BIOLOGY

CURRICULUM FOR SECONDARY EDUCATION (SHS 1 - 3)

NaCCA

NATIONAL COUNCIL FOR CURRICULUM & ASSESSMENT OF MINISTRY OF EDUCATION

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CURRICULUM & ASSESSMENT
OF MINISTRY OF EDUCATION

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FOREWORD

Through the National Council for Curriculum and Assessment (NaCCA), Ghana's Ministry of Education has introduced a series of curriculum reforms to improve the quality and relevance of learning experiences in pre-tertiary schools in the country. These reforms will improve learning through the introduction of innovative pedagogies that encourage critical thinking and problem-solving. For a long time, our learners memorise facts and figures, which does not develop their analytical and practical skills. The Ministry recognises that learners need to be equipped with the right tools, knowledge, skills and competencies to deal with the fast-changing environment and the challenges facing their communities, the nation and the world.

These curriculum reforms were derived from the Education Strategic Plan (ESP 2018-2030), the National Pre-tertiary Education Curriculum Framework (NPTECF) and the National Pre-Tertiary Learning Assessment Framework (NPLAF), which were all approved by Cabinet in 2018. The new standards-based curriculum implemented in 2019 in basic schools, aims to equip learners to apply their knowledge innovatively to solve everyday problems. It also prioritises assessing learners' knowledge, skills, attitudes, and values, emphasising their achievements. The content of the basic school standards-based curriculum was therefore designed to promote a curriculum tailored to the diverse educational needs of the country's youth. It addresses the current curriculum's deficiencies in learning and assessment, especially in literacy and numeracy. These reforms have been carried out in phases. The curriculum for the basic school level – KG, Primary and Junior High School (JHS) – was developed and implemented from 2019 to 2021.

The curriculum for Senior High School (SHS), Senior High Technical School (SHTS) and Science, Technical, Engineering and Mathematics (STEM), which constitutes the next phase, is designed to ensure the continuation of learning experiences from JHS. It introduces flexible pathways for progression to facilitate the choice of subjects necessary for further study, the world of work and adult life. The new SHS, SHTS and STEM curriculum emphasises the acquisition of 21st Century skills and competencies, character development and instilling of national values. Social and Emotional Learning (SEL), Information Communications Technology, Gender Equality and Social Inclusion, have all been integrated into the curriculum. Assessment – formative and summative has been incorporated into the curriculum and aligned with the learning outcomes throughout the three-year programme.

The Ministry of Education's reform aims to ensure that graduates of our secondary schools can successfully compete in international high school competitions and, at the same time, be equipped with the necessary employable skills and work ethos to succeed in life. The Ministry of Education, therefore, sees the Senior High School (SHS) curriculum as occupying a critical place in the education system – providing improved educational opportunities and outcomes for further studies, the world of work and adult life – and is consequently prioritising its implementation.

ACKNOWLEDGEMENTS

This standards-based SHS curriculum was created using the National Pre-Tertiary Learning Assessment Framework (NPLAF), the Secondary Education Assessment Guide (SEAG), and the Teacher and Learner Resource Packs which include Professional Learning Community (PLC) Materials and Subject Manuals for teachers and learners. All the above-mentioned documents were developed by the National Council for Curriculum and Assessment (NaCCA). The Ministry of Education (MoE) provided oversight and strategic direction for the development of the curriculum with NaCCA receiving support from multiple agencies of the MoE and other relevant stakeholders. NaCCA would like to extend its sincere gratitude, on behalf of the MoE, to all its partners who participated in the professional conversations and discussions during the development of this SHS curriculum.

In particular, NaCCA would also like to extend its appreciation to the leadership of the Ghana Education Service (GES), the National School Inspectorate Authority (NaSIA), the National Teaching Council (NTC), the Commission for Technical and Vocational Education and Training (Commission for TVET), West African Examinations Council (WAEC) and other agencies of the MoE that supported the entire process. In addition, NaCCA acknowledges and values the contributions made by personnel from various universities, colleges of education Industry players, Vice Chancellors Ghana, Vice Chancellors Technical Universities as well as educators and learners working within the Ghana education landscape.

Special appreciation is extended to consultants who contributed to development of the curriculum. The development process involved multiple engagements between national stakeholders and various groups with interests in the curriculum. These groups include the teacher unions, the Association of Ghana Industries, and heads of secondary schools.

CONTENTS

THE SHS CURRICULUM OVERVIEW

The vision for this curriculum is to ensure the nation has a secondary education system that enables all Ghanaian children to acquire the 21st Century skills, competencies, knowledge, values and attitudes required to be responsible citizens, ready for the world of work, further studies and adult life. The nation's core values drive the SHS curriculum, and it is intended to achieve Sustainable Development Goal 4: 'Inclusive, equitable quality education and life-long learning for all'. Above all, it is a curriculum enabling its graduates to contribute to the ongoing growth and development of the nation's economy and well-being.

The curriculum is inclusive, flexible, and robust. It was written under the auspices of the National Council for Curriculum and Assessment by a team of expert curriculum writers across Ghana. It reflects the needs of critical stakeholders, including industry, tertiary education, the West African Examination Council, SHS learners, teachers, and school leaders. It has been written based on the National Pre-Tertiary Learning and Assessment Framework and the Secondary Education Policy.

The key features of the curriculum include:

- flexible learning pathways at all levels, including for gifted and talented learners and those with deficiencies in numeracy and literacy, to ensure it can meet the needs of learners from diverse backgrounds and with different interests and abilities.
- the five core learning areas for secondary education: science and technology, language arts, humanities, technical and vocational and business; with emphasis placed on STEM and agriculture as integral to each subject.
- a structured, standards-based approach that supports the acquisition of knowledge, skills and competencies, and transition and seamless progress throughout secondary education, from JHS to SHS and through the three years of SHS.
- a focus on interactive approaches to teaching and assessment to ensure learning goes beyond recall enabling learners to acquire the ability to understand, apply, analyse and create.
- guidance on pedagogy, coupled with exemplars, demonstrating how to integrate cross-cutting themes such as 21st Century skills, core competencies, the use of ICT, literacy and mathematics, Social Emotional Learning, Gender Equality and Social Inclusion as tools for learning and skills for life. Shared Ghanaian values are also embedded in the curriculum.

The curriculum writing process was rigorous and involved developing and using a Curriculum Writing Guide which provided systematic instructions for writers. The process was quality assured at three levels: through (a) evaluation by national experts, (b) trialling curriculum materials in schools and (c) through an external evaluation by a team of national and international experts. Evidence and insights from these activities helped hone the draft's final version. The outcome is a curriculum coherently aligned with national priorities, policies and the needs of stakeholders. A curriculum tailored to the Ghanaian context ensures that all learners benefit from their schooling and develop their full potential.

The following section highlights the details of the front matter of the draft curriculum. The vision, philosophy and goal of the curriculum are presented. This is followed by the details of the 21st Century skills and competencies, teaching and learning approaches, instructional design and assessment strategies. The template for the curriculum frame, which outlines the scope and sequence, the design that links the learning outcomes to particular 21st Century skills and competencies, as well as Gender Equality and Social Inclusion, Social and Emotional Learning and Ghanaian values are presented together with the structure of the lesson frame showing the links between the content standards, learning indicators with their corresponding pedagogical exemplars and assessment strategies.

INTRODUCTION

Effective implementation of this Senior High School (SHS) curriculum is the key to creating a well-educated and well-balanced workforce that is ready to contribute to Ghana's progress by harnessing the potential of the growing youth population, considering the demographic transition the country is currently experiencing (Educational Strategic Plan [ESP] 2018-2030). SHS curriculum aims to expand equitable, inclusive access to relevant education for all young people, including those in disadvantaged and underserved communities, those with special educational needs and those who are gifted and talented. Senior High School allows young people to develop further skills and competencies and progress in learning achievement, building from the foundation laid in Junior High School. This curriculum intends to meet the learning needs of all high school learners by acquiring 21st Century skills and competencies to prepare them for further studies, the world of work and adult life. Changing global economic, social and technological context requires life-long learning, unlearning, and continuous processes of reflection, anticipation and action.

Philosophy of Senior High School Curriculum

The philosophy underpinning the SHS curriculum is that every learner can develop their potential to the fullest if the right environment is created and skilled teachers effectively support them to benefit from the subjects offered at SHS. Every learner needs to be equipped with skills and competencies of interest to further their education, live a responsible adult life or proceed to the world of work.

Vision of Senior High School Curriculum

The vision of the curriculum is to prepare SHS graduates equipped with relevant skills and competencies to progress and succeed in further studies, the world of work and adult life. It aims to equip all learners with the 21st Century skills and competencies required to be responsible citizens and lifelong learners. When young people are prepared to become effective, engaging, and responsible citizens, they will contribute to the ongoing growth and development of the nation's economy and well-being.

Goal of Senior High School Curriculum

The goal of the curriculum is to achieve relevant and quality SHS through the integration of 21st Century skills and competencies as set out in the Secondary Education Policy. The key features to integrate into the curriculum are:

- Foundational Knowledge: literacy, numeracy, scientific literacy, information, communication and digital literacies, financial literacy and entrepreneurship, cultural identity, civic literacy and global citizenship
- Competencies: critical thinking and problem-solving, innovation and creativity, collaboration, and communication
- Character Qualities: discipline, integrity, self-directed learning, self-confidence, adaptability and resourcefulness, leadership, and responsible citizenship.

The JHS curriculum has been designed to ensure that learners are adequately equipped to transition seamlessly into SHS, where they will be equipped with the relevant knowledge, skills and competencies. The SHS curriculum emphasises character building, acquisition of 21st Century skills and competencies and nurturing core values within an environment of quality education to ensure the transition to further study, the world of work and adult life. This requires the delivery of robust secondary education that meets the varied learning needs of the youth in Ghana. The SHS curriculum, therefore, seeks to develop learners to become technology-inclined, scientifically literate, good problem-solvers who can think critically and creatively and are equipped to communicate with fluency, and possess the confidence and competence to participate fully in Ghanaian society as responsible local and global citizens – (referred to as 'Glocal citizens').

The SHS curriculum is driven by the nation's core values of truth, integrity, diversity, equity, discipline, self-directed learning, self-confidence, adaptability and resourcefulness, leadership, and responsible citizenship, and with the intent of achieving the Sustainable Development Goal 4: 'Inclusive, equitable quality education and life-long learning for all'. The following sections elaborate on the critical competencies required of every SHS learner:

Gender Equality and Social Inclusion (GESI)

- Appreciate their uniqueness about others.
- Pay attention to the uniqueness and unique needs of others.
- Value the perspective, experience, and opinion of others.
- Respect individuals of different beliefs, political views/ leanings, cultures, and religions.
- Embrace diversity and practise inclusion.
- Value and work in favour of a democratic and inclusive society.
- Be conscious of the existence of minority and disadvantaged groups in society and work to support them.
- Gain clarity about misconceptions/myths about gender, disability, ethnicity, age, religion, and all other excluded groups in society
- Interrogate and dispel their stereotypes and biases about gender and other disadvantaged and excluded groups in society.
- Appreciate the influence of socialisation in shaping social norms, roles, responsibilities, and mindsets.
- Identify injustice and advocate for change.
- Feel empowered to speak up for themselves and be a voice for other disadvantaged groups.

21st Century Skills and Competencies

In today's fast-changing world, high school graduates must be prepared for the 21st Century world of work. The study of Mathematics, Science, and Language Arts alone is no longer enough. High school graduates need a variety of skills and competencies to adapt to the global economy. Critical thinking, creativity, collaboration, communication, information literacy, media literacy, technology literacy, flexibility, leadership, initiative, productivity, and social skills are needed. These skills help learners to keep up with today's fast-paced job market. Employers want workers with more than academic knowledge. The 21st Century skills and competencies help graduates navigate the complex and changing workplace. Also, these help them become active citizens who improve their communities. Acquisition of 21st Century skills in high school requires a change in pedagogy from the approach that has been prevalent in Ghana in recent years. Teachers should discourage and abandon rote memorisation and passive learning. Instead, they should encourage active learning, collaboration, and problem-solving, project-based, inquiry-based, and other learner-centred pedagogy should be used. As well as aligning with global best practices, these approaches also seek to reconnect formal education in Ghana with values-based indigenous education and discovery-based learning which existed in Ghana in pre-colonial times. This is aligned with the 'glocal' nature of this curriculum, connecting with Ghana's past to create confident citizens who can engage effectively in a global world. Digitalisation, automation, technological advances and the changing nature of work globally mean that young people need a new set of skills, knowledge and competencies to succeed in this dynamic and globalised labour market.

Critical Thinking and Problem-Solving Competency

- Ability to question norms, practices, and opinions, to reflect on one's values, perceptions, and actions.
- Ability to use reasoning skills to come to a logical conclusion.
- Being able to consider different perspectives and points of view
- Respecting evidence and reasoning
- Not being stuck in one position
- Ability to take a position in a discourse
- The overarching ability to apply different problem-solving frameworks to complex problems and develop viable, inclusive, and equitable solution options that integrate the above-mentioned competencies, promote sustainable development,

Creativity

- Ability to identify and solve complex problems through creative thinking.
- Ability to generate new ideas and innovative solutions to old problems.
- Ability to demonstrate originality and flexibility in approaching tasks and challenges.
- Collaborating with others to develop and refine creative ideas
- Ability to incorporate feedback and criticism into the creative process
- Utilising technology and other resources to enhance creativity
- Demonstrating a willingness to take risks and experiment with new approaches
- Adapting to changing circumstances and further information to maintain creativity

- Integrating multiple perspectives and disciplines to foster creativity
- Ability to communicate creative ideas effectively to a variety of audiences

Collaboration

- Abilities to learn from others; to understand and respect the needs, perspectives, and actions of others (empathy)
- Ability to understand, relate to and be sensitive to others (empathic leadership)
- Ability to deal with conflicts in a group
- Ability to facilitate collaborative and participatory problem-solving
- Ability to work with others to achieve a common goal.
- Ability to engage in effective communication, active listening, and the ability to compromise.
- Ability to work in groups on projects and assignments.

Communication

- Know the specific literacy and language of the subjects studied
- Use language for academic purposes
- Communicate effectively and meaningfully in a Ghanaian Language and English Language
- Communicate confidently, ethically, and effectively in different social contexts.
- Communicate confidently and effectively to different participants in different contexts
- Ability to communicate effectively verbally, non-verbally and through writing.
- Demonstrate requisite personal and social skills that are consistent with changes in society
- Ability to express ideas clearly and persuasively, listen actively, and respond appropriately
- Ability to develop digital communication skills such as email etiquette and online collaboration.
- Ability to engage in public speaking, debate, and written communication.

Learning for Life

- Understand subject content and apply it in different contexts
- Apply mathematical and scientific concepts in daily life
- Demonstrate mastery of skills in literacy, numeracy, and digital literacy.
- Develop an inquiry-based approach to continual learning.
- Be able to understand higher-order concepts and corresponding underlying principles.
- Participate in the creative use of the expressive arts and engage in aesthetic appreciation.
- Use and apply a variety of digital technologies
- Be digitally literate with a strong understanding of ICT and be confident in its application.
- Be equipped with the necessary qualifications to gain access to further and higher education and the world of work and adult life
- Ability to apply knowledge practically in the workplace so that they are able to utilise theory by translating it into practice.
- Develop their abilities, gifts and talents to be able to play a meaningful role in the development of the country
- Be able to think critically and creatively, anticipate consequences, recognise opportunities and be risk-takers
- Ability to pursue self-directed learning with the desire to chart a path to become effective lifelong learners.
- Independent thinkers and doers who show initiative and take action.
- Ability to innovate and think creatively, building on their knowledge base so that they take risks to achieve new goals
- Ability to think critically and solve problems so that they become positive change agents at work, in further study and in their personal lives.
- Be motivated to adapt to the changing needs of society through self-evaluation and ongoing training
- Be able to establish and maintain innovative enterprises both individually and in collaboration with others.
- Be able to ethically prioritise economic values to ensure stability and autonomy
- Show flexibility and preparedness to deal with job mobility
- Be committed towards the improvement of their quality of life and that of others
- Feel empowered in decision-making processes at various levels e.g., personal, group, class, school, etc.

- Be able to seek and respond to assistance, guidance and/or support when needed.
- Ability to make and adhere to commitments.
- Adopt a healthy and active lifestyle and appreciate how to use leisure time well.
- Be enthusiastic, with the knowledge, understanding and skill that enable them to progress to tertiary level, the world of work and adult life.
- Ability to transition from school to the world of work or further study by applying knowledge, skills and attitudes in new situations.
- Be independent, have academic and communication skills such as clarity of expression (written and spoken), and the ability to support their arguments.
- Be innovative and understand the 21st Century skills and competencies and apply them to everyday life.

Global and Local (Glocal) Citizenship

- Appreciate and respect the Ghanaian identity, culture, and heritage
- Be conscious of current global issues and relate well with people from different cultures
- Act in favour of the common good, social cohesion and social justice
- Have the requisite personal and social skills to handle changes in society
- Appreciate the impact of globalisation on the society.
- Ability to be an honest global citizen displaying leadership skills and moral fortitude with an understanding of the wider world and how to enhance Ghana's standing.

Systems Thinking Competency

- Ability to recognise and understand relationships
- Ability to analyse complex systems
- Ability to think of how systems are embedded within different domains and different scales
- Ability to deal with uncertainty

Normative Competency

- Ability to understand and reflect on the norms and values that underlie one's actions
- Ability to negotiate values, principles, goals, and targets, in a context of conflicts of interests and trade-offs, uncertain knowledge and contradictions

Anticipatory Competency

- Ability to understand and evaluate multiple futures – possible, probable, and desirable
- Ability to create one's vision for the future.
- Ability to apply the precautionary principle
- Ability to assess the consequences of actions
- Ability to deal with risks and changes

Strategic Competency

- Ability to collectively develop and implement innovative actions that further a cause at the local level and beyond.
- Ability to understand the bigger picture and the implications of smaller actions on them

Self-Awareness Competency

- The ability to reflect on one's role in the local community and (global) society
- Ability to continually evaluate and further motivate one's actions
- Ability to deal with one's feelings and desires

Social Emotional Learning (SEL): Five Core Competencies with Examples

1. *Self-Awareness*

Understanding one's emotions, thoughts, and values and how they influence one's behaviour in various situations. This includes the ability to recognise one's strengths and weaknesses with a sense of confidence and purpose. For instance:

- *Integrating personal and social identities;*
- *Identifying personal, cultural, and linguistic assets;*
- *Identifying one's emotions;*
- *Demonstrating honesty and integrity;*
- *Connecting feelings, values, and thoughts;*

- *Examining prejudices and biases;*
- *Experiencing self-efficacy;*
- *Having a growth mindset;*
- *Developing interests and a sense of purpose;*

2. *Self-Management*

The capacity to control one's emotions, thoughts, and actions in a variety of situations and to realise one's ambitions. This includes delaying obtaining one's desires, dealing with stress, and feeling motivated and accountable for achieving personal and group goals. For instance:

- *Managing one's emotions;*
- *Identifying and utilising stress-management strategies;*
- *Demonstrating self-discipline and self-motivation;*
- *Setting personal and group goals;*
- *Using planning and organisation skills;*
- *Having the courage to take the initiative;*
- *Demonstrating personal and collective agency;*

3. *Social Awareness*

The capacity to comprehend and care for others regardless of their backgrounds, cultures, and circumstances. This includes caring for others, understanding larger historical and social norms for behaviour in different contexts, and recognising family, school, and community resources and supports. For instance:

- *Recognising others' strengths*
- *Demonstrating empathy and compassion*
- *Caring about others' feelings*
- *Understanding and expressing gratitude*
- *Recognising situational demands and opportunities*
- *Understanding how organisations and systems influence behaviour*

4. *Relationship Skills*

The capacity to establish and maintain healthy, beneficial relationships and adapt to various social situations and groups. This includes speaking clearly, listening attentively, collaborating, solving problems and resolving conflicts as a group, adapting to diverse social and cultural demands and opportunities, taking the initiative, and asking for or offering assistance when necessary. For instance:

- *Communicating effectively;*
- *Building positive relationships;*
- *Demonstrating cultural competence;*
- *Working as a team to solve problems;*
- *Constructively resolving conflicts;*
- *Withstanding negative social pressure;*
- *Taking the initiative in groups;*
- *Seeking or assisting when needed;*
- *Advocating for the rights of others.*

5. *Responsible Decision-Making*

The capacity to make thoughtful and constructive decisions regarding acting and interacting with others in various situations. This includes weighing the pros and cons of various personal, social, and group well-being actions. For example:

- *Demonstrating curiosity and an open mind;*
- *Solving personal and social problems;*
- *Learning to make reasonable decisions after analysing information, data, and facts;*
- *Anticipating and evaluating the effects of one's actions;*
- *Recognising that critical thinking skills are applicable both inside and outside of the classroom;*
- *Reflecting on one's role in promoting personal, family, and community well-being;*
- *Evaluating personal, interpersonal, community, and institutional impacts*

Learning and Teaching Approaches

Learning and teaching should develop learners as self-directed and lifelong learners. Learners must be helped to build up deep learning skills and competencies to develop the ability to acquire, integrate and apply knowledge and skills to solve authentic and real-life problems. Learners need to be exposed to a variety of learning experiences to enable them to collaborate with others, construct meaning, plan, manage, and make choices and decisions about their learning. This will allow them to internalise newly acquired knowledge and skills and help them to take

ownership of their education. The 21st Century skills and competencies describe the relevant global and contextualised skills that the SHS curriculum is designed to help learners acquire in addition to the 4Rs (Reading, wRiting, aRithmetic and cReativity). These skills and competencies, as tools for learning and teaching and skills for life, will 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 and contributing to national development.

Given the diverse needs of learners, teachers need to have a thorough grasp of the different pedagogies as they design and enact meaningful learning experiences to meet the needs of different learners in the classroom. The teaching-learning techniques and strategies should include practical activities, discussion, investigation, role play, problem-based, context-based, and project-based learning. Active learning strategies have become increasingly popular in education as they provide learners with meaningful opportunities to engage with the material. These strategies emphasise the use of creative and inclusive pedagogies and learner-centred approaches anchored on authentic and enquiry-based learning, collaborative and cooperative learning, differentiated teaching and learning, holistic learning, and cross-disciplinary learning. They include experiential learning, problem-based learning, project-based learning, and talk-for-learning approaches. Some of the pedagogical exemplars to guide learning and teaching of the SHS curriculum include:

- **Experiential Learning:** Experiential learning is a hands-on approach to learning that involves learners in real-world experiences. This approach focuses on the process of learning rather than the result. Learners are encouraged to reflect on their experiences and use them to develop new skills and knowledge. Experiential learning can take many forms, including internships, service learning, and field trips. One of the main benefits of experiential learning is that it allows learners to apply what they have learned in the classroom to real-world situations. This can help them develop a deeper understanding of the material and make connections between different concepts. Additionally, experiential learning can help learners develop important skills such as critical thinking, problem-solving and communication.
- **Problem-Based Learning:** Problem-based learning is an approach that involves learners in solving real-world problems. Learners are presented with a problem or scenario and are asked to work together to find a solution. This approach encourages learners to take an active role in their learning and helps them develop important skills such as critical thinking and problem-solving. One of the main benefits of problem-based learning is that it encourages learners to take ownership of their learning. By working together to solve problems, learners can develop important skills such as collaboration and communication. Additionally, problem-based learning can help learners develop a deeper understanding of the material as they apply it to real-world situations.
- **Project-Based Learning:** Project-based learning is a hands-on approach to learning that involves learners in creating a project or product. This approach allows learners to take an active role in their learning and encourages them to develop important skills such as critical thinking, problem-solving, collaboration, and communication. One of the main benefits of project-based learning is that it allows learners to apply what they have learned in the classroom to real-world situations. Additionally, project-based learning can help learners develop important skills from each other and develop a deeper understanding of the material.
- **Talk for Learning Approaches:** Talk for learning approaches (TfL) are a range of techniques and strategies that are used to encourage learners to talk by involving them in discussions and debates about the material they are learning. This approach encourages learners to take an active role in their learning and helps them develop important skills such as critical thinking, collaboration and communication and also makes them develop confidence. One of the main benefits of TfL is that it encourages learners to think deeply about the material they are learning. By engaging in discussions and debates, learners can develop a deeper understanding of the material and make connections between different concepts.
- **Initiating Talk for Learning:** Initiating talk for learning requires the use of strategies that would encourage learners to talk in class. It helps learners to talk and participate meaningfully and actively in the teaching and learning process. Apart from developing skills such as communication and critical thinking, it also helps learners to develop confidence. Some strategies for initiating talk among learners are Activity Ball; Think-Pair-Share; Always, Sometimes, Never True; Matching and Ordering of Cards.
- **Building on What Others Say:** Building on what others say is an approach that involves learners in listening to and responding to their classmates' ideas.

This approach encourages learners to take an active role in their learning and helps them develop important skills such as critical thinking and communication. One of the main benefits of building on what others say is that it encourages learners to think deeply about the material they are learning. By listening to their classmates' ideas, learners can develop a deeper understanding of the material and make connections between different concepts. Additionally, building on what others say can help learners develop important skills such as collaboration and reflection. Some of the strategies to encourage learners to build on what others say are brainstorming, concept cartoons, pyramid discussion, and 5 Whys, amongst others.

- **Managing Talk for Learning:** Managing talk for learning requires the use of various strategies to effectively coordinate what learners say in class. Effective communication is a crucial aspect of learning in the classroom. Teachers must manage talk to ensure that learners are engaged, learning, and on-task in meaningful and purposeful ways. Some strategies for managing learners' contributions are debates, think-pair-share, sage in the circle etc.
- **Structuring Talk for Learning:** One effective way to shape learners' contributions is to structure classroom discussions. Structured discussions provide a framework for learners to engage in meaningful dialogue and develop critical thinking skills. Teachers can structure discussions by providing clear guidelines, such as speaking one at a time, listening actively, and building on each other's ideas. One popular structured discussion technique is the "think-pair-share" method. In this method, learners think about a question or prompt individually, and then pair up with a partner to discuss their ideas. Finally, the pairs share their ideas with the whole class. This method encourages all learners to participate and ensures that everyone has a chance to share their thoughts. Another effective way to structure talk for learning is to use open-ended questions. Open-ended questions encourage learners to think deeply and critically about a topic. They also promote discussion and collaboration among learners. Teachers can use open-ended questions to guide classroom discussions and encourage learners to share their ideas and perspectives. Other strategies that can be used are Concept/Mind Mapping, "Know," "Want to Know," "Learned" (KWL); Participatory Feedback; and the 5 Whys.
- **Diamond Nine:** The Diamond Nine activity is a useful tool for managing talk for learning in the classroom. This activity involves ranking items or ideas in order of importance or relevance. Learners work in groups to arrange cards or sticky notes with different ideas or concepts into a diamond shape, with the most important idea at the top and the least important at the bottom. The Diamond Nine activity encourages learners to think critically about a topic and prioritise their ideas. It also promotes collaboration and discussion among group members. Teachers can use this activity to introduce a new topic, review material, or assess student understanding.
- **Group Work/Collaborative Learning:** Group work or collaborative learning are effective strategies for managing talk for learning in the classroom. These strategies encourage learners to work together to solve problems, share ideas, and learn from each other. Group work and collaborative learning also promote communication and collaborative skills that are essential for success in the workplace and in life. To implement group work effectively, teachers must provide clear guidelines and expectations for group members. They should also monitor group work to ensure that all learners are participating and on-task. Teachers can also use group work as an opportunity to assess individual student understanding and participation.
- **Inquiry-Based Learning:** Learners explore and discover new information by asking questions and investigating.
- **Problem-Based Learning:** Learners are given real-world problems to solve and must use critical thinking and problem-solving skills.
- **Project-Based Learning:** Learners work on long-term projects that relate to real-world scenarios.
- **Flipped Classroom:** Learners watch lectures or instructional videos at home and complete assignments and activities in class.
- **Mastery-Based Learning:** Learners learn at their own pace and only move on to new material once they have mastered the current material.
- **Gamification:** Learning is turned into a game-like experience with points, rewards, and competition.

These strategies provide learners with opportunities to engage with the material in meaningful ways and develop important skills such as critical thinking, problem-solving, collaboration, and communication. By incorporating these strategies into their teaching, teachers can help learners develop a deeper understanding of the material and prepare them for success in the real world. Effective communication is essential for learning in the classroom. Teachers must manage talk to ensure that learners are engaged in learning and on-task. Strategies such as structuring

talk for learning, using Diamond Nine activities, and implementing group work/ collaborative learning can help teachers manage talk effectively and promote student learning and engagement. By implementing these strategies, teachers can create a positive and productive learning environment where all learners can succeed.

Universal Design for Learning (UDL) in the SHS Curriculum

The design of the curriculum uses UDL to ensure the creation of flexible learning environments that can accommodate a wide range of learner abilities, needs, and preferences. The curriculum is designed to provide multiple means of engagement, representation, and action and expression, so teachers can create a more inclusive and effective learning experience for all learners. UDL is beneficial for all learners, but it is particularly beneficial for learners needing special support and learners who may struggle with traditional teaching approaches. The integration of UDL in the pedagogy is aimed at making learning accessible to everyone and helping all learners reach their full potential. For instance, teachers need to:

- incorporate multiple means of representation into their pedagogy, such as using different types of media and materials to present information.
- provide learners with multiple means of action and expression, such as giving them options for how they can demonstrate their learning.
- consider incorporating multiple means of engagement into their choice of pedagogy, such as incorporating games or interactive activities to make learning more fun and engaging.

By doing these, teachers can help ensure that the curriculum is accessible and effective for all learners, regardless of their individual needs and abilities.

Curriculum and Assessment Design: Revised Bloom's Taxonomy and Webb's Depth of Knowledge

The design of this curriculum uses the revised Bloom's Taxonomy and Webb's Depth of Knowledge (DoK) as frameworks to design what to teach and assess.

The Revised Bloom's Taxonomy provides a framework for designing effective learning experiences. Understanding the different levels of learning, informed the creation of activities and assessments that challenge learners at the appropriate level and help them progress to higher levels of thinking. Additionally, the framework emphasises the importance of higher-order thinking skills, such as analysis, evaluation, and creation, which are essential for success in today's complex and rapidly changing world. This framework is a valuable tool for educators who want to design effective learning experiences that challenge students at the appropriate level and help them develop higher-order thinking skills. By understanding the six levels of learning and incorporating them into their teaching, educators can help prepare students for success in the 21st century. The six hierarchical levels of the revised Bloom's Taxonomy are:

1. **Remember** – At the foundation is learners' ability to remember. That is retrieving knowledge from long-term memory. This level requires learners to recall concepts—identify, recall, and retrieve information. Remembering is comprised of identifying, listing, and describing. Retrieving relevant knowledge from long-term memory includes, recognising, and recalling is critical for this level.
2. **Understand** – At understanding, learners are required to construct meaning that can be shown through clarification, paraphrasing, representing, comparing, contrasting and the ability to predict. This level requires interpretation, demonstration, and classification. Learners explain and interpret concepts at this level.
3. **Apply** – This level requires learners' ability to carry out procedures at the right time in a given situation. This level requires the application of knowledge to novel situations as well as executing, implementing, and solving problems. To apply, learners must solve multi-step problems.
4. **Analyse** – The ability to break things down into their parts and determine relationships between those parts and being able to tell the difference between what is relevant and irrelevant. At this level, information is deconstructed, and its relationships are understood. Comparing and contrasting information and organising it is key. Breaking material into its constituent parts and detecting how the parts relate to one another and an overall structure or purpose is required. The analysis also includes differentiating, organising and attributing.
5. **Evaluate** – The ability to make judgments based on criteria. To check whether there are fallacies and inconsistencies. This level involves information evaluation, critique, examination, and formulation of hypotheses.
6. **Create** – The ability to design a project or an experiment. To create, entails learners bringing something new. This level requires generating information—planning, designing, and constructing.

Webb's Depth of Knowledge (DoK) is a framework that helps educators and learners understand the level of cognitive engagement required for different types of learning tasks. The framework includes four levels. By understanding the four DoK levels, educators can design learning activities that challenge students to engage in deeper thinking and problem-solving. DoK is an essential tool for designing effective instruction and assessments. By understanding the different levels of DoK, teachers can design instruction and assessments that align with what they intend to achieve. DoK is a useful tool for differentiating instruction and providing appropriate challenges for all learners. Teachers can use DOK to identify students who need additional support or those who are ready for more advanced tasks. The four levels of Webb's' DoK assessment framework are:

- **Level 1: Recall and Reproduction –** Assessment at this level is on recall of facts, concepts, information, and procedures—this involves basic knowledge acquisition. Learners are asked specific questions to launch activities, exercises, and assessments. The assessment is focused on recollection and reproduction.
- **Level 2: Skills of Conceptual Understanding –** Assessment at this level goes beyond simple recall to include making connections between pieces of information. The learner's application of skills and concepts is assessed. The assessment task is focused more on the use of information to solve multi-step problems. A learner is required to make decisions about how to apply facts and details provided to them.
- **Level 3: Strategic Reasoning** – At this level, the learner's strategic thinking and reasoning which is abstract and complex is assessed. The assessment task requires learners to analyse and evaluate composite real-world problems with predictable outcomes. A learner must apply logic, employ problem-solving strategies, and use skills from multiple subject areas to generate solutions. Multitasking is expected of learners at this level.
- **Level 4: Extended Critical Thinking and Reasoning –** At this level of assessment, the learner's extended thinking to solve complex and authentic problems with unpredictable outcomes is the goal. The learner must be able to strategically analyse, investigate, and reflect while working to solve a problem, or changing their approach to accommodate new information. The assessment requires sophisticated and creative thinking. As part of this assessment, the learner must know how to evaluate their progress and determine whether they are on track to a feasible solution for themselves.

The main distinction between these two conceptual frameworks is what is measured. The revised Bloom's Taxonomy assesses the cognitive level that learners must demonstrate as evidence that a learning experience occurred. The DoK, on the other hand, is focused on the context—the scenario, setting, or situation—in which learners should express their learning. In this curriculum, the revised Bloom's taxonomy guided the design, and the DoK is used to guide the assessment of learning. The taxonomy provides the instructional framework, and the DoK analyses the assignment specifics. It is important to note that Bloom's Taxonomy requires learners to master the lower levels before progressing to the next. So, suppose the goal is to apply a mathematical formula. In that case, they must first be able to identify that formula and its primary purpose (remember and understand). The cognitive rigour is therefore presented in incremental steps to demonstrate the learning progression. When measuring assessments in DoK, learners move fluidly through all levels. In the same example, while solving a problem with a formula, learners recall the formula (DoK 1) to solve the problem (DoK 2 and DoK 3). Depending on the difficulty of the problem to be solved, the learner may progress to DoK 4.

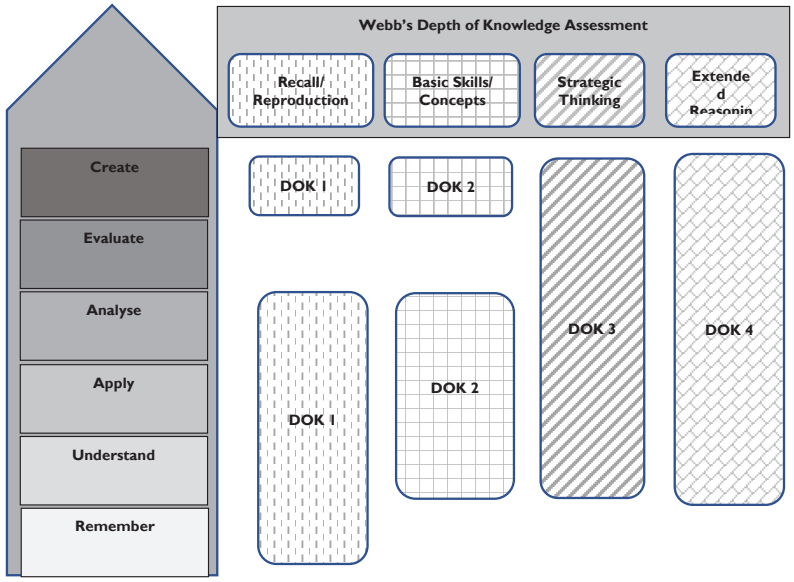

Figure 1: Revised Bloom Taxonomy combined with Webb's Depth of Knowledge for Teaching and Assessment

The structure of teaching and the assessment should align with the six levels of Bloom's knowledge hierarchy and DoK shown in Figure 1. Each level of DoK should be used to assess specific domains of Bloom's Taxonomy as illustrated in the table below:

Depth of Knowledge (DoK) Assessment	Bloom's Taxonomy applied to DoK
• Level 1: Recall and Reproduction	• Remembering, Understanding, Application, Analysis and Creation
• Level 2: Basic Skills and Concepts	• Understanding, Application, Analysis and Creation
• Level 3: Strategic Thinking	• Understanding, Application, Analysis, Evaluation and Creation
• Level 4: Extended Reasoning	• Understanding, Application, Analysis, Evaluation and Creation

In line with the National Pre-Tertiary Learning and Assessment Framework, the Secondary Education Assessment Guide (SEAG) requires that classroom assessments should cover **Assessment as learning (AaL), Assessment of learning (AoL) and Assessment for learning (AfL).** Therefore, teachers should align the Revised Bloom's Taxonomy with the DoK framework of assessment. Formative assessments should include classroom discussions, project-based assignments, and self-reflection exercises, while summative assessments should include standardised tests and rubric-based evaluations of learners' work. It is important to seek feedback from learners themselves, as they may have unique insights into how well they are developing these skills in the classroom.

To assess 21st Century skills and competencies in the classroom, teachers will have to use a combination of both formative and summative assessments to evaluate learners' acquisition of these skills and competencies. For instance:

- Identify the specific 21st Century skills and competencies to be assessed. For instance, you might want to assess *critical thinking, problem-solving, or creativity*.
- Align the skills and competencies with the DoK levels. For example, lower DoK levels might be more appropriate for assessing basic knowledge and comprehension, whereas higher DoK levels might be more appropriate for assessing more complex skills such as *analysis, synthesis, and evaluation*.
- Develop assessment items that align with the DoK levels and the skills and competencies you want to assess. These items should be designed to elicit evidence of learning across the different levels of the DoK framework.
- Administer the assessment and collect data. Analyse the data to gain insights into student learning and identify areas where learners may need additional support or instruction.

The DoK framework is a powerful tool for assessing the acquisition of 21st Century skills and competencies in the classroom, helping teachers to better understand how learners are learning and identify areas for improvement.

Educational success is no longer about producing content knowledge, but rather about extrapolating from what we know and applying the knowledge creatively in new situations.

The overall assessment of learning at SHS should be aligned with the National Pre-Tertiary Learning and Assessment Framework and the Secondary Education Assessment Guide. Formative and summative assessment strategies must be used.

Definition of Key Terms and Concepts in the Curriculum

- **Learning Outcomes:** It is a statement that defines the knowledge, skills, and abilities that learners should possess and be able to demonstrate after completing a learning experience. They are specific, measurable, attainable, and aligned with the content standards of the curriculum. It helps the teachers to determine what to teach, how to teach, and how to assess learning. Also, it communicates expectations to learners and helps them to better master the subject.
- **Learning Indicators:** They are measures that allow teachers to observe progress in the development of capacities and skills. They provide a simple and reliable means to evaluate the quality and efficacy of teaching practices, content delivery, and attainment of learning outcomes.
- **Content Standards:** It is a statement that defines the knowledge, skills, and understanding that learners are expected to learn in a particular subject area or grade level. They provide a clear target for learners and teachers and help focus resources on learner achievement.
- **Pedagogical Exemplars:** They are teaching examples used to convey values and standards to learners. Pedagogical Exemplars are usually demonstrated through teacher behaviour.
- **Assessment:** It is the systematic collection and analysis of data about learners' learning to improve the learning process or make a judgement on learner achievement levels. Assessment is aimed at developing a deep understanding of what learners know, understand, and can do with their knowledge because of their educational experiences. Assessment involves the use of empirical data on learners' learning to improve learning. Assessment is an essential aspect of the teaching and learning process in education, which enables teachers to assess the effectiveness of their teaching by linking learner performance to specific learning outcomes.
- **Teaching and Learning Resources:** Teaching and learning resources are essential tools for teachers to provide high-quality education to their learners. These resources can take various forms, including textbooks, audiovisual materials, online resources, and educational software. It is also important to avoid stereotypes and use inclusive language in teaching and learning resources. This means avoiding language that reinforces negative stereotypes and using language that is respectful and inclusive of all individuals regardless of their background. Using a consistent tone, style, and design is very important.

PHILOSOPHY, VISION AND GOAL OF BIOLOGY

Philosophy

The next generation of scientists can be empowered through observation, curiosity, innovation, and exposure to practically related concepts and opportunities that leverage hands-on activities in a learner centred environment.

Vision

Biology learners equipped with 21st Century Skills and Competencies to explore, understand, and apply creative and critical thinking processes in nature inspired-situations for the conservation and sustenance of life and the environment.

Goal

That the SHS Biology learner is equipped with the requisite knowledge, processes, skills, and attitudes necessary to understand nature inspired-situations, conservation and sustenance of life and the environment and contribute to the 'Glocal' body of knowledge and the field of work. It is also to nurture learners' interest and curiosity in biology, equip leaners with scientific literacy, be familiar with the language of biology and to be able to communicate scientific ideas, embrace learning diversity, strengthen learners' ability to integrate and apply knowledge and skills including hands-on skills, recognise the economic, social, ethical and environmental implications of biological studies and develop an attitude for responsible citizenship as well as prepare learners for further studies, adult life and the world of work.

Contextual Issues

Biology education at the SHS level suffers from lack of practical activity and investigative work – emphasis is given to theory at the expense of the practical application of knowledge, broad scientific literacy and hands-on activities. Consequently, learners achieve limited understanding of how biological processes apply to nature inspired-situations, conservation and sustenance of life and the environment. Teachers limit the acquisition and understanding of broad concepts and ideas in biology without attempting to demonstrate how these concepts and ideas applied in practice.

The pedagogical approaches and strategies, including the classroom assessment used by the teacher hugely promotes the memorisation of the concepts and ideas, and do not encourage the acquisition of skills, competencies, scientific literacy and practical application

Rationale

The study of Biology in this new curriculum will enable learners to develop an in-depth knowledge and understanding of the natural world, and acquire critical thinking skills, which are needed for sound approaches to daily decisions on issues of life. The Biology study emphasizes the engagement of learners in the classroom, laboratory, on the field, and through virtual means to meet the current scientific and biological challenges confronting humanity. This is aimed at promoting hands-on experience crucial to the learning process which will cut across the entire three-year study duration. Indigenous knowledge, materials, and biological processes common to the learners' community and daily life will be employed in the course to arouse the interest of learners to appreciate and value nature and manage resources in their environment in a sustainable manner. Mixed ability practices, group projects, and presentations will be hallmarked to address Gender Equality and Social Inclusion issues. This will enable the nurturing of a confident and lifelong learner who has a strong sense of civic responsibility and employs biological ideologies in everyday life

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SCOPE AND SEQUENCE

Biology Summary

S/N	STRAND	SUB-STRAND	YEAR 1			YEAR 2			YEAR 3		
			CS	LO	LI	CS	LO	LI	CS	LO	LI
1	Exploring Biology in Society	Biology as the Science of Life	4	4	5	1	1	2	-	-	-
		Biology and Entrepreneurship	1	1	3	1	1	2	1	1	4
2	Life in the Fundamental Unit	Cell structure and Functions	-	-	-	2	2	6	5	5	7
		Movement of substances in living organisms	1	1	3	-	-	-	-	-	-
3	Diversity of living things and their Environment	Living Organisms	3	3	3	3	4	6	1	1	2
		Ecology	5	5	7	1	1	2	2	2	4
		Diseases and infections	1	1	1	1	1	2	1	1	2
4	Systems of life	Mammalian Systems	1	1	2	1	1	2	1	1	4
		Plant Systems	1	1	3	1	1	2	1	1	4
Total			17	17	27	11	12	24	13	13	29

Overall Totals (SHS 1 – 3)

Content Standards	41
Learning Outcomes	42
Learning Indicators	80

YEAR ONE

Subject BIOLOGY
Strand 1. EXPLORING BIOLOGY IN SOCIETY
Sub-Strand 1. BIOLOGY AS THE SCIENCE OF LIFE

Learning Outcomes	21st Century Skills and Competencies	GESI[1], SEL[2] and Shared National Values
1.1.1.LO.1		
Explain the importance of Biology and its branches and relate this to everyday life.	**Communication and Collaboration:** Learners speak politely and clearly as they share ideas on the video and pictures they watched with their peers and accept constructive feedback from their peers. **Critical Thinking and Problem-Solving Skills:** Learners analyse the work of the biologist in the development of products for human consumption. **Digital Literacy skills:** learners use the internet to research the applications of the branches of biology in everyday life. **Cultural Identity and Global Citizenship:** by researching about the application of biology to address challenges within the community and the world at large.	**GESI:** • Respect individuals of different beliefs, religions, and cultures. • Embrace diversity and practise inclusion. • Be gender responsive and have the ability to tackle injustice. • Be aware of personal biases and stereotypes. • Be sensitive to the inter-relatedness of the various spheres of life, groups, and individuals. **SEL:** • Learners work together and build self-confidence. • Learners learn to listen to their peers' opinions and express disagreement in constructive ways. • Learners adjust to real-world scenarios • Learners believe that their thoughts and opinions are valued. **National Core Values:** • Respect for each member of the group. • Integrity and honesty. • Selflessness and perseverance.

[1] Gender Equality and Social Inclusion
[2] Socio-Emotional Learning

		• Time consciousness and commitment to achieving excellence.
1.1.1.LO.2		
Solve everyday problems using the scientific method.	**Communication and Collaboration:**learners speak clearly and share ideas to identify problems in their immediate environment(e.g., school). Learners work together and build self-confidence. **Critical Thinking and Problem-Solving Skills:** learners reflect and analyse critically to solve an identified problem within the community, as they share ideas through communication and collaboration. **Digital Literacy skills:** learners research on the internet and other relevant sources to gather information on the use of the scientific method. **Cultural Identity and Global Citizenship:** by applying the scientific method to address problems within the community **Creativity and Innovation:** through the generation of learner's own solutions to address identified problems.	**GESI:** • Respect individuals of different beliefs, religions, and cultures. • Embrace diversity and practice inclusion. • Be gender responsive and have the ability to tackle injustice. • Be aware of personal biases and stereotypes. • Be sensitive to the inter-relatedness of the various spheres of life, groups, and individuals. **SEL:** • Work together and build self-confidence. • Learners learn to listen to their peers' opinions and express disagreement in constructive ways. • Learners adjust to real-world scenarios and believe that their thoughts and opinions are valued. • Develop respectful relationships with one another, families and other people. **National Core Values:** • Respect for each member of the group. • Integrity and honesty. • Selflessness and perseverance. • Time consciousness and commitment to achieving excellence.
1.1.1.LO.3		
Apply knowledge of body symmetry, orientation, and sectioning of various organisms, and make labelled drawings of specimens.	**Communication and Collaboration:** learners work together and discuss the orientation of specimens. **Critical Thinking and Problem Solving:** learners think deeply to determine the lines of symmetries of organisms and	**GESI:** • Respect individuals of different beliefs, religions, and cultures. • Embrace diversity and practise inclusion. • Be gender responsive and have the ability to tackle

	their organs and make sections through them. **Leadership and Personal Development:** through the assignment of roles and responsibilities to each of the learners during the group activities.	injustice. • Be aware of personal biases and stereotypes. • Be sensitive to the inter-relatedness of the various spheres of life, groups, and individuals. **SEL:** • Learners work together and build self-confidence. • Learn to listen to their peers' opinions and express disagreement in constructive ways. • Learners identify and express their feelings respectfully. **National Core Values:** • Respect for each member of the group. • Integrity and honesty. • Selflessness and perseverance. • Time consciousness and commitment to achieving excellence.
1.1.1.LO.4		
Explain the safe ways of using the light microscope and the functions of its parts.	**Communication and Collaboration:** learners talk among themselves, and collaborate, as they discuss the parts and functions of the microscope. **Personal Development**: learners develop deep manipulative skills in demonstrating the use of the microscope to obtain sharp, non-blurred images. **Digital Literacy:** by working together to operate the compound light microscope.	**GESI:** • Respect individuals of different beliefs, religions, and cultures. • Embrace diversity and practise inclusion. • Be gender responsive and have the ability to tackle injustice. • Be aware of personal biases and stereotypes. • Be sensitive to the inter-relatedness of the various spheres of life, groups, and individuals. **SEL:** • Learners learn to listen to their peers' opinions and express disagreement in constructive ways. • Learners learn to adjust to real-world scenarios and believe that their thoughts and opinions are valued.

		National Core Values: • Respect for each member of the group. • Integrity and honesty. • Selflessness and perseverance. • Time consciousness and commitment to achieving excellence.

Content Standards	**Learning Indicators and Pedagogical Exemplars with 21st Century Skills and Competencies, and GESI**			**Assessment**
1.1.1.CS.1	1.1.1.LI.1			1.1.1.AS.1
Demonstrate knowledge and understanding of Biology, the various branches and fields of study, and their benefits in everyday life.	**Observe and discuss the importance of Biology, its various branches and their applications in everyday life.** **Talk for Learning (TFL):** in mixed ability, gender-balanced groups, observe pictures, videos of specimens relating to Biology (e.g., honey and dry Tilapia, etc.) and share ideas with peers and accept feedback on their observations: Learners in mixed-ability groups learn from each other and provide emotional support to one another to achieve targets. **Think-Pair-Share:** learners in pairs discuss, analyse and share the contribution of biologists to the development of society; learners speak to each other to improve on communication. Learners learn from each other. **Enquiry-Based Approach:** in mixed-ability, all-inclusive groups, research from the internet, textbooks, scientific journals, and other related sources to find out the importance of the branches of Biology in everyday life and present their findings within a given time in a written report for feedback: Learners improve communication through group discussion. Learners develop forbearance, hence tolerate views from other peers.			Level 1 Recall Level 2 Skills of conceptual understanding **Level 3 Strategic reasoning** **Level 4 Extended critical thinking and reasoning**
Teaching and Learning Resources	• Computer/projectors/TV/smart phone • Pen drive • Pictures	• Simulations of biological specimens • Honey	• Dry fish (“Kobi”) • Bottled fruit juices	• Milk • Medicines

Content Standards	**Learning Indicators and Pedagogical Exemplars with 21st Century Skills and Competencies, and GESI**			**Assessment**
1.1.1.CS.2	1.1.1.LI.1			1.1.1.AS.1
Understand and apply the method through which biologist work to solve problems.	**Explain how the scientific method is used to solve problems in the immediate environment** **Group Presentation:** in mixed ability, socially inclusive, and gender-balanced groups, identify common problems within the school community (e.g., sanitation, power outages, etc) and make presentations, explaining how the scientific method is employed to solve these problems, focusing on each of the key steps. Learners discuss and submit reports for presentation: Learners work in to learn from one another, and to improve on communication skills. **Individual-based Learning:** predict with explanations, what will happen if the scientific method is not used correctly by biologists: Learners work individually to develop self-assurance and self-confidence.			**Level 1 Recall** **Level 2 Skills of conceptual understanding** **Level 3 Strategic reasoning** **Level 4 Extended critical thinking and reasoning**
Teaching and Learning Resources	• LCD/TV • Posters	• Projectors • Flyers	• Laptops and photos	

Content Standards	**Learning Indicators and Pedagogical Exemplars with 21st Century Skills and Competencies, and GESI**				**Assessment**
1.1.1.CS.3	1.1.1.LI.1				1.1.1.AS.1
Demonstrate knowledge and understanding of symmetry, orientation, sectioning, and biological drawings of specimens.	**Observe and identify the various orientations and symmetries of different organisms.** **Group Project-Based Learning:** in mixed ability, gender-neutral task-based groups, collect biological specimens (e.g., orange fruits, flowers of Crotalaria and Allamanda, and insects such as cockroaches, butterflies, etc.) and display them on a table: Learners build self-confidence through talking during discussion, and psychological strength as they offer emotional support for each group member. **Observational and Differential Learning:** learners in mixed-ability groups critically observe and identify the orientations and symmetries of the collected specimens, and each group member should draw and label any one of the specimens: Learners research independently and therefore become independent thinkers; learners learn from one another and receive social and emotional support for one another. **Initiate Talk for Learning:** mixed-ability groups discuss their observations and prepare a group report on their key findings for class presentation: In every group work, all individuals, introverts and extroverts play a role, and this builds teamwork spirit.				**Level 1 Recall** **Level 2 Skills of conceptual understanding** **Level 3 Strategic reasoning** **Level 4 Extended critical thinking and reasoning**
Teaching and Learning Resources	• Sweep nets • Sample bottles	• Fruits • Flowers	• Insects • Razor blade/knife	• Hand lens	

Content Standards	Learning Indicators and Pedagogical Exemplars with 21stCentury Skills and Competencies, and GESI	Assessment
1.1.1.CS.4	1.1.1.LI.1	1.1.1.AS.1
Demonstrate knowledge, skill, and safety in the use of the microscope.	**Identify the parts of the microscope and state their functions.** **Task-Based Group Learning:** in a mixed-ability, socially inclusive, task-based groups, learners examine the various parts of the microscope (with emphasis on the eyepiece lens, objective lens, stage, clips, revolving nosepiece, diaphragm, limb, base/foot): Mixed ability grouping ensures respect for every learner regardless of their social background. **Observational Learning/Initiate Talk for Learning:** learners critically observe and examine each part of the microscope in relation to its function and share their observations in group discussions; learners improve on the skill of oratory through group discussions and learn from one another.	Level 1 Recall Level 2 Skills of conceptual understanding **Level 3 Strategic reasoning** Level 4 Extended critical thinking and reasoning
	1.1.1.LI.2	1.1.1.AS.2
	Demonstrate the safe usage of the microscope to observe specimens. **Experiential Learning Approach:** in mixed-ability, task-based groups, learners mount different slides provided on the stage of the microscope and observe the specimen on the slide: Learner gains first-hand experience on lessons and relate to real world situations. **Differential Learning Approach:** in mixed-ability groups, learners mount different slides on the stage and observe and discuss the images formed; learner develops the skill of critical observation and inquisition; learner improves speech ability through discussion. **Collaborative Learning:** learners in mixed-ability groups exchange slides with different groups and examine other types of slides following the same procedure**:** Draw the images obtained at sharp focuses; learner works in team to develop team spirit.	Level 1 Recall Level 2 Skills of conceptual understanding Level 3 Strategic reasoning **Level 4 Extended critical thinking and reasoning**
Teaching and Learning Resources	• Microscopes • Slides • Source of light • Specimens • Sketch books • Pencils • Pens • Erasers.	

Subject BIOLOGY
Strand 1. EXPLORING BIOLOGY IN SOCIETY
Sub-Strand 2. BIOLOGY AND ENTREPRENEURSHIP

Learning Outcomes	21st Century Skills and Competencies	GESI, SEL and Shared National Values
1.1.2.LO.1		
Apply the knowledge of basic concepts in biology to improve productivity in fish farming.	**Communication and Collaboration:** • Learner's watch, discuss and share ideas on the various techniques employed in fish production. • Learners discuss in groups to know why particular biological principles are used in fish harvesting and processing. • Learners discuss among themselves and collaborate to find out about best management practices in fish farming. **Leadership and Personal Development:** by assigning different roles to members in all group activities whilst learning about how to improve fish production. **Critical Observation and Inquisition Skills:** • Learners develop the skill of observing critically and asking questions during field trips to fish-rearing centres. • Learners embark on trips to observe and ask questions on suitable harvesting practices. **Critical Thinking and Problem-Solving:** • The construction of an aquarium, studying the growth pattern in fish, collecting and analysing data explore deep thinking skills in solving problems. • Learners develop the skill of critical thinking as they examine essential biological principles required in fish harvesting and processing. • Learners research the sustainable management and exploitation of fish and collect them.	**GESI:** • Respect individuals of different beliefs, religions, and cultures. • Embrace diversity and practise inclusion. • Be gender responsive and have the ability to tackle injustice. • Be aware of personal biases and stereotypes. • Be sensitive to the inter-relatedness of the various spheres of life, groups, and individuals. **SEL:** • Learners learn to listen to their peers' opinions and express disagreement in constructive ways. • Develop respectful relationships with one another, families and other people. • Learners adjust to real-world scenarios and believe that their thoughts and opinions are valued. **National Core Values:** • Respect for each member of the group. • Integrity and honesty. • Selflessness and perseverance.

	Digital Literacy: learners acquire knowledge in the operation of technological devices such as the use of the pen drive and simulation devices.	• Time consciousness and commitment to achieving excellence.

Content Standards	Learning Indicators and Pedagogical Exemplars with 21st Century Skills and Competencies, and GESI	Assessment
1.1.2.CS.1	1.1.2.LI.1	1.1.2.AS.1
Demonstrate knowledge of the application of biological concepts to improve fish production.	**Identify the biological concepts that are used in the nursery and grow-out stages to improve fish production.** **Task-Based Learning:** learners in mixed-ability, all-inclusive groups, watch videos and documentaries on fish farming or embark on field trips to fish rearing and research centres to study the various biological principles applied in fish production and make their own notes on this for discussion: Learner learns how to interact with different people from different socio-economic background. Learner develops team spirit. **Project-Based Learning:** in mixed-ability groups, look for materials such as aquarium tanks, scoop net and water storage tanks to make an aquarium, and obtain fingerlings from a fish farm or nearby waterbody to stock the aquarium; learner experiences real-life situations. Learner develops innovative skills and become self-initiators. **Project-Based and Experiential Learning Approaches:** learners in mixed-ability groups apply suitable fish farming practices to feed and aerate the fish, while studying their growth patterns and making notes on the changes; learners develop the skill of critical thinking and observation; learners develop independent thinking. Learners develop the ability of working and supporting one another in a teamwork. **Analytical Learning Approach:** over a period, learners in mixed-ability groups collate results obtained from project, analyse and discuss the findings in class presentations: Learners working in groups provide emotional and psychological support to one another to obtain results. Learners develop analytical skills.	Level 1 Recall **Level 2 Skills of conceptual understanding** Level 3 Strategic reasoning **Level 4 Extended critical thinking and reasoning**
	1.1.2.LI.2	1.1.2.AS.2
	Explain the use of biological principles in the harvesting and processing of fish to improve production. **Task-Based Learning:** In mixed-ability, all-inclusive groups, learners research from textbooks, the internet, videos, and documentaries and embark on field trips to learn about the biological principles applicable in the harvesting and processing of fish and discuss these in a group report: Group discussions improve on learners' public speaking; group work ensures social bonding among learners.	Level 1 Recall Level 2 Skills of conceptual understanding **Level 3 Strategic reasoning** **Level 4 Extended**

	Experiential-Based Learning: Learners employ the principles studied in harvesting (e.g., increase feed one or two weeks before harvesting, starving, draining, etc) and processing to practically harvest mature fish from the school fishpond (where available): Learners become practical-oriented. Learners acquire the skill of solving problems on their own (self-initiated). **Experiential/Talk-Based Learning:** learners in mixed-ability groups employ suitable practices studied from research in fish processing (e.g., removing scales, removing intestines, drying processed fish, salting, etc) to keep the harvested fish. Discuss and write a report on your project for class presentations: Learners obtain real-world scenarios of lessons studied.	**critical thinking and reasoning**
	1.1.2.LI.3	1.1.2.AS.3
	Identify the biological concepts and principles that are used in the management and sustainable exploitation of wild stocks to improve fish production. **Task-Based Learning:** in mixed-ability, gender-responsive groups, learners research into suitable management practices in fish farming by watching videos, and documentaries, going on field trips to inquire about sustainable management and exploitation of fish, reading from textbooks, etc: Learners develop the skill of inquisition and oratory; learners support each other in teamwork. **Think-Pair-Share Learning:** discuss in pairs of two in within groups, the various ways by which fish is exploited (e.g., avoiding overfishing, maintaining healthy breeding population, separating coarse fish from trout fish, performing bio-manipulation practices such as removing planktivorous fishes to avoid extreme growth of phytoplankton due to eutrophication to improve water quality, etc.) and later discuss the thoughts within the larger group: Learners learn from one another; learners acknowledge the inputs and contributions peers in lessons. **Talk for Learning:** in mixed-ability groups, learners submit written reports within a given period on all your findings on the sustainable management and exploitation of fish for a class presentation: Learners develop team-working attitude and learn to work within a given timeframe.	Level 1 Recall Level 2 Skills of conceptual understanding **Level 3 Strategic reasoning** **Level 4 Extended critical thinking and reasoning**

Teaching and Learning Resources	• Fish nets • Salt • Oven • Fridge • Ice chess	• 1-Videos • Aquarium tanks • Scoop nets • Water storage containers • Aerators	• Fish feed • Field notebooks • Weighing scales • Measuring board/meter rule	• Videotapes • Projectors • Pen drives • Simulation devices

Subject BIOLOGY
Strand 2. LIFE IN THE FUNDAMENTAL UNIT
Sub-Strand 1. MOVEMENT OF SUBSTANCES IN LIVING ORGANISMS

Learning Outcomes	21st Century Skills and Competencies	GESI, SEL and Shared National Values
1.2.1.LO.1		
Explain the significance of the various processes involved in the movement of substances in and out of the cell and the factors affecting them.	**Communication and Collaboration:** learners work together in the analysis and critiquing of their observations on bulk transport, osmosis and diffusion. In working together, learners learn to listen to their peers' opinions and express disagreement in constructive ways. **Digital Literacy:** through the operation of digital devices. **Creativity and Innovation:** by creating models to demonstrate a phenomenon, learners develop respectful relationships. **Critical Thinking and Problem-Solving skills:** this is enhanced through the making of observations and constructively critiquing of each other's views on bulk transport, osmosis and diffusion to come out with valid explanations and conclusions.	**GESI:** • Respect individuals of different beliefs, religions, and cultures. • Embrace diversity and practise inclusion. • Be gender responsive and have the ability to tackle injustice. • Be aware of personal biases and stereotypes. • Be sensitive to the inter-relatedness of the various spheres of life, groups, and individuals. **SEL:** • Listen to their peers' opinions and express disagreement in constructive ways. • Develop respectful relationships with one another, families and other people. **National Core Values:** • Respect for each member of the group. • Integrity and honesty. • Selflessness and perseverance. • Time consciousness and commitment to achieving excellence.

Content Standards	Learning Indicators and Pedagogical Exemplars with 21st Century Skills and Competencies, and GESI	Assessment
1.2.1.CS.1	1.2.1.LI.1	1.2.1.AS.1
Demonstrate understanding of processes by which substances move across the cell membrane.	**Describe how substances move across the cell membrane.** **Project-Based Learning:** learners in mixed-ability groups watch videos, documentaries and simulations or pictures on bulk transport/bulk movement/bulk flow of substances across the cell membrane and make individual notes: learners in group learning learn from one another; learners learn to make personal/independent notes. **Talk for Learning (TFL):** learners in mixed-ability groups discuss the observations and identify any patterns in the movement of substances from notes made in the project exercise and discuss these: this improves on their public speaking ability; learners develop the skill of critical thinking as they critically assess movement of substances in the cell.	Level 1 Recall **Level 2 Skills of conceptual understanding** Level 3 Strategic reasoning **Level 4 Extended critical thinking and reasoning**
	1.1.2.1.LI.2	1.1.2.1.AS.2
	Discuss the effect of the movement of substances across the cell membrane. **Talk-For Learning and Collaborative Learning:** in mixed ability, all-inclusive groups, learners analyse and write down their findings on the effect of bulk transport/bulk movement/bulk flow of substances across the cell membrane from earlier project exercise and compare and discuss their notes: learners develop socially as they learn collaboratively through group studies; learners learn to support each other socially and emotionally in group discussions.	Level 1 Recall **Level 2 Skills of conceptual understanding** **Level 3 Strategic reasoning** **Level 4 Extended critical thinking and reasoning**
	1.1.2.1.LI.3	1.1.2.1.AS.3
	Discuss the factors that affect the movement of substances across the cell membrane. **Collaborative Project-Based Learning:** in mixed-ability, all-inclusive groups, learners research at the library, on the internet, books and other relevant sources about the factors that affect bulk transport/bulk movement/bulk flow of substances across the cell membrane: learners develop socially by learning together in groups. Learners become critical thinkers. **Experiential Learning**: in mixed-ability, all-inclusive groups, learners design an experiment based on findings on the factors that affect bulk transport/bulk movement/bulk flow of substances across the cell membrane (findings made from earlier researches/lessons): learners designing an experiment in order to make them	Level 1 Recall Level 2 Skills of conceptual understanding Level 3 Strategic reasoning **Level 4 Extended critical thinking and reasoning**

	independent critical thinkers: learners work together and therefore develop the team work attitude; learners support one another socially and emotionally in designing the experiment.			
Teaching and Learning Resources	• Computer/projectors/TV/smart phone • Pen drive	• Pictures • Simulation device	• Yam tissue • Concentrated salt/sugar solution	• Water • Crystals of potassium permangan ate

Subject BIOLOGY
Strand 3. DIVERSITY OF LIVING THINGS AND THEIR ENVIRONMNET
Sub-Strand 1. LIVING ORGANISMS

Learning Outcomes	21st Century Skills and Competencies	GESI, SEL and Shared National Values
1.3.1.LO.1		
Apply the knowledge of biological keys to identify living things.	**Communication and Collaboration:** learners come together in search for common specimens in the immediate environment and interact by communicating with one another in their attempt to identify these organisms by their common features. By working together, learners acquire the skill of managing stressful experiences. **Critical Thinking and Problem-Solving:** by applying analytical and evaluative skills to examine common patterns in living things to identify them.	**GESI:** • Respect individuals of different beliefs, religions, and cultures. • Embrace diversity and practise inclusion. • Be gender responsive and have the ability to tackle injustice. • Be aware of personal biases and stereotypes. • Be sensitive to the inter-relatedness of the various spheres of life, groups, and individuals. **SEL:** • Develop respectful relationships with one another. • Learn ways of managing stressful experiences. **National Core Values:** • Respect for each member of the group. • Integrity and honesty. • Selflessness and perseverance. • Time consciousness and commitment to achieving excellence.
1.3.1.LO.2		
Apply the principles of classification to group lower living things.	**Communication and Collaboration:** learners express themselves, and team up in observing and analysing video tapes/images on classification, and in collecting organisms from different habitats for classification.	**GESI:** • Respect individuals of different beliefs, religions, and cultures. • Embrace diversity and practise inclusion. • Be gender responsive and have the ability to

	Critical Thinking and Problem-Solving: learners require insightful thinking to be able to identify common patterns in living things and put them under single taxonomic groups. **Leadership and Personal Development:** by playing different roles in the group and taking active part, they acquire personal skills in classifying organisms based on their similarities and differences. **Digital Literacy:** is promoted through the watching of videos and PowerPoint presentation on classification of organisms.	tackle injustice. • Be aware of personal biases and stereotypes. • Be sensitive to the inter-relatedness of the various spheres of life, groups, and individuals. **SEL:** • Develop respectful relationships with one another. • Learn ways of managing stressful experiences. • Learners adjust to life experiences and real-world scenarios. **National Core Values:** • Respect for each member of the group. • Integrity and honesty. • Selflessness and perseverance. • Time consciousness and commitment to achieving excellence.
1.3.1.LO.3		
Describe the life processes and economic importance of lower organisms.	**Communication and Collaboration:** in analysing video tapes and working in groups to observe and analyse life processes of lower organisms, learners discuss among themselves, and collaborate on key issues concerning classification. **Digital Literacy:** learners learn the operationalisation of technological tools such as projectors, video tapes, smart/android phones, and the microscope.	**GESI:** • Respect individuals of different beliefs, religions, and cultures. • Embrace diversity and practise inclusion. • Be gender responsive and have the ability to tackle injustice. • Be aware of personal biases and stereotypes. • Be sensitive to the inter-relatedness of the various spheres of life, groups, and individuals. **SEL:** • Learners learn to listen to their peers' opinions and express disagreement in constructive ways. • Develop respectful relationships with one another, families and other people.

		National Core Values: • Respect for each member of the group • Integrity and honesty. • Selflessness and perseverance. • Time consciousness and commitment to achieving excellence.

Content Standards	Learning Indicators and Pedagogical Exemplars with 21st Century Skills and Competencies, and GESI	Assessment
1.1.3.1.CS.1	1.1.3.1.LI.1	1.1.3.1.AS.1
Demonstrate knowledge and understanding of the use of biological keys in identifying living organisms.	**Identify living organisms using numbered and dichotomous keys.** **Project-based and Experiential Learning:** in small task-based, mixed-ability groups, learners sample common living organisms in their environment and identify common features and patterns observed among them (e.g.: types of eye, body parts and segmentation, colour and nature of body covering etc.) and make notes on them; learners work together through team working to collect samples and therefore develop team-spirit; learners learn to be observant and critical thinkers in identifying common features of living organisms. **Talk for Learning Approach:** learners in mixed-ability groups analyse and discuss the nature of biological keys (taxonomic keys) and examine the types (numbered keys and dichotomous keys, (briefly mention polytomous key)): learners support one another psychologically and emotionally in group learning; learners develop the skill of independent thinking through analysis. Learners learn the skill of oratory by contributing in group discussions. **Differential Project-Based Learning:** learners in mixed-ability groups collect different samples of organisms within the school community and apply the acquired knowledge in biological keys to group the sampled organisms, assigning reasons in each case: Learners learn from one another as members in each group attempt to identify samples collected by the different groups; learners learn to work together to develop socially.	**Level 1 Recall** Level 2 Skills of conceptual understanding **Level 3 Strategic reasoning** **Level 4 Extended critical thinking and reasoning**
Teaching and Learning Resources	• Different groups of common organisms (e.g., insects such as butterflies, amphibians such as frogs, reptiles such as lizards, etc.) • sampling equipment e.g., Sweep nets, butterfly net, pooter, sample bottles, preservatives etc.	

Content Standards	Learning Indicators and Pedagogical Exemplars with 21st Century Skills and Competencies, and GESI		Assessment
1.3.1.CS.2	1.3.1.LI.2		1.3.1.AS.2
Demonstrate Understanding of the principles of classification of organisms.	**Explain how lower organisms are classified into their taxonomic groups.** **Project-based, Group and Experiential Learning:** learners in mixed-ability groups watch documentaries and presentations on the classification of living things, examining and making notes on their taxonomical hierarchies: learners develop the skill of critical thinking as they examine taxonomical hierarchies of living things. **Project-Based Differential Learning:** learners in mixed-ability groups collect different samples of organisms from the environment and sort them out into groups based on their similarities and common morphological features: learners experience lessons in real life scenario as they collect specimens and identify common their common features. **Talk for Learning Approach:** learners discuss and classify the collected samples of living organisms into their taxonomic groups such as the domains, kingdoms, phyla, class, order, etc., and give reasons for the groupings; write a report on this for a general class presentation: learners become independent thinkers through analysis; learners develop team spirit in group work; learners support one another socially and emotionally to achieve set goals.		**Level 1 Recall** **Level 2 Skills of conceptual understanding** **Level 3 Strategic reasoning** **Level 4 Extended critical thinking and reasoning**
Teaching and Learning Resources	• Phylogenetic/Taxonomic tree • Taxonomic maps and charts • Numbered keys	• Dichotomous keys • Different common organisms (e.g., insects such as butterflies, amphibians such as frogs, reptiles such as lizards, etc.)	

Content Standards	**Learning Indicators and Pedagogical Exemplars with 21st Century Skills and Competencies, and GESI**			**Assessment**
1.3.1.CS.3	1.3.1.LI.3			1.3.1.AS.3
Demonstrate knowledge and understanding of the life processes of living things.	**Discuss the life processes and economic importance of lower organisms (*Amoeba, Euglena* and *Spirogyra*)** **Differential Task-based Learning:** in mixed ability, all-inclusive, task based- groups, learners observe the *Amoeba*, *Euglena* and *Spirogyra* in turn under the light microscope from temporary slides prepared from freshly fetched water from a ditch or pond; make diagrams of these in sketch books: Learners acquire the skill of critical observation skills; learners develop their technological skills; learners in groups learn to acknowledge the contributions of each member. **Experiential/Talk for Learning:** learners in mixed-ability groups critically observe the activities of simple/unicellular life forms (*Amoeba*/*Euglena*/*Paramecium*) under the microscope; compare and discuss their distinctive features: Learners improve on critical thinking skills; learners develop independent learning abilities; learners learn the skill of oratory.			Level 1 Recall **Level 2 Skills of conceptual understanding** **Level 3 Strategic reasoning** **Level 4 Extended critical thinking and reasoning**
Teaching and Learning Resources	• Computer/projectors/TV/smart phone • Pen drive • Pictures	• Light microscopes • Slides of *Amoeba*	• *Euglena* and *Spirogyra* • Videos on life processes of lower living organisms such as *Amoeba, Euglena* and *Spirogyra*.	

Subject BIOLOGY
Strand 3. DIVERSITY OF LIVING AND THINS AND THEIR ENVIRONMNET
Sub-Strand 2. ECOLOGY

Learning Outcomes	21st Century Skills and Competencies	GESI, SEL and Shared National Values
1.3.2.LO.1		
Apply the knowledge of ecological terms to describe the concept of ecology.	**Communication and Collaboration:** learners express themselves and learn to tolerate others' views and collaborate with one another during ecological tours and class discussions. **Digital Literacy:** learners become digitally/technologically incline as they acquire knowledge in the operation of digital/technological tools. **Critical Thinking and Problem Solving:** learners engage in thorough thinking as they examine the importance of ecological concepts.	**GESI:** • Respect individuals of different beliefs, religions, and cultures. • Embrace diversity and practise inclusion. • Be gender responsive and have the ability to tackle injustice • Be aware of personal biases and stereotypes • Be sensitive to the inter-relatedness of the various spheres of life, groups, and individuals. **SEL:** • Learners learn to listen to their peers' opinions and express disagreement in constructive ways. • Develop respectful relationships with one another, families and other people. **National Core Values:** • Respect for each member of the group • Integrity and honesty • Selflessness and perseverance • Time consciousness and commitment to achieving excellence.
1.X1.3.2.LO.2		
Explain how the living and non-living components of the environment interact to ensure the sustenance of	**Communication and Collaboration:** learners discuss in teamwork how living things are supported by the non-living components of an ecosystem and depend on one another for survival.	**GESI:** • Respect individuals of different beliefs, religions, and cultures. • Embrace diversity and practise inclusion.

life.	**Digital Literacy:** learners become acquainted with technological tools. **Cultural Identity and Global Citizenship:** by relating the concept being learnt to the ecosystems in which they find themselves and other ecosystems in other parts of the world (identifying the biotic and abiotic components of both). **Leadership and Personal Development:** by playing different roles in the group, learners acquire leadership skills, whilst they develop their individual observational and analytic skills by observing different ecosystems to identify the interactions and interdependence between different components.	• Be gender responsive and have the ability to tackle injustice • Be aware of personal biases and stereotypes • Be sensitive to the inter-relatedness of the various spheres of life, groups, and individuals. **SEL:** • Learners work together to build self-confidence and believe that their thoughts and opinions are valued. • Learners learn to listen to their peers' opinions and express disagreement in constructive ways. • Learners appreciate real-life situations. • Develop respectful relationships with one another. **National Core Values:** • Respect for each member of the group • Integrity and honesty • Selflessness and perseverance • Time consciousness and commitment to achieving excellence.
1.3.2.LO.3		
Explain and show how various simple ecological tools can be used to estimate the population of species in a given habitat.	**Digital Literacy:** learners become acquainted with the use of ICT in their learning process. **Communication and Collaboration:** learners talk clearly and politely during discussions, to share their findings and ideas with one another and agree on facts from their research, concerning the use of various ecological tools in estimating the population of organisms in a habitat.	**GESI:** • Respect individuals of different beliefs, religions, and cultures. • Embrace diversity and practise inclusion. • Be gender responsive and have the ability to tackle injustice • Be aware of personal biases and stereotypes • Be sensitive to the inter-relatedness of the various spheres of life, groups, and individuals.

		SEL: • Learners work together to build self-confidence and believe that their thoughts and opinions are valued. • Learners learn to listen to their peers' opinions and express disagreement in constructive ways. • Learners appreciate real-life situations. **National Core Values:** • Respect for each member of the group • Integrity and honesty • Selflessness and perseverance • Time consciousness and commitment to achieving excellence
1.3.2.LO.4		
3.2.4.1: Explain the relevance of direct counting, gut examination and radioactive/tracer methods of determining the flow of energy in an ecosystem.	**Communication and Collaboration:** learners share ideas during discussions, by talking to one another and agreeing on facts from their research, concerning the various methods of determining the energy flow in an ecosystem. **Critical Thinking and Problem-Solving:** learners require deep thinking to analyse the advantages and disadvantages of the methods of determining the flow of energy in an ecosystem.	**GESI:** • Respect individuals of different beliefs, religions, and cultures. • Embrace diversity and practise inclusion. • Be gender responsive and have the ability to tackle injustice • Be aware of personal biases and stereotypes • Be sensitive to the inter-relatedness of the various spheres of life, groups, and individuals. **SEL:** • Learners work together to build self-confidence and believe that their thoughts and opinions are valued. • Learners learn to listen to their peers' opinions and express disagreement in constructive ways. **National Core Values:** • Respect for each member of the group

		• Integrity and honesty • Selflessness and perseverance • Time consciousness and commitment to achieving excellence.
1.3.2.LO.5		
Explain the methods of determining and comparing the efficiency of energy flow in pyramids of numbers, biomass and energy.	**Communication and Collaboration:** learners share ideas during discussions and agreed on their findings concerning the various methods of determining the energy flow in ecological pyramids. **Critical thinking and Problem-solving:** learners require deep thinking skills to analyse the efficiency, advantages and disadvantages of the methods of the flow of energy in ecological pyramids. **Cultural identity and global citizenship:** learners acquire knowledge on how to preserve ecosystems to ensure their long term sustenance.	**GESI:** • Respect individuals of different beliefs, religions, and cultures. • Embrace diversity and practise inclusion. • Be gender responsive and have the ability to tackle injustice • Be aware of personal biases and stereotypes • Be sensitive to the inter-relatedness of the various spheres of life, groups, and individuals. **SEL:** • Learners work together to build self-confidence and believe that their thoughts and opinions are valued. • Learners learn to listen to their peers' opinions and express disagreement in constructive ways. • Learners appreciate real-life situations. **National Core Values:** • Respect for each member of the group • Integrity and honesty • Selflessness and perseverance • Time consciousness and commitment to achieving excellence.

Content Standards	Learning Indicators and Pedagogical Exemplars with 21st Century Skills and Competencies, and GESI	Assessment
1.3.2.CS.1	1.3.2.LI.1	1.3.2.AS.1
Demonstrate knowledge and understanding of ecological terms and the significance of ecological concepts.	**Explain various Ecological terms.** **Task-Based/Project-Base Learning:** learners in mixed-ability, all-inclusive groups watch pictures/videos, or embark on a visit to a nearby ecosystem, making notes and discussing various terminologies associated with ecosystems and the relationships and interactions that exist among organisms in various ecosystems: learners show kindness and respect to one another in mixed ability groups; learners learn to accommodate one another in group work; learners become independent thinkers but also show respect to one another and acknowledge their strengths and weaknesses and learn how to help them. **Task-Based Learning:** the whole class embarks on ecological trips/ecological tours to observe and study the effect of ecological factors in different habitats, and form mixed-ability, all-inclusive groups to report given their findings to be presented in class: learners learn to appreciate and respect the environment as they embark on ecological tours; learners develop courage, and improve their speech skills as they present group reports before other learners.	**Level 1 Recall** Level 2 Skills of conceptual understanding **Level 3 Strategic reasoning** **Level 4 Extended critical thinking and reasoning**
	1.3.2.LI.2	1.3.2.AS.2
	Describe the importance of ecological concepts in named habitats. **Individual-Based Learning:** Learners in mixed-ability groups research to explain ecological terms (ecology, ecosystems, community, population, habitat, biome, biotic and abiotic factors, etc.) and cite examples of these from the ecological trips they embark on: learners learn to accept learners from different social, emotional, psychological and economic backgrounds: learners broaden their scope of understanding about real life situations of the environment. **Group-Based Learning:** learners in mixed-ability groups analyse and discuss the various ecological terms in relation to the survival of ecosystems and the living things within them: the learner becomes an analytical critical thinker through the systemic examination of ecological terms; learners learn from one another and learn to accept the contributions of others in a group work.	Level 1 Recall **Level 2 Skills of conceptual understanding** **Level 3 Strategic reasoning** **Level 4 Extended critical thinking and reasoning**

Teaching and Learning Resources				
	• Computer/Projectors/TV/Smart phone • Pen drive	• Binoculars • Quadrats • Sweep net	• Secchi disk • Pooter • Sample bottle	• Videos on different habitats • Textbooks

	• Pictures • Tape measure/ surveyor's tape	• Rain gauge		

Content Standards	Learning Indicators and Pedagogical Exemplars with 21st Century Skills and Competencies, and GESI	Assessment
1.3.2.CS.2	1.3.2.LI.1	1.3.2.AS.1
Demonstrate knowledge and understanding of how the living and non-living components of the environment interact to ensure the sustenance of life.	**Analyse the interdependency of living organisms in their named habitats.** **Group-Based Learning:** in mixed-ability, all-inclusive group sessions, discuss the roles of the living (plants, animals, micro-organisms, etc.) and non-living (water, soil, air) components of the environment in ensuring stability within the ecosystem; learners work as a team and therefore develop team spirit; learners learn to respect others' views and present their disagreements in a very modest way. **Analytical Talk-Based Approach:** learners in mixed-ability groups analyse and predict the expected outcomes, if the non-living components of the ecosystem were absent in the environment, and examine the interrelationships between the living and non-living components of the environment and make inferences for a class presentation: learners learn from one another in group discussions; learners become analytical and develop independent thoughts. **Project-Based Learning:** learners in mixed-ability, all-inclusive groups, design and discuss models to represent the interdependency of organisms to one another through feeding relationships such as food chains and food webs and symbiotic relationships such as parasitism, mutualism and commensalism: learners support one another socially and emotionally, and therefore develop strong social spirit; learners learn the act of public speaking through group discussions; learners become independent thinkers as they develop models of the lessons learnt.	**Level 1 Recall** Level 2 Skills of conceptual understanding **Level 3 Strategic reasoning** **Level 4 Extended critical thinking and reasoning**
	1.3.2.LI.2	1.3.2.AS.2
	Explain the outcome of the interdependency of living organisms in their environment. **Observational/Talk-Based Learning:** in mixed ability, gender-responsive groups, learners observe the activities of living things within the community (animals serving as agents of pollination, fungi and bacteria causing decomposition, trees providing shade for animals, etc.): learners develop team spirit by working in groups; learners develop critical competencies such as being very observant; learners improve on the ability to talk in public. **Collaborative-Based, Talk for Learning Approaches:** in mixed-ability, all-inclusive groups, learners watch video documentaries, listen to audio, study visuals and read from the library and the internet, the interactions of living things in some tropical habitats, and propose and discuss hypotheses to explain what would happen if living things exist as independent, isolated entities: learners develop digital literacy by operating digital materials; learners collaborate with one another and support themselves socially and	Level 1 Recall **Level 2 Skills of conceptual understanding** **Level 3 Strategic reasoning** **Level 4 Extended critical thinking and reasoning**

	emotionally to achieve set goals; learners improve on oratory. **Analytical-Based Learning:** Learners in mixed-ability groups, analysed the proposed hypotheses, discuss and critically examine the importance of the interdependencies of living things, and the results of such interdependencies in named ecosystems: learners develop critical independent thoughts through analysis; learners become self-initiating.		
Teaching and Learning Resources	• Computer/projectors/TV/smart phone • Pen drive	• Pictures	

Content Standards	**Learning Indicators and Pedagogical Exemplars with 21st Century Skills and Competencies, and GESI**			**Assessment**
1.3.2.CS.3	1.3.2.LI.1			1.3.2.AS.1
Demonstrate knowledge and understanding of the use of ecological devices and methods such as the quadrat, pitfall trap, pooter, and Lincoln's index to study populations of organisms.	**Use the appropriate ecological tool to estimate the population of given species in a named habitat.** **Task-Based Learning:** in mixed-ability, all-inclusive groups, learners watch videos, research from the internet, and listen to presentations on the estimation of the population of organisms in habitats using the Lincoln Index and other tools. Submit a written report on the steps involved in the process: learners develop social and emotional spirit. Learners develop team spirit. **Project-Based-Learning:** select areas in the school compound or nearby community to estimate the population of various organisms using a quadrat, pitfall trap, sweep net and pooter. Learners appreciate real-life situations by undertaking project assignment in their nearby community.			**Level 1 Recall** **Level 2 Skills of conceptual understanding** **Level 3 Strategic reasoning** Level 4 Extended critical thinking and reasoning:
Teaching and Learning Resources	• Computer/projectors/TV/smart phone • Pen drive • Pictures • Tape measure/ surveyor's tape	• Pitfall trap • Hand lens • Quadrats	• Sweep net • Rain gauge • Secchi disk	• Pooter • Sample bottle and preservative • Textbooks.

Content Standards	**Learning Indicators and Pedagogical Exemplars with 21st Century Skills and Competencies, and GESI**			**Assessment**
1.3.2.CS.4	1.3.2.LI.1			1.3.2.AS.1
Demonstrate knowledge and understanding of methods of determining energy flow in an ecosystem.	**Distinguish between the direct counting, gut examination and radioactive/tracer methods of determining the flow of energy in an ecosystem.** **Inquiry-Based Learning:** learners in small mixed-ability groups research or listen to presentations on the various methods of determining energy flow in an ecosystem to be better informed, and discuss these in a class presentation: by conducting an inquiry-based research, learners become self-initiating and develop self-confidence as they also learn to work in a team. Learners work together to build self-confidence. Learners respect the contributions of other members, and present their opinions in candid but humble and respectful ways. **Task-Based Learning:** learners in all-inclusive groups create a chart on the advantages and disadvantages of the various methods of determination of energy flow and demonstrate their charts in class presentations: as learners work together, they build team-spirit and learn to support one another socially and emotionally; each member in the group become self-initiating and develop confidence as each member plays a specific role in the group.			Level 1 Recall Level 2 Skills of conceptual understanding **Level 3 Strategic reasoning** **Level 4 Extended critical thinking and reasoning**
Teaching and Learning Resources	• Computer/projectors/TV/smart phone • Pen drive	• Pictures • Textbooks	• Specimens of organisms in different habitats	

Content Standards	Learning Indicators and Pedagogical Exemplars with 21st Century Skills and Competencies, and GESI	Assessment
1.3.2.CS.5	1.3.2.LI.1	1.3.2.AS.1
Demonstrate knowledge and understanding of energy flow and efficiency in an ecosystem with emphasis on ecological pyramids.	**Explore the methods of determining pyramids of numbers, biomass and energy, and compare the efficiency of energy flow in them.** **Task-Based Learning Approach:** learners in mixed-ability, all-inclusive groups watch videos or presentations on the methods of determining energy flow in the various ecological pyramids, analyse and discuss the efficiency, advantages and disadvantages of the various methods and discuss their findings: learners contribute to discussions on what they learn from the videos and presentations, thereby building confidence; learners critique their peers' opinions during discussions and express disagreement in humble and constructive ways. **Differentiated Learning Approach:** learners in mixed-ability groups are given different tasks to create timeline charts on the key stages involved in the estimation of energy flow based on the various methods discussed, and prepare a report for presentation.	Level 1 Recall **Level 2 Skills of conceptual understanding** **Level 3 Strategic reasoning** **Level 4 Extended critical thinking and reasoning**
Teaching and Learning Resources	• Computer/projectors/TV/smart phone • Pen drive • Pictures • Specimens of organisms in different habitats	

Subject BIOLOGY
Strand 3. DIVERSITY OF LIVING THINGS AND THEIR ENVIRONMENT
Sub-Strand 3. DISEASES AND INFECTIONS

Learning Outcomes	21st Century Skills and Competencies	GESI, SEL and Shared National Values
1.3.3.LO.1		
Apply the knowledge of the life cycles of common disease-causing organisms, to stop or prevent their effects on humans and other living things.	**Communication and Collaboration:** learners deliberate and communicate in teams over how diseases are transmitted; the causes, life cycles of causative organisms, symptoms, and treatments/prevention/control mechanisms of common diseases in the environment. **Critical Thinking and Problem-Solving:** learners acquire critical thoughts to examine the life cycles of causative organisms/agents of diseases, and how they are transmitted and controlled/prevented. **Digital Literacy:** learners acquire digital literacy through the operation and control of technological devices.	**GESI:** • Respect individuals of different beliefs, religions, and cultures. • Embrace diversity and practise inclusion. • Be gender responsive and have the ability to tackle injustice. • Be aware of personal biases and stereotypes. • Be sensitive to the inter-relatedness of the various spheres of life, groups, and individuals. **SEL:** • Learners work together, build self-confidence and believe that their thoughts and opinions are valued. • Learners learn to listen to their peers' opinions and express disagreement in constructive ways. • Learners appreciate real-life situations. **National Core Values:** • Respect for each member of the group • Integrity and honesty • Selflessness and perseverance • Time consciousness and commitment to achieving excellence.

Content Standards	Learning Indicators and Pedagogical Exemplars with 21st Century Skills and Competencies, and GESI		Assessment
1.3.3.CS.1	1.3.3.LI.1		1.3.3.AS.1
Demonstrate knowledge and understanding of the life cycles of common disease-causing organisms, and their effects on humans and the environment.	**Discuss common disease-causing organisms, their transmission, their effect on humans and the measures which could be taken to reduce or prevent their spread.** **Project-Based Learning**: learners in mixed-ability, all-inclusive groups, gather data on common diseases among humans and livestock within the environment (malaria by *Plasmodium*, tapeworm infestations, *Schistosoma*, *Ascaris* and Hookworm etc.), and discuss the diseases identified, including the vectors, causative organism's agents, their life cycles, symptoms and control or preventive measures to curb them: learners are assigned specific roles in group work; this allows learners to be self-initiating and develop confidence; learners learn to humbly accept suggested answers from peers; learners show love and care for one another as they are placed in groups.		Level 1 Recall **Level 2 Skills of conceptual understanding** **Level 3 Strategic reasoning** **Level 4 Extended critical thinking and reasoning**
Teaching and Learning Resources	• Computer/projectors/TV/smart phones • Pen drive • Pictures • Permanent slides of Plasmodium	• Tapeworm • Ascaris and hookworm schistosoma • Fasciola	

Subject BIOLOGY
Strand 4. SYSTEMS OF LIFE
Sub-Strand 1. Mammalian systems

Learning Outcomes	21st Century Skills and Competencies	GESI, SEL and Shared National Values
1.4.1.LO.1		
Describe the morphology of mammals and relate the structures to their functions.	**Communication and Collaboration:** learners discuss together the various external and internal features of a mammal and relate them to their functions. **Critical Thinking and Problem-Solving:** learners are able to analyse the various features of mammals and the role of these features in their survival. **Digital literacy**: Digital literacy skills of learners are enhanced through online research and watching of videos and presentations on the structure of different animals. **Personal Development Skills:** learners exercise care and precision during dissection, so as to avoid damaging the organs.	**GESI:** • Respect individuals of different beliefs, religions, and cultures. • Embrace diversity and practise inclusion. • Be gender responsive and have the ability to tackle injustice. • Be aware of personal biases and stereotypes. • Be sensitive to the inter-relatedness of the various spheres of life, groups, and individuals. **SEL:** • Learners work together, build self-confidence and believe that their thoughts and opinions are valued. • Learners learn to listen to their peers' opinions and express disagreement in constructive ways. **National Core Values:** • Respect for each member of the group. • Integrity and honesty. • Selflessness and perseverance. • Time consciousness and commitment to achieving excellence.

Content Standards	Learning Indicators and Pedagogical Exemplars with 21st Century Skills and Competencies, and GESI		Assessment
1.4.1.CS.1	1.4.1.LI.1		1.4.1.AS.1
Demonstrate knowledge and understanding of the morphology of mammals.	**Relate the external and internal features of mammals to their functions.** **Experiential Learning:** learners in mixed-ability, all-inclusive groups, critically observe, discuss and write down their findings on the external features of a sedated mammal (e.g., Albino rat, rabbit, Guinea pig etc.) presented to them at the lab: learner experiences lessons in real life scenarios. **Experiential Learning:** • Learners watch a video on how dissection is done or observe their teacher demonstrate the dissection of a small mammal and note the steps involved in the procedure. • Learners in mixed ability groups take turns to dissect the mammals and observe the internal organs in groups, discuss their observations and write down key ideas. By carrying out these hands on activities, learners overcome their fears and anxieties in dissection and appreciate real-life situations. Working together builds self-confidence and team spirit among learners. **Group Learning:** in groups discuss and write down the functions of the internal and external features of the small mammals dissected and draw an annotated diagram of the final dissected mammal."		**Level 1 Recall** **Level 2 Skills of conceptual understanding** **Level 3 Strategic reasoning** **Level 4 Extended critical thinking and reasoning**
	1.4.1.LI.2		1.4.1.AS.2
	Compare the digestive systems and associated organs of different groups of mammals. **Task-based Learning:** in randomly formed mixed-ability and gender-responsive groups, obtain three different species of small mammals and dissect them, discuss the arrangement and functions of the internal organs and tissues, and compare them with those of other mammals. By carrying out these hands-on activities learners overcome their fears and anxieties in dissection and appreciate real-life situations. Working together builds self-confidence and team spirit among learners.		Level 1 Recall Level 2 Skills of conceptual understanding **Level 3 Strategic reasoning** **Level 4 Extended critical thinking and reasoning**
Teaching and Learning Resources	• Three different species of the different groups of mammals (e.g., rabbit, albino rat, guinea pig, cat, etc.) • Dissecting scissors • Forceps or tweezers	• Scalpels • Hand gloves • Dissecting board	

Subject **BIOLOGY**
Strand **4. SYSTEMS OF LIFE**
Sub-Strand **2. PLANT SYSTEMS**

Learning Outcomes	21st Century Skills and Competencies	GESI, SEL and Shared National Values
1.4.2.LO.1		
Describe the morphology of flowering plants and explain how these are related to their growth and development.	**Communication and Collaboration:** • Learners team up to identify the various morphological adaptations of plants. • Learners discuss the various identified morphological adaptations of plants. **Critical Thinking and Problem-Solving:** • Learners do critical thinking by analysing the various features of monocotyledonous and dicotyledonous plants to bring out the similarities and differences between them. • Learners acquire critical thinking skills to analyse and present findings. **Digital Literacy:** they acquire digital competencies through the operation of digital devices to research and make group presentations in class." **Innovation and Creativity:** predictions and the formulation of hypotheses require the skills of innovation and creativity.	**GESI:** • Respect individuals of different beliefs, religions, and cultures. • Embrace diversity and practise inclusion. • Be gender responsive and have the ability to tackle injustice. • Be aware of personal biases and stereotypes. • Be sensitive to the inter-relatedness of the various spheres of life, groups, and individuals. **SEL:** • Learners work together, build self-confidence and believe that their thoughts and opinions are valued. • Learners learn to listen to their peers' opinions and express disagreement in constructive ways. • Learners appreciate real-life situations. **National Core Values:** • Respect for each member of the group • Integrity and honesty. • Selflessness and perseverance. • Time consciousness and commitment to achieving excellence.

Content Standards	Learning Indicators and Pedagogical Exemplars with 21st Century Skills and Competencies, and GESI	Assessment
1.4.2.CS.1	1.4.2.LI.1	1.4.2.AS.1
Demonstrate knowledge and understanding of the morphology, growth and development of flowering plants	**Distinguish between the external and internal features of monocotyledonous and dicotyledonous plants and relate these plant structures to their functions.** **Task-Based Learning:** in mixed-ability gender-responsive and all -inclusive tasked-based groups, learners sample different flowering plants from their immediate environment, and carefully observe and write down features that are common to monocotyledonous and dicotyledonous groups. Learners appreciate real-life situations by undertaking project assignment in their immediate environment. **Collaborative Learning:** in groups**,** design and present PowerPoint presentations on the morphological adaptations, similarities and differences between monocotyledonous and dicotyledonous plants to the entire class. By carrying out this task, learners work together, build self-confidence and believe that their thoughts and opinions are valued. **Individual-Based Learning:** sample flowering plants from the immediate environment, and create a poster on monocotyledonous and dicotyledonous plants, focusing on the features that are common to both groups of plants. Learners listen to their peers' opinions and accept constructive criticism.	**Level 1 Recall** Level 2 Skills of conceptual understanding **Level 3 Strategic reasoning** **Level 4 Extended critical thinking and reasoning**
	1.4.2.LI.2	1.4.2.AS.2
	Relate the tissues of the leaf, stem, and roots of monocotyledonous and dicotyledonous plants to their functions. **Group-Based and Experiential Learning:** • In mixed-ability and tasked-based groups, watch videos/pictures/charts or listen to presentations on the internal tissues of flowering plants. Learners discuss what they learn from the video or presentation to build self-confidence and also, they learn to critique their peers' opinions and express disagreement in constructive ways. • Obtain monocotyledonous and dicotyledonous plants, make thin sections of parts such as the roots, stems, and leaves, and critically use a microscope to observe and compare the internal structures. • In pairs, create a poster on an A4 sheet, showing the various structures of the plants and their functions. • Submit your final posters for a gallery walk or whole class exhibition. By conducting these group activities, learners appreciate real-life situations. Working together builds self-confidence and team	Level 1 Recall **Level 2 Skills of conceptual understanding** **Level 3 Strategic reasoning** **Level 4 Extended critical thinking and reasoning**

	spirit among learners.	
	1.4.2.LI.3	1.4.2.AS.3
	Explain the factors that affect the growth and development of flowering plants. **Inquiry-Based Learning:** research on the factors that affect the growth and development of flowering plants. Learners learn to work independently, develop self-confidence and believe that their thoughts and opinions are valued. **Experiential Learning:** conduct experiments to demonstrate the effects of the various factors on the growth and development of flowering plants. Learn ways of managing new and stressful experiences as an individual while respectfully consulting peers and teachers when in need.	**Level 1 Recall** Level 2 Skills of conceptual understanding **Level 3 Strategic reasoning** **Level 4 Extended critical thinking and reasoning**

Teaching and Learning Resources	• Three different species of the different groups of mammals (e.g., rabbit, albino rat, guinea pig, cat, etc.), dissection kits such as dissecting scissors, forceps or tweezers, scalpels, hand gloves, a dissecting board, etc. • Young monocotyledonous and dicotyledonous plants (e.g., mango/orange seedling, maize seedling), dissecting kits, microscope, slides, etc. • Flowering plants (monocotyledons and dicotyledons) with flowers, shears, trays and scalpels • "TV/LCD projector, • Monocotyledonous and dicotyledonous plants • Blade/scalpel • Board • Light microscope • Petri dish • Microscope slide • Coverslip • Eosin stain • Water • A young monocot and dicot plants (e.g., mango/orange seedling, maize seedling) • Dissecting kits	• Microscope • Slides, etc." • Computer/Projectors/TV/Smart phone • Pen drive • Pictures • Simulation device • Yam tissue • Concentrated salt/sugar solution • Water • Crystals of potassium permanganate • Source of water • Source of light • Nutrients • A temperature-regulated environment.

YEAR TWO

Subject BIOLOGY
Strand 1. EXPLORING BIOLOGY IN SOCIETY
Sub-Strand 1. BIOLOGY AS THE SCIENCE OF LIFE

Learning Outcomes	21st Century Skills and Competencies	GESI[3], SEL[4] and Shared National Values
2.1.1.LO.1		
Relate the knowledge of the characteristics and life processes of common simple living organisms to their economic importance.	**Communication and Collaboration:** • Learners interact in groups and collaborate on their findings to write and present a report. • Learners in groups, analyse and agree on the importance of some lower-living things **Critical Thinking and Problem Solving:** learners require critical thinking skills to analyse the life processes and common characteristics among living things. **Personal Development and Leadership:** the acquisition of this skill is enhanced through learners' active participation in the various practical activities on the characteristics and life processes of simple living organisms.	**GESI:** • Respect individuals of different beliefs, religions, and cultures. • Embrace diversity and practise inclusion. • Be gender responsive and have the ability to tackle injustice. • Be aware of personal biases and stereotypes. • Be sensitive to the inter-relatedness of the various spheres of life, groups, and individuals. **SEL:** • Learners learn to listen to their peers' opinions and express disagreement in constructive ways. • Develop respectful relationships with one another. **National Core Values:** • Respect for each member of the group • Integrity and honesty. • Selflessness and perseverance. • Time consciousness and commitment to achieving excellence.

[3] Gender Equality and Social Inclusion
[4] Socio-Emotional Learning

<table>
<tr><th>Content Standards</th><th colspan="4">Learning Indicators and Pedagogical Exemplars with 21st Century Skills and Competencies, and GESI</th><th>Assessment</th></tr>
<tr><td>2.1.1.CS.1</td><td colspan="4">2.1.1.LI.1</td><td>2.1.1.AS.1</td></tr>
<tr><td rowspan="3">Demonstrate knowledge and understanding of common simple living organisms in the environment.</td><td colspan="4">Describe the distinctive characteristics and life processes of some common simple living organisms (Rhizopus, Moss and Fern).

Collaborative Learning: in mixed-ability, gender-responsive and all-inclusive groups, learners observe characteristics and life processes of common simple living organisms from Relia, videos, textbooks, microscopes, etc., and discuss their observations; they learn to listen to their peers and express disagreements in a constructive manner.

Project-based Learning: learners in their groups write a report and present their findings on the key processes and characteristics common to the simple living organisms studied, developing healthy and respectful relationships with one another by this means.</td><td>Level 1 Recall
Level 2 Skills of conceptual understanding
Level 3 Strategic reasoning
Level 4 Extended critical thinking and reasoning</td></tr>
<tr><td colspan="4">2.1.1.LI.2</td><td>2.1.1.AS.2</td></tr>
<tr><td colspan="4">Discuss the economic importance of some common simple living organisms (Rhizopus, Moss and Fern).

Collaborative Learning: in mixed-ability, gender-responsive and all-inclusive groups, research from textbooks and on the internet the economic importance of some common simple living organisms; collaborative learning encourages learners to learn from one another and to appreciate the contributions of each member of the group.

Talk for Learning: develop and give presentations on the benefits and harmful effects of these simple organisms in class; learners learn the act of public speaking and build confidence among themselves.</td><td>Level 1 Recall
Level 2 Skills of conceptual understanding
Level 3 Strategic reasoning
Level 4 Extended critical thinking and reasoning</td></tr>
<tr><td>Teaching and Learning Resources</td><td>• LCD projector
• TV</td><td>• Light microscope
• Microscope slides and cover slips</td><td>• Android phone.
• Internet facility</td><td>• Computers/laptop Computer/mobile phone
• Appropriate textbooks</td><td></td></tr>
</table>

Subject BIOLOGY
Strand 1. EXPLORING BIOLOGY IN SOCIETY
Sub-Strand 2. BIOLOGY AND ENTREPRENEURSHIP

Learning Outcomes	21st Century Skills and Competencies	GESI, SEL and Shared National Values
2.1.2.LO.1		
Apply the knowledge of the basic concepts in Biology to improve crop and animal production.	**Communication and Collaboration:** • Learners discuss basic biological systems and work collaboratively on biological concepts required to improve crop production. • Learners discuss and work together in groups. **Critical Thinking and Problem Solving:** • Learners think deeply to appreciate biological concepts to solve problems of the living world. • Learners require deep thinking skills to explain basic biology concepts to improve food (meat) production. **Creativity and Innovation:** learners formulate their own concepts on some biological processes which would answer some of the current challenges humans face in crop production. **Cultural Identity and Global Citizenship:** the acquisition of this skill in learners is enhanced through the design of concepts to address current societal challenges in crop and animal production	**GESI:** • Respect individuals of different beliefs, religions, and cultures. • Embrace diversity and practise inclusion. • Be gender responsive and can tackl injustice. • Be aware of personal biases and stereotypes. • Be sensitive to the inter-relatedness of the various spheres of life, groups, and individuals. **SEL:** • Learners learn to listen to their peers' opinions and express disagreement in constructive ways. • Develop respectful relationships with one another, families and other people. • Learners adjust to real-world scenarios and believe that their thoughts and opinions are valued **National Core Values:** • Respect for each member of the group • Integrity and honesty. • Selflessness and perseverance. • Time consciousness and commitment to achieving excellence.

Content Standards	Learning Indicators and Pedagogical Exemplars with 21st Century Skills and Competencies, and GESI	Assessment
2.1.2.CS.1	2.1.2.LI.1	2.1.2.AS.1
Demonstrate knowledge and understanding of some basic concepts in Biology and their applications to improve crop and animal production.	**Identify some basic concepts in Biology and how these can be used to improve crop production.** **Problem-Based Learning: e**mbark on field trips to a nearby farm or observe pictures and videos to identify some basic concepts for improving crop production (e.g., green manuring, composting, pruning, grafting, selective breeding, etc.); learners are then able to connect to real world scenarios, allowing them to assess their own thoughts and opinions about the topic. **Collaborative Learning:** engage the whole class in discussions on the concepts studied, their benefits and differences within the various concepts; learners acquire the skill of learning from one another through class discussions.	**Level 1 Recall** Level 2 Skills of conceptual understanding Level 3 Strategic reasoning **Level 4 Extended critical thinking and reasoning**
	2.1.2.LI.2	2.1.2.AS.2
	Explain some basic concepts in Biology and how these can be used to improve animal production. **Collaborative Learning:** in small, random-based task-based groups, learners relate some basic concepts identified and studied in Biology to increase animal production; learners learn the tolerance of listening to one another and make constructive contributions. **Talk for Learning:** explain how some practices (biological concepts) are applied in animal production to increase productivity (e.g., selective breeding, supplementary feeding, flushing, deworming and some other husbandry practices); learners learn from peers that have first-hand experiences or otherwise on these biological processes.	Level 1 Recall Level 2 Skills of conceptual understanding Level 3 Strategic reasoning **Level 4 Extended critical thinking and reasoning**
Teaching and Learning Resources	• Appropriate textbooks • Internet facilities • Smartphone • TV • Appropriate documentaries • LCD • Pen drive/laptop/ computers	

Subject BIOLOGY
Strand 2. LIFE IN THE FUNDAMENTAL UNIT
Sub-Strand 1. CELL STRUCTURE AND FUNCTIONS

Learning Outcomes	21st Century Skills and Competencies	GESI, SEL and Shared National Values
2.2.1.LO.1		
Relate the knowledge and understanding of the cell theory and structure to the different types of cells in all life forms.	**Communication and Collaboration:** learners in groups discuss the cell theory. **Critical Thinking and Problem-Solving:** these skills are brought to bear as learners critically examine the cell theory and apply the knowledge of the theory to solve problems.	**GESI:** • Respect individuals of different beliefs, religions, and cultures. • Embrace diversity and practise inclusion. • Be gender responsive and have the ability to tackle injustice. • Be aware of personal biases and stereotypes. • Be sensitive to the inter-relatedness of the various spheres of life, groups, and individuals. **SEL:** • Learners learn to listen to their peers' opinions and express disagreement in constructive ways. • Learners believe that their thoughts and opinions are valued. **National Core Values:** • Respect for each member of the group • Integrity and honesty. • Selflessness and perseverance. • Time consciousness and commitment to achieving excellence.

Content Standards	Learning Indicators and Pedagogical Exemplars with 21st Century Skills and Competencies, and GESI	Assessment
2.2.1.CS.1	2.2.1.LI.1	2.2.1.AS.1
Demonstrate knowledge and understanding of Cell structure and Functions.	**Apply knowledge of the cell theory and structure to classify and describe the types of cells and relate their structures to their functions.** **Project-Based Learning:** in randomly formed mixed-ability groups, examine the cell theory and its relevance to organismal life; learners appreciate the social background of every member as learner groups are constituted randomly. **Building on what Others say:** apply knowledge in the cell structure as the bases to classify and describe cells and discuss the functions of various types of cells; learners building on the foundations of others realise the efforts and contributions of others and the essence of teamwork in building a healthy academic environment. **Project-based Learning:** create prototypes of different types of cells using cardboards, play dough or any other appropriate materials; learners develop a positive outlook about themselves as they are allowed to experience creativity by their own thoughts and opinions.	**Level 1 Recall** **Level 2 Skills of conceptual understanding** **Level 3 Strategic reasoning** Level 4 Extended critical thinking and reasoning:
	2.2.1L.I.2	**2.2.1AS.2**
	Apply the knowledge of cell structure and functions to movement of substances in cells. **Collaborative Learning**: Engage the whole class in discussions on the concepts endocytosis and exocytosis and their benefits. Learners link these concepts to the cell structure; learners acquire the skill of learning from one another through class discussions Building on what others say. **Think-pair-share:** In mixed-ability, gender-responsive and all-inclusive groups, learners watch a video on endocytosis, exocytosis, and discuss their observations; they learn to listen to their peers and express disagreements in a constructive manner.	**Level 1 Recall** **Level 2 Skills of conceptual understanding** **Level 3 Strategic reasoning** Level 4 Extended critical thinking and reasoning:
Teaching and Learning Resources	• Textbooks • Models	• Internet facilities • Other relevant sources • LCD projector • Pen drive

Subject BIOLOGY
Strand 2. LIFE IN THE FUNDAMENTAL UNIT
Sub-Strand 2. CELL STRUCTURE AND FUNCTIONS

Learning Outcomes	21stCentury Skills and Competencies	GESI, SEL and Shared National Values
2.2.2.LO.2		
Explain the Watson-Crick model of Nucleic acids (the DNA), and their roles in synthesising proteins for building the body of living things.	**Communication and Collaboration:** • Learners work together to discuss the Watson-Crack Model of DNA. • Learners work in different teams to understand and describe the process involved in DNA replication. • Learners in groups discuss DNA and RNA and the relevance of these molecules to living things. • Learners talk and discuss how proteins are built in cells, and their importance to living things. **Critical Thinking and Problem - Solving:** • Learners require deep-thinking capabilities to be able to appreciate the Watson-Crick Model of the DNA molecule. • Learners develop critical thinking and analysis in appreciating the process of DNA replication. • Learners develop critical thinking skills as they examine the relevance of the DNA and RNA molecules to life in living things. • Learners develop critical thinking skills as they examine the relevance of protein synthesis in living cells. **Digital Literacy:** by watching simulation videos, pictures and other e-based files on DNA replication.	**GESI:** • Respect individuals of different beliefs, religions, and cultures. • Embrace diversity and practise inclusion. • Be gender responsive and can tackle injustice. • Be aware of personal biases and stereotypes. • Be sensitive to the inter-relatedness of the various spheres of life, groups, and individuals. **SEL:** • Learners learn to listen to their peers' opinions and express disagreement in constructive ways. • Learners adjust to real-world scenarios and believe that their thoughts and opinions are valued. • Acquire the skill of learning from each other. **National Core Values:** • Respect for each member of the group. • Integrity and honesty. • Selflessness and perseverance. • Time consciousness and commitment to achieving excellence.

Content Standards	Learning Indicators and Pedagogical Exemplars with 21st Century Skills and Competencies, and GESI	Assessment
2.2.2.CS.2	2.2.2.LI.1	2.2.1.AS.1
Demonstrate knowledge and understanding of the molecular structure of nucleic acids and their importance in the synthesis of protein in living things.	**Describe in detail the Watson-Crick Model of the DNA and state the significance of the model in a eukaryotic cell.** **Project-Based Learning:** watch videos and charts on nucleic acids and DNA and draw the Watson-Crick Model of the DNA. **Collaborative Learning:** in mixed-ability groups, discuss the Model in detail, and examine its significance in a eukaryotic cell	Level 1 Recall **Level 2 Skills of conceptual understanding** **Level 3 Strategic reasoning** **Level 4 Extended critical thinking and reasoning**
	2.2.2.LI.2	2.2.1.AS.2
	Examine the processes of DNA replication. **Collaborative Learning**: in mixed-ability groups watch videos and PowerPoint presentations on DNA replication; learners acquire the skill of working with one another, respecting each member's views and opinions, and learning to be tolerant. **Task-based learning:** design a timeline chart or a chronological chart, to describe the nature of DNA replication and the processes and stages involved (e.g., Initiation, Elongation and Termination) and discuss among one another; learners attempt to connect with real-world scenarios and boost their confidences to believe themselves and one another. **Talk-for-Learning Approach:** discuss further, various aspects of replication together with the enzymes involved, and individually present a report on them; learners listen to one another and seek to appreciate their views or use a constructive approach in expressing disagreements.	Level 1 Recall **Level 2 Skills of conceptual understanding** **Level 3 Strategic reasoning** **Level 4 Extended critical thinking and reasoning**
	2.2.2.LI.3	2.2.1.AS.3
	Relate the structure of DNA and RNA molecules to their relevance in living things. **Group-Based Learning/Project-Based Learning:** in mixed ability, task-based groups, research into the link between DNA and RNA, and the relevant roles these play in the life of living things; learners learn to support one another socially and emotionally through team work.	Level 1 Recall **Level 2 Skills of conceptual understanding** **Level 3 Strategic reasoning** Level 4 Extended critical

	Creativity and Talk for Learning: design models of DNA and RNA using sheets of paper, manila cards, cardboard or any other appropriate resources; learners build confidence in learning to be creative, and this raises the awareness of *"I can do"* within them.		thinking and reasoning:
	2.2.2.LI.4		2.2.1.AS.4
	Describe how proteins are formed in the cell and explain the importance of protein synthesis in living things. **Project-Based Learning**: watch video tapes and simulations about protein synthesis and form mix-ability groups to discuss their observations; learners in mixed ability groups learn to appreciate the strength and abilities of each member, working together and help one another to achieve results. **Diamond Nine Learning Approach:** create a flowchart diagram on the processes involved in protein synthesis and describe the steps involved in each process; application of diamond nine offer students an open and frank discussion over the topic, encouraging members to speak, and allowing members to assess the depth of each learner's understanding of the topic and help one another to fully appreciate the lesson. **Initiating Talk for Learning:** make personal notes on processes involved in protein synthesis and their importance to life and explain this in class; learners reflect over what they can do as individuals, thereby building confidence in them and learning to accept what other people can do.		**Level 1 Recall** Level 2 Skills of conceptual understanding **Level 3 Strategic reasoning** **Level 4 Extended critical thinking and reasoning**
Teaching and Learning Resources	• LCD/TV • Pen drive	• Models of DNA. • Models of eukaryotic cells	• Mobile phone

Subject BIOLOGY
Strand 3. DIVERSITY OF LIVING THINGS AND THEIR ENVIRONMENT
Sub-Strand 1. LIVING ORGANISMS

Learning Outcomes	21st Century Skills and Competencies	GESI, SEL and Shared National Values
2.3.1.LO.1		
Relate the knowledge of the life processes of grain weevil, butterfly, housefly and honeybee to their economic importance.	**Collaborative Learning:** Learners work in groups, which allows for discussions and taking of collective decisions. **Critical Thinking and Problem-Solving:** learners require deep thinking skills to assess the harmful and beneficial aspects of these organisms. **Learning for life:** • Be equipped with the necessary qualifications to gain access to further and higher education and the world of work and adult life. • Develop the ability to pursue self-directed learning with the desire to chart a path to become effective lifelong learners. **Cultural Identity and Global Citizenship:** learners acquire a sense of cultural identity through the study of various insects that have economic importance within the local community and the larger society.	**GESI** • Respect individuals of different beliefs, religions, and cultures. • Embrace diversity and practise inclusion. • Be gender responsive and can tackle injustice. • Be aware of personal biases and stereotypes. • Be sensitive to the inter-relatedness of the various spheres of life, groups, and individuals. **SEL:** • Learners work together to build self-confidence. • Learners learn to listen to their peers' opinions and express disagreement in constructive ways. • Learners learn to adjust to real-world scenarios and believe that their thoughts and opinions are valued. • Develop respectful relationships with insects of economic importance in their ecological environment. **National Core Values:** • Respect for each member of the group

		• Integrity and honesty. • Selflessness and perseverance. • Time consciousness and commitment to achieving excellence.

Content Standards	Learning Indicators and Pedagogical Exemplars with 21st Century Skills and Competencies, and GESI	Assessment
2.3.1.CS.1	2.3.1.LI.1	2.3.1.AS.1
Demonstrate knowledge and understanding of the life processes of grain weevil, butterfly, housefly and honeybee as examples of higher living organisms in the environment.	**Identify and describe the distinctive features, life cycle and characteristics of grain weevil, butterfly, housefly and honeybee.** **Collaborative Learning Technique:** in mixed-ability, gender-responsive and all-inclusive tasked-based groups, research from textbooks and related resources, the distinctive features, life cycle and characteristics of the grain weevil, housefly, butterfly and honey bee; gender responsiveness and social inclusion in a group address the social and emotional needs of each learner, such that each member learns to accept the background of another and seek to meet their emotional needs for a healthy academic exercise. **Project-Based Learning:** as a project work, learners in their groupings identify the habitats of the grain weevil, butterfly, housefly and honey bee, sample them as specimens, and study the various adaptations of each specimen to their named habitat. Each group presents a written report from their research findings. Learners learn to be creative and appreciate the contribution of each member in a group project exercise. **Initiating Talk for Learning:** design charts on the life cycles of the various insects studied. Learners build self-confidence as they self-practice the lesson in their own ways; learners appreciate the abilities of their peers as they assess the inputs of every member.	**Level 1 Recall** Level 2 Skills of conceptual understanding **Level 3 Strategic reasoning** **Level 4 Extended critical thinking and reasoning**
	2.3.1.LI.2	2.3.1.AS.2
	Discuss the economic importance of selected higher organisms **Project-based Learning:** in mixed-ability, gender-responsive and all-inclusive tasked-based groups, identify within your locality and discuss some beneficial and harmful activities carried out by grain weevil, butterfly, housefly and the honeybee. Each group makes presentations of their findings and responds to feedback from their peers; this encourages introvert members of the group to be open and speak as they are assigned roles in group presentations. **Creative Learning:** present your answer in the form of a poster or mind map on the given insect, detailing their benefits, harmful effects and control; learners become creative and appreciate diversity in learning by experiencing different posters and mind maps from peers.	**Level 1 Recall** Level 2 Skills of conceptual understanding **Level 3 Strategic reasoning** **Level 4 Extended critical thinking and reasoning**

Teaching and Learning Resources	• Specimen of Grain weevil, butterfly, housefly, honeybee (each in a different petri dish), hand lens, and forceps. • Photos and posters of specimens to be studied. • Videos

Subject BIOLOGY
Strand 3.Diversity of living things and their environment
Sub-Strand 2.Ecology

Learning Outcomes	21st Century Skills and Competencies	GESI, SEL and Shared National Values
2.3.2.LO.1		
Explain the features of various tropical habitats and how living organisms are adapted to these habitats.	**Communication and Collaboration:** • Learners are able to express themselves in speech, and team up with members to embark on ecological trips. • Learners communicate and work together as a team, on field trips. **Critical Thinking and Problem-Solving:** learners develop and improve their critical thinking skills which are required for explaining how various organisms adapt to their habitats. **Creativity and Innovation:** Learners become more innovative and self-initiating as they examine tropical organisms and their adaptive features in specific habitats which allow them to survive successfully. **Digital Literacy:** the acquisition of digital literacy skills is promoted as learners do online research or watch videos on different tropical habitats and the adaptations of living organisms in them.	**GESI:** • Respect individuals of different beliefs, religions, and cultures. • Embrace diversity and practise inclusion. • Be gender responsive and have the ability to tackle injustice. • Be aware of personal biases and stereotypes. • Be sensitive to the inter-relatedness of the various spheres of life, groups, and individuals. **SEL:** • Learners appreciate real-life situations. • Learn ways of coping with stressful experiences. • Learners practice managing their emotional reactions, thoughts and behaviors. • Learners seize the opportunity to explore how they learn from each other and their environment. **National Core Values:** • Respect for each member of the group • Integrity and honesty. • Selflessness and perseverance.

		• Time consciousness and commitment to achieving excellence.

Content Standards	Learning Indicators and Pedagogical Exemplars with 21st Century Skills and Competencies, and GESI	Assessment
2.3.2.CS.1	2.3.2.LI.1	2.3.2.AS.1
Demonstrate knowledge and understanding of major tropical ecological habitats and how living things are adapted to these habitats.	**Describe the characteristic features of a tropical Rainforest, Savannah, Desert, Lagoon, Estuary, Seashore, River Pond and Lake.** **Experiential Learning:** embark on an ecological trip to some tropical habitats, (e.g., lagoons, estuaries, freshwater, rainforest, savannahs, etc.); learners embrace cultural diversity by learning from different environments. **Initiating Talk-for-Learning Approach:** discuss in detail the distinctive features of each of the types of tropical habitats and the special adaptations of organisms in these habitats; learners learn to tolerate other's views and present disagreements in a more constructive form. **Collaborative Learning:** work in groups to prepare PowerPoint presentations (or summarise your points on a cardboard) on a given tropical habitat for critiquing and feedback by the entire class. Group base presentation allows each member to play a role, creating the spirit of teamwork and socio-emotional forbearances among one another.	Level 1 Recall **Level 2 Skills of conceptual understanding** **Level 3 Strategic reasoning** **Level 4 Extended critical thinking and reasoning**
	2.3.2.LI.2	2.3.2.AS.2
	Describe how common tropical organisms are adapted to their habitats. **Project-Based Learning:** embark on an ecological trip to observe and identify specific organisms that occupy peculiar habitats: this offers learners to learn academic lessons from different cultures and environments, giving them rich socio-emotional lessons to accept learners from diverse cultural, social and emotional backgrounds. **Managing Talk-for-Learning Approach:** write down your findings regarding the adaptive features which allow the organisms to survive successfully in their habitats and discuss these in class. Talking among peers in class enriches the learner's confidence and takes away any feel of inferiority arising from the learner's social, cultural and emotional background.	**Level 1 Recall** Level 2 Skills of conceptual understanding **Level 3 Strategic reasoning** Level 4 Extended critical thinking and reasoning:

Teaching and Learning Resources				
	• Binoculars • Tape measure	• Hand lens • Secchi disk	• Clinometer • Sweep net	• Specimen bottles

Subject BIOLOGY
Strand 3. DIVERSITY OF LIVING THINGS AND THEIR ENVIRONMENT
Sub-Strand 3. DISEASES AND INFECTIONS

Learning Outcomes	21st Century Skills and Competencies	GESI, SEL and Shared National Values
2.3.3.LO.1		
Explain immunization, vaccination, and inoculation stating their importance	**Communication and Collaboration:** learners work as a team and share ideas on explanations of various terminologies in diseases and infection. **Innovation:** learners become innovative as they research into how the various terminologies are applied in health services. **Critical Thinking and Problem-Solving:** learners do close analyses in seeking an understanding of medical processes such as immunisation, vaccination and inoculation.	**GESI** • Respect individuals of different beliefs, religions, and cultures. • Embrace diversity and practise inclusion. • Be gender responsive and have the ability to tackle injustice. • Be aware of personal biases and stereotypes. • Be sensitive to the inter-relatedness of the various spheres of life, groups, and individuals. **SEL:** • Learners work together to build self-confidence. • Learners practice managing their emotional reactions, thoughts and behaviors. • Learners seize opportunity to explore how they learn from each other. **National Core Values:** • Respect for each member of the group • Integrity and honesty. • Selflessness and perseverance. • Time consciousness and commitment to achieving excellence.

Content Standards	Learning Indicators and Pedagogical Exemplars with 21stCentury Skills and Competencies, and GESI	Assessment
2.3.3.CS.1	2.3.3.LI.1	2.3.3.AS.1
Demonstrate knowledge and understanding of immunization, vaccination, and inoculation and their importance.	**Distinguish between immunisation, vaccination, and inoculation stating the importance of each.** **Invitation of Professionals:** invite a resource person such as the school health nurse for a talk on immunization, vaccination, and inoculation, allowing learners to ask questions after presentation; learners receive first-hand information from professionals, thereby building self-confidence and self-respect. **Collaborative/Initiate Talk for Learning:** in mixed-ability, all-inclusive groups, learners examine by discussion, the differences and similarities among the various terms discussed in the presentation and make group charts for presentations. Group work builds confidence in learners and introduces respect and emotional support for each member.	**Level 1 Recall** **Level 2 Skills of conceptual understanding** Level 3 Strategic reasoning **Level 4 Extended critical thinking and reasoning**
Teaching and Learning Resources	• Desk-top/lap-top computer/android mobile phone	

Subject BIOLOGY
Strand 4. SYSTEMS OF LIFE
Sub-Strand 1. MAMMALIAN SYSTEMS

Learning Outcomes	21st Century Skills and Competencies	GESI, SEL and Shared National Values
2.4.1.LO.1		
Explain how the cardiovascular and excretory systems of humans, function to ensure good health.	**Communication and Collaboration:** learners share ideas on the cardiovascular and excretory systems of humans, their parts and functions. **Critical Thinking and Problem Solving:** • Learners develop their faculty through the examination of the more complex cardiovascular system and identify ways of maintaining its health. • Learners acquire critical thinking skills as they discuss in detail and research on how excretory organs as separate components, act together to ensure a balanced and healthy body. **Personal Development and Leadership:** learners play different roles in the group activities and work together in role playing the processes of the cardiovascular system. **Digital Literacy:** through the conduct of online research on the processes, functions and parts of the cardiovascular and excretory systems.	**GESI:** • Respect individuals of different beliefs, religions, and cultures. • Embrace diversity and practise inclusion. • Be gender responsive and have the ability to tackle injustice. • Be aware of personal biases and stereotypes. • Be sensitive to the inter-relatedness of the various spheres of life, groups, and individuals. **SEL:** • Learners work together to build self-confidence. • Learners learn to listen to their peers' opinions and express disagreement in constructive ways. • Learners practice managing their emotional reactions, thoughts and behaviors. **National Core Values:** • Respect for each member of the group • Integrity and honesty. • Selflessness and perseverance. • Time consciousness and commitment to achieving excellence.

Content Standards	Learning Indicators and Pedagogical Exemplars with 21st Century Skills and Competencies, and GESI	Assessment
2.4.1.CS.1	2.4.1.LI.1	2.4.1.AS.1
Demonstrate knowledge and understanding of the cardio-vascular and excretory systems in humans.	**Discuss the cardiovascular system of humans and relate the parts to their functions** **Collaborative Learning:** in small, mixed-ability, all-inclusive groups, watch videos, or study charts on the human heart, and relate its structures to their functions, and design a mind map on the cardiovascular system, its parts and the functions of these parts; learners learning in teams and groups are exposed to learners from diverse backgrounds, helping them to support one another culturally, socially and emotionally. **Observational/Experiential Learning:** obtain a small mammal (e.g. the guinea pig, rabbit, etc.), and carefully dissect it at the ventral part to observe its internal organs and examine them. Practices such as examining biological specimens in academic exercises remove certain cultural, social and religious barriers as learners from some backgrounds are forbidden to touch some organisms. This is effective in liberating the learner from the enslavements of ignorance. Learners also connect to real-world scenarios and experiences to broaden their knowledge. **Talk for Learning:** in mixed-ability groups, learners discuss their presentation on the morphology and physiology of mammalian organs.	Level 1 Recall **Level 2 Skills of conceptual understanding** **Level 3 Strategic reasoning** **Level 4 Extended critical thinking and reasoning**
	2.4.1.LI.2	2.4.1.AS.2
	Discuss the excretory system of humans and relate the parts to their functions in homeostasis. **Observational/Virtual Experiential Learning:** study charts and or watch PowerPoint presentations and videos on the excretory system of mammals, observing and discussing the organs of excretion. Learners build self-confidence and self-respect as they contribute to group learning. **Differential Group Project Learning:** in gender-neutral, all-inclusive, differential groups, obtain cardboards and draw the liver, kidney, skin and lungs, displaying these diagrams on your classroom walls. Study the diagrams further and construct a summary table on the morphological and physiological differences and similarities of these organs. Learners take part in group learning, and this ensures tolerance in one another. **Talk for Learning:** mixed ability groups brainstorm and discuss the effects of an excretory organ failure (e.g. the kidney) on the body of a named mammal, and how its body may adjust to such	**Level 1 Recall** Level 2 Skills of conceptual understanding **Level 3 Strategic reasoning** **Level 4 Extended critical thinking and reasoning**

	mishaps; each group member reflects on his or her contribution in the group to build self-confidence and develop self-acceptance and respect.		
Teaching and Learning Resources	• Dissecting kit • Board • Pins	• Water • Cotton wool • A small mammal (albino rat, guinea pig rabbit, etc.)	• Models of the cardiovascular system • LCD projector/TV/mobile phone

Subject BIOLOGY
Strand 4. SYSTEMS OF LIFE
Sub-Strand 2. PLANT SYSTEMS

Learning Outcomes	21st Century Skills and Competencies	GESI, SEL and Shared National Values
2.4.2.LO.1		
Explain the processes of transportation and photosynthesis in flowering plants.	**Communication and Collaboration:** learners enhance the communication skills through group discussions and exchange of ideas on transportation and photosynthesis **Critical Thinking and Problem-Solving:** discussions on, and analysis of substance transport in plants promotes the development of learners' critical thinking abilities. **Innovativeness**: exploring factors affecting photosynthesis requires the skill of innovation.	**GESI:** • Respect individuals of different beliefs, religions, and cultures. • Embrace diversity and practise inclusion. • Be gender responsive and have the ability to tackle injustice. • Be aware of personal biases and stereotypes. • Be sensitive to the inter-relatedness of the various spheres of life, groups, and individuals. **SEL:** • Learners work together to build self-confidence. • Learners learn to listen to their peers' opinions and express disagreement in constructive ways. • Learners practice managing their emotional reactions, thoughts and behaviors. **National Core Values:** • Respect for each member of the group • Integrity and honesty. • Selflessness and perseverance. • Time consciousness and commitment to achieving excellence.

Content Standards	Learning Indicators and Pedagogical Exemplars with 21st Century Skills and Competencies, and GESI	Assessment
2.4.2.CS.1	2.4.2.LI.1	2.4.2.AS.1
Demonstrate knowledge and understanding of transport and nutrition in flowering plants.	**Explain how substances are transported in flowering plants and state the factors affecting them.** **Initiating Talk for Learning:** based on research from textbooks, the internet and documentaries on Botany, engage in a whole class discussion on how substances are transported in flowering plants; learners learn from one another and learn to accept the views of peers or disagree with them constructively. **Individualised Learning:** individually, write down the key processes involved in the transport of minerals in plants and the factors which influence these processes: learners learn to work privately and independently, invoking the *"can do"* attitude in them, and boosting their confidence and morale. **Experiential Learning:** in small groups, conduct the Ring Experiment, using trees around the school community; each group prepares a report for class presentation after two or three days; learners gain real-world experiences, thus, becoming confident and appreciating the abilities of their peers.	**Level 1 Recall** **Level 2 Skills of conceptual understanding** **Level 3 Strategic reasoning** **Level 4 Extended critical thinking and reasoning**
	2.4.2.LI.2	2.4.2.AS.2
	Explain Photosynthesis and the factors affecting it. **Observational/Experiential Learning:** in an all-inclusive, mixed-ability groups go out to observe various forms of plants with particular emphasis on their green leaves**.** Learners build confidence and self-respect through experiential, real world study scenarios, and acknowledge the strength of peers through teamwork to achieve results within a set timeframe. **Initiate Talk for Learning:** In a general class, each member discusses their observations as to why plants with many green leaves appear healthier than those with fewer green leaves; by this, learners learn to solve problems independently and build confidence and strength; learners learn the act of public speaking through individual presentations, they learn to perform a task within a given time, and learn and respect the contributions of peers to promote healthy academic exercises. **Collaborative Learning:** examine the process of nutrition in plants (photosynthesis) through videos, charts and pictures and analyse and discuss reports on the requirements of water, carbon dioxide, chlorophyll and sunlight as necessary conditions for photosynthesis: learners work together and learn	Level 1 Recall **Level 2 Skills of conceptual understanding** Level 3 Strategic reasoning **Level 4 Extended critical thinking and reasoning**

	to socially and emotionally support one another in achieving set goals. **Experiential Group Project Learning:** in an all-inclusive, mixed-ability groups, carry out experiments to determine the effect of water, carbon dioxide, chlorophyll and sunlight on photosynthesis: learners obtain first hand practical experiences in lesson, supporting group members socially and emotionally, and encouraging the "can do" attitude in them to collectively obtain results.			
Teaching and Learning Resources	• Appropriate textbooks • Internet facility • Lap-top/TV/mobile phone. • Knives and cutlasses	• Seedlings of dicotyledonous plant in a pot • Test tube • Iodine	• Methanol • Scalpel/blade • Burner	• Petri dish • White tile • Beaker

YEAR THREE

Subject BIOLOGY
Strand 1. EXPLORING BIOLOGY IN SOCIETY
Sub-Strand 2. BIOLOGY AND ENTREPRENEURSHIP

Learning Outcomes	21st Century Skills and Competencies	GESI[5], SEL[6] and Shared National Values
3.1.2.LO.1		
Apply knowledge and skills in biotechnology to enhance the value of products that help improve human lives and the environment.	**Communication and Collaboration:** • Learners discuss among themselves and agree on facts. • Learners discuss among themselves how gene editing (genetic recombinant DNA technology) is done. • Learners in groups carry out activities that employ clear speech in decision-making to agree on facts. **Critical Thinking and Problem-Solving:** • Learners develop deep thinking abilities in the application of modern technology in Biology, such as in tissue culturing. • In-depth knowledge is required to describe biological concepts to solve problems such as the treatment of polluted water. **Digital Literacy:** by conducting online research on modern biotechnological processes.	**GESI:** • Respect individuals of different beliefs, religions, and cultures. • Embrace diversity and practice inclusion. • Be gender responsive and can tackle injustice. • Be aware of personal biases and stereotypes. • Be sensitive to the inter-relatedness of the various spheres of life, groups, and individuals. **SEL:** • Learners work together to build self-confidence. • Learners learn to listen to their peers' opinions and express disagreement in constructive ways. • Learners practice managing their emotional reactions, thoughts and behaviors. **National Core Values:** • Respect for each member of the group • Integrity and honesty. • Selflessness and perseverance. • Time consciousness and commitment to achieving excellence.

Content Standards	Learning Indicators and Pedagogical Exemplars with 21st Century Skills and Competencies, and GESI	Assessment
3.1.2.CS.1	3.1.2.LI.1	3.1.2.AS.1
Demonstrate knowledge and skills of some basic concepts in biotechnology and their application to enhance the value of products that help improve human lives and the environment.	**Describe the biological principles behind the preparation of some local foods and beverages** **Differential Project-Based Learning:** • In mixed-ability, gender-responsive and all-inclusive differential tasked-based groups, identify some common local foods and beverages in the community (e.g., local yoghurt, kenkey, pito, bread, akpeteshie) and investigate how they are prepared; present a written report on how each is prepared by the local people in the community. Learners inculcate new cultures and shed off harmful and socially sensitive beliefs about some cultures and their eating habits. Learners learn to respect the positive beliefs of some cultures and develop the spirit of team working. • Identify some common biological principles employed in the preparation of local foods (e.g., fermentation in the preparation of yoghurt, kenkey, pito and bread), and describe in a written report how these biological processes are applied in preparing each food item. Learners develop self-confidence both in teamwork and in individual assigned roles during independent and group research. **Experiential/Project Based Learning:** collect different resources and raw materials and work in groups at the laboratory to produce some local foods and beverages such as yoghurt and kenkey: by this, learners connect to real-life scenarios and disconnect from harmful beliefs and taboos they ignorantly attach to. Learners learn to work to achieve results and offer emotional support and respect to peers they work with.	**Level 1 Recall** **Level 2 Skills of conceptual understanding** Level 3 Strategic reasoning Level 4 Extended critical thinking and reasoning:
	3.1.2.LI.2	3.1.2.AS.2
	Describe the process of tissue culture and its application in food production. **Individual/Independent Learning Approach:** research from textbooks, the internet, documentaries and other relevant sources, and make summary notes on tissue culture and the major processes involved in it: learners research on their own to develop the skill of independency and build confidence and strength. Learners also learn from their peers and seek personal collaboration with them, thereby developing respect for one another.	**Level 1 Recall** Level 2 Skills of conceptual understanding **Level 3 Strategic reasoning** **Level 4 Extended critical thinking and reasoning**

	Diamond Nine Learning Approach: in mixed–ability, all-inclusive groups, create flow charts on the processes involved in making tissue culture, and critique each group's work in class discussions; learners learn the act of fair grading/judgment and to accept constructive criticisms. Learners also learn public speaking and learn from one another through critiquing. **Experiential/Group Project Learning Approach:** learners work in large groups to make sample plant tissue cultures with support and resources from the teacher and lab/resource personnel (e.g. from scientific resource centres in institutions and universities), with each group presenting a report on the project: Learners obtain real-world experience on study. Learners learn to help one another socially and emotionally in teamwork.	
	3.1.2.LI.3	3.1.2.AS.3
	Describe how genetic recombinant technology is applied in biotechnology to produce GMOs. **Group-Based Learning:** • In mixed ability, all-inclusive groups, listen to a presentation by a resource person or your teacher on genetic recombinant technology also known as Recombinant DNA technology (rDNA) and note down your observations and discuss them: Learners develop teamwork and involvement attitude. • Design a flow chart on the key processes involved in this technology. Learners contribute to assigned tasks, thereby building self-confidence and respect. **Group Project-Based Learning: i**n mixed-ability, all-inclusive groups, learners read/research from textbooks, libraries, journals and newspapers to acquire further information on genetically modified crops and animals in Africa produced using recombinant DNA technology. Learners gain broader understanding on the socio-cultural and emotional concerns on genetically modified organisms and crops (GMOs and GMCs) and educate families and the masses on these beliefs. Learners share information and acknowledge the efforts of peers.	**Level 1 Recall** Level 2 Skills of conceptual understanding **Level 3 Strategic reasoning** **Level 4 Extended critical thinking and reasoning**
	3.1.2.LI.4	3.1.2.AS.4
	Describe the application of biological concepts in the treatment of water, extraction of minerals (e.g., gold), and production of bio-oils **Collaborative/Project Based Learning:** In mixed-ability, gender-responsive and all-inclusive groups, read and share knowledge on the use of biological principles in treating polluted water, extracting minerals, and the production of biofuels: Learners share tasks and work with	Level 1 Recall Level 2 Skills of conceptual understanding **Level 3 Strategic reasoning** **Level 4 Extended critical thinking and reasoning**

	encourage one another socially and emotionally to complete tasks within a set time. **Observational Learning Approach:** listen to a presentation or watch a video on the types of microbes (bacteria) that are employed in the treatment of polluted water, extraction of minerals, and production of biofuels and make personal notes to be used in group work. Learners learn independent inquiry and learn to reach out to others for support when necessary. **Experiential/Observational Learning Approach:** in mixed-ability, all-inclusive groups, research on the biological activities involved in large-scale treatment of water and in the extraction of minerals and production of bio-oils. Design a laboratory method of biological treatment of water for group class presentations. Learners develop confidence in their abilities and learn from one another.		
Teaching and Learning Resources	• Sugar • Yeast • Wheat flour water • fresh milk • Millet and corn dough • Sugar cane and distillation apparatus. • Laptops	• Videos • Photos and posters • Laptops • Smart phones • Projectors • Production of bio-oils. • Simulations	• Photos and posters on tissue culture • Textbooks • Photos and posters on recombinant DNA technology, and production of GMOs. • Photos and posters on the past and present state of inland water bodies in Ghana • Water treatment plants • Activities in gold mines • Use of bacteria culture in bioremediation of polluted water bodies

Subject BIOLOGY
Strand 2. LIFE IN THE FUNDAMENTAL UNIT
Sub-Strand 1. CELL STRUCTURE AND FUNCTIONS

Learning Outcomes	21st Century Skills and Competencies	GESI, SEL and Shared National Values
3.2.2.LO.1		
Explain key terms in Genetics and their applications.	**Communication and Collaboration:** learners communicate in their groups about terms essential in the study of genetics. **Critical Thinking and Problem Solving:** apply the knowledge of genetics to explain the acquisition of various traits and characteristics by off springs. **Creativity and Innovation**: through the application of genetic principles to predict the outcome of various crossings or physical characteristics of offspring. **Digital Literacy**: learners enhance their digital skills by researching for information on various genetic laws, principles and terminologies as well as preparation of PowerPoint presentations.	**GESI:** • Respect individuals of different beliefs, religions, and cultures. • Embrace diversity and practise inclusion. • Be gender responsive and can tackle injustice. • Be aware of personal biases and stereotypes. • Be sensitive to the inter-relatedness of the various spheres of life, groups, and individuals. **SEL:** • Learners work together to build self-confidence. • Learners learn to listen to their peers' opinions and express disagreement in constructive ways. **National Core Values:** • Respect for each member of the group • Integrity and honesty. • Selflessness and perseverance. • Time consciousness and commitment to achieving excellence.
3.2.1.LO.2		
Relate Mendel's laws and concepts of inheritance to human blood groups and their importance.	**Communication and Collaboration:** • Learners communicate over issues and make collective decisions on facts concerning blood group and Rhesus factor. • Learners communicate in groups about the various types of human blood groups, the success of blood transfusion and its relevance.	**GESI:** • Respect individuals of different beliefs, religions, and cultures. • Embrace diversity and practise inclusion. • Be gender responsive and have the ability to tackle injustice.

	Critical Thinking and Problem-Solving: learners need to be analytical in assessing the understanding of the concepts of blood grouping and Rhesus factor.	• Be aware of personal biases and stereotypes. • Be sensitive to the inter-relatedness of the various spheres of life, groups, and individuals. **SEL:** • Learners work together to build self-confidence. • Learners learn to adjust to real-life situations and believe that their thoughts and opinions are valued • Learners practice managing their emotional reactions, thoughts and behaviours. **National Core Values:** • Respect for each member of the group • Integrity and honesty. • Selflessness and perseverance. • Time consciousness and commitment to achieving excellence.
3.2.1.LO.3		
Explain the concept of variation, its causes, processes, and consequences in life.	**Communication and Collaboration:** • Learners discuss among themselves and agree on specific issues in dealing with variation under genetics. • Learners discuss by speech, the theories of evolution and the evidence available to support the respective theories. **Critical Thinking Problem-Solving:** • Learners reflect deeply over the causes of variation, and factors that affect them. • Learners develop deep thinking abilities in examining the causes of variation and factors that influence these.	**GESI:** • Respect individuals of different beliefs, religions, and cultures. • Embrace diversity and practise inclusion. • Be gender responsive and have the ability to tackle injustice. • Be aware of personal biases and stereotypes. • Be sensitive to the inter-relatedness of the various spheres of life, groups, and individuals. **SEL:** • Learners listen to their peers' opinions and express disagreement in constructive ways. • Believe that their thoughts and opinions are valued.

		• Develop respectful relationships with one another and other people. **National Core Values:** • Respect for each member of the group • Integrity and honesty. • Selflessness and perseverance. • Time consciousness and commitment to achieving excellence.
3.2.1.LO.4		
Explain evolution and the factors leading to its occurrence in nature.	• **Communication and Collaboration:** learners communicate, in describing and explaining theories of evolution and the pieces of evidence available to support them.	**GESI:** • Respect individuals of different beliefs, religions, and cultures. • Embrace diversity and practise inclusion. • Be gender responsive and have the ability to tackle injustice. • Be aware of personal biases and stereotypes. • Be sensitive to the inter-relatedness of the various spheres of life, groups, and individuals. **SEL:** • Learners listen to their peers' opinions and express disagreement in constructive ways. • Believe that their thoughts and opinions are valued. • Develop respectful relationships with one another and other people. **National Core Values:** • Respect for each member of the group • Integrity and honesty. • Selflessness and perseverance. • Time consciousness and commitment to achieving excellence.

3.2.1.LO.5		
Explain the cell cycle, cell division, and their relevance in living things.	**Communication and Collaboration:** learners discuss together the background to the cell cycle and its various phases and processes. **Personal Development and Leadership:** learners enhance their practical skills and self-confidence by playing diverse roles within their respective groups	**GESI:** • Respect individuals of different beliefs, religions, and cultures. • Embrace diversity and practise inclusion. • Be gender responsive and have the ability to tackle injustice. • Be aware of personal biases and stereotypes. • Be sensitive to the inter-relatedness of the various spheres of life, groups, and individuals. **SEL:** • Learners work together to build self-confidence. • Learners practice managing their emotional reactions, thoughts and behaviours. • Learners acknowledge the importance of self and peer evaluation. **National Core Values:** • Respect for each member of the group • Integrity and honesty. • Selflessness and perseverance. • Time consciousness and commitment to achieving excellence.

Content Standards	Learning Indicators and Pedagogical Exemplars with 21st Century Skills and Competencies, and GESI			Assessment
3.2.1.CS.1	3.2.1.LI.1			3.2.1.AS.1
Demonstrate understanding of the concept of Genetics	**Explain the application of the key terminologies in the study of Genetics** **Individual/Independent Learning Approach:** Learner **r**esearch from textbooks, the internet, libraries and other relevant sources, the background to the study of genetics, and terms used in describing genetic processes and activities; the learner believe in the capacity to work independently when required and learns diverse learning experiences from other peers in similar research assignments. Learners develop the necessary emotional and psychological strength to work that accompanies independent working. **Talk for Learning:** In mixed ability, all-inclusive groups, brainstorm and discuss the key terminologies used in genetics (e.g. heredity, traits, chromosomes, genotypes, etc.): Each member of a group is assigned at least a term to discuss before the class: Learner develops self-confidence by learning to speak before peers. Peers of the same group learn to offer the required social and emotional support to their members during the class discuss.			Level 1 Recall **Level 2 Skills of conceptual understanding** **Level 3 Strategic reasoning** Level 4 Extended critical thinking and reasoning:
Teaching and Learning Resources	• Simulations • Photos	• Textbooks and posters on genetics terminologies, and outcomes of Mendel's experiments on inheritance. • Pea plants and seeds	• Four o'clock plant • Maize cob with grains of different colours	• Albino rats

Content Standards	Learning Indicators and Pedagogical Exemplars with 21st Century Skills and Competencies, and GESI	Assessment
3.2.1.CS.2	3.2.1.LI.1	3.2.1.AS.1
Demonstrate knowledge and understanding of Mendel's laws and concepts of inheritance, blood groups and their applications in life.	**Explain Mendel's laws of inheritance.** **Experiential, Project-Based Learning:** in mixed ability, all-inclusive groups, learners research from textbooks and libraries on Mendel's experiments with the pea plant, and the class embarks on a visit to a nearby farm (e.g. the school farm) where learners may observe common organisms used as models for genetic experiments. Equally, learners may observe charts and pictures showing the results of Mendel's experiments on monohybrid and dihybrid inheritance. Learners note their observations for presentation. Learners develop self and group emotional and social support in these activities. **Task-Based Learning Approach:** using marbles of different colours demonstrate the application of Mendel's first law (law of segregation), second law (law of independent assortment), and third law (the law of Dominance) of inheritance in mixed ability, all-inclusive groups. Learners acquire self-confidence and emotional satisfaction by experiencing genetic principles and how they work through such simple exercises. **Talk-for-Learning Approach**: using practical examples, discuss, based on the groups, how Mendel's laws can be applied to ensure the breeding of off-springs with desired characteristics: Learners learn from one another in group presentations and boost their confidence in contributing to group work.	Level 1 Recall **Level 2 Skills of conceptual understanding** **Level 3 Strategic reasoning** **Level 4 Extended critical thinking and reasoning**
	3.2.1.LI.2	3.2.1.AS.2
	Discuss why it is necessary to know one's blood group and Rhesus factor classification. **Enquiry-Based Learning:** research from textbooks, the internet, the library and other relevant sources, the background and importance of blood groups, blood transfusion and Rhesus factor in humans, and discuss your findings in class discussions; learners develop emotional and psychological satisfaction through their ability to find answers to questions through research. **Task-Based Learning:** Learners work in mixed-ability groups to create charts on the various blood groups and the associated blood donors and recipients, presenting their lessons in discussions; learners learn from one another during discussions, and express opinions in modest constructive and presentable tones.	Level 1 Recall Level 2 Skills of conceptual understanding **Level 3 Strategic reasoning** **Level 4 Extended critical thinking and reasoning**

Teaching and Learning Resources	• Simulations • Photos • Textbooks and posters on variation in skin colour hair texture and shape of nose	• Fingerprints of humans etc. • Phenylthiocarbamide - PTC.

Content Standards	Learning Indicators and Pedagogical Exemplars with 21st Century Skills and Competencies, and GESI	Assessment
3.2.1.CS.3	3.2.1.LI.1	3.2.1.AS.1
Demonstrate knowledge and understanding of the concept and consequences of Variation.	**Discuss variation and its causes, stating the processes and factors affecting each.** **Collaborative Learning:** in mixed-ability, all-inclusive groups, study pictures/videos or charts and documentaries on variation and discuss its causes and consequences in class group presentations: Learners learn from one another during discussions and develop tolerance in dealing with their emotions. **Differential, Task-Based:** In mixed-ability, all-inclusive, socially minded groups, develop various charts and maps on the concept of variation, its causes, processes and factors: Group based work ensure emotional and psychological support from group to each member. Contribution by members in group gives inner strength and satisfaction and confidence when the learner feels involved in the work.	Level 1 Recall **Level 2 Skills of conceptual understanding** **Level 3 Strategic reasoning** Level 4 Extended critical thinking and reasoning:
	3.2.2.LI.2	3.2.2.AS.2
	Describe the application of principles of variation among humans to improve life. **Think Pair Share:** through think pair sharing, the learner research and share with another learner the advantages and disadvantages associated with genetic variation among humans. A general class discussion follows, think pair share allows many learners to share their thoughts, as it also fosters social and emotional well-being as thoughts are shared with the other learner. The strategy, together with class discussions, improves learner oratory. **Task-Based/Talk for Learning Approaches:** a mixed-ability, all-inclusive groups, share with the rest present learners present discussions on the application of variation to improve the well-being and health of humans: learners in group share common emotional and psychological thoughts, and support one another for a healthy academic exercise. Learners socially connect through mixed-ability class groupings.	**Level 1 Recall** Level 2 Skills of conceptual understanding **Level 3 Strategic reasoning** Level 4 Extended critical thinking and reasoning:

Teaching and Learning Resources	• Simulations • Photos	• Textbooks and posters on variation in skin colour hair texture and shape of nose • Fingerprints of humans etc.	• Phenylthiocarbamide - PTC.

Content Standards	**Learning Indicators and Pedagogical Exemplars with 21st Century Skills and Competencies, and GESI**		**Assessment**
3.2.1.CS.4	3.2.1.LI.1		3.2.1.AS.1
Demonstrate knowledge and understanding of evolution and factors leading to its occurrence in nature.	**Describe various evidence of the processes of evolution and the factors affecting them**. **Group/Individual-Based Project Learn:** individually, learners collect pictures/videos/documentaries on different sources of evidence of evolution (such as fossil records, comparative anatomy, comparative embryology, geographical distribution, etc.) and study them. In mixed-ability, all-inclusive groups, learners brainstorm their findings, write and present group reports. These ensure that learners learn from one another and appreciate the efforts of each member in group discussions. **Talk for Learning Approach:** learners in mixed-ability groups discuss the unique features of the forms of evidence of evolution and create group posters for class discussions: learners become inquisitive in explaining charts and posters. Learners acknowledge the strength of each member and offer required psychological and emotional support to achieve group goals.		Level 1 Recall **Level 2 Skills of conceptual understanding** **Level 3 Strategic reasoning** Level 4 Extended critical thinking and reasoning:
Teaching and Learning Resources	• Simulations • Photos	• Textbooks and posters on evolution and factors/ evidence of.	

<table>
<tr><th>Content Standards</th><th colspan="4">Learning Indicators and Pedagogical Exemplars with 21st Century Skills and Competencies, and GESI</th><th>Assessment</th></tr>
<tr><td>3.2.1.CS.5</td><td colspan="4">3.2.1.LI.1</td><td>3.2.1.AS.1</td></tr>
<tr><td>Demonstrate knowledge and understanding of the process of the cell cycle and cell division in eukaryotic cells.</td><td colspan="4">Describe the cell cycle and relate it to how mitosis and meiosis occur in a living cell.

Individual/Independent-Based Learning: each learner collects and study charts, maps and diagrams on mitosis and meiosis, and analyse them to understand the basic concepts of cell division; learner builds self-confidence and the ability to perform tasks independently. Learner becomes inquisitive and learns from others.

Group Based-Talk for Learning: in mixed ability, all-inclusive groups, discuss the events that occur in the cell during division (i.e. the interphase and five stages of the cell cycle (gap 1/G1 stage, synthesis/S stage, gap 2/G2 stage and mitosis/M stage)). Groups compare mitosis and meiosis in living things. Learners become inquiry-based and learn from one another. Learners improve on their speaking skills. Learners are emotionally and psychologically connected during group work.

Project-Based Learning: design charts on the stages of meiosis and mitosis.</td><td>Level 1 Recall
Level 2 Skills of conceptual understanding
Level 3 Strategic reasoning
Level 4 Extended critical thinking and reasoning</td></tr>
<tr><td>Teaching and Learning Resources</td><td>• The following should be made available for learners use in practical work:
• Onion root
• Razor blade</td><td>• Iodine stain
• Microscope
• Petri dish</td><td>• Microscope slide and cover slip
• Water</td><td>• Simulations
• Photos and posters on Cell cycle and cell division.</td><td></td></tr>
</table>

Subject BIOLOGY
Strand 3. DIVERSITY OF LIVING THINGS AND THEIR ENVIRONMENT
Sub-Strand 1. LIVING ORGANISMS

Learning Outcomes	21st Century Skills and Competencies	GESI, SEL and Shared National Values
3.3.1.LO.1		
Relate the knowledge of the characteristic features and life processes of tilapia, toad, wall gecko and Domestic fowl to their economic importance.	**Communication and Collaboration:** learners express themselves in speech in describing the characteristic features of the wall gecko, lizard and the domestic fowl. **Observational Skills:** learners need to critically observe features to analyse and describe them. **Critical-Thinking and Problem-Solving:** describing features of organisms require critical thinking ability to identify the named organisms. **Cultural identity and global citizenship:** learners examine the role of the wall gecko, lizard and domestic fowl in shaping the ecosystem	**GESI:** • Respect individuals of different beliefs, religions, and cultures. • Embrace diversity and practise inclusion. • Be gender responsive and have the ability to tackle injustice. • Be aware of personal biases and stereotypes. • Be sensitive to the inter-relatedness of the various spheres of life, groups, and individuals. **SEL:** • Learners work together to build self-confidence. • Learners practice managing their emotional reactions, thoughts and behaviours. • Learners acknowledge the importance of self and peer evaluation. • Develop respectful relationships with one another and organisms of economic importance in their ecological environment **National Core Values:** • Respect for each member of the group

		• Integrity and honesty. • Selflessness and perseverance. • Time consciousness and commitment to achieving excellence.

Content Standards	Learning Indicators and Pedagogical Exemplars with 21st Century Skills and Competencies, and GESI	Assessment
3.3.1.CS.1	3.3.1.LI.1	3.3.1.AS.1
Demonstrate knowledge and understanding of the characteristic features and life processes of tilapia, frog, wall gecko and Domestic fowl and their economic importance.	**Describe the characteristic features and life processes of the Wall gecko, Tilapia, and Domestic fowl** **Project-Based Learning**: Work in large groups to conduct research on the life cycle of the Tilapia, frog and domestic fowl, with particular emphasis on their general characteristics. **Collaborative Learning**: Examine the features and life processes of the wall gecko, lizards, Tilapia and domestic fowl by discussing in groups and making observations and notes on these. **Talk-for-Learning Approach:** Do group presentations with the aid of charts, pictures or PowerPoint slides on the various animals studied. "	Level 1 Recall **Level 2 Skills of conceptual understanding** **Level 3 Strategic reasoning** **Level 4 Extended critical thinking and reasoning**
	3.3.1.LI.2	3.3.1.AS.2
	Discuss the economic importance of tilapia, frog, wall gecko and domestic fowl. **Talk-for-Learning Approach:** based on the previous group activities on the selected common organisms, engage in a whole class discussion on the economic importance of each of the animals (tilapia, frog, wall gecko and domestic fowl) **Task-based Learning:** observe the suggested organisms (wall gecko, lizard and frogs) within your locality; make notes and discuss some of the unique attributes and perceptions the locals have on these organisms, and how this informs their approach and interactions with them (the common organisms).	Level 1 Recall **Level 2 Skills of conceptual understanding** Level 3 Strategic reasoning **Level 4 Extended critical thinking and reasoning**
Teaching and Learning Resources	• Materials and specimens to be made available for use by learners in practical are wall gecko, Tilapia, domestic fowl, drawing paper, pencil and eraser.	

Subject BIOLOGY
Strand 3. DIVERSITY OF LIVING THINGS AND THEIR ENVIRONMENT
Sub-Strand 2. ECOLOGY

Learning Outcomes	21st Century Skills and Competencies	GESI, SEL and Shared National Values
3.3.2.LO.1		
Explain the interdependencies of living things and their environment and indicate the ecological importance of each.	**Communication and Collaboration:** • Learners express themselves in speeches by describing the interdependencies and interactions of the living and non-living components of the ecosystem. • Learners discuss among themselves, the interdependencies and interactions of living things. **Critical Thinking and Problem-Solving**: learners need to be tactically thoughtful in analysing the interdependencies of the living and non-living components of the environment in ensuring a stable ecosystem. **Cultural Identity and Global Citizenship:** learners learn about how best to maintain the ecosystem for humans and other living organisms. **Digital Literacy:** through the conduct of online research and the preparation of PowerPoint presentations on interdependencies within an ecosystem.	**GESI** • Respect individuals of different beliefs, religions, and cultures. • Embrace diversity and practise inclusion. • Be gender responsive and have the ability to tackle injustice. • Be aware of personal biases and stereotypes. • Be sensitive to the inter-relatedness of the various spheres of life, groups, and individuals. **SEL:** • Learners work together to build self-confidence. • Learners practice managing their emotional reactions, thoughts and behaviours. • Develop respectful relationships with one another and organisms of economic importance in their ecological environment **National Core Values:** • Respect for each member of the group • Integrity and honesty. • Selflessness and perseverance. • Time consciousness and commitment to achieving excellence.

3.3.2.LO.2		
Accurately collect and analyse data, draw valid conclusions and inferences to address problems in the environment.	**Communication and Collaboration:** Learners express in groups how data is collected, analysed and interpreted in biological lessons. **Personal Development Skills:** individual learners acquire skills on data gathering and analysis as well as interpretation **Leadership Skills:** by playing different roles within the group.	**GESI:** • Respect individuals of different beliefs, religions, and cultures. • Embrace diversity and practise inclusion. • Be gender responsive and have the ability to tackle injustice. • Be aware of personal biases and stereotypes. • Be sensitive to the inter-relatedness of the various spheres of life, groups, and individuals. **SEL**: • Learners work together to build self-confidence. • Learners practice managing their emotional reactions, thoughts and behaviours. • Develop respectful relationships with one another and organisms of economic importance in their ecological environment **National Core Values:** • Respect for each member of the group • Integrity and honesty. • Selflessness and perseverance. • Time consciousness and commitment to achieving excellence

<table>
<tr><th>Content Standards</th><th>Learning Indicators and Pedagogical Exemplars with 21st Century Skills and Competencies, and GESI</th><th>Assessment</th></tr>
<tr><td>3.3.2.CS.1</td><td>3.3.2.LI.1</td><td>3.3.2.AS.1</td></tr>
<tr><td rowspan="3">Demonstrate knowledge and understanding of the interaction between the living and non-living components of the environment to ensure the sustenance of life.</td><td>Describe the interdependency of living and non-living components of the environment.

Project-Based Learning: embark on field trips to various habitats in and around your community to investigate the interdependencies and interactions among living things (e.g., how producers and consumers interact in nature, how decomposers bring about decomposition, etc.).
Write down the types and explanations of the biological relationships observed in the various habitats visited.

Talk-for-Learning: discuss how the living and non-living components of the environment interact and interdependent on each other to ensure successful living.</td><td>Level 1 Recall
Level 2 Skills of conceptual understanding
Level 3 Strategic reasoning
Level 4 Extended critical thinking and reasoning</td></tr>
<tr><td>3.3.2.LI.2</td><td>3.3.2.AS.2</td></tr>
<tr><td>Explain the interdependency of Living things and its importance to life.

Task-Based Learning: in gender-responsive, mixed-ability and differential task-based groups, find out and document the various types of ecological/biological associations (e.g., symbiosis, parasitism, mutualism, commensalism, saprophytism, epiphytism) in the community with an emphasis on the ecological importance of such associations.

Talk for Learning: discuss the importance of these interdependencies and interactions among living things and distinguish between the various types of ecological associations.</td><td>Level 1 Recall
Level 2 Skills of conceptual understanding
Level 3 Strategic reasoning
Level 4 Extended critical thinking and reasoning:</td></tr>
<tr><td>Teaching and Learning Resources</td><td colspan="2">Simulations and photos of different habitats of living organisms
Specimens of organisms specific to each habitat studied (e.g., mangroves in estuaries and lagoons, ghost crabs on sandy beaches) and how they interact.
Root nodules of legumes
epiphytes, commensals
Symbionts
Saprophytes
Simulations and video clips on biological associations.</td></tr>
</table>

Content Standards	Learning Indicators and Pedagogical Exemplars with 21st Century Skills and Competencies, and GESI	Assessment
3.3.2.CS.2	3.3.2.LI.1	3.3.2.AS.1
Demonstrate knowledge and understanding of data collection, analysis, interpretation and making valid conclusions and inferences to address problems in the environment.	**Accurately collect and analyse data on Body Mass Index of the learners and plant density on the school compound.** **Experiential learning Approach:** learners take turns to accurately measure the height and mass of every individual in their group and use the data to determine the mean BMI of the class. **Project-Based Approach:** research from books, the internet documentaries and related sources, (discuss) the various tools and methods (e.g., quadrat sampling, the pitfall trap, wicker net trap, direct count, the Lincoln index, etc.) used for biological sampling. **Experiential learning Approach:** learners go to the field and collect data to demonstrate how ecological tools are used to gather and record data.	Level 1 Recall Level 2 Skills of conceptual understanding **Level 3 Strategic reasoning** **Level 4 Extended critical thinking and reasoning**
	3.3.2.LI.2	3.3.2.AS.2
	Draw valid conclusions and inferences on the analysed data. **Task-based Learning:** organise the collected data for plotting of graphs, such as pie charts, histograms, bar charts, and frequency curves. **Talk for Learning Approach**: analyse the results, discuss and interpret to make valid deductions/conclusions and recommendations.	**Level 1 Recall** **Level 2 Skills of conceptual understanding** Level 3 Strategic reasoning Level 4 Extended critical thinking and reasoning
Teaching and Learning Resources	• Provide the following for use by learners: measuring tape, weighing balance, quadrat frames, line, field notebook. • Provide the following for use by learners: measuring tape, weighing balance, Sweep and butterfly nets, pooter, rain gauge, thermometers, quadrat frames, line, field notebook, graph books etc.	

Subject BIOLOGY
Strand 3. DIVERSITY OF LIVING THINGS AND THEIR ENVIRONMENT
Sub-Strand 3. DISEASES AND INFECTIONS

Learning Outcomes	21st Century Skills and Competencies	GESI, SEL and Shared National Values
3.3.3.LO.1		
Examine and explain emerging diseases and infections and suggest how they can be prevented	**Communication and Collaboration:** • Discussions on emerging and modern trends of human diseases require strong communication skills among members of groups. • Discussion on emerging plant diseases requires strong communication skills. **Critical Thinking and Problem-Solving:** learners develop the ability for deep thinking as they research current/emerging diseases and work out solutions to solve diseases and infection problems. **Critical Thinking and Problem-Solving:** examining the trends in emerging diseases and their effects on humans requires critical thinking. **Innovation:** innovative skills are required in dealing with the challenges posed by modern emerging diseases **Digital Literacy:** learners develop literal skills using the internet, projectors and simulators in research activities.	**GESI:** • Respect individuals of different beliefs, religions, and cultures. • Embrace diversity and practise inclusion. • Be gender responsive and have the ability to tackle injustice. • Be aware of personal biases and stereotypes. • Be sensitive to the inter-relatedness of the various spheres of life, groups, and individuals. **SEL:** • Learners practice managing their emotional reactions, thoughts and behaviours. • Develop respectful relationships with one another and organisms of economic importance in their ecological environment **National Core Values:** • Respect for each member of the group • Integrity and honesty. • Selflessness and perseverance. • Time consciousness and commitment to achieving excellence

Content Standards	Learning Indicators and Pedagogical Exemplars with 21st Century Skills and Competencies, and GESI	Assessment
3.3.3.CS.1	3.3.3.LI.1	3.3.3.AS.1
Explore some emerging diseases and infections and show their prevention methods.	**Discuss how emerging human diseases (SARS-COVID-19, Ebola, Buruli ulcer, Swine flu/H1N1 flu and Monkey pox) are transmitted and suggest steps to prevent their spread.** **Project-Based Learning:** in mixed-ability, social and gender-responsive groups, research from textbooks, documentaries and other relevant sources, about emerging trends of diseases (e.g., SARS, Ebola, Covid-19, Swine flu/H1N1, etc.) and their threats to human life and present group reports on these diseases. Learners connect socially to various beliefs associated with emerging diseases and vaccination projects and, become better informed. Learners learn to be identified with local folks who are ignorant about the true nature of these diseases and support programmes to educate them. **Group-Based/Collaborative Learning:** learners discuss in mixed-ability and all-inclusion groups, the modes of transmission of emerging human diseases (SARS-COVID-19, Ebola, Buruli ulcer, Swine flu/H1N1 flu and Monkey pox) and the preventive and curative methods available to control them: learners learn from one another and appreciates the efforts of peers. **Initiating Talk for Learning:** learners prepare reports on emerging/contemporary diseases (e.g., SARS-COVID-19, Ebola, Buruli ulcer, Swine flu/H1N1 flu and Monkey pox) and present their findings and ways of combating and preventing them in class group presentations. Learners develop confidence for the knowledge obtained in emerging diseases: learners connect to victims both socially and emotionally and seek to support them through education and such other programmes.	**Level 1 Recall** Level 2 Skills of conceptual understanding **Level 3 Strategic reasoning** **Level 4 Extended critical thinking and reasoning**
	3.3.3.LI.2	3.3.3.AS.2
	Research on other diseases of plants and animals and suggest steps to prevent their spread. **Field-Based Learning Approach (Experiential):** learners are taking out on a farm plantations and livestock centres within the community to observe some common diseases of plants (e.g., blight and wilt diseases by bacteria) and animal-rearing centres to observe and study animal diseases (e.g., brucellosis, tuberculosis, etc.): learners are put into mixed-ability, all-inclusive groups to prepare group presentations. Learners obtain real world scenarios of lessons learnt in class, thereby boosting their morale.	**Level 1 Recall** Level 2 Skills of conceptual understanding **Level 3 Strategic reasoning** **Level 4 Extended critical thinking and reasoning**

	Collaborative Learning: learners discuss in mixed-ability, all-inclusive groups the transmission, symptoms and effects of common diseases of plants livestock; learners, through education, obtain the requisite knowledge to educate learners, thereby being self-assured through self-confidence. Learners also learn from one another. **Talk for Learning:** in mixed-ability, socially-inclusive groups, learners engage in timed sessions on the prevention and cure of plant and livestock diseases; learners learn from one another through the discussions. Members in groups are socially and emotionally connected to support one another to achieve the set target within the timeframe.	
Teaching and Learning Resources	• Simulations • Videos and documentaries on emerging diseases.	

Subject BIOLOGY
Strand 4. SYSTEMS OF LIFE
Sub-Strand 1. MAMMALIAN SYSTEMS

Learning Outcomes	21stCentury Skills and Competencies	GESI, SEL and Shared National Values
3.4.1.LO.1		
Explain how the mammalian respiratory, reproductive, musculoskeletal, nervous and hormonal systems are related in their functions to ensure the sustenance of life.	**Communication and Collaboration:** discussion on the structure and functions of the respiratory system of mammals **Skills of Observation and Accuracy:** learners employ and develop these skills in making drawings of the specified organ system (the respiratory system of mammals). **Critical Thinking and Problem-Solving:** learners need critical mind reflections in describing the functioning of the respiratory system and its organs.	**GESI:** • Respect individuals of different beliefs, religions, and cultures. • Embrace diversity and practise inclusion. • Be gender responsive and have the ability to tackle injustice. • Be aware of personal biases and stereotypes. • Be sensitive to the inter-relatedness of the various spheres of life, groups, and individuals. **SEL:** • Learners work together and build self-confidence. • Learners identify and express their opinions and feelings. **National Core Values:** • Respect for each member of the group • Integrity and honesty. • Selflessness and perseverance. • Time consciousness and commitment to achieving excellence

Content Standards	Learning Indicators and Pedagogical Exemplars with 21st Century Skills and Competencies, and GESI	Assessment
3.4.1.CS.1	3.4.1.LI.1	3.4.1.AS.1
Demonstrate knowledge and understanding of mammalian systems with specific emphasis on human Respiratory, Reproductive, musculoskeletal, Nervous and Hormonal systems and how they function to ensure sustenance of human life	**Describe with labelled drawings, how the respiratory system in mammals function and work with other systems to ensure healthy living.** **Group-Task-Based Learning:** in mixed ability, all-inclusive groups, examine the respiratory system in a named mammal (e.g., humans, guinea pig, Rabbit, Albino rat, etc.) and its importance from textbooks, documentary videos, improvised lab specimens, etc., and note the various organs and their functions and draw and name parts of the excretory organs in humans: learners learn to appreciate the contribution of each member in the group and support themselves psychologically. **Talk for Learning Approach:** learners in groups discuss the forms and processes of respiration in mammals, with emphasis on the two types of cellular respiration, describing the various phases involved, especially glycolysis. Details of Kreb's cycle and the respiratory chain/electron carrier system are not needed: learners learn from each other, and every member of the group is encouraged to talk, thereby improving on the learners' communication skills. **Experimental/Experiential-Based Learning:** use maize/groundnut seeds soaked in water to demonstrate that heat energy is released during aerobic respiration, and yeast to show how carbon dioxide is produced as a by-product and discuss and interpret your results with a conclusion. Learners obtain real world scenarios and first-hand knowledge to boost their confidence. Learners in group tasks are socially and emotionally linked to support one another to achieve the set goals.	Level 1 Recall **Level 2 Skills of conceptual understanding** **Level 3 Strategic reasoning** **Level 4 Extended critical thinking and reasoning**
	3.4.1.LI.2	3.4.1.AS.2
	Describe with labelled drawings, how the reproductive system in mammal's functions and works together with other systems to ensure the survival of all species. **Collaborative Learning:** learners in mixed-ability, all-inclusive groups collect charts, videos, documentaries and photos on the reproductive system of humans and study it, noting the functions of its various parts: learners learn from one another and present their views constructively. Learners become emotionally and psychologically connected. **Initiating Talk for Learning:** where possible, teacher may invite a resource person to give talks on some common diseases and problems of the reproductive system of humans, their causes, symptoms, prevention and treatment: learners acquire enhanced knowledge of the reproductive system and ask	Level 1 Recall **Level 2 Skills of conceptual understanding** Level 3 Strategic reasoning **Level 4 Extended critical thinking and reasoning**

	questions on unclear parts of the lesson, thereby improving on speaking ability: learners are also freed of some beliefs and practices associated with the reproductive system, thereby giving them emotional and psychological boost. **Demonstrative Learning:** use charts/diagrams and photos to explain common reproductive diseases such as gonorrhoea and syphilis, and show how to use contraceptive devices (e.g., condoms, and recommended medications) to control birth. Allow learners to ask questions and to contribute what they have read on the lesson: learners are allowed to express themselves freely; this improves their speaking skills. Learners shed off perceptions about some reproductive diseases as they become better informed. This offers them self-confidence and emotional satisfaction.	
	3.4.1.LI.3	3.4.1.AS.3
	Describe with labelled drawings how the musculoskeletal system in mammal's functions and works together with other systems to ensure healthy living. **Differential Task-Based Learning:** in mixed-ability, all-inclusive groups, learners create an improvised structure of the mammalian skeleton (e.g. humans) and point out the various parts and discuss their importance in group presentation: Differential learning allows each member of the group to perform one task or another, thereby recognising the importance of each member in the group. Learners are also connected emotionally as they seek to achieve set goals in the group. **Creative and Imaginative Learning:** learners in mixed ability groups identify the major parts of the skeletal system and draw the structures, (the skull, vertebrae, the limbs with their girdles and the ribs with the sternum) with annotations on specific functions and adaptive features and discuss the drawings: learners acquire the skills of observation and exactness. Learners acknowledge the skills of peers and learn from them. **Demonstrative Learning:** show how muscles act on bones (e.g., antagonistic movements of biceps and triceps on the limbs) to bring about movements on body parts and prepare a general presentation on the lesson: learners are able to emotionally connect with the lessons through demonstrations.	**Level 1 Recall** **Level 2 Skills of conceptual understanding** **Level 3 Strategic reasoning** **Level 4 Extended critical thinking and reasoning**
	3.4.1.LI.4	3.4.1.AS.4
	Describe how the nervous and hormonal systems in mammals' function and work together with other systems to ensure healthy living. **Individual/Independent -Based Learning:** in mixed-ability, all-inclusive group, learners research from textbooks, the internet, documentary films and other relevant sources about coordination in	**Level 1 Recall** **Level 2 Skills of conceptual understanding** **Level 3 Strategic**

	mammals, noting down major aspects of the nervous and hormonal systems responsible for this process: learners support one another emotionally and psychologically to research on lessons. **Talk for Learning:** learners in mixed-ability groups discuss the functions and interactions of nerves and hormones in coordination: all learners have the opportunity to contribute to discussions to enrich their talking ability and boost their confidence in crowd. **Differential Task-Based Learning Approach:** learners in mixed-ability, all-inclusive groups choose any of the organs of coordination and the sensory organs (e.g. the brain, nerve, ear, eye, etc.) and make diagrams and charts for exhibition and demonstration; learners build confidence in themselves by carrying out complex tasks. Learners support each other emotionally and psychologically and tolerate one another in the group.	**reasoning** **Level 4 Extended critical thinking and reasoning**
Teaching and Learning Resources	• Models of main organ systems of humans • Appropriate textbooks	• LCD/ TV • Posters	• Photos and videos on organ systems of humans.

Subject BIOLOGY
Strand 4. SYSTEMS OF LIFE
Sub-Strand 2. PLANT SYSTEMS

Learning Outcomes	21stCentury Skills and Competencies	GESI, SEL and Shared National Values
3.4.2.LO.1		
Describe reproduction and excretion and relate them to their importance in flowering plants.	**Communication and Collaboration:** • Learners' express methods of reproduction in flowering plants in groups by language communication. • Discussing the importance of reproduction in flowering plants in groups requires effective communication and collaborating with other group members. • Discussing excretion in flowering plants requires groups talking and reasoning among members in a group. **Critical Thinking and Problem-Solving:** • Learners require critical thoughts to explain the various processes involved in the method of reproduction in flowering plants, with emphasis on sexual reproduction. • Learners require tactically deep thoughts to examine the importance of reproduction in plants, with emphasis on sexual reproduction. " • Analysing excretion in flowering plants requires an appreciable level of deep thinking.	**GESI:** • Respect individuals of different beliefs, religions, and cultures. • Embrace diversity and practise inclusion. • Be gender responsive and have the ability to tackle injustice. • Be aware of personal biases and stereotypes. • Be sensitive to the inter-relatedness of the various spheres of life, groups, and individuals. **SEL:** • Learners work together and build self-confidence. • Learners identify and express their opinions and feelings. • Learners acknowledge the importance of self and peer evaluation. **National Core Values:** • Respect for each member of the group • Integrity and honesty. • Selflessness and perseverance. • Time consciousness and commitment to achieving excellence.

Content Standards	Learning Indicators and Pedagogical Exemplars with 21st Century Skills and Competencies, and GESI	Assessment
3.4.2.CS.1	3.4.2.LI.1	3.4.2.AS.1
Demonstrate knowledge and understanding of excretion and reproduction in flowering plants.	**Explain the methods of reproduction in flowering plants with emphasis on sexual reproduction.** **Collaborative Learning Approach:** in mixed-ability, social-inclusive groups, learners research the two main types of reproduction in plants (sexual and asexual with both natural and artificial forms such as vegetative propagation and budding) and take notes on lessons learnt: learners in a group learn from other members and build teamwork confidence. **Experiential Learning Approach:** learners go on a tour in floral gardens around the school compound or an area of choice to study various forms of flowering plants to identify the whorls/floral parts (calyx, corolla, androecium and gynoecium); this offers the learner real-world scenarios, hence first-hand information of lessons. **Initiate Talk for Learning Approach:** in mixed-ability, all-inclusive groups, learners discuss with examples, various adaptations of flowering plants for self-pollination and cross pollination; learners analyse and make annotated diagrams of double fertilisation in flowering plants, types of fruits, and discuss seeds and fruit dispersal: learners learn to accept one another's view and develop tolerance through discussions. **Differential Task-Based Learning:** Learners in their groups set up experiments to investigate the various factors necessary for seed germination and prepare a PowerPoint slide for class presentations and discussions: Laboratory and field experiments offer the learner first-hand experiences to understand lessons better. Learners boost confidence and obtain emotional satisfaction.	**Level 1 Recall** **Level 2 Skills of conceptual understanding** **Level 3 Strategic reasoning** **Level 4 Extended critical thinking and reasoning**
	3.4.2.LI.2	3.4.2.AS.2
	Discuss the importance of reproduction in flowering plants for the sustenance of life. **Individual Project-Based Learning Approach:** each learner is tasked to read and make summary notes on the importance of reproduction in flowering plants: learners build self-confidence and emotional satisfaction when they are to work on an assignment/project independently; learners learn from one another. **Talk for Learning Approach:** in mixed-ability, all-inclusive learner groups, draw and label the diagram of a flowering plant observed on the field, extracting its floral formula with explanations, and	Level 1 Recall Level 2 Skills of conceptual understanding Level 3 Strategic reasoning **Level 4 Extended critical thinking and**

	identifying the male and female reproductive parts (stamens, anther, pollen grains, style, stigma, etc.): learners learn from one another as quick learners support slow learners in their groups, thereby offering emotional boosting. **Differential Task-Based Learning**: learners in mixed-ability all-inclusive groups, create posters and album on different parts of the flower, their location and functions. This introduces creativity in learners and gives them positive outlook of their capabilities. **Collaborative Learning Approach:** in mixed-ability and all-inclusion, groups research from textbooks, journals and tape records how plant reproduction is important to the survival of other forms of life, especially animals. Based on the group research, develop flow charts in the key processes involved in sexual reproduction in flowering plants: learners develop creativity and develop diverse methods of performing the same task, thereby learning from one another and boosting their self-confidence.	**reasoning**
	3.4.2.LI.3	3.4.2.AS.3
	Discuss excretion in flowering plants. **Project-Based/Collaborative and Observational Learning**: take the whole class on an educational trip around the school compound to assess different forms of plants and how they excrete waste materials. Each class member makes personal notes on the project for class group discussions: learners work independently to build confidence and self-assurance; learners learn from one another and offer emotional support. **Talk-for-Learning Approach Discuss:** in their respective mixed-ability groups, learners discuss the importance of some named plant waste products (e.g., resins, latex, gum, carbon dioxide, water, oxygen, etc.) and how they are excreted. Groups discuss why, unlike animals, plants generally lack specialised excretory organs and structures for removing waste materials from their bodies.	**Level 1 Recall** Level 2 Skills of conceptual understanding **Level 3 Strategic reasoning** **Level 4 Extended critical thinking and reasoning**
Teaching and Learning Resources	• Flowers and fruits of the following plants: flamboyant, *crotalaria*/*centrocema*, pride of barbados, • *Tridax* should be provided for practical exercises. • Simulations	• Videos • Posters and photos on reproduction and excretion in flowering plants.