;
- Define what an argument is
- Prove equivalence from truth tables
- Differentiate between valid argument and valid conclusion
- Determine the validity of arguments
- Work cooperatively in groups;
- Engagement in meaningful discussions;
- Order matrices;
- Calculations of sets of matrices;
- Real world situations involving matrices.

Prior Learning

Check that students can:

- Determine the number of subsets of a given set;
- List all the possible subsets of a given set;
- Solve simple problems involving, at most, two subsets of the universal set.

NUMBERS: SETS**Standard**

Use the basic operations, number relationships, patterns, number facts, calculators and software to compute and estimate in order to solve real world problems involving fractions, percentages and decimals.

Objectives**Students will be able to:**

- Solve simple problems involving, at most, three subsets of the universal set (with at most two intersecting).
- Establish the truth value of compound propositions using truth tables
- Use truth tables to determine if two propositions are logically equivalent
- Define an argument
- Differentiate between valid argument and valid conclusion
- Apply deductive reasoning to determine the validity of arguments

Students will:

Carry out the following investigation:

We need to construct a logic table to help us solve this problem. Rihanna, Tamara, and Miley are sisters. You need to deduce which sister is 9 years old and which one is 12 and which one is 14 years old. You are given two clues:

Clue 1: Tamara's age is not in the 4-times table.

Clue 2: Miley's age can be divided exactly by the number of days in a week.

- What should the rows and columns contain?
- How do we mark 'true' or 'not true'?
- What can we fill in?
- What can we be sure about?

To find the age of the three sisters, you can present the information in a logic table.

Use the logic grid below to solve the problem:

Fill in the information given in the logic grid as shown below:

	9 years	12 years	14 years
Rihanna			
Tamara			
Miley			

A cross (x) in any box means that the statement is not true.

A tick (✓) in any box means that the statement is true.

- Classify
- logical reasoning
- Investigate/research
- Make observations
- Apply concepts
- Analyze, draw
- Critique
- Organize
- Collect
- Match
- Separate
- Problem-solving
- Construct Venn diagrams
- Compute
- Construct truth tables
- Determine the validity of arguments and conclusions
- Define argument
- Truth tables are correct
- Validity of arguments correct
- Validity of conclusions correct

Clue 1: Tamara's age is not in the 4-times table.

	9 years	12 years	14 years
Rihanna			
Tamara			
Miley			

Which column would best describe the clue? _____

Identify the symbol that you would put in Tamara's row and appropriate column? _____

What does this information suggest? _____

Clue 2: Miley's age can be divided exactly by the number of days in a week.

	9 years	12 years	14 years
Rihanna			
Tamara			
Miley			

What does this information suggest? _____

Which column would best describe the clue? _____

Identify the symbol that you would put in the row in which Miley's name appears row and appropriate column? _____

Examine the column marked '12 years old'.

Which of the sisters do you think is 12 years old? _____

Fill in the ticks and crosses in the row for the sister identified above.

Examine the column marked '9 years old'.

Which of the sisters do you think is 9 years old? _____

Fill in the ticks and crosses in the row for the sister identified above.

Conclusion:

Ages of the three sisters:

_____ is 9 years old.

_____ is 12 years old.

_____ is 14 years old.

Learning Outcomes

Students will be able to:

- ✓ Solve simple problems involving, at most, three subsets of the universal set (with at most two intersecting);
- ✓ Use set language correctly;
- ✓ Work cooperatively in groups, Prove the validity of arguments, Prove the validity of conclusions, Construct correct truth tables

Points to Note

- Suggest the use of T and F, 0 and 1 or \surd and X
- Link the use of 0 and 1 to Information Technology and Electrical Technology; however, teachers should agree on a consistent way to complete the truth table.
- Give hints if needed, for example, which numbers out of the 3 are in 4 times table and which are not?
- Consider a 7 days week for the activity.

Extended Learning

Carry out the following exercise:

In a plane flying to London, five passengers are seated in a row next to each other. Their professions are: journalist, singer, teacher, sailor, engineer; and their nationalities, in any order are: English, French, German, Italian, Dutch. Their ages are 21 years, 24 years, 32 years, 40 years, 52 years; and each plays a different one of the following sports handball, swimming, volleyball, athletics, football. They will each travel from London to a different destination: London, Birmingham, Manchester, Newcastle or Plymouth.

- Clue 1: The engineer is seated on the extreme left.
- Clue 2: The volleyball player is seated in the middle.
- Clue 3: The Englishman is a journalist.
- Clue 4: The singer is 21 years old.
- Clue 5: The teacher's sport is swimming.
- Clue 6: The sailor is travelling to Plymouth.
- Clue 7: The handball player is French.
- Clue 8: The passenger from Holland is bound for Birmingham.
- Clue 9: The passenger bound for Liverpool is 32 years old.
- Clue 10: The athlete is bound for Newcastle.
- Clue 11: The French passenger is seated next to the German.
- Clue 12: The 52-year-old passenger is seated next to the passenger who is travelling to Birmingham.
- Clue 13: The 24-year-old passenger is seated next to the passenger who is travelling to Birmingham.
- Clue 14: The engineer is seated next to the Italian.

Use the clues above to deduce the answers to these questions:

1. How old is the sailor?
2. What is the nationality of the football player?

RESOURCES

Smart devices, teacher-generated worksheet

KEY VOCABULARY

Sets, Venn Diagrams, classification, grouping, collecting, subsets, empty/null sets, intersection, complement, universal, union, disjoint, living things, argument, equivalence, truth table, implication, conclusion, logically equivalent, validity

LINKS TO OTHER SUBJECTS

Technical and vocational:

- Attainment Target 1: creativity and innovation: explore a range of problem solving contexts and develop ideas for solutions utilizing new technologies
- Attainment Target 3: apply solutions: use the design process in planning the execution of solution for an identified problem.

Science:

- Analyze experimental data and allow for anomalies. Carry out multi step calculations.

Technical and vocational:

- Attainment Target 2: explore methods and procedures: make informed decisions in the selection of materials, tools and equipment and demonstrate increasing skill in the execution of tasks
 - Attainment Target 3: apply solutions: build practical skills and the technical competencies necessary for effecting a solution/outcome.
-

Prior Learning

Check that students can:

- Perform basic arithmetic operations on integers;
- Use the commutativity and distributivity properties

NUMBERS: MATRICES**Standard**

Use the basic operations, number relationships, patterns, number facts, calculators and software to compute and estimate in order to solve real world problems involving fractions, percentages and decimals.

Objectives**Students will be able to:**

- Identify the order of a matrix;
- Perform scalar multiplication;
- Perform calculations to illustrate the commutativity and distributivity of matrices under addition.

Suggested Teaching and Learning Activities

Key Skills

Assessment Criteria

Students will:

Visit the website:

<http://www.mathwarehouse.com/algebra/matrix/real-world-applications-matrix.php>

and follow the instructions supplied and access the links for further work.

- Arrange items in rows and columns
- Make observation
- Engage in meaningful discussions
- Work in groups
- State the order of any given matrix.

- Complete activities in groups
- Engagement in meaningful discussions
- Matrices ordered correctly

Learning Outcomes

Students will be able to:

- ✓ Matrices ordered correctly;
- ✓ Perform given operations on matrices accurately;

Points to Note

Make use of the website as follows, where best fits your context:

1. One computer and projector: display the website and have students answer the questions before showing the answers. Have other real life matrices as shown on the website to show for students to write the matrix.
2. Students have access to smart devices, have students access the website and answer the questions. Again, have similar questions for students to give answers to.
3. If there is no internet access at school, screen print the pages beforehand, save the screen prints as a word document and use it as in 1 above.
4. Ensure that as many pages of the website are done. Have students give their own examples of matrices and have others write them in matrix form.

Extended Learning

Investigate the use of matrix transforms in the world of computer graphics. Software and hardware graphics processor uses matrices for performing operations such as scaling, translation, reflection and rotation in computer animations.

RESOURCES

Laptops/tablets/smart phones, Multi-media projector

KEY VOCABULARY

Scalar, Order, Identity, Matrix, Matrices, Commutativity, Non-commutativity, Distributivity, Square.

LINKS TO OTHER SUBJECTS

Technical and vocational:

- Attainment Target 1: creativity and innovation: explore a range of problem solving contexts and develop ideas for solutions utilizing new technologies;
- Attainment Target 3: apply solutions: use the design process in planning the execution of solution for an identified problem.

Science:

- Analyze experimental data and allow for anomalies. Carry out multi step calculations.
-

About the Unit

In this unit students will learn about/to:

- Write vectors in column format;
- Define position vectors given two points;
- Relative position vectors;
- Right angled triangles used to represent a vector;
- Using Pythagoras' theorem to find the length of a vector;
- The various uses of quadratics in everyday life;
- Present data in a variety of ways;
- Participate in group discussions and activities;
- Problem solving situations involving quadratics;
- Graphs of quadratic solutions.

Prior Learning

Check that students can:

- Identify, add and subtract like and unlike terms;
- State the properties of polygons;
- Plot points;
- Use Pythagoras' theorem to find the length of lines in a right angled triangle;
- Perform translations and state the associated translation vector.

ALGEBRA: VECTORS**Standard**

Employ algebraic reasoning through the use of expressions, equations and formulae to interpret, model and solve problems involving unknown quantities.

Objectives**Students will be able to:**

- Define a vector as the sum total of horizontal and vertical displacement;
- Write vectors in column format;
- Define position vectors given two points;
- Use grid to locate and draw, position and relative position vectors;
- Draw a right angled triangle representing a vector;
- Use Pythagoras' theorem to find the length of a vector;
- Write the reverse vector ($-x$) given a vector x (multiply a vector by -1);
- Find the relative position vector of collinear vectors given a ratio of division;
- Use the properties of an appropriate polygon to find the relative position vector of parallel, non-collinear vectors.

Students will:

Watch a presentation on a navigation method called 'Dead Reckoning' from the site:

<https://www.youtube.com/watch?v=TxAdmbuu93I>

Hypothesize on reasons for being able to navigate as precisely as possible. Answer questions on worksheet 1 where they are to draw the lines/vectors to represent the distance and direction travelled.

Assess the effects of wind on sailing. Watch the video on jet streams to see how winds work and how they affect sailing and weather:

<http://www.youtube.com/watch?v=PrO7ejaVdzs> and revise their initial assessment where needed.

Answer questions on worksheet 2 that includes wind factor that affects sailing. Investigate the effects of wind direction causing a boat to go to the wrong place.

Develop a travel path from Spain to any point on the African coast, and then determine the wind correction vectors that would take their boat there after 1 month of sailing east 10 squares. Exchange these corrections with a partner (without letting the partner see their sheet) and calculate where they would arrive in Africa using their partner's corrections on their own sheets.

Use blank worksheets to plot their own courses – recording movements, directions and corrections along the way. Give the new instructions to a partner to determine if she/he can sail to the new spot.

Use Pythagoras' theorem to find the distances travelled by the boat on the way to (i) Florida, (ii) Cuba, from Spain. Do the same for the distance between Spain and the African coast selected. The distances should be in miles and converted to kilometres.

Calculate the speed of the boat in miles per month, miles per hour, kilometres per month and kilometres per hour.

- Draw lines
- Represent vectors in column form
- Discuss key terms
- Determine the movement of vectors
- Use properties appropriately
- Calculate distances from scales given
- Use Pythagoras' Theorem to find distances
- Identify positions

- Vectors written in column format
- Definition of key terms
- Locating and drawing of vectors
- Draw right angled triangles representing a vector
- Draw resultant vector
- Use of Pythagoras' Theorem to find the length of a vector
- Give instructions

Assess: (i) if these speeds are fast or slow; (ii) when there were no engines, what happened to food supply if there were always a breeze of 6 squares east.

Formulate measures that could be put in place to deal with part (ii) above.

Learning Outcomes

Students will be able to:

- ✓ Write vectors in column format;
- ✓ Define position vectors given two points;
- ✓ Locate and draw position and relative position vectors;
- ✓ Draw right angled triangles representing a vector;
- ✓ Use Pythagoras' theorem to find the length of a vector.
- ✓ Formulate solutions
- ✓ Give instructions

Points to Note

For this activity, students will use a navigational system called 'dead reckoning' to understand vectors. Students will use vectors to plot their course based on time and speed. They will then correct the positions with vectors representing winds and currents.

Ensure that the videos are downloaded before class time. Assist students to draw the first 2 vectors if needed. If possible, project worksheet 1 and do the drawings there. Do the same for worksheet 2 re assisting students.

Photocopy adequate worksheets for students to use. Ask questions such as 'Why should sailors be concerned about wind and current when travelling long distances?' Make sure to point out that the boats being dealt with initially do not have engines but use sails. Show a picture if needed. Discuss the kind of boats Jamaican fishermen use. Ask what effects the wind has on boats that use engines and not sails, if there are any effects.

See Appendix D for the worksheets

Extended Learning

- Research how engineers, pilots of ships and planes use vectors.
- Research wind and water movements, forces of magnetic and electric fields.
- Investigate the uses of Pythagoras' Theorem
- Investigate old and new navigation systems and how they work e.g. Christopher Columbus' voyages to the Caribbean.
- Design navigational maps for visitors to their schools to use to get from one location to the next.

RESOURCES

Teacher generated worksheets, Ruler, Coloured pencils – 3 each group of 2/3 students, smart devices, Internet, Speakers

KEY VOCABULARY

Displacement, Position, Vectors, Resultant, Parallel, Non-collinear, Scalar, Polygon, Translation, Collinear, Navigation, Coordinates, Cartesian Plane, Distance, Direction, Magnitude, Current (Wind and Water), Speed, Time, North-East trade winds.

LINKS TO OTHER SUBJECTS

Technical and vocational:

- Attainment Target 1: creativity and innovation: explore a range of problem solving contexts and develop ideas for solutions utilizing new technologies;
- Attainment Target 2 Explore methods and procedures: use resources efficiently and use appropriate techniques in the execution of tasks;
- Attainment Target 3: apply solutions: use the design process in planning the execution of solution for an identified problem.

Science:

- Analyze experimental data and allow for anomalies. Carry out multi step calculations.
-

Prior Learning

Check that students can:

- Plot the ordered pairs of a mapping as a graph;
- Draw straight line graphs of the form $y = mx + c$ by (a) plotting points, (b) using the gradient and intercept;
- Determine gradients and intercepts of straight line graphs;
- Relate gradient of a graph to the rate of change of quantities;
- Find the equation of straight line graphs;
- Plot two linear equations on the same pair of axes and interpret the point(s) of intersection (if any);
- Graph linear inequalities on the coordinate plane and identify regions on the graph.

ALGEBRA: GRAPHING QUADRATIC EQUATIONS**Standard**

Employ algebraic reasoning through the use of expressions, equations and formulae to interpret, model and solve problems involving unknown quantities.

Objectives**Students will be able to:**

- Write a quadratic mapping as a set of ordered pairs;
- Plot the ordered pairs of a quadratic mapping as a graph;
- Interpret the points of intersection of a quadratic graph with the axes.

Suggested Teaching and Learning Activities

Key Skills

Assessment Criteria

Students will:

Use the given interactive program to investigate quadratic functions and their intercepts located at <https://drive.google.com/drive/u/1/folders/0B85w38KXTa7HN0NUV1JGTIVOc1U>

- Conduct Research
- Carry out activities
- Make observations
- Record data
- Analyze information
- Make predictions
- Draw conclusions
- navigate digital content

- Correct roots found.
- Y - Intercept correctly identified

Learning Outcomes

Students will be able to:

- ✓ Research on the use of quadratics in everyday life;
- ✓ Present data in a variety of ways;
- ✓ Participate in group discussions and activities;
- ✓ Graph quadratic functions accurately;

Points to Note

Ensure that the grade9_quadratics.ggb file is open for students to use at <https://drive.google.com/drive/u/1/folders/0B85w38KXTa7HN0NUV1JGTIVOc1U>.

This means geogebra should already be installed on the computer(s) to be used. This software can be downloaded from www.geogebra.org.

Open ended questioning is best used in this activity, such as:

- 'What would happen if the slider 'a' is moved to zero?'
- 'What would happen if slider 'b' is moved to zero?'
- 'What would happen if slider 'c' is moved to zero?'

Ensure that the connection is made between the constant and the y-intercept from the graph. Allow students to say what the intercepts are before showing the answer.

Extended Learning

- Investigate the use of quadratics in construction.
- Investigate the occurrence of quadratics in everyday life
- Investigate other ways of finding the roots of quadratic functions

RESOURCES

Internet, smart devices, Internet, Geogebra file grade9_quadratic.ggb at <https://drive.google.com/drive/u/1/folders/0B85w38KXTa7HN0NUV1JGTIV0c1U>

KEY VOCABULARY

Quadratic equations, Quadratic mappings, Ordered pairs, Graph, Points of intersection, Axes, Cartesian plane, roots, intercept.

LINKS TO OTHER SUBJECTS

Science:

- Analyze experimental data and allow for anomalies. Carry out multi step calculations.

Technical and vocational:

- Attainment Target 1: creativity and innovation: explore a range of problem solving contexts and develop ideas for solutions utilizing new technologies;
- Attainment Target 3: apply solutions: use the design process in planning the execution of solution for an identified problem;
- Attainment Target 2 Explore methods and procedures: use resources efficiently and use appropriate techniques in the execution of tasks;
- Attainment Target 3 Apply solutions: manage resources with the aid of appropriate technologies in the execution of tasks;
- Attainment Target 2: explore methods and procedures: make informed decisions in the selection of materials, tools and equipment and demonstrate increasing skill in the execution of tasks;
- Attainment Target 3: apply solutions: build practical skills and the technical competencies necessary for effecting a solution/outcome.

Physical Education:

- Attainment Target: games and sports: exhibit the capacity to cope with new and varied skill difficulties and to cooperate with others in regular practice in order to refine technique;
 - Attainment Target: team tactics: Demonstrate advanced strategies and tactics in competitive play and undertake the role/roles of player, coach or spectator.
-

The background features a textured, grey, stone-like surface. Overlaid on this are several large, overlapping geometric shapes in black and grey. A prominent white horizontal band runs across the center of the page, containing the main title text.

NSC

MATHEMATICS

GRADES 7-9: APPENDICES

The 21st century is a time of rapid technological growth and social change. The school curriculum must, therefore, ensure that young people are well prepared for the challenges and opportunities that they will meet as adults in this century. The MoEYI is making every effort to provide for the multiple intelligences of our children and cater to their diverse needs in order to fully maximize their capabilities. Hence, the MoEYI has created alternative pathways to receiving an education at the secondary level.

Providing alternative pathways will be far-reaching in carrying out the Ministry's mantra, "Every child can learn....every child must learn". Learning pathways will allow for an inclusive approach in which instruction is based on tailored curricula, enabling each learner to perform to his/her fullest potential based on aptitude, interest and ability. Alternative Pathways represent a new approach to secondary education. Secondary education in Jamaica is being reframed and re-positioned as customised, diverse, relevant, equitable, outcomes-based, and inclusive; and significantly, this approach will signal the introduction of a seven year (Grades 7-13) period of instruction for students on all secondary pathways.

Goals of the APSE

- Design the school system to offer differentiated instructional programmes, informed by the National Standards Curriculum (NSC).
- Develop individualized intervention/learning plans based on students' performance profile.
- Provide special educators as Pathway Coaches to support subject teachers of students on Secondary Pathways II and III in the delivery of instruction.
- Facilitate a functional academic approach at the secondary level characterised by response to intervention (RtI) methodology, interactive, learner-centred, project-based and problem-based learning, reflection and alternative forms of assessment.
- Foster a system for ALL students to exit the secondary level with the knowledge, skills, competences and attitudes which will have them ready for the world of work or to access tertiary level education.

Secondary Pathways I, II & III (SP I, II & III)

All students will access secondary education via the prevailing Grade Six examination. The exit examination will provide individual profiles to inform decisions for pathway access and standards for differentiation.

SPI is a 7-year programme with a curriculum based on the constructivist approach. At Grades 7-9 students will access the National Standards Curriculum (NSC), and at Grades 10, 11, 12 & 13, they will access the curricula/syllabi of the examining body.

SP II is a 2-year transitional programme with a curriculum based on the constructivist approach. Special educators/pathway coaches will work with teachers and students on this pathway. Students will be provided the required intervention and support to allow for transition. At the end of Grade 8 students will be re-evaluated through psycho-educational evaluation to determine their readiness for crossing over into either SP I or SP III.

SP III is a 7-year programme with a curriculum based on the constructivist approach. At Grades 7-9 students will access the National Standards Curriculum (NSC), and at Grades 10 & 11, they will access the curricula/syllabi of the examining body. At the end of Grade 11 SP III students will transition into the Career Advancement Programme.

At Grades 7-9 the NSC, will be modified to meet the needs of the SP III students. Students in SP III will be instructed through a functional academics curriculum in the core subjects- Mathematics, English Language, Communication, Social Studies and Science. Their instruction will be further enriched with Personal Empowerment, Technical and Vocational instruction, as well as the performing and creative arts. Pathway Coaches will collaborate with subject teachers to prepare content, ensuring differentiation in instruction for students on SP II and III. These students will also be supported through use of the Response to Intervention (RtI) methodology.

PERSPECTIVES OF SCIENCE, TECHNOLOGY, ENGINEERING, MATHEMATICS & THE AESTHETICS (STEM/STEAM) IN RELATION TO THE NATIONAL STANDARD CURRICULUM (NSC)

INTRODUCTION & BACKGROUND

The integration of theoretical principles that relate to STEM/STEAM Education in the NSC began in June 2014. This move was influenced by recommendations of the STEM Steering Committee that emphasized the need to develop learners who are not just productive, but who would also be innovative Jamaicans. STEM integration was also regarded as one of the strategic long term means of addressing the economic challenges being faced by Jamaica using education as a primary vehicle for the implied transformational change to happen, beginning from short term efforts.

Initial discussions and deliberations promoted an emphasis on STEM rather than STEAM Education. However, critical analysis of the conversations conveyed the perspective of STEM as a collection of related disciplines that all learners should have the opportunity of pursuing, to develop the competencies they offer and as a consequence be able to gain employment or become employers in STEM related areas. As stakeholders from different backgrounds processed their understanding of STEM, new meanings of the concept emerged from the discussions. One was the perspective of STEM as a methodology. There was, however, concern about the exclusion of “A” in STEM. This “A” component however, brought to the discussion, multiple meanings. In some Aesthetics as a field and was considered an important component to be included if educators are serious about issues of discrimination, holistic learning and current research on the iterative function of the brain that warrants attention to brain based learning and the role of the Arts in promoting knowledge integration to cater to multiple domains of learning. There was also discontent about neglecting the Performing Arts when related creative industries contribute significantly to economic development. The concern was that the role of the Arts to economic development was being trivialized.

The call for the integration of the Aesthetics or Art forms became more pronounced as STEM took on more national significance. This was supported by research that indicates the importance of the Aesthetics in developing values and attitudes, in promoting holistic learning and in serving as drivers of innovations. By integrating principles from STEM with those from the Arts/Aesthetics, the approach to problem solving would encourage greater appreciation for and reliance on the interdependent nature of knowledge when science and arts intersect. Additionally, STEAM as a methodology encourages the harmonizing of the cognitive and the emotional domains in the problem-solving process.

The concept of STEAM was adopted in 2015, as an integrative approach to education and a methodology that pays attention to the benefits to be derived from the inclusion of the Arts or Aesthetics with STEM related principles. These collective benefits are supported by Jolly (2014), Sousa and Pilecki (2013) and include divergent thinking; differentiated learning; Arts integration; focus on intrinsic motivation and informed decision-making.

PERSPECTIVES OF STEM/STEAM IN THE CONTEXT OF THE NSC

In the context of the NSC, STEM/STEAM is used in a number of ways. These include:

STEM/STEAM as an integrative learning approach and methodology in facilitating learning. This perspective places emphasis on STEM/STEAM as a means of helping learners become creative or innovative problem solvers and lifelong learners who rely on scientific principles (laws and theories) to address issues/concerns or to deal with observed phenomenon that are puzzling for them or that inspire interest. As an approach, the focus is on solving problems based on principles. As methodology, the focus is on the system of practical procedures to be used to translate principles into the problem - solving processes or to choose from available problem- solving models.

STEM/STEAM as an Experiential-Vocational Learning Framework that is based on problem solving through the project-based approach. Emphasis is placed on solving real life problems in a context that requires learners and their facilitators to observe work-based principles. The primary purpose for this focus is for learners to: (i) become employable (ii) prepare for further education and/or for occupational or work readiness.

STEM as types of institutions in which learning is organized as a meta-discipline as described by Morrison and Bartlett (2009). Based on this perspective, STEM facilitates the demonstration of knowledge in a manner that removes the boundaries of each discipline for application to problem as would be practised in the real world.

IMPLICATIONS OF PERSPECTIVES OF STEM/STEAM IN LIGHT OF THE NSC

Since the NSC is based on Constructivism principles, STEM/STEAM as an approach and methodology, has to be established on post-positivistic thinking. From this position, STEM/STEAM influences the kind of practice that promotes collaboration, negotiation of meaning and openness to scrutiny.

The NSC developers selected a Constructivist approach that included the deliberation, designing and development stages of the curriculum process. Evidence of the influence of Constructivism can be seen the NSC Framework Document that conveys the following emphasis:

- (i) The element of objectives is presented in two forms; firstly as Learning Objectives to focus attention on process and experience rather than product. Secondly as Learning Outcomes that serve as some of the outputs of the process. They include the basic understandings, skills and dispositions anticipated from learners' engagement in the planned experiences.
- (ii) The element of content is treated as contexts for learners to think critically, solve problems creatively while developing their identity as Jamaicans. Content is not expected to be treated as disciplines to be mastered but as areas that contribute knowledge, skill sets and attitudes that form the composite of competencies to be acquired from their integration in the learning situations.
- (iii) The element of learning experiences (method) is presented as a set of learning activities that serves as a source of problems to be addressed as a part of the learning process. These real-life activities provide the scope of knowledge, skills and required dispositions or character traits for learners to make sense of that aspect of life or the world that they represent. They are the threads that connect all the other elements of the curriculum and allow for the integration of STEM/STEAM in the following ways:
 - Identification of activities that are presented as problems to be solved using the STEM/STEAM approach based on contextual factors that include the profile of the learner, the learning conditions and the anticipated impact.
 - Integrating activities to form a real problem to be solved as a short, medium or long term project to which the project based learning would be applied.
 - The examination of learning activities by learners and teachers as co-learners through multiple lenses using content of science, technology, mathematics and the humanities that they have already explored to engage in the problem identification and definition processes.
 - Extending learning in the formal setting to the informal by connecting co-curricular initiatives that are STEM/STEAM based that learners are undertaking at the institutional level through clubs and societies, as whole school projects or in partnership with external stakeholders.
 - Using the learning activities to review STEM/STEAM initiatives that form a part of the informal curriculum to and for reflection on action.

- Using activities as springboards for reflecting on career or occupational interest in STEM/STEAM related areas.
- (iv) The element of evaluation is communicated in two major ways; firstly as prior learning which serves diagnostic purpose and secondly as an on-going developmental process. This formative focus is indicated by the inclusion of explicitly stated assessment criteria that are to be used alongside the learning activities. The use of assessment criteria as counterparts of the learning activities also indicates that assessment is learner centred since it is serving developmental rather than promotional purpose and as a consequence, allows learners to self-correct as they use feedback to develop feed-forward capabilities. Evidence of learning, based on the learning outcomes, can be collected from various types of assessment methods that emphasize the learner centred constructivist orientation. This brings to the fore the need for serious consideration to be given to differentiation in assessment for fairness and credibility of claims about learners' capabilities and to inform decisions that will impact their educational journey.

In general, this integrated approach, which is the context of STEAM, is aimed at improving the quality of the educational experience for learners while influencing the achievement of the aims of education that relate to productivity and creativity as part of the profile of the Jamaican learner.

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- Trochim, Williams, M.K., (2006). *Positivism & post-positivism*. Web Centre for Social Research Methods. Retrieved from: <http://www.socialresearchmethos.net/kb/positivism.php>

The 5Es Overview: “The 5E Learning Cycle”

What is a 5E Learning Cycle?

This model describes an approach for facilitating learning that can be used for entire programmes, specific units and individual lessons. The NSC supports the 5E constructivist learning cycle, as it places emphasis on the processes that may be used to help students to be personally involved in the learning situation as they are guided to build their own understandings from experiences and new ideas.

5E Instructional Model

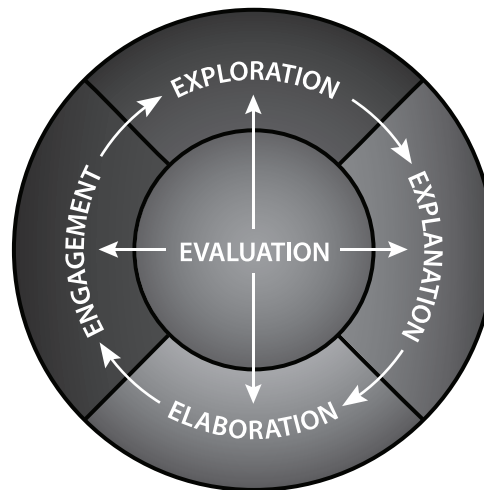


Figure 1. Illustrating one version of the 5E model that conveys the role of valuation as an interconnecting process that is at the core of the learning experience.



Figure 2, illustrating a cyclical perspective of the model with each process being given similar emphasis in contributing to the learning experience on a whole.

EXPLANATION OF THE INSTRUCTIONAL MODEL

What are the 5Es?

The 5Es represent five key interrelated processes that provide the kind of learning experiences for learners to experience the curriculum or planned learning episodes: Engage, Explore, Explain, Extend (or Elaborate), and **Evaluate**.

ENGAGE: The purpose of the ENGAGEMENT dimension is to help students to be ready intellectually, socially, emotionally etc. for the session. Attention is given to the students' interests and to getting them personally involved in the lesson, while pre-assessing prior understandings, attitudes and/or skills. During the experience, students first encounter and identify the instructional task and their roles and responsibilities. During the ENGAGEMENT activity, students make connections between past and present learning experiences, setting the organizational groundwork for upcoming activities. The engagement activity may be used to (a) help student unearth prior knowledge (b) arouse their curiosity (c) encourage students to ask questions as a sign that they have wonderments or are puzzled.

EXPLORE: The purpose of the EXPLORATION dimension is to get students involved in solving a real problem that is based on a selected context. EXPLORATION provides them with a chance to build their own understanding of the phenomenon being investigated and the attitude and skills involved for arriving at a workable solution. In exploring the students have the opportunity to get directly involved with the phenomenon and materials. As they work together in learning teams or independently, the need to share and communicate becomes necessary from the experiences. The teacher functions as a facilitator, providing materials, guarding against obstacles to learning and guiding the students to operate based on agreements. The students become inquirers and co-owners of the learning process. In exploring, they also ask questions, formulate hypothesis, search for answers or information/data, reflect with others, test their own predictions and draw conclusions.

EXPLAIN: The purpose of the EXPLANATORY dimension is to provide students with an opportunity to assess their thinking and to use intellectual standards as critical thinkers to communicate their perspectives and/or the meaning of the experiences. They rely on communication tools and their skills as Language users to: (a) organize their thoughts so that they are clear, relevant, significant, fair, accurate etc. (b) validate or affirm others (c) self-motivate. Reflection also occurs during the process and may cause students to adjust their perspective or justify their claims and summarise the lessons being learned. Providing explanations contributes to vocabulary building and self-corrective actions to deal with misconceptions that they become aware of from feedback of their peers and/or their facilitator.

EXTEND: The purpose of this dimension is to allow students to use their new knowledge and continue to explore its significance and implications. Students work independently or with others to expand on the concepts and principles they have learned, make connections to other related concepts and principles within and/or across disciplines, and apply their understandings in new ways to unfamiliar situations.

EVALUATE: The purpose of the EVALUATION dimension is for both students and facilitator to determine progress being made or the extent to which learning has taken place based on the stated objectives or emergent objectives. EVALUATION is treated primarily as an on-going diagnostic and developmental process that allows the learner to become aware of gaps to be treated and progress made from their efforts to acquire the competencies that were the focus of the session. Examples of competencies include understanding of concepts, principles and processes and demonstrating various skills. Evaluation and assessment can occur at different points during the learning episode. Some of the tools that assist in this diagnostic and formative process include rubrics, teacher observation log, self-inventories, peer critique, student interviews, reflective presentations, displays/expositions, portfolios, performances, project and problem-based learning products. Analysis of reflections, video recordings are useful in

helping students to determine the depth of their thinking and understanding and the objectives they have or have not achieved.

Who developed the 5E model?

The Biological Science Curriculum Study (BSCS), a team led by Principal Investigator Roger Bybee, developed the instructional model for constructivism, called the “Five Es”.

The Link between the 5E model and Types of Learning Activities

The five (5) types of Learning Activities purported by Yelon (1996) can be integrated with the 5E’s so as to enrich the teaching and learning process. He noted that every instructional plan should include the following learning activities

1. Motivation Activities: Intended to help learners to be ready for the session
2. Orientation Activities: Inform students of their roles and responsibilities based the purpose or objectives of a learning episode.
3. Information Activities: Allow students to manipulate current knowledge, access/retrieve and generate new ideas
4. Application Activities: Allow for the use of knowledge and skills in novel situations
5. Evaluation Activities: Allow for reflection, corrective actions and sourcing of evidence to confirm/refute claims about learning.

These activities can be planned to serve one of the purposes of each dimension of the 5E model. For example, ENGAGEMENT may be comprised a Motivation Activity and an Orientation Activity. EXPLORATION and EXPLANATION require an Information Activity, while EXTEND requires an Application Activity. EVALUATION requires the kind of activity that will contribute to the collection of data for assessing and arriving at a conclusion about performance based on stated or expected purpose for which learning is being facilitated.

REFERENCES

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- The 5 E Model (n.d.). Retrieved from <http://tiny.cc/oogijy>

Estimated Mass/Unit	State Unit of Estimate Here	mg	g	kg
Your body				
A vitamin tablet				
A stone				
Sponge				
Etc.				

Name of Solid/	Faces	Edges	Vertices
Cube			
Cuboid			
etc			

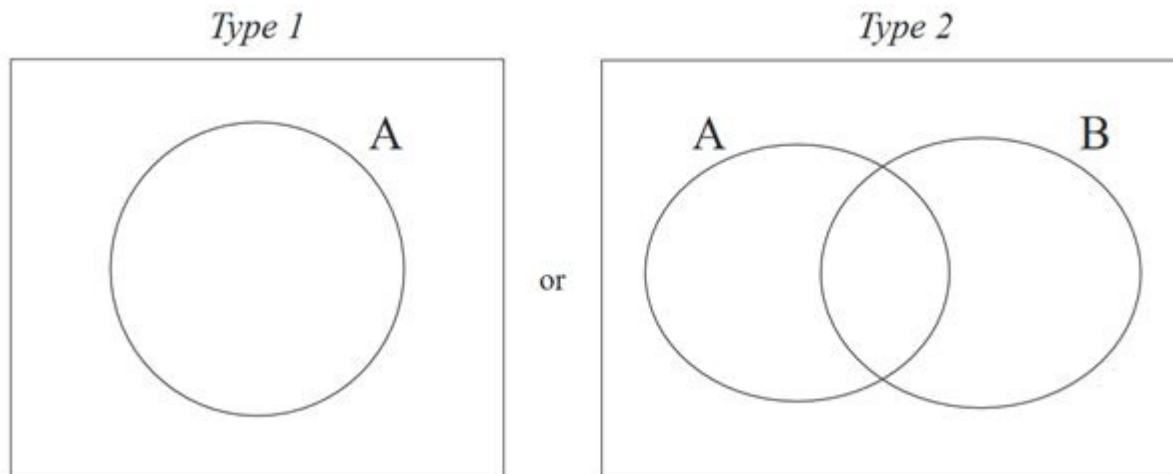
Step	Total number of new infections	Total number of infections in population
0	1	1
1	2	3
2	4	7
3		

Grade 8 Logics Activity

This a whole-class or group activity

The students should be placed in sets according to the given criteria. Each student must find their appropriate place on a Venn diagram of the type shown below, which will be indicated on the classroom floor.

In all cases, the complete set consists of all the pupils in the class.



1. Using Type 1, Let A = set of boys
Using logic and set notation, describe the set of girls in terms of A
2. Using Type 1, Let A = set of students who are 13 years old
 - a. Shade the region of the Venn diagram that represents the students in the complement of A
 - b. Describe this region in terms of A using words
3. Using Type 2, Let A = boys and B = girls
Use set and logic notation to describe
 - a. the union of A and B
 - b. the intersection of A and B
 - c. the complement of A and B
4. Using Type 2, Let A = students with at least one sister, B = students with at least one brother, State in words what is shown by
 - a. the intersection of A and B
 - b. the complement of the union of A and B

Grade 9 - Logics

Group Activity

A waiter brings these meals to the table in a restaurant.

- Chips, chicken, and salad
- Baked potato, cheese, and beans
- Chips, Vegetable pizza and salad

Use the clues to decide who eats which meal.

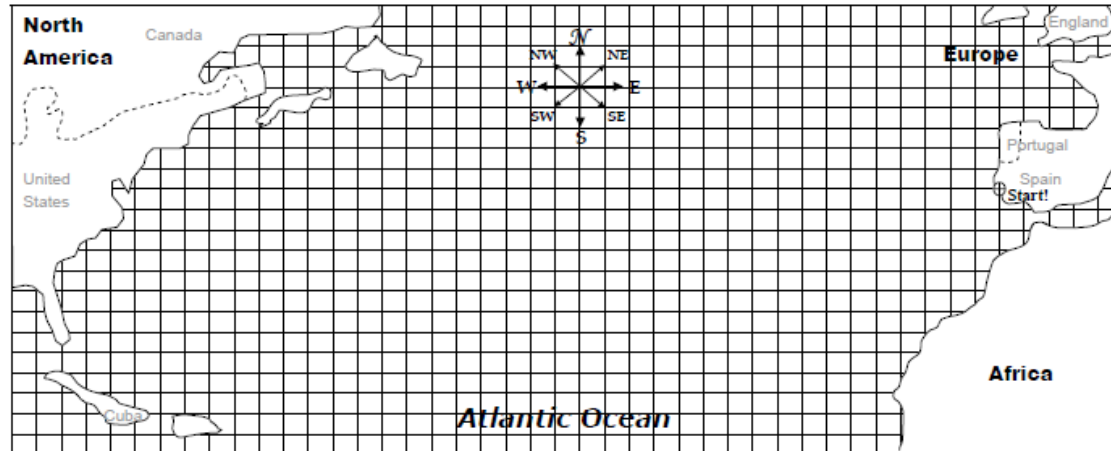
- Chris does not eat salad.
- Adam is a vegetarian.

Construct a truth table to support your answer.

Name: _____

Date: _____

Vector Voyage Worksheet 1



Vector Voyage Instructions

Part 1: Your ship can sail 10 squares/month. Starting from Spain and travelling west (or bearing 270), draw one vector for each month of travel using your red pencil. In what country will you make landfall? _____ How many months will it take to reach land (how many 10-square vectors is it)? _____

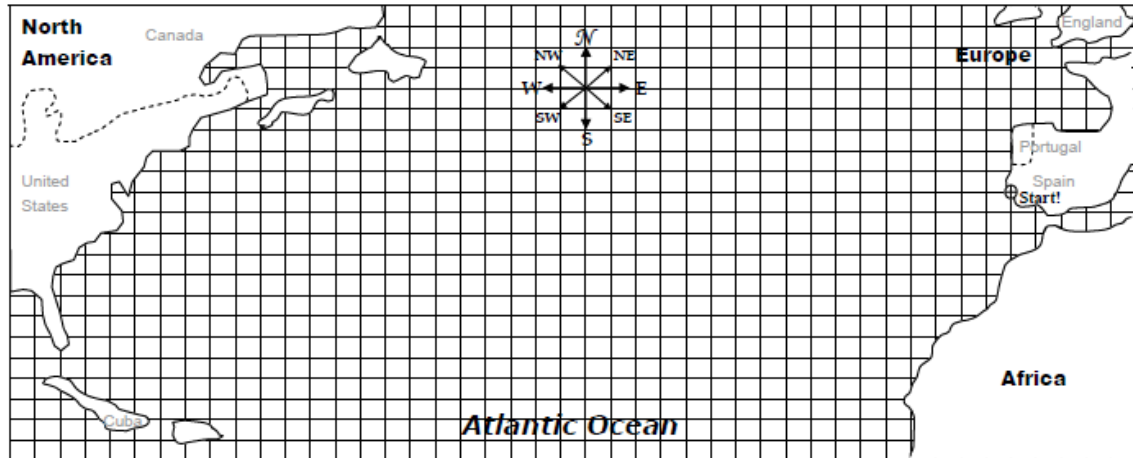
Part 2: Unfortunately, the wind does not always blow the way you want! To determine how the wind effects our travel, let's include the wind vector. First, draw your ship vector, just like in part 1, using your red pencil. Now at the end of that vector, add the wind vector using your blue pencil. Now draw the resulting vector (just adding the two vectors) with your blue pencil. That's where you are when the first month ends. Now do the same for the next month and the month after that until you reach land. Remember that the wind changes, so each month you will have to add a different wind vector. The list of different winds for each month is on the following line.

Month 1: 2 squares south Month 2: 4 diagonal squares southeast Month 3: 2 squares west Month 4: No wind
Where will you make landfall now? _____ How many months to reach land (only count the solid 10-square vectors)? _____

Name: _____

Date: _____

Vector Voyage Worksheet 2



Vector Voyage #2 Instructions

Part 3: Unfortunately, ocean currents affect boats too! Each month, you must also add a current correction vector to find your actual final position. So just like in Part 2, for each month, draw your ship vector (in red), and your wind vector (in blue) and now add on your ocean vector (in green). Now using your green pencil, draw the resulting vector from all of these (add the red and the blue and green vectors). Do this for each month until you hit land. Remember the wind and the ocean vector's will be different for each month. They are listed below.

Wind Vectors:

- Month 1: 2 squares south
- Month 2: 4 diagonal squares southeast
- Month 3: 2 squares west
- Month 4: No wind

Ocean Vectors:

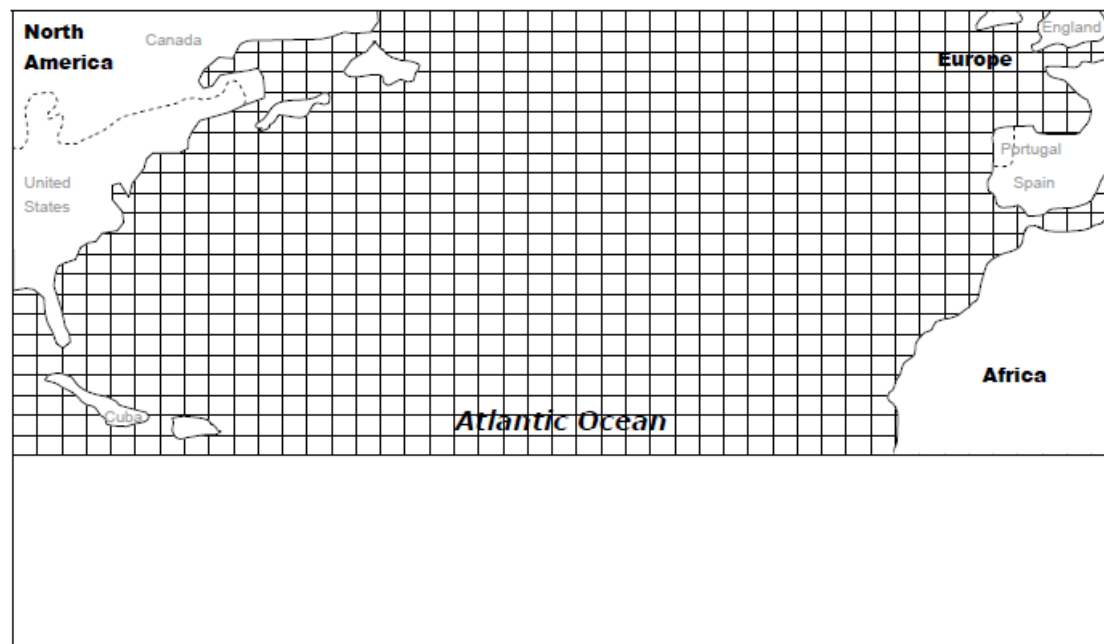
- Month 1: 2 squares south
- Month 2: 4 squares west
- Month 3: 3 diagonal squares southwest

Where will you make landfall now? _____ How many months to reach land (only count the solid 10-square vectors)? _____

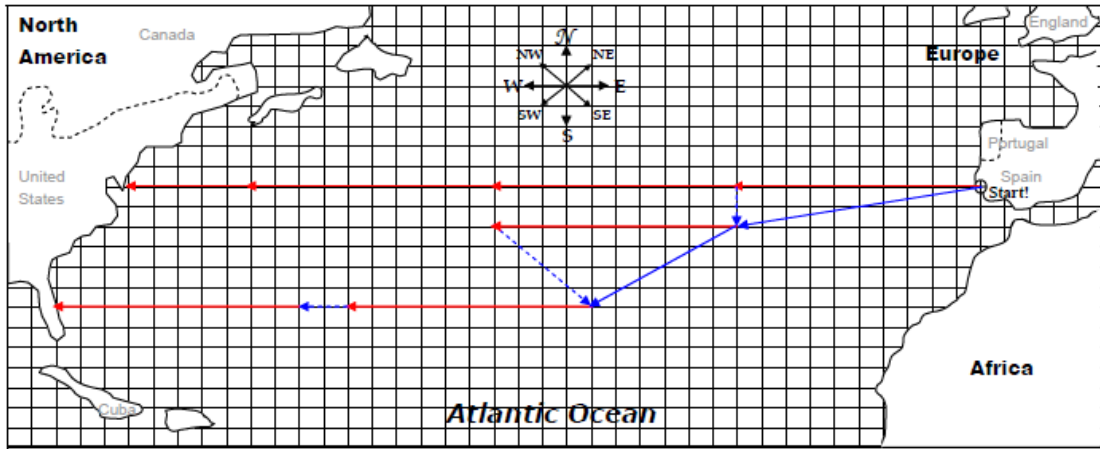
Name: _____

Date: _____

Vector Voyage Worksheet



Vector Voyage Solution Worksheet 1



Vector Voyage Instructions

Part 1: Your ship can sail 10 squares/month. Sailing directly West from the Start position (Spain), draw one vector for each month of travel. In what country will you make landfall? USA (NY) How many months will it take to reach land (how many 10-square vectors is it)? 3.5

←-----

Part 2: Unfortunately, the wind does not always blow the way you want! Each month, you must add a wind correction vector to find your position:

Month 1: 2 squares south Month 2: 4 diagonal squares southeast Month 3: 2 squares west Month 4: No wind

Where will you make landfall now? USA (FL) How many months to reach land (how many 10-square vectors is it)? 4

Every Beat of Your Heart

NAME _____

The heart of a child below the age of twelve beats about 100 times a minute.

Try the following experiment: Check your heartbeat by pressing your fingers as shown below to find your pulse. The pulse is the throbbing, or beating, felt when blood is pumped by the heart. Once you can feel your pulse, count how many times your heart beats in one minute.



1. Determine the following:
 - a. Number of heart beats in one minute while at rest _____
 - b. Number of heart beats in one minute after exercise:
Stepping up and down _____ Walking _____ Running in place _____
2. Does the heart beat faster at rest or after exercise?
3. Which exercise caused the heart to beat the fastest: stepping up and down, walking, or running?
4. Would the heart beat faster if you exercised for more than one minute? Why?
5. Do you think the heart would beat faster after running, or after biking? How could you test your prediction?
6. Whose heart would beat faster: a person who has just run a long race, or someone who has just played a baseball game? How could you find out?

Answer Key – Every Beat of Your Heart

1. Student pulse rates will vary.
2. After exercise
3. Running
4. The heart rate increases as the intensity of the exercise increases. However, as you reach a point of exhaustion, your heart rate begins to level off. (Source: Montana State University – Bozeman: Physiology and Psychology)
5. Students may suggest it depends on how fast you run or bike; most students would say running. To test the prediction, take someone's pulse after doing each activity for the same amount of time.
6. Assuming the two people were in the same physical shape, someone who has just run a long race

GRADE: 7
UNIT(S): Measurement, Statistics & Probability, Number
TOPIC: Are your height and weight related to your health
DURATION: Four Session

Standards

Number

Use the basic operations, number relationships, patterns, number facts, calculators and software to compute and estimate in order to solve real world problems involving fractions, percentages, and decimals.

Measurement

Use the correct units, tools and attributes to estimate, compare and carry out the processes of measurement to given degree of accuracy

Statistics & Probability

Collect, organize, interpret and represent data and make inferences by applying knowledge of statistics and probability.

Objectives

General Objectives

- Perform the four basic operations, including multiple operations, on real numbers, mentally, using paper and pencil, and in problem situations;
- Give reasonable estimates of the results of operations on numbers;
- Measure length using appropriate instruments;
- Conduct simple experiments, to collect data;
- Draw appropriate conclusions from calculations
- Measure length, mass, time, temperature, volume, capacity using appropriate instruments;
- Perform conversions within units and across related units. (up to square units).

Specific Objectives

- Measure at least 5 heights, to the nearest centimeter, accurately
- Convert heights from meters to centimeters, accurately
- Measure at least 5 weights, to the nearest kg
- Find the squared height of each individual
- State correctly, the body mass index of persons using the height and weight
- State correctly, the number of persons underweight, overweight or obese in the class
- State correctly, personal body mass index
- Design presentations of findings

- Make presentations of findings

Key Skills:

Investigate, Measure, Observe, Share, Compare, Estimate, Record information, Listen carefully, Make measuring instruments, Work in groups, Problem-solve, Tabulate data, Model area, and perimeter, Manipulate digital content, Insert illustrations, Navigate digital content

Key Vocabulary

Measurement, length, metric, meter, centimeter, accurate, height, variables, data, weight, kilogram, body mass index, health, diet.

Resources

Computer, tablet, smartphone, etc, Teacher-generated activity sheet, Spreadsheet with BMI calculator (body_mass_index.xls), Measuring tape, Scale

Prior Learning

Check that students can:

- Use a measuring tape
- Use a scale

Learning Outcome

Students will be able to:

- Manipulate measuring instruments to demonstrate a variety of measuring attributes;
- Actively participate in group activities and discussions;
- Engage in problem-solving situations involving measurement;
- Safely and correctly use measuring instruments
- Perform the 4 basic operations correctly;
- Draw conclusions based on calculations
- Complete table with measures of height and weight
- Presentation of findings done

Teaching/Learning Activity

Students will:

Carry out supplied activity

Assessment

- Group participation
- Calculations are done correctly
- Measurements were done accurately and in specified unit of measure
- Values entered correctly

Extended Learning

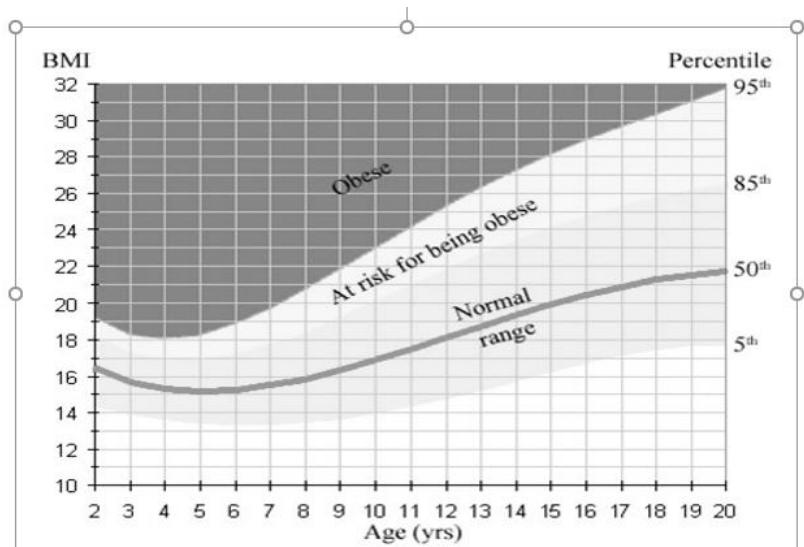
Challenge students to Investigate the relationship between BMI and healthy lifestyle

Links to other subjects

- Science
- Physical Education
- Food and Nutrition
- ICT

Activity

Is your height and weight related to your health? We will explore this question by collecting data on two variables – the height and weight of your body.



Step 1: Collecting the Data

Organize yourselves so that there are 2 persons each to measure weight, height, and 1 person to enter the data into the supplied spreadsheet (body_mass_index.xls). Ensure that there is a bathroom scale and measuring tape. Measurements are to be in metric units. To collect the height, the person should stand with their back against the wall and the height marked with a pencil and this height. Use the measuring tape to read off the height. Ensure that the bathroom scale is calibrated properly and that the spreadsheet is open and ready to accept data. Enter your data in the supplied spreadsheet which should look like the table below.

Student	Gender	Age	Height (m)	Weight (kg)	Body Mass Index (BMI)	Weight Status
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Step 2 Interpreting data

Body Mass Index (BMI) is a person's weight in kilograms divided by the square of height in meters. A high BMI can be an indicator of high body fatness. BMI can be used to screen for weight categories that may lead to health problems. Although BMI is not a direct measure of body fatness, it is a fairly reliable indicator of a person's fat levels, and an elevated BMI can be a sign of future health risks. BMI can be measured in children (aged 2-19) but is interpreted differently for girls and boys.

BMI is calculated as follows: $BMI = (\text{weight in kg})/(\text{height in meters})^2$

Do not worry about the calculations as they are already done for you in the spreadsheet.

Step 3. Using the information from the spreadsheet, answer the following questions:

1. How many students are in the population for this exercise?
2. What is the probability, that a student selected at random, has a normal BMI?
3. How many girls have a BMI less than 25?
4. How many boys have a BMI over 30?
5. What is the probability of selecting a girl with a BMI less than 18?
6. What is the probability of selecting a boy with a BMI greater than 20?

Step 4

- A. Design a diet plan for persons whose BMI is (i) underweight; (ii) normal; (iii) overweight; (iv) obese. You are free to research and prepare these plans, exhibit and encourage the school to adopt these meal plans.
- B. Design an exercise regimen for persons whose BMI is (i) underweight; (ii) normal; (iii) overweight; (iv) obese. You are free to research and record these exercises. Share them formally with the school for everyone to do.

