TEACHER'S RESOURCE PACK

Mathematics BASIC 7

NATIONAL COUNCIL FOR CURRICULUM & ASSESSMENT OF MINISTRY OF EDUCATION

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Part A

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About the Teacher's Resource Guide

The teacher resource guide is a condensed version of all the important information in the curriculum. It is a document carefully packaged to help the teacher facilitate learning in the classroom. The Guide has been developed with the primary audience being Basic School mathematics teachers in the CCP in mind. To this end, the resource guide aims to promote the use of best practices for teaching and learning, for high-quality mathematics learning outcomes in schools. In addition to important background information about high quality mathematics learning outcomes (content standards and core competencies), this resource guide contains lesson frames to guide the teachers' lesson planning and sample lesson plans.

The lesson frames contain the following important components that are necessary for developing the CCP mathematics learning outcomes:

- Key words/vocabulary and command words.
- Suggested activities for teaching (these include indicators and exemplars from the Common Core Programme curriculum document).
- Suggested activities for learning and assessment (these should include the exemplars from the common core curriculum document, along with other learning and assessment activities supported by the learner resources);
- Equipment and resources for learning;
- Page references to the Learner Resource Guide;
- Progression (describing how knowledge and understanding will be built as the content standard is addressed);
- Suggestions for homework, project work and/or community engagement which focus on ideas for refining, extending or applying what has been learnt;
- Cross-curriculum links or cross-cutting issues (which require the identification of links between concepts, content or learning related to other disciplines and making reference to opportunities for the core competencies);
- Potential misconceptions and/or learners with learning difficulties, which require the identification of the challenges that might

be presented as the learner works to achieve the content standard, and include any suggestions that help the teacher to overcome them, such as adaptations to teaching and learning activities.

To use the Guide, the teacher is encouraged to do the following:

§ Read the Guide thoroughly and carefully alongside the curriculum document which contains all strands, sub-strands, content standards, indicators and exemplars.

§ Become familiar with the components of the lesson frame.

§ Note that the lesson frames cover all the content standards but not all the indicators. It is, therefore, necessary that in planning for lessons teachers cover all the indicators that are not in the frameworks.

INTRODUCTION

Why the review of the curriculum?

National and international assessment results consistently indicate that a few (less than 25%) of basic school pupils in Ghana possess the mathematical proficiency needed to access the opportunities that the 21st century offers them. The low performance is largely as a result of an education system that appears to direct focused attention on preparing learners for passing examinations, at the expense of helping them to develop core skills such as critical thinking, creativity, digital literacy, reflection and evaluation they will need to participate fully in society.

An analysis of the previous objective-based mathematics curriculum by the NaCCA subject panel revealed the following causes:

1. Too many subtopics in each content domain (or strand) that are poorly aligned. In the standard-based curriculum we ensure:
    - Less is better (not too many standards);
    - Content Standards represent "big ideas";
    - In addition to the standards specific to each subject/discipline, there are core competencies that run across all disciplines.
2. Many objectives limited work only within their content domains and were not taught across the other domains; this limits application of content.; for instance, teaching fractions (including decimal and percentages) with measurement.
3. Some essential content areas were found missing; e.g. though calculating speed is in the syllabus, distance-time graphs are missing.
4. Little attempt was made to integrate ICT in developing the mathematical concepts.
5. Few and limited use of teaching learning resources including models and other manipulatives were found.
6. Competences needed in society and working life (or skills for building a sustainable future) which are not emphasised by the objectives and teacher-learner activities included:
    - development of conceptual understandings and application of concepts;
    - development of number sense;
    - development of mental strategies for adding, subtracting, multiplying, and dividing numbers;
    - developing mathematical reasoning and communication skills.

Teachers often tend to present mathematical concepts, work several examples on the board, and then assign exercises in which learners practise whatever has just been presented, that is, an approach that has been widely criticised. The learning experiences, thus, appear to ignore the varied uses of mathematics in different local contexts to amplify the beauty of mathematics in solving real-life problems nor do they take account of learners' differing language and literacy abilities, accessibility and inclusivity issues.

In addition, respect for culture and diversity as well as affording learners the opportunity to make connections between local and global contexts and then share their understanding with others appear limited in most of our mathematics classrooms. Given the incredible power that teachers hold to make a difference to pupils' mathematical development, a reasonable point

of entry for changing the narrative is a teacher education curriculum that inspires and develop highly competent, reflective teaching professionals committed to the holistic development of their pupils and the improvement of society. This course plays an important role in this regard.

CCP MATHEMATICS

Rationale

Mathematics forms an integral part of our everyday lives and it is a universal truth that development is hinged on mathematics. Mathematics is the backbone of social, economic, political, and physical development of a country. It is a never-ending creative process, which serves to promote discovery and understanding. It consists of a body of knowledge which attempts to explain and interpret phenomena and experiences. Mathematics has changed our lives and it is vital to Ghana's future development.

To provide quality mathematics education, teachers must facilitate learning in the mathematics classroom. This will provide the foundations for discovering and understanding the world around us and lay the grounds for mathematics and mathematics related studies at higher levels of education. Learners should be encouraged to understand how mathematics can be used to explain what is occurring, predict how things will behave and analyse causes and origin of things in our environment. The mathematics curriculum has considered the desired outcomes of education for learners at the basic level. Mathematics is also concerned with the development of attitudes and therefore it is important for all citizens to be mathematically and technologically literate for sustainable development. Mathematics therefore ought to be taught using hands-on and minds-on approaches which learners will find as fun and adopt mathematics as a culture.

Philosophy

Teaching Philosophy

Ghana believes that an effective mathematics education needed for sustainable development should be inquiry-based. Thus mathematics education must provide learners with opportunities to expand, change, enhance and modify the ways in which they view the world. It should be pivoted on learner-centred mathematics teaching and learning approaches that engage learners physically and cognitively in the knowledge-acquiring process in a rich and rigorous inquiry-driven environment.

Learning Philosophy

Mathematics Learning is an active contextualized process of constructing knowledge based on learners' experiences rather than acquiring it. Learners are information constructors who operate as researchers. Teachers serve as facilitators by providing the enabling environment that promotes the construction of learners' own knowledge, based on their previous experiences. This makes learning more relevant to the learner and leads to the development of critical thinkers and problem solvers.

Aims

General Aim

The curriculum is aimed at developing individuals to become mathematically literate, good problem solvers, have the ability to think creatively and have both the confidence and competence to participate fully in Ghanaian society as responsible local and global citizens.

Subject Aims

The mathematics curriculum is designed to help learners to:

1. recognise that mathematics permeates the world around us
2. appreciate the usefulness, power and beauty of mathematics
3. enjoy mathematics and develop patience and persistence when solving problems
4. understand and be able to use the language, symbols and notation of mathematics
5. develop mathematical curiosity and use inductive and deductive reasoning when solving problems
6. become confident in using mathematics to analyse and solve problems both in school and in real-life situations

7. develop the knowledge, skills and attitudes necessary to pursue further studies in mathematics
8. develop abstract, logical and critical thinking and the ability to reflect critically upon their work and the work of others.

Structure and Organisation of the Mathematics Curriculum

A unique annotation is used to label the class, strands, sub-strands, content standards and learning indicators in the curriculum for the purpose of easy referencing. The annotations are defined below and Figure 1 illustrates them in an excerpt of the curriculum.

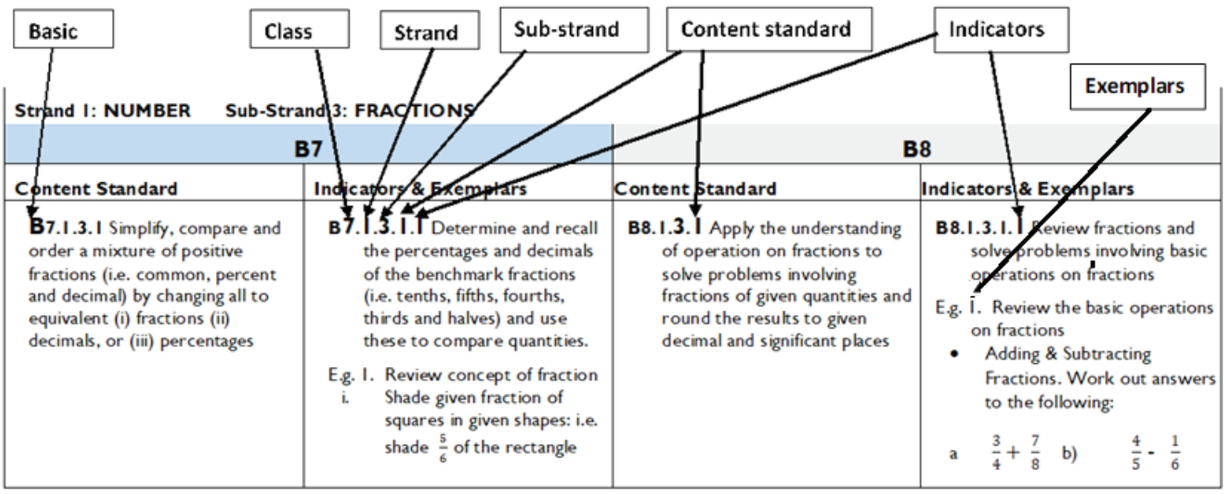


Figure 1

Strands are the broad areas/sections of the mathematics content to be studied.

Sub-strands are the topics within each strand under which the content is organised.

Content standard refers to the pre-determined level of knowledge, skill and/or attitude that a learner attains by a set stage of education.

Indicator is a clear outcome or milestone that learners have to exhibit in each year to meet the content standard expectation. The indicators represent the minimum expected standard in a year.

Exemplar – support and guidance which clearly explains the expected outcomes of an indicator and suggests what teaching and learning activities could take to support the facilitators/teachers in the delivery of the curriculum.

Table 1 shows Strands, Sub-strands, Scope and Sequence of the B7 – B10

S/N	STRAND	SUB-STRAND	CONTENT STANDARDS			
			B7	B8	B9	B10
1.	**Number**	Number and Numeration Systems	1	2	2	2
2.		Number Operations	3	3	3	3
3.		Fractions, Decimals and Percentages	3	1	1	1
4.		Ratios and Proportion	1	1	1	1
5.	**Algebra**	Pattern and Relationships	1	1	1	1
6.		Algebraic Expressions	1	1	1	1
7.		Variables and Equations	1	1	1	1

Table 1: *Strands, sub-strands, Scope and Sequence of the B7 – B10*

S/N	STRAND	SUB-STRAND	CONTENT STANDARDS			
8.	**Geometry and Measurement**	Shapes and Space	2	2	1	2
9.		Measurement	3	2	2	2
10.		Position and Transformation	1	1	1	1
11.	**Handling Data**	Data	2	2	2	2
12.		Chance or Probability	1	1	1	1
13.		**Total**	20	18	18	18

Planning, Teaching and Assessment

Creative and Learning-centred Teaching

Creative pedagogical approaches include the approaches, methods and strategies for ensuring that every learner benefits from appropriate and relevant teaching and learning episodes which are timely assessed, and feedback provided to the learner and other stakeholders such as parents and education authorities. Creative pedagogical approaches include the types and use of appropriate and relevant teaching and learning resources to ensure that all learners make the expected level of learning outcomes.

The curriculum emphasises:

i. The creation of learning-centred classrooms through the use of creative approaches to teaching and learning as strategies to ensuring learner empowerment and independent learning.

ii. The positioning of inclusion and equity at the centre of quality teaching and learning.

iii. The use of differentiation and scaffolding as teaching and learning strategies for ensuring that no learner is left behind.

iv. The use of Information Communications Technology (ICT) as a pedagogical tool.

v. The identification of subject specific instructional expectations needed for making learning in the subject relevant to learners.

vi. The integration of assessment for learning, as learning and of learning into the teaching and learning process and as an accountability strategy, and

vii. Use of questioning techniques that promote deeper learning.

Learning-Centred Pedagogy

The learner is at the centre of learning. At the heart of the curriculum is learning progression and improvement of learning outcomes for Ghana's young people with a focus on the 4**R**s – Reading, w**R**iting, a**R**ithmetic and c**R**eativity. It is expected that at each curriculum phase, learners would be offered the essential learning experiences to progress seamlessly to the next phase. Where there are indications that a learner is not sufficiently ready for the next phase, a compensatory provision through differentiation should be provided to ensure that such a learner is ready to progress with their class mates. At the early basic levels of education, the progression phases are: pre-primary (KG1 – 2), and the primary phases (B1 – B3, and B4 to B6).

The curriculum encourages the creation of a learning-centred classroom that enables learners to engage in meaningful "hands-on" activities that bring home to the learner what they are learning in school, and what they know from outside of school. The learning centred classroom is a place for the learners to discuss ideas, and through the inspiration of the teacher, actively engage in looking for answers through working in groups to solve problems. This also includes researching for information and analysing and evaluating the information obtained. The aim of the learning-centred classroom approach is to develop learner autonomy so that learners can take ownership of their learning. It provides the opportunity for deep and profound learning to take place.

The teacher should create a learning atmosphere that ensures:

- Learners feel safe and accepted.
- Learners are given frequent opportunities to interact with varied sources of information, teaching and learning materials and ideas in a variety of ways.

- The teacher assumes the position of a facilitator or coach who helps learners to identify a problem suitable for investigation via project work.
- Problems are connected to the context of the learners' world so that it presents authentic opportunities for learning.
- Subject matter around the problem, not the discipline
- Learners responsibly define their learning experience and draw up a plan to solve the problem in question.
- Learners collaborate whilst learning.
- Demonstrate the results of their learning through a product or performance.

It is more productive for learners to find answers to their own questions rather than for teachers to provide the answers and their opinions in a learning-centred classroom.

Inclusion

Inclusion entails access and learning for all learners especially those disadvantaged. All learners are entitled to a broad and balanced curriculum in every school in Ghana. The daily learning activities to which learners are exposed should ensure that the learners' rights of equal access to quality education are being met. The curriculum suggests a variety of approaches that address learners' diversity and their special needs in the learning process. These approaches when used in lessons, will contribute to the full development of the learning potential of every learner. Learners have individual needs and different learning styles, learning experiences and different levels of motivation for learning. Planning, delivery and reflection on daily learning episodes should take these differences into consideration.

The curriculum therefore promotes:

- learning that is linked to the learner's background and to their prior experiences, interests, potential and capacities;
- learning that is meaningful because it aligns with learners' abilities (e.g. learning that is oriented towards developing general capabilities and solving the practical problems of everyday life); and
- the active involvement of the learners in the selection and organisation of learning experiences, making them aware of their importance in the process and also enabling them to assess their own learning outcomes.

Differentiation

The CCP mathematics curriculum is to be delivered through the use of creative approaches. Differentiation and Scaffolding are pedagogical approaches to be used within the context of the creative approaches.

Differentiation is a process by which differences among learners (learning styles, interest and readiness to learn etc.) are accommodated so that all learners in a group have the best possible chance of learning. Differentiation could be by task, support and/or outcome. Differentiation as a way of ensuring each learner benefits adequately from the delivery of the curriculum can be achieved in the classroom through:

- Task
- One-on-one support, and
- Outcome

Differentiation by task involves teachers setting different tasks for learners of different ability e.g. in sketching the plan and shape of their classroom some leaners could be made to sketch with free hand while others would be made to trace the outline of the plan of the classroom.

Differentiation by support involves the teacher providing a targeted support to learners who are seen as performing below expected standards or at risk of not reaching the expected level of learning outcome. This support may include a referral to a Guidance and Counselling Officer for academic support.

Differentiation by outcome involves the teacher allowing learners to respond at different levels. In this case, identified learners are allowed more time to complete a given task.

Scaffolding

Scaffolding in education refers to the use of a variety of instructional techniques aimed at moving learners progressively towards stronger understanding and ultimately greater independence in the learning process.

It involves breaking up the learning episode, experience or concepts into smaller parts and then providing learners with the support they need to learn each part. The process may require a teacher

assigning an excerpt of a longer text to learners to read, engaging them to discuss the excerpt to improve comprehension of its rationale, and then guiding them through the key words/vocabulary to ensure learners have developed a thorough understanding of the text before engaging them to read the full text.

Common scaffolding strategies available to the teacher include:

- Giving learners a simplified version of a lesson, assignment, or reading, and then gradually increasing the complexity, difficulty, or sophistication over time.
- Describing or illustrating a concept, problem, or process in multiple ways to ensure understanding.
- Giving learners an exemplar or model of an assignment, they will be asked to complete.
- Giving learners a vocabulary lesson before they read a difficult text.
- Clearly describing the purpose of a learning activity, the directions learners need to follow, and the learning goals they are expected to achieve.
- Explicitly describing how the new lesson builds on the knowledge and skills learners were taught in a previous lesson.

Information Communications Technology

ICT has been integrated into this curriculum as a teaching and learning tool to enhance deep and independent learning. Some of the expected outcomes that the mathematics curriculum aims to achieve through ICT use for teaching and learning are:

- Improved teaching and learning processes.
- Improved consistency and quality of teaching and learning.
- Increased opportunities for more learner-centred pedagogical approaches
- Improved inclusive education practices by addressing inequalities in gender, language, ability.
- Improved collaboration, creativity, higher order thinking skills.
- Enhanced flexibility and differentiated approach of delivery.

The use of ICT as a teaching and learning tool is to provide learners with access to varied information online. It also provides the framework for analysing data to investigate patterns and relationships in a geographical context. Once learners have made their findings, ICT can then help them organise, edit and present information in many different ways.

Learners need to be exposed to the various ICT tools around them including calculators, radios, cameras, phones, television sets and computer, and related software like Microsoft Office packages – Word, PowerPoint and Excel – as teaching and learning tools. The exposure that learners are given at the early basic school level to use ICT in exploring learning will build their confidence, and increase their levels of motivation to apply ICT use in later years, both within and outside of education. ICT use for teaching and learning is expected to enhance the quality of and learners' competence in the 4Rs.

Assessment of Learners' Learning

Assessment in the Standards-based Curriculum

Assessment is an integral part of teaching and learning and it becomes a critical issue in the teaching and learning of mathematics and one that requires careful consideration by teachers and pre-service teachers alike. A good teacher is constantly assessing performance and giving timely and direct feedback. Assessment is paramount in the math classroom. Assessments must be planned in order to make sure they are carried out effectively. Also, assessment should not be carried out just because it is supposed to be done. As teachers, we use, and value assessment because they inform our feedback to Learners and the way we will deliver instruction in the future.

Multiple sources of assessment will involve different ways of presenting tasks to learners, as well as different ways of probing assessment information so that valid inferences about learners' progress can be made. Assessment tasks can include a variety of formats (written, oral, practical); can be closed or open-ended; real life or abstract; completed individually or as a group.

Ways to assess mathematics in the classroom

Performance assessment

Learners can demonstrate what they have learned and how to solve problems through a collaborative effort in solving a complex problem together. You should offer learners the opportunity to show how they understand problems and strategies that best work for them. You should create learning centres with adequate resources that help learners to demonstrate their understanding of concepts. The use of project works and group assignments help learners showcase their abilities in mathematics.

Open-response questions

To help learners grasp ideas in class, ask open-ended questions that get them writing/talking. They will undoubtedly reveal more than you would've thought to ask directly. Avoid yes/no questions and phrases. Use follow up questions that provoke thinking and generate discussions in the classroom. Encourage learners to use mathematics terms and command words in explaining their solutions and communicating their ideas.

Investigations

To use investigations, give basic math problems in which the learner can demonstrate how they have mastered the basic concepts and skills. Ask learners to interpret, calculate, explain, describe or predict whatever it is they are analysing. Investigations provide the opportunity for Learners to go through a real mathematical experience of formulating questions, posing and testing conjectures, and arguing and proving statements. For example: working with numbers, write the first 10 multiples of 5. Then ask learners to look at the digits. Prompt: *Do you find any patterns? Now investigate what happens with the multiples of 4 and 6.*

Self-assessment

Using self-assessment strategies helps learners develop confidence in themselves. After teaching, ask learners to evaluate their own work and participation. Responding to the following questions will help learners learn to assess themselves and their work objectively:

- What was the most difficult part of this topic for you?
- What do you think you should do next?
- If you could do this task again, would you do anything differently? If yes, what?

Group Assessment

In Mathematics learners learn better when they collaborate and share ideas. You can use "think-pair-share", "group", etc. strategies where learners take a few minutes to think about the question or prompt. Next, they pair or move into groups with designated partner(s) to compare thoughts before sharing with the whole class. Learners ask one another questions about the topic, or problem, the questions initiate a conversation that continues with a series of responses and additional questions. By so doing, learners learn to formulate questions that address issues to facilitate their own discussion and arrive at a new understanding.

Formative pencil–paper assessment

Learners respond individually to short, pencil–paper formative assessments of skills and knowledge taught in the lesson. The teacher collects assessment results to monitor individual student progress and to inform future instruction.

Instructional expectations

The following are the major roles the teacher is expected to undertake in the implementation of the CCP mathematics curriculum:

1. Guide and facilitate learning by generating discourse among learners and challenging them to accept and share responsibility for their own learning, based on their unique individual differences.
2. Select mathematics content, adapt and plan lessons to meet learners' interests, knowledge, understanding, abilities, and experiences. It should be noted that in the standards-based curriculum, lessons are not expected to be limited to only specific objective(s) but should broadly cover the processes of learning for the learners to cumulatively engage in activities/experiences to demonstrate what they know and can do (i.e. the indicators), as well as develop such core competences.
3. Work together as colleagues within and across disciplines and grade levels to develop

communities of STEM[1] learners who exhibit the STEM skills including mathematical inquiry, attitudes and social values conducive to mathematics learning.

4. Use multiple methods and systematically gather data about learner understanding and ability to guide mathematics teaching and learning, with arrangements to provide feedback to both learners and parents.
5. Design and manage learning environments that provide learners with the time, space, and resources needed for learning mathematics.
6. Aid learners to make sense of problems and persevere in solving them, including using higher order reasoning and problem-solving skills.
7. Get learners to think critically about tasks and their solutions by asking questions and challenging each other's views until a consensus is reached.
8. Encourage learners to present their own ideas in ways that make sense to others and critique each other's reasoning.
9. Enable learners to work together to represent real-life situations of mathematical concepts in multiple ways (e.g. oral, text, pictures, diagrams, equations, etc).
10. Support learners to use appropriate technologies to solve problems embedded in their culture and the larger society.
11. Provide opportunities for learners to realise that it is necessary to be precise when sharing mathematical ideas. Also, allow them to support each other to improve on their precision.
12. Guide learners to look for and express patterns or regularity in repeated reasoning.

1 STEM Education is an approach to teaching and learning that integrates the content and skills of the STEM disciplines (i.e. Science, Technology, Engineering and Mathematics) and other disciplines to answer complex questions, investigate global issues, solve real-world problems and challenges, and in the process, address the development of a set of personal attributes and transversal competencies needed for success in the 21st century. As well as working scientifically, STEM involves students working mathematically, working digitally (or technologically), and working like an engineer.

Lesson Planning

A lesson plan (referred to as lesson notes) based on this scheme of learning must be prepared for the associated indicators to the content standard to be achieved. A lesson plan does not have to be lengthy. What is important is to make sure they contain the main elements of the lesson. A lesson plan is a sketch to guide the presentation of instructional activities so that teachers can optimize classroom time and students' learning.

Phases of the Lesson

Teachers must understand how to arrange the different learning activities in the indicators into a logical progression of learning for learners. To do this effectively, it is recommended that lessons in early basic school levels should comprise the following three phases of learning activities:

1. Phase 1: **Starter (preparing the brain for learning)**
2. Phase 2: **Main (new learning including assessment)**
3. Phase 3: **Plenary/Reflections (Learner and teacher)**

Phase 1: The Starter Phase

The starter sets the tone. Activities which engage learners, get them thinking and provide a clear focus on learning, creates a purposeful atmosphere in which the teacher is in charge and the Learners are ready and willing to work. As learners are learning a new game, song, rhyme and the related concepts, it may be necessary to progress a little slower. However, teachers should quickly pick up the pace so that pupils become faster and faster at accessing these important concepts. The goal is to maintain a lively pace and provide an energetic start to the class.

It is important to review and reinforce concepts covered in previous weeks or classes as part of the starters. For that reason, the weekly schemes of works outline short, fun games and activities teachers can do to reinforce understanding. Teachers should strive to do at least a short starter activity per lesson.

Phase 2: The Main Phase

The bulk of the **main (new learning including assessment)** phase in a lesson plan should be devoted to having *all* learners:

- explore the new learning areas for the day
- work in pairs or groups to carry out differentiated tasks
- work with resources or tools to carry out differentiated tasks
- share and discuss their results and strategies
- develop relevant core competencies (i.e. problem solving, critical thinking, communication, digital literacy, collaboration etc.).

In addition to the above, and for the purpose of **assessment,** in each lesson, time should be set aside for learners to work independently or collaboratively on problems. During this time, the teacher should move around, look at and check learners' works.

Phase 3: The Plenary/Reflections Phase

The **Plenary/Reflections** phase is a fantastic opportunity to reflect, recap on and consolidate the learning that has happened in the day's lesson. They can also be used to introduce ideas that will be visited in the next lesson, thereby forming a bridge for continuous learning.

Ideally, an effective plenary:

- Usually occurs at the end of a lesson but can also be used at other points in the lesson if appropriate.
- Brings the whole group together to participate.
- Is used by the teacher (and to an extent by the pupils) to check on learning so far and to identify any misconceptions that need to be corrected.
- Directs Learners to the next phase of learning.
- Helps learners to understand not only **what** they have learned, but also **how** they learned it.

Some useful plenary techniques include:

1. *Post-it notes* for learners to collect 3 things they have learnt.
2. Using a flip chart or whiteboard/chalkboard to collect group learning achievements.
3. Showing 5, 4, 3, 2, 1 fingers to demonstrate success in learning progress on a five-scale point. For example, 5 fingers mean 'I really got it', 4 means 'mostly got it', 3 means 'got some of it', 2 means 'got little of it' and 1 means 'didn't get it'.
4. Sit in a hot seat and make 3 points as a key character that would be an expert in the lesson outcome, hand on to another class member who has to make 2 points, then down to 1.

Note: Always finish on time so that you do not miss out the plenary in your lesson plan. It should be very clear to any observer that learners have made progress in learning and can demonstrate it. Where insufficient progress has been made, it should be clear what the plan of action will be to address this next lesson. One of the most common criticisms is that teachers do not use assessment outcomes to inform future planning. Make it clear that you can see what each and every learner has learnt and what the next steps are to secure progress.

Time Allocation for the Phases of a Lesson

The curriculum is designed to be delivered in a single period daily of 50 minutes for four days. The recommended allocations of time to phases is summarised in Table 3.

Content Standards for B7

Table1 shows the Content Standards for B7. These can be taught in any order of arrangement. The teacher is free to teach the sub-strands in any order within a class per local requirements and resources. It is important for teachers to note that the strands in Table 1, have not been necessarily organised sequentially for teaching.

Table 1: B7 Contend Standards

S/N	Strand	Sub-strand/Topic	Content Standard
1.	Number	Number and numerals	**B7.1.1.1** Demonstrate understanding and the use of place value for expressing quantities recorded as base ten numerals in as well as rounding these to given decimal places.
2.		Number Operations	**B7.1.2.1** Apply mental mathematics strategies and number properties to solve problems.
3.		Number Operations	**B7.1.2.2** Demonstrate an understanding of addition, subtraction, multiplication and division of (i) whole numbers, and (ii) decimals, to solve problems.
4.		Number Operations - Powers	**B7.1.2.3** Demonstrate understanding and the use of powers of natural numbers in solving real life problems.
5.		Number Operations - Integers	**B7.1.2.4** Demonstrate an understanding of the basic operations on integers.
6.		Number Fractions	**B7.1.3.1** Simplify, compare and order a mixture of positive fractions (i.e. common, percent and decimal) by changing all to equivalent (i) fractions (ii) decimals, or (iii) percentages
7.		Number Fractions	**B7.1.3.2** Demonstrate an understanding of the process of addition and/or subtraction of fractions and apply this in solving problems.
8.		Number Fractions	**B7.1.3.3** Demonstrate an understanding of the process of multiplying and dividing positive fractions and apply this in solving problems.
9.		Number - Ratios	**B7.1.4.1** Demonstrate an understanding of the concept of ratios and its relationship to fractions and use it to solve problems that involve rates, ratios, and proportional reasoning.
10.	Algebra	Algebra – Pattern and Relations	**B7.2.1.1** Derive the rule for a set of points of a relation, draw a table of values to graph the relation in a number plane and make predictions about subsequent elements of the relation.
11.		Algebra – Algebraic Expressions	**B7.2.2.1** Simplify algebraic expressions involving the four basic operations and substituting values to evaluate algebraic expressions.
12.		Algebra – Equations	**B7.2.3.1** Demonstrate an understanding of linear equations of the form x + a = b (where a and b are integers) by modelling problems as a linear equation and solving the problems concretely, pictorially, and symbolically.
13.	Geometry & Measurement	Geometry - Angles	**B7.3.1.1** Demonstrate understanding of angles including adjacent, vertically opposite, complementary, supplementary and use them to solve problems.
14.		Geometry – Construction 1	**B7.3.1.2** Demonstrate how to construct a perpendicular to a line from a given point, bisect a line, bisect angles.
15.		Measurement - Perimeter	**B7.3.2.1** Demonstrate the ability to find the perimeter of plane shapes including circles using the concept of pi (π) to find the circumference a circle.
16.		Measurement - Area	**B7.3.2.2** Derive the formula for determining the area of a triangle and use it to solve problems.
17.		Measurement – Bearings and Vectors	**B7.3.3.1** Demonstrate understanding bearings, vectors and its components using real live cases.
18.		Geometry - Transformation	**B7.3.3.2** Perform a single transformation (i.e. reflection and translation) on a 2D shape using graph paper (including technology) and describe the properties of the image under the transformation (i.e. congruence, similarity, etc.).

S/N	Strand	Sub-strand/Topic	Content Standard
19.	Data & Probability	Data and Probability - Data	**B7.4.1.1** Select, justify, and use appropriate methods to collect data (quantitative and qualitative), display and analyse the data (grouped/ ungrouped) presented in frequency tables, line graphs, pie graphs, bar graphs or pictographs and use these to solve and/or pose problems.
20.		Data and Probability - Data	**B7.4.1.2** Determine the measures of central tendency (mean, median, mode) for a given ungrouped data and use it to solve problems.
21.		Data and Probability - Probability	**B7.4.3.1** Identify the sample space for a probability experiment involving single events and express the probabilities of given events as fractions, decimals, percentages and/or ratios to solve problems.

In the new curriculum, teachers are expected to make connections across standards and given sub-strands, it is necessary to have related standards and indicators "clustered" (i.e. grouped together) under a key idea or topic. The use of clustered standards for planning and delivery of lessons allows teachers to quickly recognise the different related understandings or skills pupils need to develop in order to achieve full understanding of a key idea. It also ensures concepts taught earlier are reinforced so that by the end of the year they would have been well grasped or consolidated. Teachers are therefore required to carefully read the standards they plan developing in their learners each week and identify the group of indicators the learners have to demonstrate for achieving these standards.

Table 2:*Recommended allocation of time to lesson phases*

	SINGLE, 50 MINUTES CLASS
Duration	**Activity**
10 min	**Starter** A starter should stimulate curiosity and open mindedness and prepare the brain for learning. Review and reinforcement of previous content These can be random and/or linked to the content standard. E.g. Random Mental activities (fast paced games) or short reinforcement activities
35 min	**Main (new learning including assessment)** Activities to explore new learning content for day (including at least 20 minutes where pupils do problems or exercises alone or collaboratively, in their exercise books and teacher moves around to monitor and check work)
5 mins	**Plenary/Reflections** Reflect, recap on and consolidate the learning that has happened in the day's lesson.

Yearly Curriculum Overview

WEEK	TERM 1 SUB-STRANDS/TOPIC	TERM 2 SUB-STRANDS/TOPIC	TERM 3 SUB-STRANDS/TOPIC
1	Number Operations – Mental Mathematics Strategies	Number Operations –Mental Mathematics Strategies	Number and Numerals - Whole Numbers up to 10,000,000,000
2	Number and Numerals - Whole Numbers up to 10,000,000,000	Number and Numerals - Whole Numbers up to 10,000,000,000	Fractions – Multiplying of Positive Fractions
3	Number Operations – Basic Operations on Whole and Decimal Numbers	Number Operations – Basic Operations on Whole and Decimal Numbers	Number Operations – Powers of Numbers
4	Fractions – Comparing Fractions	Fractions – Addition and Subtraction of Fractions	Handling Data - Data
5	Number Operations – Operation on Integers	Algebra – Algebraic Expressions	Geometry and Measurement – Area of a Triangle
6	Fractions – Ratios and Proportion	Handling Data - Data	Algebra – Equations

WEEK	TERM 1 SUB-STRANDS/TOPIC	TERM 2 SUB-STRANDS/TOPIC	TERM 3 SUB-STRANDS/TOPIC
7	Geometry and Measurement – Perimeter of Plane Shapes/Circles	Geometry and Measurement: – Construction	Fractions – Ratios and Proportion
8	Geometry and Measurement – Angles	Fractions – Ratios and Proportion	Fractions – Dividing of Positive Fractions
9	Algebra – Patterns and Relations	Geometry and Measurement – Bearings and Vectors	Handling Data – Probability
10	Handling Data – Data	Handling Data – Data	Geometry and Measurement Transformation – Translation

Scheme of Learning (SOL) for B7 Term 1, Weeks 1 - 4

WEEK	TERM 1 SUB-STRANDS/ TOPIC	Content Standards	Indicators	Resources
1	Number Operations – Mental Mathematics Strategies	B7.1.2.1	B7.1.2.1.1, B7.1.2.1.2, B7.1.2.1.3	Teacher's Mental Maths Exercises Book (TMMEB)[1]; Number facts flash cards; Flashcards with 4-digit to 7-digit numbers
2	Number and Numerals - Whole Numbers up to 10,000,000,000	B7.1.1.1	B7.1.1.1.1 B7.1.1.1.2 B7.1.1.1.3	TMMEB, Number facts flash cards, Flashcards with 4-digit to 7-digit numbers; Multi-base ten materials (or manipulatives); Place value chart, Graph sheets;
3	Number Operations – Basic Operations on Whole and Decimal Numbers	B7.1.2.2	B7.1.2.2.1 B7.1.2.2.2 B7.1.2.2.3	TMMEB, Number facts flash cards, Flashcards with 4-digit to 7-digit numbers; Multi-base ten materials (or manipulatives); Place value chart, Graph sheets; Calculator for checking results
4	Fractions – Comparing Fractions	B7.1.3.1	B7.1.3.1.1 B7.1.3.1.2	Square grid sheet; Geodot paper for shading fractions; Benchmark fractions chart; Calculator for checking results

Scheme of Learning (SOL) for B7 Term 1, Weeks 5 – 10

WEEK	TERM 1 SUB-STRANDS/ TOPIC	Content Standards	Indicators	Resources
5	Number Operations – Operation on Integers			
6	Fractions – Ratios and Proportion			
7	Geometry and Measurement – Perimeter of Plane Shapes including Circles			
8	Geometry and Measurement – Angles			
9	Algebra – Patterns and Relations			
10	Handling Data - Data			

1 This is an exercise book the mathematics teacher is expected to keep for setting Mental Maths Exercises for learners. In addition to the lesson plan, it is helpful to keep a Teacher's Mental Maths Exercises Book (TMMEB) in which the teacher prepares and keeps mental exercises. Such exercises are either read or written on the board for learners to do in their mental exercise books. Written and/or aural mental exercises should be done in learners' exercises books at least twice each week.

Part B

LESSON FRAMES

LESSON B7.1 NUMBER AND NUMERALS – WHOLE NUMBERS UP TO 10,000,000,000

Strand: Number			
Sub-strand: Number and Numerals			
Content standard: B7.1.1.1 Demonstrate understanding and the use of place value for expressing quantities recorded as base ten numerals, well as rounding these to given decimal places.			
Indicators: B7.1.1.1.1 Model number quantities more than 1,000,000,000 using graph sheets and multi-base block. B7.1.1.1.2 Compare and order whole numbers more than 1,000,000,000 and represent the comparison using ">, <, or =" B7.1.1.1.3 Round (off, up, or down) whole numbers more than 1,000,000,000 to the nearest hundred-thousand, ten-thousands, thousands, hundreds and tens.			
Key words/vocabulary: Model, place value, strategy, rounding up, rounding down, rounding off, less than, greater than, equal to			
Suggested activities for learning and assessment.	**Equipment/ Resources**	**Learner Resource (LR) page ref.**	**Progression:**
Read and write numbers using words and figures/numerals Skip counting forward and backwards in 10,000s 100,000, etc. Continue a given pattern of number sequence on number line; Identify missing number(s) in a sequence of numbers on a number line;	Flash cards with 4-digit to 7-digit numbers.		Read and write numbers using words and figures/ numerals Identify missing number(s) in a sequence of numbers Finding the value of the digit underlined in numbers Comparing and ordering numbers Model 8-digit numbers using graph sheets and multi-base ten materials Rounding off to a required estimation
Finding the value of the digit underlined in numbers: 45<u>6</u>7 3<u>4</u>2893 4<u>5</u>73934			
Comparing numbers using < or >, and ordering numbers: - Compare a) 345 and 395; b) 4726 and 9726 - Rewrite these numbers in the boxes below in order of size: 4565, 2996, 9013, 4720, 5758			

<table>
<tr>
<td>Model 8-digit numbers using graph sheets and multi-base ten materials (or manipulatives) and placing the digits of the number in the appropriate columns of the place value frame/mat. For instance, with multi-base ten, one cube = 100,000, one rod = ten of the cubes (1,000,000), a flat =10,000,000, and a block =100,000,000 as shown below
 
1. Model given 8-digit numbers use graph sheets and multi-base ten materials (or manipulatives) and place them the appropriate columns of the place value frame/mat (working in pairs/groups).</td>
<td>Graph sheets
Multi-base ten materials (or manipulatives)
Place value frame/mat</td>
<td>LRP pp2-3</td>
<td></td>
</tr>
<tr>
<td>2. Determine how many blocks will make a billion.
a. Round off 1,679,653 to the nearest hundred thousand.
b. Round off 1,679,653 to the nearest ten thousand.
NB: To round down, learners consider the smaller of the two approximated numbers, while rounding up considers the bigger of the two numbers. The table below may make the meaning of these two concepts clearer
<table>
<tr><th>214765</th><th>Round up</th><th>Round down</th><th>Round off</th></tr>
<tr><td>to the nearest ten</td><td>214,770</td><td>214,760</td><td>214,970</td></tr>
<tr><td>to the nearest hundred</td><td>214,800</td><td>214,700</td><td>214,800</td></tr>
<tr><td>to the nearest thousand</td><td>215,000</td><td>214,000</td><td>215,000</td></tr>
</table>
</td>
<td>place value chart</td>
<td></td>
<td></td>
</tr>
<tr>
<td colspan="4">Homework/project work/community engagement suggestions:
• This should include ideas for refining, extending or applying what has been learned
• Reference Learner Resource page number</td>
</tr>
<tr>
<td colspan="4">Visit three or four sister schools in the community and take data on the number of pupils in each school and compare.</td>
</tr>
<tr>
<td colspan="4">Cross-curriculum links/cross-cutting issues
• Identify links between concepts, content or learning related to other disciplines. Reference opportunities for the activities to contribute to achieving cross-cutting aims of the Common Core Curriculum</td>
</tr>
<tr>
<td colspan="4">Core competencies and Inclusion</td>
</tr>
<tr>
<td colspan="4">Potential misconceptions/student learning difficulties:
• Identify challenges that might be presented as the learner works to achieve the content standard, and include any suggestions that help the teacher to overcome them, such as adaptations to teaching and learning activities</td>
</tr>
<tr>
<td colspan="4">Mathematics is for boys; mathematics is a difficult subject</td>
</tr>
</table>

LESSON B7.2 NUMBER OPERATIONS – MENTAL MATHEMATICS STRATEGIES

Strand: Number

Sub-strand: Number Operations

Content standard:
B7.1.2.1 Apply mental mathematics strategies and number properties used to solve problems.

Indicators:
B7.1.2.1.1 Multiply and divide by multiples of 10 including decimals and the benchmark fractions.
B7.1.2.1.2 Apply mental mathematics strategies and number properties used to do calculation.
B7.1.2.1.3 Apply mental mathematics strategies to solve word problems.

Key words/vocabulary: halving, doubling, distributive property

Suggested activities for learning and assessment.	**Equipment/ Resources**	**Learner Resource (LR) page ref.**	**Progression:**
Recall multiplication facts and related division facts.	Multiplication chart		Addition Subtraction Multiplication Division
Apply halving and doubling to determine a given product of two numbers. i. 28 x 5, think 14 x 10 =140 ii. 125 x 4, think (125 x 2) x 2 = 250 x 2 = 500	Multiplication chart		
Do mental maths word problems. • Addition through words like plus, add, calculate the sum, increase a number by, and find the total; • Subtraction from words like minus, from a number take, minus, find the difference, and what must be added to make; • Multiplication through words like times, multiply, find the product, square, and what must be divided by … to give …; • Division through words like - *divide, share, how many times does it go into*? And *what must be multiplied by … to give …*	Multiplication chart, place value chart, abacus		

Homework/project work/community engagement suggestions
- This should include ideas for refining, extending or applying what has been learned
- Reference Learner Resource page number

Find out the number of girls and boys in Basic 7-9 and go on to find the number of Learners in the school.
Do the same for teachers in the school.
Find the student-teacher ratio.

Cross-curriculum links/cross-cutting issues
- Identify links between concepts, content or learning related to other disciplines. Reference opportunities for the activities to contribute to achieving cross-cutting aims of the Common Core Curriculum

Core competencies and Inclusion

Potential misconceptions/student learning difficulties
- Identify challenges that might be presented as the learner works to achieve the content standard, and include any suggestions that help the teacher to overcome them, such as adaptations to teaching and learning activities

Mental maths is difficult and you need to be smart to do it.

LESSON B7.3 NUMBER OPERATIONS – BASIC OPERATIONS ON WHOLE AND DECIMAL NUMBERS

Strand: Number			
Sub-strand: Number Operations			
Content standard: B7.1.2.2 Demonstrate an understanding of addition, subtraction, multiplication and division of (i) whole numbers, and (ii) decimals, to solve problems.			
Indicators: B7.1.2.2.1 Add and subtract up to four-digit numbers. B7.1.2.2.2 Multiply or divide multi-digit numbers by 1- and 2-digit numbers. B7.1.2.2.3. Create and solve story problems involving decimals on the four basic operations.			
Key words/vocabulary: Addition, subtraction, multiplication, division, whole number, decimals			
Suggested activities for learning and assessment.	**Equipment/ Resources**	**Learner Resource (LR) page ref.**	**Progression:**
Use partitioning and place value system to add and subtract the following numbers: a. 3456 + 4563 b. 9865 – 4563 c. 237.68 + 764.89 d. 432.98 – 387.91	Place value chart		Addition of numbers including decimals Subtraction of numbers including decimals Multiplication of numbers including decimals Division of numbers including decimals
Use to multiply and divide these numbers: a. 8.842 × 842 b. 786,848 × 422.16 c. 548 ÷ 10 d. 884.16 ÷ 4.2	Multiplication chart		
Homework/project work/community engagement suggestions This should include ideas for refining, extending or applying what has been learned Reference Learner Resource page number			
• Collect data on the ages of boys and girls in B7-B9 in your school. Add the ages of the boys and divide the total age by the number of boys. Repeat the same activity for girls.			
Cross-curriculum links/cross-cutting issues Identify links between concepts, content or learning related to other disciplines. Reference opportunities for the activities to contribute to achieving cross-cutting aims of the Common Core Curriculum			
Core competencies and Inclusion			
Potential misconceptions/student learning difficulties Identify challenges that might be presented as the learner works to achieve the content standard, and include any suggestions that help the teacher to overcome them, such as adaptations to teaching and learning activities. E.g.:			
• Mathematics is for boys. mathematics is a difficult subject.			

LESSON B7.4 NUMBER OPERATIONS – POWERS OF NUMBERS

Strand: Number

Sub-strand: Powers of Numbers

Content standard:
B7.1.2.3 Demonstrate understanding and use of powers of natural numbers in solving real life problems.

Indicators:
B7.1.2.3.4 Solve for the value of a number written in index form.
B7.1.2.3.5 Apply the concept of powers of numbers (product of prime) to find HCF.

Key words/vocabulary: Power, base, index, indices, simplify, exponent

Suggested activities for learning and assessment	**Equipment/ Resources**	**Learner Resource (LR) page ref.**	**Progression**:
Mental maths games and mental maths word problems. For example, skip counting forwards and backwards in 5s and 10s. Review learners previous knowledge on multiplication and division facts. The should particularly review their knowledge on ratio from primary school.	• Index cards (one for each student) • pencils • red and yellow counters	B7.1.4.1.1 -5	Explain power of a number. Expand a given number with an exponent. Solve for the value of a number written in index form. Solve for the HCF using product of prime.
An index number is a number which is raised to a power. The power, also known as the index, tells you how many times you have to multiply the number by itself. For example, 2^5 means that you have to multiply 2 by itself five times = 2×2×2×2×2 = 32. The other way round is when given 32, you have to find out how many times 2 will multiply itself to give 32. Then you raise 2 to the number of times got.			
To find HCF using the knowledge of powers of numbers, say 36 and 72 **i** First, find the prime factors of both numbers: 36= 2 x 2 x 3 x 3 72= 2 x 2 x 2 x 3 x 3 **ii.** Use one of each of the numbers that are in both lists HCF = 2 x 2 x 3 x 3 HCF = 36			

Homework/project work/community engagement suggestions

- This should include ideas for refining, extending or applying what has been learned
- Reference Learner Resource page number

Answer the following questions in your homework books.

1. Simplify each of the following:
   i. b × b × b × b × b × b
   ii. 3cm × 2cm × 1cm × 2cm
   iii. $3 \times 3 \times 3 \times 3 \times 3 \times x^3 \times x^3 \times x^3$

2. Solve for the HCF using product of prime.
   i. 12 and 72
   ii. 6 and 36
   iii. 8 and 12

Cross-curriculum links/cross-cutting issues

Identify links between concepts, content or learning related to other disciplines. Reference opportunities for the activities to contribute to achieving cross-cutting aims of the Common Core Curriculum

Differentiated learning

- Slow learners: Limit assessment tasks to few items and examples used in class.
- More able learners: Extend the assessment tasks to include new examples not used in class.
- Core Competencies – Encourage communication, collaboration, time for critical thinking and problem solving, investigating flags on the internet to enhance their digital literacy

Potential misconceptions/student learning difficulties

Identify challenges that might be presented as the learner works to achieve the content standard, and include any suggestions that help the teacher to overcome them, such as adaptations to teaching and learning activities

Possible learner difficulties:

- A failure to develop fluency in using index notation from the start leads to one of the most fundamental and frustrating misconceptions: the dreaded 32 = 6 and its algebraic partner in crime, a x a = 2a

Overcoming possible difficulties

- Be consistent and crystal clear about definitions, and notation. That is, use correct terms always.
- Allow learners enough time to practise lots of examples and non-examples. Extensive examples and non-examples leave no room for confusion. Address misconceptions head on.
- Do not cover more than one new thing at a time.
- Consider depth not speed. Thus, do not rush stuff you think is simple or obvious. It is no good for anyone to move on too quickly. Once they are confident working with powers, your learners will enjoy exploring problems, patterns, etc.

LESSON B7.5 NUMBER OPERATIONS – OPERATION ON INTEGERS

Strand: Number			
Sub-strand: Number Operations			
Content standard: B7.1.1.6 Demonstrate an understanding of the relationship between integers and number of the rational number system, and solve real life problem involving integers.			
Indicators: B7.1.1.6.1 Identify sets of integers and relate them within the real number system. B7.1.1.6.2: Identify real and practical example of integers. B7.1.1.6.3: Solve simple basic operations – Addition, Subtraction, Multiplication and Division involving integers.			
Key words/vocabulary: Integers, rational numbers, real numbers, whole numbers, counting, natural numbers, debt, credit, height above/below sea level depth, temperature below /freezing points. negative/positive, directed numbers			
Suggested activities for learning and assessment.	**Equipment/ Resources**	**Learner Resource (LR) page ref.**	**Progression:**
At zero on the number line, turn right and jump two spaces. Then at 2, turn to the left because the sign of the second number is negative. Move 5 spaces since the operation sign is plus. The last position gives the answer. At zero on the number line, turn left. At your current position, turn right and move 5 spaces backwards towards zero and stop at the number 2.	Number line, green colours for positive integers and red colours for negative integers .		Recognise what integers are. How integers relate to real number system Operations involving integers. Solving real life problems involving integers.
Homework/project work/community engagement suggestions *This should include ideas for refining, extending or applying what has been learned* *Reference Learner Resource page number*			
• Investigate how integers relate in business. For example, the idea of debt or loans verses credit			
Cross-curriculum links/cross-cutting issues Identify links between concepts, content or learning related to other disciplines. Reference opportunities for the activities to contribute to achieving cross-cutting aims of the Common Core Curriculum			
Core Competencies and Inclusion			
Potential misconceptions/student learning difficulties Identify challenges that might be presented as the learner works to achieve the content standard, and include any suggestions that help the teacher to overcome them, such as adaptations to teaching and learning activitie. E.g.:			
• That mathematics is a difficult subject. That a girl cannot be good in mathematics.			

LESSON B7.6 FRACTIONS – COMPARING FRACTIONS

Strand: Number

Sub-Strand 3: Fractions, Decimals and Percentages

Content standard:

B7.1.3.1 Simplify, compare and order a mixture of positive fractions (i.e. common, percent and decimal) by changing all to equivalent (i) fractions (ii) decimals, or (iii) percentages

Indicators:

B7.1.3.1.1 Determine and recall the percentages and decimals of the benchmark fractions (i.e. tenths, fifths, fourths, thirds and halves) and use these to compare quantities.

B7.1.3.1.2 Compare and order fractions (i.e. common, percent and decimal fractions up to thousandths) limit to the benchmark fractions

Key words/vocabulary: Fraction, numerator, denominator, benchmark fractions, percentages and decimals; equivalent fractions; tenths; hundredths; arrange; order; compare; ascending order; descending order.

Suggested activities for learning and assessment.	**Equipment/ Resources**	**Learner Resource (LR) page ref.**	**Progression:**
Mental maths games and mental maths word problems. Review the concept of fractions: **i.** Shade given fraction of squares in given shapes: i.e. shade $\frac{5}{6}$ of the rectangle **ii.** Write down 3 fractions equivalent to $\frac{2}{3}$ **iii.** Express the fraction $\frac{6}{10}$ in its simplest form: $\frac{6}{10} = \frac{3}{5}$ **iv.** Convert to mixed numbers: $\frac{12}{5}$ **v.** Convert to improper fractions: $2\frac{5}{9}$	Square grid sheet or Geodot paper for shading fractions	B7.1.2.1.1-3; B7.1.3.1.1; LR - -	• Identify fractions (i.e. common, percent and decimal) of quantities • Identify equivalents of common fractions in percent and decimals • Change all given fractions into decimals or percentages • Compare pairs of fractions by changing them into decimals or percentages • Order a set of given fractions by changing them into decimals or percentages.
Work out common, decimal and percent equivalences of the benchmark fractions:	Benchmark fractions chart	B7.1.3.1.2	
Simplify common fractions. Change given common fractions to the same denominator, compare and order them. Change given common fractions to decimals or percentages.	Use of calculator for checking results	B7.1.3.1.3	

Homework/project work/community engagement suggestions

This should include ideas for refining, extending or applying what has been learned

Reference Learner Resource page number

- Investigate fractions of colours in a flag, (limit to flags of African countries, state the fractions in the Ghanaian language, and express them in common, percent and decimal forms). Use Atlases or the internet.
- Identify benchmark fractions used in the media and describe the context in which they are used.
- Create patterns with Geodot paper, e.g. shading half of a rectangle (e.g. area, 24 square units) in multiple of ways:

Cross-curriculum links/cross-cutting issues

- Identify links between concepts, content or learning related to other disciplines. Reference opportunities for the activities to contribute to achieving cross-cutting aims of the Common Core Curriculum

Differentiation

- Low achievers (or slow learners): Limit to proper fractions that are multiples of halves.
- More able learners: Extend to all benchmark fractions.
- Core Competencies – Encourage communication, collaboration, time for critical thinking and problem solving, investigating flags on the internet to enhance their digital literacy

Potential misconceptions/student learning difficulties

Identify challenges that might be presented as the learner works to achieve the content standard, and include any suggestions that help the teacher to overcome them, such as adaptations to teaching and learning activities

- Reading the fraction notation, e.g. reading $\frac{1}{2}$ as one half or a half and not one over two; or $\frac{2}{3}$ ⟶ two-thirds and not two over three.
- Reading the decimal fraction notation, e.g. reading 1.25 as one point two five and not 1.25 as one point twenty-five.

LESSON B7.7 FRACTIONS – ADDITION AND SUBTRACTION OF FRACTIONS

Strand: Number

Sub-strand: Fractions: Addition and Subtraction of Fractions

Content standard:

B7.1.3.2 Demonstrate an understanding of the process of addition and/or subtraction of fractions and apply this in solving problems.

Indicators:

B7.1.3.2.1 Explain the process of addition and subtraction of two or three unlike and mixed fractions.

B7.1.3.2.2 Solve problems involving addition or subtraction of fractions.

Key words/vocabulary: numerator, denominator, equivalent fractions, lowest common denominator

Suggested activities for learning and assessment.	**Equipment/ Resources**	**Learner Resource (LR) page ref.**	**Progression:**
To add mixed fractions, i.e. $2\frac{2}{5}$ and $1\frac{2}{3}$, we first add the whole numbers and then add the fractions; i.e. $2 + 1 + \frac{2}{5} + \frac{2}{3} = 3 + \frac{6}{15} + \frac{10}{15} = 3\frac{6+10}{15} = \frac{16}{15} = 1\frac{1}{15}$		CCC B7.1.3.2.1	• Determine the least common denominator (LCD) in the like or unlike fractions. • Change all given fractions into equivalent fractions with same LCD. • A add or subtract fractions expressed as equivalent fractions with same LCD and simplify the result.
To subtract mixed fractions, i.e. $2\frac{4}{5}$ and $1\frac{2}{3}$, we first add the whole numbers and then subtract the fractions; i.e. $(2 - 1) + \frac{4}{5} - \frac{2}{3} = 1\frac{12-10}{15} = 1\frac{2}{15}$		CCC B7.1.3.2.2	
Solve word problems involving addition or subtraction of fractions. $3\frac{1}{3}$ feet are cut off a board that is $12\frac{1}{4}$ feet long. How long is the remaining part of the board? If you add 2 fractions and the sum is greater than ½, what can you say about the fractions?			

Homework/project work/community engagement suggestions

This should include ideas for refining, extending or applying what has been learned

Reference Learner Resource page number

- If you add 2 fractions and the sum is greater than ½, what can you say about the fractions? Investigate.

Cross-curriculum links/cross-cutting issues

Identify links between concepts, content or learning related to other disciplines. Reference opportunities for the activities to contribute to achieving cross-cutting aims of the Common Core Curriculum

- Core Competencies – Encourage communication, collaboration, time for critical thinking and problem solving, investigating flags on the internet to enhance their digital literacy.

Potential misconceptions/student learning difficulties

Identify challenges that might be presented as the learner works to achieve the content standard, and include any suggestions that help the teacher to overcome them, such as adaptations to teaching and learning activities

Finding the LCM and expressing the fractions in equivalent forms using the LCD.

For two unlike fractions, using the cross-multiplication method to find the numerators and multiplying the denominators to get the common denominator.

LESSON B7.8 FRACTIONS – MULTIPLYING AND DIVIDING OF POSITIVE FRACTIONS

Strand: Number			
Sub-strand: Fractions: Multiplying and dividing of positive fractions			
Content standard: B7.1.3.3 Demonstrate an understanding of the process of multiplying and dividing positive fractions and apply this in solving problems.			
Indicators: B7.1.3.3.1 Explain the process of multiplying a fraction (i.e. common, percent and decimal fractions up to thousandths) by a whole number and by a fraction. B7.1.3.3.2 Find a fraction of given quantity (i.e. money or given quantity of objects). B7.1.3.3.3 Explain the process of dividing a fraction (i.e. common, percent and decimal fractions up to thousandths) by a 1-digit whole number and by a fraction. B7.1.3.3.4 Determine the result of dividing a quantity (i.e. money or objects) or a fraction by a fraction.			
Key words/vocabulary: numerator, denominator, highest common factor (HCF), simplify			
Suggested activities for learning and assessment.	**Equipment/ Resources**	**Learner Resource (LR) page ref.**	**Progression:**
To multiply a whole number by a fraction, the multiplication is read as 'times'. For instance, $3 \times 2\frac{2}{3}$ means 3 times $2\frac{2}{3}$ or 3 groups of $2\frac{2}{3}$; i.e. $3 \times (2 + \frac{2}{3})$ or $3 \times \frac{8}{3}$. The product can be obtained by (i) changing all into common fraction; (ii) multiplying all numerators and denominators; (iii) simplifying the results.		B7.1.3.3.1	• Changing all into Common fractions. • Multiplying all numerators and all denominators. • Simplifying the results.
To multiply a fraction by a fraction, the multiplication is read as 'of'. For instance, $\frac{2}{3} \times \frac{1}{2}$ means $\frac{2}{3}$ of $\frac{1}{2}$; i.e. $\frac{2}{3} \times \frac{1}{2} = \frac{2 \times 1}{3 \times 2} = \frac{2}{6}$ $\frac{2}{3} \times \frac{1}{2} = \frac{2 \times 1}{3 \times 2} = \frac{2}{6} = \frac{1}{3}$. The product can be obtained by (i) changing all into common fraction; (ii) multiplying all numerators and denominators; (iii) simplifying the results. [Note: (ii) and (iii) can be alternated]		B7.1.3.3.1	
Find a fraction of a given quantity. To multiply a fraction by a given quantity is just like multiplying by a whole number, so the multiplication is read as 'of'. For instance, $\frac{2}{3} \times$ ¢60 means $\frac{2}{3}$ of ¢60, i.e. $\frac{2}{3} \times ¢\frac{60}{1} = ¢\frac{2 \times 60}{3 \times 1} =$ ¢40.		B7.1.3.3.2	
To divide a whole number by a fraction, the division means 'how many times the fraction goes into the whole number' or the product of the fraction and which number makes 3? For instance, $3 \div \frac{1}{4}$ means how many $\frac{1}{4}$s can be obtained in 3, or $3 = \frac{1}{4} \times \square$. The quotient can be obtained by multiplying both dividend and divisor by the reciprocal of the divisor. For $3 \div \frac{1}{4}$, the reciprocal of the divisor is $\frac{4}{1}$.		B7.1.3.3.2	

Determine the result of dividing a quantity (i.e. money or objects) or a fraction by a fraction. To divide by a fraction, multiply both dividend and divisor by the reciprocal of the divisor, hence $10 \div \frac{1}{4} \rightarrow (\frac{4}{1} \times 10) \div (\frac{1}{4} \times \frac{4}{1}) = 40$			

Homework/project work/community engagement suggestions

- *This should include ideas for refining, extending or applying what has been learned*
- *Reference Learner Resource page number*

Investigate fractions in circle graphs.

The graph shows the ages of pupils in a B5 class. (i) Approximately what fraction of the pupils are 10 years old? (ii) How many pupils are 11 years old if there are 32 pupils in the class?

Cross-curriculum links/cross-cutting issues

Identify links between concepts, content or learning related to other disciplines. Reference opportunities for the activities to contribute to achieving cross-cutting aims of the Common Core Curriculum.

- Core Competencies – Encourage communication, collaboration, time for critical thinking and problem solving, investigating flags on the internet to enhance their digital literacy

Potential misconceptions/student learning difficulties

Identify challenges that might be presented as the learner works to achieve the content standard, and include any suggestions that help the teacher to overcome them, such as adaptations to teaching and learning activities.

Multiplying the numerators and denominators but not simplifying.

LESSON B7.9 FRACTIONS – RATIOS AND PROPORTION

Strand: Number			
Sub-strand: Ratios and Proportion			
Content standard: B7.1.4.1 Demonstrate an understanding of the concept of ratios and its relationship to fractions and use it to solve problems that involve rates, ratios, and proportional reasoning.			
Indicators: B7.1.4.1.1 Find ratio and use ratio language to describe the relationship between two quantities. B7.1.4.1.2 Use the concept of a unit rate a/b associated with a ratio a:b with b ≠ 0, and use rate language in the context of a ratio relationship. B7.1.4.1.3 Make tables of equivalent ratios (written as common fractions) relating quantities that are proportional. B7.1.4.1.4 Use the proportional reasoning to find missing values in the tables, and plot pairs of values on the coordinate plane. B7.1.4.1.5 Find a percent of a quantity as a rate per 100 (e.g., 30% of a quantity means 30/100 times the quantity); solve problems involving finding the whole, given a part and the percent and apply it in solving energy efficiency problems.			
Key words/vocabulary: Ratio, rate, percent, proportional, equivalent, unit, reasoning			
Suggested activities for learning and assessment.	**Equipment/ Resources**	**Learner Resource (LR) page ref.**	**Progression:**
Mental maths games and mental maths word problems. For example, skip counting forwards and backwards in 5s and 10s. Review learners' previous knowledge on multiplication and division facts. They should particularly review their knowledge on ratios from B1 to B6 levels.	Index cards (one for each student) pencils red and yellow counters	CCC B7.1.4.1.1 -5	Describe relationship between two quantities using ratio language. Make tables of equivalent ratios. Use the proportional reasoning to find missing values in the tables. Plot pairs of values on the coordinate plane. Find a percent of a quantity as a rate per 100.
A ratio is the comparison between two values. The comparison can be part-to-whole (ratio of apples to total amount of fruit in a bowl) or part-to-part (ratio of apples to bananas). Ratios can be expressed in the following forms: 3/5, 3 to 5, or 3:5.			
Determining the ratio of given quantities: To determine the ratio of given quantities, you can write it as a fraction and find a common factor to reduce the numbers to the simplest form. For example, there are 60 boys and 120 girls in a school. So the ratio of boys to girls in the school is $\frac{60}{120} = \frac{1}{2}$ = 1:2 or 1 to 2. **Note**, however that to express any two quantities as a ratio, they must be in the same unit.			
Simplifying ratios: Ratios may be simplified by dividing each part by the same number. In some problems the given ratio is not in its simplest form so change it to the simplest form first. For example, 4:16 is the same as 2:8, which is also the same as 1:4.			
Generating Equivalent ratios: To generate equivalent ratios, multiply each part of the ratio by the same number. For example, 2:5 is equivalent to 4:10 or 10:25.			

As we learned in previous lessons in B1-B6, tables can be used to show equivalent ratios. As a review, look at example below. With a partner, complete the table.

Example: Find the missing value marked x in a table of equivalent ratios:

3	10
6	x
9	30
y	40

$$\frac{x}{6} = \frac{10}{3} \quad x = \frac{10}{3} \times 6 = \frac{60}{3} = \mathbf{20}$$

Plotting pairs of values on the coordinate plane:

Ratios can be plotted as ordered pairs.

Using the example below, we can find the points to plot by using the ratio [number of shirts: cost]. The number of shirts will be the x-coordinate, and the cost will be the y-coordinate in the ordered pair. We found that 1 shirt costs Gh¢9, or 1:9, so our first ordered pair is (1,9).

We can find the remaining ordered pairs by multiplying both numerals in the ratio pair by the same number.

Homework/project work/community engagement suggestions

- This should include ideas for refining, extending or applying what has been learned
- Reference Learner Resource page number

Homework Task

Answer the following questions:

A. Investigate and write five activities in your community that make use of the concept of ratios.

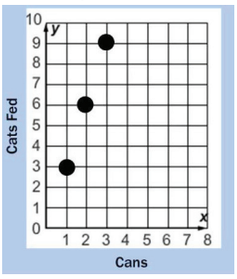
B. Mr. Kuma uses 15% of his monthly salary on firewood every month. If he spends Gh¢ 120 in buying the firewood, how much is his salary for the month?

C. Mr. Kuma uses 15% of his monthly salary on firewood every month. If he receives Gh¢ 1200 every month, how much does he spend on firewood?

D. The table shows the weight and cost of meat at Worawora Market. If 2kg of meat costs GH¢ 40. Use the information to complete the table.

Meat (kg)	0.5	2	4	8	20
Cost (Gh¢)			80		

E. The graph shows the number of cats that can be fed with each large can of food. Use the information in the graph to complete the table.



Cans (x)	Cats (y)
1	3
2	3
9	4
5	6

Cross-curriculum links/cross-cutting issues

Identify links between concepts, content or learning related to other disciplines. Reference opportunities for the activities to contribute to achieving cross-cutting aims of the Common Core Curriculum

Differentiation

- Core Competencies – Encourage communication, collaboration, time for critical thinking and problem solving, investigating flags on the internet to enhance their digital literacy

Potential misconceptions/student learning difficulties

Identify challenges that might be presented as the learner works to achieve the content standard, and include any suggestions that help the teacher to overcome them, such as adaptations to teaching and learning activities

Possible Learner difficulties

- Learners may be unsure which quantity should come first in a ratio. For example, in sports the ratio represents wins to losses. Four wins to two losses would be written 4:2 or 4 to 2 not 2:4 or 2 to 4. Ask, is there a way to write 2 to 4 for this situation? Yes, so long as you match the labels and units correctly. Unlike fractions where the part is always named first, ratios can be read either way so long as the unit is attached. For this situation the wording would have to then be losses to wins.
- Learners may have difficulty determining if a ratio is part to whole or part to part. For example, there are 13 girls for every 11 boys in the class (13:11), but 13:23 learners in the class are girls.

LESSON B7.10 ALGEBRA: PATTERNS AND RELATIONS

Strand: Algebra

Sub-strand: Patterns and Relations

Content standard:

B7.2.1.1 Derive the rule for a set of points of a relation, draw a table of values to graph the relation in a number plane and make predictions about subsequent elements of the relation.

Indicators:

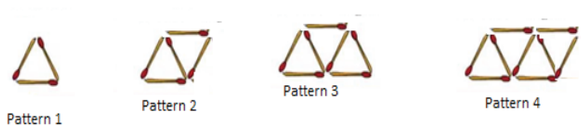
B7.2.1.1.1 Extend a given relation presented with and without symbolic materials and explain how each element differs from the preceding one.

B7.2.1.1.2 Describe the rule for a given relation using mathematical language such as one more, one less, twice as many as, etc.

B7.2.1.1.3 Identify the relation or rule in a pattern/mapping presented numerically or symbolically and predict subsequent elements.

B7.2.1.1.4 Locate points on the number plane, draw a table of values of a given relation, draw graphs for given relations and use it to solve problems.

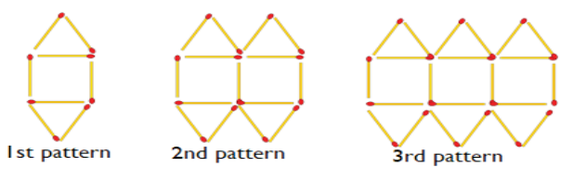
Key words/vocabulary: Relation, mapping, pattern, domain, co-domain, range, rule, corresponding, numerical, Cartesian, symbolically…

Suggested activities for learning and assessment.	**Equipment/ Resources**	**Learner Resource (LR) page ref.**	**Progression**
Mental maths games and mental maths word problems. For example, skip counting forwards and backwards in 5s and 10s. Review learners' previous knowledge on patterns from early basic school levels (B1-B6) **i.** Complete the table below for the number of match sticks used in this geometric pattern  Pattern 1 Pattern 2 Pattern 3 Pattern 4	Match sticks, mathematical sets, coloured beads, number cards,	CCC B7.2.1.1.1-4	Identify and extend non-numeric patterns. Identify and extend numeric patterns/ mapping and explain how each element differs from the preceding one. Describe the rule for a given relation using mathematical language such as one more, one less, twice as many as, etc. Draw tables of values of a given relation. Locate points on the number plane and draw graphs of values of a given relation.

Number of triangles	1	2	3	4	5	6	7		n
Match sticks	3	5	7						

Extending a given relation and explaining how each element differs from the preceding one.

To extend a given pattern/relation, first identify how each pattern differs from the other. In the pattern bellow, the second pattern is 7 more than the first. Then the third pattern is also 7 more than the second. This means to get the next pattern we have to add 7 to the third pattern which will be 29.



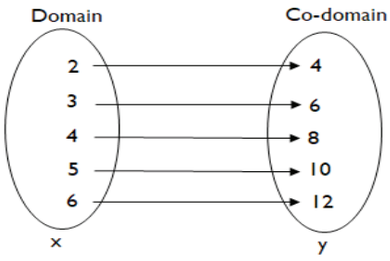
Pattern No.	1	2	3	4	5	6	7
Number of sticks	8	15	22				

E.g. Extend a given relation symbolically

Describing the rule for a given relation.

To get the rule for a given relation, first identify how each pattern differs from the other.

For example, in the relation below, all the numbers in the domain are half of the numbers in the co-domain. Or all the members in the co-domain are doubles of the numbers in the domain. Therefore, we can describe the rule for this relation as "x is half of".



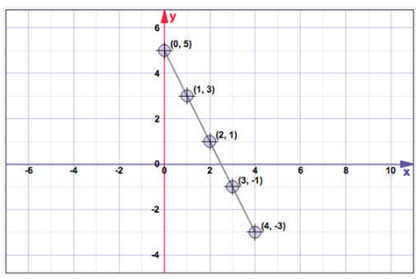
1) Constructing tables of values of a given relation and locating points on the number plane.

To complete a table of values for a given relation, use the rule for the relation to solve for the other values.

Complete the table of values for the relation Rule: $y \rightarrow 2x + 5y$

{0, 1, 2, 3,4}

x	y
0	5
1	3
2	1
3	-1
4	-3



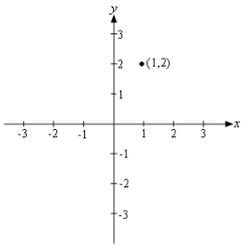
You can then use the values in the table to draw a graph.

Homework/project work/community engagement suggestions

- This should include ideas for refining, extending or applying what has been learned
- Reference Learner Resource page number

Homework Task

A. Draw the number plane and locate the following points on it.
E.g. (x, y) (1, 2)



Draw the number plane and locate the following points:

i. (-2, 4)

ii. (5, 3)

iii. (-3, -6)

iv. (7, -2)

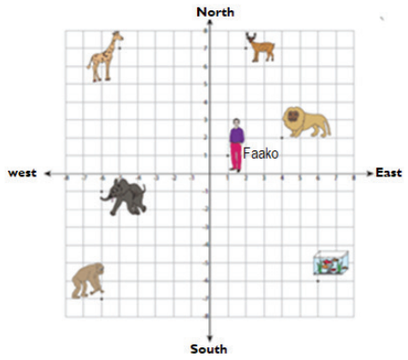
The Cartesian plane shows the location of animals. Use the plane to answer the questions that follow:

i. If Faako walks 7 units West and 8 units South, which animal does he see?

ii. Which animal is closest to Faako?

iii. Which animal is located at the point (2, 7)?

iv. What is point at which the giraffe is located?



B. Plot the point on a Cartesian plane and join the points with a line.

x	y
0	5
1	3
2	1
3	-1
4	-3

Cross-curriculum links/cross-cutting issues

Identify links between concepts, content or learning related to other disciplines. Reference opportunities for the activities to contribute to achieving cross-cutting aims of the Common Core Curriculum.

Differentiation

- Less able (or slow) Learners: Allow them more practice time on rule in words:
- More able Learners: Extend numeric mapping to include fractions.
- Core Competencies – Encourage communication, collaboration, time for critical thinking and problem solving, investigating flags on the internet to enhance their digital literacy

Potential misconceptions/student learning difficulties

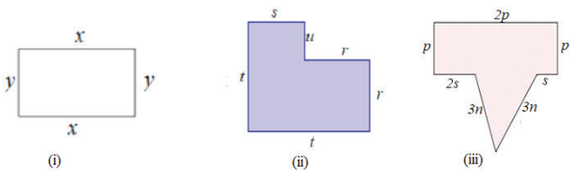
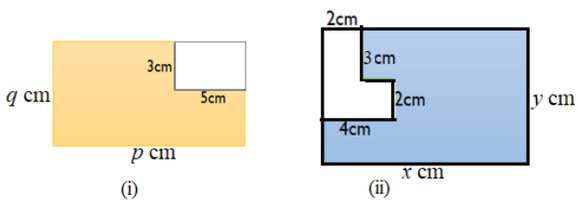
Identify challenges that might be presented as the learner works to achieve the content standard, and include any suggestions that help the teacher to overcome them, such as adaptations to teaching and learning activities.

Possible Learner difficulties

- Learners may have difficulties with writing the rule for given relations in words.
- Learners may also have difficulties with completing table so encourage them to find the rule first.

LESSON B7.11 ALGEBRA: ALGEBRAIC EXPRESSIONS

Strand: Algebra			
Sub-strand: Algebraic Expressions			
Content standard: B7.2.2.1 Simplify algebraic expressions involving the four basic operations and substituting values to evaluate algebraic expressions.			
Indicators: B7.2.1.1.1 Create simple algebraic expressions using simple logic to translate a set of instructions into an algebraic expression. B7.2.1.1.2 Perform addition and subtraction of algebraic expressions with rational coefficients. B7.2.1.1.3 Perform multiplication and division of algebraic expressions with rational coefficients. B7.2.1.1.4 Substitute values to evaluate algebraic expressions. B7.2.1.1.5 Use properties of the four operations to solve multi-step problems of algebraic expressions with rational coefficients.			
Key words/vocabulary: Coefficients, algebraic, expressions, evaluate, Simplify, substitute,			
Suggested activities for learning and assessment.	**Equipment/ Resources**	**Learner Resource (LR) page ref.**	**Progression:**
Mental maths games and mental maths word problems. For example, skip counting forwards and backwards in 5s and 10s. Review learners' previous knowledge on powers of numbers, addition, subtraction, multiplication and division facts, and finding an unknown in a mathematical problem.	mathematical sets, coloured beads, number cards,	CCC B7.2.1.1.1 -5	• Identify variables and constants in real life situations and relate them to mathematical problems. • Form algebraic expressions when given real life situations. • Simplify addition and subtraction of algebraic expressions. • Simplify multiplication and division of algebraic expressions. • Write expressions for finding the area and perimeter of plane shapes. • Simplify algebraic expressions involving the four operations. • Substitute values to evaluate algebraic expressions
Identify variables and constants in real life situations and relate it to mathematical problems. For example, at the Makola Market identify which of the following groups of people can be considered variables and which are constant: • Police men and women who work at the police department in charge of security at the complex. • People employed by the municipal corporation that is in charge of civic maintenance of the complex. • Hawkers. • Shop owners whose shop are on the first floor. • Restaurant owners on the ground floor. • Electricity supply companies. • Visitors wanting to purchase a laptop.			
Form algebraic expressions when given real life situations Examples: **i.** Mawuli is 3 years older than Maako. If Maako is now *x* years old, what is Mawuli's age? **ii.** Agbolosu and Tetteh were given GH¢400.00 to share. Tetteh had Gh¢35.00 more than Agbolosu. If Agbolosu's share is *x*, find an expression for Tetteh's share.			

Simplify algebraic expressions involving the four operations. Examples: **a.** $3abc + 4abc + 2abc$ **b.** $3x - 4x - 2x$ **c.** $7xy + 5x - 4x + 2xy - 3$ **d.** $5xy^2 \times 4x^4y^3$ **e.** $\frac{21x^7}{3x^4}$ **f.** $3xy \times 2x + \frac{6x^2y^3}{2y^2}$			
Write expressions for finding the area and perimeter of plane shapes. Examples:  			
Substitute values to evaluate algebraic expressions Example: If $x = 2, y = 4, a = 3, b = 2, z = 1 \text{ and } c = -1,$ Simplify the following expressions and substitute the values to evaluate them. **a.** $\frac{8xyz}{16xy}$ **b.** $\frac{5ab^2}{ab}$ **c.** $\frac{21x^4}{3x^2}$			
Homework/project work/community engagement suggestions • This should include ideas for refining, extending or applying what has been learned • Reference Learner Resource page number			
Homework Tasks **Task 1**: Identifying constants and variables in real life. Imagine you are at a market place like Makola, make a list of items/elements/people that you consider to be variables (quantities that vary) and constants (quantities that stay the same) playing a role in the market. Some examples could be the car park, the hawkers or the number of shops on the first floor. **Task 2:** Write an expression for finding the perimeter of the bigger shape  			

Task 3: Simplify the following expressions>

I. $15p^3q^2 \times 12x^5y^3 \div 36pq \times 45xy$

II. $\frac{7x^2+2x^2}{3x^2}$

III. $7a - 7a^3 + 14a^4$

Task 4: Simplify the following expressions and substitute the values to evaluate them.

$x = 2, y = 4, p = 3$ *and* $z = -1,$

i. $3xy \times 5y$

ii. $7xy + 5x - 4x + 2xy - 3$

iii. $4p \times 8z^2$

iv. $5x + 4 - 9y + 3x + 2y - 7$

Cross-curriculum links/cross-cutting issues

Identify links between concepts, content or learning related to other disciplines. Reference opportunities for the activities to contribute to achieving cross-cutting aims of the Common Core Curriculum

Differentiation

- Less able (or slow) Learners: limit writing expressions for regular plane shapes.
- More able Learners: Extend writing expressions to include composite shapes.

Core Competencies

- Encourage communication, collaboration, time for critical thinking and problem solving, investigating flags on the internet to enhance their digital literacy

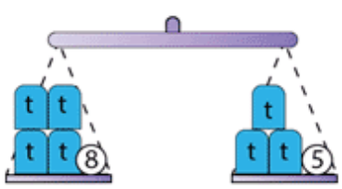
Potential misconceptions/student learning difficulties

Identify challenges that might be presented as the learner works to achieve the content standard, and include any suggestions that help the teacher to overcome them, such as adaptations to teaching and learning activities

Potential misconceptions:

- Learners may confuse 2cm x 2cm to be 4cm instead of $4cm^2$.
- Learners may also confuse the variable *x* with the operation x.
- Learners may also combine non-like terms. E.g. $5x + 4 = 9x$
- Learners also easily get confused with why for example $2x + 2x = 4x$ but $2x \times 2x = 4x^2$

LESSON B7.12 ALGEBRA: EQUATIONS

Strand: Algebra			
Sub-strand: Equations			
Content standard: B7.2.3.1 Demonstrate an understanding of linear equations of the form x + a = b (where a and b are integers) by modelling problems as a linear equation and solving the problems concretely, pictorially, and symbolically.			
Indicators: B7.2.3.1.1 Translate word problems to linear equations in one variable and vice versa. B7.2.3.1.2 Model and solve linear equations using concrete materials (e.g., counters and integer tiles) and describe the process orally and symbolically. B7.2.3.1.3 Model linear equations, then write mathematical expression and describe the process of solving the equation. B7.2.3.1.4 Solve linear equations in one variable.			
Key words/vocabulary: Linear, equations, variable			
Suggested activities for learning and assessment.	**Equipment/ Resources**	**Learner Resource (LR) page ref.**	**Progression**
Mental maths games and mental maths word problems: Review learners' previous knowledge on patterns from B1-B6.	• Index cards • Paper • Mathematical sets • Colour pencils	B7.2.3.1.1-4	• Change word problems to linear equations in one variable and vice versa. • Use concrete materials such as counters to represent linear equations. • Describe, orally, given linear equations. • Solve linear equations using concrete materials. • Write mathematical expression for linear equation. • Solve linear equations in one variable and describe the process of solving the equation.
Changing word problems to linear equations in one variable and vice versa. To change word problems to mathematical statements, read the problem carefully. Then choose a letter to represent the unknown you have to find. *For example:* when a certain number is subtracted from 10 and the result is multiplied by 2, the final result is 4. *Solution:* Let the number be z, then we have (10-x) and when this is multiplied by 2 we have 2(10-x). This final result is equal to 4.			
Use concrete materials to represent linear equations. To represent linear equations concretely, we can use the balance method. For example: $4t + 8 = 3t + 5$ can be represented as shown below:  In the left pan, there are 4t and 8. Then in the other pan there are 3t and 5. So we equate the two and solve for t.			

Solving linear equations in one variable: Linear equations often involve more than one operation as in the example below. So we need to group all numbers with variables and those without variables. $3x + 5 = 26$, *find the value of x* $3x + 5 — 5 = 26 — 5$, *grouping like terms* $3x = 21$, *simplifying both sides* $x = 7$			

Homework/project work/community engagement suggestions

This should include ideas for refining, extending or applying what has been learned

Reference Learner Resource page number

Homework Task

A. Solve the following equations:

1. $2x - 6 = 0$

2. $7x - 2 = 8 - x$

3. $8 - 2x = 5 - 4x$

4. $4 + 3x = 2 - 2x$

5. $2(x - 1) + 2(3x - 1) = 0$

6. $4(x-1) - (2x - 5) = 4$

B. Solve the following equations

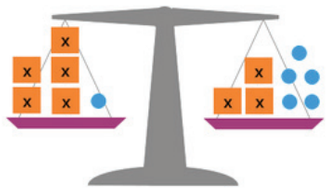
1. Ten added to thrice a whole number gives 40. Find the number.

2. Four-fifths of a number is greater than three-fourths of a number by 8. Find the number.

3. The sum of two consecutive multiples of 4 is 60. Find the number.

C. Write three linear equations on your own and sketch the equations. Look at the example below

$5x + 1 = 3x + 5$



Cross-curriculum links/cross-cutting issues

- *Identify links between concepts, content or learning related to other disciplines. Reference opportunities for the activities to contribute to achieving cross-cutting aims of the Common Core Curriculum*

Differentiation

- Less able (or slow) Learners: Limit equations to whole number coefficients.
- More able Learners: Extend equations to include rational coefficients.
- Core Competencies – Encourage communication, collaboration, time for critical thinking and problem solving, investigating flags on the internet to enhance their digital literacy

Potential misconceptions/student learning difficulties

Identify challenges that might be presented as the learner works to achieve the content standard, and include any suggestions that help the teacher to overcome them, such as adaptations to teaching and learning activities

Possible Learner difficulties:

- Learners may have difficulties with dealing with computations on integers.
  E.g. $2x = —5 —3$

LESSON B7.13 GEOMETRY AND MEASUREMENT – ANGLES

Strand: Geometry and Measurement

Sub-strand : Shape and Space

Content standard:

B7.3.1.1 Demonstrate understanding of angles including adjacent, vertically opposite, complementary, supplementary and use them to solve problems.

Indicators:

B7.3.1.1.1 Measure and classify angles according to their measured sizes – right, acute, obtuse and reflex.

B7.3.1.1.2 Apply the fact that (i) complementary angles are two angles that have a sum of 90°, and (ii) supplementary angles are two angles that have a sum of 180° to solve problems.

B7.3.1.1.3 Use adjacent, supplementary and vertically opposite angles to solve problems.

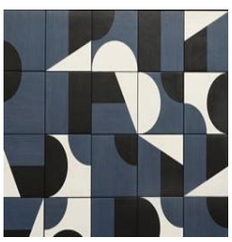
Key words/vocabulary: Angles (acute, right, obtuse, reflex, supplementary, complementary), vertex, arm

Suggested activities for learning and assessment.	**Equipment/ Resources**	**Learner Resource (LR) page ref.**	**Progression:**
Learners watch a short clip of a construction site. Leaners discuss the clip in groups and share with the whole class.			• Learners should understand and recall the concepts of planes, points, etc. • Demonstrate the concept of angles by using two (long red) Geostrips (straws) fastened together at one end.
Classify and describe angles. Describe the various angle types in terms of degrees. Relate angles to shape. Name an angle. Identify and name parallel and perpendicular lines, vertical and horizontal lines. Learners discuss among themselves what angles are and give examples. Learners explain how they can form angles. Learners demonstrate how to measure angles and say what instrument is used to measure angles. Learners demonstrate how angles are measured. Give learners pictures to identify angles they can find in them.	• Ruler • protractor • paper • geostrips • geometry sets • straws • office pins • any available objects that have the principles of angles embedded in them (E.g. furniture in the classroom)		

Homework/project work/community engagement suggestions

- This should include ideas for refining, extending or applying what has been learned
- Reference Learner Resource page number

Identify and label the complementary and supplementary angles in the diagram.

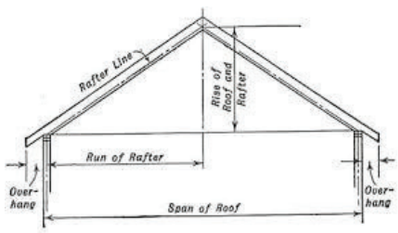


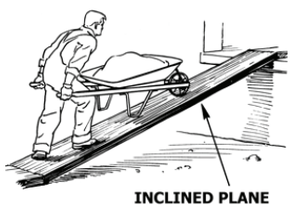
Cross-curriculum links/cross-cutting issues

Uses of angles in engineering and construction; inclined planes in science.

Explain how the cars are uploaded onto the flatbeds of the towing truck. Label all angles that move the same number of degrees. Name the type of angle you have labelled.

- Name the type of angle you have labelled.

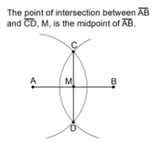
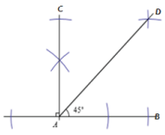
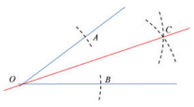
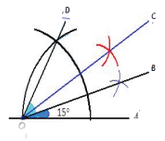
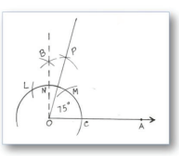




Potential misconceptions/student learning difficulties:

- The size of an angle varies with the length of the arms.
- The size of an angle varies with the size of the arc made with the angle vertex as centre.
- Different orientations of an angle as a source of confusion.
- That a right angle only exists between vertical and horizontal lines.

LESSON B7.14 GEOMETRY AND MEASUREMENT – CONSTRUCTION

Strand: Geometry and Measurement			
Sub-Strand: Shape and Space			
Content Standard: B7.3.1.2 Demonstrate how to construct a perpendicular to a line from a given point, bisect a line, bisect angles, and construct angles of the following sizes: 30˚, 45˚, 60˚, 75˚ and 90˚.			
Indicators B7.3.1.2.1 Construct a line segment perpendicular to another line segment. B7.3.1.2.2: Construct the perpendicular bisector of a line segment B7.3.1.2.3: Copy an and bisect angles B7.3.1.2.4: Construct angles of 90 and 45 B7.3.1.2.5: Construct angles of 60˚ and 30˚ B7.3.1.2.6: Construct angles of 15˚ and 75˚ B7.3.1.2.7: Describe examples of perpendicular line segments, perpendicular bisectors and angle bisectors in the environment.			
Key words/Vocabulary: Angles, construct, bisector, degrees, perpendicular bisectors			
Suggested Activities For Learning And Assessment	**Equipment/ Resources**	**Learner Resource Page Ref**	**Progression**
Let learners play a matching game to recall the principles of lines and angles.	Pen and paper		Ask learners questions to elicit their what they think, know about the clip • Ask learners questions to test understanding and recall of concepts of perpendicular lines. • Demonstrate the concept of constructing perpendiculars. • Demonstrate the construction of base angles 60˚and 90˚
Let learners sketch and draw different types of lines. Let learners draw perpendicular to different types of lines.			
Let learners demonstrate how they constructed their respective perpendiculars. Learners construct angles 60˚ and 90˚. Learners bisect 60˚ and 90˚ to construct 30˚ and 45˚ respectively.	Ruler, protractor, paper, compass  		
Learners draw the bisectors of angles.		B7.3.1.2.3: Copy and bisect angles	
Combine angles in appropriate ways to construct 75˚. Bisection of angles to construct 15˚. Construct an angle of 15˚ by bisecting an angle of30˚ (i.e. bisect $\angle AOB = 60^{o}$ to obtain $\angle AOC = 30^{o}$ and then bisect $\angle AOC = 30^{o}$ to obtain $\angle AOB = 15^{o}$ E.g.3: Use a pair of compasses and a ruler to construct an angle of 75˚ at a point on a given line segment [i.e. construct a right angle $\angle AOC = 90^{o}$); bisect the arc *MN* and join through *P* to obtain $\angle AOP = 75^{o}$)	 		

Homework/project work/community engagement suggestions
• Watch the video on the following link https://www.youtube.com/watch?v=_WuACRsNPPg Construct the
Cross-curriculum links/cross-cutting issues
• Use of geometrical construction in architecture and engineering. • Use GeoGebra to explore more angles where applicable.
Potential misconceptions/student learning difficulties
• Sketch, draw and construct lines do not mean the same. • Perpendiculars to all kinds of lines must definitely run from top down. • Arc/lines should not intercept unnecessarily. • Perpendicular always divide lines into (equal) parts.

LESSON B7.15 GEOMETRY AND MEASUREMENT – PERIMETER OF PLANE SHAPES INCLUDING CIRCLES

Strand: Geometry and Measurement

Sub-strand: Measurement

Content standard:

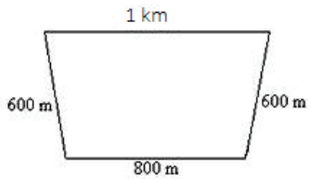
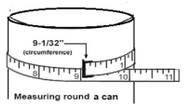
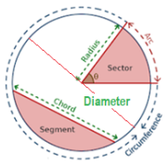
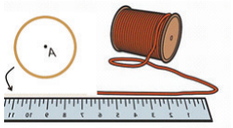
B7.3.2.1 Demonstrate the ability to find the perimeter of plane shapes including circles using the concept of pi (π) to find the circumference a circle.

Indicators:

B7.3.2.1.1 Calculate the perimeter of given shapes whose dimensions are in two units (i.e. cm and mm, m and cm, or km and m).

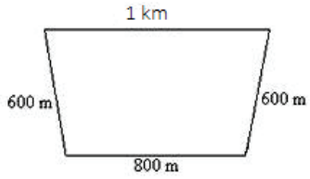
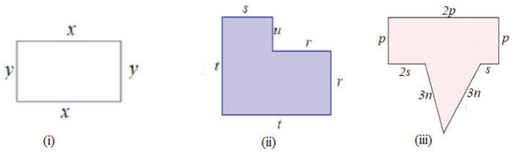
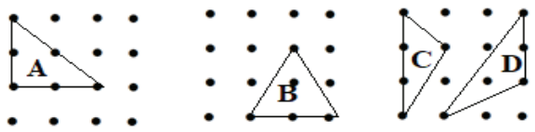
B7.3.2.1.2 Use the relationship between the diameter and circumference to deduce the formula for finding the circumference a of circle and use it to solve problems.

Key words/vocabulary: Perimeter, dimension, circle, conversion, diameter, circle

Suggested activities for learning and assessment.	**Equipment/ Resources**	**Learner Resource (LR) page ref.**	**Progression:**
Show photographs of different types of fence walls and let learners tell their uses.			• Ask learners to convert 50 cm to other units, e.g. mm, m. • Review the formula for finding the perimeter of a square and a rectangle.
Learners explore how to find the perimeter of given shapes.  	Square grid paper		
Measure the radius, diameter and circumference of circular objects like base or cross section of cylindrical objects like cans, tyres, bowls, etc., roundabouts, etc. and describe the measuring tools used. [Learners in groups share their findings with the whole class] **Circle** | **Circumference(C)** | **Diameter(D)** | **C ÷ D** Tin A | 13 | 4 | 13 ÷ 4 = Tin B | 38 | 12 | 38 ÷ 12 = An approximation to π π≈3.14159265358979323846264338327950288419716939937510582097494459230781640628620899862803482534211706798214808651328230664709384460955058223172535940812848111745028410270193852110555964462294895493038196442881097566593344612847564823378678316527120190914564856692346034861045432664821339360726024914127372458700660631558817488152092096282925409171536436789259036001133053054882046652138414695194151160 9.....forever…. Explain the relationship between the diameter and circumference of a circle by observing the results of C ÷ D. [The letter π, is used as the symbol for the ratio of the circumference of a circle to its diameter. The ratio itself is approximately 3.141592+.]	Square grid paper   		• Identify several circular objects and discuss how the pereimeter of the circular sections and diameter can be measured accurately; • Measure and record the the pereimeter of the circular sections (or circumference) and diameter of various circles in the table; Completing the table for the results of C ÷ D. Explain the relationship between the diameter and circumference of a circle.  

Learners solve questions of circumference: If the radius of a circle is 2 metres, what is the diameter? What is the circumference?			
Homework/project work/community engagement suggestions			
• You and your friends are fencing in and mulching a circular area of your school garden. The diameter of the circular area needs to be 4 metres. Determine how many metres of fencing you need and how many square metres the mulch must cover. Show all your work.			
Cross-curriculum links/cross-cutting issues			
• See what circles are used for in design technology.			
Potential misconceptions/student learning difficulties			
"Confusion the difference between units and square units when recording perimeter and area." (Moyer, 2001, pg. 57) Learners should note that $\pi \neq 3.142$ or $\frac{22}{7}$, but $\pi \approx 3.142$ or $\frac{22}{7}$. Confusing diameter with chord.			

LESSON B7.16 GEOMETRY AND MEASUREMENT – AREA OF A TRIANGLE

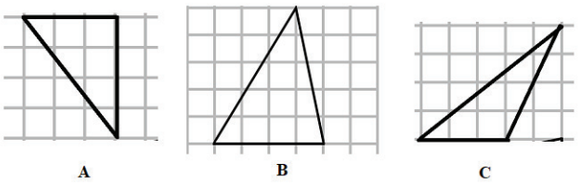
Strand : Geometry and Measurement			
Sub-strand : Measurement			
Content standard: B7.3.2.2 Derive the formula for determining the area of a triangle and use it to solve problems. B7.3.2.1 Demonstrate the ability to find the perimeter of plane shapes including circles using the concept of pi (π) to find the circumference a circle.			
Indicators: B7.3.2.2.1 Use the relationships between a triangle and a rectangle (or parallelogram) to deduce the formula for determining the area of a triangle. B7.3.2.2.3 Determine the area of a triangle.			
Key words/vocabulary: Triangle, parallelogram, area, height, base			
Suggested activities for learning and assessment.	**Equipment/ Resources**	**Learner Resource (LR) page ref.**	**Progression:**
Learners revise how to find the perimeter of given shapes:  Write an expression for the perimeter of the following shapes:  	Square grid paper		
Investigate triangles with given areas (say 2, 3 or 4 square units) in a geodot.  What is the area of each triangle? Which triangles have the same area?	Ruler, grid paper or geodot paper		• Ask learners to convert 50 cm to other units, e.g. mm, m. • Draw triangles in a geodot with given area (say 2, 3 or 4 square units). • Spot the rectangle or parallelogram enclosing the triangles. • Establish the formula for finding area of a triangle as = $\frac{1}{2}$ Rectangle Area = $\frac{1}{2}$ base ×

Determine the number of unit squares enclosed by the triangles below.

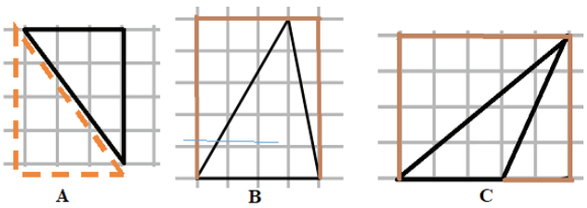
i. What is the perpendicular height of each triangle?

ii. What is the area?

iii. How does the perpendicular help in calculating the area?

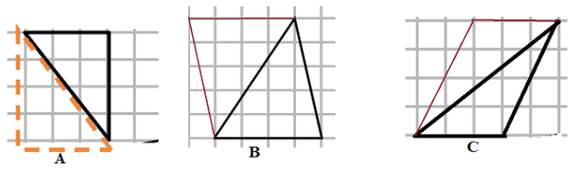


Spot the RECTANGLE enclosing the triangles to find the unit squares in each triangle. Notice the base and height of the triangle.



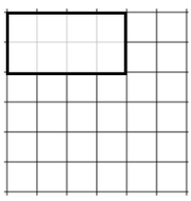
Triangle Area = $\frac{1}{2}$ Rectangle Area = $\frac{1}{2}$ base × height

Spot the *Parallelogram* from which the triangle was formed.



Triangle Area = $\frac{1}{2}$ Parallelogram Area

Draw a rectangle whose perimeter is twice as large as the one in the grid.

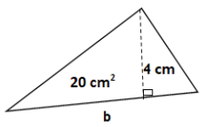


Ruler, grid paper or geodot paper

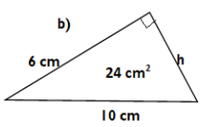
Draw a triangle whose area is square units on a geodot sheet.

i. The area of each triangle is given. Find the unknown measure.

a)



b)



Homework/project work/community engagement suggestions

1. Estimate the perimeter of the classroom floor and very by measuring with a measuring tape.
2. How many different triangles can be drawn in the 4x4 geodot or square grid using the points as vertices?
3. Which triangle has the least area?
4. Which triangle has the largest area?

Cross-curriculum links/cross-cutting issues

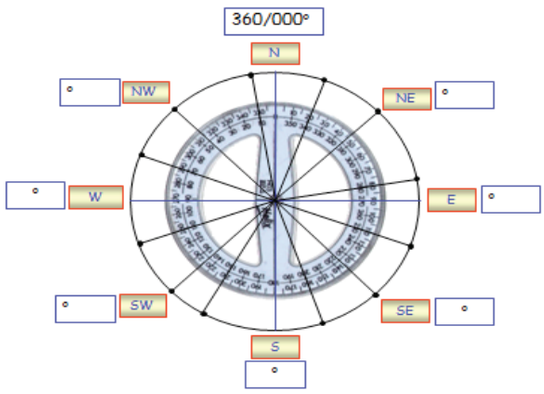
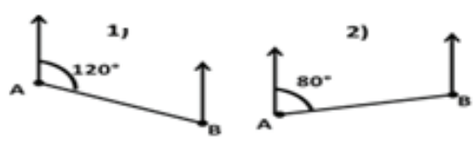
- See what triangles are used for in design technology.

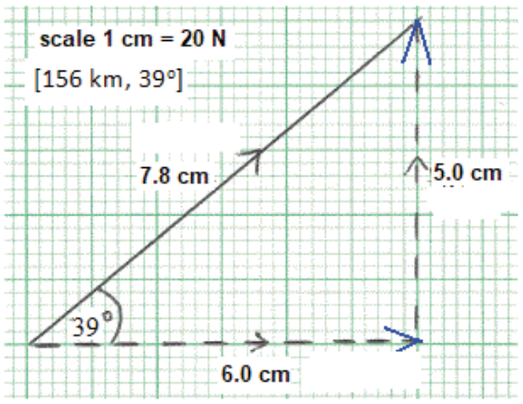
Potential misconceptions/student learning difficulties

- Perimeter and area are usually taught together in many instances and learners often get confused. Some effort should be put in by teachers to make the distinction clear especially the units used for the two.

LESSON B7.17 GEOMETRY AND MEASUREMENT – BEARINGS AND VECTORS

Strand: Geometry
Sub-strand: Bearings and Vectors
Content standard:
B7.3.2.3 Demonstrate understanding of bearings, vectors and their components using real life cases.
Indicators B7.3.2.3.1 Describe the bearing of a point from another point. B7.3.2.3.2 Explain how to find the back bearing when the direction of travel has a bearing which is less than 180˚ and/or greater than 180˚ B7.3.2.3.3 Distinguish between scalar and vector quantities. B7.3.2.3.4 Represent vectors in the column (component) form $\begin{pmatrix} x \\ y \end{pmatrix}$ and determine its magnitude and direction. B7.3.2.3.5 Convert vectors in the column (component) form $\begin{pmatrix} x \\ y \end{pmatrix}$ to the magnitude–bearing form (k, θ) and vice versa.
Key words/vocabulary: bearing, direction, whole circle bearing, cardinal points, back bearing, vector, scalar, component, magnitude

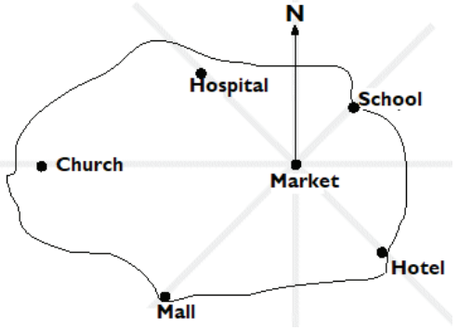
Suggested activities for learning and assessment.	**Equipment/ Resources**	**Learner Resource (LR) page ref.**	**Progression**
Finding bearings and back bearings of one point from another. Give learners in groups an enlarged photocopy of the figure and ask them to use a protractor to measure the bearing of each point from the centre of the circle and complete the boxes. 	Protractors, Worksheet B7.17 as in Figure 1		• Measure angles from the north and go clockwise • Find bearings of one point from another. • Find bearings and back bearings of one point from another • Draw given vectors using an appropriate scale, a ruler and a protractor. • Find the magnitude and direction of given vectors.
Reading bearings and finding the back bearing (or reciprocal bearing) to given bearings. (Ask learners in groups to do the exercises on page 87 of the learner resource and present findings to class) E.g. On what bearing is a ship sailing if it is heading East? What is the back bearing (or reciprocal) bearing to 30°?	Protractors, Worksheet B7.17		
Using a protractor to measure marked angles, describing the bearing of an object from point N, and finding the bearings and back bearings of one point from another. 	Protractors, Worksheet B7.17		

Using an appropriate scale to draw given vectors using a ruler and a protractor e.g. $\overrightarrow{AB}$= (3km, 045)	Ruler and Protractor Protractors, Worksheet B7.17		
Using an appropriate scale to draw given vectors on graph sheets and writing their column vector.  	Protractors, Graph sheet, Worksheet B7.17		
Find the magnitude and the direction of given vectors: e.g. $\overrightarrow{AB}=\begin{pmatrix}10\\15\end{pmatrix}$	Protractors, Worksheet B7.17		

Homework/project work/community engagement suggestions

- *This should include ideas for refining, extending or applying what has been learned*
- *Reference Learner Resource page number*

Reading the bearing of locations from a map. (See map of an island, Learner Resource page 90)



Cross-curriculum links/cross-cutting issues

Identify links between concepts, content or learning related to other disciplines. Reference opportunities for the activities to contribute to achieving cross-cutting aims of the Common Core Curriculum

Core Competencies

- Links/references in some content standards of Social Studies e.g. reading directions and drawing plans, and Creative Arts. Encourage communication, collaboration, time for critical thinking and problem solving, read direction of locations with Compass Apps to enhance their digital literacy

Potential misconceptions/student learning difficulties

Identify challenges that might be presented as the learner works to achieve the content standard, and include any suggestions that help the teacher to overcome them, such as adaptations to teaching and learning activities

LESSON B7.18 GEOMETRY AND MEASUREMENT – TRANSFORMATION (I.E. REFLECTION AND TRANSLATION)

Strand: Geometry

Sub-strand: Transformation

Content standard:

B7.3.3.3 Perform a single transformation (i.e. reflection and translation) on a 2D shape using graph paper (including technology) and describe the properties of the image under the transformation (i.e. congruence, similarity, etc.).

Indicators

B7.3.3.3.1 Determine shapes in real life that have reflectional (or fold) symmetries.

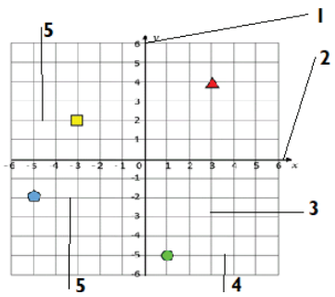
B7.3.3.3.1 Identity pairs of congruent and similar shapes in a chart or coordinate plane.

B7.3.3.3.2 Plot points and shapes (i.e. plane figures) on a coordinate plane and draw their images under reflection in given lines.

B7.3.3.3.3 Understand and translate points and plane shapes on a coordinate plane.

Key words/vocabulary:

symmetry, symmetries, reflectional symmetry, horizontal grid lines - $x = 0$, $x = 1$, $x = 2$, etc; major vertical grid lines - $y = 0$, $y = 1$, $y = 2$, , adinkra fabrics

Suggested activities for learning and assessment.	**Equipment/ Resources**	**Learner Resource (LR) page ref.**	**Progression**
Identify examples of designs (or objects) in everyday life that have reflectional (or fold) symmetries (e.g. adinkra symbols). 	adinkra symbols chart or worksheet	B7.3.3.3.1	• Identifying designs with reflectional symmetries and shapes that are congruent and/or similar. • Plotting points and shapes with given coordinates in the number plane. • Identifying by their labels major vertical grid lines and major horizontal grid lines in a coordinate plane. • Drawing the images of given points and shapes under reflection in given lines. • Drawing the images of given points and shapes under translation by a given vector.
Review plotting points and shapes (i.e. plane figures) with given coordinates in the number plane and naming the major vertical grid lines (i.e. $x = 0$, $x = 1$, $x = 2$, etc.,) and the major horizontal grid lines (i.e. $y = 0$, $y = 1$, $y = 2$, etc.,) in a coordinate plane. In the figure Line 1 is $x = 0$ *or* y-axis; Line 5 is y = −2 	Geodot paper and graph sheets	B7.3.3.3.1	
Plot points and shapes (i.e. plane figures) in a coordinate plane and draw their images under reflection in given lines.	Geodot paper and graph sheets	B7.3.3.3.2	
Plot points and shapes (i.e. plane figures) in a coordinate plane and draw their images under translation by a given vector.	Geodot paper and graph sheets	B7.3.3.3.3	
Verify the concept of congruent and similar shapes in the coordinate plane using properties of both the object(s) and image(s); and in real life situations (carpet designs, fabric pattern)	Congruent and similar shapes worksheets	B7.3.3.3.4	

Homework/project work/community engagement suggestions This should include ideas for refining, extending or applying what has been learned Reference Learner Resource page number
• Identify five objects at home that have symmetries.
Cross-curriculum links/cross-cutting issues Identify links between concepts, content or learning related to other disciplines. Reference opportunities for the activities to contribute to achieving cross-cutting aims of the Common Core Curriculum
Core Competencies • Encourage communication, collaboration, time for critical thinking and problem solving, investigating flags on the internet to enhance their digital literacy
Potential misconceptions/student learning difficulties Identify challenges that might be presented as the learner works to achieve the content standard, and include any suggestions that help the teacher to overcome them, such as adaptations to teaching and learning activities

LESSON B7.19 HANDLING DATA – DATA

Strand : Handling Data

Sub-strand : Data

Content standard:

B7.4.1.1 Select, justify, and use appropriate methods to collect data (quantitative and qualitative), display and analyse the data (grouped/ungrouped) presented in frequency tables, line graphs, pie graphs, bar graphs or pictographs and use these to solve and/or pose problems.

Indicators:

B7.4.1.1.1 Select and justify a method to collect data (quantitative and qualitative) to answer a given question.

B7.4.1.1.2 Design and administer a questionnaire for collecting data to answer a given question(s) and record the results.

B7.4.1.1.3 Organise and present data from a survey into a table and/or chart, and analyse it to solve and/or pose problems.

Key words/vocabulary: Collect, data, record, design, administer, quantitative and qualitative, methods of collecting data (questionnaire, interview observation experiments, survey databases electronic media or internet).

Suggested activities for learning and assessment.	**Equipment/ Resources**	**Learner Resource (L.R.) page ref**	**Progression**
In small groups, learners discuss and write down for example, how they would make decisions in the following situations (what facts they would take into account and how they would collect these 'facts/data): **(a)** The type of drinks to buy for a class party. **(b)** The make of football boots to buy for the school team. **(c)** People who eat more fufu develop pot belly?			• Identify situations that need collection of data • Aware of facts to be taken into account and • describe the methods for data collection • Organise and present data from a survey
Ask each group to identify which method they will use to gather the facts/data for each situation in (a), (b) and (c), and give them sticker papers. Let each group paste their method on the wall and allow them to go round to read the methods other groups have identified. At plenary, lead a discussion on the methods identified for learners to appreciate the appropriate methods to be used.	sticker papers, permanent makers, etc.		
Lead learners to design a Class Survey Form for the collection of data and a suitable table for organising the data. Learners present data from the survey in tables, a chart/graph, and analyse it to solve and/or pose problems.			

Homework/project work/community engagement suggestions

- Learners design a survey form to collect data on the number of desks in each classroom of their school.
- Learners residing in the same neigbourhood (in small groups) discuss and write down:
  1. How they would find out the number of households in the neighbourhood.
  2. How they would find out the number of people living in the households identified.
  3. The appropriate method to collect the data.
  4. Design the tool/questionnaire for the data collection.
  5. Administer the tool (e.g. questionnaire, interview, or observation) for collecting data, present data in frequency tables, line graphs, bar graphs and use these to solve the project question.

Cross-curriculum links/cross-cutting issues

- Links/references in some content standards of Social Studies e.g. market surveys, and Creative Arts

Potential misconceptions/student learning difficulties

Learners should have done much work on presentation of data pictorially e.g. line graph, bar chart etc. in B4, B5 and B6. Those activities should be reviewed to enable learners visualise their linkage to the B7.4.1.1 standard.

Why and when it is appropriate to use each method for the collection of data should be discussed thoroughly with learners using examples of each method to enable learners to conceptualise the methods, and be able to use them appropriately. The teacher should note the following during the discussions to alleviate learners' learning difficulties:

1. **Surveys:** Defined as collecting opinions and stories from people through questionnaires, interviews, or similar techniques.
2. **Observation**: Defined as viewing and recording ongoing behaviours in a naturalistic setting
3. **Experiment:** Defined as manipulating a component to see if the manipulation has an effect on other aspects of the participants.
4. **Archival**: Sefined as a process of reviewing already collected data (e.g. electronic media and internet) and analysing it.

It is important to limit the scope at this stage to **(i) Direct Observation as in field/field experiments**, **(ii) Questionnaire and what a good questionnaire must be** (e.g. *be simple and unambiguous; avoid leading questions, not contain overlapping groups if tables are included; be systematic and well organised – sequential; not too lengthy – so people do not get bored; and avoid irrelevant or personal questions).* **(iii) Direct Personal Interview**

Identify gifted learners who perform above expectation and expose them to more real-life problems that require data collection, analysis and presentation in tables, line graphs, pie graphs, bar graphs or pictographs.

LESSON B7.20 HANDLING DATA – DATA

Strand: Handling Data

Sub-strand: Data

Content standard:

B7.4.1.2 Determine measures of central tendency *(a representative value)* - (mean, median, mode) for a given ungrouped data and use them to solve problems.

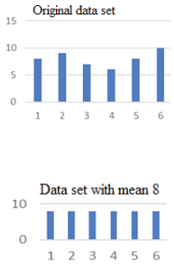
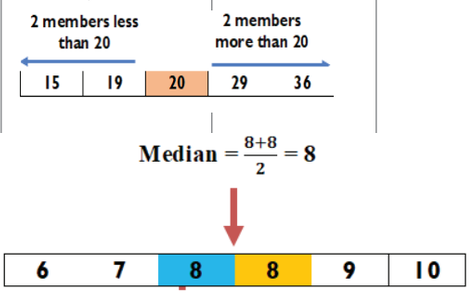
Indicators:

B7.4.1.2.1 Calculate the mean for a given ungrouped data and use it to solve problems.

B7.4.1.2.2 Calculate the median for a given ungrouped data and use it to solve problems.

B7.4.1.2.3 Calculate the mode for a given ungrouped data and use it to solve problems.

Key words/vocabulary: Mean, median, mode ungrouped data

Suggested activities for learning and assessment.	**Equipment/ Resources**	**Learner Resource (L.R.) page ref**	**Progression**
The **mean (average)** of a data set is found by adding all numbers in the data set and then dividing by the number of values in the set **i.** The mean for the data set {8, 9, 7, 6, 8, 10} is given by $\frac{8+9+7+6+8+10}{6} = 8$ Introduce learners to how to calculate the mean of a data set presented in a frequency table e.g. ages of children at a party Ages (x): 1 3 5 6 7 8 9 10 Frequency (f): 2 5 6 10 8 5 3 1 ii. Lead learners to apply the skills acquired to solve real-life problems involving calculating the mean or average. For example, **Sena has had the following scores in five of the common core subjects this term: 75, 87, 90, 88, 79. If she wishes to have an average score of 85, what must she score on the sixth test? i.e.** *Set up the problem like this: (75 + 87 + 90 + 88 + 79 + □) ÷ 6 = 85*	Large graph board (to interpret the mean pictorially; i.e. smoothing the bars of the original data set to obtain the mean.)  		*Describe how knowledge and understanding will be built as the content standard is addressed*
The **median** is the middle value when a data set is ordered from least to greatest. For example, **i.** To find the median of {19, 29, 36, 15, and 20}, the ordering from least to greatest would be 15, 19, 20, 29, 36. Since there are 5 values (odd number), **20** is the median (middle number) **ii.** In finding the median for the data set 8, 9, 7, 6, 8, and 10. (i.e. the middle item in the ordered set, *6, 7, 8, 8, 9, and 10 is 8*). NB. since there are 6 values (even number), we must find the mean or average those two middle numbers to get the median value **iii.** Lead learners to find the median mark obtained in a mathematics class test presented in the following frequency table: Score 1 2 3 4 5 Frequency 2 6 4 5 3 *NB. since there are 20 values, the 10th and 11th scores are the middle numbers and they are both 3, so the median value is 3*	Large graph board (to interpret the median) 		

Introduce learners to a real-life problem that demand the use of a median and not a mean as a measure of central tendency. For example, a skewed data set (i.e. with extreme values):

Salary (GH¢)	1000	2,500	3000	3,500	4000	8000	9000
Frequency (f):	6	8	10	8	2	2	3

The **mode** is the technical word that is used for the value in a data set that occurs most often.

Most of the data set considered in calculating the mean (average) and the median above, have some of their members occurring more than the other members in the same data set and those that occur most often is the **mode** of the given data set.

However, the data set {19, 29, 36, 15, and 20} has no mode.

Let each learner write a 4, a 5, and a 6-member data set which have no mode on paper stickers and exchange the stickers with a classmate to critic it.

paper stickers, permanent makers

Homework/project work/community engagement suggestions

This should include ideas for refining, extending or applying what has been learned

Reference Learner Resource page number

Cross-curriculum links/cross-cutting issues

- Identify links between concepts, content or learning related to other disciplines. Reference opportunities for the activities to contribute to achieving cross-cutting aims of the Common Core Curriculum

Potential misconceptions/student learning difficulties

- Note that the mode is the value in the data set that occurs most often **and not the number of times it occurs.**
- Some data sets may not have a mode.
- It is also possible for a data set to have **more than one mode.**

LESSON B7.21 HANDLING DATA – PROBABILITY

Strand: Handling Data			
Sub-strand: Probability			
Content standard: B7.4.2.1 Identify the sample space for a probability experiment involving single events and express the probabilities of given events as fractions, decimals, percentages and/or ratios to solve problems			
Indicators: B7.4.2.1.1 Demonstrate understanding of the likelihood of a single outcome occurring, by providing examples of events that are impossible, possible or certain from personal contexts. B7.4.2.1.2 Classify the likelihood of a single outcome occurring in a probability experiment as impossible, possible, or certain. B7.4.2.1.3 Calculate the probability of the event and express the probability as fractions, decimals, percentages and/or ratios.			
Key words/vocabulary: Impossible, possible, certain events, sample space, probability experiment			
Suggested activities for learning and assessment.	**Equipment/ Resources**	**Learner Resource (L.R.) page ref**	**Progression**
Write the following statements on the board. Lead a discussion to describe each statement using words like *impossible*, *possible*, or *certain*: **1.** The dog will fly tomorrow. **2.** Someone in the class would be a teacher in the future. **3.** Ghana will still be an African country tomorrow. In small groups ask learners to discuss and describe each outcome using words like *impossible*, possible, or *certain*, and justify their choices.			• Identify situations that need collection of data • Aware of facts to be taken into account and • describe the methods for data collection • Organise and present data from a survey
Ask learners to work in groups to discuss the outcome of the following events using words like *impossible*, *possible*, or *certain*: **1.** A coin lands Heads side up. **2.** The day after Monday will be Tuesday. **3.** A new born baby will be a girl. **4.** It will rain in Winneba in the first week of January.			
Ask learners to work in groups to discuss the following outcomes of throwing a die using words like *impossible*, *possible*, or *certain*: **1.** Obtaining the number 1 **2.** Obtaining the number 7 **3.** Obtaining the number 4			

Ask learners to work in groups to discuss the following outcomes of throwing two dice using words like *impossible*, *possible*, or *certain*: • Obtaining a total of 12. • Obtaining a total of 2. • Obtaining a total of 13. Let learners calculate the probability of rolling **i.** factors of 60 **ii.** divisors of 12 **iii.** a 3 or smaller number with a die; and **iv.** express their probabilities as fractions, decimals, percentages and/or ratios.			
Homework/project work/community engagement suggestions			
• Explore and state events in real-life situations that are impossible, possible, or certain and justify your choice.			
Cross-curriculum links/cross-cutting issues			
• Identify links between concepts, content or learning related to other disciplines. Reference opportunities for the activities to contribute to achieving cross-cutting aims of the Common Core Curriculum			
Potential misconceptions/student learning difficulties			

Part C

SAMPLE LESSON PLANS

MATHEMATICS: Term 1, Week ..... Lesson 1 A

Date: **Time:** 50 Minutes **Class:** B7 **Class size:** 38		**Subject:** MATHEMATICS **Strand:** Number **Sub Strand:** Whole numbers up to 10,000,000,000
Content Standard: B7.1.1.1**:** Express quantities (whole numbers) recorded as base ten numerals using place value and round these to given decimal places.	**Indicators:** B7.1.1.1.1, B7.1.1.1.2, B7.1.1.1.3	**References:** Maths B7 TRP[1], pp 1-3, Maths B7 LRP, pp 1-7
Performance Standard: - Model given 8-digit numbers using graph sheets and multi-base ten materials, write the number in expanded form, in digits and in words. - Discriminate and find missing numbers in number sequences up to 100,000,000. - Round numbers to the nearest thousand and the nearest ten thousand.		**Core Competencies:** PS, CT, CI, CC, PD, DL
Key words: place value, digit, expanded form, numeral		

Time	Learner activity	TLMs/Resources
Starter (preparing the brain for learning)	Mental maths games Mental maths games to include: - Skip counting forward and backwards in (i) 10,000s from 10,000 to 100,000; (ii) 50,000s from 1,000,000s to (iii) 100,000s from 100,000s to 1,000,000; etc. - Learners continue a given pattern of number sequence on number line. - Learners identify missing number(s) in a sequence of numbers on a number line. - Number facts involving the four basic operations - Basic numeracy application problems involving the four basic operations. Read and write numbers (on flashcards) using words and figures. Use flashcards to engage learners to talk about and explain (in multiple of ways) how to represent numbers including the expanded notation, (or renaming) with the concepts of place value. Use flashcard games and other activities to review identification, discrimination and finding missing numbers up to 1,000,000	Teacher's Mental Maths Exercises Book (TMMEB) Flashcards with 4-digit to 7-digit numbers.

	Review and Reinforcement Activities Read and write in words numbers up to 7-digit numbers shown o flash cards. Review use of graph sheets and multi-base ten materials (or manipulatives) to model numbers up to 1,000,000.	Flashcards with 4-digit to 7-digit numbers. Multi-base ten materials (or manipulatives)
Main (new learning) Activity	Day 1 & 2 Model given 8-digit numbers using graph sheets and multi-base ten materials (or manipulatives), and place them in the appropriate columns of the place value frame/mat (working in pairs/groups). Determining the place value of numbers. See TRP, pp 2 and LRP, pp 2-6.	Number flash cards; Multi-base ten materials (or manipulatives), Place value chart, graph sheets
	Day 3 & 4 *Comparing, Ordering and Rounding numbers* Use number lines and other activities to review identification, discrimination and finding missing numbers up to 100,000,000. Round numbers to the nearest thousand, nearest ten thousand and nearest hundred thousand. See TRP, pp 2 and LRP, pp 2-9.	Number lines, Worksheets
Classroom Organisation	***Differentiated learning*** Learners will be put in ability groups during the practice part of the lesson. - *Less able (or slow) Learners:* Limit to the expanded form of given 3-digit numbers modelled using bagged 10 bundles of 10s straws, bundles of tens straws and loose straws. - *More able Learners:* Extend the work to the expanded form of given 8-digit numbers modelled using graph sheets and multi-base ten materials The classroom will be arranged in such a way that it is attractive, well-organised, safe and adapted to group work conditions.	Worksheets Alternatively, differentiated exercises can be obtained from the current textbooks, or worksheets can be downloaded from the internet.
Assessment	Assessment See assessment tasks in LRP, pp 2-9.	Alternatively, exercises can be obtained from the current textbooks, or the internet.
Plenary/Reflections (Learner and teacher	What new things have you learned today? Learning Progress voting: - Ask learners to show by their fingers of 5 or 3 or 1 as to those who "really got it", "got some of it" or "didn't get it" respectively**.** Independent Activity/Homework: See LRP pp9.	
Remarks		

MATHEMATICS: Term 1, Week ..... Lesson 4A

Date: **Time:** 50 Minutes **Class:** B7	**Class size:** 40	**Subject:** MATHEMATICS **Strand:** Number **Sub Strand:** Powers of Natural Numbers
Content Standard: B7.1.2.3 Demonstrate understanding and the use of powers of natural numbers in solving real life problems.	**Indicators:** B7.1.2.3.1, B7.1.2.3.2, B7.1.2.3.3	**References:** TRP[3], B7, pp 10 LRP B7, pp 18
Performance Standard: - Explain the meaning of repeated factors. - Expand a given number with an exponent. - Prove that the value of any natural number with zero as exponent or index is 1.		**Core Competencies:** PS, CT, CI, CC, PD, DL
Key words: Power, base, index, indices, simplify, exponent…etc.		

Time	Learner activity	TLMs/Resources
Starter (preparing the brain for learning) 10 minutes	Mental maths games Mental maths games to include: - Do skip count forwards and backwards activities in 50s, 100s and 1000s. - Drill multiplication facts up to 12 x 12. - Do mental drill on factors of numbers.	Teacher's Mental Maths Exercises Book (TMMEB)
	Review and Reinforcement Activities - Review your knowledge on multiplication facts. - Review your knowledge on factors of numbers.	• Indices dominos, • cut out shapes, • counters, • oware, • Math set,
Main (new learning) Activity	Day 1 & 2 Working with a partner, illustrate with examples the meaning of repeated factors. Together with your partner work on expanding numbers with exponents. See TRP, pp 11 and LRP, pp 18.	Index cards (one for each student) pencils red and yellow counters
	Day 3 & 4 In small groups, illustrate with examples why the value of any natural number with zero as exponent or index is 1. Discuss as a group how the concept helps in solving everyday problems. In pairs, solve problems on powers of natural numbers. See TRP, pp 11 and LRP, pp 18.	Index cards (one for each student) pencils red and yellow counters Worksheets
Assessment	Assessment See assessment tasks in LRP, pp 20.	Alternatively, worksheet can be downloaded from the internet
Classroom Organisation	***Differentiated learning*** Learners will be put in ability groups during the practice part of the lesson • *Less able (or slow) Learners:* Limit assessment tasks to few items and examples used in class. • *More able Learners:* Extend the assessment tasks to include new examples not used in class.	Index cards (one for each student) pencils red and yellow counters

Plenary/Reflections (Learner and teacher) 5 minutes	What new things have you learned today? Learning Progress voting: - Ask learners to show by their fingers of 5 or 3 or 1 as to those who "really got it", "got some of it" or "didn't get it" respectively. Independent Activity/Homework: $2 \times 2 = 2^2$ $2 \times 2 \times 2 = 2^3$ I. What would come next? II. Can you write or extend the pattern in both directions? III. What is 20? Search for worksheets on powers of natural numbers from the internet and complete the tasks. See TRP, pp 12 and LRP, pp 20.	
Remarks		

MATHEMATICS: Term 1, Week ..... Lesson 4 B

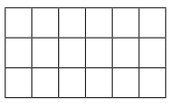
Date: **Time:** 50 Minutes **Class:** B7	**Class size:** 40	**Subject:** MATHEMATICS **Strand:** Number **Sub Strand:** Powers of Natural Numbers
Content Standard: B7.1.2.3 Demonstrate understanding and the use of powers of natural numbers in solving real life problems.	**Indicators:** B7.1.2.3.4, B7.1.2.3.5	**References:** TRP B7, pp 10 LRP B7, pp 18
Performance Standard: - Solve for the value of a number written in index form. - Apply the concept of powers of numbers (product of prime) to find HCF.		**Core Competencies:** PS, CT, CI, CC, PD, DL
Key words: Power, base, index, indices, simplify, exponent…etc.		

Time	Learner activity	TLMs/Resources
Starter (preparing the brain for learning) 10 minutes	Mental maths games Mental maths games to include: - Do skip counting forwards and backwards activities in 50s, 100s and 1000s. - Drill multiplication facts up to 12 x 12. - Do mental drill on factors of numbers. - Drill of HCF on some simple pair of numbers, e.g. 6 and 12.	Teacher's Mental Maths Exercises Book (TMMEB)
	Review and Reinforcement Activities - Review your knowledge on powers of numbers. - Review your knowledge on HCF using product of prime.	Index cards (one for each student) pencils red and yellow counters
Main (new learning) Activity	Day 1 & 2 Working with a partner, write a given number in index form and vice versa. Together, describe the process of solving the equation. Where different ways can be used, share with your partner and try it out. See TRP, pp 11 and LRP, pp 18.	Index cards (one for each student) pencils red and yellow counters
	Day 3 & 4 In small groups, workout HCF for given numbers. Discuss as a group how the concept of powers of numbers is applied in finding HCF. In pairs, do speed trial on finding the HCF of a chosen number to see who finishes first. (Note: there are no winners and losers) See TRP, pp 11 and LRP, pp 18.	Index cards (one for each student) pencils red and yellow counters Worksheets
Assessment	Assessment See assessment tasks in LRP, pp 20.	Alternatively, worksheet can be downloaded from the internet
Classroom Organisation	***Differentiated learning*** Learners will be put in ability groups during the practice part of the lesson • *Less able (or slow) Learners:* Limit assessment tasks to few items and examples used in class. • *More able Learners:* Extend the assessment tasks to include new examples not used in class.	

Plenary/Reflections (Learner and teacher 5 minutes	What new things have you learned today? Learning Progress voting: - Ask learners to show by their fingers of 5 or 3 or 1 as to those who "really got it", "got some of it" or "didn't get it" respectively. Independent Activity/Homework: - Write pairs of numbers and workout the HCF using the product of prime. - Search for worksheets on powers of natural numbers from the internet and complete the tasks. See TRP, pp 12 and LRP, pp 20.	
Remarks		

MATHEMATICS: Term 1, Week ..... Lesson 6

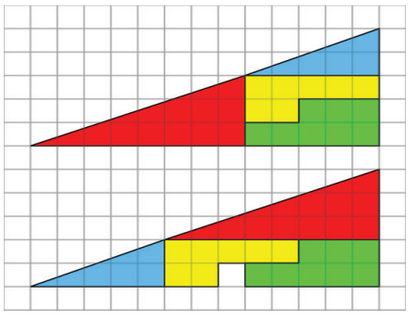
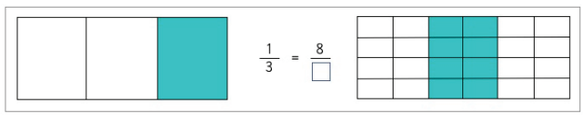
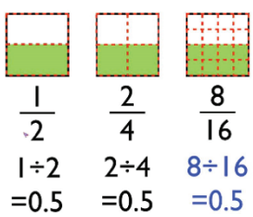
Date: **Time:** 50 Minutes **Class:** B7 **Class size:** 38		**Subject:** MATHEMATICS **Strand:** Number **Sub Strand:** Fractions, Decimals and Percentages
Content Standard: B7.1.3.1 Simplify, compare and order a mixture of positive fractions (i.e. common, percent and decimal) by changing all to equivalent (i) fractions (ii) decimals, or (iii) percentages	**Indicators:** B7.1.3.1.1, B7.1.3.1.2	**References:** Maths B7 TRP[4], pp 19-21, Maths B7 LRP, pp 22-25
Performance Standard: - Simplify, compare and order a mixture of positive fractions		**Core Competencies:** PS, CT, CI, CC, PD, DL
Key words: fraction, numerator, denominator, benchmark fractions, percentages and decimals; equivalent fractions; tenths; hundredths; arrange; order; compare; ascending order; descending order.		

Time	Learner activity	TLMs/Resources
Starter (preparing the brain for learning)	Mental maths games Mental maths games to include: - Skip counting forward and backwards in multiples of 10,000s and 100,000 - number facts involving the four basic operations and fractions - basic numeracy application problems involving the four basic operations Read and write fractions (on flashcards) using words and figures to review the concept of fraction	Teacher's Mental Maths Exercises Book (TMMEB) Flashcards with fractions in words and numerals or figures
	Review and Reinforcement Activities  • Shade given fraction of squares in given shapes: i.e. shade $\frac{5}{6}$ of the rectangle • Write down 3 fractions equivalent to $\frac{2}{3}$ • Express the fraction $\frac{6}{10}$ in its simplest form: $\frac{6}{10} = \frac{3}{5}$ • Convert to mixed numbers: $\frac{12}{5}$ • Convert to improper fractions: $2\frac{5}{9}$	Geodot paper, Square Grid paper or Graph sheets Worksheet B7.6, Activity A
Main (new learning) Activity	Day 1 & 2 Working in pairs/groups lead learners to **review Percentages, Fractions, Decimals using Square Models** (see LRP, pp 23-24) Working in pairs/groups lead learners to **work out common, decimal and percent equivalences of the benchmark fractions** (see TRP, pp 19 and LRP, pp 24).	Geodot paper, Square Grid Worksheet B7.6, Activity B Worksheet B7.6, Activity C1; Can add exercises from current textbooks, or worksheets from the internet
	Day 3 Working in pairs/groups lead learners to **change two fractions to the same denominator** (or types, i.e. the decimal and percent equivalences) **and compare using the symbols < or >**; (see LRP, Activity C2, pp 24).	LRP Worksheet B7.6, Activity C2, PP24 Can add exercises from current textbooks, or worksheets from the internet

	Day 4 Working in pairs/groups lead learners to **change three fractions to the same denominator** (or types, i.e. the decimal and percent equivalences) **and arrange these in the ascending or descending order** (see LRP, Activity C3, pp 25).	LRP Worksheet B7.6, Activity C3 Can add exercises from current textbooks, or worksheets from the internet
Classroom Organisation	***Differentiated learning*** Learners will be put in ability groups during the practice part of the lesson Encourage communication, collaboration, time for critical thinking and problem solving. Arrange the classroom in such a way that it is attractive, well-organised, safe and adapted to group work conditions. Investigate flags on the internet to enhance their digital literacy	
Assessment	Assessment See assessment tasks in LRP, pp 23-24.	
Plenary/Reflections (Learner and teacher	What new things have you learned today? Learning Progress voting: Discuss Independent Activity/Homework: See LRP pp25.	
Remarks		

MATHEMATICS: Term 1, Week ..... Lesson 9

Date: **Time:** 50 Minutes **Class:** B7	**Class size:** 40	**Subject:** MATHEMATICS **Strand:** Number **Sub Strand:** Ratio and Proportion
Content Standard: B7.1.4.1 Demonstrate an understanding of the concept of ratios and its relationship to fractions and use it to solve problems that involve rates, ratios, and proportional reasoning.	**Indicators:** B7.1.4.1.1, B7.1.4.1.2, B7.1.4.1.3	**References:** TRP[6] B7, pp 28 LRP B7, pp 36
Performance Standard: - Find ratio of given quantities. - Describe relationship between two quantities using ratio language. - Make tables of equivalent ratios.		**Core Competencies:** PS, CT, CI, CC, PD, DL
Key words: Ratio, rate, percent, proportional, equivalent, unit, reasoning…		

Time	Learner activity	TLMs/Resources
Starter (preparing the brain for learning) 10 minutes	Mental maths games Mental maths games to include:  The four coloured pieces can be put together in two different ways to make these shapes with base 13 units and height 5 units. Why is there one square missing in the second arrangement?	Teacher's Mental Maths Exercises Book (TMMEB) Graph sheets
	Review and Reinforcement Activities • Work out some examples of equivalent fractions.   	Graph sheets

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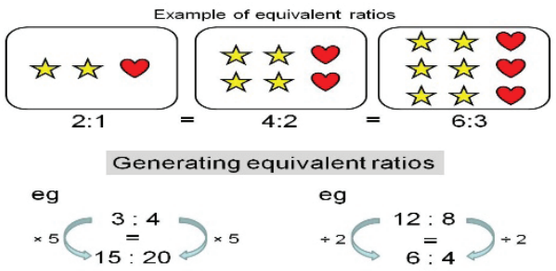
• Make tables of equivalent figures/ratios.
<table>
<tr><td></td><td>Afia</td><td>Bedu</td><td>Caro</td></tr>
<tr><td>Ratio of S:W</td><td>3:14</td><td>2:7</td><td>1:4</td></tr>
<tr><td>Ratio as fraction</td><td>$\frac{3}{14}$</td><td>$\frac{2}{7}$</td><td>$\frac{1}{4}$</td></tr>
<tr><td>Equivalent ratios</td><td>$\frac{6}{28}$</td><td>$\frac{8}{28}$</td><td>$\frac{7}{28}$</td></tr>
</table>
• Reduce given fractions to the simplest form:
E.g. $\frac{39}{65} = \frac{13 \times 3}{13 \times 5} = \frac{3}{5}$
• Review knowledge on ratio from primary school.
</td>
<td></td>
</tr>
<tr>
<td>Main (new learning) Activity</td>
<td>
<u>Day 1 & 2</u>
Perform some activities on “Equipartitioning”. i.e. Producing equal sized groups (from collections) or pieces (from continuous wholes) as ‘fair shares’ for each of a set of individuals.
Do some multiplicative comparison activities. E.g. The coconut tree is 3 times as tall as the guava tree.
Work out simple ratios from given quantities.
For example, there are 60 boys and 120 girls in a school. So the ratio of boys to girls in the school is $\frac{60}{120} = \frac{1}{2}$ = 1:2 or 1 to 2.

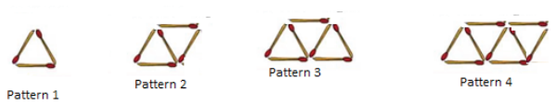
Relate ratios to fractions. E.g. 3:4 can be written in fraction form as $\frac{3}{4}$.
See TRP, pp 29 and LRP, pp 37.
</td>
<td>Graph sheets
TRP, pp 29 and LRP, pp 37.</td>
</tr>
<tr>
<td></td>
<td>
<u>Day 3 & 4</u>
Describe the relstionships between quantities using ratio language and express them as fractions as well.
Example:
<table>
<tr><td>Statement</td><td>Ratio relationship</td><td>Fraction form</td></tr>
<tr><td>In a bag there are two white balls and three blue balls.</td><td>The ratio of white to blue balls is 2:3.</td><td>The white balls are of the total balls in the bag; or the blue balls … etc.</td></tr>
</table>
Work out equivalent ratios of given quantities. E.g.


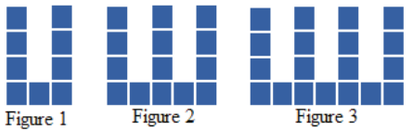
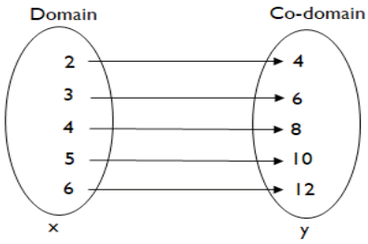
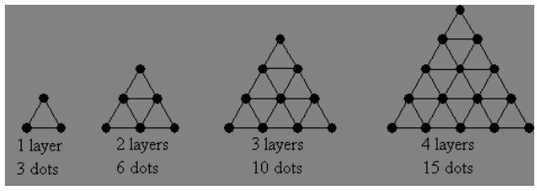
See TRP, pp 29 and LRP, pp 37.
</td>
<td>Worksheets</td>
</tr>
<tr>
<td>Assessment</td>
<td>
<u>Assessment</u>
See assessment tasks in LRP, pp 38.
</td>
<td>Alternatively, worksheet can be downloaded from the internet</td>
</tr>
</table>

Classroom Organisation	***Differentiated learning*** Learners will be put in ability groups during the practice part of the lesson - *Less able (or slow) Learners:* allow them enough time to use diagrams to generate equivalent ratios. Also, give then numbers that are friendlier to use, especially when reducing ratios. - *More able Learners:* Extend the work to reducing ratios mentally. ***Addressing misconceptions*** Refer to TRP, pp 32	
Plenary/Reflections (Learner and teacher 5 minutes	What new things have you learned today? Learning Progress voting: - Ask learners to show by their fingers of 5 or 3 or 1 as to those who "really got it", "got some of it" or "didn't get it" respectively**.** Independent Activity/Homework: - Refer to LRP, pp 31 - Go to the internet and google "ratio worksheet". Download a worksheet on equivalent ratios and complete it.	
Remarks		

MATHEMATICS: Term 1, Week ..... Lesson 10 A

Date: **Time:** 50 Minutes **Class:** B7	**Class size:** 40	**Subject:** MATHEMATICS **Strand:** Algebra **Sub Strand:** Patterns and Relations
Content Standard: B7.2.1.1 Derive the rule for a set of points of a relation, draw a table of values to graph the relation in a number plane and make predictions about subsequent elements of the relation.	**Indicators:** B7.2.1.1.1, B7.2.1.1.2	**References:** TRP B7, pp 34 LRP B7, pp 43
Performance Standard: - Extend given relations symbolically and numerically. - Explain how each element in a given pattern differs from the preceding one. - Describe the rule for a given relation (Use mathematical language such as one more, one less, twice as many as, etc.) - Use a given rule to create and/or extend patterns.		**Core Competencies:** PS, CT, CI, CC, PD, DL
Key words: Relation, mapping, pattern, domain, co-domain, range, rule, corresponding, numerical, Cartesian, symbolically...		

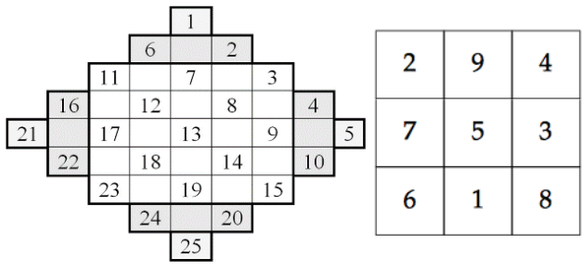
Time	Learner activity	TLMs/Resources
Starter (preparing the brain for learning) 10 minutes	<u>Mental maths games</u> Mental maths games to include: - Skip counting in 5s, 10s, 50s, etc. - Investigate the pattern of numbers in the calendar S M T W T F S 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31	Teacher's Mental Maths Exercises Book (TMMEB) Calendars
	<u>Review and Reinforcement Activities</u> - Review lessons on patterns from primary school. Complete the table below for the number of match sticks used in this geometric pattern  Pattern 1 Pattern 2 Pattern 3 Pattern 4	Match sticks, mathematical sets, coloured beads, number cards,

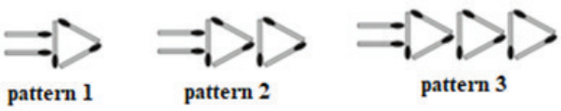
Main (new learning) Activity	Day 1 & 2 Working in small groups or pairs, extend given relations symbolically and numerically, and describe the patterns. For example: The pattern below shows the arrangement of tiles on a wall.  Figure 1 Figure 2 Figure 3 **i.** Draw the next five patterns. **ii.** How many tiles are in the 10th figure? **iii.** Explain how each pattern differs from the preceding one. See TRP, pp 35 and LRP, pp 44	mathematical sets, coloured beads, number cards,
	Day 3 & 4 Investigate the rule for a given pattern and describe it using mathematical language such as one more, one less, twice as many as, etc. For example, the rule for the mapping below cam be described as "y is a double of x".  Extend and create patterns. For example, extend the pattern to the 7th figure. Create a different pattern using dots and describe the rule for your mapping.  See TRP, pp 35 and LRP, pp 44	Match sticks, mathematical sets, coloured beads, number cards,
Assessment	Assessment See assessment tasks in LRP, pp 45	Alternatively, worksheet can be downloaded from the internet
Classroom Organisation	***Differentiated learning*** Learners will be put in ability groups during the practice part of the lesson - *Less able (or slow) Learners:* Avoid patterns involving powers of numbers. - *More able Learners:* Extend work to include powers of numbers. - ***Addressing Misconceptions*** Refer to TRP, pp **40**	

Plenary/Reflections (Learner and teacher 5 minutes	What new things have you learned today? Learning progress voting: - Ask learners to show by their fingers of 5 or 3 or 1 as to those who "really got it", "got some of it" or "didn't get it" respectively. Independent Activity/Homework: - Refer to LRP, pp - Go to the internet and google "pattern worksheet". Download a worksheet on patterns.	
Remarks		

MATHEMATICS: Term 1, Week ..... Lesson 10 B

Date: **Time:** 50 Minutes **Class:** B7	**Class size:** 40	**Subject:** MATHEMATICS **Strand:** Algebra **Sub Strand:** Patterns and Relations
Content Standard: B7.2.1.1 Derive the rule for a set of points of a relation, draw a table of values to graph the relation in a number plane and make predictions about subsequent elements of the relation.	**Indicators:** B7.2.1.1.3, B7.2.1.1.4	**References:** TRP B7, pp 34 LRP B7, pp 43
Performance Standard: - Identify the relation or rule in a pattern/mapping. - Locate points on the number plane. - Draw table of values of a given relation. - Draw graphs for given relations and use it to solve problems.		**Core Competencies:** PS, CT, CI, CC, PD, DL
Key words: Relation, mapping, pattern, domain, co-domain, range, rule, corresponding, numerical, Cartesian, symbolically...		

Time	Learner activity	TLMs/Resources
Starter (preparing the brain for learning) 10 minutes	Mental maths games Mental maths games to include: - Skip counting in 5s, 10s, 50s, etc.	Teacher's Mental Maths Exercises Book (TMMEB
Starter (preparing the brain for learning) 10 minutes	- Investigate the pattern of numbers in magic squares  2 9 4 7 5 3 6 1 8	Teacher's Mental Maths Exercises Book (TMMEB)
	Review and Reinforcement Activities - Review lessons on patterns from previous lessons. - Create simple riddles on numerical patterns. For example: Which number should be added to 32, so the resulting numbers read the same from left-to-right and right-to-left?	

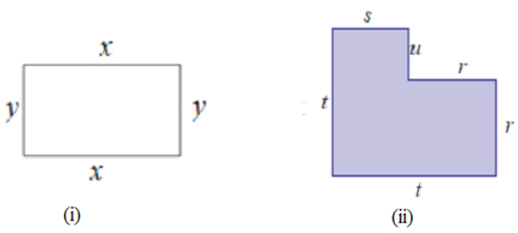
<table>
<tr>
<td>Main (new learning) Activity</td>
<td>
<u>Day 1 & 2</u>
Working in small groups or pairs identify the relation or rule in a pattern/mapping.


<table>
<tr><td>Pattern Number (n)</td><td>1</td><td>2</td><td>3</td><td>4</td><td>n</td></tr>
<tr><td>Number of match sticks</td><td>5</td><td>8</td><td></td><td></td><td></td></tr>
</table>
What is the rule determining the number of match sticks in a pattern?
In pairs draw table of values for a given relation. E.g.
The table shows the weight and cost of meat at Worawora market. If 2kg of meat costs GH¢ 40. Use the information to complete the table.
<table>
<tr><td>Meat (kg)</td><td>0.5</td><td>2</td><td>4</td><td>8</td><td>20</td></tr>
<tr><td>Cost (Gh¢)</td><td></td><td></td><td>80</td><td></td><td></td></tr>
</table>
- See TRP, pp 35 and LRP, pp 44
</td>
<td>Match sticks, mathematical sets, coloured beads, number cards,</td>
</tr>
<tr>
<td></td>
<td>
<u>Day 3 & 4</u>
Working in small groups, locate points on the number plane. Working in small groups, collect data from the class and use it to draw graphs.
Generate problems out of the graph and solve them.
See TRP, pp 35 and LRP, pp 44
</td>
<td>Worksheets
Mathematical sets,</td>
</tr>
<tr>
<td>Assessment</td>
<td>
<u>Assessment</u>
See assessment tasks in LRP, pp 45
</td>
<td>Alternatively, worksheet can be downloaded from the internet</td>
</tr>
<tr>
<td>Classroom Organisation</td>
<td>
Differentiated learning
Learners will be put in ability groups during the practice part of the lesson
- Less able (or slow) Learners: Avoid patterns involving powers of numbers.
- More able Learners: Extend work to include powers of numbers and fractions.

Addressing Misconceptions
Refer to TRP, pp 40
</td>
<td></td>
</tr>
<tr>
<td>Plenary/Reflections (Learner and teacher)
5 minutes</td>
<td>
What new things have you learned today?
Learning Progress voting:
- Ask learners to show by their fingers of 5 or 3 or 1 as to those who “really got it”, “got some of it” or “didn’t get it” respectively.

Independent Activity/Homework:
- Refer to LRP, pp 39
- Go to the internet and google “pattern worksheet”. Download a worksheet on patterns.
</td>
<td></td>
</tr>
<tr>
<td>Remarks</td>
<td></td>
<td></td>
</tr>
</table>

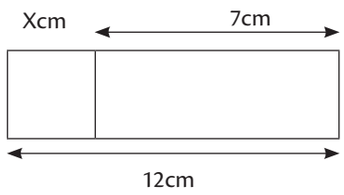
Date: **Time:50** Minutes **Class:** B7	**Class size:** 40	**Subject:** MATHEMATICS **Strand:** Algebra **Sub Strand:** Algebraic Expressions
Content Standard: B7.2.2.1 Simplify algebraic expressions involving the four basic operations and substituting values to evaluate algebraic expressions.	**Indicators:** B7.2.1.1.1, B7.2.1.1.2	**References:** TRP B7, pp 41 LRP B7, pp 52
Performance Standard: - Create simple algebraic expressions. - Add and subtract algebraic expressions with rational coefficients.		**Core Competencies:** PS, CT, CI, CC, PD, DL
Key words: Coefficients, algebraic, expressions, evaluate, Simplify, substitute, etc.		

Time	Learner activity	TLMs/Resources
Starter (preparing the brain for learning) 10 minutes	Mental maths games Mental maths games to include: - Do skip counting forwards and backwards activities in 500s and 5000s.	Teacher's Mental Maths Exercises Book (TMMEB)
	Review and Reinforcement Activities - Review previous knowledge on powers of numbers, addition, subtraction, multiplication and division facts, and finding an unknown in a mathematical problem.	
Main (new learning) Activity	Day 1 & 2 Create simple algebraic expressions from simple real-life situations (working in pairs/groups). Write simple algebraic expressions from given shapes (working in pairs/groups). E.g.  See TRP, pp 42 and LRP, pp 52	mathematical sets, number cards, Worksheets
	Day 3 & 4 Working in pairs, perform simple addition and subtraction of algebraic expressions with rational coefficients. See TRP, pp 42 and LRP, pp 52.	Number lines, Worksheets
Assessment	Assessment See assessment tasks in LRP, pp 53.	Alternatively, worksheet can be downloaded from the internet

Classroom Organisation	***Differentiated learning*** Learners will be put in ability groups during the practice part of the lesson - *Less able (or slow) Learners:* Limit addition and subtraction of algebraic expressions to only whole number coefficients. - *More able Learners:* Extend the work to expressions involving rational coefficients.	
Plenary/Reflections (Learner and teacher 5 minutes	What new things have you learned today? Learning Progress voting: - Ask learners to show by their fingers of 5 or 3 or 1 as to those who "really got it", "got some of it" or "didn't get it" respectively. Independent Activity/Homework: - Draw several shapes and represent the sides with letters and write expressions for them. - Google algebraic expression worksheets from the internet and complete the tasks.	mathematical sets, number cards, Worksheets
Remarks		

MATHEMATICS: Term 1, Week ..... Lesson 11 B

Date: **Time:** 50 Minutes **Class:** B7 **Class size:** 40		**Subject:** MATHEMATICS **Strand:** Algebra **Sub Strand:** Algebraic Expressions
Content Standard: B7.2.2.1 Simplify algebraic expressions involving the four basic operations and substituting values to evaluate algebraic expressions.	**Indicators:** B7.2.1.1.3, B7.2.1.1.4	**References:** TRP B7, pp 41 LRP B7, pp 52
Performance Standard: - Perform multiplication and division of algebraic expressions with rational coefficients. - Substitute values to evaluate algebraic expressions.		**Core Competencies:** PS, CT, CI, CC, PD, DL
Key words: Coefficients, algebraic, expressions, evaluate, Simplify, substitute, etc.		

Time	Learner activity	TLMs/Resources
Starter (preparing the brain for learning) 10 minutes	Mental maths games Mental maths games to include: - Do skip counting forwards and backwards activities in 5s and 10s. - Find the unknown lengths in given diagrams (not drawn to scale)  	Teacher's Mental Maths Exercises Book (TMMEB)
	Review & Reinforcement Activities - Review previous knowledge on powers of numbers, addition, subtraction, multiplication and division facts, and finding an unknown in a mathematical problem.	mathematical sets, number cards,
Main (new learning) Activity	Day 1 & 2 Working in groups, workout some examples on powers of natural numbers. Working in pairs, perform multiplication and division of algebraic expressions with rational coefficients. - Working in pairs, write expressions for finding the area of given shapes. See TRP, pp 42 and LRP, pp 52	Worksheets on powers of numbers.
	Day 3 & 4 Working in pairs, substitute values to evaluate algebraic expressions. E.g.  If $x = 5$ *and* $y = 3$ calculate the perimeter of the shape. See TRP, pp 42 and LRP, pp 52	Worksheets

Assessment	Assessment See assessment tasks in LRP, pp 53	Alternatively, worksheet can be downloaded from the internet
Time	**Learner activity**	**TLMs/Resources**
Classroom Organisation	***Differentiated learning*** Learners will be put in ability groups during the practice part of the lesson - *Less able (or slow) Learners:* Limit multiplication and division of algebraic expressions to only whole number coefficients. - *More able Learners:* Extend the work to expressions involving rational coefficients.	mathematical sets, number cards,
Plenary/Reflections (Learner and teacher 5 minutes	What new things have you learned today? Learning Progress voting: - Ask learners to show by their fingers of 5 or 3 or 1 as to those who "really got it", "got some of it" or "didn't get it" respectively. Independent Activity/Homework: - Google algebraic expression worksheets on multiplication and division from the internet and complete the tasks.	mathematical sets, number cards, Worksheets
Remarks		

MATHEMATICS: Term 1, Week ..... Lesson 12 A

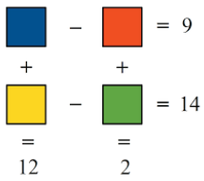
Date: **Time:** 50 Minutes **Class:** B7	**Class size:** 40	**Subject:** MATHEMATICS **Strand:** Algebra **Sub Strand:** Equations
Content Standard: B7.2.3.1 Demonstrate an understanding of linear equations of the form x + a = b (where a and b are integers) by modelling problems as a linear equation and solving the problems concretely, pictorially, and symbolically.	**Indicators:** B7.2.3.1.1, B7.2.3.1.2	**References:** TRP B7, pp 47 LRP B7, pp 58
Performance Standard: - Translate word problems to linear equations in one variable. - Translate linear equations in one variable into word problems. - Model linear equations using concrete materials. - Describe linear equations process orally and symbolically.		**Core Competencies:** PS, CT, CI, CC, PD, DL
Key words: Linear, equations, variable, etc.		

Time	Learner activity	TLMs/Resources
Starter (preparing the brain for learning) 10 minutes	Mental maths games Mental maths games to include: - Do skip counting forwards and backwards activities in 5s and 10s. - Perform some missing value activities mentally. ● + ● + ● = 60 ● + ♦ + ♦ = 40 ♦ + △ + △ = 20 ● + ♦ × △ = ?	Teacher's Mental Maths Exercises Book (TMMEB)
	Review and Reinforcement Activities - Review your knowledge on addition, subtraction, multiplication and division facts. - Also, review your knowledge of finding the unknown from primary school.	counters and integer tiles
Main (new learning) Activity	Day 1 & 2 In small groups, work on changing simple word problems into linear equations in one variable. In pairs, write your own word problems and its corresponding mathematical statement. With a partner, translate linear equations in one variable into word problems. Write your own simple linear equations for your partner to translate it into word problems. See TRP, pp 49 and LRP, pp 60.	Worksheets

	Day 3 & 4 In small groups, write simple linear equations and model them using concrete materials such as counters, straws of different colours, playing cards, etc. Make simple illustration to model linear equations. Work with a partner to describe linear equations process orally, then your partner models the equation symbolically. See TRP, pp 49 and LRP, pp 60.	Worksheets counters, straws of different colours, playing cards, etc.
Assessment	Assessment See assessment tasks in LRP, pp 50.	Alternatively, worksheet can be downloaded from the internet
Classroom Organisation	***Differentiated learning*** Learners will be put in ability groups during the practice part of the lesson - *Less able (or slow) Learners:* limit equations to whole number coefficients. - *More able Learners:* Extend equations to include rational coefficients.	counters, straws of different colours, playing cards, etc.
Plenary/Reflections (Learner and teacher 5 minutes	What new things have you learned today? Learning Progress voting: - Ask learners to show by their fingers of 5 or 3 or 1 as to those who "really got it", "got some of it" or "didn't get it" respectively**.** Independent Activity/Homework: - Google worksheets on linear equations in one variable from the internet and complete the tasks.	
Remarks		

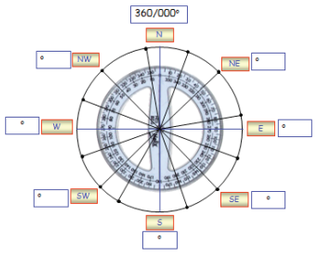
MATHEMATICS: Term 1, Week ..... Lesson 12 B

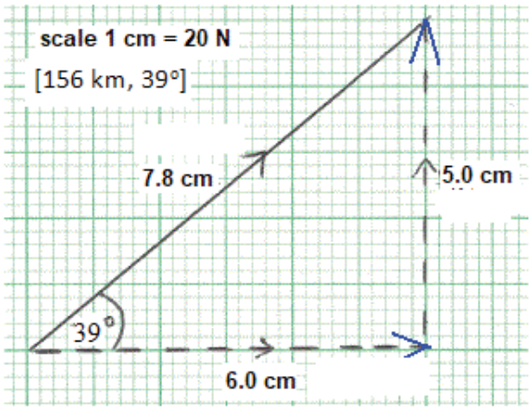
Date: **Time:** 50 Minutes **Class:** B7 **Class size:** 40		**Subject:** MATHEMATICS **Strand:** Algebra **Sub Strand:** Equations
Content Standard: B7.2.3.1 Demonstrate an understanding of linear equations of the form x + a = b (where a and b are integers) by modelling problems as a linear equation and solving the problems concretely, pictorially, and symbolically.	**Indicators:** B7.2.3.1.3, B7.2.3.1.4	**References:** TRP B7, pp 47 LRP B7, pp 58
Performance Standard: - Model linear equations, then write mathematical expression and describe the process of solving the equation. - Solve linear equations in one variable.		**Core Competencies:** PS, CT, CI, CC, PD, DL
Key words: Linear, equations, variable, etc.		

Time	Learner activity	TLMs/Resources
Starter (preparing the brain for learning) 10 minutes	Mental maths games Mental maths games to include: - Do skip counting forwards and backwards activities in 5s and 10s. - Perform some missing value activities mentally.  	Teacher's Mental Maths Exercises Book (TMMEB)
	Review and Reinforcement Activities - Review your knowledge on linear equations. - Write some simple linear equations for a partner to model and vice versa.	counters and integer tiles
Main (new learning) Activity	Day 1 & 2 Working with a partner, model linear equations for your partner to write mathematical expression and vice versa. Together, describe the process of solving the equation. Where different ways can be used, share with your partner and try it out. See TRP, pp 49 and LRP, pp 60 .	worksheets
	Day 3 & 4 In small groups, solve linear equations in one variable. Write simple linear equation for a partner to solve and vice versa. Discuss the solution together. - See TRP, pp 49 and LRP, pp 60	Number lines, Worksheets
Assessment	Assessment See assessment tasks in LRP, pp 59.	Alternatively, worksheet can be downloaded from the internet

Classroom Organisation	***Differentiated learning*** Learners will be put in ability groups during the practice part of the lesson - *Less able (or slow) Learners:* limit equations to whole number coefficients. - *More able Learners:* Extend equations to include rational coefficients.	counters, straws of different colours, playing cards, etc.
Time	**Learner activity**	**TLMs/Resources**
Plenary/Reflections (Learner and teacher 5 minutes	What new things have you learned today? Learning Progress voting: - Ask learners to show by their fingers of 5 or 3 or 1 as to those who "really got it", "got some of it" or "didn't get it" respectively**.** Independent Activity/Homework: - Write simple linear equations and solve them. - Google worksheets on linear equations in one variable from the internet and complete the tasks. - See TRP, pp 50 and LRP, pp 59.	counters, straws of different colours, playing cards, etc.
Remarks		

Date: **Time:** 50 Minutes **Class:** B7 **Class size:** 38		**Subject:** MATHEMATICS **Strand:** Geometry and Measurement **Sub Strand:** Bearings and Vectors
Content Standard: B7.3.2.3 Demonstrate understanding of bearings, vector and its components using real life cases	**Indicators:** B7.3.2.3.1; B7.3.2.3.2; B7.3.2.3.4;	**References:** Maths B7 TRP[9], pp 19-21, Maths B7 LRP, pp 22-25
Performance Standard: - Describe the bearing of a point from another point and find the back bearing - Represent vector in the column (component) form $\begin{pmatrix} x \\ y \end{pmatrix}$ and determine its magnitude and direction		**Core Competencies:** PS, CT, CI, CC, PD, DL
Key words: bearing, direction, whole circle bearing, cardinal points, back bearing, vector, scalar, component, magnitude		

Time	Learner activity	TLMs/Resources
Starter (preparing the brain for learning)	Mental maths games Mental maths games to include: - number facts involving the four basic operations and fractions - basic numeracy application problems involving the four basic operations - place value questions up to 1,0000,000; - geometry questions based around 2D and 3D shape properties; - measures problems	Teacher's Mental Maths Exercises Book (TMMEB)
	Review and Reinforcement Activities Review the cardinal points. Use a protractor to measure the size of angles from North to East, East to South, South to West, and West to North (working in pairs/groups). Complete the exercises in Worksheet B7.17, Activity A1, LRP pp84-85.	LRP Worksheet B7.17, Activity A1, pp84-85
Main (new learning) Activity	Day 1 & 2 **Finding bearings of one point from another**. Give learners in groups an enlarged photocopy of the figure and ask them to **use protractor to measure the bearing** of each point from the centre of the circle and complete the boxes. (see LRP Activity A1 and B, pp 84-85).  Ask learners in groups to **read the bearings from to given points**. (Ask learners in groups to do the exercises on page 85 of the learner resource and present findings to class) E.g. On what bearing is a ship sailing if it is heading east? What is the back bearing (or reciprocal) bearing to 30°	Protractors Worksheet B7.17, Activity A1 and B; Can add exercises from current textbooks, or worksheets from the internet Make links/references to some content standards in Social Studies e.g. reading directions and drawing plans
Time	**Learner Activity**	**TLMs/Resources**

	Day 3 **Finding bearings and back bearings** of one point from another. Ask learners in groups to do the exercises on page 85 of the learner resource and present findings to class. Learners use protractor to measure marked angles, **describing the bearing of the object from point N and finding bearings and back bearings** of one point from another.  E.g. On what bearing is a ship sailing if it is heading east? What is the back bearing (or reciprocal) bearing to 30°	Worksheet B7.17, Activity D; Can add exercises from current textbooks, or worksheets from the internet
	Day 4 Using an appropriate scale to **draw given vectors using a ruler and protractor**; e.g. $\overrightarrow{AB}$= (3km, 045). Use a scale of 2 cm : 1 km to draw given vectors on graph sheets and write their column vector. **Find the magnitude and the direction of given vectors**; e.g. $\overrightarrow{AB}=\begin{pmatrix}10\\15\end{pmatrix}$ using a scale of 1 cm:1 km ; Ask learners in groups to do the exercises on page 86 of the learner resource and present findings to class  	Worksheet B7.17, Activity E; Can add exercises from current textbooks, or worksheets from the internet
Classroom Organisation	Learners will be put in ability groups during the practice part of the lesson. Encourage communication, collaboration, time for critical thinking and problem solving. Arrange the classroom in such a way that it is attractive, well-organised, safe and adapted to group work conditions. Read direction of locations with Compass Apps to enhance their digital literacy.	
Assessment	Assessment See assessment tasks in LRP, pp 86	

11 TRP is Teacher Resource Pack and LRP is Learner Resource Pack

12 This is an exercise book the mathematics teacher is expected to keep for setting Mental Maths Exercises for learners. In addition to the lesson plan, it is helpful to keep a Teacher's Mental Maths Exercises Book (TMMEB) in which the teacher prepares and keeps mental exercises. Such exercises are either read or written on the board for learners to do in their mental exercise books. Written and/or aural mental exercises should be done in learners' exercises books at least twice each week.

Plenary/ Reflections (Learner and teacher	Do a recap of the lesson.. Learning Progress voting: Discuss Independent Activity/Homework: See LRP pp 86.	
Remarks		

MATHEMATICS: Term 1, Week ..... Lesson 19 A

Date: **Time: 50 minutes** **Class: B7** **Class size: 40**		**Subject:** MATHEMATICS **Strand:** Handling Data **Sub Strand:** Data
Content Standard: B7.4.1.1 Select, justify, and use appropriate methods to collect data (quantitative and qualitative), display and analyse the data (grouped/ungrouped) presented in frequency tables, line graphs, pie graphs, bar graphs or pictographs and use these to solve and/or pose problems	**Indicators** B7.4.1.1.1; B7.4.1.1.2; B7.4.1.1.3	**References:** Maths B7 CC Curriculum Maths B7 TRP[11], pp 73-76 Maths B7 LRP, pp 94-96
Performance Standard: - Choose the most appropriate method to collect data to solve a given *simple* problem/to take a decision - Design and administer a questionnaire/survey form to collect the data - Organise and present data using frequency tables, bar graphs and pie charts as appropriate and use observed patterns to make decisions or solve problems		**Core Competencies:** CP, CC, DL
Key words: design, administer questionnaire, interview, observation, experiments, survey, pie charts		

Time	Learner activity	TLMs/Resources
Starter (preparing the brain for learning)	Mental maths games - Addition Strategies: Put additions on board of two-digit numbers, where one number is close to a multiple of 10. Have learners solve addition by "moving a quantity from one number to other" and explain what they did - Interpreting Pictographs - Interpreting Bar Graphs	Teacher's Mental Maths Exercises Book (TMMEB)
	Review and Reinforcement Activities - Determining whether a given set of data can be represented by a line graph (continuous data) or a series of points (discrete data) and explain why - Complete the exercise on Assessment Task in Worksheet B7.19, LRP	
Main (new learning) Activity	Day 1 Selecting and justifying the appropriate method for data collection In small groups, learners discuss and write down for example, how they would make decisions in the following situations, what facts they would take into account and how they would collect these 'facts/data: **a.** The type of drinks to buy for a class party. **b.** The make of football boots to buy for the school team **c.** Are people who eat more fufu develop pot belly? Have each group present their discussions on a flip chart, organised under the underlined text in (1), for justification and further discussion.	

Time	Learner activity	TLMs/Resources
	Day 2 and 3 Have each group identify a method it will use to collect the required data and paste its decision on a wall or hang them on ropes across the classroom. Have learners go around to read the methods identified by other groups. At plenary, lead a discussion on methods for the collection of data. Relate the methods to those identified by learners to enable them appreciate the appropriate methods to be used.	Ref.: B7.4.1.1.1- of CC Curriculum
	Day 4 Have each group design a Class Survey Form for the collection of the data and a suitable table for organizing the data Have two or three learners administer the Class Survey Form for each class in the school. Learners present data from the survey in frequency tables, appropriate chart/graph, and analyse it and write their conclusion as appropriate.	Ref: LRP - WORKSHEET B7.19 (A, B C)
Classroom Organisation	Learners will be put in mixed ability groups during the group work, discussions and organisation of collected data. Encourage communication, collaboration, time for critical thinking and problem solving,	
Assessment	Assessment See assessment tasks in LRP, pp 96	
Plenary/Reflections (Learner and teacher	Do a recap of the lesson.. Learning Progress: Thumb up/down (or any other appropriate voting e.g. secret voting and filling a form with smileys) Discuss Independent Activity/Homework: See LRP pp	
Remarks		

Date: **Time: 50 minutes** **Class: B7**	**Class size: 40**	**Subject:** MATHEMATICS **Strand:** Handling Data **Sub Strand:** Data
Content Standard: **B7.4.1.2 Determine measures of central tendency *(a representative value)* - (mean, median, mode) for a given ungrouped data and use it to solve problems**	**Indicators** B7.4.1.2.1; B7.4.1.2.2 B7.4.1.2.3	**References:** Maths B7 CC Curriculum Maths B7 TRP[13], pp 77-80 Maths B7 LRP, pp 97-103
Performance Standard: - Calculate the mean, median and mode of a given ungrouped data set and use it to solve problems - Know when to use either the mean, median or mode in a given situation		**Core Competencies:** CP, CC,
Key words: mean/average, median, mode, ordered set of data (array), data point, frequency		

Time	Learner activity	TLMs/Resources
Starter (preparing the brain for learning)	Mental maths games - Put additions up to 100 on board, where one number is close to multiple of 10 (e.g.: 49 + 57). Have learners use "Making 10s" to find the answer mentally and explain what they did - Subtraction Strategies: Put subtractions up to 1000, where the second number is close to a multiple of 10, which can be solved by constant difference (adding or subtracting the same amount from both numbers.). Have learners use the strategy to find the answer mentally and explain what they did.	Teacher's Mental Maths Exercises Book (TMMEB)
	- Estimating Sums or Differences: Place addition and subtraction, with estimates on the board. Say: "I want you to look at the addition and subtraction and tell me which of the three estimates against the question is closest to the answer. Then tell me why the number you have chosen is the best estimate" *[NOTE: Give learners not more than 5 seconds per question then remove the question and place next question on the board.]* E.g. -	
	Review and Reinforcement Activities - Number and Number operations (ordering a set of numbers from the least to the greatest, addition, division). - Review the concept of data set using real life examples (marks obtained by learners in a test; surveys; ages of each member of their families; weight of learners in the class; etc.). - Smoothing the bars of the original data set to obtain a value that appropriately represent the data set.)	Ref.; TRP Lesson B7.19 pp 78
Time	**Learner activity**	**TLMs/Resources**

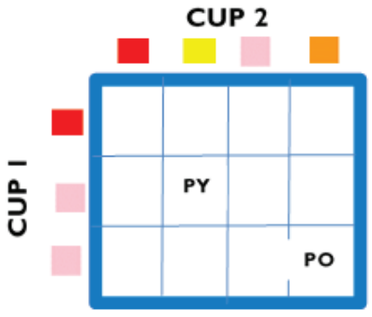
Main (new learning) Activity	Day 1 Explore the **mean (average)** of a data set as a balance point or a fair share. E.g. learners pick six cards on from a bag with marks obtained by learners recorded on them. 8 | 9 | 7 | 6 | 8 | 10 **i.** Arrange the data points as follows: 6 7 8 8 9 10 **ii.** Observe the difference between each data point **iii.** Have learners suggest where the balance point would be: "8" **iv.** Modify the activity to drive home the conceptual understanding of the mean before introducing the procedural/computational approach – sum of data points divided by number of data points	Materials: Decks of playing cards; paper stickers; pen and markers Modify activities with real life examples to best meet the needs of learners.
	Day 2 Review exploring the mean (average) of the data set in Day 1 as a fair share using pavement blocks. 	
	Introduction of the procedural/computational approach – sum of data points divided by number of data points.	
	Day 3 Learners individually or in groups 2 or 3 explore the median as the middle value when a data set (of **odd** number of data points) is ordered from least to greatest. Learners individually or in groups f 2 or 3 explore the median as the middle value when a data set (of **even** number of data points) is ordered from least to greatest. Learners should exhibit their answers and explain the method used whether the answer is correct or wrong.	LRP Worksheet B7.20 Ref.: TRP pp 79-80 LRP pp
	Day 4 Learners individually or in groups 2 or 3 explore the mode as the date point in a data set that occurs most often. [NOTE: the mode is the value in the data set that occurs most often and not just the number of times it occurs. Some data sets may not have a mode. It is also possible for a data set to have more than one mode] Learners should exhibit their answers and explain the method used whether the answer is correct or wrong Refer to page 80 for examples on the NOTE	

15 TRP is Teacher Resource Pack and LRP is Learner Resource Pack.

16 This is an exercise book the mathematics teacher is expected to keep for setting Mental Maths Exercises for learners. In addition to the lesson plan, it is helpful to keep a Teacher's Mental Maths Exercises Book (TMMEB) in which the teacher prepares and keeps mental exercises. Such exercises are either read or written on the board for learners to do in their mental exercise books. Written and/or aural mental exercises should be done in learners' exercises books at least twice each week.

Classroom Organisation	Learners can work individually or in groups of two or three. Learners will be put in mixed ability groups during the group work, and discussions. Encourage communication, collaboration, time for critical thinking and problem solving.	
Time	**Learner activity**	**TLMs/Resources**
Assessment	Assessment See assessment tasks in LRP, pp 101 Homework in LRP, pp 103	
Plenary/Reflections (Learner and teacher	Do a recap of the lesson. Learning Progress: Thumb up/down (or any other appropriate voting e.g. secret voting and filling a form with smileys) Discuss Independent Activity/Homework: See LRP pp 102-103	
Remarks		

Date: **Time: 50 minutes** **Class: B7**	**Class size: 40**	**Subject:** MATHEMATICS **Strand:** Handling Data **Sub Strand:** Data
Content Standard: B7.4.2.1 Identify the sample space for a probability experiment involving single events and express the probabilities of given events as fractions, decimals, percentages and/or ratios to solve problems	**Indicators** B7.4.2.1.1; B7.4.2.1.2 , B7.4.2.1.3	**References:** Maths B7 CC Curriculum Maths B7 TRP[15], pp 82-85 Maths B7 LRP, pp 104-107
Performance Standard: - Determine when an event is impossible, possible, or certain. - Calculate simple probabilities and express the probabilities of given events as fractions, decimals, percentages and/or ratios to solve problems		**Core Competencies:** CP; CC; PL
Key words: impossible, possible, and certain events, sample space, probability experiments, random		

Time	Learner activity	TLMs/Resources
Starter (preparing the brain for learning)	Mental maths games **1.** Play "representing fractions as decimals, percentages and ratios" Pull out simple fractions flash cards which could be express as decimals, percentages and ratios. Tell learner, "I will show you a fraction flash card. Tell me its equivalent in decimals" Continue the game with as many learners as time will allow in a period. You may prepare decimals, percentages and ratios flash cards and request for their equivalence to enrich the game.	Teacher's Mental Maths Exercises Book (TMMEB) Fractions, Decimals, Percentages and Ratios Flash cards
	2. Prepare a model 3 by 4 matrix on a manila card as shown below. Put the model on the board and call learners, one at a time, to complete the model.  - Say "Tell me the chance or probability of ... i. P(RO) ii. P(PY) iii. P(OO) iv. P(at least one P) i.e. one pink v. P(no Y) i.e. no yellow vi. Is it reasonable to assume that orange is the least popular colour based on sample size and the result of this model?	Masking Tape; Markers; Coloured pieces of cardboards (red, pink, yellow, orange, etc.); two shallow plastic cups for the pieces of cardboards.
Time	**Learner activity**	**TLMs/Resources**

	Review and Reinforcement Activities - Difference and relationship between theoretical probability and experimental probability. - Predicting the probability of a given outcome occurring for a given probability experiment by using theoretical probability. - Calculating the probability of simple events and moving onto higher level questions as appropriate	Ref.; B6.4.2.2 pp 192-195;
Main (new learning) Activity	Day 1 Certainty or otherwise of an event occurring. **1.** Learners discuss, in groups of 5 or 7, certainty or otherwise of the following events occurring and record their decisions on A4 sheets under the headings "**impossible"; "possible"; and "certain**" i. *The dog will fly tomorrow* ii. *Someone in the class would be a teacher in the future* iii. *Ghana will still be an African Country tomorrow* **2.** Say "each group should paste its sheet on the wall/hang on ropes" as appropriate **3.** Groups should walk around read other groups work before plenary session. **4.** Lead a discussion at plenary to enable learners justify their choices and conceptually understand the terms ***"impossible"; "possible"; and "certain***	Ref.: LRP pp 105 TRP pp 83-84
	Day 2 Learners move on to higher level events/statements as appropriate Learners work in groups to discuss the outcome of the following events using words like: impossible, possible, or certain i. A coin lands Heads side up. ii. The day after Monday will be Tuesday. iii. A new born baby will be a girl. iv. It will rain in Winneba in the first week of January. Learners work on further examples and complete '**B'** of Worksheet **B7.21**	Ref.: LRP pp 105 TRP pp 83-84
	Day 3 and 4 **1.** Learners work on further examples and complete '**A** 'and **C** of Worksheet **B7.21**	LRP pp 105-106
Classroom Organisation	Learners will be put in mixed ability groups during the group work, and discussions. Encourage communication, collaboration, time for critical thinking and problem solving.	
Assessment	Assessment See assessment tasks in LRP, pp 107 Homework: Learners explore and state events in real-life situations that are impossible, possible, or certain and justify your choice	
Plenary/ Reflections (Learner and teacher	Recap the lesson. Learning Progress: Thumb up/down (or any other appropriate voting e.g. secret voting and filling a form with smileys) Discuss Independent Activity/Homework: See TRP pp 84	
Remarks		

APPENDICES

Appendix A: GUIDELINES FOR THE FORMATION OF PROFESSIONAL LEARNING COMMUNITIES (PLCs)

The National Council for Curriculum and Assessment (NaCCA), as part of the strategies for an effective implementation of the Common Core Programme Curriculum for Basic 7 (JHS1) – Basic 10 (SHS1) has come out with guidelines for the formation of Professional Learning Communities (PLCs).

FORMATION OF PROFESSIONAL LEARNING COMMUNITIES (PLCs)

The focus of education in recent times has been on *transformation.* Currently, most countries are shifting from block scheduling to tele-collaborative projects, from discovery learning to authentic assessment, etc. In realising these transformation agenda, new ideas for efficient education delivery and best performance attainment levels come and fade away or metamorphose into other models. One of these is the concept of Professional Learning Communities (PLCs). This has taken the central stage in most advanced countries in their quest for making education delivery robust and responsive in meeting their developmental needs. Ghana is no exception.

An article published by *Glossary of Education Reform* describes the professional learning community (PLC), as a group of educators that meets regularly, shares expertise, and works collaboratively to improve teaching skills and the academic performance of learners." According to Hord (1997b), "professional learning community is seen as a powerful staff-development approach and a potent strategy for school change and improvement." A PLC is a learning approach where teachers are activated as learning resources.

Generally, PLCs are considered as collegial groups of administrators and school staff who are united and committed to learners' learning. They function as an effective strategy for building school capacity around core issues of teaching and learning (Darling-Hammond, 1995). They serve as a mechanism to transform school culture. In other words, PLCs connect teachers with information, strategies, and best practices.

How is PLC formed?

- The head-teacher through consultation with his/her teachers and the major stakeholders (PTA, SMC, school improvement support officer (SISO), the education directorate, etc.) puts a committee in place.
- The committee is headed by a ***curriculum lead*** who must be a staff of the school.

What are the terms of reference of the committee?

The PLC in consultation with the entire membership and other stakeholders:

- agrees on the PLC session (or meeting) schedules for the term;
- identifies for PLC sessions, individual challenges in effective lesson delivery and innovative practices in teaching;
- creates common platform for members to share ideas, skills, knowledge and experiences;
- Identifies and invites facilitators for each session;
- Ensures that the focus of the school is changed from teaching to learning;

- Sets SMART goals for best practices in the school to meet expected performance outcomes and targets;
- collates data on all issues that relate to teaching and learning in the school for informed decisions;
- keeps records of attendance of members during PLC meetings;
- considers ways of changing the school's climate positively;
- plans and shares best practice lessons and integrated cross-curricular projects to all staff;
- creates a database on learner achievement scores that guides decisions for interventions;
- reviews and reflects on school data to plan instruction across the school curricular;
- considers extra-curricular experiences for learners.

What are some Characteristics of an Effective PLC?

- Shares values and norms.
- Creates time for collaborative work.
- Focuses collectively on learner's learning.
- Encourages collaborative work by creating common work spaces using proximity.
- Ensures leadership support for all PLC activities – school heads must be supportive.
- Respects and trusts one another.

What are the Guidelines for PLC's Activities?

- PLCs should be conducted once every week.
- The session should be for a minimum of one hour and should be set as the last hour of the day.
- The head of school will take the lead role.
- Roles should be assigned to encourage participation.
- The activities must focus on the Common Core Programme (CCP) Subjects-Curricula.
- The agenda for the next meeting should be developed at the end of each meeting for participants to prepare adequately for effective participation.

The minutes for each meeting should be made available after each session and sent to the regional PLC platform for headquarters' validation. The platform will be made up of the following officers from the Metropolitan, Municipal, District and Regional level:

- Training Officers
- Supervision and Monitoring (S&M) Officers
- Basic School Coordinators
- Heads of School
- School Improvement Support Officers (SISOs)
- Curriculum Leads

NB: PLC sessions should be conducted from the second week of the term through to revision week.

Who are the Key Actors in the PLC?

- District Education Oversight Committee (DEOC)
- MMD Director of Education
- MMD Head of Monitoring and Supervision,
- School Improvement Support Officer (SISO)
- Head of School
- Curriculum Lead
- JHS and SHS subject teachers

MMD Education Oversight Committee

- Validates the PLC programmes
- Develops guidelines for the effective implementation of all PLC programmes in the MMD
- Provides a supervisory role for the MMD Education Office in the performance of duties relating to PLC programmes and activities.

MMD Director of Education

- Approves the calendar for the integration of PLC activities into MMD plan
- Provides overall leadership and supervision of all PLC activities in the MMD and assigns targeted roles and responsibilities to subordinates.

MMD Supervision and Monitoring Officer

- Develops, in collaboration with DDE and School Improvement Support Officers (SISOs), a plan for monitoring Fidelity of Implementation (FOI) initiative and the overall evaluation of the success of the PLC initiative.
- Reviews (with support from SISOs) monitoring, evaluation & fidelity of implementation data for each term and implement needed changes. In consultation with the DDE, select/recruit curriculum leads for the PLC for each school.

School Improvement Support Officer (SISO)

- Participates in the selection/recruitment of curriculum leads for the schools.
- Collects, collates, and submits to the MMDEO M&E and FOI data (nature of data and regularity of collection and reporting to be determined by GES in consultation with NaCCA).
- Identifies the training needs of the heads of schools and subject-teachers in partnership with the MMD Training Officer.
- Trains the heads of schools and curriculum leads and refers matters relating to attitudes and behaviours that are detrimental or advantageous to the intervention to the MMD Head of Monitoring and Supervision for moderation, share/promote the experiences of the various interventions among schools under his supervision.

Head of School

- Attends initial training on PLC programme
- Ensures the support of the School-based Management Committee (SMC), Parents-Teacher Association (PTA) and other stakeholders for the PLC programmes.
- Ensures the active participation of all teachers during PLC Sessions, as well as the implementation of innovative lesson-delivery strategies and best practices discussed at PLC meetings.
- Identifies and puts in place measures to acknowledge teachers who make an effort to implement best practices discussed at PLC meetings.
- Puts in place measures to monitor and report on learners' progress concerning performance indicators and established national performance standards.
- Adopts the FOI of learning for accountability.

JHS and SHS Subject Teachers

- Participate actively in all PLC Sessions (activities and programmes).
- Follow the revised CCP Curriculum, prepare scheme of learning and lesson plans/notes according to specification and keep track of challenges or difficulties encountered.
- Try out new teaching activities, strategies and practices discussed during PLC Sessions.
- Share challenges and successes with teaching colleagues in future PLC meetings.

How Do We Conduct an Effective PLC Session?

Pre-Discussion

- Register and introduce participants and key facilitators if any.
- Nominate a PLC secretary to take note of discussion points.
- Identify and discuss challenging themes, i.e. themes evolving from the CCP Curriculum training and implementation.
- Identify and invite an expert or colleague with in-depth knowledge of the theme

identified to facilitate a PLC session or lead the discussions.

- Assign specific themes to different teachers (members of the PLC) to research and lead future PLC sessions.
- Encourage mutual discussions and contributions by all members.

Discussion stage (action)

- The lead facilitator takes participants through the content and demonstration lessons (where applicable) associated with the theme.
- Facilitation should be participatory, engaging and interactive.

Post-Discussion Stage

- At this stage participants evaluate the content and demonstration lesson learnt and assess the extent of improvement through reflection and debriefing.
- The agenda for the next meeting should be developed (or agreed upon) at the end of each meeting for participants and the PLC lead to prepare adequately for effective participation.
- Participants are expected to improve on their daily teaching skills through leading questions.
- Participants are encouraged to use group platforms strictly dedicated to PLC for professional learning and providing colleagues with useful professional materials.

Who Monitors the Activities of PLC?

- The Ghana Education Service (GES)
  - Headteacher
  - Circuit Supervisor
  - MMD Monitoring Officers
  - Regional Monitoring Officer
- National Inspectorate Board (NIB)
- National Teaching Council (NTC)
- National Council for Curriculum and Assessment (NaCCA)

http://www.allthingsplc.info/
http://www.sedl.org/pubs/change34/2.html
http://www.inspiringteachers.com

CONTINUOUS PROFESSIONAL DEVELOPMENT DAY (CPDD) FOR JHS BEGINNING 2020/21 ACADEMIC YEAR

Teachers in the Public JHS shall observe a Continuous Professional Development Day beginning 2020/21 Academic Year.

The observation of the CPDD shall help the teachers (facilitators) develop and/or adopt new strategies for teaching which will help them overcome identified challenges in their day to day activities as teachers (facilitators). Continuous Professional Development is in two folds:

1. **Professional Learning Communities (PLCs)**

   PLC, as explained earlier, is a group of educators and other stakeholders who meet regularly to share expert knowledge, skills and experiences for the improvement in the performance of learners, through effective lesson delivery and assessment. PLCs serve as an innovative mechanism for transforming the learning culture and social environment of the school. It connects and equips teachers from not only the same school, but from other schools within or outside the geographical location with information, learning and teaching strategies and best practices.

   About 50 minutes (one period of co-curricular activities) has been assigned to PLC activities every week on the school's timetable. It can be organised at the cluster or circuit level as well as subject-based. On PLC days, learners will close and go home while teachers meet at PLC sessions to learn and share ideas, concepts, skills, knowledge, and experiences to upgrade and improve themselves.

2. **Continuous Professional Development Days (CPDDs)**

   This will be organised once every quarter – 4 times a year. On these days, learners will be given a holiday to stay at home. Teachers will have a full training day to update their content knowledge, sharpen

their lesson delivery and pedagogical skills, as well as share experiences and best practices – leadership for learning, conducive social environment, sustainable learning concepts, etc.

Appendix B: DESIGNING SCHOOL-BASED TIMETABLES

A **school timetable** is a table for regulating and coordinating activities of the learners, teacher and school. Timetables are cyclical. These activities recur every week or every fortnight (in cases of shift schools).

The timetable for the Common Core Programme (CCP) Curriculum to be rolled out in the 2020/21 academic year has the following characteristics.

1. **Proposed Contact Hours (Time on Task)**

Number of periods per day:	8 periods
Number of periods per week:	40 periods (8 periods × 5days)
Duration per period:	50 minutes

2. **Length of School Day**

Time on Task:	400 minutes (50 minutes x 8 periods)
Break Time	60 minutes (two breaks at 30 minutes each)
Extra-curricular activities	50 minutes per day
Total length of school day	510 minutes (8.5 hours)

3. **Proposed options for Length of School Day**

S/No	Lessons Start	Lessons Close	Extra-Curricula
1	7.00am	2.40pm	2.40pm – 3.30pm
2	7.30am	3.10pm	3.10pm – 4.00pm
3	8.00am	3.40pm	3.40pm – 4.30pm

4. **Proposed Co-Curricular Activities**

- Life and Psychosocial Skills:
  - *Sports and Games*
  - *Tourism, Arts and Culture Club*
  - *STEM Club*
  - *Creative Writers/Debaters Club*
  - *Human Rights Club*
  - *Friends of the Earth Club*
  - *NGO Activities: Talks and Sensitisation etc.*
- Research, Science, Agriculture (Gardening) and Community Project
- Entrepreneurship Development, Guidance and Counselling.
- Library, Sustainable Learning and Study Skills
- Professional Learning Community (PLC), CPD and School/Cluster-based INSET

5. **Period Allocations for Subjects**

Subject	**No. of Periods**
Mathematics	4
English	4
Ghanaian Languages	3
French/Arabic	3
Science	4
Computing	3
Social Studies	3
Religious and Moral Education	3
Career Technology	4
Creative Arts and Design	4
Physical Education	3
Worship and Library Studies	2
TOTAL	**40**

Timetable Template

	30m	1 50m	2 50m	**B1** 30m	3 50m	4 50m	5 50m	6 50m	**B2** 30m	7 50m	8 50m	Co-Curricular
M	**ASSEMBLY & REG**			**BREAK**					**BREAK**			
T												
W												
T												
F												

- **Things to consider when populating the Timetable**

  In populating the template to develop a school-based community friendly timetable, the officer should consider the following:

  - Local dynamics – average walking distance from home to school.
  - Socio-cultural and economic activities etc. within the community.
  - If possible, the periods for Mathematics and the languages should be completed before lunch.
  - Activity-based lessons such as Computing, Career Technology, and Creative Arts and Design can be organised after lunch.
  - PLC should be allocated one of the 5 slots for co-curricular activities.

For further inquiries contact
National Council for Curriculum and Assessment (NaCCA)
Tel. No. +233 302 909 071
Email: info@nacca.gov.gh
Website: www.nacca.org.gh

Appendix C: Assessment in the CCP Curriculum

The ultimate goal of Assessment is to improve Learner's learning

[This document was prepared by the Assessment Unit of NaCCA led by Antwi Aning]

Introduction: What is Assessment?

Assessment is the process of collecting information or evidence of learning and achievements and using it to improve teaching and learning. It is about getting to know our learners and the quality of their learning. It is an ongoing process for gathering evidence of learning and using it to enhance learners' learning.

Why assess learners in our classrooms?

Assessment is the bridge between teaching and learning and the central process in effective instruction.

Generally, we assess to find out:

- what learners know
- what learners can do, and how well they can do it
- improve learners' learning
- gather evidence of learning
- inform instruction
- yield information about areas of weakness and problems of teaching and learning
- show the strength and weaknesses of learners
- identify individual differences and achievement gaps among learners
- assist teachers in the process of remediation.
- determine whether expected outcomes have been met

The CCP curriculum will be assessed both formatively and summatively but the outcome of both assessments will be used to move learning forward.

Formative Assessment

Formative Assessment is a concept which covers various approaches for using assessment to improve learners' learning. Two of such approaches are assessment **for** learning and assessment **as** learning**.** Formative assessment deals with finding out on day-to-day basis, information about learners' progress and difficulties so that immediate measures can be taken.

Any instructional activity that allows teachers to uncover the way learners think about what is being taught and which can be used to promote improvements in learners' learning can serve a formative purpose. Formative Assessment supports learning during the learning process.

Characteristics of Effective Formative Assessment

- Clarifying, understanding, and sharing learning goals and criteria for success with learners.
- Creating effective classroom discussions, questions, activities, and tasks that offer the right type of evidence of how learners are progressing to the agreed learning goals.
- Providing feedback that moves learners forward.
- Activating learners as learning resources for one another.
- Activating learners as owners of their own learning.
- Using varied instructional methods to meet diverse learner's needs.
- Using varied approaches to assessing learner's understanding.

(Thompson & William, 2007)

Summative Assessment

It is an assessment which is generally taken by learners at the end of a unit, a term or semester, end of year or a course to demonstrate the "**sum**" of what they have or have not learned.

- Usually, it is called Assessment of Learning
- It compares learners' knowledge or skills against standards or benchmarks.
- It evaluates mastery of learning and offers information on what learners know and do not know.
- It provides educators with the metrics to know what's working and what's not.

- Usually, it is high stakes, for example when used for promotion, admission, certification, selection, accountability, etc.
- Can also be used formatively if it provides feedback to inform teaching and learning.
- Does not provide teachers with vital information to use in crafting remedial instruction.
- Plays a pivotal role in education by troubleshooting weaknesses in the system despite its shortcomings.
- Provides educators with valuable information to determine the effectiveness of instruction for a particular unit of study, to make high-stakes decisions and to evaluate the effectiveness of schoolwide interventions.
- Works to improve overall instruction.
    - by providing feedback on progress measured against benchmarks,
    - by helping teachers to improve, and
    - as an accountability instrument for continuous improvement of systems (Hart et al., 2015).

Formative Assessment Approaches

1. Assessment for learning (AfL)

Assessment for Learning (AfL) is an approach, integrated into teaching and learning, which creates feedback for learners to improve learning. i.e. occurs when assessment and learning are integrated.

AfL is not a means of evaluating schools, teachers or learners, rather it is a feedback mechanism.

It provides learners with rich, meaningful and timely feedback on their learning and progress throughout a programme of study. Assessment for Learning is an ongoing part of teaching & learning in which both teachers and learners share the responsibility for learning. It can take many forms, and may be either formal or informal (Yorke 2003). With AfL, teachers can understand better how their learners are learning and use this to plan what they will do next with a class or individual learners. AfL helps the learner to see what they are aiming for and understand what they need to do to achieve those aims. AfL therefore focuses on the teacher and the learners' understanding.

Why is AfL important?

Assessment for learning is a key pedagogical tool for:

- establishing where the learners are in their learning
- establishing where they are going
- working out how to get them there

(William, 2009)

2. Assessment as learning (AaL)

In this approach, learners are their own assessors. They monitor their own learning, ask questions and use a range of strategies to decide what they know and can do, and how to use assessment for new learning. AaL helps learners to take more responsibility for their own learning and monitoring future directions. Learners are able to learn about themselves as learners and become aware of how they learn. They reflect on their work on a regular basis, usually through self and peer assessment and decide what their next learning will be.

The teacher's role in assessment *as* learning is to:

- model and teach the skills of self-assessment
- guide learners in setting their own goals, and monitoring their progress towards them
- provide examples and models of good practice and quality work that reflect curriculum outcomes
- work with learners to develop clear criteria of good practice

Feedback in Assessment

Feedback is an important component of the formative assessment process. Formative assessment gives information to teachers and learners about how learners are doing relative to learning goals. Giving good feedback is one of the skills teachers need to master as part of good formative assessment. *(Ref: Susan M. Brookhart)*

For feedback to be effective for learners, they need the following:

- an understanding of the desired learning goal;

- evidence about their present position in relation to that goal;
- guidance on the way to close the gap between the two.

Effective feedback should:

- focus on what is being learned (learning outcomes) and how learners should go about it (success criteria)
- occur as the learners are doing the learning, i.e. be given at a time when the response will help the learner improve their learning
- provide information on how and why the learner has or has not met the criteria
- be phrased so the learner can understand how he/she should respond and;
- provide strategies or act as guidance showing how the learner can improve; and
- encourage a dialogue (where appropriate), so the learner can probe for clarification on next steps needed to progress their learning.

Success Criteria

It is important in the learning cycle that the learners and teacher are all aware of what will show that learning has taken place.

Why Are Success Criteria Important?

- Improve understanding
- Empower learners
- Encourage independent learning
- Enable accurate feedback
- Enhance quality assessment which is totally dependent on the use of success criteria

What Are Success Criteria?

'… success criteria summarise the key steps or ingredients the learner needs in order to fulfil the learning goal – the main things to do, include or focus on.' (Shirley Clarke)

Effective Success Criteria

- are linked to the learning intention;
- are specific to an activity;
- are measurable;
- are discussed and agreed with learners prior to undertaking the activity;
- provide a scaffold and focus for learners while engaged in the activity; and
- are used as the basis for feedback and peer-/self-assessment

Sample success criteria

B 2.1.2.3.1 Describe a solid-solid mixture and explain how to separate the components	Low	Medium	High
	I can correctly identify and give an example of a solid- solid mixture	I can form and describe a solid-solid mixture	I can separate a solid-solid mixture into its components

Assessment for Learning Strategies

The following are samples of activities that you can try in your classroom. These can be adapted to be applied to all subjects and stages of education.

Shared Learning Goals

Promote learner's autonomy over their learning progression by sharing with them the learning goals, and most importantly the success criteria.

Learners write or ask questions

For example –

- About what they would like to know on a new topic;
- To ask the teacher or other learners in order to assess their learning;
- To demonstrate their learning/ misconceptions/areas they would like to further explore.

Lesson Target Setting

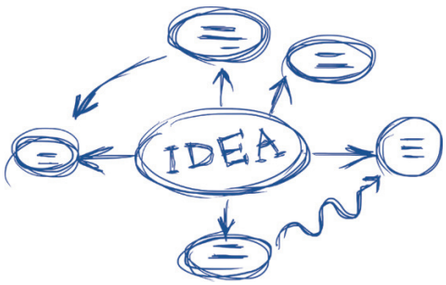
- Make the lesson more purposeful for learners by setting targets at the beginning about what you and the class are going to do;
- These can be referred to through the lesson and/or revisited in the plenary;
- Learners could then show how they have met targets in the plenary and/or set targets for next lesson.

Making Learning Goals Clear

- Put lesson goals on the board at the beginning of the lesson;
- Talk to learners about why they are studying what they are studying;
- Contextualise short-term goals in long-term goals and make real life application clear (e.g. understanding the nature of things in the environment – living and non-living will contribute to our wider understanding of the world around us) and;
- Check with learners whether they understand the goals of the lesson.

Brainstorming

- Brainstorming is a technique used to determine what a learner may already know about a particular topic. Learners often feel free to participate because there is no criticism or judgment.
- Follow this with a clear description of what concepts to be covered in the lesson (to consolidate and clarify understandings)



Devising Questions

Devise questions that –

- Challenge common mistaken beliefs about a topic (misconceptions)
- Create conflict that requires discussion
- Explore ambiguity and encourage discussion and clarification

Wait time

- Wait time allows learners time to think and therefore to produce answers. Also, not everyone in the class thinks at the same speed or in the same way – waiting allows learners to build their thoughts and explore what has been asked.
- 2 types of wait time –
  - Teacher speaks and then waits before taking learners' responses.
  - Learner response ends and then teacher waits before responding. This gives the learner space to elaborate or continue – or for another learner to respond.

Observations

Teacher observations can be made in the course of delivery, during times of questioning and feedback and when learners are engaged in activities, either alone or with peers or groups. Look out for the look of confusion, nod or spark of understanding etc. We observe to be responsive and adjust to keep the learning going or notice when it is time to stop or recap a concept.

Tell your neighbour

- Learners 'tell their neighbour' as a means of articulating their thoughts.
- Ask a question, give thinking time and then ask learners to tell their neighbour their thoughts.
- This can either prepare whole class for 'hands down' questioning (where teacher asks randomly selected learner to contribute) or can precede a whole class discussion.

Think–Pair–Share

Give learners the opportunity to articulate their thinking before answering:

- Allow 30 seconds – 1-minute silent thinking before any answers
- Ask learners to write some thoughts down before answering
- Ask learners to brainstorm in pairs first for 2-3 minutes
- Then, get learners ready to talk about their own ideas or their group's ideas in a whole class discussion

Think–Pair–Square

- Think-Pair-Square is the same as Think-Pair-Share except that learners share their answers with another pair instead of the whole class.

Debates

- Debates enable the teacher to informally evaluate learners' oral work by assessing their oral presentation skills in terms of their ability to understand concepts and present them to others in an orderly fashion.

Post-It /Slate/ Mini-whiteboard/ Rough-workbook

Use post-it notes (or the other materials above) to evaluate learning. Groups, pairs or individuals can answer:

- Did I meet the success criteria?
- What should be done to improve next time?

Or:

- What have I learnt?
- What have I found easy?
- What have I found difficult?
- What do I want to know now?

K – W – L

- At the beginning of a topic let learners create a grid with three columns –

What They Know	What They Want To Know	What They Have Learnt

- They begin by brainstorming and filling in the first two columns and then return to the third at the end of the unit (or refer throughout).
- Variation – extra column 'How Will I Learn?'

Response Partners

- Paired or partnership oral marking. Learners invite a partner or a group to discuss or comment on their work. For it to be effective, learners should be aware of the learning goals and success criteria. They should also appreciate the role of a response partner – to offer positive and constructive feedback around the learning goals.
- Learners could be given prompt questions to ask the person who has done the work.

Exemplar Work

- When setting learners a piece of work, show them examples that make it clear what it is they are being asked to do – and what they need to do in order to meet the assessment criteria.
- Learners could mark exemplar work using the assessment criteria. This will help model what is being asked for and how it relates to the process of assessment.

2 Stars and a Wish

For peer assessment, ask learners to give two stars and a wish.

- Two stars = 2 things that are good about the piece of work.
- A wish = something they can improve to make it even better.

Traffic Lights

Use traffic lights as a visual means of showing understanding. Coloured card or paper could be used.

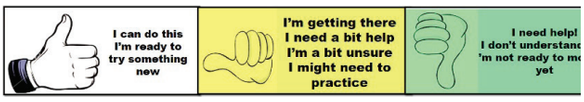
- Variation – Using smiley faces

  Where coloured card is unavailable, simple face emojis can be used to communicate learners' understanding.

  ☺😐☹

Hand Signals

- Hand signals range from learners raising their hands to respond to a question posed by the teacher to a group to "thumbs up/down" signal to determine learners "acknowledged" understanding of a concept or process.



When using traffic lights or hand signal techniques, it is important to ask a few follow up questions to check learners' actual level of understanding. Learners who are confident can also be used to support or explain to others who are not as confident yet.

Show and Tell

- During teaching, you can use mini-whiteboards/slates/rough-work book so that every learner can write or draw their answer and show it to you (or their peers) immediately. Follow up with questioning to check for genuine understanding or to build upon answers especially in subjects like [insert subject] where there is often one answer.

Active Learners

Key to AfL is learners being active, engaged participants in their learning. Think of ways in which content can be manipulated for these ends, rather than the other way round. If the content seems boring make the approach fun or interesting.

Learners write Questions

For example –

- About what they would like to know on a new topic
- To ask the teacher or other learners in order to assess their learning
- To demonstrate their learning/ misconceptions/areas they would like to further explore

The classroom could have a question box where learners drop questions at the end of a lesson.

Or, a plenary could involve learners writing questions that the class then work on together, or forms the basis of the next lesson.

Learners ask Questions

Create opportunities for learners to ask questions. This could be of their peers, of the teacher or as a means to develop discussion.

A 'question box' for written questions offers a different means of communication for learners

Allow time for learners to ask questions about pieces of work. This helps open up assessment and eliminate ambiguity

Comment-only Marking

Comment-only marking provides learners with a focus for progression instead of a reward or punishment for their ego (as a grade does).

Comments could be made in books, in a table at the front of their books, in a learning diary or journal. The latter are helpful for teacher and learner to track the progression of comments and see improvement.

Comments should make it clear how the learner can improve.

Plan activities and work with feedback in mind – let the design assist the process.

Mid-unit Assessment

Having an assessment at the end of a unit may not provide time for you to go over areas learners have struggled with, or in which there are general misconceptions.

Timing assessment during a unit allows time to review, reflect and revisit. It also gives the teacher an opportunity to focus explicitly on areas of weak understanding supported by evidence.

Might

When questioning, insert the word 'might' to give learners greater opportunity to think and explore possible answers.

e.g.

What is meaning of democracy?

What might the meaning of democracy be?

The first infers a single answer known by the teacher whereas the second is inherently more open.

What might the Great Depression look like today?

Wait time

Wait time allows learners time to think and therefore to produce answers. Also, not everyone in the class thinks at the same speed or in the same way – waiting allows learners to build their thoughts and explore what has been asked.

2 types of wait time –

i) Teacher speaks and then waits before taking learners' responses.

ii) Learner's response ends and then teacher waits before responding. This gives the learner space to elaborate or continue – or for another learner to respond.

Open vs closed

Closed questions can be useful however they are not great at facilitating the use of abstract thinking skills, encouraging talking or eliciting much understanding. Open questions are more likely to do this and thus improve learning. E.g.

Did you go out last night? - (How can you make this question open?)

What did you do after school yesterday?

Exemplar Work

When setting learners a piece of work, show them examples that make it clear what it is they are being asked to do – and what they need to do in order to meet the assessment criteria.

Learners could mark exemplar work using the assessment criteria. This will help model what is being asked for and how it relates to the process of assessment.

Learner Marking

By taking part in the process of assessment, learners gain a deeper understanding of topics, the process of assessment and what they are doing in their own work. This helps to make them more aware of 'what learning is' and thus see their own learning in this way.

Learners could self- or peer- mark homework or assessments.

This could be done in pairs or individually with a learner-made or 'official' mark-scheme.

Lesson Target Setting

Make the lesson more purposeful for learners by setting targets at the beginning about what you and the class are going to do.

These can be referred to through the lesson and/or revisited in the plenary.

Learners could show how they have met targets in the plenary and/or set targets for next lesson.

2 Stars and a Wish

For peer assessment, ask learners to give two stars and a wish.
Two stars = 2 things that are good about the piece of work
A wish = something they can improve to make it even better

Articulate then Answer

Give learners the opportunity to articulate their thinking before answering –

- 30 seconds silent thinking before any answers
- Brainstorm in pairs first for 2-3 minutes
- Write some thoughts down before answering
- Discuss with your neighbour first

Tell your Neighbour

Learners 'tell their neighbour' as a means of articulating their thoughts.

- Ask a question, give learners time to think and then ask learners to tell their neighbour their thoughts.
- Tell learners what the new topic is and ask them to tell their neighbour everything they know about it.

Idea Thoughts

When you have received an answer to a question, open up the thinking behind it by asking what others think about the idea. E.g. "What do others think about _____'s idea?"

Devising Questions

Devise questions that –

- Challenge common misconceptions
- Create effective classroom activities, questions and tasks that prompt the right type of discussions
- Explore ambiguity and encourage discussion and clarification

Learning Journal

Create a learning journal in which learners can reflect and review their learning. It could include plenary activities, a target setting chart, aims and goals, etc.

Group Feedback

Group feedback to a teacher concerning peer-assessment of work can help make the teacher aware of learning needs in a manageable way.

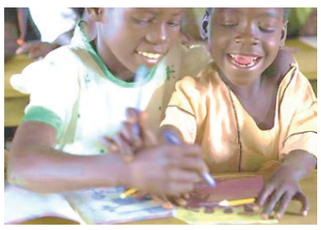
If a group feeds back then it draws more attention and presents information that has already been ordered and sorted (meaning less repetition for the teacher).

Peer Marking

Learners mark each other's' work according to assessment criteria.

Encourages reflection and thought about the learning as well as allowing learners to see model work and reason past misconceptions.

Opportunities to do this throughout individual lessons and schemes of work.



Teach Collaboration

Peer assessment requires learners to act collaboratively. Indeed, AfL is a collaborative enterprise therefore, explicitly teach skills of collaboration.

This process can be assisted by discussing collaboration with learners and making it visible as a part of the classroom.

Traffic-Light Revision

When revising a topic or subject, work through the different areas with learners and ask them to traffic light according to their grasp of each.

Subsequently, learners should be able to target their revision more carefully and engage in it actively, rather than simply reviewing everything they have done or reading passively over their entire notes.

Group Answers

Learners work in small groups to agree on answers – when tests are returned or in other situations.

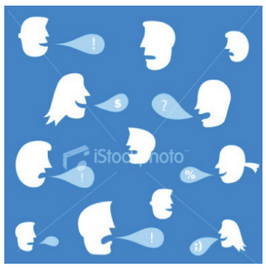
The process of agreeing should include reasoning over the validity of the consensus answer, as well as reasoned negation of misconceptions or wrong answers.

Think-through Talking

Talking allows learners to articulate their thoughts and thus to learn.

Encourage thinking through talking with –

- Discussion activities
- Structured group/pair work
- Modelling by teacher and learners (small group work increases the 'surface area' of talk in the classroom as opposed to whole class discussions)



Communication

Ask learners to communicate thinking through different mediums – not just writing; drawing, drama, maps, sculpture etc.

The medium is the message and therefore circumscribes to some extent how communication can take place. Using alternative mediums allows the teacher to 'see' learners' understanding from different angles.

Appendix D: ABRIDGED GUIDELINES FOR THE FORMATION AND MANAGEMENT OF SCHOOL-BASED CLUBS AND SOCIETIES (SCS) FOR THE IMPLEMENTATION OF THE STANDARDS-BASED AND CCP CURRICULA

Introduction

These guidelines provide tips and ideas for teachers and learners on how to establish and manage **SCSs** at the pre-tertiary level of education in Ghana. They also suggest simple activities that the clubs can carry out. However, this is only a start since the real success of the club in your school will depend on the efforts of the leadership of the clubs being creative, thinking outside the box and coming up with innovative ideas, concepts, projects and activities. The innovations are expected to motivate and elicit in members, the desire go the extra mile while having fun as they learn.

What are School-based Clubs and Societies?

School-based clubs or societies are organised groups approved by the school authorities to offer learners the opportunity to participate in activities they enjoy, learn new skills, explore their talents, meet new colleagues, share experiences and engage in healthy competitions. Learners showcase their talents and acquire functional and lifelong skills. Through SCS activities, learners experience the life that exists outside the classroom and school walls. Majority of learners enjoy club activities because they get the occasion to spend time with their friends and engage in activities they consider as fun and interesting**.** School administrators and teachers also like to see learners participate in co-curricular activities as it helps them know the learners better. The learners demonstrate sterling qualities and skills such as leadership, communicative, organisational, critical thinking, problem solving, creative, innovative, collaborative etc. Every School-based club must have a teacher to supervise the club's activities and report to the school head. Learners are to be given leadership positions such as president, vice-president, secretary and organiser.

Why School-based Clubs and Societies?

The **SCS** seeks to:

- Equip the learner with foundational, functional and lifelong skills.
- Strengthen the acquisition and application of the of the 4Rs and core competencies:
  - critical thinking and problem solving skills;
  - creative and innovative skills;
  - collaborative and communication skills;
  - global citizenship;
  - entrepreneurial skills.
- Introduce the learner to research and project-based learning, enhanced community networking and linking of schools and learners.
- Equip learners with the spirit of volunteerism and community service.

What are the suggested SCS for our Schools?

- Community Service Club
- Digital Literacy Club
- Friends of the Earth Club
- Human Rights Club
- Literary Club (Debaters, Creative Writers and Drama)
- Sports and Games
- STEAM (STEM) Club (Currently, there is what is called STEAM Club. It aims to spark the excitement of young people for Science, Technology, Engineering, Art, Mathematics and More. The challenge is that learners focus more on the Sciences and forget about the interrelatedness between Science and the Arts)
- Tourism, Arts and Culture Club

Other clubs approved by the Ghana Education Service (GES)

How Do We Establish SCS?

1) ***Planning, Consultation and Stakeholder Engagement:***
   - Community engagement is key to the success of your club – this should be kept in mind as well for any community project.
   - Talk to staff members, identify interests, hobbies, talents, and skills of learners, and decide with colleagues which club ideas learners will be comfortable participating in.
   - Align the interest of colleagues to the interests, hobbies, talents, and skills you have all identified. Get them to commit to helping the club to develop.
   - Arrange with the head of school and administration for permission to start a club or identified clubs.
   - Talk to parents and other stakeholders (chief, assembly member, etc.) and seek their support.
   - Speak to other volunteers in the school and community to get like-minded colleagues to help run the club with you.
2) ***Choosing Club Members***
   - Choosing club members should mainly be based on the interests, hobbies, talents, and skills of the learner.
   - Decide on a class, form or grade level as target group with a focus on inclusion.
   - Decide on gender mix; are you targeting more boys or more girls? Why?
   - Targeting a particular class or grade level allows for effective monitoring and evaluation.
   - It is always helpful to have learners from different classes and programmes represented, so they can learn from one another, and provide feedback about what they learn to their other mates.

- Get enough people interested - at least 1 teacher and at least ten (10) learners.
- Guide club members to elect club officials - president, secretary, organiser, financial secretary, ladies' rep etc.
- Paste names of elected officials on notice board.
- Inform them of their roles and responsibilities through an orientation.

3) ***Branding the Club:***

- Get a name for the Club.
- Brainstorm on club's mission - What do you want to accomplish and how it can be done?
- Draw up action plan – what activities and projects will you carry out to accomplish the club's objectives?
- Make paraphernalia, souvenirs and create a Social Media presence on Facebook, Twitter, or a club web blog where you can host an online club magazine. These make learners feel special and have a sense of belonging.

4) ***Invitation to Club Members***

- Get parents, CSOs, NGOs, other schools and school heads involved.
- Explain to parents and learners what the club stands for and the benefits it will offer the learner.
- Together with some learners who have bought into the idea of the club, design a membership form.
- Publicise club activities - announce upcoming events and updates of club activities on notice boards, during assemblies and through social media, etc.
- Invite 'specially targeted' learners to the club.
- Keep records of the club's activities – minutes, attendance, projects, etc.

5) ***Launch the Club***

- Launch the Club and explain to the members the focus of the club.
- Make the club activities fun and engaging, and perhaps offer some incentives as long as these can be sustained.
- Ensure that the club activities do not become an extension of classroom learning activities.

6) ***Keeping it Simple***

- Don't feel any pressure to run complicated activities.
- Simple projects work well for new clubs.
- Meet an hour once every week as captured on the school's timetable.
- Use the club's activities to discuss effective ways of doing things - 'Dos' and 'Don'ts'
- Regularly review your projects and revise your action plan accordingly.

***NB**: Sample club activities can be downloaded from the internet.*

7) ***Selecting Club Patrons***

- Club Patrons are volunteers who voluntarily offer their human and material resources to support the activities of the club.
- Consult and select patrons who are willing to support the activities of the club.
- Patrons should be persons whose interests, skills, and hobbies align with the aims, objectives and goals of the club.

8) ***Celebrating Achievements***

- Celebrate members for actively participating in the activities and programmes of the club.
- Provide certificates and other souvenirs to members who dedicate themselves.
- These awards could be done during school assemblies and other social gatherings to help raise the profile of the club across the school and also to motivate other learners.

- A journal/diary should be designed to help learners reflect on what they do during club activities.

Community Service

Learners get motivated to practise what they learn at school when they are given the opportunity to undertake community service. They become agents of change in their communities and learn to be proactive citizens. During community service learners are guided to identify common challenges and the relationship between community resources and opportunities to an improved way of life. Some activities they can do are:

- Community projects on climate change, tree planting, clean-up exercises etc.
- Community sensitisation and awareness on emerging issues.

Excursions and Field Trips

Excursions and field trips help learners to gain more insight into socio-cultural and economic issues and offer them an opportunity to have a first-hand experience of what they only hear or read about. They learn about current situations and get informed about how they can improve their performance in other learning areas. Learners can visit:

- Historical and heritage sites;
- Industries and production units;
- Government institutions and departments;
- Botanical gardens or wildlife parks; and
- Power plants using alternative energy sources such as solar, wind, geothermal, etc.

Projects

- Robotics
- Creative Arts productions: art and craft works, theatre and musical concerts etc. to sensitise, educate and entertain
- Tree planting
- Renewable energy projects
- Essay competitions
- Climate change
- Research and surveys

For further information contact NaCCA
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Appendix E: FIDELITY OF IMPLEMENTATION OF THE COMMON CORE PROGRAMME (CCP)

KEYS (✓ TICK AS APPLIES): **YES**: Indicates indicator has been attained

NO: Indicates that indicator has not been attained

N**OT YET:** Indicates that the indicator is yet to be initiated

NEEDS SUPPORT: Indicates indicator where a teacher needs assistance from a SISO, Head teacher, a colleague, a resource person, Curriculum lead or any DEO. A teacher can tick any of the above three and this section. Write specific area the teacher needs support in the Remarks Column. ***NB: Not applicable to all indicators***

A. TEACHERS CHECKLIST

S/N	INDICATORS	YES	NO	NOT YET	NEEDS SUPPORT	REMARKS
1.	Prepares and submits lesson notes on time					
2.	Applies differentiation and scaffolding in lesson delivery					
3.	Understands Assessment for Learning, Assessment as Learning and Assessment of Learning strategies					
4.	Frequently uses Assessment for Learning, Assessment as Learning and Assessment of Learning strategies in lessons					
5.	Gives immediate feedback to learners after assessment					
6.	Has teacher learner resource packs available for lesson planning and delivery					
7.	Understands issues of barriers to learning and takes measures to assist learners overcome them					
8.	Partakes in PLC meetings					
9.	Partakes in school clubs and societies					
10.	Assists learners as individuals with differentiated abilities, needs, achievement and learning styles					
11.	Shares learning goals and success criteria with learners before lessons					
12.	Maintains consistent and proactive discipline					
13.	Anticipates classroom challenges					
14.	Remediates where learners have learning difficulties					
15.	Assists learners to reflect and take responsibility of their own learning					
16.	Assists learners set their own goals					
17.	Works with learners to develop clear criteria of good practice					
18.	Supports school administration with assigned tasks and responsibilities effectively					

B. HEADTEACHER

S/N	INDICATORS	YES	NO	NOT YET	NEEDS SUPPORT	REMARKS
1.	Understands the Core Competencies, 4Rs, Knowledge, Skills, Values and Attitudes					
2.	Specific remedial programmes are put in place to help learners with learning needs					
3.	Conducts classroom observation (*Select One*)					
4.	Provides feedback on classroom observation for teachers to improve teaching and learning					
5.	Supervises records keeping on PLC meetings					
6.	Takes part in INSETS and PLC sessions in the school this term					
7.	Has Curriculum Lead (CL) in the school					
8.	Takes measures to overcome barriers of learning in the school					
9.	Has functional clubs and societies in the school					
10.	Monitors activities of clubs and societies in the school					
11.	Teacher and Learner Resource Packs and other resources for each subject available					
12.	Teaches alongside administrative duties					
13.	Supports teachers to access additional resources for implementation of the CCP					
14.	Involves the community in the implementation of the CCP					
15.	The community provides support to the school in implementing the SBC					
16.	SISO supports the school in the implementation of the CCP					
17.	Aside the SISO, other District Education Officers come to this school to monitor facilities, teaching quality, or teacher attendance					

C. CURRICULUM LEAD

S/N	INDICATORS	YES	NO	NOT YET	NEEDS SUPPORT	REMARKS
1	Organises PLC meetings in the school *(Select One)* A. Once a week B. Twice a week C. More than once a week C. Once every two weeks D. Once a month					
2	Keeps record of PLC meetings					
3	Partakes in INSET meetings in the school					
4	Develops and initiates capacity building programmes to support efficient implementation of the CCP					
5	Involves resources person to address challenges during PLC meetings					
6	Has resources to assist during PLCs meetings					

Appendix F: COMMON CORE PROGRAMME (CCP) CONCEPT

Introduction

In the first four years of high school education, learners are expected to take a Common Core Programme (CCP) that emphasises a set of high, internationally-benchmarked career and tertiary education readiness standards. Learners need to acquire these for post-secondary education, the workplace or both. The standards articulate what learners are expected to know, understand and be able to do by focusing on their social, emotional, cognitive and physical development. The CCP runs from Basic 7 through Basic 10.

The common core attributes of the learner, which describe the essential out- comes in the three domains of learning (i.e. cognitive, psychomotor and affective), are at the centre of the CCP (see Figure 1). Inspired by the values which are important to the Ghanaian society, the CCP provides an education of the heart, mind and hands in relation to the learner's lifetime values, well-being, physical development, metacognition and problem-solving abilities. Ultimately, this will produce character-minded learners who can play active roles in dealing with the increasing challenges facing Ghana and the global society.

The features that shape the common core programme are shown in Figure1. These are:

- learning and teaching approaches – the core competencies, 4Rs and pedagogical approaches;
- learning context – engagement, service and project;
- learning areas – mathematics, science, computing, languages (English, Ghanaian Languages, French and Arabic), career technology, social studies, physical and health education, creative arts and design and religious and moral education.

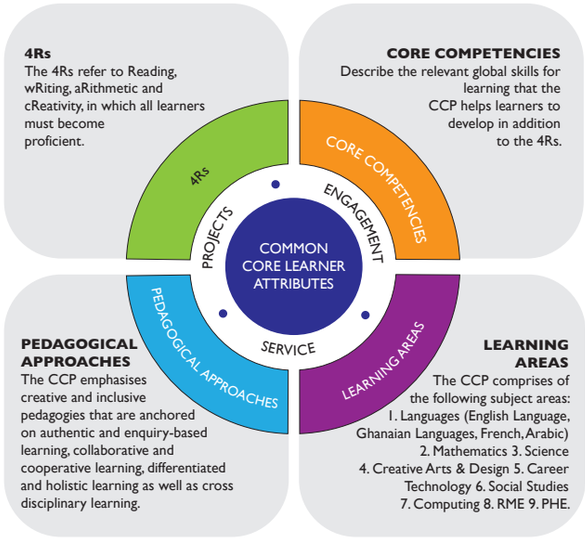

Figure 1: CCP Learner Attributes

These are elaborated subsequently:

Learning and teaching approaches

- **The core competencies***:* Describe the relevant *global skills for learning* that the CCP helps learners to develop in addition to the 4Rs. The global skills for learning allow learners to become critical thinkers, problem-solvers, creators, innovators, good communicators, collaborators, digitally literate, and culturally and globally sensitive citizens who are life-long learners with a keen interest in their personal development.
- **Pedagogical approaches:** The CCP emphasises creative and inclusive pedagogies that are anchored on authentic and enquiry-based learning, collaborative and cooperative learning, differentiated learning and holistic learning as well as cross disciplinary learning.
- **The 4Rs across the Curriculum:** The 4Rs refer to Reading, wRiting, aRithmetic and cReativity, which all learners must become fluent in.

Learning context

The CCP places emphasis on engagement of learners in the classroom activities and projects (in and outside classroom).These projects can involve individual or group tasks which all learners are required to complete by the end of Basic 10. The CCP project provides learners with contexts to demonstrate creativity and inventiveness in various areas of human endeavour. Community service offers an opportunity for learners to nurture, love and care for, and solve problems in their community.

Learning Areas

The CCP comprises the following learning areas:

1. Languages (English Language, Ghanaian Languages, French, Arabic)
2. Mathematics
3. Science
4. Creative Arts and Design (CAD)
5. Career Technology
6. Social Studies
7. Computing
8. Religious and Moral Education (RME)
9. Physical and Health Education (PHE)

This document sets out the standards for learning Mathematics in the Common Core Programme (CCP). The standards in the document are posited in the expectation that the CCP (B7 – B10) will offer quality education for all types of learners. The design of this curriculum is based on the features of the CCP as shown in Figure 1. It emphasises a set of high internationally-benchmarked career and tertiary education readiness standards. Learners need to acquire these competencies in Mathematics for post-secondary education, work- place training or both. The curriculum has been designed to be user friendly because it provides a detailed preamble that covers the rationale, philosophy, aims, profile of expected learning behaviours (i.e. knowledge, skills, attitudes and values), pedagogical approaches, core competencies and the 4Rs, assessment practices and instructional expectations.

Appendix G: LEARNING SCENARIOS

Case Study 1

Consider these two lesson scenarios and then discuss and answer the questions below:

Scenario 1

When the teacher enters his B7 class, some of the learners are shouting at each other; some are talking quietly; some are moving around restlessly; and others are quietly waiting for the lesson to begin. He claps his hands and orders the learners to take out their maths textbooks. The teacher asks the learners what they did yesterday. When they tell him, 'LCM', he asks them to go to the next exercise, 'Solving word problems involving LCM'.

He asks one of the learners, who is often chosen to read during the maths class, to stand up and read the first exercise. While the boy is reading, some learners are still trying to find their book, some are trying to find the page and others are still talking; many of them do not have the book to follow. Only a few learners are paying attention to the text and listening to the boy read. When the boy completes reading the question, the teacher asks, 'who can work that for us on the board?'

While this is happening, the teacher completes the attendance register and occasionally looks up and shouts "Hey, look at what he is doing on the board and follow. I am going to ask some questions. All of those who do not answer the questions correctly will have extra homework." When the exercise has been done correctly on the blackboard correctly by the learner, the teacher asks, have you all seen it? The class responds, 'yes sir'. The teacher then asks 'who doesn't understand what has been done on the board?' … but receives no response from the learners.

The teacher tells the learners to take their class exercise books, do the next two exercises and bring their completed works for marking at his table.

Scenario 2

When the teacher enters her B7 class she spends a few minutes talking to the class, encouraging them to relax for some mental maths games. The teacher asks the class to stand and skip count in 50s to 1000 and skip backwards. She asks the class to repeat the skip counting activity using the play-time language of the majority of learners. She then asks the learners to stand in a circle around the desks in the classroom. She explains that in the final mental maths game, we are playing "One more than double" the number that shows on the card (with numbers 1 to 9) that you pick. You can go and sit down only when you have your mental maths fact right. Let's start, …

After all learners have had their round with the mental maths game, the teacher writes the topic of the new learning activity on the chalkboard "Solving word problems involving LCM". She reviews what the class was given as homework the previous day, i.e. to find LCM of some pairs of 1-digit numbers.

Then the teacher asks the learners to take their B7 maths textbooks and open at page 42, and read the first exercise … "Packets that are 12 centimetres tall are being piled next to packets that are 10 centimetres tall. What is the least height in centimetres at which the two piles will be the same height?" The teacher makes sure learners who didn't have the textbook pair up with friends having the book.

She introduces the problem by asking questions about it to gain their interest. She asks different questions for example:

'What is the height of the packets being packed?'

'What is the height of three 10-centimeters packets piled?'

'What is the height of two 12-centimeters packets piled?'

'At what height will the piles be of the same height?'

She waits a moment after each question to give an opportunity for all the learners to raise their hands before choosing one to give the answer. Sometimes she asks a learner who hasn't raised their hand, if she thinks they will know the answer but are being lazy. The teacher goes on to ask other members of the class to explain the answer.

The teacher asks the learners to work in pairs to discuss and work out when they think the height of the piles will be of the same height. After a few minutes, the teacher asks one pair to give the results of their discussion. She asks if any other pairs think the same and they raise their hands. She then asks any of the remaining pairs for their thoughts.

The teacher tells the learners to take their class exercise books and work in pairs to do the next two exercises. She asks pairs having difficulties to seek help from other pairs as she goes round to mark the learners work and give suggestions. As homework, she asks her students to do the next four exercises in the textbook for the next day.

Discuss and answer:

1. Which of the two lessons do you think is most effective and why?
3. How does each teacher gain and maintain all students' attention, participation and engagement?
4. What does the teacher do to accommodate all ability levels in each scenario?
5. How does each teacher assess learning?
6. Can you find any missed opportunities in scenario 2 where the teacher could have used assessment for learning techniques?
7. How does each teacher use existing material and human resources in an interesting way?
8. In a coaching session a teacher prepare and demonstrate other possible strategies for handling the problem.

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