SENIOR SCHOOL CURRICULUM DESIGN

GRADE 10

BIOLOGY

KENYA INSTITUTE OF CURRICULUM DEVELOPMENT
2024

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Nurturing Every Learner's Potential

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NATIONAL GOALS OF EDUCATION

Education in Kenya should:

1. **Foster nationalism and patriotism and promote national unity**

   Kenya's people belong to different communities, races and religions, but these differences need not divide them. They must be able to live and interact as Kenyans. It is a paramount duty of education to help young people acquire this sense of nationhood by removing conflicts and promoting positive attitudes of mutual respect which enable them to live together in harmony and foster patriotism in order to make a positive contribution to the life of the nation.

2. **Promote the social, economic, technological and industrial needs for national development**

   Education should prepare the youth of the country to play an effective and productive role in the life of the nation.

   a) **Social Needs**

      Education in Kenya must prepare children for changes in attitudes and relationships which are necessary for the smooth progress of a rapidly developing modern economy. There is bound to be a silent social revolution following in the wake of rapid modernization. Education should assist our youth to adapt to this change.

   b) **Economic Needs**

      Education in Kenya should produce citizens with the skills, knowledge, expertise and personal qualities that are required to support a growing economy. Kenya is building up a modern and independent economy which is in need of an adequate and relevant domestic workforce.

   c) **Technological and Industrial Needs**

      Education in Kenya should provide learners with the necessary skills and attitudes for industrial development. Kenya recognizes the rapid industrial and technological changes taking place, especially in the developed world. We can only be part of this development if our education system is deliberately focused on the knowledge, skills and attitudes that will prepare our young people for these changing global trends.

3. **Promote individual development and self-fulfilment**

   Education should provide opportunities for the fullest development of individual talents and personality. It should help children to develop their potential interests and abilities. A vital aspect of individual development is the building of character.

4. Promote sound moral and religious values

Education should provide for the development of knowledge, skills and attitudes that will enhance the acquisition of sound moral values and help children to grow up into self-disciplined, self-reliant and integrated citizens.

5. Promote social equity and responsibility

Education should promote social equality and foster a sense of social responsibility within an education system which provides equal educational opportunities for all. It should give all children varied and challenging opportunities for collective activities and corporate social service irrespective of gender, ability or geographical environment.

6. Promote respect for and development of Kenya's rich and varied cultures

Education should instill in the youth of Kenya an understanding of past and present cultures and their valid place in contemporary society. Children should be able to blend the best of traditional values with the changing requirements that must follow rapid development in order to build a stable and modern society.

7. Promote international consciousness and foster positive attitudes towards other nations

Kenya is part of the international community. It is part of the complicated and interdependent network of peoples and nations. Education should therefore lead the youth of the country to accept membership of this international community with all the obligations and responsibilities, rights and benefits that this membership entails.

8. Promote positive attitudes towards good health and environmental protection

Education should inculcate in young people the value of good health in order for them to avoid indulging in activities that will lead to physical or mental ill health. It should foster positive attitudes towards environmental development and conservation. It should lead the youth of Kenya to appreciate the need for a healthy environment.

LEARNING OUTCOMES FOR SENIOR SCHOOL

By the end of senior school, the learner should be able to:

1. communicate effectively and utilize information and communication technology across varied contexts,
2. apply mathematical, logical and critical thinking skills for problem solving,
3. apply basic research and scientific skills to manipulate the environment and solve problems,
4. exploit individual talents for leisure, self-fulfillment, career growth, further education and training,
5. uphold national, moral and religious values and apply them in day-to-day life,
6. apply and promote health care strategies in day-to-day life,
7. protect, preserve and improve the environment for sustainability,
8. demonstrate active local and global citizenship for harmonious co-existence,
9. demonstrate appreciation of diversity in people and cultures,
10. manage pertinent and contemporary issues responsibly.

THE SENIOR SCHOOL IN THE COMPETENCY BASED CURRICULUM (CBC)

Senior School is the forth level of Basic Education in the Competency Based Curriculum (CBC) that learners shall come to after the Pre-Primary, Primary and Junior School (JS). The essence of Senior School is to offer learners a Pre- University/ Pre-career experience where the learners have an opportunity to choose pathways where they have demonstrated interest and/or potential at the earlier levels. Senior school comprises three years of education for learners in the age bracket of **15 to 18 years** and lays the foundation for further education and training at the tertiary level and the world of work. In the CBC vision, learners exiting this level are expected to be ***engaged, empowered and ethical citizens*** ready to participate in the socio-economic development of the nation.

At this level, learners shall take **SEVEN (07) learning areas (LAs)** as recommended by the *Presidential Working Party on Educational Reforms* (PWPER). These shall comprise **Four Compulsory** learning areas, and Three learning areas opted for by the learner according to their choses Pathway. While English and Kiswahili are indicated as Compulsory, the learners who opt for these learning areas as their subjects of specialization shall go through a *differentiated curriculum* in terms of scope, experiences and assessment. Such learners shall; therefore, take *Advanced English* or *Kiswahili Kipevu* with additional two lessons. It is recommended that AT LEAST TWO learning areas should be from chosen Pathway. In exceptional cases, some learners may opt for ONE learning area from the chosen Pathway and a maximum of TWO learning areas from any of the three pathways; depending on the learner's career projections and with guidance by the principals at Senior School.

PROPOSED LIST OF SUBJECTS AT SENIOR SCHOOL

Compulsory Subjects	Science, Technology, Engineering & Mathematics (STEM)	Social Sciences	Arts & Sports Science
1. English 2. Kiswahili/KSL 3. Community Service Learning 4. Physical Education ***NB: ICT skills will be offered to all students to facilitate learning and enjoyment***	5. Mathematics/Advanced Mathematics 6. Biology 7. Chemistry 8. Physics 9. General Science 10. Agriculture 11. Computer Studies 12. Home Science 13. Drawing and Design 14. Aviation Technology 15. Building and Construction 16. Electrical Technology 17. Metal Technology 18. Power Mechanics 19. Wood Technology 20. Media Technology* **21.** Marine and Fisheries Technology*	22. Advanced English 23. Literature in English 24. Indigenous Language 25. Kiswahili Kipevu/Kenya Sign Language 26. Fasihi ya Kiswahili 27. Sign Language 28. Arabic 29. French 30. German 31. Mandarin Chinese 32. History and Citizenship 33. Geography 34. Christian Religious Education/ Islamic Religious Education/Hindu Religious Education 35. Business Studies	36. Sports and Recreation 37. Physical Education (C) 38. Music and Dance 39. Theatre and Film 40. Fine Arts

LESSON DISTRIBUTION AT SENIOR SCHOOL

The number of lessons in each of the compulsory learning areas shall be 4; while the optional areas shall be 6 lessons each. A lesson shall be 40 minutes. The "free" lessons shall be used for development of ICT skills, Pastoral Instruction Programme (PPI), projects, collaborative study and further reading.

ESSENCE STATEMENT

Biology is a branch of Science that deals with the study of life as manifested in life forms such as viruses, bacteria, fungi and complex organisms such as plants and animals. The interrelationships within, among them and with their environments ensure continuity of life. This depends on the working of this broad spectrum of organisms in relation to that of the humans.

The achievement of Vision 2030 greatly depends on Science, Technology and Innovation. For a breakthrough towards industrialisation, achievement of the desired economic growth targets, social and human capital development through education and training should be prioritised (Sessional Paper No.1 of 2005). This can be achieved by promoting the teaching of science and technology. Sessional paper No. 1 of 2019 also underscores the need for sustainable basic and higher education with emphasis on Science, Technology and Innovation (ST&I). This makes it necessary for Biology as a subject to be taught in Senior School as its content is needed for developing technologies that support humans and other life forms.

The Biology content presents basic knowledge for the learner to understand how the human body and other life systems work. The content provided empowers the learners to make informed decisions in promoting positive attitude towards their individual health, community and the environment for sustainable development.

Biology is a foundational subject for careers in Medicine, Agriculture, Marine Science, Anthropology, Environmental Studies and other related fields. The subject also enables learners to build relevant knowledge, skills and attitudes necessary for further education and training in the related careers.

Suggested pedagogical approaches include Inquiry Based Learning, Project Based Learning and Problem Based Learning as advocated by constructivist theory. The theory emphasizes that the learner is given an opportunity to learn through hands-on activities which develop practical life skills.

BIOLOGY GENERAL LEARNING OUTCOMES

By the end of the course the learner should be able to:

1. develop relevant knowledge, skills and attitudes for further education and for training in biology related scientific fields;
2. demonstrate an understanding of interrelationships among humans, other organisms and their environment and apply the knowledge to conserve nature;
3. describe features of various groups of living organisms and identify unknown organisms using simple biological keys;
4. apply the knowledge gained on human body systems and functions to improve the quality of life for self and the community while enhancing healthy living;
5. design and carry out practical activities and projects that will enable them to understand biological concepts;
6. demonstrate relevant technical skills and scientific knowledge necessary for socio-economic development;
7. demonstrate resourcefulness in designing projects necessary for community service learning;
8. communicate biological information in a precise, clear and logical manner;
9. apply knowledge on plant and animal structure and functions to industrialization, innovation and sustainability of life;
10. use knowledge gained to make informed decisions about scientifically-based personal and societal issues to solve emerging issues in health and environment.

SUMMARY OF STRANDS AND SUB STRANDS

Strand/ Sub Strand	Suggested Number of Lessons
1.0 Cell Biology and Biodiversity	
1.1 Introduction to Biology	6
1.2 Scientific investigations in Biology	14
1.3 Cell structure and Specialization	20
1.4 Chemicals of life	24
2.0 Anatomy and Physiology of Plants	
2.1 Nutrition	12
2.2 Transport	22
2.3 Gaseous exchange and Respiration	22
3.0 Anatomy and Physiology of Animals	
3.1 Nutrition	12
3.2 Transport	24
3.3 Gaseous exchange and Respiration	24
Total Number of Lessons	**180**

Note: The suggested number of lessons per Sub Strand may be less or more depending on the content.

STRAND 1.0: CELL BIOLOGY AND BIODIVERSITY

Strand	Sub Strand	Specific Learning Outcomes	Suggested Learning Experiences	Suggested Key Inquiry Questions
1.0 Cell Biology and Biodiversity	**1.1 Introduction to Biology (6 lessons)** • Application of Biology • Fields of study and Careers related to Biology	By the end of the sub strand, the learner should be able to: a) explain the application of Biology in everyday life, b) relate fields of study in Biology to career opportunities, c) Illustrate the careers related to fields of study in Biology, d) appreciate the importance of Biology in everyday life.	Learner is guided to: • search for information on the meaning and application of Biology in everyday life and share with peers, • collaboratively search for information from print and non-print media on fields of study in Biology *(include Botany, Zoology, Taxonomy, Anatomy, Physiology, Ecology, Biochemistry, Biotechnology, Genetics, Parasitology, Microbiology, Entomology)* and relate them to career opportunities, • discuss the factors that influences career choices *(include interest, ability).* Reinforce on those that should not *(gender, culture, disability, environment and stereotypes),*	Why is it important to study Biology?

			• use locally available material to design a career wheel to relate fields of study in Biology to careers and make presentations, • use flash cards, fishing games or other available materials to present information on fields and careers related to Biology, • where possible interact with resource persons whose careers are related to Biology.	

Core competencies to be developed

- Imagination and Creativity: The learner visualizes prospective fields and careers related to Biology using flash cards as well as designing career wheels to illustrate the same.
- Self-efficacy: The learner develops a sense of self-awareness while discussing the factors that influence career choices.

Values

- Respect: The learner appreciates diverse opinions during discussions on the factors that influence career choices.
- Responsibility: The learner searches for information on fields of study in Biology from safe internet sites.

Pertinent and Contemporary Issues (PCIs)

- Environmental Conservation: The learner responsibly uses locally available materials to design a career wheel to relate fields of study in Biology to different careers.
- Safety and Security: The learner searches for information on the meaning and application of Biology in everyday life from safe internet sites.

Strand	Sub Strand	Specific Learning Outcomes	Suggested Learning Experiences	Suggested Key Inquiry Questions
1.0 Cell Biology and Biodiversity	**1.2 Specimen Collection and Preservation** **(14 lessons)** • Apparatus for collecting specimen • Specimens collecting, processing and preserving • **Project** on collecting, processing and preserving biological specimens	By the end of the sub strand, the learner should be able to: a) identify apparatus and materials used for collecting, processing and preserving specimens, b) collect, process and preserve specimens for biological studies using improvised and conventional apparatus, c) appreciate the importance of collecting, processing and preserving specimens in Biology.	Learner is guided to: • in groups search for information on apparatus and materials for collecting specimens, *(such as pooter/aspirator, pitfall trap, soapy water, pair of forceps, sweep net/aerial net, light traps, Tullgren funnel, envelopes for butterflies, labels, pencils or permanent ink pens, tracing paper, hand lens, knife/ pair of secateurs, collecting bags labels, hand gloves, digger),* • improvise apparatus from locally available materials and use them for collecting, processing and preserving specimens, • make a herbarium to preserve specimens *(pressing, drying, mounting, labeling to include*	How are specimens collected and preserved?

			common/local name and locality, storage and protection), • collect small animals using appropriate apparatus *(such as pooter/aspirator, pitfall trap, forceps, sweep net/aerial net, light traps, Tullgren funnel, bait trap),* • search for information on preservatives used in preservation of specimens and discuss with peers, • process and preserve animal specimens *(sorting, mounting on soft boards, ethanol/wet preservation, labeling).* **Project** Carry out a project on collecting, processing and preserving biological specimens *(include discussion on financial literacy*	

			components such as planning, budgeting, specimen collection, recording). Learner keeps a portfolio to document progress of the project and make presentations.	

Core competencies to be developed

- Critical Thinking and Problem Solving: The learner improvises apparatus from locally available material and uses them for collecting, processing and preserving specimens to address the shortage in their school.
- Self-efficacy: The learner gains self-esteem and confidence while successfully collecting, processing and preserving biological specimens.

Values

- Unity: The learner collaborates with peers while searching for information on apparatus and materials for collecting specimens.
- Integrity: The learner enhances honesty while carrying out the project and keeping a portfolio to document the progress of the project.

Pertinent and Contemporary Issues (PCIs)

- Safety and Security: The learner observes safety precautions while collecting, processing and preserving biological specimens.
- Environmental conservation: The learner conserves the environment while collecting specimens.

Strand	Sub Strand	Specific Learning Outcomes	Suggested Learning Experiences	Suggested Key Inquiry Questions
1.0 Cell Biology and Biodiversity	**1.3 Cell Structure and Specialization** **(30 lessons)** • Preparation of slides for observation under a microscope • Estimation of cell size during microscopy • Differences between the light and electron microscope • Cell structure as observed under the electron microscope • Differences between plant and animal cells • Specialized cells in plants and animals *(adaptations to their functions)*	By the end of the sub strand, the learner should be able to: a) differentiate between light and electron microscope as used in the study of cell structure, b) describe the structure and functions of plant and animal cells as observed in an electron microscope, c) prepare temporary slides for observation and estimation of cell size using a light microscope, d) relate the structures of specialized cells in plants and animals to their functions,	Learner is guided to: • search for information sing print and non-print media on structural and functional differences between light and electron microscope, (*include the concept of resolution and magnification*), • carry out experiments on the procedures in preparation of specimen slides for observation on a light microscope, (*sectioning, staining, mounting and fixation*), • prepare temporary slides and use them under light microscope to estimate the cell sizes (*use onion bulbs, kales or young herbaceous stems and leaves; avoid use of human specimen*),	1. Why do plant and animal cells differ? 2. How are cells specialized?

	• Cell organization *(organelles, cells, tissues, organs and organ systems)*	e) appreciate the cell as the basic unit of life.	• use photomicrographs/charts to compare the structure of plant and animal cells as seen under electron microscope, • draw and label the structure of plant and animal cells as seen under electron microscope, share with peers, • model the structure of plant and animal cells as seen under electron microscope, • discuss the on specialized cells in plants and animals, and relate them to their function *(include root hair cells, palisade cells, guard cells, pollen grains; muscle cells, nerve cells, blood cells, reproductive cells)*and share with peers, • observe photomicrographs/ permanent slides of specialized plant and	

			animal cells, draw and label, • discuss levels of organization in an organism *(organelles, cells, tissues, organs and organ systems).*	
Core Competencies to be developed • Communication and Collaboration: The learner cooperates and shares information in groups as they use photomicrographs to compare the structure of plant and animal cells as seen under electron microscope. • Digital Literacy: The learner gains digital literacy while searching for information on structural and functional differences between light and electron microscope.				
Pertinent and Contemporary Issues (PCIs) • Safety and Security: The learner observes safety precautions while modeling the structure of plant and animal cells as seen under electron microscope. • Waste Management: The learner appropriately disposes of the waste materials generated from modeling the structure of plant and animal cells as seen under electron microscope.				
Values • Respect: The learner demonstrates tolerance, respecting peers during the group discussion on the use of photomicrographs to compare the structure of plant and animal cells as seen under electron microscope. • Responsibility: The learner searches for information from appropriate internet sites on the structural and functional differences between light and electron microscope.				

Strand	Sub Strand	Specific Learning Outcomes	Suggested Learning Experiences	Suggested Key Inquiry Questions
1.0 Cell Biology and Biodiversity	**1.4 Chemicals of Life** **(28 lessons)** • Composition, properties and functions of chemical of life *(Carbohydrates, Lipids, Proteins and Vitamins)* • Enzymes *(meaning, factors affecting enzymes activity)* • Functions of water and mineral salts	By the end of the sub strand, the learner should be able to: a) describe the composition, properties and functions of the chemicals of life in organisms, b) investigate the presence of carbohydrates, lipids, proteins and vitamin C in food substances, c) investigate the presence of enzymes in living tissues, d) determine factors affecting enzymatic reactions in cells, e) appreciate the importance of chemical components in cells.	Learner is guide to: • search for information on the composition, properties and functions of the chemical components in cells, and discuss with peers *(carbohydrates, proteins, lipids, enzymes, vitamins, water and mineral salts)* and share. Exclude chemical structure for all; omit composition for enzymes, vitamins and mineral salts, • carry out experiments to test for the presence of carbohydrates, lipids, proteins and vitamin C in food substances *(include locally available food substances)*, • carry out experiments to investigate the presence of catalase enzymes in living tissues, • carry out experiments to determine factors affecting enzymatic activities and discuss with peers	1. How are chemicals important in cells? 2. How is the presence of chemicals of life determined?

			(pH, temperature, substrate and enzyme concentration), • examine packaging labels of common food products, appreciate the quality, quantity, and safety of the chemical components indicated *(preservatives, colourings and expiry).*	

Core competencies to be developed

- Critical thinking and Problem Solving: The learner analyzes and makes inferences while carrying out food tests on the various food Suggested s.
- Learning to Learn: The learner examines packaging labels of common food products, appreciates the quality, quantity and safety of the chemical components indicated.

Pertinent and Contemporary Issues (PCIs)

- Safety and Security: The learner observes safety precautions while carrying out experiments on chemicals of life.
- Life Skills: The learner makes preferential decisions about purchasing various food products after examining packaging labels of common food products.

Values

- Love: The learner shares resources and ideas with others while carrying out experiments to determine factors affecting enzymatic activities.
- Unity: The learner collaborates with others while carrying out experiments to investigate the presence of catalase enzymes in living tissues.

Suggested Assessment Rubric

Indicator	Exceeds Expectations	Meets Expectations	Approaches Expectations	Below Expectations
Ability to relate fields of study in Biology to career opportunities	Correctly and precisely relates all fields of study in Biology to the respective career opportunities	Correctly relates all fields of study in Biology to career opportunities	Relates most fields of study in Biology to career opportunities	Relates a few fields of study in Biology to career opportunities
Ability to collect, process and preserve specimens for biological studies using improvised and conventional apparatus	Procedurally collects, sorts, processes and preserves specimens for biological studies using improvised and conventional apparatus	Procedurally collects, processes and preserves specimens for biological studies using improvised and conventional apparatus	Collects, processes and preserves specimens for biological studies using conventional apparatus only	Collects and processes but fails to preserve specimens for biological studies
Ability to describe the structure and functions of plant and animal cells as seen under electron microscope	Coherently describes the structure and functions of plant and animal cells as seen under electron microscope	Describes the structure and functions of plant and animal cells as seen under electron microscope	Partly describes the structure and functions of plant and animal cells as seen under electron microscope	Incoherently describes the structure and functions of plant and animal cells as seen under electron microscope
Ability to describe the composition, properties and functions of the chemicals of life	Correctly describes the composition, properties and functions of all chemicals of life with appropriate illustrations	Correctly describes the composition, properties and functions of all chemicals of life	describes the composition, properties and functions of most of the chemicals of life	describes the composition, properties and functions of a few of the chemicals of life

STRAND 2.0: ANATOMY AND PHYSIOLOGY OF PLANTS

Strand	Sub Strand	Specific Learning Outcomes	Suggested Learning Experiences	Suggested Key Inquiry Questions
2.0 Anatomy and Physiology of Plants	**2.1 Nutrition** **(12 lessons)** • Types of nutrition in plants *(Autotrophic and Heterotrophic - parasitic, saprophytic, symbiotic and insectivorous modes in plants)* • Structure of chloroplast • Process of photosynthesis	By the end of the sub strand, the learner should be able to: a) describe types of nutrition in plants, b) relate the structure of the chloroplast to its function in plant cells, c) illustrate the light and dark stages of photosynthesis in plants, d) appreciate the significance of photosynthesis in nature.	Learner is guided to: • search for information on different types of nutrition in plants and share with peers, • discuss the structure of chloroplast in relation to its function, • watch animations/video clips on the process of photosynthesis and discuss, • in groups use illustrations to show reactions during the light and dark stages of photosynthesis *(flow charts, animations, equations)*,	How do plants obtain food?
Core competencies to be developed • Self-Efficacy: The learner performs assigned tasks while using illustrations to show reactions of the light and dark stages of photosynthesis. • Digital literacy: The learner manipulates digital devices as they search for information and watch animations on the process of photosynthesis.				

Value

- Unity: The learner cooperates with peers during the searching of information and group discussions on the process of photosynthesis.
- Respect: The learner displays patience while listening to peers during the discussion on the structure of chloroplast in relation to its function.

Pertinent and Contemporary Issues

- Environmental Conservation: The learner appreciates the need to conserve the environment while watching animations/video clips on the process of photosynthesis.
- Safety and Security: The learner responsibly uses the internet while searching for information on different types of nutrition in plants.

Strand	Sub Strand	Specific Learning Outcomes	Suggested Learning Experiences	Suggested Key Inquiry Questions
2.0 Anatomy and Physiology of Plants	**2.2 Transport (18 lessons)** • Transport system in plants *(structure, functions and adaptations of roots, stems, leaves and vascular tissues in relation to transport)* • Vascular tissues in monocots and dicots • Uptake of water and mineral salt • Transpiration • Mechanism of translocation in plants	By the end of the sub-strand, the learner should be able to: a) relate structures of the plant transport system to their functions in plants, b) illustrate the arrangement of vascular tissues in monocotyledonous and dicotyledonous plants, c) demonstrate the uptake of water and mineral salts from the roots to the leaves, d) demonstrate factors that affect the rate of transpiration in plants, e) describe the translocation of manufactured food in plants,	Learner is guided to: • discuss the structures of external parts of a plant in relation to functions (roots, stems and leaves), • use a microscope/hand lens to observe and draw cross-sections of monocotyledonous and dicotyledonous roots and stems; identify the similarities and differences, • search for information on mechanisms of water and mineral salt uptake in plants and discuss with peers *(include: root pressure, capillarity, transpiration pull)*, • carry out experiments to demonstrate uptake of water in plants using locally available materials *(such as transparent bags, dye/ink experiment)* and report findings to peers *(where*	How are materials transported in plants?

		f) appreciate the significance of transport in plants.	*possible, observe exudation, guttation, and root pressure),* • use digital devices to search for animations on uptake of water and mineral salts and translocation of manufactured food from the leaves; share with peers, • search for information from available resources on structural and environmental factors that affect the rate of transpiration and share with peers, • carry out experiments to demonstrate factors that affect the rate of transpiration *(use locally available materials like improvised fan, transparent polythene bags, light/heat bulbs),* • carry out a bark ringing/girdling experiment to demonstrate evidence of translocation *(to be done*	

			responsibly at home or school).	

Core competencies to be developed:

- Critical Thinking and Problem Solving: The learner objectively analyses results of the bark ringing/girdling experiment to demonstrate evidence of translocation.
- Imagination and Creativity: The learner seeks clarification from others while carrying out the experiment to demonstrate the mechanisms of water and mineral salt uptake.

Pertinent and Contemporary Issues (PCIs)

- Environmental Conservation: The learner responsibly bark-rings or girdles trees to observe translocation.
- Safety and Security: The learner observes safety precautions while taking nature walks and making observations on the differences between monocotyledonous and dicotyledonous plants.

Values

- Responsibility: The learner takes care of trees during the bark ringing/girdling experiment to observe translocation in plants.
- Integrity: The learner displays honesty and truthfulness while reporting their findings on the mechanism of translocation of manufactured food from the leaves.

Strand	Sub Strand	Specific Learning Outcomes	Suggested Learning Experiences	Suggested Key Inquiry Questions
2.0 Anatomy and Physiology of Plants	**2.3 Gaseous Exchange and Respiration** **(22 lessons)** • Structure, adaptations and functions of gaseous exchange sites *(include aquatic and terrestrial plants)* • Mechanism of opening and closing of the stomata • Types of respiration *(Aerobic and anaerobic)*	By the end of the sub strand, the learner should be able to: a) relate the structure of gaseous exchange sites in plants to their function, b) describe the mechanism of opening and closing of stomata in plants, c) investigate aerobic and anaerobic respiration in living organisms, d) explain the economic importance of anaerobic respiration in nature, e) appreciate the significance of gaseous exchange and respiration to	Learner is guide to: • search for information on the meaning of gaseous exchange and its significance to plants and the environment; discuss with peers, • collect fresh leaves, stems and roots of plants or use photomicrographs to observe sites of gaseous exchange (cuticle, lenticel, stomata, and pneumatophores); share with peers, • discuss the adaptations of gaseous exchange sites in plants to their to function *(include aquatic and terrestrial environment)*, • search for information on mechanism of opening and closing of the stomata; discuss with peers *(include photosynthetic theory, starch -*	1. Why is gaseous exchange important to plants? 2. How is respiration useful to plants?

	• Applications of anaerobic respiration	plants and the environment.	*sugar interconversion theory and potassium ions theory),* • where possible, use digital devices to search for animations showing the mechanism of opening and closing of stomata and discuss with peer, • carry out experiments to compare the number, size and distribution of stomata on surfaces of leaves from different habitats, • search for information on the process of respiration and share with peers, • carry out experiments to distinguish aerobic and anaerobic respiration, • discuss the economic importance of anaerobic respiration and share with peers. **Project:** Carry out a project on fermentation using locally available materials	

			(biogas production, porridge, silage, liquid manure or baking).	

Core Competencies to be developed:

- Communication and Collaboration: The learner cooperates with others while discussing theories explaining the mechanism of opening and closing of stomata.
- Learning to Learn: The learner applies the information acquired on the economic importance of anaerobic respiration to carry out the project.

Pertinent and Contemporary Issues (PCIs)

- Waste Management: The learner disposes waste products from the experiments responsibly.
- Financial Literacy: The learner applies knowledge from anaerobic respiration to make fermentation products for sale.

Values

- Responsibility: The learner appropriately disposes of the products of fermentation .
- Social justice: The learner ensures equity, equality and gender balance in distribution of learning resources during group activities.

Suggested Assessment Rubrics

Indicator	Exceeds Expectations	Meets Expectations	Approaches Expectations	Below Expectations
Ability to illustrate the light and dark stages of photosynthesis	Accurately illustrates the light and dark stages of photosynthesis	Illustrates the light and dark stages of photosynthesis	Partly illustrates the light and dark stages of photosynthesis	Partly illustrates the light and dark stages of photosynthesis with prompts
Ability to relate the structures of the plant transport system to their functions	Comprehensively relates the structures of the plant transport system to their functions	Relates the structures of the plant transport system to their functions	Relates some structures of the plant transport system to their functions	Relates some structures of the plant transport system to their functions with difficulty
Ability to describe the mechanism of opening and closing of stomata in plants	Comprehensively describes the mechanism of opening and closing of stomata in plants	Correctly describes all the mechanism of opening and closing of stomata in plants	Partially describes the mechanism of opening and closing of stomata in plants	Partially describes the mechanism of opening and closing of stomata in plants with prompts
Ability to describe the economic importance of anaerobic respiration	Correctly describes the economic importance of anaerobic respiration citing examples	Correctly describes the economic importance of anaerobic respiration	Describes some of the economic importance of anaerobic respiration	Describes some of the economic importance of anaerobic respiration with difficulty

STRAND 3.0: ANATOMY AND PHYSIOLOGY OF ANIMALS

Strand	Sub Strand	Specific Learning Outcomes	Suggested Learning Experiences	Suggested Key Inquiry Questions
3.0 Anatomy and Physiology of Animals	**3.1 Nutrition** **(12 lessons)** • Mouth parts of insects *(Adaptations to feeding modes)* • Beaks of birds *(Adaptations to feeding and their functions*	Specific learning outcomes By the end of the sub strand learner should be able to: a) relate the structure of mouthparts of insects to their functions, b) illustrate mouthparts in different insects, c) relate the structure of beaks of birds to their functions, d) appreciate diversity in feeding modes of insects and birds.	Learner is guided to: • collect fresh specimens of locust/grasshopper/cockroach. Observe the mouthparts using a hand lens or dissecting microscope, discuss with peers and draw, • search for information on mouthparts of locust/ grasshopper/ cockroach (biting and chewing), mosquito (piercing and sucking), butterfly/moth (siphoning), tsetse fly (cutting) and share with peers, • watch animations/videos; study illustrations and photographs/photomicrographs of mouthparts of different insects and discuss how the mouthparts are related to the mode of feeding, • in groups observe images/animations/charts of beaks of birds showing different modes of feeding (include grains/seeds,	How do insects and birds feed?

			nectar, fish, flesh, filter feeders, multipurpose, wood chippers, insect eaters, fruit eaters). Discuss how the beaks are adapted to the mode of feeding, • undertake a nature walk to observe different birds and their feeding habits. Write a short report on the observed birds.	

Core Competencies to be developed:

- Communication and collaboration: The learner cooperates with others while collecting fresh specimens of insects to observe their mouthparts.
- Digital literacy: The learner uses digital devices to access and watch animations/videos on mouth parts of different insects and beaks of birds.

Pertinent and Contemporary Issues (PCIs)

- Environmental conservation: The learner conserves biodiversity by collecting only the required number of insect specimens.
- Safety and security: The learner observes safety precautions while undertaking nature walk to observe different birds and their feeding habits.

Values

- Responsibility: The learner diligently observes safety precautions as they collect fresh specimens of insects to observe their mouthparts.
- Social justice: The learner promotes equity, equality and gender consideration in distribution of learning resources as well as assigning responsibilities during group activities.

Strand	Sub Strand	Specific Learning outcomes	Suggested Learning Experiences	Suggested Key Inquiry Questions
3.0 Anatomy and Physiology of Animals	**3.2 Transport** **(14 lessons)** • Significance of transport in animals • Transport systems in insects, fish, amphibians, reptiles and mammals • Types of circulatory systems in animals • Pumping mechanism of the mammalian heart • Human lymphatic and immune systems • Blood clotting mechanism in humans.	By the end of the sub strand the learner should be able to: a) explain the importance of transport in animals, b) illustrate structure of the transport systems in insects, fish, amphibians, reptiles and mammals, c) describe the pumping mechanism of the mammalian heart, d) describe the human lymphatic and immune systems, and blood clotting mechanism, e) explain the ABO and rhesus factor blood grouping systems in humans, f) appreciate the diversity of transport systems in animals.	Learner is guided to: • search and discuss information on the meaning and importance of transport systems in animals, • search and discuss information on the structures of transport in insects, fish and amphibians, reptiles and mammals, • search for information from available sources and resources on different transport systems in animals (open and closed, single and double circulatory systems), iIllustrate the systems and share, • study illustrations/ photographs and where	1. Why is transport important in animals? 2. How do transport systems in animals differ?

	• **ABO** and Rhesus factor blood grouping systems in humans		possible watch animations illustrating transport systems in fish, insects, amphibians, reptiles and mammals, • make drawings illustrating the transport system in fish, insects and amphibians and peer-assess each other's work, • watch animations illustrating the human lymphatic system and the pumping mechanism of a mammalian heart, • dissect a small mammal to observe and draw parts of the transport system. .watch animations illustrating the mechanism of blood clotting, • prepare charts illustrating blood donor-recipient compatibility, • visit a health facility and discuss the ABO and	

			rhesus blood grouping with a resource person.	

Core Competencies to be developed:

- Critical thinking and problem solving: The learner analyzes the compatibility of blood donor and recipient for safe transfusion of blood.
- Self-efficacy: The learner exhibits confidence and self-esteem during dissection of a small mammal to examine the transport system.

Pertinent and Contemporary Issues (PCIs)

- Animal welfare: The learner handles animals humanely during dissection of animals.
- Life skills: The learner applies peaceful conflict resolution skills while managing dynamics in their groups during the practical activities.

Values

- Love: The learner respects others while searching and discussing information on the transport system of mammals.
- Peace: The learner displays tolerance towards other group members while carrying out the dissection of mammals.

Strand	Sub strand	Specific Learning outcomes	Suggested Learning Experiences	Suggested Key Inquiry Questions
3.0 Anatomy and Physiology of Animals	3.3 G**aseous Exchange and Respiration** **(24 lessons)** • Respiratory surfaces in animals • Aerobic and anaerobic respiration • Oxygen debt • Factors affecting energy requirement • Respiratory substrates and determination of the respiratory quotient	By the end of the sub-strand the learner should be able to: a) explain the general characteristics of respiratory surfaces in animals, b) describe the structure and adaptations of respiratory structures in animals, c) describe the mechanism of gaseous exchange in humans, d) describe the process of aerobic and anaerobic respiration, e) calculate the respiratory quotient for different foods,	Learner is guide to: • search and discuss information on characteristics of the respiratory surfaces of animals, • observe and discuss images /photomicrographs of structure and adaptations of respiratory surfaces of animals (insects-tracheal system, respiratory siphons and tracheal gills), fish (gills), amphibians (lungs, buccal cavity and skin), birds (lungs) and mammals (lungs), • collect locusts/ /grasshoppers from the local environment /or use photographs/illustrations and make observations of gaseous exchange structures (spiracles) and draw. Discuss the adaptations of gaseous exchange sites and structures to their habitat, • use fresh specimen /preserved /video/ animations/charts to observe gaseous exchange structures in bony	1. How does gaseous exchange occur in animals? 2. Why is respiration important to animals?

	• Investigating factors affecting the rate of respiration • **Project:** • Construction of models to demonstrate the process of gaseous exchange	f) appreciate the importance of gaseous exchange and respiration in animals.	fish, make labeled drawings and present, • dissect a small mammal, observe and draw the gaseous exchange structures, • make models to demonstrate inhalation and exhalation in humans, • carry out experiments on aerobic and anaerobic respiration, • engage in a physical activity and check their breathing rate, • search for information on factors affecting energy requirements in humans and calculate respiratory quotient for various foods with peers.	
Core Competencies to be developed: • Communication and collaboration: The learner listens keenly to group members and speaks clearly to share information during group activities. • Learning to learn: The learner develops relationships while sharing information with group members.				
Pertinent and Contemporary Issues (PCIs) • Social awareness skills: The learner communicates effectively to peers while working in groups. • Animal welfare: The learner handles the animals humanely during the practical and project activities.				
Values • Respect: The learner is considerate of others opinions while working together in groups discussing the adaptations of respiratory sites and structures.				

- Responsibility: The learner engages in assigned roles and duties within groups as they search for information on adaptations of respiratory sites.

Suggested Assessment Rubric

Indicator	**Exceeds Expectations**	**Meets Expectations**	**Approaches Expectations**	**Below Expectations**
Ability to relate the structure of mouthparts of insects to their functions	Correctly relates, providing illustrations of structure of mouthparts of insects to their functions	Correctly relates all the structures of mouthparts of insects to their functions	Relates some structures of mouthparts of insects to their functions	Relates some structures of mouthparts of insects to their functions with difficulty
Ability to describe the pumping mechanism of the mammalian heart	Comprehensively describes the pumping mechanism of the mammalian heart	Describes the pumping mechanism of the mammalian heart	Partially describes the pumping mechanism of the mammalian heart	Partially describes the pumping mechanism of the mammalian heart with prompts
Ability to describe the structure and adaptations of respiratory structures in animals	Distinctively describes the structure and adaptations of respiratory structures in animals	Accurately describes the structure and adaptations of respiratory structures in animals	Describes the structure and adaptations of respiratory structures in animals but leaves out some details	Describes the structure and adaptations of respiratory structures in animals but leaves many details
Ability to describe the process of aerobic and anaerobic respiration	Comprehensively describes the process of aerobic and anaerobic respiration using illustrations	Describes the process of aerobic and anaerobic respiration	Partially describes the process of aerobic and anaerobic respiration	Partially describes the process of aerobic and anaerobic respiration with prompts

APPENDIX: SUGGESTED ASSESSMENT METHODS, LEARNING RESOURCES AND NON FORMAL ACTIVITIES

Assessment Methods in Science	Learning Resources	Non-Formal Activities
• Reflections • Game Playing • Pre-Post Testing • Model Making • Explorations • Experiments • Investigations • Conventions, Conferences and Debates • Teacher Observations • Project • Journals • Portfolio • Oral or Aural Questions • Learner's Profile • Written Tests • Anecdotal Records	• Laboratory Apparatus and Equipment • Textbooks • Models • Digital media (Radio and TV education programmes, Kenya education cloud and OERs) • Print media (charts, pictures, journals, magazines) • Digital Devices • Software • Recordings • Resource persons	• Visit the science historical sites. • Use digital devices to conduct scientific research. • Organising walks to have live learning experiences. • Developing simple guidelines on how to identify and solve some community problems. • Conducting science document analysis. • Participating in talks by resource persons on science concepts. • Participating in science clubs and so cieties. • Attending and Participating in Science and Engineering fairs. • Organising and participating in exchange programs. • Making oral presentations and demonstrations on science issues.

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