GHANA EDUCATION SERVICE

(MINISTRY OF EDUCATION)

REPUBLIC OF GHANA

COMPUTING CURRICULUM FOR BASIC 7 – 10 (COMMON CORE PROGRAMME)

SEPTEMBER 2020

NaCCA
NATIONAL COUNCIL FOR CURRICULUM & ASSESSMENT OF MINISTRY OF EDUCATION

Computing Curriculum for B7- B10

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FOREWORD

The Ministry of Education, acting through the National Council for Curriculum and Assessment (NaCCA) has, in recent times, been working on curriculum and assessment reforms to improve the quality and relevance of learning experiences in pre-tertiary schools in Ghana. This curriculum, known as the Common Core Programme (CCP), is a sequel to the Kindergarten-Primary standards-based school curriculum, the implementation of which commenced with the 2019/2020 academic year. The CCP is carefully designed for learners in Basic 7 to Basic 10 (JHS 1 – SHS 1) as part of a holistic learning experience that prepares them for post-secondary education, the world of work or both. The curriculum focuses on building character and nurturing values, in addition to ensuring a seamless progression for all learners from JHS to SHS and creates clear pathways for academic and career-related programmes from Basic 11 to Basic 12 (SHS2 - SHS3).

In the twenty-first century, memorisation of facts and figures is no longer a sufficient learner attribute. Therefore, the CCP focuses on the acquisition of the 4Rs (Reading, wRiting, aRithmetic and cReativity) and core competencies to afford learners the ability to apply knowledge innovatively to solve everyday problems. Personal projects, community projects and community service have been integrated into the CCP as part of a comprehensive assessment programme, including assessment of knowledge, skills, attitudes and values that mainly emphasise what learners can do. It is hoped that the content of this curriculum will promote better high school education that meets the varied learning needs of the young people in the country and addresses the shortfalls in the current school curriculum in relation to learning and assessment.

The Ministry of Education is committed to ensuring that our schools develop globally competitive high school graduates who have the requisite employable skills and workplace ethos. The CCP curriculum will, therefore, play an important role in this regard. The Ministry will support the effective implementation of the CCP to include capacity development of all teachers to ensure improved learning experiences and outcomes for our young people.

Dr. Matthew Opoku Prempeh (MP)
The Honourable Minister of Education

ACKNOWLEDGEMENTS

This Common Core Programme (CCP) curriculum was developed together with the National Pre-tertiary Learning Assessment Framework (NPLAF) and Teacher's and Learner's Resource Packs. All these documents were developed by the National Council for Curriculum and Assessment (NaCCA), under the oversight and strategic direction of the Ministry of Education (MoE) with support from some agencies of the MoE and other relevant stakeholders.

NaCCA, acting on behalf of the Ministry of Education (MoE), would like to express its sincere gratitude to all its partners who participated in the professional conversations and discussions during the course of the development of the CCP curriculum.

NaCCA also extends special commendations to the leadership of the Ghana Education Service (GES), National School Inspectorate Authority (NaSIA), National Teaching Council (NTC), Commission for Technical and Vocational Education and Training (Commission for TVET) and other agencies of the MoE.

Additionally, NaCCA acknowledges the contributions of staff from various Universities and Colleges of Education as well as teachers and learners within the Ghana Education Service.

Special thanks go to those who also contributed to shaping this curriculum content through the consultation process, including the national stakeholder engagement conducted in Accra in February, 2020.

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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 outcomes 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 Figure 1. These are

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

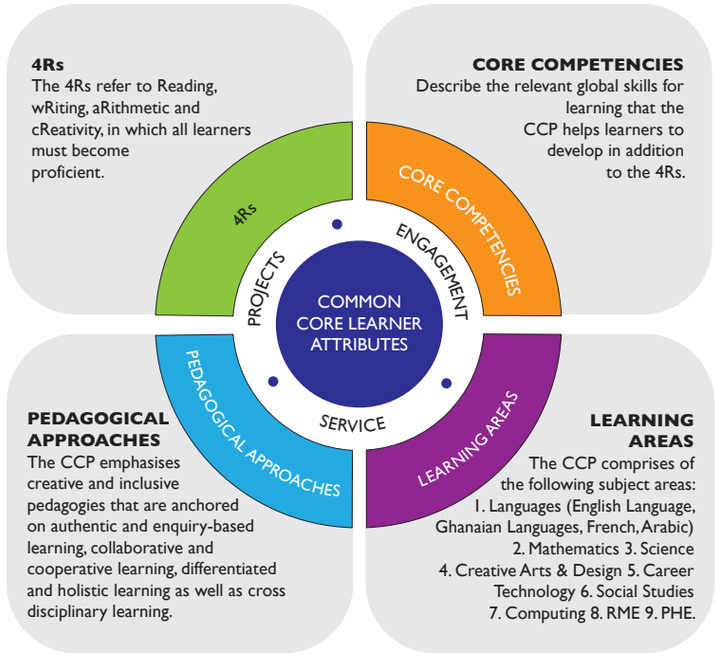


Figure 1: CCP Learner Attributes

Learning and Teaching Approaches

- The core competencies: 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 projects provide learners with contexts to demonstrate creativity and inventiveness in various areas of human endeavour. Community service offers opportunities 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 Computing 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 Computing for post-secondary education, workplace 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.

RATIONALE

To facilitate the implementation of a flexible, coherent and diversified curriculum for Basic Schools, the Ministry of Education is continuing with the implementation of the standard based curriculum for Basic 7 to 10 in the common core.

This Curriculum is designed to provide the rationale, philosophy and aims of the curriculum, followed by core competencies, profile of the expected learning behaviours, attitudes, values and process skills.

The Curriculum encourages creative and inclusive pedagogies, extensive assessments and learner-centred experiences to achieve the instructional expectations.

Computing is one of the essential school subjects that permeates and can be applied to all areas of learning. This is because it provides learners with access to important computing ideas, knowledge and skills that they can draw on in their personal and work lives, as well as their learning of other school subjects.

Learning computing provides the opportunity for learners to develop essential skills and competencies, and motivates them to become flexible problem solvers and life-long learners. In an increasingly technological age, the possession of problem-solving and decision-making skills is an essential pre-requisite and these are acquired in the learning of computing.

PHILOSOPHY

Teaching Philosophy

The teaching is focused around a supportive and inclusive learning environment by positively engaging teacher-learner relationships. Teachers/facilitators have the responsibility to create a cooperative learning environment where learners feel safe and secure. In addition, appropriate improvisation techniques would be used to represent the actual devices when they are not available.

Relevance, engagement and problem-solving best describe the computing teaching philosophy. In other words, teaching of computing adopts the hands-on approach that is, the tactile/kinesthetic approach. Students learn computing subject best when they are actively involved in the learning process, and that an engaging classroom best facilitates this. Learners should be engaged in computing by using diverse teaching methods, encouraging the use of a variety of their cognitive skills. The more learners process data, the more likely they would be able to apply, analyse, synthesise, and evaluate the information.

Teaching of computing should enable learners know how data can be used to understand themselves, explain situations they find themselves in, describe the why and how some things happened or predict what might happen in the future.

Learning Philosophy

Computing education develops a wide range of skills including problem solving, design construction, communication, critical thinking, analysis, synthesis and evaluation. The skills learnt can then be applied to other fields of endeavour. Learners should have freedom of expression and creativity. Learners should be able to experiment and realise their strengths and weaknesses in the computing subject. Each learner's learning style should be tied to the learning of computing to enable learners grow and learn on their own. Learners should be given the chance to pose their own questions and try to answer them independently. Learners should be encouraged to find information in a variety of ways. Learners should also be encouraged to work on projects in groups to foster collaborative learning.

AIMS

General Aim

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

Specific Aims

The computing curriculum is designed to help learners to:

1. acquire basic ICT literacy;
2. communicate effectively using ICT tools;
3. develop interest and acquire skills in the use of the internet;
4. develop basic ethics in using ICT tools;
5. acquire basic programming and database skills.

PROFILE OF EXPECTED LEARNING BEHAVIOURS

A central aspect of this curriculum is the concept of three integral learning domains that should be the basis for instruction and assessment. These are:

- Knowledge, Understanding and Application
- Process Skills
- Attitudes and Values

Knowledge, Understanding and Application

Under this domain, learners acquire knowledge through some learning experiences. They may also show understanding of concepts by comparing, summarising, re-writing etc. in their own words and constructing meaning from instruction. The learner may also apply the knowledge acquired in some new contexts. At a higher level of learning behaviour, the learner may be required to analyse an issue or a problem. At higher levels, the learner may be required to synthesise knowledge by integrating a number of ideas to formulate a plan, solve a problem, compose a story or a piece of music. Further, the learners may be required to evaluate, estimate and interpret a concept. At the last level, which is the highest, learners may be required to create, invent, compose, design and construct. These learning behaviours, "knowing", "understanding", "applying", "analysing", "synthesising", "evaluating" and "creating" fall under the domain "Knowledge, Understanding and Application".

In this curriculum, learning indicators are stated with action words to show what the learner should know and be able to do. For example, the learner will be able to describe something. Being able to "describe" something after teaching and learning has been completed means that the learner has acquired "knowledge". Being able to explain, summarise, and give examples, means that the learner has understood the concept taught.

Similarly, being able to develop, defend, etc. means that the learner can "apply" the knowledge acquired in some new context. You will note that each of the

indicators in the curriculum contains an **"action word"** that describes the behaviour the learner will be able to demonstrate after teaching and learning has taken place. "Knowledge, Understanding and Application" is a domain that should be the prime focus of teaching and learning in schools. Teaching in most cases has tended to stress knowledge acquisition to the detriment of other higher level behaviours such as applying knowledge.

Each action word in any indicator outlines the underlying expected outcome. Each indicator must be read carefully to know the learning domain towards which you have to teach. The focus is to move teaching and learning from the didactic acquisition of "knowledge" where there is fact memorisation, heavy reliance on formulae, remembering facts without critiquing them or relating them to real world – surface learning – to a new position called – deep learning. Learners are expected to deepen their learning by knowledge application to develop critical thinking skills, explain reasoning and generate creative ideas to solve real life problems in their school lives and later in their adult lives. This is the position where learning becomes beneficial to the learner.

The keywords and explanation involved in the "Knowledge, Understanding and Application" domain are as follows:

Knowing: The ability to remember, recall, identify, define, describe, list, name, match, state principles, facts and concepts. Knowledge is the ability to remember or recall material already learnt and this constitutes the lowest level of learning.

Understanding: The ability to explain, summarise, translate, rewrite, paraphrase, give examples, generalise, estimate or predict consequences based on a trend. Understanding is generally the ability to grasp the meaning of some concepts that may be verbal, pictorial, or symbolic.

Applying: This dimension is also referred to as "Use of Knowledge". Ability to use knowledge or apply knowledge, apply rules, methods, principles, theories, etc. to situations that are new and unfamiliar. It also involves the ability to produce, solve, plan, demonstrate, discover etc.

Analysing: The ability to break down material/information into its component parts; to differentiate, compare, distinguish, outline, separate, identify significant points etc., ability to recognise unstated assumptions and logical fallacies; ability to draw inferences from facts etc.

Synthesising: The ability to put parts or ideas together to form a new whole. It involves the ability to combine, compile, compose, devise, plan, revise, organise, create, generate new ideas and solutions.

Evaluating: The ability to appraise, compare features of different things and make comments or judgement, criticise, justify, support, discuss, conclude, make recommendations etc. Evaluation refers to the ability to judge the worth or value of some material based on some criteria.

Creating: The ability to use information or materials to plan, compose, produce, manufacture or construct other products.

From the foregoing, creating is the highest form of thinking and learning and is therefore the most important behaviour. This, unfortunately, is the area where most learners perform poorly. In order to get learners to develop critical thinking, it is advised that you do your best to help your learners to develop analytical skills and processes as stated previously.

Attitudes, Values and Process Skills

To be effective, competent and reflective citizens who will be willing and capable of solving personal and societal problems, learners should be exposed to situations that challenge them to raise questions and attempt to solve problems. Learners therefore need to acquire positive attitudes, values and psychosocial skills that will enable them participate in debates and take a stand on issues affecting them and others. The computing curriculum thus focuses on the development of attitudes and values.

The computing curriculum aims at helping learners to acquire the following:

1. **Commitment**: determination to contribute to national development.
2. **Tolerance**: willingness to respect the views of others.

3. **Patriotism**: readiness to defend the nation.
4. **Flexibility in ideas**: willingness to change opinion in the face of more plausible evidence.
5. **Respect for evidence**: willingness to collect and use data on one's investigation and also have respect for data collected by others.
6. **Reflection**: the habit of critically reviewing ways in which an investigation or observation has been carried out to see possible faults and other ways in which the investigation or observation can be improved upon.
7. **Comportment** conforming to acceptable societal norms.
8. **Co-operation** the ability to work effectively with others.
9. **Responsibility**: the ability to act independently and make decisions; morally accountable for one's action; capable of rational conduct.
10. **Environmental Awareness**: being conscious of one's physical and socio-economic surroundings.
11. **Respect for the Rule of Law**: obeying the rules and regulations of the land.

The teacher should ensure that learners cultivate the above attitudes and skills as basis for living in the nation as effective citizens.

Values

At the heart of this curriculum is the belief in nurturing honest, creative and responsible citizens. As such, every part of this curriculum, including the related pedagogy, should be consistent with the following set of values.

Respect: This includes respect for the nation of Ghana, its institutions and laws and the culture and respect among its citizens and friends of Ghana.

Diversity: Ghana is a multicultural society in which every citizen enjoys fundamental rights and responsibilities. Learners must be taught to respect the views of all persons and to see national diversity as a powerful force for nation development. The curriculum promotes social cohesion.

Equity: The socio-economic development across the country is uneven. Consequently, it is necessary to ensure an equitable distribution of resources based on the unique needs of learners and schools. Ghana's learners are from diverse backgrounds which require the provision of equal opportunities to all, and that, all strive to care for each other.

Commitment to achieving excellence: Learners must be taught to appreciate the opportunities provided through the curriculum and persist in doing their best in whatever field of endeavour as global citizens. The curriculum encourages innovativeness through creative and critical thinking and the use of contemporary technology.

Teamwork/Collaboration: Learners are encouraged to be committed to team-oriented working and learning environments. This also means that learners should have an attitude of tolerance to be able to live peacefully with all persons.

Truth and Integrity: The curriculum aims to develop learners into individuals who will consistently tell the truth irrespective of the consequences and be morally upright with the attitude of doing the right thing even when no one is watching. Also, be true to themselves and be willing to live the values of honesty and compassion. Equally important is the practice of positive values as part of the ethos or culture of the workplace, which includes integrity and perseverance. These values must underpin the learning processes to allow learners to apply skills and competencies in the world of work.

The action words provided in the learning indicators in each content standard, should help you to structure your teaching and learning to achieve the desired learning outcomes. Check the learning indicators to ensure that you have given the required emphasis to each learning domain in your instruction and assessment.

ASSESSMENT

Assessment is a process of collecting and evaluating information about learners and using the information to make decisions to improve their learning. Assessment may be formative, summative, diagnostic or evaluative depending on its purpose. It is integral to the teaching-learning process, promotes leaner learning and improves instruction. In CCP, it is suggested that assessment involves assessment for learning, assessment of learning and assessment as learning, which are described in the subsequent paragraphs.

Assessment for Learning (AfL)

Assessment for Learning (AfL) is the process of seeking and interpreting evidence for use by learners and their teachers to decide where the learner is in their learning, where they need to be (the desired goal) and how best to get them there. Assessment for Learning also refers to all the activities undertaken by teachers and/or learners, which provide information to be used as feedback to modify the teaching and learning activities. AfL can be achieved through processes such as sharing criteria with learners, effective questioning and feedback.

It is a continuous process that happens at all stages of the instructional process to monitor the progress of a learner and to offer feedback or change teaching strategies to achieve the goal of a lesson.

Assessment as Learning (AaL)

Assessment as Learning develops and supports learners' sense of owner- ship and efficacy about their learning through reflective practices. This form of self-assessment helps in building the competencies of learners to achieve deeper understanding of their own learning and what they are taught.

Assessment of Learning (AoL)

Assessment of Learning provides a picture of the achieved standards of the teacher and performance of learners at the terminal stage of the learning process. This information provides data for accountability and educational decisions such as grading, selection and placement and promotion and certification. Through AoL, stakeholders such as parents and guardians are informed about the extent learners have attained expected learning outcomes at the end of their grade or programme

What do we assess?

Emphasis in assessment in the CCP is on the Common Core Learner Attributes, which are essential outcomes in the three domains of learning (i.e. cognitive, psychomotor and affective).

Knowledge and skills with emphasis on the 4Rs **in the learning areas**

Core competencies with emphasis on attitudes and values developed **through the learning and its context as well as the pedagogical approaches.** The Process is illustrated diagrammatically in Figure 2.

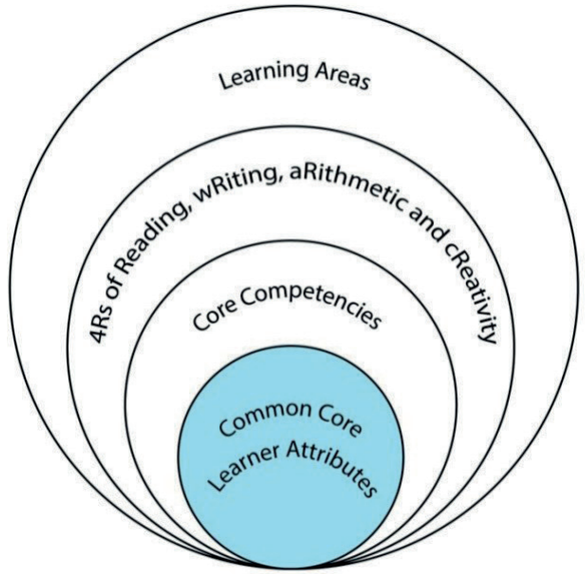


Figure 2: Essential Assessment Features

How do we monitor progress?

School Based Assessments (SBA) cover all forms/modes of assessment including AfL, AaL and AoL (see Table 1), that can be undertaken by any school-level actor (learner, teacher, head teacher) to monitor the learner's achievement over a period of time. Data collection and keeping records of the data are central to the conduct of SBA.

Table 1 Modes of Assessment

Assessment for Learning	Assessment of Learning	Assessment as Learning
Class exercises	Class Assessment Task (CAT)	Portfolio
Quizzes	End of term	Journal entries
Class tests (written, oral, aural and/or practical)	End of year	Project work
Class Assessment Task (CAT)		Checklist
		Questionnaire

The following are samples of relevant records that can be kept on the learner's learning.

- Learner's Progress Record (Cumulative Record)
- Learner's Report Card
- School-Based Assessment Termly Recording Register

Details of guidelines on SBA can be found in the National Pre-tertiary Learning Assessment Framework (NPLAF) document (Ministry of Education, 2020a) and the School-Based Assessment Guidelines (Ministry of Education, 2020b).

Reporting School-Based Assessment (SBA) in the CCP

The CCP uses a criterion-referenced model of presenting and reporting school-based assessment data. Assessment throughout the four-year duration of CCP, is done against criteria linked to performance standards and not against the work of other learners. The CCP provides levels of proficiency to be attained and descriptors for all grade levels of the programme (see Table 2). These levels and descriptors cannot be changed by individual schools and are, therefore common to all learners as well as learning areas nationwide. For each assessment criterion or (benchmark for the level of proficiency), a number of descriptors are defined as shown in Table 2.

Table 2 Benchmarks, levels of proficiency and the grade level descriptors

Level of Proficiency	Benchmark	Grade Level Descriptor
1: Highly proficient (HP)	80% +	Learner shows high level of proficiency in knowledge, skills and values and can transfer them automatically and flexibly through authentic performance tasks.
2: Proficient (P)	68-79%	Learner demonstrates sufficient level of proficient knowledge, skills and core understanding; can transfer them independently through authentic performance tasks
3: Approaching Proficiency (AP)	54-67%	Learner is approaching proficiency in terms of knowledge, skills and values with little guidance and can transfer understanding through authentic performance tasks

Level of Proficiency	Benchmark	Grade Level Descriptor
4: Developing (D)	40-53%	Learner demonstrates developing level of knowledge, skills and values but needs help throughout the performance of authentic tasks
5: Emerging (E)	39% and below	Learner is emerging with minimal understanding in terms of knowledge, skills, and values but needs a lot of help.

The grading system presented, shows the letter grade system and equivalent grade boundaries. In assigning grades to learners' test results, or any form of evaluation, the above grade boundaries and the descriptors may be applied. The descriptors (Highly Proficient [HP], Proficient [P], Approaching Proficiency [AP], Developing [D], Emerging [E] indicate the meaning of each grade.

In addition to the school-based assessment (SBA), a national standards assessment test is conducted in Basic 8 to provide national level indicators on learners' achievement.

CREATIVE PEDAGOGICAL APPROACHES

These are the methods, strategies and relevant teaching and learning resources for ensuring that every learner benefits from the teaching and learning process. The curriculum emphasises the:

1. creation of learning-centred classrooms through the use of creative approaches to ensure learner empowerment and independent learning;
2. positioning of inclusion and equity at the centre of quality teaching and learning;
3. use of differentiation and scaffolding as teaching and learning strategies for ensuring that no learner is left behind;
4. use of Information Communication Technology (ICT) as a pedagogical tool;
5. identification of subject specific instructional expectations needed for making learning in the subject relevant to learners;
6. integration of assessment as learning, for learning and of learning into the teaching and learning process and as an accountability strategy; and
7. questioning techniques that promote deep learning.

Learning-Centred Pedagogies

The learner is at the centre of learning. At the heart of the CCP curriculum is the learning progression and improvement of learning outcomes for Ghana's young people with a focus on the 4Rs – Reading, wRiting, aRithmetic and cReativity. 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 cohort.

The Curriculum encourages the creation of a learning-centred classroom with the opportunity for 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 through the inspiration of the teacher. The learners then become actively engaged in looking for answers and working in groups to solve problems. They also research information, analyse and evaluate information. The aim of the learning-centred classroom is to enable learners to take ownership of their learning. It provides the opportunity for deep and profound learning to take place.

The teacher as a facilitator needs to create a learning environment that:

1. makes learners feel safe and accepted,
2. helps learners to interact with varied sources of information in a variety of ways,
3. helps learners to identify a problem suitable for investigation through project work,
4. connects the problem with the context of the learners' world so that it presents realistic opportunities for learning,
5. organises the subject matter around the problem, not the subject,
6. gives learners responsibility for defining their learning experience and planning to solve the problem,
7. encourages learners to collaborate in learning,
8. expects all learners to 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 teachers providing the answers and their opinions in a learning-centred classroom.

Inclusion

Inclusion is ensuring 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 learners' right to equal access and accessibility to quality education is met. The Curriculum suggests a variety of approaches that addresses learners' diversity and their special needs in the learning process. When these approaches are effectively used in lessons, they will contribute to the full development of the learning potential of every learner. Learners have individual needs and learning experiences and different levels of motivation for learning. Planning, delivery and reflection on daily learning experiences should take these differences into consideration.

The curriculum therefore promotes:

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

Differentiation and Scaffolding

Differentiation is a process by which differences (learning styles, interest and readiness to learn) between learners are accommodated so that all learners in a group have the best chance of learning. Differentiation could be by content, tasks, questions, outcome, groupings and support. Differentiation as a way of ensuring each learner benefits adequately from the delivery of the curriculum can be achieved in the classroom through (i) Task (ii) Support from the Guidance and Counselling Unit and (iii) Learning outcomes.

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

Differentiation by support involves the teacher giving needed support and referring weak learners to the Guidance and Counselling Unit for academic support.

Differentiation by outcome involves the teacher allowing learners to respond at different levels. Weaker learners are allowed more time for complicated tasks.

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 task, 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 and engaging them to discuss the excerpt to improve comprehension. The teacher goes ahead to guide them through the keywords/ 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 are:

1. give learners a simplified version of a lesson, assignment, or reading, and gradually increase the complexity, difficulty or sophistication over time.
2. describe or illustrate a concept, problem, or process in multiple ways to ensure understanding;
3. give learners an exemplar(s): or model of an assignment they will be asked to complete;
4. give learners a vocabulary lesson before they read a difficult text;
5. describe the purpose of a learning activity clearly and the learning goals they are expected to achieve; and
6. describe explicitly how the new lesson builds on the knowledge and skills learners were taught in a previous lesson

Information Communication Technology

Information Communication Technology (ICT) has been integrated into the computing curriculum as part of the core of education, alongside reading, writing and numeracy. Thus, the curriculum is designed to use ICT as a teaching and learning tool to enhance deep and independent learning. For instance, the teacher in certain instances is directed to use multimedia to support the teaching and learning process.

ICT has the potential to innovate, accelerate, enrich, and deepen skills. It also motivates and engages learners to relate school experiences to work practices. It provides opportunities for learners to fit into the world of work.

Some of the expected outcomes that this curriculum aims to achieve are:

1. improved teaching and learning processes;
2. improved consistency and quality of teaching and learning;
3. increased opportunities for more learner-centred pedagogical approaches;
4. improved inclusive education practices;
5. improved collaboration, creativity, higher order thinking skills; and
6. enhanced flexibility and differentiated approach of delivery.

The use of ICT as a teaching and learning tool is to provide learners access to large quantities of information online and offline. It also provides the frame- work for analysing data to investigate patterns and relationships in the computing context. Once learners have made their findings, ICT can help them organise, edit and print the information in many different ways.

Learners need to be exposed to various ICT tools around them including calculators, radios, cameras, phones, television sets, computers and related software like Microsoft Office packages - Word, PowerPoint and Excel as teaching and learning tools. The exposure that learners are given from Basic 7 – 10 to use ICT in exploiting learning will build their confidence and will increase their level 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 and competence level of learners.

CORE COMPETENCIES

In using this curriculum, we hope that certain core competencies will be developed in learners to help them develop our country, Ghana. These competencies include:

Critical Thinking and Problem Solving (CP)

This skill develops learners' cognitive and reasoning abilities to enable them analyse and solve problems. Critical thinking and problem-solving skill enable learners to draw on their own experiences to analyse situations and choose the most appropriate out of a number of possible solutions. It requires that learners embrace the problem at hand, persevere and take responsibility for their own learning.

Creativity and Innovation (CI)

Creativity and Innovation promote the development of entrepreneurial skills in learners through their ability to think of new ways of solving problems and developing technologies for addressing the problem at hand. It requires ingenuity of ideas, arts, technology and enterprise. Learners having this skill are also able to think independently and creatively.

Communication and Collaboration (CC)

This competence promotes in learners the skills to make use of languages, symbols and texts to exchange information about themselves and their life experiences. Learners actively participate in sharing their ideas. They engage in dialogue with others by listening to and learning from them. They also respect and value the views of others.

Cultural Identity and Global Citizenship (CG)

This competence involves developing learners to put country and service foremost through an understanding of what it means to be active citizens. This is done by inculcating in learners a strong sense of social and economic awareness. Learners make use of the knowledge, skills, competencies and attitudes acquired to contribute effectively towards the socioeconomic development of the country and on the global stage. Learners build skills to critically identify and analyse cultural and global trends that enable them to contribute to the global community.

Personal Development and Leadership (PL)

This competence involves improving self-awareness and building self-esteem. It also entails identifying and developing talents, fulfilling dreams and aspirations. Learners are able to learn from mistakes and failures of the past. They acquire skills to develop other peoples needs. It involves recognising the importance of values such as honesty and empathy and seeking the well-being of others. Personal development and leadership enable learners to distinguish between right and wrong. The skill helps them to foster per- severance, resilience and self-confidence. It helps them acquire the skill of leadership, self-regulation and responsibility necessary for lifelong learning.

Digital Literacy (DL)

Digital Literacy involves developing learners to discover, acquire, and communicate through ICT to support their learning. It also makes them use digital media responsibly

NB: Refer to Appendix 1 for details of the core competencies.

INSTRUCTIONAL EXPECTATIONS

The teacher is expected to:

- 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.
- select computing content, adapt and plan lessons to meet the interests, knowledge, understanding, abilities and experiences of learners.
- work together as colleagues within and across disciplines and grade levels to develop communities of computing learners who exhibit the skills of computing inquiry and the attitudes and social values conducive to computing learning.
- use multiple methods and systematically gather data about learners' understanding and ability to guide computing teaching and learning, with arrangements to provide feedback to both learners and parents.
- design and manage learning environments that provide learners with the time, space and resources needed for learning computing.

Suggested Time Allocation

A total of three periods a week, each period consisting of 50 minutes, is allocated to the teaching of computing from B7 – B10. One period per day (50-minutes per period) is recommended.

ORGANISATION AND STRUCTURE OF THE CURRICULUM (Basic 7-10)

The Computing Curriculum is organised into strands, sub-strands, content standards, indicators and exemplars.

Strands are the broad learning areas or domains of the computing content to be studied.

Sub-strands are the sub-divisions of the broad learning areas or strands.

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

Indicators are clear outcomes or milestones that learners have to exhibit in each year to meet the content standard expectation. The indicators represent the minimum expected standard in a year.

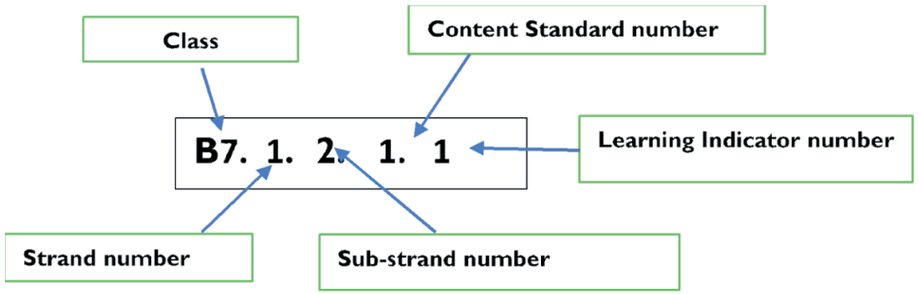
Exemplars clearly explain the expected outcomes of indicators and serve as support and guidance to the facilitator/teacher in the delivery of the curriculum.

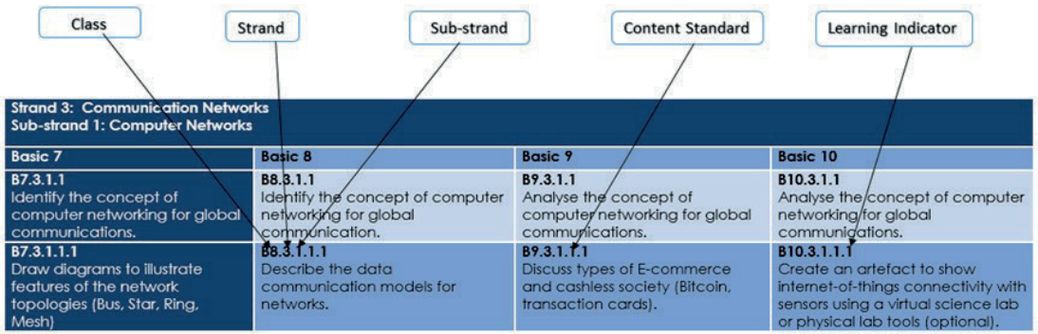
Scope and Sequence

Strand	Sub-strand	B7	B8	B9	B10
Introduction to Computing	Components of Computers and Computer Systems	✓	✓	✓	✓
	Technology in The Community	✓	✓	✓	✓
	Health and Safety in the use of ICT Tools	✓	✓	✓	✓
Productivity Software	Introduction to Word Processing	✓	✓	✓	✓
	Introduction to Presentation	✓	✓	✓	✓
	Introduction to Desktop Publishing			✓	✓
	Introduction to Electronic Spreadsheet	✓	✓	✓	✓
Communication Networks	Computer Networks	✓	✓	✓	✓
	Internet and Social Media	✓	✓	✓	✓
	Information Security	✓	✓	✓	✓
	Web Technologies	✓	✓	✓	✓
Computational Thinking	Introduction to Programming	✓	✓	✓	✓
	Algorithm	✓	✓	✓	✓
	Robotics	✓	✓	✓	✓
	Artificial Intelligence	✓	✓	✓	✓

Curriculum Reference Numbers

A unique annotation used for numbering the strands, sub-strands, content standards and indicators in the curriculum for the purpose of easy referencing is shown below:





Strand 3: Communication Networks Sub-strand 1: Computer Networks			
Basic 7	**Basic 8**	**Basic 9**	**Basic 10**
B7.3.1.1 Identify the concept of computer networking for global communications.	**B8.3.1.1** Identify the concept of computer networking for global communication.	**B9.3.1.1** Analyse the concept of computer networking for global communications.	**B10.3.1.1** Analyse the concept of computer networking for global communications.
B7.3.1.1.1 Draw diagrams to illustrate features of the network topologies (Bus, Star, Ring, Mesh)	**B8.3.1.1.1** Describe the data communication models for networks.	**B9.3.1.1.1** Discuss types of E-commerce and cashless society (Bitcoin, transaction cards).	**B10.3.1.1.1** Create an artefact to show internet-of-things connectivity with sensors using a virtual science lab or physical lab tools (optional).

BASIC 7

STRAND 1: INTRODUCTION TO COMPUTING

SUB-STRAND 1: COMPONENTS OF COMPUTERS AND COMPUTER SYSTEMS

CONTENT STANDARD	INDICATORS AND EXEMPLAR(S)	CORE COMPETENCIES
B7.1.1.1. Identify parts of a computer and their uses	**B7.1.1.1.1 Discuss the second and third generation of computers**	**Creativity and Innovation (CI), Communication and Collaboration (CC), Digital Literacy (DL),Critical Thinking and Problem Solving (CP)**
	Exemplar(s): 1. Discuss the features of the second and third generation of computers 2. Identify major components on the motherboard; 3. Show pictures of parts of the system board and identify a transistor.	**CI6.1:** Exhibit strong memory, intuitive thinking and respond appropriately. **CC8.1:** Speak clearly and explain ideas. Share a narrative or extended answer while speaking to a group.
	B7.1.1.1.2 Demonstrate understanding of the use of input and (wireless keyboard, wireless mouse, light pen, touchscreen). **Exemplar(s):** 1. Handle/watch video/pictures of wireless keyboard, mouse and touchscreen in class 2. Identify the input devices listed 3. Distinguish manual (e.g. keyboard, etc.) and automatic (e.g. barcode reader etc.) input devices 4. Explore areas where different types of input devices are used.	**CI6.1:** Exhibit strong memory, intuitive thinking, and respond appropriately **CC7.4:** Identify underlying themes, implications and issues when listening.

CONTENT STANDARD	INDICATORS AND EXEMPLAR(S)	CORE COMPETENCIES
B7.1.1.2. Demonstrate the use of the features of the Windows Desktop	**B7.1.1.2.1 Describe storage devices: full-sized external hard drives, hard drive speed, disk caching** **Exemplar(s):** 1. Explore magnetic storage devices. 2. Bring storage devices or pictures to class 3. Discuss features of magnetic storage devices 4. Explore the differences in the various Hard Disk Drives (HDD).	**CI6.1:** Exhibit strong memory, intuitive thinking; and respond appropriately **CC8.2:** Explain ideas in a clear order with relevant detail, using correct construction and structure of speech.
	B7.1.1.2.2 Discover the latest Windows Operating System (Start screen, Use of tiles, Taskbar buttons, Preview thumbnails) **Exemplar(s):** 1. Show the desktop, tiles, taskbar. 2. Demonstrate how to preview thumbnails	**CC8.1:** Speak clearly and explain ideas. Share a narrative or extended answer while speaking to a group.
	B7.1.1.2.3 Practise file management techniques (file and folder management) **Exemplar(s):** 1. Demonstrate file management techniques by following the naming conventions and organising files in folders and subfolders 2. Explore the types and importance of file extensions.	**CC8.1:** Speak clearly and explain ideas. Share a narrative or extended answer while speaking to a group. **CI6.9:** Interpret and apply learning in new contexts.

STRAND 1: INTRODUCTION TO COMPUTING

SUB-STRAND 2: TECHNOLOGY IN THE COMMUNITY

CONTENT STANDARD	INDICATORS AND EXEMPLAR(S)	CORE COMPETENCIES
B7.1.2.1. Demonstrate the use of Technology in the community.	**B7.1.2.1.1. Describe and give examples of at least five technology tools for learning in each subject (e.g. Spreadsheets, Virtual Museum, Scrabble, Presentation, Scratch, etc.)** **Exemplar(s):** 1. Explore the various technology tools that can be used for learning. NB: Exploration can be done through learners surfing the internet or the teacher guiding them to brainstorm the ICT tools.	**DL5.3:** Ability to find and utilise digital content. **CC8.1:** Speak clearly and explain ideas. Share a narrative or extended answer while speaking to a group.
	B7.1.2.1.2. Demonstrate the use of at least three technology tools identified in B7.1.2.1.1. **Exemplar(s):** 1. Demonstrate the use of a technology tool in groups and present to the whole class how that tool works.	**CC8.1:** Speak clearly and explain ideas. Share a narrative or extended answer while speaking to a group. **DL5.3:** Ability to find and utilise digital content
	B7.1.2.1.3. Discuss the benefits of using technology tools in learning. **Exemplar(s):** 1. Discuss in pairs the benefits of using technology tools in learning (e.g. using spreadsheet to draw graphs)	**CC8.1:** Speak clearly and explain ideas. Share a narrative or extended answer while speaking to a group. **DL5.3:** Ability to find and utilise digital content.

STRAND 1: INTRODUCTION TO COMPUTING

SUB-STRAND 3: HEALTH AND SAFETY IN THE USE OF ICT TOOLS

CONTENT STANDARD	INDICATORS AND EXEMPLAR(S)	CORE COMPETENCIES
B7.1.3.1. Demonstrate how to apply Health and Safety measures in using ICT Tools	**B7.1.3.1.1 Describe health measures and current regulatory requirements and potential computing-related disorders** **Exemplar(s):** 1. Watch videos on the health hazards of prolonged use of computing devices or show pictures of bad body postures and other hazards in using computing devices e.g. hearing impairment from loud Public Address (PA) Systems, vision impairment from the monitor, repetitive strain injury, Carpal tunnel syndrome, computer vision syndrome, etc. 2. Identify the health hazards associated with each device. 3. Provide preventive measures regarding the stated health and safety risks. **B7.1.3.1.2 Describe Safety measures in using ICT tools** **Exemplar(s):** 1. Discuss the danger of spilling liquids on a computer device or on the electronic circuit. 2. Discuss tripping over power cables and touching the negative and positive terminals of electrical wires.	**CC8.1:** Speak clearly and explain ideas. Share a narrative or extended answer while speaking to a group. **DL5.1:** Ability to ascertain when information is needed and be able to identify, locate, evaluate and effectively use it to solve a problem. **DL5.1:** Ability to ascertain when information is needed and be able to identify, locate, evaluate and effectively use it to solve a problem

STRAND 2: PRODUCTIVITY SOFTWARE

SUB-STRAND 1: INTRODUCTION TO WORD PROCESSING

CONTENT STANDARD	INDICATORS AND EXEMPLAR(S)	CORE COMPETENCIES
B7.2.1.1 Demonstrate how to use Microsoft Word (Editing)	**B7.2.1.1.1. Explain the importance of word processing software** **Exemplar(s):** 1. Discuss the meaning of word processors. 2. Brainstorm to elicit the importance of word processors 3. Brainstorm to elicit examples of some common word processing software packages (e.g. MS-Word, Corel WordPerfect, AbiWord, Google Docs, LibreOffice Writer, NotePad, WordPad, etc.)	**CC8.2:** Explain ideas in a clear order with relevant detail, using correct construction and structure of speech. **DL5.1:** Ability to ascertain when information is needed and be able to identify, locate, evaluate and effectively use it to solve a problem.
	B7.2.1.1.2. Demonstrate how to insert, select, delete and move text **Exemplar(s):** 1. Show projected examples of MS-Word interface with the aid of a computer, projector or pictures. 2. Explore tools for editing in MS Word 3. Explore the use of the overtype or insert option by right-clicking the status bar.	**DL5.1:** Ability to ascertain when information is needed and be able to identify, locate, evaluate and effectively use it to solve a problem.
	B7.2.1.1.3. Demonstrate how to find and replace content and undo edited changes **Exemplar(s):** 1. Make use of the Find and Replace tool in MS-Word under the Home tab 2. Explore the use of the Editing group under the Home tab	**DL5.1:** Ability to ascertain when information is needed and be able to identify, locate, evaluate and effectively use it to solve a problem.

CONTENT STANDARD	INDICATORS AND EXEMPLAR(S)	CORE COMPETENCIES
	B7.2.1.1.4. Demonstrate how to spell check, carry out content translation, language setting **Exemplar(s):** 1. Demonstrate the use of the Proofing and Language group under the Review tab 2. Show how to use the Language, Spelling & Grammar, Thesaurus and other tools in MS-Word under the Home tab. NB**:** This is to help learners gain software knowledge in office applications (word processing) to grasp the concept better.	**DL5.1:** Ability to ascertain when information is needed and be able to identify, locate, evaluate and effectively use it to solve a problem.

STRAND 2: PRODUCTIVITY SOFTWARE

SUB-STRAND 2: INTRODUCTION TO PRESENTATION SOFTWARE

B7.2.2.1 Demonstrate how to use Microsoft PowerPoint (Editing): Introduction to PowerPoint.	**B7.2.2.1.1. Explain the importance of presentation software** **Exemplar(s):** 1. Discuss the meaning of presentation software. 2. Discuss the benefits of using presentation software. 3. Brainstorm to elicit the names of some common presentation software packages (e.g. MS-PowerPoint, Corel Presentation, Adobe persuasion, Google Slides, Keynotes etc.)	**DL5.1:** Ability to ascertain when information is needed and be able to identify, locate, evaluate and effectively use it to solve a problem
	B7.2.2.1.2. Explore features of MS-PowerPoint interface. **Exemplar(s):** 1. Show examples of MS-PowerPoint interface with the aid of a projector or pictures. 2. Explore MS-PowerPoint themes and templates 3. Explore the use of the Proofing and Language group under the Review tab 4. Demonstrate the use of the Language, Spelling & Grammar, Thesaurus and other buttons in MS-PowerPoint under the Review tab	**DL5.1:** Ability to ascertain when information is needed and be able to identify, locate, evaluate and effectively use it to solve a problem.

	B7.2.2.1.3. Demonstrate how to use Special Characters. **Design a 7-slide presentation in MS-PowerPoint using the tools under the *Insert* ribbon.** **Exemplar(s):** 1. Explore the use of special characters section under the Insert tab under the Symbol group 2. Present a prepared project or exercise using the editing group of the ribbons studied. 3. Use projected examples of a PowerPoint interface with the aid of a projector or pictures. NB: This is to help learners gain software knowledge of MS PowerPoint to grasp the concept better.	**CI5.4:** Ability to visualise alternatives, see possibilities and identify problems and challenges. **CC9.6:** Ability to work with all group members to complete a task successfully.

STRAND 2: PRODUCTIVITY SOFTWARE

SUB-STRAND 3: INTRODUCTION TO ELECTRONIC SPREADSHEET

CONTENT STANDARD	INDICATORS AND EXEMPLAR(S)	CORE COMPETENCIES
B7.2.3.1. Demonstrate how to use the Spreadsheet (Editing Worksheets)	**B7.2.3.1.1. Explain the importance of electronic spreadsheet** **Exemplar(s):** 1. Discuss the meaning of electronic spreadsheet. 2. Discuss the benefits of using electronic spreadsheet software. 3. Brainstorm to elicit response some common electronic spreadsheet software packages (e.g. MS Excel, Lotus 1-2-3, LibreOffice Calc, Google Sheets etc.)	**DL5.1:** Ability to ascertain when information is needed and be able to identify, locate, evaluate and effectively use it to solve a problem.
	B7.2.3.1.2. Explore features of MS-Excel interface **Exemplar(s):** 1. Show projected examples of MS-Excel interface with the aid of a projector or pictures. 2. Explore operations of inserting, selecting, deleting and moving data. 3. Demonstrate how to insert, select, delete and move data using a sample data set.	**DL5.1:** Ability to ascertain when information is needed and be able to identify, locate, evaluate and effectively use it to solve a problem.
	B7.2.3.1.3. Demonstrate how to set the cell datatype (General, Number, Currency, etc.). **Exemplar(s):** 1. Investigate how to set and modify the cell type of values and text. 2. Enter values, text, dates and time in worksheet cells and change the formats for presentation. E.g. General, Number, Currency, Accounting, Dates, Time, etc.	**DL5.1:** Ability to ascertain when information is needed and be able to identify, locate, evaluate and effectively use it to solve a problem.

CONTENT STANDARD	INDICATORS AND EXEMPLAR(S)	CORE COMPETENCIES
	B7.2.3.1.4. Demonstrate how to use Align Text, Merge & Wrap, Borders and Shades **Exemplar(s):** 1. Demonstrate how to change text alignment (Horizontal & Vertical), merge cells and wrap text. 2. Investigate how to access border & shade features and format the appearance of a worksheet as group work.	**DL5.1:** Ability to ascertain when information is needed and be able to identify, locate, evaluate and effectively use it to solve a problem.

STRAND 3: COMMUNICATION NETWORKS

SUB-STRAND 1: COMPUTER NETWORKS

CONTENT STANDARD	INDICATORS AND EXEMPLAR(S)	CORE COMPETENCIES
B7.3.1.1. Identify the concept of computer networking for global communications	**B7.3.1.1.1 Draw diagrams to illustrate features of the network topologies (Bus, Star, Ring, Mesh)** **Exemplar(s):** 1. Explore key hardware for setting up network systems (such as server, client, hub, switch, cable, etc.). 2. Explain network topologies. 3. Discuss the features of each network topology. 4. Present in groups diagrams of well-elaborated network topologies. NB: Watch any appropriate video on the above	**CI6.1:** Exhibit strong memory, intuitive thinking and respond appropriately. **DL5.1:** Ability to ascertain when information is needed and be able to identify, locate, evaluate and effectively use it to solve a problem
	B7.3.1.1.2 Describe types of networks [Personal Area Network (PAN), Local Area Network (LAN), Metropolitan Area Network (MAN), Wide Area Network (WAN)] **Exemplar(s):** 1. Explain the various types of networks available (e.g. PAN, LAN, MAN, WAN, WLAN, INTERNET, etc.). - A Metropolitan Area Network (MAN) connects local networks across a larger geographical region.	**CI6.6:** Being open-minded, adapting and modifying ideas to achieve creative results. **DL5.4:** Ability to construct knowledge from a non-linear hyper textual navigation

CONTENT STANDARD	INDICATORS AND EXEMPLAR(S)	CORE COMPETENCIES
	B7.3.1.1.3 Discuss the entrepreneurial opportunities in networking computing devices **Exemplar(s):** 1. Discuss the benefits and challenges of networking in different environments (school, business, health, etc.). 2. Identify different environments where the various types of networks can be applied 3. Identify the business aspect of networking and how they can be turned into a lucrative business.	**DL5.4:** Ability to construct knowledge from a non-linear hyper textual navigation

STRAND 3: COMMUNICATION NETWORKS

SUB-STRAND 2: INTERNET AND SOCIAL MEDIA

CONTENT STANDARD	INDICATORS AND EXEMPLAR(S)	CORE COMPETENCIES
B7.3.2.1 Demonstrate the use of Social Networking and Electronic Mail	**B7.3.2.1.1 Identify the various types and uses of Social Media sites such as those for Social Networking (Facebook, LinkedIn, WhatsApp) and Microblogging (Twitter, Tumblr)** **Exemplar(s):** 1. Illustrate the use of social networking sites such as Facebook, LinkedIn, WhatsApp, etc. 2. Demonstrate the use of microblogging platforms such as Twitter, Tumblr, etc.	**CI 6.3:** Ability to select the most effective creative tools for work, and give reasons for the choice **DL6.3:** Use digital tools to create novel things
	B7.3.2.1.2 Demonstrate the use of the following features of Electronic mail: Attachment and Address book **Exemplar(s):** 1. Demonstrate the steps in creating, sending and receiving email 2. Demonstrate replying to and forwarding email 3. Demonstrate, giving reasons for using from: To: cc:, bcc: and subject features when sending an email.	**CI 6.3:** Ability to select the most effective creative tools for work, and give reasons for the choice **DL:** Create and use digital content

STRAND 3: COMMUNICATION NETWORKS

SUB-STRAND 3: INFORMATION SECURITY

CONTENT STANDARD	INDICATORS AND EXEMPLAR(S)	CORE COMPETENCIES
B7.3.3.1. Recognise data threats and means of protection	**B7.3.3.1.1 Discuss the key principles of information security (confidentiality, integrity and availability)** **Exemplar(s):** 1. Research in pairs the key principles of information security. 2. Discuss the three key principles of information security. 3. Research scenarios involving information security	**DL6.5:** Recognition of societal issues emanating from the use of digital technologies **CC8.1:** Speak clearly and explain ideas. Share a narrative or extended answer while speaking to a group.
	B7.3.3.1.2 Explore the legal issues regarding intellectual property rights (e.g. Copyright, Patent, Trademark, Piracy, Copyright Infringement) **Exemplar(s):** 1. Discuss issues pertaining to copyright (e.g. freeware, shareware, crippleware). 2. Differentiate between the various legal issues mentioned. 3. Discuss the consequences associated with breaking these laws.	**DL5.1:** Ability to ascertain when information is needed and be able to identify, locate, evaluate and effectively use it to solve a problem. **CC8.4:** Anticipate different responses from the participants and plan for them.
B7.3.3.1. Recognise data threats and means of protection	**B7.3.3.1.3 Evaluate information security forensic auditing and criminal laws against offenders** **Exemplar(s):** 1. Watch a video of how offenders of data security breach are identified. 2. Discuss the laws protecting data and the applicable sanctions for their breach. 3. Identify some common occurrences of data security breaches that people in the community overlook and their corresponding sanctions.	**DL6.6:** Knowledge and recognition of ethical use of information **CC9.5:** Appreciate importance of including all team members in discussions and actively encourage contributions from them

STRAND 3: COMMUNICATION NETWORKS

SUB-STRAND 4: WEB TECHNOLOGIES

CONTENT STANDARD	INDICATORS AND EXEMPLAR(S)	CORE COMPETENCIES
B7.3.4.1. Demonstrate the use of a Web Browser (Search engine)	**B7.3.4.1.1 Identify the importance of the web in learning [Virtual Learning Environments (VLEs)]** **Exemplar(s):** 1. Explore the importance of VLEs for learning. • Allow self-paced learning (E-learning). • Create opportunity to learn new skills without having to use a regular classroom.	**CC6.1:** Exhibit strong memory, intuitive thinking; and respond appropriately **DL5.1:** Ability to ascertain when information is needed and be able to identify, locate, evaluate and effectively use it to solve a problem
	B7.3.4.1.2 Explore the use of open learning websites in the classroom **Exemplar(s):** 1. Explore the uses of open learning websites in the classroom e.g. Khan Academy, Coursera, Edx, Saylor, etc.	**CI5.4:** Ability to visualise alternatives, see possibilities, and identify problems and challenges. **DL6.3:** Use digital tools to create novel things.
	B7.3.4.1.3 Demonstrate the techniques for evaluating web pages (Accuracy, Credibility, Content, Current, Functionality) **Exemplar(s):** 1. Demonstrate the techniques for evaluating web pages. • Accuracy: How true is the information? • Credibility: Who wrote the page? Is the person an expert in the subject matter? • Content: Is it on the correct subject matter? • Current: Is the content up-to-date? When was the last time it was updated? • Functionality: Does the site work well?	**DL5.1:** Ability to ascertain when information is needed and be able to identify, locate, evaluate and effectively use it to solve a problem

STRAND 4: COMPUTATIONAL THINKING

SUB-STRAND 1: INTRODUCTION TO PROGRAMMING

CONTENT STANDARD	INDICATORS AND EXEMPLAR(S)	CORE COMPETENCIES
B7.4.1.1. Show an understanding of the concept of programming	**B7.4.1.1.1 Demonstrate the correct use of programming terminologies** **Exemplar(s):** 1. List the terminologies in alphabetical order or grouping to aid recall 2. Explain each of the terminologies	**CC8.1:** Speak clearly and explain ideas. Share a narrative or extended answer while speaking to a group **DL5.5:** Evaluate the quality and validity of information
	B7.4.1.1.2 Demonstrate understanding in the use of data types (e.g. float, integer, string, char, etc.) **Exemplar(s):** 1. Develop key questions around daily activities to identify the data type. Example: The first name of your best friend is written as a string data type.	**CP5.1:** Ability to combine information and ideas from several sources to reach a conclusion **DL6.5:** Recognition of societal issues emanating from the use of digital technologies
	B7.4.1.1.3 Demonstrate the use of constants and variables used in programming **Exemplar(s):** 1. Show how constants and variables are used in programming. 2. Discuss the benefits of using variables instead of constants.	**CC8.2:** Explain ideas in a clear order with relevant detail, using correct construction and structure of speech.

STRAND 4: COMPUTATIONAL THINKING

SUB-STRAND 2: ALGORITHM

CONTENT STANDARD	INDICATORS AND EXEMPLAR(S)	CORE COMPETENCIES
B7.4.2.1. Analyse the correct step-by-step procedure in solving any real-world problem	**B7.4.2.1.1 Understand the use of sequence, selection and iteration in writing a programme. Describe the meanings of the term's algorithm, decomposition and abstraction** **Exemplar(s):** 1. Write numbers (1-10) in an orderly arrangement to represent sequence. Write your itinerary for a day in a logical order (Sequence). NB: The above should be linear with no branching statements. 2. Present a case study that has more than one option to choose from and still achieve the same outcome with any option chosen. For example, tea with or without sugar options can still meet a beverage outcome (selection). 2. Develop a solution to a problem which uses iteration to control the flow of the programme **(iteration).** NB: Programs such as lightbot could be used for practical lessons.	**CP6.1:** Ability to effectively define goals towards solving a problem **CC8.2:** Explain ideas in a clear order with relevant detail, using correct construction and structure of speech.
	B7.4.2.1.2 Perform a linear search **Exemplar(s):** 1. Locate a given value position out of listed values. 2. Arrange some given values or data in increasing and decreasing order.	**CP6.1:** Ability to effectively define goals towards solving a problem.

STRAND 4: COMPUTATIONAL THINKING

SUB-STRAND 3: ROBOTICS

CONTENT STANDARD	INDICATORS AND EXEMPLAR(S)	CORE COMPETENCIES
B7.4.3.1 Discuss Robot Intelligence Concepts	**B7.4.3.1.1 Review the various applications of robotic machines in society** **Exemplar(s):** 1. State the applications and uses of robots in society (e.g. manufacturing, health, education, assembling and packing, transport, surgery, laboratory research, mass production of consumer and industrial goods, taking pictures, etc.) 2. Explore prospects and challenges of using robots in various operations	**DL6.5:** Recognition of societal issues emanating from the use of digital technologies **CC8.2:** Explain ideas in a clear order with relevant detail, using correct construction and structure of speech.

STRAND 4: COMPUTATIONAL THINKING

SUB-STRAND 4: ARTIFICIAL INTELLIGENCE

CONTENT STANDARD	INDICATORS AND EXEMPLAR(S)	CORE COMPETENCIES
B7.4.4.1. Discuss Artificial intelligence concepts	**B7.4.4.1.1 Discuss the application of various areas of artificial intelligence (Machine learning, Artificial Neural Networks, Virtual Reality, Augmented Reality, Mixed Reality, Gamification** **Exemplar(s):** 1. Compare the key technologies: machine learning, Artificial Neural Networks (ANN), Reality, Augmented reality, Gamification, Deep Learning, Artificial Data Mining and Analytics. (NB: general definitions only) 2. Discuss the uses and importance of Artificial Intelligence (AI) to society. 3. Watch video/picture of the use of AI in society (intelligent robots).	**DL6.5:** Recognition of societal issues emanating from the use of digital technologies **CC8.1:** Speak clearly and explain ideas. Share a narrative or extended answer while speaking to a group

BASIC 8

STRAND 1: INTRODUCTION TO COMPUTING

SUB-STRAND 1: COMPONENTS OF COMPUTERS AND COMPUTER SYSTEMS

CONTENT STANDARD	INDICATORS AND EXEMPLAR(S)	CORE COMPETENCIES
B8.1.1.1. Examine the parts of a computer	**B8.1.1.1.1. Discuss the fourth-generation computers** **Exemplar(s):** 1. Discuss features of fourth generation computers 2. Identify a microchip 3. Explore the architecture of a processor	**Creativity and Innovation (CI), Communication and Collaboration (CC), Digital Literacy (DL),Critical thinking and Problem solving (CP). Cultural Identity and Global Citizenship, Personal Development and Leadership (PL)**
		CI6.1: Exhibit strong memory, intuitive thinking and respond appropriately; Recognise and generalise information and experience; search for trends and patterns. **CC8.1:** Speak clearly and explain ideas. Share a narrative or extended answer while speaking to a group.
	B8.1.1.1.2. Demonstrate understanding in the use of input devices (barcode, scanner, etc.) **Exemplar(s):** 1. Watch video or picture of input devices in use. 2. Demonstrate the use of input devices in a computer laboratory/classroom. 3. Explore the advantages and disadvantages of input devices.	**CC8.1:** Speak clearly and explain ideas. Share a narrative or extended answer while speaking to a group. **DL5.3:** Ability to find and utilise digital content

CONTENT STANDARD	INDICATORS AND EXEMPLAR(S)	CORE COMPETENCIES
B8.1.1.1. Examine the parts of a computer	**B8.1.1.1.3. Examine the uses of the output devices: graphing plotter, data and multimedia projectors as well as pico projector** **Exemplar(s):** 1. Watch video or pictures of output devices in use. 2. Demonstrate the use of output devices in a computer laboratory/classroom. 3. Explore the advantages and disadvantages of output devices.	**CC8.1:** Speak clearly and explain ideas. Share a narrative or extended answer while speaking to a group. **DL5.3:** Ability to find and utilise digital content
	B8.1.1.1.4 Examine Storage portable hard drives, Optical Discs and Drives. **Exemplar(s):** E. g. Read-Only Optical Discs: CD-ROM, DVD-ROM, and BD-ROM Discs Recordable Optical Discs: CD-R, DVD-R, DVD+R and BD-R Discs Rewritable Optical Discs: CD-RW, DVD-RW, DVD+RW and BD-RE Discs **Exemplar(s):** 1. Identify portable hard drives/Optical Discs and Drives or pictures of these items to class. 2. Discuss the features of hard drives/Optical Disc storage media. 3. Explore the maximum capacities of these storage devices. 4. Explore the different write speeds of these storage devices.	**CC8.1:** Speak clearly and explain ideas. Share a narrative or extended answer while speaking to a group. **DL5.3:** Ability to find and utilise digital content.

CONTENT STANDARD	INDICATORS AND EXEMPLAR(S)	CORE COMPETENCIES
B8.1.1.2. Demonstrate the use of the features of a desktop	**B8.1.1.2.1 Discover temporal peeking into a window on a taskbar** **Exemplar(s):** 1. Explore the features of the taskbar. 2. Demonstrate how to preview windows on the taskbar.	**CC8.1:** Speak clearly and explain ideas. Share a narrative or extended answer while speaking to a group. **DL5.3:** Ability to find and utilise digital content.
	B8.1.1.2.2 Practice file management techniques (Users & Accounts) **Exemplar(s):** 1. Explore different account levels for users of computer systems. 2. Explore different permission levels that are applied to files and folders.	**DL5.6:** Preparedness to make better decisions using available information.
B8.1.1.3. Demonstrate the use of Data and identify sources of data	**B8.1.1.3.1 Learn Probabilistic Data Structures and Distinct Value Sketches** **Exemplar(s):** 1. Demonstrate the use of logical statements with the use of counters for increasing and decreasing values. 2. Explore the use of counters in automated systems (e.g. hotel reservation, booking a flight, etc.)	**CC8.3**: Apply appropriate diction, and structure sentences correctly for narrative, persuasive, imaginative and expository purposes **DL5.6:** Preparedness to make better decisions using available information.

STRAND 1: INTRODUCTION TO COMPUTING

SUB-STRAND 2: TECHNOLOGY IN THE COMMUNITY (COMMUNICATION)

CONTENT STANDARD	INDICATORS AND EXEMPLAR(S)	CORE COMPETENCIES
B8.1.2.1. Demonstrate the use of technology in the community	**B8.1.2.1.1. Examine the negative impact of computers and computer use on the environment** **Exemplar(s):** 1. Observe people who use and work with computers in the community. 2. Visit websites or watch videos/pictures of how computers, including other electronic components, are disposed of. 3. Discuss the impact of computers and computer use on the environment.	**CC8.1:** Speak clearly and explain ideas. Share a narrative or extended answer while speaking to a group. Explain ideas in a clear order with relevant detail, using conjunctions to structure and speech. **DL6.5:** Recognition of societal issues emanating from the use of digital technologies.
	B8.1.2.1.2. Propose environmentally responsible practices that can be used to reduce the negative impact of computers and computer use on the environment **Exemplar(s):** 1. Discuss how the negative effects identified can be reduced. 2. Evaluate environmentally responsible practices. 3. Propose measures to effectively manage e-waste in a particular environment (e.g. Agbogbloshie).	**CG6.4:** Exhibit a sense of nationality and global identity. **CC8.1:** Speak clearly and explain ideas. Share a narrative or extended answer while speaking to a group. **PL5.3:** Recognise one's emotional state and their preparedness to apply emotional intelligence.
	B8.1.2.1.3. Create a component from disposed computer parts. **Exemplar(s):** 1. Collect disposed computer/electronic parts from the community. 2. Watch a video/picture depicting the recycling of computer parts.	**CI 5.2:** Ability to merge simple/complex ideas to create novel situations or things **PL5.3:** Recognise one's emotional state and their preparedness to apply emotional intelligence.

STRAND 1: INTRODUCTION TO COMPUTING

SUB-STRAND 3: HEALTH AND SAFETY IN THE USE OF ICT TOOLS

CONTENT STANDARD	INDICATORS AND EXEMPLAR(S)	CORE COMPETENCIES
B8.1.3.1. Demonstrate how to apply Health and Safety measures in Using ICT Tools	**B8.1.3.1.1 Examine workstation health risk assessment methods** **Exemplar(s):** 1. Explore the risks associated with workstations and how to overcome them (e.g. wrist pains, eye problems, back and neck pains, faulty electrical connections, etc.)	**PL5.3:** Recognise one's emotional state and their preparedness to apply emotional intelligence. **CP 5.7:** Provide new insight into controversial situation or task
	B8.1.3.1.2 Explore safety measures at workstations **Exemplar(s):** 1. Identify measures that will help to eliminate workstation hazards and where they cannot be eliminated, discuss how to minimise the risk. (e.g. evaluating display screen, adjusting the chair for comfort, avoiding potential slips and falls, re-positioning of devices, etc.)	**PL5.3:** Recognise one's emotional state and their preparedness to apply emotional intelligence **CP 5.7:** Provide new insight into controversial situation or task

STRAND 2: PRODUCTIVITY SOFTWARE

SUB-STRAND 1: INTRODUCTION TO WORD PROCESSING

CONTENT STANDARD	INDICATORS AND EXEMPLAR(S)	CORE COMPETENCIES
B8.2.1.1 Demonstrate how to use Microsoft Word (Formatting Text)	**B8.2.1.1.1. Demonstrate how to use text-decoration, change text case, text size and colour** **Exemplar(s):** 1. Explore the use of the Font group under the Home tab 2. Demonstrate the use of sentence case, font size, colour and font decoration features in MS-Word 3. Project examples of MS-Word interface to learners with the aid of a projector or pictures.	**DL5.1:** Ability to ascertain when information is needed and be able to identify, locate, evaluate and effectively use it to solve a problem. **CI5.4:** Ability to visualise alternatives, see possibilities and identify problems and challenges
	B8.2.1.1.2. Demonstrate how to align text, indent paragraphs, bullet, line space and shade **Exemplar(s):** 1. Explore the use of the Paragraph group, using the align left, centre, align right and justified in MS-Word under the Home tab. 2. Explore the use of Bullets, Decrease and Increase Indentation under the Home tab. 3. Identify the use of the Border Button and set line spacing using the dialogue Box Launcher button under the Home tab.	**DL5.1:** Ability to ascertain when information is needed and be able to identify, locate, evaluate and effectively use it to solve a problem. **CI5.4:** Ability to visualise alternatives, see possibilities and identify problems and challenges
B8.2.1.1 Demonstrate how to use Microsoft Word (Formatting Text)	**B8.2.1.1.3. Demonstrate how to set tabs and apply formatting** **Exemplar(s):** 1. Explore the Tab button to set the centre and right tabs NB: This is to help learners with software knowledge in office applications (word processing) to grasp the concept better.	**DL5.1:** Ability to ascertain when information is needed and be able to identify, locate, evaluate and effectively use it to solve a problem **CI5.4:** Ability to visualise alternatives, see possibilities and identify problems and challenges

STRAND 2: PRODUCTIVITY SOFTWARE

SUB-STRAND 2: INTRODUCTION TO PRESENTATION

CONTENT STANDARD	INDICATORS AND EXEMPLAR(S)	CORE COMPETENCIES
B8.2.2.1 Demonstrate how to use Microsoft PowerPoint (Formatting)	**B8.2.2.1.1. Demonstrate how to change text case, text size, text colour and decorate text** **Exemplar(s):** 1. Explore the use of the Font group under the ***Home*** ribbon. 2. Make use of the sentence case, font size, colour and font decoration features in MS-PowerPoint 3. Project examples of PowerPoint interface to learners with the aid of a projector or pictures.	**DL5.1:** Ability to ascertain when information is needed and be able to identify, locate, evaluate and effectively use it to solve a problem. **CI5.4:** Ability to visualise alternatives, see possibilities, and identify problems and challenges**.**
B8.2.2.1 Demonstrate how to use Microsoft PowerPoint (Formatting)	**B8.2.2.1.2. Demonstrate how to align text, indent paragraphs, borders and shades.** **Exemplar(s):** 1. Explore the use of the Proofing and Language Sections under the Review ribbon. 2. Use the Language, Spelling & Grammar, Thesaurus and other buttons in MS-PowerPoint under the Review ribbon.	**DL5.1:** Ability to ascertain when information is needed and be able to identify, locate, evaluate and effectively use it to solve a problem. **CI5.4:** Ability to visualise alternatives, see possibilities, and identify problems and challenges.
	B8.2.2.1.3. Demonstrate the use of the Slide Master, design template, and be able to give a 5-slide presentation in MS-PowerPoint using the tools of the ribbons studied. **Exemplar(s):** 1. Explore the use of Master Views group under the View ribbon 2. Prepare and present a prepared project or exercise using what has been studied in Indicator 1 and 2. NB: This is to help the learners with software knowledge in MS-PowerPoint, Office Applications to grasp the concept well.	**DL5.1:** Ability to ascertain when information is needed and be able to identify, locate, evaluate and effectively use it to solve a problem **CI5.4:** Ability to visualise alternatives, see possibilities, and identify problems and challenges.

STRAND 2: PRODUCTIVITY SOFTWARE

SUB-STRAND 3: INTRODUCTION TO ELECTRONIC SPREADSHEET

CONTENT STANDARD	INDICATORS AND EXEMPLAR(S)	CORE COMPETENCIES
B8.2.3.1. Demonstrate how to format a worksheet	**B8.2.3.1.1 Demonstrate how to adjust margins and set page orientation** **Exemplar(s):** 1. Demonstrate how to adjust margins and set page orientation for printing. 2. Perform margin adjustment on different page sizes 3. Explore the display of worksheets in different views as listed on the View tab.	**DL5.1:** Ability to ascertain when information is needed and be able to identify, locate, evaluate and effectively use it to solve a problem. **CI5.4:** Ability to visualise alternatives, see possibilities and identify problems and challenges.
	B8.2.3.1.2. Demonstrate how to set up a header and a footer. **Exemplar(s):** 1. Demonstrate how to set up header and footer elements. 2. Explore the use of page numbers, current date, time and file name in setting up headers and footers.	**DL5.1:** Ability to ascertain when information is needed and be able to identify, locate, evaluate and effectively use it to solve a problem
	B8.2.3.1.3. Demonstrate the use of the Autofill function in MS-Excel worksheet **Exemplar(s):** 1. Demonstrate the use of the Autofill function e.g. to generate the days of the week, months of the year, set of numbers (e.g. counting numbers, odd numbers, multiplication tables etc.).	**DL5.1:** Ability to ascertain when information is needed and be able to identify, locate, evaluate and effectively use it to solve a problem
B8 2.3.2 Demonstrate how to use spreadsheet formula	**B8.3.2.1. Demonstrate how to create formulas** **Exemplar(s):** 1. Create simple formulas starting with the equal sign (=)	**DL5.1:** Ability to ascertain when information is needed and be able to identify, locate, evaluate and effectively use it to solve a problem. **CP5.1:** Ability to combine information and ideas from several sources to reach a conclusion

STRAND 3: COMMUNICATION NETWORKS

SUB-STRAND 1: COMPUTER NETWORKS

CONTENT STANDARD	INDICATORS AND EXEMPLAR(S)	CORE COMPETENCIES
B8.3.1.1. Identify the concept of computer networking for global communication	**B8.3.1.1.1 Describe the data communication models for networks.** **Exemplar(s):** 1. Explain the Open System Interconnection (OSI) model 2. Identify the different layers in the OSI model. 3. Discuss the purpose or benefits of the layers in ensuring interoperability of different hardware devices.	**CC9.1**: Demonstrate behaviour and skills of working towards group goals
	B8.3.1.1.2 Describe the Internet, world wide web (www) and Internet Protocol (IP) addresses **Exemplar(s):** 1. Describe the Internet and the classes of internet addresses. 2. Explain the internet Domain Name Server (DNS), which is equivalent to the function of a phonebook. 3. Distinguish between IPv4 and IPv6 addresses. 4. Explore the difference between internet and world wide web (www).	**CC7.5**: Identify and analyse different points of views of speaker

STRAND 3: COMMUNICATION NETWORKS

SUB-STRAND 2: INTERNET AND SOCIAL MEDIA

CONTENT STANDARD	INDICATORS AND EXEMPLAR(S)	CORE COMPETENCIES
B8.3.2.1 Demonstrate the use of Social Networking and Electronic Mail	**B8.3.2.1.1 Identify the various types of Social Media sites such as those for photo sharing (Instagram, Snapchat, Pinterest, etc.) and video sharing (YouTube, Facebook Live, Periscope, Vimeo, etc.)** **Exemplar(s):** 1. Discuss the use of photo sharing sites such as Instagram, Snapchat, Pinterest, etc. 2. Demonstrate the use of video sharing platforms such as YouTube, Facebook Live, Periscope, Vimeo, etc. 3. Illustrate the steps involved in attaching a document to an email. 4. Explore the use of the address book as a feature of email.	**CC8.2:** Explain ideas in a clear order with relevant detail, using correct construction and structure of speech. **DL6.5:** Recognition of societal issues emanating from the use of digital technologies

STRAND 3: COMMUNICATION NETWORKS

SUB-STRAND 3: INFORMATION SECURITY

CONTENT STANDARD	INDICATORS AND EXEMPLAR(S)	CORE COMPETENCIES
B8.3.3.1. Recognise data threats and security protections	**B8.3.3.1.1 Describe the nature of four major data threats (Interruption, Interception, Modification, Fabrication)** **Exemplar(s):** 1. Watch a video on threats to data security. 2. Discuss the threats that can prevent information from reaching its destination. 3. Discuss the threats that can cause data corruption. 4. Describe the nature of the four major data threats.	**CC8.2:** Explain ideas in a clear order with relevant detail, using correct construction and structure of speech. **DL6.5:** Recognition of societal issues emanating from the use of digital technologies
B8.3.3.1. Recognise data threats and security protections	**B8.3.3.1.2 Map the protection methods to each of the four identified data threats (Authorisation, Authentications, Encryption and Decryption)** **Exemplar(s):** 1. Brainstorm the methods of protecting data against the four main threats. 2. Describe the threats to data security and the methods of preventing each threat.	**CC9.1**: Demonstrate behaviour and skills of working towards group goals **CP 5.5:** Effectively evaluate the success of solutions used in an attempt to solve a complex problem.

STRAND 3: COMMUNICATION NETWORKS

SUB-STRAND 4: WEB TECHNOLOGIES

CONTENT STANDARD	INDICATORS AND EXEMPLAR(S)	CORE COMPETENCIES
B8.3.4.1. Demonstrate the use of a web browser (Search engine)	**B8.3.4.1.1 Demonstrate how to effectively search from a web browser.** **Exemplar(s):** 1. Identify effective search techniques (e.g. using search phrases with exact spelling, use of AND, OR, NOT, etc. 2. Demonstrate how to search with any of the techniques or a combination of techniques.	**CP 5.5:** Effectively evaluate the success of solutions used in an attempt to solve a complex problem **CP6.5:** Ability to select alternative(s) that adequately meet selected criteria
	B8.3.4.1.2 Explore the use of more than one search engine **Exemplar(s):** 1. Investigate the use of more than one search engine e.g. Ask, Google, yahoo! 2. Explore different search engines with the same search string/terms and observe the outcome 3. Discuss the results of your findings in Exemplar(s): 2 above.	**DL5.1:** Ability to ascertain when information is needed and be able to identify, locate, evaluate and effectively use it to solve a problem **CP5.1:** Ability to combine information and ideas from several sources to reach a conclusion

STRAND 4: COMPUTATIONAL THINKING

SUB-STRAND 1: INTRODUCTION TO PROGRAMMING

CONTENT STANDARD	INDICATORS AND EXEMPLAR(S)	CORE COMPETENCIES
B8.4.1.1. Show an understanding of the concept of programming	**B8.4.1.1.1 Describe the basic concepts in programming (Constants, Variables, Expressions, Statements /Instructions, logical and arithmetic operators, Operator precedence, etc.)** **Exemplar(s):** 1. Create a table to compare how the same arithmetic notations are represented in coding and in classroom mathematics.	**CP5.1:** Ability to combine information and ideas from several sources to reach a conclusion.

STRAND 4: COMPUTATIONAL THINKING

SUB-STRAND 2: ALGORITHM

CONTENT STANDARD	INDICATORS AND EXEMPLAR(S)	CORE COMPETENCIES
B8.4.2.1. Analyse the correct step-by-step procedure in solving any real-world problem	**B8.4.2.1.1 Apply variables, expressions, assignment statements and operator precedence order (BODMAS rule) to process and store numbers and text in a programme** **Exemplar(s):** 1. Compute an expression following the operator precedence order (BODMAS) to exemplify how computers process input data to print out an answer.	**CP 5.5:** Effectively evaluate the success of solutions used in an attempt to solve a complex problem
B8.4.2.1. Analyse the correct step-by-step procedure in solving any real-world problem	**B8.4.2.1.2 Describe and use sequence, selection and iteration statements in a programme. Understand the difference between variables and constants and be able to choose appropriate naming conventions when writing statements.** **Exemplar(s):** 1. Draw the four basic symbols representing programme start-stop, input-output, process and decision. 2. Identify a real case problem in the environment and arrange the symbols to represent a logical step-by-step sequence in solving that problem. (Example, illustrate the logical steps to prepare the land for a maize farm).	**CP6.5:** Ability to select alternative(s) that adequately meet selected criteria **CP 5.5:** Effectively evaluate the success of solutions used in an attempt to solve a complex problem

STRAND 4: COMPUTATIONAL THINKING

SUB-STRAND 3: ROBOTICS

CONTENT STANDARD	INDICATORS AND EXEMPLAR(S)	CORE COMPETENCIES
B8.4.3.1. Discuss Robot Intelligence Concepts	**B8.4.3.1.1 Describe the principles underlying the operation of the components of a robot (Controller Mechanical, Sensors)** **Exemplar(s):** 1. Explain the controller as the "brain" of the robot. 2. Demonstrate understanding of mechanical parts such as motors, pistons, grippers, wheels and gears that make the robot move, grab, turn around or lift (Actuators). 3. Watch video/pictures of the various parts of the robot. 4. Describe how a range of sensors can be used to input data into a computer system, including light, temperature, magnetic field, gas, pressure, moisture, humidity, pH and motion 5. Describe how these sensors are used in real-life scenarios, for example: street lights, security devices, pollution control, games, and household and industrial applications NB: Sensors are used to estimate a robot's condition and environment. The controller is run by a computer programme	**CC8.2:** Explain ideas in a clear order with relevant detail, using correct construction and structure of speech **CP 5.2:** Analyse and make distinct judgement about viewpoints expressed in an argument

STRAND 4: COMPUTATIONAL THINKING

SUB-STRAND 4: ARTIFICIAL INTELLIGENCE

CONTENT STANDARD	INDICATORS AND EXEMPLAR(S)	CORE COMPETENCIES
B8.4.4.1 Discuss Artificial Intelligence Concepts	**B8.4.4.1.1 Discuss Artificial Neural Networks (ANN) and compare intelligence in humans, animals and machines** **Exemplar(s):** 1. Compare intelligence in humans, animals and machines. 2. Compare the limitations and capabilities of the three intelligences in processing information 3. Discuss the difference between strong and weak artificial intelligence. 4. Discuss hologram science basics and link the application in creating a 3Dimension mixed reality (MR) intelligence.	**CC9.3**: Understand roles during group activities

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STRAND 1: INTRODUCTION TO COMPUTING

SUB-STRAND 1: COMPONENTS OF COMPUTERS AND COMPUTER SYSTEMS

CONTENT STANDARD	INDICATORS AND EXEMPLAR(S)	CORE COMPETENCIES
B9.1.1.1. Identify parts of a computer and technology tools	**B9.1.1.1.1. Discuss the fifth generation of computers with emphasis on quantum computing** **Exemplar(s):** 1. Discuss the features of the fifth-generation computers. 2. Describe quantum computing using the Google operational quantum computing called "Sycamore". 3. Discuss parallel processing hardware and Artificial Intelligence (AI) software.	**Communication and Collaboration (CC), Digital Literacy (DL)** **CC8.1:** Speak clearly and explain ideas. Share a narrative or extended answer while speaking to a group.
	B9.1.1.1.2. Demonstrate understanding of direct data entry devices (Graphic Tablet, Magnetic Card Reader, Optical Card Reader, QR code reader, Radio Frequency Identification (RFID) Readers) **Exemplar(s):** 1. Identify Graphic tablet, Magnetic card reader, optical card reader, QR code reader, Radio Frequency Identification (RFID) Readers from video or pictures. 2. Explore features of these input devices. 3. Explore how these input devices work in real life situations. 4. Generate QR codes and link them to specific websites.	**DL5.3:** Ability to find and utilise digital content.

CONTENT STANDARD	INDICATORS AND EXEMPLAR(S)	CORE COMPETENCIES
B9.1.1.1. Identify parts of a computer and technology tools	**B9.1.1.1.3. Examine the uses of the output devices: Braille printers, Impact, Inkjet, Thermal, Wax, 3D printers** **Exemplar(s):** 1. Identify Braille printers, Impact, Inkjet, Thermal, Wax, 3D printers from pictures or videos. 2. Explore the features of these output devices. 3. Explore how these output devices work in real life situations.	**DL5.3:** Ability to find and utilise digital content
	B9.1.1.1.4 Describe storage devices: Flash Memory Storage Systems, Embedded Flash Memory Cards and Readers, USB Flash Drives, Solid State Drives and Hybrid hard drives **Exemplar(s):** 1. Illustrate the use of Flash Memory Storage Systems, Embedded Flash Memory, Flash Memory Cards and Readers, USB Flash Drives, Solid State Drives and Hybrid hard drives. 2. Discuss the features of Flash Memory Storage Systems, Embedded Flash Memory Flash Memory Cards and Readers.	**CC8.1:** Speak clearly and explain ideas. Share a narrative or extended answer while speaking to a group. **DL5.3:** Ability to find and utilise digital content
B9.1.1.2. Demonstrate the use of the Desktop features.	**B9.1.1.2.1 Explore the use of the Charms bar** **Exemplar(s):** 1. Identify the icons in the Charms bar 2. Describe features of the Charms bar icons	**DL5.3:** Ability to find and utilise digital content
	B9.1.1.2.2. Practise file management techniques (Drive Management) **Exemplar(s):** 1. Demonstrate the file management techniques such as defragmentation, compression of files, etc. 2. Explore ways of partitioning a hard disk.	**DL5.3:** Ability to find and utilise digital content

STRAND 1: INTRODUCTION TO COMPUTING

SUB-STRAND 2: TECHNOLOGY IN THE COMMUNITY

CONTENT STANDARD	INDICATORS AND EXEMPLAR(S)	CORE COMPETENCIES
B9.1.2.1. Demonstrate the use of Technology in the Community	**B9.1.2.1.1. Discuss technologies that help to improve computer accessibility (adaptive and assistive technologies)** **Exemplar(s):** 1. Identify the categories of people with special needs. 2. Discuss technologies that can be used to help people with special needs (e.g. Computer software and hardware such as voice recognition programs, screen readers, and screen enlargement applications, to help people with mobility and sensory impairments use computers and mobile devices, etc.)	**DL5.3:** Ability to find and utilise digital content **CC8.1:** Speak clearly and explain ideas. Share a narrative or extended answer while speaking to a group.
	B9.1.2.1.2. Describe how portable computing devices affect our everyday lives **Exemplar(s):** 1. Discuss portable computing devices that we use daily e.g. mobile phones, smart watches, etc. 2. Describe how these devices affect our daily lives.	**DL5.3:** Ability to find and utilise digital content **CC8.1:** Speak clearly and explain ideas. Share a narrative or extended answer while speaking to a group.
	B9.1.2.1.3. Explain the issues associated with online services (e.g. social media, wikis, blogs, etc.) **Exemplar(s):** 1. Identify the online services that learners normally use or have access to. 2. Evaluate issues that are associated with online service delivery.	**DL5.3:** Ability to find and utilise digital content

STRAND 1: INTRODUCTION TO COMPUTING

SUB-STRAND 3: HEALTH AND SAFETY IN THE USE OF ICT TOOLS

CONTENT STANDARD	INDICATORS AND EXEMPLAR(S)	CORE COMPETENCIES
B9.1.3.1. Demonstrate How to Apply Health and Safety measures in Using ICT Tools	**B9.1.3.1.1 Discuss health issues at workstations** Exemplar (s): 1. Discuss the importance of taking regular breaks from bulk work (possibly after every hour). 2. Discuss the adoption of good posture while at the computer 3. Discuss the use of document holders to avoid having to lean over and bend your neck while looking at paperwork.	**PL5.6:** Ability to set and maintain personal standards and values. **DL5.3:** Ability to find and utilise digital content.
	B9.1.3.1.2 Discuss safety measures in risk reduction at workstations Exemplar (s): 1. Demonstrate the use of appropriate volumes when using speakers and earpieces. 2. Demonstrate the use of screen protectors/spectacles to control the amount of light received by our eyes. 3. Illustrate how not to overload electric sockets but use trailing multi-socket units rather than plug adapters.	**PL5.6:** Ability to set and maintain personal standards and values.

STRAND 2: PRODUCTIVITY SOFTWARE

SUB-STRAND 1: INTRODUCTION TO WORD PROCESSING

CONTENT STANDARD	INDICATORS AND EXEMPLAR(S):	CORE COMPETENCIES
B9.2.1.1 Demonstrate How to Use Microsoft Word (tables and hyperlink pages)	**B9.2.1.1.1. Demonstrate how to create a table and hyperlinks** **Exemplar(s):** 1. Explore the use of the Tables group under the Insert tab 2. Create tables, columns and resize them in MS-Word 3. Explore the use of hyperlinks to create non-linear presentations.	**CI5.4:** Ability to visualise alternatives, see possibilities and identify problems and challenges**.** **DL5.1:** Ability to ascertain when information is needed and be able to identify, locate, evaluate and effectively use it to solve a problem.
	B9.2.1.1.2. Demonstrate how to merge, split, add formula, borders and shades **Exemplar(s):** 1. Explore merging, splitting, adding formulas, borders and shades in MS-Word under the Insert tab. 2. Explore the use of the bullets; decrease and increase indentation under the Home tab. 3. Explore the use of the Border Button and set line spacing (e.g. explore the use of the dialogue Box Launcher button under the Home tab)	**DL5.1:** Ability to ascertain when information is needed and be able to identify, locate, evaluate and effectively use it to solve a problem.
	B9.2.1.1.3. Demonstrate how to format a page (e.g. page adjustment, inserting header and footer, page numbers, breaks and orientations) **Exemplar(s):** 1. Demonstrate how to format pages by adjusting the header, footer, page numbers, and page orientation NB. This is to help the learners with software knowledge in office applications (word processing) to grasp the concept better.	**DL5.1:** Ability to ascertain when information is needed and be able to identify, locate, evaluate and effectively use it to solve a problem.

STRAND 2: PRODUCTIVITY SOFTWARE

SUB-STRAND 2: INTRODUCTION TO PRESENTATION

CONTENT STANDARD	INDICATORS AND EXEMPLAR(S)	CORE COMPETENCIES
B9.2.2.1 Demonstrate how to use Microsoft PowerPoint (Multimedia)	**B9.2.2.1.1. Demonstrate how to add pictures, screenshot and edit and format pictures** **Exemplar(s):** 1. Explore the use of the Images Group under the Insert tab 2. Demonstrate the use of ClipArt, Photo Album and Screenshot 3. Project examples of the PowerPoint interface to learners with the aid of a projector or pictures.	**DL5.1:** Ability to ascertain when information is needed and be able to identify, locate, evaluate and effectively use it to solve a problem. **CC9.6:** Ability to work with all group members to complete a task successfully.
	B9.2.2.1.2. Demonstrate how to add a drawing canvas, shapes, and also edit, format and add text to shapes **Exemplar(s):** 1. Explore the use of the Illustrations group under the Insert tab 2. Illustrate the use of Shapes and SmartArt 3. Explore the use of the drawing canvas to group shapes.	**CI5.4:** Ability to visualise alternatives, see possibilities, and identify problems and challenges. **DL5.1:** Ability to ascertain when information is needed and be able to identify, locate, evaluate and effectively use it to solve a problem.
B9.2.2.1 Demonstrate how to use Microsoft PowerPoint (Multimedia)	**B9.2.2.1.3. Demonstrate how to add text to shapes and arrange shapes.** **Exemplar(s):** 1. Explore the use of the Format Ribbon once a shape is selected 2. Explore the editing features of the Insert Shapes and Shape Styles. 3. Present a prepared project or exercise using what has been studied in Indicator 1 and 2. NB: This is to help the learners with software knowledge in MS PowerPoint, Office Applications to grasp the concept well.	**CC9.6:** Ability to work with all group members to complete a task successfully **DL5.1:** Ability to ascertain when information is needed and be able to identify, locate, evaluate and effectively use it to solve a problem.

STRAND 2: PRODUCTIVITY SOFTWARE

SUB-STRAND 3: INTRODUCTION TO DESKTOP PUBLISHING

CONTENT STANDARD	INDICATORS AND EXEMPLAR(S)	CORE COMPETENCIES
B9.2.3.1. Demonstrate how to use MS-Publisher	**B9.2.3.1.1. Explain the importance of desktop publishing software (DTP)** **Exemplar(s):** 1. Discuss the meaning of desktop publishing software. 2. Brainstorm to elicit the importance of DTP. 3. Brainstorm to elicit responses of some DTP packages. (e.g. MS-Publisher, Adobe InDesign, LibreOffice Draw, QuarkXpress etc.)	**CI5.4:** Ability to visualise alternatives, see possibilities and identify problems and challenges. **DL5.1:** Ability to ascertain when information is needed and be able to identify, locate, evaluate and effectively use it to solve a problem.
	B9.2.3.1.2 Create and save a new document from a blank or pre-designed template **Exemplar(s):** 1. Open a desktop publishing software (e.g. MS-Publisher). 2. Create a new document from a blank publication 3. Create a new document from a pre-designed template. 4. Save the document with the appropriate name.	**CI5.4:** Ability to visualise alternatives, see possibilities and identify problems and challenges **DL5.1:** Ability to ascertain when information is needed and be able to identify, locate, evaluate and effectively use it to solve a problem
B9.2.3.1. Demonstrate how to use MS-Publisher	**B9.2.3.1.3 Demonstrate the use of the commands in MS-Publisher ribbons under each tab (Home, Page Design, Mailings, Review, View)** **Exemplar(s):** 1. Working in pairs, explore the use of the commands in a desktop publishing software (e.g. MS-Publisher ribbons: Home, Page Design, Mailings, Review, and View).	**CC9.6:** Ability to work with all group members to complete a task successfully. **DL5.1:** Ability to ascertain when information is needed and be able to identify, locate, evaluate and effectively use it to solve a problem.

CONTENT STANDARD	INDICATORS AND EXEMPLAR(S)	CORE COMPETENCIES
	B9.2.3.1.4 Change the orientation and margins of a document **Exemplar(s):** 1. Explore and change the orientation and margins of your document by working pairs.	**CC9.6:** Ability to work with all group members to complete a task successfully. **DL5.1:** Ability to ascertain when information is needed and be able to identify, locate, evaluate and effectively use it to solve a problem.
	B9.2.3.1.5 Add and modify pictures from different sources **Exemplar(s):** 1. Explore addition and modification of pictures from different sources to your document by working in pairs.	**CI5.4:** Ability to visualise alternatives, see possibilities and identify problems and challenges **DL5.1:** Ability to ascertain when information is needed and be able to identify, locate, evaluate and effectively use it to solve a problem.
B9.2.3.1. Demonstrate how to use MS-Publisher	**B9.2.3.1.6 Add and modify text** **Exemplar(s):** 1. Explore addition and modification of text using different font types in your document.	**DL5.1:** Ability to ascertain when information is needed and be able to identify, locate, evaluate and effectively use it to solve a problem.
	B9.2.3.1.7 Create and present a Publisher document (flyer, advertisement, invitation cards, business cards) **Exemplar(s):** 1. Create a one-page Publisher document e.g. flyer, advertisement, invitation cards, business cards, etc. 2. Present documents to demonstrate creative abilities.	**CC9.6:** Ability to work with all group members to complete a task successfully **CI5.4:** Ability to visualise alternatives, see possibilities and identify problems and challenges. **DL5.1:** Ability to ascertain when information is needed and be able to identify, locate, evaluate and effectively use it to solve a problem.

STRAND 2: PRODUCTIVITY SOFTWARE

SUB-STRAND 4: INTRODUCTION TO ELECTRONIC SPREADSHEET

CONTENT STANDARD	INDICATORS AND EXEMPLAR(S)	CORE COMPETENCIES
B9.2.4.1. Demonstrate How to Use the Spreadsheet (using functions and complex formulas)	**B9.2.4.1.1. Perform operations using functions and Built-in functions** **Exemplar(s):** 1. Enumerate the difference between formulas and functions. 2. Access built-in functions to perform operations on sample data. 3. Demonstrate the use of common spreadsheet functions such as SUM, AVERAGE, COUNT, COUNTA, COUNTIF, MAX and MIN.	**DL5.1:** Ability to ascertain when information is needed and be able to identify, locate, evaluate and effectively use it to solve a problem.
	B9.2.4.1.2 Demonstrate how to create complex formulas **Exemplar(s):** 1. Create complex formulas (e.g. finding percentages, commissions, interest rates, etc.).	**DL5.1:** Ability to ascertain when information is needed and be able to identify, locate, evaluate and effectively use it to solve a problem. **CP5.1:** Ability to combine information and ideas from several sources to reach a conclusion
B9.2.4.1. Demonstrate how to use the Spreadsheet. (using functions and complex formulas)	**B9.2.4.1.3. Demonstrate how to copy formulas and references** **Exemplar(s):** 1. Demonstrate the procedure for copying and pasting formulas in a worksheet. 2. Explore how to reference cells and ranges in a worksheet. 3. Demonstrate the use of relative and absolute cell referencing in creating formulas. 4. Explore how to correct common formula errors. 5. Complete a project that involves creating a set of formulas with common functions (e.g. simple interest formula)	**DL5.1:** Ability to ascertain when information is needed and be able to identify, locate, evaluate and effectively use it to solve a problem **CP5.1:** Ability to combine information and ideas from several sources to reach a conclusion

STRAND 3: COMMUNICATION NETWORKS

SUB-STRAND 1: COMPUTER NETWORKS

CONTENT STANDARD	INDICATORS AND EXEMPLAR(S)	CORE COMPETENCIES
B9.3.1.1. Know the Concept of Computer Networking for Global Communications	**B9.3.1.1.1 Discuss types of e-commerce and the cashless society (Bitcoin, Transaction cards, Quick Response code (QR) payment system)** **Exemplar(s):** 1. Explore the use of the Internet to engage in online business: selling, buying and paying for products online. 2. Discuss the use of online banking systems (e.g. using mobile money, bitcoin, the use of MasterCard, Visa card, QR code payment system, etc.).	**Digital Literacy (DL), Communication and Collaboration (CC)** **DL5.3:** Ability to find and utilise digital content **CC8.5**: Vary the level of detail and the language used when presenting to make it appropriate to the audience
	B9.3.1.1.2 Justify eLearning potentials **Exemplar(s):** 1. Explain the concept of eLearning, its benefits and disadvantages. 2. Discuss projects on a collaborative platform (e.g. iBox network, the use of ad hoc network to share resources, Wikis, Google Docs] etc.)	**CC8.1:** Speak clearly and explain ideas. Share a narrative or extended answer while speaking to a group **DL5.1:** Ability to ascertain when information is needed and be able to identify, locate, evaluate and effectively use it to solve a problem

STRAND 3: COMMUNICATION NETWORKS

SUB-STRAND 2: INTERNET AND SOCIAL MEDIA

CONTENT STANDARD	INDICATORS AND EXEMPLAR(S)	CORE COMPETENCIES
B9.3.2.1 Demonstrate the Use of Social Networking and Electronic Mail	**B9.3.2.1.1 Identify the advantages and risks in the use of social media platforms** **Exemplar(s):** 1. Illustrate the benefits of using social media sites 2. Discuss the issues and risks surrounding the usage of social media platforms and how to avoid them. 3. Explore reply, reply all, forward and forward all features in the use of emails	**DL5.1:** Ability to ascertain when information is needed and be able to identify, locate, evaluate and effectively use it to solve a problem.

STRAND 3: COMMUNICATION NETWORKS

SUB-STRAND 3: INFORMATION SECURITY

CONTENT STANDARD	INDICATORS AND EXEMPLAR(S)	CORE COMPETENCIES
B9.3.3.1. Recognise data threats and the means of protection	**B9.3.3.1.1 Discuss cyberbullying, cyberstalking, digital footprint and digital shadow on the Internet** **Exemplar(s):** 1. Watch a film or do a reading on cyberbullying, cyberstalking, digital footprint, digital shadows. 2. Discuss the nature of cyberbullying, cyberstalking, digital footprint and digital shadows. 3. Identify examples of cyberbullying, cyberstalking, digital footprint and digital shadows.	**Creativity and Innovation (CI), Digital Literacy (Dl), Critical Thinking and Problem Solving (CP), Communication and Collaboration (CC)** **DL 6.1:** Understand the sociological and emotional aspects of cyberspace **CP 6.4:** Ability to identify important and appropriate criteria and use them to evaluate available alternatives **CC8.5**:Vary the level of detail and the language used when presenting to make it appropriate for the audience
B9.3.3.1. Recognise data threats and the means of protection	**B9.3.3.1.2 Explain ten (10) information hacking techniques on the Internet environment.** **Exemplar(s):** 1. Brainstorm information hacking techniques on the internet environment. 2. Explain ten (10) information hacking techniques e.g. phishing, keyloggers, Denial of Service attack, eavesdropping, etc.	**DL5.1:** Ability to ascertain when information is needed and be able to identify, locate, evaluate and effectively use it to solve a problem .

STRAND 3: COMMUNICATION NETWORKS

SUB-STRAND 4: WEB TECHNOLOGIES

CONTENT STANDARD	INDICATORS AND EXEMPLAR(S)	CORE COMPETENCIES
B9.3.4.1 Demonstrate the Use of a Web Browser (Blogging)	**B9.3.4.1.1 Examine the importance of creating blogs** **Exemplar(s):** 1. Discuss the importance of creating blogs.	**Creativity and Innovation (CI), Digital Literacy (DL).** **CI 6.6:** Being open-minded, adapting and modifying ideas to achieve creative results. **DL5.3:** Ability to find and utilise digital content
	B9.3.4.1.2 Develop a blog for the school or a social club **Exemplar(s):** 1. Investigate the items to include in a school or social club blog. 2. Develop a blog for the school or a social club.	**DL6.3:** Use digital tools to create novel things
	B9.3.4.1.3 Explore the steps in publishing a blog **Exemplar(s):** 1. Identify steps in publishing a blog. 2. Demonstrate the procedure for publishing a blog and invite others to comment.	**DL6.3:** Use digital tools to create novel things

STRAND 4: COMPUTATIONAL THINKING

SUB-STRAND 1: INTRODUCTION TO PROGRAMMING

CONTENT STANDARD	INDICATORS AND EXEMPLAR(S)	CORE COMPETENCIES
B9.4.1.1. Show an Understanding of the Concept of Programming	**B9.4.1.1.1 Describe the conversion of decimal into binary data type for computer to recognise the meaning, process and store** **Exemplar(s):** 1. Convert decimal, binary and hexadecimal data from one format to another. 2. Show the results of calculating two or more binary numbers using the mathematical notation or operators in the number base two rule.	**Creativity and Innovation (CI), Critical Thinking and Problem Solving (CP).** **CP 5.5:** Effectively evaluate the success of solutions used in an attempt to solve a complex problem
	B9.4.1.1.2 Identify the different tools which are accessible in Integrated Development Environment (IDE) to aid the development of codes **Exemplar(s):** 1. Explore programming languages such as Snap, Scratch and Python to explain the key terminologies (variables, operators, controls, events, etc.) around the coding environment. 2. Explore a web development programme to create a simple website.	**CI 5.5:** Ability to try new alternatives and different approaches. **CP 6.6:** Preparedness to recognise and explain results after implementation of plans.

STRAND 4: COMPUTATIONAL THINKING

SUB-STRAND 2: ALGORITHM

CONTENT STANDARD	INDICATORS AND EXEMPLAR(S)	CORE COMPETENCIES
B9.4.2.1. Analyse the Correct Step-by-step Procedure in Solving any Real-world Problem	**B9.4.2.1.1 Write a programme using flowchart and Pseudocode algorithm that includes sequence, selection and iteration choices in problem-solving** **Exemplar(s):** 1. Discuss at least three ways to do proper hand-washing and prepare beverages with or without sugar and/or milk. 2. Write an algorithm for Exemplar(s): 1 that focuses on procedure correctness and shortest time to execute.	**Creativity and Innovation (CI), Critical Thinking and Problem Solving (CP).** CI6.1: Exhibit strong memory, intuitive thinking; and respond appropriately. **CP 6.4:** Ability to identify important and appropriate criteria and use them to evaluate available alternatives.
	B9.4.2.1.2 Translate a Flowchart algorithm to Pseudocode format and vice versa **Exemplar(s):** 1. Write an algorithm using flowchart format. Convert or translate the same flowchart algorithm into a Pseudocode format. (do a vice versa translation example to reinforce critical thinking)	**CI5.4:** Ability to visualise alternatives, see possibilities and identify problems and challenges.

STRAND 4: COMPUTATIONAL THINKING

SUB-STRAND 3: ROBOTICS

CONTENT STANDARD	INDICATORS AND EXEMPLAR(S)	CORE COMPETENCIES
B9.4.3.1. Discuss Robot Intelligence Concepts	**B9.4.3.1.1 Construct a robot artefact using available lab components and tools or emulator/simulator software pack.** **Exemplar(s):** 1. Explain the three basic laws of robotics by Isaac Asimov i.e. Asimov's science fiction laws of robotics. 2. Demonstrate how a robot is assembled using real robots' toolkit/video/ pictures. 3. Explore a robotic software pack, e.g. Scratch, Webot, Snap, Mbot software, EV3 and Mobile Applications such as lightbot	**Creativity and Innovation (CI), Critical Thinking and Problem Solving (CP).** **CI 6.3:** Ability to select the most effective creative tools for work and give reasons for the choice **CP 5.4:** Generate hypothesis to help answer complex problems

STRAND 4: COMPUTATIONAL THINKING

SUB-STRAND 4: ARTIFICIAL INTELLIGENCE

CONTENT STANDARD	INDICATORS AND EXEMPLAR(S)	CORE COMPETENCIES
B9.4.4.1 Discuss Artificial intelligence Concepts	**B9.4.4.1.1. Describe the knowledge-based systems (Expert systems) as the classical Artificial intelligence** **Exemplar(s):** 1. Illustrate the use of IF-THEN control structure for querying an expert system 2. Demonstrate how to input a request in any knowledge-based system to generate an output or result (e.g. Telemedicine system) 3. Demonstrate how to go onto the web and use Google's Teachable Machine demo to get a basic understanding of how machine learning works (e.g. Whatisit as an open-source cloud-based app which can identify the object in an image/photo) NB: Demonstrate how data is collected and the extent to which information can be used. Also discuss thoughts on machine learning. https://teachablemachine.withgoogle.com	**Communication and Collaboration (CC), Critical Thinking and Problem Solving (CP)** **CC8.2**: Explain ideas in a clear order with relevant detail, using correct construction and structure of speech. **CP 6.6:** Preparedness to recognise and explain results after implementation of plans.

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STRAND 1: INTRODUCTION TO COMPUTING

SUB-STRAND 1: COMPONENTS OF COMPUTERS AND COMPUTER SYSTEMS

CONTENT STANDARD	INDICATORS AND EXEMPLAR(S)	CORE COMPETENCIES
B10.1.1.1Identify parts of a Computer and Technology Tools	**B10.1.1.1.1. Discuss the trends in the next generation of computers** **Exemplar(s):** 1. Identify features expected to be seen in the next generation of computers. 2. Describe Google quantum computer (sycamore) and compare its processing power with other supercomputers (focus on processor).	**Communication and Collaboration (CC)** **CC7.5**: Identify and analyse different points of views of speaker. **CC7.3**: Provide feedback in areas of ideas, organisation, voice, word choice and sentence fluency in communication.
	B10.1.1.1.2. Examine the concept of Perceptual Computing **Exemplar(s):** 1. Discuss the features of Perceptual Computing.	**CC7.5**: Identify and analyse different points of views of speaker. **CC7.3**: Provide feedback in areas of ideas, organisation, voice, word choice and sentence fluency in communication.
	B10.1.1.1.3 Discuss the uses of Output devices such as Wearable Displays, E-Paper, E-Books, Kindle **Exemplar(s):** 1. Describe Wearable Displays (e.g. Google Glass), E-Paper, E-Books (e.g. Kindle)	**Communication and Collaboration (CC), Digital Literacy (DL)** **CC7.5**: Identify and analyse different points of views of speaker.
	B10.1.1.1.4 Describe Storage Systems: Network and Cloud Storage Systems, Smart Cards, Holographic Storage, Storage Systems for Large Computer Systems (home servers or media servers) **Exemplar(s):** 1. Discuss Network and Cloud Storage Systems, Smart Cards, Holographic Storage, Storage Systems for Large Computer Systems (home servers or media servers). 2. Explore common cloud storage examples such as Google Drive, One Drive, etc. 3. Discuss the pros and cons of using cloud storage.	**DL5.3:** Ability to find and utilise digital content. **CC7.5**: Identify and analyse different points of views of speaker.

CONTENT STANDARD	INDICATORS AND EXEMPLAR(S)	CORE COMPETENCIES
B10.1.1.2. Demonstrate the Use of the Desktop	**B10.1.1.2.1 Explore personalisation of the computer** **Exemplar(s):** 1. Change desktop icons. 2. Change mouse pointers.	**Communication and Collaboration (CC), Digital Literacy (DL)** **DL5.1:** Ability to ascertain when information is needed and be able to identify, locate, evaluate and effectively use it to solve a problem.
	B10.1.1.2.2 Identify and use file management techniques (drivers and hardware) **Exemplar(s):** 1. Identify and explore the use of device drivers e. g. sound drivers and video graphic drivers 2. Explain plug-and-play devices. 3. Demonstrate how to install, update or delete drivers.	**CC7.5**: Identify and analyse different points of views of speaker. **DL5.3:** Ability to find and utilise digital content.

STRAND 1: INTRODUCTION TO COMPUTING

SUB-STRAND 2: TECHNOLOGY IN THE COMMUNITY (COMMUNICATION)

CONTENT STANDARD	INDICATORS AND EXEMPLAR(S)	CORE COMPETENCIES
B10.1.2.1. Demonstrate the Use of Technology in the Community	**B10.1.2.1.1. Evaluate problems in the community that can be solved with technology** **Exemplar(s):** 1. Discuss problems in the community that can be solved using technology. Work in pairs.	**Creativity and Innovation (CI), Communication and Collaboration (CC), Critical Thinking and Problem Solving (CP).** **CC8.1:** Speak clearly and explain ideas. Share a narrative or extended answer while speaking to a group. **CC9.2**: Understand and use interpersonal skills. **CP5.1:** Ability to combine information and ideas from several sources to reach a conclusion.
B10.1.2.1. Demonstrate the Use of Technology in the Community	**B10.1.2.1.2. Propose solutions to the problems identified** **Exemplar(s):** 1. Present technological solutions to the problems identified in B10.1.2.1.1.	**CC8.1:** Speak clearly and explain ideas. Share a narrative or extended answer while speaking to a group. **CP5.1:** Ability to combine information and ideas from several sources to reach a conclusion.
	B10.1.2.1.3. Design the solution selected **Exemplar(s):** 1. Design the solution selected. 2. Present the solution designed.	**CI 5.7:** Putting forward constructive comments, ideas, explanations and new ways of doing things. **CC8.1:** Speak clearly and explain ideas. Share a narrative or extended answer while speaking to a group.

STRAND 1: INTRODUCTION TO COMPUTING

SUB-STRAND 3: HEALTH AND SAFETY IN THE USE OF ICT TOOLS

CONTENT STANDARD	INDICATORS AND EXEMPLAR(S)	CORE COMPETENCIES
B10.1.3.1. Demonstrate How to Apply Health and Safety Measures in the Use ICT Tools	**B10.1.3.1.1 Evaluate health issues at workstations** **Exemplar(s):** 1. Discuss the use of ergonomic tools such as ergonomic keyboard and paper stand. 2. Demonstrate the appropriateness of the lighting system while working with the computer.	**CC8.1:** Speak clearly and explain ideas. Share a narrative or extended answer while speaking to a group.
	B10.1.3.1.2 Evaluate Safety Risk Reduction at issues at workstations **Exemplar(s):** 1. Discuss the heat generated by machines (e.g. computers, printers etc.) and how to reduce excess heat.	**CC8.1:** Speak clearly and explain ideas. Share a narrative or extended answer while speaking to a group.

STRAND 2: PRODUCTIVITY SOFTWARE

SUB-STRAND 1: INTRODUCTION TO WORD PROCESSING

CONTENT STANDARD	INDICATORS AND EXEMPLAR(S)	CORE COMPETENCIES
B10.2.1.1 Demonstrate How to Use Microsoft Word (Multimedia)	**B10.2.1.1.1. Demonstrate how to add pictures, insert a screenshot and screen clipping and print screen** **Exemplar(s):** 1. Explore the use of the clip art, screenshot and screen clipping in the Insert Ribbon. 2. Demonstrate the use of the print screen key in capturing and inserting pictures.	**Creativity and Innovation (CI), Digital Literacy (DL)** **CI5.4:** Ability to visualise alternatives, see possibilities and identify problems and challenges. **DL5.1:** Ability to ascertain when information is needed and be able to identify, locate, evaluate and effectively use it to solve a problem.
	B10.2.1.1.2. Demonstrate the use of SmartArt **Exemplar(s):** 1. Illustrate the use of SmartArt in the Illustrations group of the Insert Ribbon.	**CI5.4:** Ability to visualise alternatives, see possibilities and identify problems and challenges. **DL5.1:** Ability to ascertain when information is needed and be able to identify, locate, evaluate and effectively use it to solve a problem.
	B10.2.1.1.3. Demonstrate how to add Multimedia (audios, videos, animations), Charts and Hyperlinks **Exemplar(s):** 1. Explore the use of the clip art and screenshot in the Insert Ribbon.	**CI5.4:** Ability to visualise alternatives, see possibilities and identify problems and challenges. **DL5.1:** Ability to ascertain when information is needed and be able to identify, locate, evaluate and effectively use it to solve a problem.

STRAND 2: PRODUCTIVITY SOFTWARE

SUB-STRAND 2: INTRODUCTION TO PRESENTATION

CONTENT STANDARD	INDICATORS AND EXEMPLAR(S)	CORE COMPETENCIES
B10.2.2.1 Demonstrate How to Use Microsoft PowerPoint (Multimedia)	**B10.2.2.1.1. Demonstrate how to add pictures and insert screenshots** **Exemplar(s):** 1. Explore the use of the clip art and screenshot in the Insert Ribbon.	**Creativity and Innovation (CI), Digital Literacy (DL)** **CI5.4:** Ability to visualise alternatives, see possibilities and identify problems and challenges **DL5.1:** Ability to ascertain when information is needed and be able to identify, locate, evaluate and effectively use it to solve a problem
	B10.2.2.1.2. Demonstrate how to animate slides in a presentation **Exemplar(s):** 1. Demonstrate the use of transitions and animations. 2. Create a seven-slide presentation with animations and transitions.	**CI5.4:** Ability to visualise alternatives, see possibilities and identify problems and challenges **DL5.1:** Ability to ascertain when information is needed and be able to identify, locate, evaluate and effectively use it to solve a problem
	B10.2.2.1.3. Demonstrate how to add Multimedia (audios,videos etc.), tables and charts **Exemplar(s):** 1. Explore the use of the Insert Ribbon tab to add multimedia (e.g. audios, videos, etc.). 2. Demonstrate the use of tables and charts in slides.	**CI5.4:** Ability to visualise alternatives, see possibilities and identify problems and challenges **DL5.1:** Ability to ascertain when information is needed and be able to identify, locate, evaluate and effectively use it to solve a problem

STRAND 2: PRODUCTIVITY SOFTWARE

SUB-STRAND 3: INTRODUCTION TO DESKTOP PUBLISHING

CONTENT STANDARD	INDICATORS AND EXEMPLAR(S)	CORE COMPETENCIES
B10.2.3.1. Critique a Desktop Published Document	**B10.2.3.1.1 Create and present a desktop published document (flyer, advertisement, invitation cards, business cards)** **Exemplar(s):** 1. Create and present a four-page document with images and overflow e.g. flyer, advertisement, storybook.	**Creativity and Innovation (CI), Communication and Collaboration (CC), Digital Literacy (DL),Critical Thinking and Problem Solving (CP).** **CI5.4:** Ability to visualise alternatives, see possibilities and identify problems and challenges **DL5.1:** Ability to ascertain when information is needed and be able to identify, locate, evaluate and effectively use it to solve a problem. **CC9.6:** Ability to work with all group members to complete a task successfully.
	B10.2.3.1.2 Describe a desktop published document **Exemplar(s):** 1. Give out your document to another learner assigned to you and collect the learner's document. 2. Examine the document received in terms of the position of text and images, use of colour, mechanics, content accuracy, etc.	**DL5.1:** Ability to ascertain when information is needed and be able to identify, locate, evaluate and effectively use it to solve a problem. **CP5.1:** Ability to combine information and ideas from several sources to reach a conclusion **CC9.6:** Ability to work with all group members to complete a task successfully

CONTENT STANDARD	INDICATORS AND EXEMPLAR(S)	CORE COMPETENCIES
B10.2.3.1. Critique a Desktop Published Document	**B10.2.3.1.3 Evaluate a desktop published document** **Exemplar(s):** 1. Evaluate the assigned document using, but not limited to the following criteria: position of text and images, general layout of the document, use of colour, mechanics (punctuation, spelling, italics, capitalisation, etc.), and appropriateness of the design for the intended purpose.	**CC9.6:** Ability to work with all group members to complete a task successfully. **CP5.1:** Ability to combine information and ideas from several sources to reach a conclusion.

STRAND 2: PRODUCTIVITY SOFTWARE

SUB-STRAND 4: INTRODUCTION TO ELECTRONIC SPREADSHEET

CONTENT STANDARD	INDICATORS AND EXEMPLAR(S)	CORE COMPETENCIES
B10.2.4.1. Demonstrate How to Use Spreadsheet (Advanced Operations)	**B10.2.4.1.1 Perform data filtering, sorting and validation** **Exemplar(s):** 1. Describe Fields (columns), Records (rows) and Tables (structured/ unstructured). 2. Illustrate examples of structured and unstructured tables. 3. Construct a structured data table of class members (e.g. data table may have the following fields: Surname, First name, Date of Birth, Sex, Home Town, Region, etc). 4. Apply validation rules to check for errors. 5. Convert data tables to a list in MS Excel. 6. Demonstrate the process of entering data to a list. 7. Demonstrate the use of validation list in the Sex column (in Exemplar(s): 3) to provide options in a drop-down for data entry. 8. Demonstrate how to sort data in alphabetical order (ascending/descending) and filter data to display only selected data.	**Communication and Collaboration (CC), Digital Literacy (DL),Critical Thinking and Problem Solving (CP).** **DL5.1:** Ability to ascertain when information is needed and be able to identify, locate, evaluate and effectively use it to solve a problem **CP5.1:** Ability to combine information and ideas from several sources to reach a conclusion **CC9.6:** Ability to work with all group members to complete a task successfully

CONTENT STANDARD	INDICATORS AND EXEMPLAR(S)	CORE COMPETENCIES
B10.2.4.1. Demonstrate how to use spreadsheet (Advanced Operations)	**B10.2.4.1.2. Demonstrate how to use styles, themes, templates and macros** **Exemplar(s):** 1. Describe the difference between templates and macros. 2. Create new spreadsheet documents from predefined templates in MS Excel. 3. Demonstrate the use of styles and themes on sample worksheets. 4. Do a project on formatting a dataset by applying styles and themes. 5. Explore the use of macros.	**Creativity and Innovation (CI), Communication and Collaboration (CC), Digital Literacy (DL),Critical Thinking and Problem Solving (CP).** **CI5.4:** Ability to visualise alternatives, see possibilities and identify problems and challenges. **DL5.1:** Ability to ascertain when information is needed and be able to identify, locate, evaluate and effectively use it to solve a problem. **CC9.6:** Ability to work with all group members to complete a task successfully.
	B10.2.4.1.3. Demonstrate the use of data tables, pivot tables, charts and pivot charts **Exemplar(s):** 1. Explore pivot tables and charts. 2. Explore the use of a pivot table to display a summary of the dataset (refer to indicator **B10.2.4.1.1**). 3. Insert a pivot chart to display the number of males and females in the class. 4. Demonstrate the use of the sort and filter features of the pivot table.	**CC9.6:** Ability to work with all group members to complete a task successfully. **CP5.1:** Ability to combine information and ideas from several sources to reach a conclusion.

STRAND 3: COMMUNICATION NETWORKS

SUB-STRAND 1: COMPUTER NETWORKS

CONTENT STANDARD	INDICATORS AND EXEMPLAR(S)	CORE COMPETENCIES
B10.3.1.1. Know the concept of computer networking for global communications	**B10.3.1.1.1 Create an artefact to show Internet of Things (IoT) connectivity with sensors using a virtual science lab or physical laboratory tools (optional)** **Exemplar(s):** 1. Explain the meaning of the Internet of Things (IoT). 2. Identify the use of IoT in the community. 3. Demonstrate simple examples that can be found in the home (e.g. using your smartphone to switch on your television or air conditioner, or using smartwatches to track your daily activities. Use Raspberry-pi or Arduino board to set up IoT network).	**Creativity and Innovation (CI), Digital Literacy (DL),Critical Thinking and Problem Solving (CP).** **CP5.1:** Ability to combine information and ideas from several sources to reach a conclusion. **CP6.5:** Ability to select alternative(s) that adequately meet selected criteria. **DL5.3:** Ability to find and utilise digital content..
	B10.3.1.1.2 Describe cloud computing **Exemplar(s):** 1. Explain the meaning of cloud computing 2. Identify cloud computing systems in Ghana (e.g. https://www.epay.gov.gh, https://passport.mfa.gov.gh/) 3. Discuss types of cloud computing services (Software as a service-SaaS, Infrastructure as a service-IaaS and Platform as a service-PaaS)	**DL5.5:** Evaluate the quality and validity of information
B10.3.1.1. Know the concept of computer networking for global communications	**B10.3.1.1.3 Demonstrate how to use Google maps for vehicle services and for Ghana's digital address system.** **Exemplar(s):** 1. Demonstrate how to obtain a digital address using the Ghana Post GPS system. 2. Demonstrate how to obtain digital addresses anywhere in the world. 3. Explore the use of smartphones in finding directions to a place and give practical examples (e.g. drivers using Google maps to find their directions, etc.)	**Digital Literacy (DL),Critical Thinking and Problem Solving (CP)** **DL6.3:** Use digital tools to create novel things **CP5.1:** Ability to combine information and ideas from several sources to reach a conclusion

STRAND 3: COMMUNICATION NETWORKS

SUB-STRAND 2: INTERNET AND SOCIAL MEDIA

CONTENT STANDARD	INDICATORS AND EXEMPLAR(S)	CORE COMPETENCIES
B10.3.2.1 Demonstrate the Use of Social Networking and Electronic Mail	**B10.3.2.1.1 Demonstrate the processes involved in creating accounts on social media platforms for both personal and corporate use** **Exemplar(s):** 1. Explore the creation of accounts on social networking, microblogging, photo sharing and video sharing platforms for personal and academic use.	**DL6.3:** Use digital tools to create novel things.

STRAND 3: COMMUNICATION NETWORKS

SUB-STRAND 3: INFORMATION SECURITY

CONTENT STANDARD	INDICATORS AND EXEMPLAR(S)	CORE COMPETENCIES
B10.3.3.1. Recognise data threats and means of protection	**B10 .3.3.1.1 Demonstrate the benefits of protecting data** **Exemplar(s):** 1. Discuss laws governing data protection in Ghana and beyond. 2. Explore the benefits of data protection in society.	**PL5.3:** Recognise one's emotional state and their preparedness to apply emotional intelligence. **DL6.4:** Adhere to behavioural protocols that prevail in cyberspace. **CC8.1:** Speak clearly and explain ideas. Share a narrative or extended answer while speaking to a group.
	B10.3.3.1.2. Demonstrate how to protect data using alphanumeric (e.g. username, passwording, passphrasing) and biometrics (e.g. facial, gait, voice, iris, and retina recognition. It is also called multi-nodal biometric features) **Exemplar(s):** 1. Discuss how data is protected using username passwording, passphrasing, facial recognition, gait recognition, voice recognition and iris recognition. 2. Demonstrate data protection using alphanumeric and/or biometrics. 3. Watch video or image of data protection using biometrics.	**CC8.1:** Speak clearly and explain ideas. Share a narrative or extended answer while speaking to a group. **CC9.1**: Demonstrate behaviour and skills of working towards group goals. **DL5.1:** Ability to ascertain when information is needed and be able to identify, locate, evaluate and effectively use it to solve a problem.
	B10.3.3.1.3 Demonstrate an understanding of data protection and software intellectual property rights **Exemplar(s):** 1. Review data protection and software intellectual property rights as studied in indicator B7.3.3.1.1 2. Report a community engagement on data protection and software intellectual property rights.	**DL5.3:** Ability to find and utilise digital content. **CC9.1**: Demonstrate behaviour and skills of working towards group goals.

STRAND 3: COMMUNICATION NETWORKS

SUB-STRAND 4: WEB TECHNOLOGIES

CONTENT STANDARD	INDICATORS AND EXEMPLAR(S)	CORE COMPETENCIES
B10.3.4.1 Demonstrate the use of a web browser (creating a page)	**B10.3.4.1.1 Demonstrate the tools and steps to consider when creating a webpage** **Exemplar(s):** 1. Explore the tools and steps when creating a webpage e.g. Hypertext Markup Language (HTML), Content Management Systems (CMS).	**CI 5.3:** Identification of requirements of a given situation and justification of more than one creative tool that will be suitable. **DL5.3:** Ability to find and utilise digital content.
	B10.3.4.1.2 Demonstrate how to add an image and text to a webpage **Exemplar(s):** 1. Demonstrate how to add images and text to a webpage.	**CI 5.3:** Identification of requirements of a given situation and justification of more than one creative tool that will be suitable. **DL5.3:** Ability to find and utilise digital content.
	B10.3.4.1.3 Explore the steps in publishing a webpage **Exemplar(s):** 1. Show steps involved when publishing a webpage. 2. Demonstrate publishing the web page created in indicator B10.3.4.1.2.	**CI 5.3:** Identification of requirements of a given situation and justification of more than one creative tool that will be suitable. **DL5.3:** Ability to find and utilise digital content.

STRAND 4: COMPUTATIONAL THINKING

SUB-STRAND 1: INTRODUCTION TO PROGRAMMING AND ALGORITHM

CONTENT STANDARD	INDICATORS AND EXEMPLAR(S)	CORE COMPETENCIES
B10.4.1.1. Show an understanding of the concept of programming	**B10.4.1.1.1 Identify errors in programming and show how to debug them (e.g. syntax, run-time and semantic error)** **Exemplar(s):** 1. Explain how to detect semantic and syntax errors in any human language. 2. Use code snippets to identify errors in programming. 3. Explore how to debug the errors in programming.	**Creativity and Innovation (CI), Digital Literacy (DL), Critical Thinking and Problem Solving (CP)** **CP 5.6:** Demonstrate a thorough understanding of a generalised concept and facts specific to task or situation **DL5.3:** Ability to find and utilise digital content
	B10.4.1.1.2 Demonstrate simple coding task on a selected Integrated Development Environment (IDE) **Exemplar(s):** 1. Write simple programmes using IDEs such as Scratch, Kodu, Visual Studio, online App inventor platforms, etc.	**CI 5.2:** Ability to merge simple/complex ideas to create novel situations or things **CP5.1:** Ability to combine information and ideas from several sources to reach a conclusion **DL5.3:** Ability to find and utilise digital content

STRAND 4: COMPUTATIONAL THINKING

SUB-STRAND 2: ALGORITHM

CONTENT STANDARD	INDICATORS AND EXEMPLAR(S)	CORE COMPETENCIES
B10.4.2.1 Analyse the Correct Step-by-step Procedure in Solving any Real-world Problem	**B10.4.2.1.1 Use a trace table to follow a pseudocode algorithm** **Exemplar(s):** 1. Create a trace table for a simple pseudocode algorithm. 2. Use trace tables to follow other pseudocode algorithms.	**CI 5.2:** Ability to merge simple/complex ideas to create novel situations or things **CP5.1:** Ability to combine information and ideas from several sources to reach a conclusion **DL5.3:** Ability to find and utilise digital content
	B10.4.2.1.2 Demonstrate understanding in using logical gates in programming **Exemplar(s):** 1. AND gate: Draw the symbol, the switching arrangement and derive the truth table (binary 0, 1) using the switching arrangement. 2. OR gate: Draw the symbol, the switching arrangement and derive the truth table (binary 0, 1) using the switching arrangement. 3. NOT gate: Draw the symbol, the switching arrangement and derive the truth table (binary 0, 1) using the switching arrangement.	**CI 5.2:** Ability to merge simple/complex ideas to create novel situations or things **CP5.1:** Ability to combine information and ideas from several sources to reach a conclusion

STRAND 4: COMPUTATIONAL THINKING

SUB-STRAND 3: ROBOTICS

CONTENT STANDARD	INDICATORS AND EXEMPLAR(S)	CORE COMPETENCIES
B10.4.3.1. Discuss the Flying Robot (Drone)	**B10.4.3.1.1 Discuss the principle underlying the operation of the flying robot (Drones/ Unmanned Aerial Vehicle) and various productive applications in society** **Exemplar(s):** 1. Watch videos/pictures of drones as an example of intelligent robots (flying robots). Explain how drones work(principles). 2. Explore different types of drones and their specific applications in society. (e.g. Drones being used in Ghana's health service delivery). 3. Describe how the Unmanned Aerial Vehicle (UAV/Drone) is used for multimedia image coverage (photography). NB: This is to help learners appreciate the importance of drones in Ghanaian society.	**CP 5.7:** Provide new insight into controversial situation or task. **DL5.3:** Ability to find and utilise digital content.

STRAND 4: COMPUTATIONAL THINKING

SUB-STRAND 4: ARTIFICIAL INTELLIGENCE

CONTENT STANDARD	INDICATORS AND EXEMPLAR(S)	CORE COMPETENCIES
B10.4.4.1 Discuss Artificial Intelligence Concepts.	**B10.4.4.1.1 Discuss the application of areas in Machine learning** **Exemplar(s):** 1. Describe selected applications of machine learning such as email spam filter, social media sentiment analysis, predictive maintenance, online product recommendation to a user, chatbot (chat-robot) for online customer service. 2. Illustrate machine learning as a method that lets the machine learn from images. 3. Demonstrate how to go onto the web and use Google's Teachable Machine demo to get a basic understanding of how machine learning works (e.g. Whatisit as an open-source cloud-based app which can identify the object in the image/photo) 4. Demonstrate how data is collected and the extent to which information can be used and thoughts on machine learning. https://teachablemachinewithgoogle.com/	**CP6.1:** Ability to effectively define goals towards solving a problem. **CP 6.2:** Ability to explain plans for attaining goals. **DL5.1:** Ability to ascertain when information is needed and be able to identify, locate, evaluate and effectively use it to solve a problem. **DL5.6:** Preparedness to make better decisions using available information. **CC8.1:** Speak clearly and explain ideas. Share a narrative or extended answer while speaking to a group. **CC8.2**: Explain ideas in a clear order with relevant detail, using correct construction and structure of speech.

GLOSSARY

1.	**Holographic storage**	It is a computer storage device that uses beams of light to store three-dimensional digitally created data.
2.	**Cloud Storage**	Includes saving data in a remote physical location that can be accessed through the Internet from any device.
3.	**Wearable computer**	It is a technology tool that a customer can wear usually to monitor health and fitness-related information.
4.	**E-Paper**	It is a technology that makes this easy to read text on an electronic gadget.
5.	**E-Books**	An electronic version of a physical book that can be read on a screen or a handheld device specifically designed for reading.
6.	**Kindle**	This is the first portable hardware computer released in the U.S. Kindle shows images and text using E ink, and can use Sprint's Evolution-Data Optimised (EVDO) to get e-books over the Amazon Whispernet.
7.	**Smart Cards**	A plastic card with a built-in microprocessor, used typically to perform financial transactions.
8.	**Sensors**	A device which detects or measures a physical property and records, indicates, or otherwise responds to it.
9.	**BODMAS**	This is an acronym and it stands for Bracket, Of, Division, Multiplication, Addition and Subtraction. It is an order of operations which includes a collection of rules that reflect conventions about which procedures to perform first in order to evaluate a given mathematical expression.
10.	**Quantum**	Quantum computing is the use of quantum-mechanical phenomena such as superposition and entanglement to perform computation. A quantum computer is used to perform such computation, which can be implemented theoretically or physically.
11.	**Sycamore**	Sycamore is the name of Google's quantum processor comprising 54 qubits (quantum bits). Sycamore achieved its results using exactly 53 qubits. A 54th one on the chip failed.

APPENDICES

APPENDIX 1: CORE COMPETENCIES AND SUBSKILLS OF THE COMMON CORE PROGRAMME (CCP)

1. COMMUNICATION AN COLLABORATION (CC)

B7-B10		
CC7: LISTENING	**CC8: PRESENTING**	**CC9: TEAMWORK**
CC7.1: Identify words or sentences in context appropriately	**CC8.1**: Speak clearly and explain ideas. Share a narrative or extended answer while speaking to a group	**CC9.1**: Demonstrate behaviour and skills of working towards group goals
CC7.2: Interpret correctly and respond to non-verbal communication such as facial expressions, cues and gestures	**CC8.2**: Explain ideas in a clear order with relevant detail, using correct construction and structure of speech	**CC9.2**: Understand and use interpersonal skills
CC7.3: Provide feedback in areas of ideas, organisation, voice, word choice and sentence fluency in communication	**CC8.3**: Apply appropriate diction, and structure sentences correctly for narrative, persuasive, imaginative and expository purposes	**CC9.3**: Understand roles during group activities
CC7.4: Identify underlying themes, implications and issues when listening	**CC8.4**: Anticipate different responses from the audience and plan for them	**CC9.4**: Help group work on relevant activities
CC7.5: Identify and analyse different points of views of speaker	**CC8.5**: Vary the level of detail and the language used when presenting to make it appropriate to the audience	**CC9.5**: Appreciate the importance of including all team members in discussions and actively encourage contributions from them
		CC9.6: Ability to work with all group members to complete a task successfully
		CC9.7: Effectively perform multiple roles within the group
		CC9.8: Demonstrate an awareness of the wider team dynamics and work to minimise conflicts in the team

2. CRITICAL THINKING AND PROBLEM SOLVING (CP)

B7-B10	
CP5: CRITICAL THINKING	**CP6: PROBLEM SOLVING**
CP 5.1: Ability to combine information and ideas from several sources to reach a conclusion	**CP 6.1:** Ability to effectively define goals towards solving a problem
CP 5.2: Analyse and make distinct judgement about viewpoints expressed in an argument	**CP 6.2:** Ability to explain plans for attaining goals
CP 5.3: Create simple logic trees to think through problems	**CP 6.3:** Identify important and appropriate alternatives
CP 5.4: Generate hypothesis to help answer complex problems	**CP 6.4:** Ability to identify important and appropriate criteria and use them to evaluate available alternatives
CP 5.5: Effectively evaluate the success of solutions used in an attempt to solve a complex problem	**CP 6.5:** Ability to select alternative(s) that adequately meet selected criteria
CP 5.6: Demonstrate a thorough understanding of a generalised concept and facts specific to task or situation	**CP 6.6:** Preparedness to recognise and explain results after implementation of plans
CP 5.7: Provide new insight into controversial situation or task	**CP 6.7:** Implement strategies with accuracy
CP 5.8: Identify and prove misconceptions about a generalised concept or fact specific to a task or situation	
CP 5.9: Identify and explain a confusion, uncertainty or a contradiction surrounding an event	
CP 5.10: Develop and defend a logical plausible resolution to a confusion, uncertainty or contradiction surrounding an event	

3. PERSONAL DEVELOPMENT AND LEADERSHIP (PL)

B7-B10	
PL5: PERSONAL DEVELOPMENT	**PL6: LEADERSHIP**
PL5.1: Understanding oneself (strengths, weaknesses, goals and aspirations) in reacting and adjusting to novel situations	**PL6.1:** Ability to serve group members effectively
PL5.2: Demonstrate a sense of belonging in a group	**PL6.2:** Division of tasks into solvable units and assigning group members to task units
PL5.3: Recognise one's emotional state and their preparedness to apply emotional intelligence	**PL6.3:** Ability to manage time effectively
PL5.4: Ability to understand one's personality traits	**PL6.4:** Ability to manage and resolve conflicts
PL5.5: Desire to accept one's true self and overcome weaknesses	**PL6.5:** Ability to monitor team members to ascertain progress
PL5.6: Ability to set and maintain personal standards and values	**PL6.6:** Ability to mentor peers
	PL6.7: Actively promote effective group interaction and the expression of ideas and opinions in a way that is sensitive to the feelings and background of others
	PL6.8: Actively assist group identify changes or modifications necessary in the group activities and work towards carrying out those changes

4. CULTURAL IDENTITY AND GLOBAL CITIZENSHIP (CG)

B7-B10	
CG5: CULTURAL IDENTITY	**CG6: GLOBAL CITIZENSHIP**
CG5.1: Show a strong sense of belonging to one's culture	**CG6.1:** Understanding of influences of globalisation on traditions, languages and cultures
CG5.2: Develop and exhibit ability to defend one's cultural beliefs, practices and norms	**CG6.2:** Recognise resistance to global practices that are inimical to our culture
CG5.3: Develop and express respect, recognition and appreciation of others' cultures	**CG6.3:** Know the global discourse about the roles of males and females
CG5.4: Develop and exhibit a sense of cultural identity	**CG6.4:** Exhibit a sense of nationality and global identity
CG5.5: Adjust to the demands of customs, traditions, values and attitudes of society	

5. CREATIVITY AND INNOVATION (CI)

B7-B10	
CI5: KNOWLEDGE, UNDERSTANDING, SKILLS AND STRATEGIES	**CI6: REFLECTION AND EVALUATION**
CI 5.1: Examine alternatives in creating new things	**CI 6.1:** Exhibit strong memory, intuitive thinking and respond appropriately
CI 5.2: Ability to merge simple/complex ideas to create novel situations or things	**CI 6.2:** Ability to reflect on approaches to creative tasks and evaluate the effectiveness of tools used
CI 5.3: Identification of requirements of a given situation and justification of more than one creative tool that will be suitable	**CI 6.3:** Ability to select the most effective creative tools for work, and give reasons for the choice
CI 5.4: Ability to visualise alternatives, see possibilities and identify problems and challenges	**CI 6.4:** Imagining and seeing things in a different way
CI 5.5: Ability to try new alternatives and different approaches	**CI 6.5:** Anticipate and overcome difficulties relating to taking initiatives
CI 5.6: Understand and use analogies and metaphors	**CI 6.6:** Being open-minded, adapting and modifying ideas to achieve creative results
CI 5.7: Putting forward constructive comments, ideas, explanations and new ways of doing things	**CI 6.7:** Look and think about things differently and from different perspectives
	CI 6.8: Recognise and generalise information and experience; search for trends and patterns
	CI 6.9: Interpret and apply learning in new contexts
	CI 6.10: Reflect on work and explore the thinking behind thoughts and processes

6. DIGITAL LITERACY (DL)

B7-B10	
DL5: PHOTO-VISUAL AND INFORMATION LITERACY	**DL6: SOCIO-EMOTIONAL AND REPRODUCTION LITERACY**
DL5.1: Ability to ascertain when information is needed and be able to identify, locate, evaluate and effectively use it to solve a problem	**DL 6.1:** Understand the sociological and emotional aspects of cyberspace
DL5.2: Ability to recognise and avoid traps in cyberspace	**DL 6.2:** Create a meaningful and original piece of work, or its interpretation by integrating existing information
DL5.3: Ability to find and utilise digital content	**DL6.3:** Use digital tools to create novel things
DL5.4: Ability to construct knowledge from a non-linear hyper-textual navigation	**DL6.4:** Adhere to behavioural protocols that prevail in cyberspace
DL5.5: Evaluate the quality and validity of information	**DL6.5:** Recognition of societal issues emanating from the use of digital technologies
DL5.6: Preparedness to make better decisions using available information	**DL6.6:** Knowledge and recognition of ethical use of information

Please note these inclusivity issues

The core competencies outlined in this document must be assessed taking into consideration learners with special needs (physical disabilities, learning disabilities, etc.).
Consider the use of realia for visual and visually challenged learners.

A system of creating alternatives for tasks must also be adopted.

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