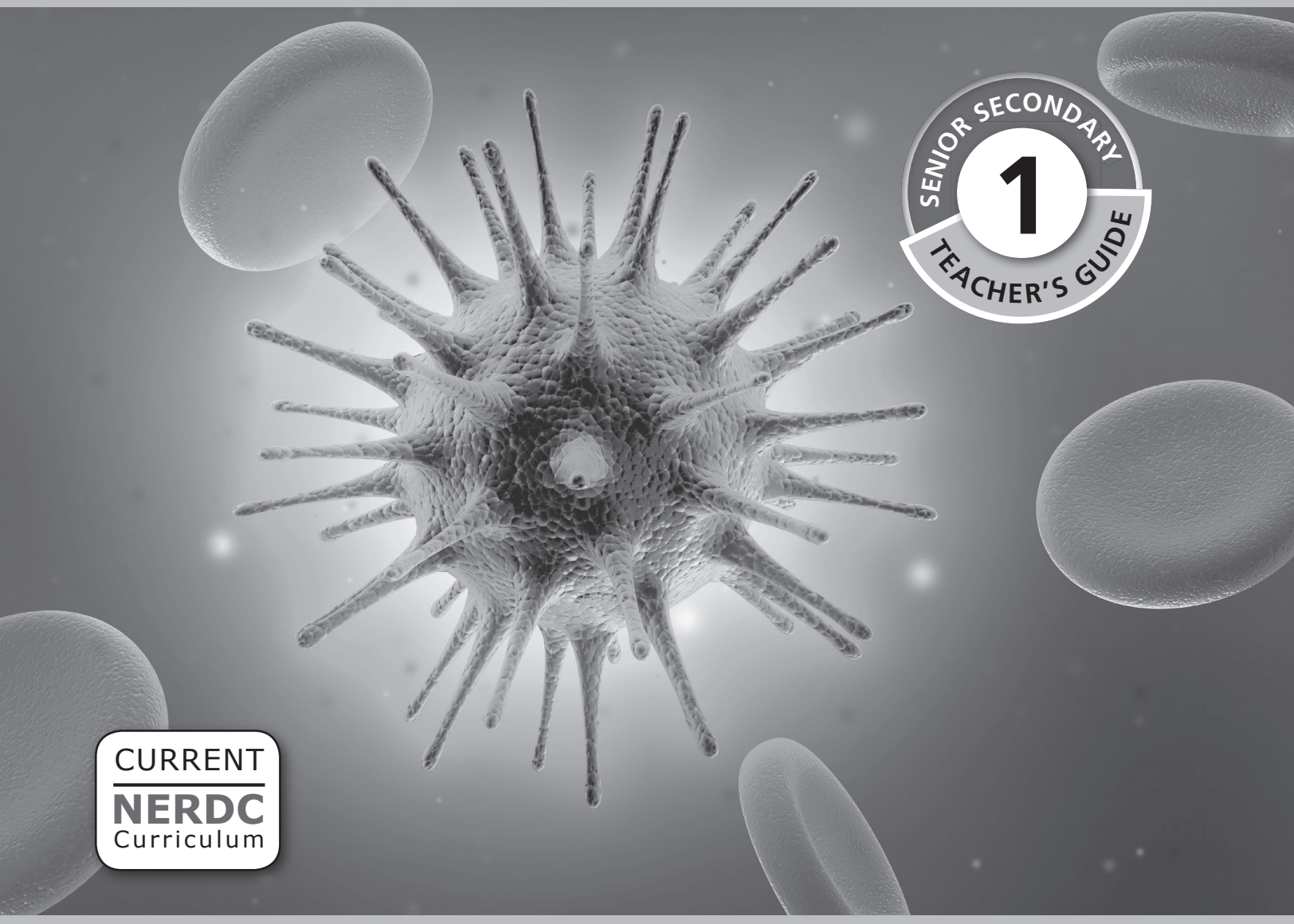
Excellence in Biology



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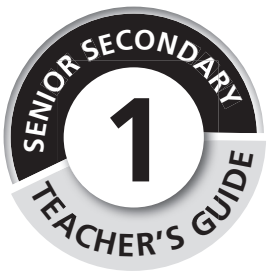

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Contents

Introduction

The purpose of the curriculum

The main objectives of the curriculum are to prepare the students to acquire:

- adequate laboratory and field skills in biology
- meaningful and relevant knowledge in Biology
- ability to apply scientific knowledge to everyday life matters
- reasonable and functional scientific attitude.

The goals

The goals of the curriculum place emphasis on:

- field studies
- guided discovery
- laboratory techniques
- skills along with conceptual thinking.

Time allocation

To cover this curriculum, the recommended weekly time allocation is 3 periods of 40 minutes each. Students need to do regular revision at home in order to cope with the content and new terminology.

The role of the teacher

One of the principle duties of a Biology teacher is to prepare and present good lessons to his or her students. The teacher has to:

- be as well informed as possible on the scheme of work of the subject
- know the aims and objective of each topic
- select appropriate content materials
- decide on the best methods of presentation such as PowerPoint, workstations, videos, discussion groups, worksheets, question-answer sessions, debate, and experiments
- gather equipment and other resources required for the activities
- keep informed about environmental issues and other current biological news in Nigeria and the rest of the world
- arrange outings and guest speakers from time to time.

To be effective in presentation, the teacher must do a written/typed plan for each lesson. This must include aims, objectives, resources, time frames, content for the lesson, activities, homework, assessment, and ideas/additional worksheets to cater for students requiring extension or learning support (remedial).

Teachers must prepare each topic in advance. Many teachers go into the classroom inadequately prepared. It is your responsibility as a Biology teacher to actively involve your students in the learning process. It is a proven fact that students learn far more by *doing* than by *listening*.

You should apply the scientific method wherever possible in the course. Science involves being curious and asking questions. Wherever possible, ask questions to engage the students and to encourage independent thought processes. Start your lessons by asking the students to write down answers to questions related to your lesson (approximately 5). This will settle them into the lesson. You can use different types of questions in your lessons:

- **diagnostic**, enabling you to determine prior knowledge on the topic
- for **consolidation** of challenging concepts during the lesson
- for **stimulation** of interest in the subject
- for **concluding** the lesson. This will assist you to find out whether students have understood the concepts/terminology in the lesson. It will also highlight any areas that they need to revise at home or for you to revisit in the next lesson.

Teachers must ensure that they do not appear to have favourites in the class, so devise a system to ensure that you ask questions fairly, but be careful not to embarrass weak students if they cannot answer questions.

How to use the book

The purpose of this Teacher's Guide is to assist you so that you may be more thoroughly prepared and your teaching will be more meaningful to your students. This book supports a hands-on approach and the concepts will be extended in SS2 and SS3.

You need to be familiar with the key features of the book. The book is divided into 30 topics. Each topic is structured in the following way:

- performance objectives required by the curriculum
- content required by the curriculum
- activities to be completed individually, with a partner or in groups
- summary of the topic
- key words – this is essential vocabulary for the topic
- revision questions.

How to use the scheme of work

A scheme of work is defined as the part of the curriculum that a teacher will be required to teach in any particular subject. Its primary function is to provide an outline of the subject matter and its content, and to indicate how much work a student should cover in any particular class. A scheme of work allows teachers to clarify their thinking about a subject, and to plan and develop particular curriculum experiences that they believe may require more time and attention when preparing lessons. The criteria all teachers should bear in mind when planning a scheme of work are continuity in learning and progression of experience. You can add your own notes to the scheme of work provided on pages vii–xviii.

The scheme of work is sequential. The sequence of the scheme of work is aligned with the textbook. Do not be tempted to jump around. Rather spend time carefully planning the term to ensure that you adhere to the scheme of work.

The curriculum needs to be completed in 3 terms. There are 10 topics in Term 1, 10 topics in Term 2 and 10 topics in Term 3. The end of term allows time for revision and an examination. This time frame may vary depending on the planning of your particular school.

The Content column (far right-hand column) gives the number of suggested lessons for each topic. This has been divided according to the content of the topic.

You should have some form of revision at the end of a topic. If you do not have time this can involve something for students to complete at home. Examples of ideas for the end of a topic include: a revision worksheet, a test, a game or a quiz. Students can also do their own revision by making mind maps, concept maps or other types of summaries. They can also set tests for each other.

It is important to note that the scheme of work provides a suggested number of lessons for the topic. This will vary according to the ability of the students in your class and their prior knowledge. If you lag behind, you will have to look for more efficient teaching methods or give a little more homework in some sections.

Your management of the class will have an enormous influence on your ability to adhere to the time frames. Focus on effective discipline strategies. You will have less discipline issues if you are: punctual, well prepared, follow a plan (write this on the board at the start of the lesson), keep your word (don't make empty threats), consistently adhere to rules, especially rules related to laboratory safety, and strive to make Biology an exciting subject. So try your best to be well-prepared and enthusiastic.

A teacher of Biology is a professional instructor who facilitates, promotes and influences students to achieve the outcomes of the scheme of work. It is the wish of the authors that the students will, at the end of each course in the series (SS1, SS2 and SS3) attain a level of Biology proficiency that will equip them for future studies in this field.

Scheme of work

Term	Week	Theme	Topic	Performance objectives (Students should be able to:)	Content/Suggested number of lessons
Term 1	1	Organisation of life	1. An introduction to Biology pp.1–6	• Define and relate Biology to Science. • Give an account of the scientific approach. • State the application of Biology.	1. The importance of Science and the scientific approach 2. What is Biology and Biology careers 3. Activity 1.1 and revision
	2		2. Recognising living things pp.7–18	• State the characteristics of living things. • Give examples of the levels of organisation of life. State the complexity of organisation in higher organisms. • Describe the various levels of organisation of life. • State the advantages and disadvantages of complexity in higher organisms. • Describe the various parts and functions of the microscope.	1. Activity 2.1. Characteristics of living things. Activity 2.2. Differences between plants and animals. Activity 2.3. 2. Levels of organisation: cells → tissues → organs → systems → organisms. Activity 2.4. Advantages and disadvantages of complexity. Activity 2.5. 3. Microscope. Activity 2.6 and Revision.
	3		3. The classification of living things pp.19–28	• State the characteristic features of the kingdoms and give specific examples of representative organisms.	1. Introduction to classification and taxonomy. Five kingdoms. Prokaryotes and Eukaryotes. Bacteria. 2. Protists, plants and fungi. Activity 3.1. 3. Animal kingdom. Activity 3.2 and Revision.
	4		4. The cell as the basic unit of life pp.29–40	• Recognise single-celled organisms. • Distinguish between free-living cells and colonies, filaments and tissues. • Describe the general structure of a cell. • Differentiate between a plant and an animal cell. • Explain cell theory.	1. Introduction to cells. Unicellular organisms. Cells as colonies. Cells as tissues. Activity 4.1. 2. Prokaryotic and eukaryotic cells. Cell theory. Activity 4.2. 3. Structure of cells. Activities 4.3, 4.4 and Revision.
	5		5. The cell and its environment pp.41–46	• Demonstrate diffusion and osmosis experimentally. • Recognise that osmosis is a form of diffusion • Recognise that plasmolysis can lead to wilting and haemolysis can lead to loss of blood.	1. Diffusion: definition and significance. Activity 5.1. 2. Osmosis: definition and significance. Activity 5.2. 3. Plasmolysis and turgidity. Haemolysis. Revision.

Term	Week	Theme	Topic	Performance objectives (Students should be able to:)	Content/Suggested number of lessons
Term 1	6	Organisation of life	6. Properties and functions of the cell – nutrition and respiration pp.47–55	• Recognise that some nutrients (micronutrients) are needed in small quantities while others (macronutrients) are needed in large quantities. • Recognise that cells require proteins, fats and carbohydrates for the production of new protoplasm, for repair, growth, and the provision of energy. • Define cellular respiration and describe the processes that are involved in cellular respiration. • Discuss the importance of the Krebs cycle. • Explain how cellular respiration results in energy release. • Define anaerobic respiration. • Show experimentally that the break-down of carbohydrates may be partial (fermentation) or complete. • Show how fermentation is used in industry and everyday life.	1. Nutrients. Activity 6.1. Cellular respiration, aerobic respiration and the Krebs cycle. 2. Aerobic respiration. Activities 6.2, 6.3 and 6.4. 3. Anaerobic respiration. Activities 6.5, 6.6, 6.7, 6.8. Differences between aerobic and anaerobic respiration. Revision. Note: The students can do some of the activities in this topic at home.
	7		7. Properties and functions of the cell – autrophy, enzymes and excretion pp.56–65	• Recognise that certain cells are autotrophic and others are heterotrophic. • Define what photosynthesis is. • Explain the process of photosynthesis. • Explain the importance of photosynthesis. • Carry out experiments in photosynthesis. • Discuss the role of enzymes in digestion. • Understand that excretion is the removal of metabolic waste from the cell, which may be toxic or in excess of the cell's needs.	1. Autotrophic and heterotrophic cells. Photosynthesis. Activities 7.1 and 7.2. 2. Factors affecting photosynthesis. Activities 7.3–7.6. 3. Chemosynthesis, enzymes and excretion. Revision. Note: The students can do some of the activities in this topic at home.

Term	Week	Theme	Topic	Performance objectives (Students should be able to:)	Content/Suggested number of lessons
Term 1	8	Organisation of life	8. Growth and movement pp.66–75	• Identify growth. • Describe the processes of mitosis, cell division, cell enlargement and cell differentiation. • Explain how apical and axillary growth takes place. • Explain how hormone growth in plants is regulated. • Demonstrate by experiment factors that affect growth. • Explain the ability of the cell to detect and respond to external stimuli. • Identify structural adaptations for mobility such as cilia and flagella.	1. Introduction to growth. Mitosis. Activities 8.1 and 8.2. 2. Primary and secondary growth. Plant hormones. Activities 8.3 and 8.4. 3. Movement and irritability. Activity 8.5 and Revision Note: The students can do some of the activities in this topic at home.
	9		9. Reproduction pp.76–82	• Recognise reproduction as the ability of living things to produce new individuals of their type. • List the different types of reproduction. • List the forms of asexual reproduction. • Describe natural and artificial vegetative propagation. Discuss the process of conjugation and its role in sexual reproduction in unicellular organisms. • Describe the fusion of male and female gametes and the importance of meiosis in sexual reproduction.	1. Introduction to reproduction. Asexual reproduction. Activities 9.1 and 9.2. 2. Vegetative propagation. Conjugation. 3. Sexual reproduction. Revision.
	10		10. Nutrient cycling in nature pp.83–86	• Define the carbon and oxygen cycles. • Explain the process of cycling in these two cycles. Explain the importance of the carbon and oxygen cycles. • Explain the carbon-oxygen balance. • Define the water cycle. • Explain the process of cycling in the water cycle. • Explain the importance of water to plants. • Explain the importance of water to animals.	1. Importance of nutrient and water cycling. The oxygen cycle. 2. The carbon cycle. Activity 10.1. 3. The water cycle. Activity 10.2 and Revision.

Term	Week	Theme	Topic	Performance objectives (Students should be able to:)	Content/Suggested number of lessons
	11		Revision/ Examinations		
Term 2	1	The organism at work	11. Tissues and supporting systems pp.87–98	• Define the concept of a skeleton. • Recognise different skeletal and supporting tissues. • State the location and arrangement of skeletal and supporting tissues in animals. • State the functions of the skeleton and supporting tissues in animals. • Describe the components and functions of the mammalian skeleton. • Describe the functions of joints and muscles.	1. Types of skeleton. Functions of the vertebrate skeleton. Skeletal materials. Activity 11.1. 2. Mammalian skeleton. Activity 11.2. 3. Joints and muscles. Activity 11.3. Revision.
	2		12. Supporting tissues in plants pp.99–103	• State the different types of supporting tissue in plants and the arrangement of these supporting tissues. Describe the structure and function of parenchyma, collenchyma and sclerenchyma and secondary xylem as supporting tissues. • State the functions of supporting tissues in plants and how these functions are performed. • Describe the basic structure of the roots and stems of herbaceous plants.	1. Types of supporting tissues in plants. 2. Structure and function of plant supporting tissues. 3. Difference between dicots and monocots. Activity 12.1 and Revision.
	3		13. Nutrition in animals pp.104–112	• Define what food substances are. • List types of food substances. • Discuss the importance of and what makes up a balanced diet. • Name the digestive enzymes and their characteristics, classes and functions.	1. Fats. Activity 13.1. Proteins. Activities 13.2 and 13.3. 2. Carbohydrates. Activities 13.4, 13.5 and 13.6. Minerals and vitamins. 3. Balanced diet. Enzymes. Activities 13.8, 13.9 and 13.10. Revision. Note: The students can do some of the activities in this topic at home.

Term	Week	Theme	Topic	Performance objectives (Students should be able to:)	Content/Suggested number of lessons
Term 2	4	The organism at work	14. Modes of nutrition pp.113–118	• List types of heterotrophic nutrition and feeding mechanisms in holozoic organisms. • Describe the feeding mechanism in holozoic organisms (including filter feeding and fluid feeding). • List types of mammalian teeth and describe their structure. • State the dental formula and adaptations of dentition to mode of nutrition.	1. Autotrophy and heterotrophy. 2. Feeding mechanisms in holozoic organisms. Different types of mammalian teeth. 3. Herbivores, carnivores and omnivores. Activity 14.1 and Revision.
	5	The organism and its environment	15. Basic ecological concepts pp.119–130	• Name components of any ecosystem. • Mention major local biotic communities. • Give names of organisms typical of each community. • Briefly describe different types of communities in tropical and temperate regions. • Name ecological factors common to all habitats. • Briefly describe each of the factors pointing out their relative importance. • Mention the factors which affect water-retentivity of soil types and determine the amount of water each soil type can hold.	1. Ecological concepts. Activity 15.1. 2. Biotic and abiotic components of an ecosystem. Activities 15.2 and 15.3. 3. Biomes of the world and Nigeria. Activity 15.4. Different soil types. Activity 15.5. Revision. Note: The students can do some of the activities in this topic at home.

Term	Week	Theme	Topic	Performance objectives (Students should be able to:)	Content/Suggested number of lessons
Term 2	6	The organism and its environment	16. Population ecology pp.131–137	• Measure or estimate sizes of some ecosystems. • Relate the dynamic nature of an ecosystem to its size. • Define the concepts of population size, population dominance and population density. • Explore different methods of population study (the use of quadrants, transects, mark re-capture). • Identify factors that affect population (food supply, mortality, natality, migration, etc.). • Apply simple measurement practices of ecological factors.	1. Population size, dominance and density. Factors that affect population growth and size. Activity 16.1. 2. Measuring populations. Activity 16.2. 3. Factors that affect density. Measuring physical factors. Activities 16.3 and 16.4. Revision.
	7		17. The functioning ecosystem pp.138–145	• Define the terms autotrophy and heterotrophy. • Recognise that food relationships exist among living things. • Recognise that chemical energy and nutrients are transferred among producers, consumers and decomposers. • Identify trophic levels. • Describe the role of food chains and food webs. • Describe how energy flows along trophic levels (pyramids of number, energy and biomass). • State that there is a progressive diminution of energy in the feeding chain. • Recognise a definite change in the number of individuals from one feeding level to another, especially between producers and consumers.	1. How ecosystems function. Activity 17.1. 2. Energy flow. Trophic levels. Activity 17.2. 3. Ecological pyramids. Activity 17.3. Revision.

Term	Week	Theme	Topic	Performance objectives (Students should be able to:)	Content/Suggested number of lessons
Term 2	8	The organism and its environment	18. Energy transformation in nature pp.146–149	• Understand energy loss in the ecosystem (solar radiation, energy loss in the biosphere). • Use the knowledge of energy loss in the ecosystem to explain the pyramidal shape of feeding relationships. • State that only a small percentage of the radiant energy actually gets to the plants. • Identify measures of primary production. • Identify the laws of thermodynamics (first and second laws). • Apply the laws of thermodynamics to ecological phenomena.	1. Energy sources. 2. Energy loss in the ecosystem. Activity 18.1. 3. Laws of thermodynamics. Revision.
	9		19. The relevance of Biology to agriculture pp.150–156	• Classify plants using botanical and agricultural techniques of classification. • Describe the effects of various agricultural activities on ecological systems. • Identify pests of certain crops and indicate their control. • Describe some common diseases caused by pests and their control. • Identify factors that affect the production of crops. • Identify some methods of preserving and storing foodstuff. • List the factors that affect population growth and the availability of food.	1. Classification of plants. Effects of agricultural activities on ecological systems. 2. Pests and diseases. Factors affecting crop production. 3. Food production and storage. Activity 19.1. Population growth and food supply. Revision.

Term	Week	Theme	Topic	Performance objectives (Students should be able to:)	Content/Suggested number of lessons
Term 2	10	The organism and its environment	20. Micro-organisms around us pp.157–166	• Define micro-organisms. • Identify some micro-organisms found in air and water. • Grow micro-organisms. • Identify micro-organisms in our bodies and food. • Describe the effects of micro-organisms on the human body.	1. What is a micro-organism? Groups of micro-organisms. 2. Growing micro-organisms. Activities 20.1, 20.2 and 20.3. 3. Micro-organisms in our body and our food. Revision.
	11		Revision/ Examination		
Term 3	1	The organism and its environment	21. Micro-organisms in action pp.167–177	• Identify micro-organisms. • Measure the rate of growth of microbes. • Identify the harmful and beneficial effects of micro-organisms. • Recognise that some micro-organisms cause diseases. • Identify the diseases caused by micro-organisms (symptoms, mode of transmission and control of diseases). • Recognise that some disease-causing micro-organisms are air-borne, water-borne and spread through our food.	1. Growth of micro-organisms. Activity 21.1. 2. Beneficial effects of micro-organisms. Activities 21.2 and 21.3. 3. Diseases caused by micro-organisms. Activity 21.4, 21.5 and 21.6. Revision. Note: The students can do some of the activities in this topic at home.

Term	Week	Theme	Topic	Performance objectives (Students should be able to:)	Content/Suggested number of lessons
Term 3	2	The organism and its environment	22. Towards better health pp.178–184	• Discuss some ways by means of which disease-causing micro-organisms can be controlled. • Define vectors. • State ways of controlling vectors. • List ways of protecting ourselves from diseases caused by micro-organisms spread by vectors. • Describe some methods used in the disposal of refuse and sewage. • State the roles individuals should play to ensure good health. • Name some national and international health organisations and provide some descriptions of what they do.	1. Control of harmful micro-organisms. Activity 22.1. 2. Vectors. Activity 22.2. 3. Personal health. Activity 22.3. Disposal of refuse and sewage. The role of health organisations. Revision.
	3		23. Marine habitats pp.185–190	• Describe the characteristics of marine habitats. • Describe the pattern of distribution of plants and animals in marine habitats, noting dominant ones. • Recognise some adaptive features of the plants and animals in these habitats. • Infer the food chain of the organisms. • Determine some of the physical factors that affect plants and animals in the marine environment.	1. Characteristics of marine habitats 2. The major ecological zones. Activity 23.1. 3. Activity 23.1 (continued). Adaptive features of marine organisms. Revision. Note: Activity 23.1 can be completed at home.

Term	Week	Theme	Topic	Performance objectives (Students should be able to:)	Content/Suggested number of lessons
Term 3	4	The organism and its environment	24. Estuarine habitats pp.191–197	• Describe the characteristics of estuarine habitats. • Describe the pattern of distribution of plants and animals in estuarine habitats, noting dominant ones. • Recognise some adaptive features of the plants and animals in the habitat. • Infer the food chain of the organisms. • Determine some of the physical characteristics. • Consider the threats to estuaries and look at environmental considerations to help conserve estuaries.	1. What is an estuary? Estuaries in Nigeria. Characteristics of estuarine habitats. Types of estuaries. 2. Distribution and adaptation of plants and animals. The importance of estuaries. Threats to estuaries. 3. Activity 24.1. Revision.
	5		25. Freshwater habitats pp.198–206	• Recognise the variety and size of freshwater habitats. • Recognise the variety, quantity and distribution of various organisms in freshwater habitats. • Recognise seasonal changes in the size and population of the habitat. • Recognise the adaptation of the animals and plants in the chosen freshwater habitat. • Estimate the proportion of mineral salt present in the freshwater habitat. • Infer the food chain in the chosen freshwater habitat.	1. Characteristics of freshwater habitats. Types of freshwater habitats and zones. 2. The distribution and adaptation of freshwater organisms. Activity 25.1. 3. Threats to freshwater ecosystems. Activity 25.2. Revision.

Term	Week	Theme	Topic	Performance objectives (Students should be able to:)	Content/Suggested number of lessons
Term 3	6	The organism and its environment	26. Marshes pp.207–211	• Recognise types of marshes. • Correlate the effect of rainfall or any other source of water and evaporation to the changes in a marsh. • Recognise the adaptations of organisms in marshy habitats. • Appreciate the marsh as being transitional between aquatic and terrestrial habitats. • Infer the food chain in a marsh environment.	1. Characteristics of a marsh. Types of marshes. Adaptive features of plants and animals that live in marshes. 2. Activity 26.1. Revision.
			27. Forest biomes (rainforests) pp.212–217	• Identify the characteristics of the forest habitat. • Recognise trophic levels and the distribution of animals in a forest. • Recognise the stratification of plants in a forest. • Recognise the adaptive features of animals and plants in a forest. • Identify and construct food chains that exist in a forest.	1. The characteristics of the forest habitat. 2. Strata in the forest. The distribution and adaptation of plants and animals. Activity 27.1. Revision. Note: The students can do some of the work in this topic at home.
	7		28. Grasslands pp.218–224	• Recognise the dominant climatic factors in grasslands. • Describe the soil structure of grasslands. • Describe the structural and other adaptations of grassland plants and animals. • Identify the predominant plant and animal species and the energy relations between them. • Describe the soil structure.	1. Characteristics of grassland. Types of grassland. Grassland soil characteristics. Distribution and adaptation of plants and animals in the grassland. 2. Types of savannah in Nigeria. Activity 28.1. Revision.

Term	Week	Theme	Topic	Performance objectives (Students should be able to:)	Content/Suggested number of lessons
Term 3		The organism and its environment	29. Arid lands pp.225–229	• Recognise arid lands as places where water is not available to organisms because it is scarce or frozen. • Understand that exposure to Sun, extremes of temperature and water scarcity are factors that desert organisms have to cope with. • Differentiate cold deserts (tundra) from hot deserts. • Describe adaptations of organisms to arid lands.	1. Characteristics of arid land. Types of arid lands. 2. Distribution and adaptation of plants and animals. Activity 29.1. Revision. Note: The students can do some of the work in this topic at home.
	8	Continuity of life	30. Reproduction in unicellular organisms and invertebrates pp.230–242	• Define reproduction. • List the different types of reproduction. • Describe the forms of asexual reproduction. • Describe sexual reproduction. • Describe reproduction in unicellular organisms and invertebrates, in *Amoeba*, in *Paramecium*, in the earthworm, in the cockroach, in the housefly and in the snail. • Differentiate between complete and incomplete metamorphosis.	1. Asexual reproduction. Activity 30.1. 2. Sexual reproduction. Meiosis. Activities 30.2, 30.3 and 30.4. 3. Activity 30.5. Reproduction in unicellular organisms and invertebrates. Revision.
	9		Practicals		
	10		Revision		
	11–12		Examination		

THEME 1

Organisation of life

TOPIC 1: An introduction to Biology

Performance objectives

1.1 Define and relate Biology to Science.
1.2 Give an account of the scientific approach.
1.3 State the application of Biology.

Introduction

This topic introduces the Biology course for SS1, SS2 and SS3. Biology is a diverse Science that involves studying all aspects of living organisms using the scientific method.

Activity 1.1: Answer questions about Biology

INDIVIDUAL (SB p.5)

Resources

The textbook

Guidelines

Facilitate: Students must know the steps of the scientific method before answering this activity.

Answers

1. Geometry
2. a) A is the experiment and B is the control.
   b) Identify the aim of the experiment; Set up the apparatus; Follow the procedure; Observation; Analyse data/results; Draw a conclusion.
   c) Bromothymol blue changes from yellow to blue because the water plant takes in carbon dioxide for photosynthesis.
3. a) The purpose for which an experiment is set up is called the aim.
   b) In a laboratory, scientists often have to use different kinds of apparatus to carry out their experiments. It is important to have a control group in any experiment, as this is used to compare with the experimental group.
   c) The data collected from an experiment can be displayed in graph or table form.
   d) This helps a scientist establish relationships or see patterns. The accuracy of the initial hypothesis is established once conclusions have been drawn from the experiment. A hypothesis is an explanation that is put forward as the basis for investigation.

Assessment

Informal: Self-assessment – check the answers to the questions with the class.

Answers to Revision questions

1. Zoology is the study of animals, their behaviour and habitats. Botanists on the other hand, study plants and their important role in ecosystems.
2. If you were to study entomology, you would be able to recognise different beetle species and be an expert in the behaviour of other invertebrates.
3. Someone who specialises in anatomy looks at what happens inside the bodies of animals, and is an expert in skeletal make-up.
4. An ecologist looks at the relationship between organisms on Earth, the biotic and abiotic components and how these work together.
5. A palaeontologist likes to dig deep to find evidence of life in years gone by and an astrobiologist casts his or her eyes skywards to find out more about the moons, planets and stars and how we are part of a bigger universe.

Assessment

Informal: Teacher assessment

How are you doing? SB p.6

Take this opportunity to ask students if there is anything that they do not understand about the scientific method. You can check their understanding by giving examples of investigations. Students must identify the aim, hypothesis, apparatus and procedure in these examples. Explain anything that students do not understand.

Key words

Biology – the study of living organisms
control – apparatus or equipment set up alongside another experiment to verify the scientific method or to compare it with another standard
experimentation – the process of carrying out an investigation/controlled test
hypothesis – an explanation for an observation or scientific problem that is tested in further investigation
Science – knowledge attained through practice or study; a way of looking at the world

TOPIC 2: Recognising living things

Performance objectives

2.1 State the characteristics of living things.
2.2 Give examples of the levels of organisation of life.
2.3 State the complexity of organisation in higher organisms.
2.4 Describe the various levels of organisation of life.
2.5 State the advantages and disadvantages of complexity in higher organisms.
2.6 Describe the various parts and functions of the microscope.

Introduction

This topic covers the seven characteristics of living things, as well as the abiotic or non-living factors that impact on living organisms. Some living things are microscopic, so this topic teaches students how to use a microscope. It also covers the different levels of organisation in a multicellular organism.

The simplest level is the cell. Cells form tissues, tissues form organs and organs form systems. Multicellular organisms such as humans consist of cells, tissues, organisms and systems.

Activity 2.1: Observe living things

PAIRS (SB p.7)

Resources

A harmless live insect in a glass container; a potted plant; a rock

Guidelines

Facilitate: Noticing similarities and differences is an important skill in Biology. Help students to differentiate between living and non-living things.

Answers

1. a) It moves quickly.
   b) There is no observable movement. It has a green stem and leaves.
   c) There is no movement. It feels cold and hard.
2. Accept all plausible answers based on students' observations.

Assessment

Informal: Self-assessment

Activity 2.2: Observe living and non-living things

PAIRS (SB p.9)

Resources

The textbook

Guidelines

Facilitate: Help students to complete the answers, but only once they have tried to answer the questions with a partner.

Answers

1. House, humans, dog, birds, cows, trees, pond, rocks, clouds, field, crops (maize), soil, sun
2.

Living things	Non-living things
Humans	House
Dog	Pond
Birds	Rocks
Cows	Clouds
Trees	Field
Crops	Soil
	Sun

   Students should be able to identify and list the key characteristics of living things (movement, growth, reproduction, respiration, response to stimuli, etc.), as well as explain that a rock, soil, sun and clouds do not display any of these. There are living and non-living things in a pond, field and house.
3. a) Living things have to make their own food or find and eat food every day. We call this <u>nutrition</u>.
   b) Plants make their own food, but animals need to <u>move</u> to find theirs.

c) All living things also respond to changes or stimuli around them.
d) They respire to release energy and excrete to get rid of any waste in their bodies.
e) As they grow and develop, they reproduce to make more of themselves.

Assessment

Informal: Self-assessment

Activity 2.3: Identify differences between plants and animals PAIRS (SB p.9)

Resources

The textbook

Guidelines

Facilitate: Students should do Question 1 first before referring to Table 2.1.

Answers

1. Students should notice that plants are green and do not move from place to place as can the animal (in this instance, the cat).
2. Students may not be able to see all the differences, but they should use their knowledge of plants and animals when doing the comparison.

Assessment

Informal: Self-assessment – check that students understand the differences between plants and animals.

Activity 2.4: Answer questions about cells, tissues, organs, systems and organisms INDIVIDUAL (SB p.13)

Resources

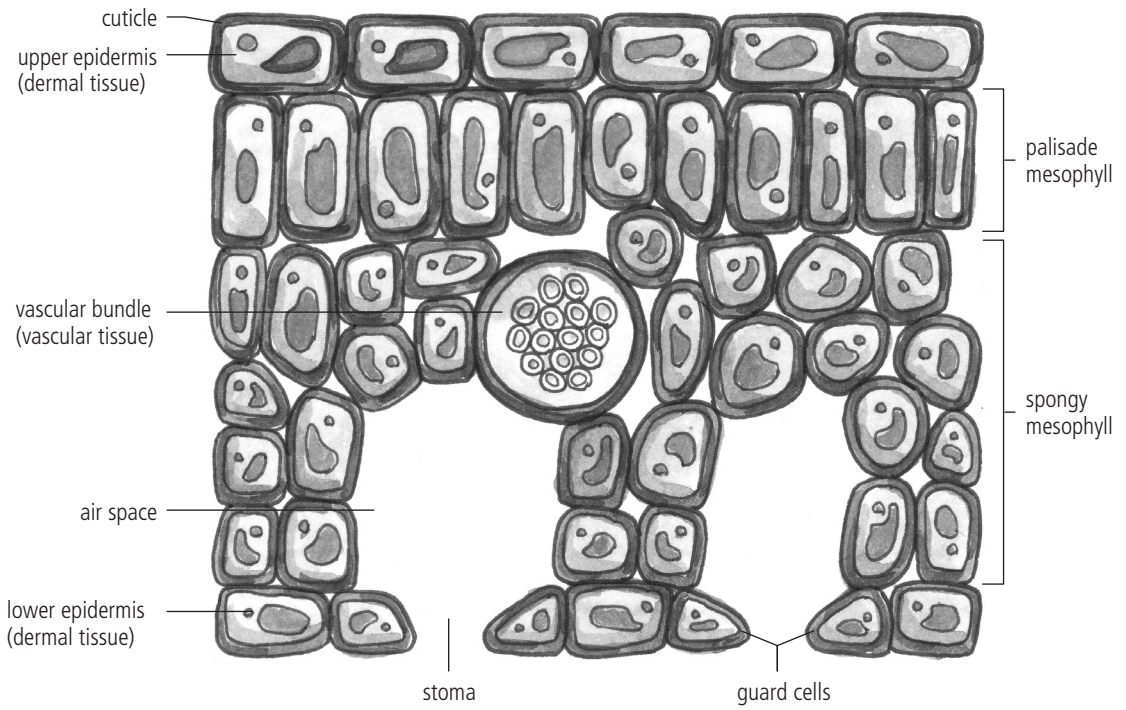
The textbook

Guidelines

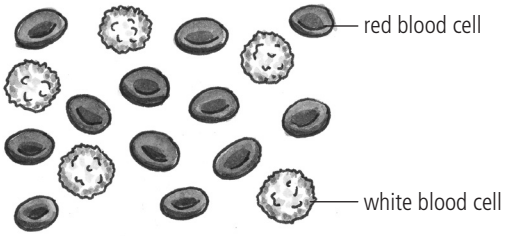
Facilitate: Students may complete this activity for homework. Check any questions that they experienced problems with at the start of the next lesson.

Answers

1. a) tissue b) organ
   c) organ d) organism
   e) system f) cell and organism
   g) tissue h) tissue
   i) system j) organ
2. Yes, a single cell can be a complete living entity that is able to carry out the seven functions of life such as grow, reproduce, feed, use energy, and so on.
3. a) A dicot leaf looks like this:



b) A blood sample looks like this:



4. a) A groups of cells with a similar structure working together for a specific function
   b) Groups of tissues that contribute to a specific function
   c) Several organs that work together to perform a function in a plant or animal
   d) A complete living entity that is able to grow, reproduce, feed and use energy
5. a) Muscle fibres
   b) Neurons
   c) Fibroblasts, adipose cells
6. A tissue is built up of a) similar cells working together. An organ is made up of b) different tissues working together. Several c) organs work together to make a system. In animals, the d) digestive system is important for breaking down food. The e) respiratory system controls the exchange of gases, and the f) reproductive system is responsible for the production of offspring.

Assessment

Informal: Self-assessment

Activity 2.5: Understand complexity vs simplicity

INDIVIDUAL (SB p.15)

Resources

The textbook; increase the size of the font of the comprehension passage for students who have language difficulties or read the passage aloud to these students.

Guidelines

Before answering the questions, students should read the passage twice and clarify anything that they do not understand. They can look up words that they do not understand in a dictionary, in the glossary at the back of the Student's Book or on Google.

Answers

1. Because they are flat, they have a bigger surface area and are thus able to diffuse more substances in and out of their system. They breathe through their surface and being flat, this allows for a larger surface-to-volume ratio. In other words, more cells are closer to the surface.
2. Unicellular algae are well adapted to living in shallow, still water that is usually rich in nutrients. Each cell is a totally self-sufficient individual. All these organisms need is light from the Sun, minerals and carbon dioxide from the water around it. They do not have to work hard to obtain nutrition, as they are permanently surrounded by nutrients.
3. It is better able to adapt to its surroundings and any fluctuations in the environment that it may encounter.
4. The advantages of complexity is that a complex organism:
   - can perform several complex functions
   - is more able to adapt to changes in the environment or to adapt to a range of different habitats
   - has division of labour, which enables the organism to function properly and efficiently
   - can grow quite large
   - has internal structure specialisation, which means that tissues and organs can carry out specific functions.

   The disadvantages of complexity are as follows:
   - more effort is needed to excrete or remove waste products from the metabolism
   - cells have no independence
   - the bigger the organism, the more effort is needed to respire, feed and move material from one part of the organism to the other. They need a specialised transport system.
   - a system of co-ordination is necessary in a complex organism (for example, a nervous system in mammals).

Assessment

Informal: Self-assessment – check the answers to the questions with the class.

Activity 2.6: Identify parts of the microscope

PAIRS (SB p.16)

Resources

Microscopes; slides; coverslips; newspaper/ magazine cuttings mounted on slides

Guidelines

This activity depends on your school's resources. If possible, have a microscope for every three students. Do a class demonstration on the use of the microscope before allowing the students to use it. Emphasise the safety precautions as microscopes are expensive instruments. The focus is on the use of the microscope and not on cells. Therefore, you can let students look at newspaper/magazine cuttings, strands of hair and any other items of interest. To see detail, the specimens must be thin enough for light to pass through.

Answers

1. and 2. Student observations
3. a) platform
   b) arm
   c) base
   d) fine focusing knob
   e) coarse focusing knob
   f) eyepiece

Assessment

Informal: Self-assessment – check the answers to the questions with the class.

Answers to Revision questions

1. They are more advanced developmentally and have more complex body shapes. Because they have systems, such as the nervous, circulatory, digestive and respiratory systems, they can exhibit more complex behaviours.
2. respiratory (lung); hearing (ear); digestive (stomach)
3. Advantages – has division of labour; can grow quite large; Disadvantages – more effort is needed to excrete or remove the waste products from metabolism; cells have no independence
4. Turn the a) fine focusing knob very slightly until the object is clearly focused. Turn the objectives until the smallest objective is in line with the opening in the platform and the b) light source shines through. Switch on the light source or turn the c) mirror to reflect enough light onto the object. Once the object is in focus, turn the nose piece to the 10× objective to d) enlarge the object. Turn the coarse focusing knob to move the objectives towards the platform. Turn the objectives away from the platform using the e) coarse focusing knob and place the glass slide with the object to be studied onto the platform. Use the fine focusing knob to focus the enlarged object again. Look through the f) eyepiece and turn the coarse focus knob away from the platform until the object being studied comes into focus. Focus the correct amount of light onto the object by turning the g) condenser and diaphragm levers.

Assessment

Informal: Teacher assessment

How are you doing? SB p.18

Take this opportunity to ask students if there is anything that they do not understand. You can check whether they know how to use the microscope by preparing a simple checklist for the groups to complete. Explain anything that students do not understand.

Key words

excretion – the process in which waste substances are removed from an organism (as urine or sweat, or as certain plant products)

magnify – to increase the actual size of something to see it more clearly

microscope – an instrument with magnifying lenses to help inspect objects that are too small to be seen in detail with the naked eye

multicellular – organisms that consist of more than one cell

organ – part of an organism that is self-contained with a specific function, for example, the heart, ear or liver in humans

reproduction – a process in which organisms generate new individuals to ensure that the species continues

respiration – a biological process that takes place in green plants and that creates oxygen and releases it into the air

system – a group of anatomically related organs or parts

tissue – types of material of which animals and plants are made, consisting of specialised cells

unicellular – an organism that is made up of one cell only

TOPIC 3: The classification of living things

Performance objectives

3.1 State the characteristic features of the kingdoms and give specific examples of representative organisms.

Introduction

This topic is about the classification of living organisms. All the biological species in the world are divided into five kingdoms according to shared characteristics.

By the end of this topic, students should be able to give some of the identifying characteristics of each kingdom. The divisions of the plant kingdom and phyla of the animal kingdom are also covered in this topic.

Activity 3.1: Examine *Amoeba* and *Chlamydomonas*

GROUPS (SB p.22)

Resources

A glass container or test tube; a light microscope; a glass slide/coverslip to view samples under the light microscope; a sample of ditch water or water from a stagnant pond; paper and a sharp pencil; prepared slides of *Amoeba* and *Chlamydomonas* (optional); websites to assist with microscope preparation and viewing of *Amoeba*, including https://www.flinnsci.com/media/406362/bf10576.pdf

http://www.instruction.greenriver.edu/kmarr/Biology%20211/Labs%20and%20ALEs/B211%20Labs/B211%20Labs/3_Lab%203%20Microscope_B211_Fall2009.pdf

https://www.youtube.com/watch?v=lkQkPXRl0Bg

Guidelines

As students may have difficulty viewing *Amoeba,* refer to the websites suggested above to assist with the preparation. Alternatively, borrow or purchase some prepared slides. You can show students a video clip of *Amoeba* under a light microscope if you are not successful with the slide preparation.

Facilitate: Help students to identify the organisms under the low and high power objectives.

Answers

3. Students should be able to identify *Amoeba* and *Chlamydomonas.*
4. Students must draw the organisms from the microscope. They should follow diagram rules: give diagrams a clear heading, including the magnification used when viewing the specimen; write the label on the right-hand side; pay attention to accuracy, proportion and neatness.
5. Protista
6. unicellular, motile, microscopic

Assessment

Informal: Self-assessment – discuss the observations with the class and evaluate their diagrams based on neatness, accuracy, and the inclusion of headings and labels.

Activity 3.2: Classify organisms

INDIVIDUAL (SB p.26)

Resources

The textbook

Guidelines

Help students to answer the questions.

Answers

1. A
2. D
3. B
4. Harmful: those causing cholera and leprosy; beneficial: those found in the human gut
5. Four characteristics include the following:
   - some protists, like the *Amoeba,* feed by ingesting their food with mouth-like structures called pseudopodia that engulf their prey
   - live in fresh water
   - many are single-celled organisms
   - the animal-like protists move using cilia and pseudopodia.

6. Protozoa are animal-like protists and algae are plant-like protists.
7. Gymnosperms include conifers, cycads, pines, firs and cedars.
   - They are evergreens.
   - Conifers reproduce from seeds.
   - The seeds (usually in cone-like structures) are 'naked'.
   - They often have needle-like leaves.

   Angiosperms include monocotyledons (monocots) and dicotyledons (dicots).
   - The majority of plants (around 230 000) belong to this category.
   - They include most trees, shrubs, vines, flowers, fruits, vegetables, and legumes.
   - Their seeds grow inside an ovary, which is embedded in a flower or fruit.
   - Flowering monocots include orchids, palms and grasses and they generally have parallel leaf veins and do not produce wood.
   - Flowering dicots include trees, shrubs, flowers and vines. Most fruit and vegetables are from this class.
8. The kingdom can be grouped in a number of ways, but the most common way of dividing or classifying is to look at:
   - reproductive characteristics
   - tissue structure (non-vascular or vascular)
   - seed structure (naked, covered seeds or spores)
   - size – mosses, ferns, shrubs, trees or herbs.
9. Characteristics:
   - They are made up of eukaryote cells.
   - Their cell walls contain cellulose.
   - They are heterotrophs (many are saprophytes or parasites).

   Value: They are vital decomposers, which are important in nutrient cycling.
10. a) i) A) Cnidaria; B) Arthropoda; C) Mollusca; D) Chordata; E) Annelida
    b) A: soft-bodied, jelly-like stinging tentacles, two-layered bodies with radial symmetry, polyps (fixed), and medusae (free swimming), reproduction (asexual)
    B: jointed legs; tough exoskeleton made of chitin; segmented body with a head, thorax, abdomen
    C: jointed legs, tough exoskeleton made of chitin, segmented body with a head, thorax, abdomen
    D: dorsal, hollow; nerve cord (spinal cord); post-anal tail (apes and frogs have no tail as adults); pharyngeal pouches (gill slits), found in most places (oceans, rivers, forests, mountains, etc.)
    E: body divided into segments, separated by internal walls; bristles are attached to each segment; similar nervous system to arthropods; head includes tentacles, palps and eyespots

Assessment

Informal: Self-assessment

Answers to Revision questions

1. Are they unicellular, multicellular or colonial (living in clusters or groups)?
   Is a nucleus present or absent in the cell and are there organelles (such as chloroplasts)?
   What is the composition of the cell wall?
   Is the organism mobile?
   How does it feed (is it autotrophic/ heterotrophic)?
   How does it reproduce (sexual or asexual reproduction)?
2. a) Animalia
   b) They are all vertebrates.
   c) mammals
   d) Other animals – they are all carnivores
   e) feline
   f) bear
   g) wolf
3. a) Eukaryotes are cells with a nucleus.
   b) bacteria
4. They are made up of eukaryote cells.
   Their cell walls contain cellulose.
   They are heterotrophs (many are saprophytes or parasites).

Assessment

Informal: Teacher assessment

How are you doing? SB p.27

Ask the students to make a mind map to summarise the facts in this topic. You can set this as a homework task and then check these summaries to see whether they have been able to extract the relevant information. Explain anything that students do not understand.

Key words

classification – the assignment of organisms into groups within a system of categories distinguished by origin, structure, etc.

eukaryotes – organisms with a cell type containing specialised organelles in the cytoplasm (all life forms except bacteria, blue-green algae, and other primitive micro-organisms)

kingdoms – in taxonomy, this is the category of the highest rank that groups together all forms of life that have certain fundamental characteristics in common

prokaryotes – cellular organisms that have no nuclear membrane and no organelles in the cytoplasm (except ribosomes); characteristic of all organisms in the kingdom Monera

taxonomy – the Science that deals with the identification, description, classification and naming of organisms

TOPIC 4: The cell as the basic unit of life

Performance objectives

4.1 Recognise single-celled organisms.
4.2 Distinguish between free-living cells and colonies, filaments and tissues.
4.3 Describe the general structure of a cell.
4.4 Differentiate between a plant and an animal cell.
4.5 Explain cell theory.

Introduction

Cells are the basic units of organisms. This includes single-celled (unicellular) organisms and those that consist of many cells (multicellular).

This topic covers the theory of cells, the structure of a generalised cell and the function of its components, as well as the differences between plant and animal cells.

Activity 4.1: Observe pond water

GROUPS (SB p.32)

Resources

Identification books or diagrams; a sample of pond water (ditch water, stagnant puddle); microscope; glass slides; iodine solution; cover slips; dropper; beaker/clear glass jar; paper towel/tissues; relevant websites/ reference books

Guidelines

Facilitate: Students must refer back to Topic 2 for the instructions on how to use a microscope and prepare a slide. Emphasise that they should observe carefully and draw accurate diagrams, paying attention to the details of the cells. This may be difficult due to the fast movement of some of the protozoans. Therefore, you should provide some microscopic images or diagrams to assist the groups.

You can refer the students to the following website:
http://www.microscopy-uk.org.uk/
http://www.microscopy-uk.org.uk/pond/index.html

They click on the link *information on how to collect microscopic pond life* or the *virtual pond dip* which gives information about specific organisms.

Answers

Students should draw three or more diagrams. Each diagram must be given a suitable heading and magnification.

Assessment

Informal: Teacher assessment – evaluate which students are able to draw accurate recordings from the microscope.

Activity 4.2: Answer questions about cell theory

INDIVIDUAL (SB p.34)

Resources

The textbook

Guidelines

Facilitate: Students can complete this activity for homework. Check the answers at the start of the next lesson.

Answers

1. B
2. Robert Hook
3. 'Tiny empty boxes with thick walls' is correct as some plant cells are rectangular and "box-like" – they have a fixed structure (animal cells are flexible). Plant cells also have thick walls, in that they have a cell wall (whereas animal cells do not). The statement is not correct because the cells are not empty (except for xylem). They contain cytoplasm and organelles. He was looking at dead cells, which is why they looked like empty 'boxes'.
4. The microscope
5. Virchow proposed that all cells come from the division of previously existing cells. This idea became key in understanding cell division.

Assessment

Informal: Self-assessment – check the answers to the questions with the class.

Activity 4.3: Answer questions about cell structure

INDIVIDUAL (SB p.37)

Resources

The textbook

Guidelines

Note: Although the plant cell is box-shaped and the animal cell round, there are a variety of shapes of cells found in animals and plants. Emphasise that animal cells have a flexible shape, whereas in plants, the shape is fixed due to the presence of a cell wall.

Facilitate: Use this activity to check whether students understand the information on the structure of cells. Once they have completed the activity, check the answers with the class.

Answers

1. a) chloroplast
   b) mitochondrion
   c) tonoplast
2. selectively permeable
3. nucleus
4. 1. Mitochondrion
   2. Cytoplasm
   3. Ribosome
   4. Endoplasmic reticulum
   5. Golgi apparatus
   6. Nucleus

Assessment

Informal: Self-assessment – check the answers to the questions with the class.

Activity 4.4: Study the similarities and differences between plant and animal cells

PAIRS (SB p.38)

Resources

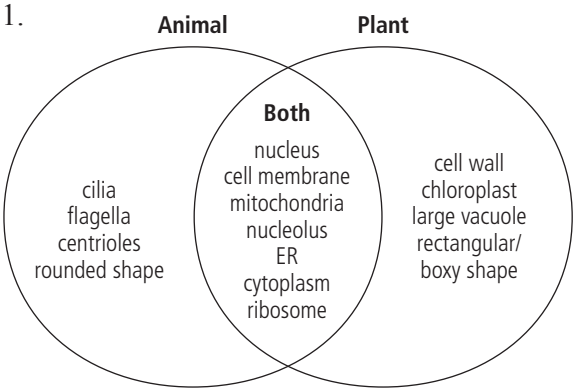
The textbook

Guidelines

Facilitate: Discuss the differences between plant and animal cells with the class. Write their points on the board in two separate columns titled *Animal cells* and *Plant cells*. Students must be given time to answer the questions with their partner. Thereafter, check the answers with the class.

Answers

1.



2. Dead
3. Cellulose microfibrils. This is a tough carbohydrate. Plants do not have a skeleton like animals. Cellulose is a tough carbohydrate that provides strength to plants to withstand environmental factors such as wind and rain.
4. Chloroplasts. Also accept large permanent vacuole.
5. For cell sap; to ensure turgidity and support, so the plant can stand upright
6. Plant cell
7. There is a clearly visible cell wall, a large vacuole and chloroplasts.

Assessment

Informal: Self-assessment – check the answers to the questions with the class.

Answers to Revision questions

1. a) B b) C c) A d) G
   e) F f) E g) D

2.

Structure	Plant cells only	Animal cells only	Both plant and animal cells
flexible shape		✓	
cytoplasm			✓
cell membrane			✓
cell wall	✓		
large vacuole	✓		
chloroplast	✓		

Assessment

Informal: Teacher assessment

How are you doing? SB p.39

There are many new terms in this topic. Suggest to students that they make a list of the new terminology. Revise the terms using short class tests or games. Students can also set tests for one another. Students should be able to draw and label diagrams of generalised plant and animal cells.

Take this opportunity to ask students if there is anything that they do not understand in the structure of cells. Explain anything that students do not understand.

Key words

binary fission – a method of asexual reproduction that involves the splitting of a parent cell into two approximately equal parts

cilia – tiny hair-like extensions that enables a cell to move

flagellum – a whip-like structure that enables a cell to move

phagocytosis – a process by which a cell engulfs a solid particle, for example, when an amoeba engulfs its prey

protozoa – single-celled organisms with animal-like behaviours

pseudopodia – temporary cytoplasm-filled parts of the cell wall that are able to change their form in order to move

selectively permeable – the capacity of cell membranes to allow certain molecules to pass through by diffusion

vacuole – a membrane-bound cavity within a cell, often containing a watery liquid or secretion

TOPIC 5: The cell and its environment

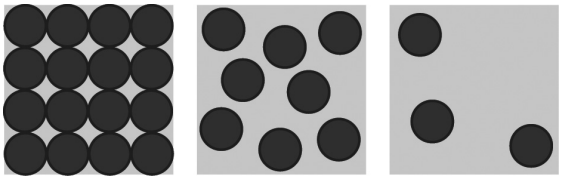
Performance objectives

5.1 Demonstrate diffusion and osmosis experimentally.
5.2 Recognise that osmosis is a form of diffusion.
5.3 Recognise that plasmolysis can lead to wilting and haemolysis can lead to loss of blood.

Introduction

Diffusion is the movement of particles from an area of high concentration to an area of low concentration until equilibrium is reached. When water diffuses through a selectively permeable membrane, this movement is called osmosis.

This topic is about the processes of diffusion and osmosis, and their significance in organisms. Students may experience some difficulty with the Physical Science concepts in this topic. At the start of this topic, you will need to explain the arrangement of particles, as well as the energy of particles in the three different phases of matter. You can use a diagram similar to the following one to assist your explanation:



Note: The particles in a solid vibrate in the same position whereas liquid and gas particles move randomly and freely. Gases have high kinetic energy (energy of movement) and move very quickly. Liquids have more kinetic energy than solids but less than that of gases.

Activity 5.1: Demonstrate diffusion

GROUPS (SB p.42)

Resources

Experiment 1:
A glass beaker or transparent jar filled with water; a drop of food colouring or other non-toxic coloured substance such as potassium permanganate

Experiment 2:
A can of spray deodorant

Guidelines

Facilitate: **Experiment 1:** Students may have difficulty understanding diffusion as particles are invisible. The use of a coloured substance enables them to see the movement of the particles. The movement will be slower if you use cold water.
Experiment 2: The student spraying the deodorant in the corner can also spray the scent in the air at the front of the classroom (Note: the can should not be pointing at any student) and the rest of the class can sit at their desks. Students can stand as they smell the deodorant so you should see them standing from the front (closest) to the back (furthest from the scent). This experiment shows that the gas moves from a high amount to a low amount until it is evenly spread. Explain that the particles of the gas are invisible but the smell demonstrates the movement of the gas. Explain that the deodorant is a liquid inside the can which evaporates (changes to a gas) at room temperature. You can also throw a small amount of ether on the black/whiteboard instead of using the deodorant. Ensure that there are no air currents in the room so that students observe particles moving spontaneously. Also close the door and windows, and turn off fans and the air conditioner.

Answers

Experiment 1:
2. The colour disperses and spreads evenly throughout the water.
3. It was concentrated in the area where you added the colour to the beaker.
4. This varies according to the temperature of the water, the temperature of the room and the amount of water used. Students should observe the results in about five minutes.

5. Diffusion is vital to the functioning of all living organisms as it involves the movement of many life-giving substances, such as water and oxygen, from one place to another.

Experiment 2:

6. The gas particles are slowly diffusing through the atmosphere in the classroom. They move or diffuse from an area of high concentration to one in which there is a low concentration until they are distributed evenly.
7. They diffuse throughout the classroom and spread evenly in the enclosed environment.
8. Students can suggest a range of examples: the smell of smoke from a neighbour's fire, smells of cooking in a kitchen that spreads through a house, the smell of flowers or perfume, effluent or sediment flowing into a river, etc.

Assessment

Informal: Self-assessment – discuss the observations and answers with the class.

Activity 5.2: Demonstrate osmosis in living and non-living tissues

GROUPS (SB p.43)

Resources

Experiment 1:

One potato or yam; two small dishes; salt; water; a knife; a tablespoon

Experiment 2:

Visking tubing or cellophane; a thistle funnel or capillary tube; sugar solution; distilled water; a beaker; a retort stand and clamp

Guidelines

Facilitate: **Experiment 1:** Students can complete this activity in their groups but ensure that they are careful when cutting the potato/yam. There should be sufficient water for the potato/yam to soak in but not too much that the dish overflows. Assist groups with the interpretation of the results.

Experiment 2: Help the groups to follow the instructions and to interpret the results.

Answers

Experiment 1:

5. The potato/yam that was soaking in the water looked similar to how it looked before the experiment but was a bit swollen with water. The potato/yam that was soaking in the salt water will look very different. It should be slightly discoloured, and the potato/yam will be much softer than the one in water.
6. Osmosis has taken place. Water has moved into the potato/yam in the dish that only has water (water molecules move from a solution of high water potential to one of lower water potential). The cells inside the potato/yam in the saltwater solution have had the water sucked out of them. The water inside the cells diffused to a lower concentration of water in the salt solution.

Experiment 2:

7. The level of liquid in the funnel rises and the water level in the beaker drops.
8. The sugar solution is a more concentrated solution. There is a movement of water molecules, by osmosis, from the water outside (in the beaker) through the Visking tubing or cellophane, to the sugar solution inside the thistle funnel. This makes the liquid level in the funnel rise.

Assessment

Informal: Self-assessment – discuss the observations and answers with the class.

Answers to Revision questions

1. a) Diffusion is important for respiration; digestion in animals also relies on diffusion as digested food molecules pass from the intestine into the blood stream.
   b) The loss of water from the body through sweating; the movement of water between living cells; the absorption of water by the colon for digestion; the formation of urine (excretion) in the kidneys
2. a) Osmosis
   b) Osmosis has taken place and water has moved into the potato strip (water molecules migrate from a solution of

high water potential to one of lower water potential).

c) Osmosis has taken place and water has moved out of the potato strip as it was immersed in a concentrated sugar solution.

Assessment

Informal: Teacher assessment

How are you doing? SB p.46

Check that the students understand the concepts of diffusion and osmosis. Students can watch the following video on osmosis and diffusion: https://www.youtube.com/watch?v=LeS2-6zHn6M

Students should consolidate the words in the key word list. You can give extra notes on water potential to students who require extension. They can watch the following video for a clear explanation of this challenging concept: https://www.youtube.com/watch?v=nDZud2g1RVY

Key words

crenation – the contraction of a cell after exposure to a hypertonic solution

diffusion – when small molecules of a substance move spontaneously from a region of high concentration to a region of low concentration

haemolysis – the breaking open of red blood cells

hypertonic solution – a solution with a higher concentration of solutes outside the cell than inside the cell

hypotonic solution – a solution that contains fewer dissolved particles outside the cell than inside the cell

isotonic solution – when two solutions have the same osmotic pressure across a semi-permeable membrane

osmosis – the tendency of a fluid, usually water, to pass through a semi-permeable membrane into a solution where the concentration of the solvent is higher

plasmolysis – the process in which cells lose water in a hypertonic solution

turgidity – when plant cells are swollen, which makes them able to keep standing upright

TOPIC 6: Properties and functions of the cell – nutrition and respiration

Performance objectives

6.1 Recognise that some nutrients (micronutrients) are needed in small quantities while others (macronutrients) are needed in large quantities.
6.2 Recognise that cells require proteins, fats and carbohydrates for the production of new protoplasm, for repair, growth and the provision of energy.
6.3 Define cellular respiration and describe the processes that are involved in cellular respiration.
6.4 Discuss the importance of the Krebs cycle.
6.5 Explain how cellular respiration results in energy release.
6.6 Define anaerobic respiration.
6.7 Show experimentally that the break-down of carbohydrates may be partial (fermentation) or complete.
6.8 State how fermentation is used in industry and everyday life.

Introduction

The first part of this topic is about macronutrients and micronutrients in food, which animals and plants need to grow and survive. In humans, the macronutrients required are carbohydrates, proteins and lipids. The micronutrients are vitamins and minerals. This topic is also about cellular respiration. Many people think that breathing and respiration are the same process. Breathing is the taking in of oxygen and the removal of carbon dioxide from an organism. Respiration refers to the chemical processes in the cell whereby energy is produced. Aerobic respiration requires oxygen and anaerobic respiration does not involve oxygen. This topic includes several experiments, which the students should enjoy. Ensure that you have the required resources before starting the topic.

Activity 6.1: Investigate the effect of fertiliser on plants

GROUPS (SB p.47)

Resources

A packet of radish seeds; five plastic pots; soil; fertiliser; water; a ruler; a measuring cup. Refer to websites for assistance with the preparation and results. Suggested websites to consult include:
http://www.all-science-fair-projects.com/print_project_1276_50
https://prezi.com/apfttz9dm9oe/can-a-plant-have-too-much-fertilizer/
http://www.livebinders. com/play/play/1589294
http://www.plantingscience.org/index.php?module=pages
etter&type=file&func=get&tid=2&fid=presentation&pid=6199

Guidelines

Allocate some time to measure the plants on the tenth day.

Facilitate: Prepare the correct concentrations of fertilisers for the groups to use but explain how you prepared them.

Answers

5. The plants grown with 100% should grow the most. The plants grown with too little (33%) or too much (166%) grew the least.

Assessment

Informal: Self-assessment – discuss the observations and answers with the class.

Activity 6.2: Investigate respiration

GROUPS (SB p.49)

Resources

A test tube; a stopper; a platform with holes; small animals such as ants; clear limewater.

Guidelines

Facilitate: This experiment involves animals so rather discuss it in theory to prevent animals from being harmed, which contravenes scientific ethics.

Answers

2. The control apparatus must be identical to that of the experimental apparatus, with only one factor left out – that is, the factor being tested. In this case, the control apparatus should not have any organisms or it could have dead, sterilised organisms.
4. The indicator will turn milky in the test tube with animals and remain clear in the control.
5. The clear limewater in the experiment turned milky, while that of the control remained clear.
6. Carbon dioxide is given off by animals during respiration. This is why the limewater turned milky in the test tube with the animals. Limewater turns milky in the presence of carbon dioxide.
7. The students could list any one of the following flaws in the investigation:
   - The oxygen is not replenished, and the animals could die before any results are obtained.
   - The excess carbon dioxide could prevent the process of respiration.
   - The control apparatus also contains air with carbon dioxide, which could cause the limewater to turn milky. There is, therefore, a need to ensure that no carbon dioxide is present in the test tube that is the control.
   - Live animals are used, which is not recommended in scientific investigations.
   - The holes in the platform must be smaller than the animals.

Assessment

Informal: Self-assessment – check the observations and answers to the questions with the class.

Activity 6.3: Investigate the need for glucose in cellular respiration

GROUPS (SB p.50)

Students plan and conduct their own experiment. Where appropriate, assist them with the planning. Ensure that they follow the guidelines set out in the Student's Book. Once you have planned the investigation, they can then write up a detailed plan.

Resources

Refer to the Internet for similar experiments such as: http://www.123helpme.com/view. asp?id=121963

https://prezi.com/xyjzk0f-ikpp/the-effects-of-glucose-concentration-on-yeast-respiration/

http://www.saps.org.uk/saps-associates/browse-q-and-a/169-q-a-a-how-does-sugar-affect-yeast-growth

Guidelines

Facilitate: Divide the class into mixed-ability groups and give the groups time to discuss the experiment during a lesson. They must each write up the plan at home. Allow them at least a week, including one weekend, to do this.

Answers

Students must follow the scientific method. Their reports must include the problem, the aim, the hypothesis, the materials, the step-by-step method, the variables – independent, dependent and at least three controlled variables, the results, their interpretation/analysis/inferences related to the results and conclusion.

Use the following as an example of a plan:
Aim: To test whether cellular respiration is dependent on the concentration of glucose.
Prediction: Glucose utilisation is proportional to the rate of cellular respiration.
Hypothesis: Glucose is required for cellular respiration. The higher the concentration of glucose, the greater the amount of carbon dioxide released, therefore the greater the rate of respiration.
Materials: four test tubes; a water bath; three different concentrations of glucose solution; a thermometer; a stopwatch; yeast

Variables:
Independent variable – a concentration of glucose
Dependent variable – a number of carbon dioxide bubbles produced per unit of time (assume that you show cellular respiration occurring through the production of carbon dioxide)
Controlled variables – temperature

Method:

1. Place equal quantities of yeast in the four test tubes.
2. Place the test tubes in a water bath to control the temperature.
3. Place the same volume of three different concentrations of glucose solution in three of the test tubes.
4. Add water to the fourth test tube (this test tube must have no glucose as it is the control).
5. Record the number of carbon dioxide bubbles released per minute.

Design of fair experiment: Control without glucose; variables not being tested are kept constant (controlled)
Results: Record the results in a table of bubble production with time and glucose concentration and a line graph (draw a line graph for each concentration of glucose on the same axes: x-axis – time, y-axis – the number of carbon dioxide bubbles)
Bibliography: Students must include a bibliography if they used any references to research ideas or to help them with other aspects of the experiment.

Assessment

Informal: Teacher assessment – assess the experimental design to ensure that it meets all the requirements of a fair, reliable and valid test.

Activity 6.4: Find out if germinating seeds release heat energy PAIRS (SB p.50)

Resources

The textbook

Guidelines

Facilitate: Allow the students time to discuss the questions with their partners. Thereafter, check the answers with the class.

Answers

1. To show that heat energy is released by germinating pea seeds.
2. Bleach acts as an antiseptic and it will therefore prevent any micro-organisms, such as bacteria and fungi, from growing on the seeds.
3. Accept any:
   - allow the carbon dioxide to escape out of the flasks. If the carbon dioxide accumulates inside the flask, it will slow down the process of respiration.
   - Hot air rises and so turning the flasks upside down will limit the loss of heat through the plug.
   - So that the thermometer could be read and the temperature recorded.
4. Since only flask A had germinating seeds and since the temperature in this flask increased, it can be concluded that heat energy is released by the germinating seeds.
5. Flask A: the germinating seeds released heat energy. Flask B: because the seeds were boiled but not soaked in bleach, micro-organisms grew on the dead seeds. Respiration by these seeds caused the increase in temperature. Flask C: there were minimal changes to the temperature because the seeds were dead and therefore not respiring. Also there were no micro-organisms growing in it because it was soaked with bleach.
6. Set up several sets of similar apparatus.

Assessment

Informal: Self-assessment – discuss the experiment and check the answers with the class.

Activity 6.5: Investigate anaerobic respiration PAIRS (SB p.52)

Resources

The textbook

Guidelines

Facilitate: Allow the students time to discuss the questions with their partners. Thereafter, check the answers with the class.

Answers

1. Accept any suitable aim: to show alcoholic fermentation/anaerobic respiration; to show that yeast cells respire anaerobically/in the absence of oxygen; to show that carbon dioxide/heat is released during anaerobic respiration/alcoholic fermentation.

2. To remove the oxygen.
3. a) To watch the temperature changes during the process of fermentation
   b) To provide a substrate/food source for respiration by the yeast cells
4. Use the same apparatus but leave out the yeast cells.

Assessment

Informal: Self-assessment – discuss the experiment and answers with the class.

Activity 6.6: Understand the process of fermentation

PAIRS (SB p.52)

Resources

The textbook

Guidelines

Facilitate: Allow the students time to discuss the questions with their partners. Thereafter, check the answers with the class.

Answers

1. The oil prevents the entry and exit of gases.
2. To allow time for the yeast to get used to the different temperatures and for standardisation to accurately compare the samples.
3. Anaerobic respiration/fermentation
4. Carbon dioxide
5. It is possible that respiration slowed down drastically at this temperature because the very high temperature could have denatured the respiratory enzymes.
6. Accept any suitable answer:
   - The sugar content will be depleted so there is not enough food for respiration.
   - The size of the yeast population could have increased drastically and so competition for space would have decreased respiration.
7. The production of wine and beer and other alcoholic drinks and baking.

Assessment

Informal: Self-assessment – discuss the experiment and check the answers with the class.

Activity 6.7: Investigate anaerobic respiration or fermentation

GROUPS (SB p.53)

Resources

Any resources that will assist students with the activity: reference books; access to the Internet using cell phones or computers. Use websites on how to make yoghurt using the process of fermentation: http://chemistry.about.com/od/foodscienceprojects/a/Yogurt-Chemistry.htm

Guidelines

Facilitate: You can get students to ask their parents, grandparents or other adult family members if they have recipes that use the process of fermentation to make food and beverages such as ginger beer or bread. If there is time and if groups choose suitable recipes, they may be able to make the product in class or at home.

Answers

1. The alcohol in the bread evaporates due to the high baking temperature.
2. a) Cooling prevents further activity of the bacteria.
   b) The answer will depend on the recipe that the groups choose.

Assessment

Informal: Self-assessment

Activity 6.8: Investigate anaerobic respiration/fermentation

INDIVIDUAL (SB p.54)

Resources

The textbook

Guidelines

Facilitate: The weaker students may experience difficulty with some of these questions, so you will need to help them understand the experiment prior to answering the questions. If possible, project the graph onto a screen so that you can explain the three different lines to the class.

Answers

1. Fermentation refers to the process of cellular respiration in the absence of oxygen. Fermentation is a process that converts sugar to acids, gases or alcohol.
2. Fermentation results in the release of carbon dioxide. An increase in carbon dioxide increases acidity, which causes the decrease in pH.
3. As the temperature of the room increases or decreases, the temperature of the brew container also increases or decreases.
4. The yeast releases heat energy, which keeps the brew container temperature above the room temperature.
5. 18 hours
6. Over time, the steepness of the slope decreases, which shows that the rate of fermentation slows down.

Assessment

Informal: Self-assessment – discuss the experiment and answers with the class.

Answers to Revision questions

1. Cellular respiration is the term that is used for the series of chemical reactions that take place within cells. These chemical reactions trap or capture energy in a molecule called adenosine triphosphate (ATP). ATP is often called the 'molecular unit of currency' because ATP transports chemical energy within cells for metabolism. When the metabolic processes use ATP as an energy source, they convert it back into the chemical components that built the molecule. This means that ATP is continually recycled in organisms.
2. The word equation for the process is:

   Glucose + oxygen $\xrightarrow{\text{enzymes}}$ carbon dioxide + water + energy (heat and ATP)

   The chemical equation is:
   $C_6H_{12}O_6 + O_2 \longrightarrow CO_2 + H_2O +$ energy (heat and ATP)
3. Glycolysis takes place in the cytoplasm of the cell, that is, outside the mitochondrion. This process does not need oxygen. During glycolysis, the fuel/glucose molecule is activated (phosphorylated). This activated glucose molecule undergoes a series of enzyme-controlled steps to form two molecules of pyruvic acid. In the process, energy is released to form ATP.
4. In the presence of oxygen, the pair of three-carbon pyruvic acid molecules from glycolysis becomes oxidised. As well as this, each pyruvic acid molecule loses carbon in the form of carbon dioxide. The pyruvic acid molecules from the glycolysis reaction enter the mitochondrion and undergo a series of cyclic reactions and are oxidised. This process of oxidation releases large amounts of energised hydrogen atoms and carbon dioxide. Oxidation is the loss of electrons when two or more substances interact. This cyclic series of reactions that result in the release of carbon dioxide and the formation of ATP molecules is called the Krebs cycle. The Krebs cycle only takes place in the mitochondrion if oxygen is present. If there is no oxygen, then there is no Krebs cycle.
5. The word 'anaerobic' means in the absence of oxygen. Many micro-organisms, such as bacteria and yeast, are able to survive in the absence of oxygen. The process of anaerobic respiration is also called fermentation. Glycolysis produces fermentation in the absence of oxygen. There is one additional step in the process of glycolysis that leads to fermentation. This additional step involves converting pyruvate to alcohol and carbon dioxide in a plant cell, or to lactic acid in an animal cell. In this process, energy is released from food by breaking it down chemically, but the reactions do not use oxygen, even though they produce carbon dioxide.

Assessment

Informal: Teacher assessment

How are you doing? SB p.55

Check that the students understand aerobic and anaerobic respiration by asking the class questions. They can test whether they understand the work by teaching the processes to a partner. Consolidate the experiments in this topic by revising the aim and conclusion. Ensure that students understand the scientific method, including the different types of variables.

Key words

adenosine triphosphate (ATP) – an energy-carrying molecule found in the cells of all living things

aerobic respiration – the process of producing cellular energy involving oxygen

anaerobic respiration – a form of respiration using electron acceptors other than oxygen

cellular respiration – the process of oxidising food molecules, such as glucose, to carbon dioxide and water

fermentation – a metabolic process that converts sugar to acids, gases or alcohol

Krebs cycle – a series of chemical reactions used by all aerobic organisms to generate energy

mitochondria – cell organelles in which the biochemical processes of respiration and energy production occur

oxidation – the interaction between oxygen molecules and other substances

phosphorylation – the addition of a phosphate to an organic molecule

TOPIC 7: Properties and functions of the cell – autotrophy, enzymes and excretion

Performance objectives

7.1 Recognise that certain cells are autotrophic and others are heterotrophic.
7.2 Define what photosynthesis is.
7.3 Explain the process of photosynthesis.
7.4 Explain the importance of photosynthesis.
7.5 Carry out experiments in photosynthesis.
7.6 Discuss the role of enzymes in digestion.
7.7 Understand that excretion is the removal of metabolic waste from the cell, which may be toxic or in excess of the cell's needs.

Introduction

This topic covers a very important process in Biology, photosynthesis. This should be an interesting section for students as it includes several experiments that test the requirements for photosynthesis. Photosynthesis ensures the continuity of life on Earth. The last part of the topic is about chemosynthesis, enzymes and excretion.

Activity 7.1: Describe the process of photosynthesis

INDIVIDUAL (SB p.57)

Resources

The textbook

Guidelines

Facilitate: Help students to complete the answers that they are experiencing difficulty with.

Answers

1. In the process of photosynthesis, a) radiant energy from the sun is transformed into chemical energy. This is stored as b) starch. In cellular respiration, c) glucose is broken down and d) chemical energy is released. This becomes available for activities in the cell. e) Glucose and f) oxygen are formed during photosynthesis. From these, g) cellulose and h) starch can be made. i) Radiant energy is absorbed during photosynthesis and j) oxygen is released. Plants and animals need oxygen for k) respiration. Life depends on the process of photosynthesis because almost all organisms obtain their energy directly or indirectly from l) plants.
2. a) A b) C c) D

Assessment

Informal: Self-assessment – check the answers to the activity with the class.

Activity 7.2: Answer questions about the light and dark phases of photosynthesis

INDIVIDUAL (SB p.59)

Resources

A chart or PowerPoint presentation showing large representations of the light and dark phase of photosynthesis.

Guidelines

Facilitate: Start the lesson by explaining the phases of photosynthesis. Ask questions to check the students' understanding of the light and dark stages of photosynthesis after they have completed Activity 7.2.

Answers

1. Photosynthesis is a biochemical process that takes place in green plants. It is where chlorophyll in leaves absorbs the sun's radiant energy and converts it into chemical energy, which is then stored as carbohydrates. The compounds used in photosynthesis are carbon dioxide and water; the products are sugars and oxygen.
2. chloroplast
3. thylakoids
4. stroma

5. ATP
6. Calvin cycle

Assessment

Informal: Self-assessment – check the answers to the activity with the class.

Activity 7.3: Show that light is necessary for photosynthesis

PAIRS (SB p.61)

Resources

The textbook. For the testing for starch demonstration, you need: a burner; a tripod stand; a beaker; water; a freshly picked soft leaf like a geranium; a test tube; alcohol; a pair of tweezers; a white tile; iodine; a dropper and a pair of safety goggles.

Note: Alcohol is flammable so ensure that the burner is extinguished before placing the test tube with alcohol in the water bath

Guidelines

Facilitate: While students are not required to test for starch, it is highly recommended that you do this experiment as a demonstration. Students should discuss the questions in this activity with their partner and write down the answers. Thereafter, check the answers with the class.

Answers

1. The experiment aims to show that light is necessary for photosynthesis and without light, the process cannot take place.
2. A control is needed in an experiment so that we have something to compare our other results to. A control is like a comparison experiment. There is normally only one difference between the control and the experiment and the control should not contain what is under investigation. In this case, the 'no light' is the experiment so the control must have 'light'.
3. The section of the leaf that has been exposed to light tests positive for starch as photosynthesis has taken place.
4. Light is necessary for photosynthesis to take place.

Assessment

Informal: Self-assessment – discuss the experiment with the class and check the answers to the questions.

Activity 7.4: Show that chlorophyll is necessary for photosynthesis

GROUPS (SB p.61)

Resources

A variegated geranium potted plant, a burner, a tripod stand; a beaker; water; a leaf from the plant (after destarching and exposure to sunlight); a test tube; alcohol; a pair of tweezers; a white tile; iodine and a dropper

Guidelines

Facilitate: Assist students to follow safety procedures when doing this experiment or do it as a class demonstration.

Answers

1. To destarch a plant, you need to place it in a dark place for 48 hours. This ensures that no starch is produced in the leaves in that time. The leaves, if tested, will show no starch present. The plant is thus destarched.
2. iodine
3. It turns blue-black.
4. The parts containing chlorophyll will turn blue-black. The white parts turn brown.
5. This shows that chlorophyll is necessary for photosynthesis. Without it, the process cannot take place.

Assessment

Informal: Self-assessment – discuss the observations and the answers to the questions with the class.

Activity 7.5: Show that carbon dioxide is necessary for photosynthesis

GROUPS (SB p.61)

Resources

Two potted destarched plants; a burner; a tripod stand; a beaker; water; a leaf from the plants (after 4–6 hours in sunlight); a bell jar or transparent plastic bag; soda lime;

potassium hydroxide; a test tube; alcohol; a pair of tweezers; a white tile; iodine and a dropper

Guidelines

Facilitate: Assist students to follow safety procedures when doing this experiment or do it as a class demonstration.

Answers

1. This is important as both plants have to be destarched. This ensures that no starch is produced in the leaves so that you can see the effect of no carbon dioxide on starch production.
2. Soda lime absorbs incoming carbon dioxide and potassium hydroxide absorbs the carbon dioxide under the bell jar.
3. The conclusion is that carbon dioxide is essential for photosynthesis. When it has been removed from the air around the plant, photosynthesis does not take place.

Assessment

Informal: Self-assessment – discuss the observations and the answers to the questions with the class.

Activity 7.6: Show that oxygen is a by-product of photosynthesis

GROUPS (SB p.62)

Resources

The textbook

Guidelines

Facilitate: Allow students to answer the questions with their partners. Thereafter, discuss the answers with the class. You can download a video showing this experiment from YouTube.

Answers

1. A water plant such as *Elodea*, so that the oxygen can be collected as bubbles from the submerged plant.
2. light
3. The glowing splint will burst into flame. This is a test for oxygen and indicates that oxygen has been produced in the experimental plant.
4. Humans and all other living organisms require oxygen for respiration in order to produce the energy required for all activities, including sleeping and eating.

Assessment

Informal: Teacher assessment – conclude this section on photosynthesis with a class test.

Answers to Revision questions

1. A
2. A
3. a) There was no oxygen present.
   b) Oxygen was present due to the mint plant.
   c) Photosynthesis produces oxygen.
   d) The splint bursts into flame, as oxygen fuels flames, so this is a good test for the presence of this gas.
4. Excretion is the removal of waste products of metabolism from organisms. Waste products include carbon dioxide, water, salts and nitrogenous wastes such as urea and uric acid.

Assessment

Informal: Teacher assessment

How are you doing? SB p.65

Ask students whether they enjoyed the experiments in this section and whether they understood the purpose of each one. You can check their understanding by asking them some questions about the information covered in the topic. Students can write summary notes on the topic, for example, by using headings and sub-headings, and adding phrases and key words under these. Explain anything that students do not understand.

Key words

autotrophic nutrition – a form of nutrition in which an organism makes its own food from inorganic substances using chemical or light energy

chemosynthesis – the use of energy released by inorganic chemical reactions to produce food

chlorophyll – a green pigment that traps sunlight for the process of photosynthesis

contractile vacuole – an organelle found in micro-organisms that periodically expands, filling with water, and then contracts, expelling its contents to the cell exterior

dark phase – the phase of photosynthesis that does not require light (carbohydrates are synthesised from carbon dioxide)

excretion – the removal of the waste products of metabolism from living organisms such as animals and plants

flame cells – excretory cells found in simple freshwater invertebrates, such as flatworms

light phase – during the light phase of photosynthesis, light energy from the Sun is harvested by special pigments in the chloroplasts

Malpighian tubules – a system of branching tubules extending from the intestinal system for the purpose of absorbing water and substances dissolved in water

photosynthesis – a process that takes place in green plants in which carbohydrates are made from carbon dioxide and water using sunlight, with oxygen as a by-product

TOPIC 8: Growth and movement

Performance objectives

8.1 Identify growth.
8.2 Describe the processes of mitosis, cell division, cell enlargement and cell differentiation.
8.3 Explain how apical and axillary growth takes place.
8.4 Explain how hormone growth in plants is regulated.
8.5 Carry out experiments to construct growth curves.
8.6 Demonstrate by experiment factors that affect growth.
8.7 Explain the ability of the cell to detect and respond to external stimuli.
8.8 Identify structural adaptations for mobility such as cilia and flagella.

Introduction

Growth is an increase in size. Growth is also an increase in the number of cells through a type of cell division, namely mitosis. There are different types of growth in plants – primary growth causing an increase in length, secondary growth causing an increase in width, and growth responses due to a stimulus such as light or gravity. Irritability is the ability of the cell to respond to stimuli. Some organisms move using cilia and flagella. Movement that occurs within the cytoplasm of plant and fungal cells is called cyclosis. This topic covers different types of growth and movement.

Activity 8.1: Answer questions about mitosis

INDIVIDUAL (SB p.69)

Resources

Try to get a chart to place in the classroom showing the stages of mitosis.

Guidelines

Ensure that students understand the stages of mitosis before they do this activity. You can show a video from YouTube such as https://www.youtube.com/watch?v=C6hn3sA0ip0

Facilitate: Allow students time to answer the questions and thereafter check the answers with the class.

Answers

1. A: cell membrane
   B: centriole
   C: chromosome
2. Six
3. An animal cell, because there is no cell wall present (only a cell membrane is present). Also, centrioles are present, which are found mostly in animal cells (only found in the cells of some lower plants, not conifers and flowering plants).
4. Metaphase, because chromosomes are arranged along the equator of the spindle, which is characteristic of metaphase.
5. Six
6. 46
7. One daughter cell has one half of a chromosome (one chromatid) that has an identical half (one chromatid) in the other daughter cell.

Assessment

Informal: Self-assessment – check the answers to the activity with the class.

Activity 8.2: Understand mitosis

PAIRS (SB p.69)

Resources

A pair of scissors; a piece of card; Prestik; blue and red colour-pencils or crayons; two sheets of A4 paper

Guidelines

This activity will help students to understand exactly how the process of mitosis takes place. Each pair of students must follow the instructions given in the activity. Ask a volunteer pair at the end of the activity to present their description to the class.

Assessment

Informal: Self-assessment – check that students understand the activity by asking relevant questions.

Activity 8.3: Investigate the effect of light from one direction on stem growth

GROUPS (SB p.72)

Resources

Two clinostats; two potted plants, two cardboard boxes, each with a small opening in one side

Guidelines

This investigation can be done as a group or class demonstration.

Facilitate: Help students to understand the use of a clinostat in investigations related to tropisms.

Answers

1. All parts of the control plant (wound clinostat) are exposed to the same amount of light. The purpose of the control is to show that the bending of the stem is caused by light from one side only (unilateral light).
2. The clinostat is wound so that it eliminates the effect of the unilateral light on the plant stem. This means that all parts of the stem of the control receive equal amounts of light.

Assessment

Informal: Self-assessment – discuss the experiment with the class and the answers to the questions.

Activity 8.4: Investigate the effect of geotropism on roots

GROUPS (SB p.73)

Resources

Five to six bean seeds; water; a transparent (see-through) container – glass or plastic jar; cotton wool/absorbent paper (newspaper, paper towel)

Guidelines

Facilitate: Help the students to position their seeds correctly. Allow time at the start of each lesson for students to observe the seedlings or allow them to measure their seedlings in their own time outside of lessons.

Answers

8. The students should explain that the roots grow downwards because the plant auxins cause geotropism. The auxins are produced near the tip of the root and they cause equal growth on all sides of the root. This makes the root grow straight downwards.

Assessment

Informal: Self-assessment – discuss the investigation with the class and the answer to Question 8.

Activity 8.5: Study cilia and flagella

PAIRS (SB p.74)

Resources

Prepared cultures of *Paramecium* and *Euglena*; microscopes; microscope slides and cover slips; dropper pipettes; paper; sharp pencils

Guidelines

Help students to identify these organisms under the microscope. You can also show the class a video clip of these organisms such as
https://www.youtube.com/watch?v=KkaFDWrBM1Y
https://www. youtube.com/watch?v=4MlR3dKfXmc

Answers

Students will observe these organisms under the microscope and draw what they see.

Assessment

Informal: Teacher assessment – evaluate the diagrams according to neatness, size (large, clear diagram), proportion, headings and magnification, and labels.

Answers to Revision questions

1. a) Mitosis and meiosis are examples of cell division that enable organisms to grow.
   b) Meiosis takes place in the sex cells and is responsible for reproduction.

c) Mitosis takes place in the cells of the body.
d) Chromosomes carry genetic material.
e) Growth in plants is controlled by substances called hormones.
f) Primary growth increases the length of a plant above and below the ground.
g) Secondary growth in plants is responsible for an increase in diameter.

Assessment

Informal: Teacher assessment

How are you doing? SB p.75

Students may find the section on mitosis and auxins difficult to understand. You can check their understanding by asking them some questions. Explain anything that students do not understand.

Key words

auxins – a family of hormones found in plants, mostly made in the tips of the shoots and roots
cilia – fine hair-like projections from certain cells that sweep in unison and help to sweep away fluids and particles
cyclosis – the regular cyclic movement of protoplasm within a cell
differentiation – the normal process by which a less specialised cell develops to take on a different form and function
flagella – a long projection, similar to a cilia, which serves as an organ of locomotion
geotropism – the growth or movement of a plant toward or away from the source of gravity
meiosis – part of the cycle of cell division in which the number of chromosomes in the parent cell is reduced by half and four gamete cells are produced
mitosis – part of the cycle of cell division in which chromosomes in a cell nucleus are separated into two identical sets of chromosomes, each in its own nucleus
phototropism – the growth or movement of a plant towards or away from a source of light
tropisms – a growth movement in plants whose direction is determined by the direction from which the stimulus strikes the plant

TOPIC 9: Reproduction

Performance objectives

9.1 Recognise reproduction as the ability of living things to produce new individuals of their type.
9.2 List the different types of reproduction.
9.3 List the forms of asexual reproduction.
9.4 Describe natural and artificial vegetative propagation.
9.5 Describe the process of conjugation and its role in sexual reproduction in unicellular organisms.
9.6 Describe the fusion of male and female gametes and explain the importance of meiosis in sexual reproduction.

Introduction

This topic serves as an introduction to reproduction. Reproduction is necessary to maintain the population of a species. This means that it is a process whereby organisms create more of their own kind. There are two types of reproduction: asexual and sexual. Vegetative reproduction is a form of asexual reproduction and occurs in plants.

Activity 9.1: Observe binary fission in *Paramecium*

GROUPS (SB p.76)

Resources

Prepared slides of *Paramecium* undergoing binary fission and/or images from the light microscope showing binary fission in *Paramecium*

Guidelines

Facilitate: Divide the class into small groups. Allocate a microscope and a prepared slide to each group. Before they start the activity, revise the correct procedure on how to use a microscope. You can also revise the rules for doing biological diagrams. Some of these include:

- drawing diagrams with a sharp pencil
- drawing large, clear diagrams using clear lines
- labelling lines must be parallel to the lines of the page and not using arrow heads at the end of label lines
- giving the diagram a suitable heading
- giving the magnification of the diagram, for example, 100× or 400×

Answers

Students should draw and label their observations. Labels can include the cytoplasm, cell membrane, nucleus, cilia, parent *Paramecium* (original cell), daughter *Paramecia* (new cells).

Assessment

Informal: Teacher assessment – evaluate whether the diagrams are drawn accurately and according to diagram rules. Students must provide a heading for the diagram and the magnification.

Activity 9.2: Observe budding in yeast

GROUPS (SB p.78)

Guidelines

Facilitate: Divide the class into small groups. If possible, allocate a microscope and a prepared slide to each group.

They should notice that the yeast cell is oval or round and has a thin membrane. Under ideal conditions of moisture, temperature, and food supply, it reproduces asexually by budding. When a yeast cell reaches full growth, a budlike swelling forms on its surface. Part of the parent cell's nucleus goes into this bud, and a wall is formed between the parent cell and the bud, which then becomes a separate cell. This new cell may break off when it is fully grown. It may, however, remain attached as it produces another bud. In this way, chains or clusters of cells are formed. Budding is a rapid process, requiring about 20 minutes to produce a new organism.

Answers to Revision questions

1. Reproduction is the ability of living things to produce new individuals. There are two forms of reproduction, sexual (when male and female gametes join together) and asexual reproduction (when the whole or part of an organism produces a new organism).
2. A type of nuclear division that ensures a constant number of chromosomes within the cells of a particular organism or a type of cell division in which a diploid cell divides to form four haploid gametes.
3. Conjugation is a form of sexual reproduction in unicellular organisms that is used under times of stress. It involves the exchange of genetic material between two individuals though a process of fusion.
4. Fertilisation is the fusion of male and female gametes.
5. Gametes are formed through the process of meiosis – a type of cell division called reduction division because each of the gametes has half the number of chromosomes that the parent cell had. In this type of division, a diploid (2n) body cell divides to form four different haploid (n) gametes. Haploid cells have only one set of chromosomes. The chromosomes do not have homologous partners. The haploid (n) number is half the diploid number. Gametes have the haploid number of chromosomes.

How are you doing? SB p.80

Check that the students understand the concepts covered in this topic by allowing them to consolidate the information in a summary format of their choice such as a mind map, concept map or headings and bulleted points. Explain anything that students do not understand. Refer to videos on YouTube related to types of reproduction; asexual reproduction and vegetative propagation.

Key words

binary fission – a method of asexual reproduction that involves the splitting of a parent cell into two approximately equal parts

budding – a form of asexual reproduction in which a new organism develops from an outgrowth or bud that is formed by cell division at one particular site

conjugation – a form of sexual reproduction occurring in unicellular organisms, for example, bacteria, *Spirogyra*

diploid – when a cell has the full set of chromosomes

fertilisation – the joining of a male sex cell (sperm) with a female sex cell (ovum) to form a zygote

gamete – a sex cell

haploid – when a cell has half the usual number of chromosomes

meiosis – a type of cell division whereby a diploid cell divides to form four haploid gametes

spore – a unit of asexual reproduction that may be adapted for dispersal and for survival

vegetative propagation – a form of asexual reproduction in a plant

TOPIC 10: Nutrient cycling in nature

Performance objectives

10.1 Define the carbon and oxygen cycles.
10.2 Explain the process of cycling in these two cycles.
10.3 Explain the importance of the carbon and oxygen cycles.
10.4 Explain the carbon-oxygen balance.
10.5 Define the water cycle.
10.6 Explain the process of cycling in the water cycle.
10.7 Explain the importance of water to plants.
10.8 Explain the importance of water to animals.

Introduction

Nutrients and water are recycled in a circular movement from the physical environment to organisms and back to the environment.

This topic covers the oxygen cycle, the carbon cycle and the water cycle. These are important cycles in ecosystems.

Activity 10.1: Answer questions about the carbon and oxygen cycles

INDIVIDUAL (SB p.83)

Resources

The textbook

Guidelines

Facilitate: Help students to answer the questions but first allow them to discuss the answers.

Answers

1. a) carbon dioxide in air; b) combustion of wood, coal and peat; c) plant respiration; d) carbon compounds in green plants; e) plants eaten by animals; f) dead animals and plants; g) photosynthesis; h) animal respiration; i) respiration of saprophytes
2. photosynthesis
3. respiration, decomposition, combustion
4. a) whether carbon dioxide is required for respiration
   b) gas: oxygen; process: photosynthesis

Assessment

Informal: Self-assessment – check the answers to the activity with the class.

Activity 10.2: Discuss the water cycle

PAIRS (SB p.85)

Resources

The textbook

Guidelines

Facilitate: Allow students time to answer the questions with their partner. Thereafter, check the answers with the class.

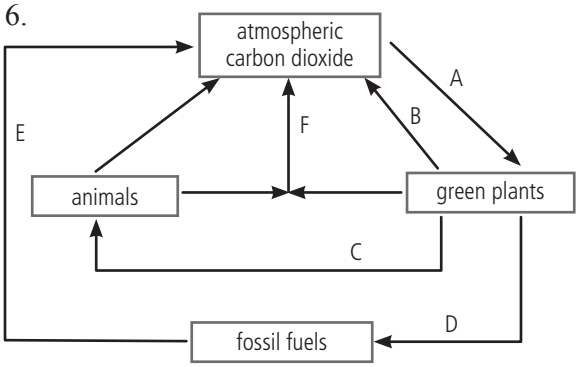
Answers

1. Water is essential for the chemical reactions that take place in organisms and it serves as a medium for the transportation of nutrients. The water cycle effects the environment, for example, rainfall is part of the water cycle.
2. hail, snow, rain, dew, fog, mist, sleet
3. Water vapour condenses on the glass. The substance is a gas which changes to a liquid as it touches the colder surface.
4. Pollution in water has affected the rate of evaporation. Increased global warming due to gases such as carbon dioxide has contributed to higher evaporation rates. Pollutants from factories have caused the rain to become acidic. Humans use water for domestic activities such as bathing and washing. Water is used in industries and agriculture.

Assessment

Informal: Self-assessment – check the answers to the activity with the class.

Answers to Revision questions

1. A: condensation; B: precipitation; C: run-off; D: evaporation
2. snow, hail, sleet, rain
3. hydrogen and oxygen
4. the sun
5. It can be over extracted by humans; used for irrigations, freshwater systems such as rivers, lakes and ponds can become polluted, the ocean gets polluted, rivers are dammed or canalised and this impacts negatively on water run off
6. 

   A – photosynthesis
   B – respiration
   C – digestion
   D – fossilisation
   E – combustion
   F – decomposition
7. Increased combustion of fossil fuels and deforestation which is removing one of the bigger global carbon sinks
8. Plants require water for photosynthesis and seed germination. Animals require water for chemical reactions; to transport substances around the body; for temperature regulation; and water aids excretion.

Assessment

Informal: Teacher assessment

How are you doing? SB p.86

Draw the cycles on the board and leave out some of the words. Students can check their understanding by completing the cycles. At every point of the cycle, discuss how humans have affected the flow of nutrients and water, and suggest solutions to these problems. Explain anything that students do not understand.

Key words

combustion – the burning of fuel in the presence of oxygen; carbon dioxide is released as a by-product of this chemical reaction

condensation – the process of water vapour reducing to water form

decomposition – the breaking down of matter, often with the help of decomposers/ organisms that are able to decompose

fossil fuels – combustible organic materials such as oil, coal, or natural gas, derived from the remains of plant and animal organisms

transpiration – the passage of water from the roots of a plant through to the atmosphere

THEME 2

The organism at work

TOPIC 11: Tissues and supporting systems

Performance objectives

11.1 Define the concept of a skeleton.
11.2 Recognise different skeletal and supporting tissues.
11.3 State the location and arrangement of skeletal and supporting tissues in animals.
11.4 State the functions of the skeleton and supporting tissues in animals.
11.5 Describe the components and functions of the mammalian skeleton.
11.6 Describe the functions of joints and muscles.

Introduction

Organisms need some type of support system to keep their shape, hold their bodies together and allow for movement. This support system in invertebrates and vertebrates is provided by a skeleton. There are three types of skeletons, namely, hydrostatic skeletons, exoskeletons and endoskeletons. This topic focuses mainly on the mammalian endoskeleton.

Activity 11.1: Answer questions about the functions of bones and cartilage

INDIVIDUAL (SB p.90)

Resources

The textbook

Guidelines

This activity can be done as a homework task.

Answers

1. Cartilage is smooth, somewhat flexible, and can be slightly compressed.
   a) The slightly flexible cartilage gives shape to the tip of the nose. The cartilage also provides support.
   b) Cartilage forms the intervertebral discs, which can be slightly compressed and thus absorbs shock and protects the vertebrae from damage. It also provides flexibility to move the back.
   c) Because cartilage is smooth, it allows bones to connect, join or link with one another. The cartilage allows the joints to move smoothly so that the bones do not grind against one another and wear away.
   d) Cartilage rings keep the trachea open and give flexibility to the trachea. The oesophagus lies next to the trachea. The opening of the C shape lies next to the oesophagus. This cartilage gives flexibility when food is swallowed so that air can still pass to the lungs and there is no obstruction.
2. Bones are made up of living cells called osteocytes. Osteocytes need nutrients and oxygen, and to have metabolic waste removed from them. Blood transports nutrients and oxygen to the osteocytes, and also carries waste away from these cells.
3. Red bone marrow is the site where white blood cells, red blood corpuscles and blood platelets are made.
4. C

Assessment

Informal: Self-assessment – check the answers to the activity with the class.

Activity 11.2: Investigate the structure and function of parts of the skeleton

GROUPS (SB p.94)

Resources

The textbook; bones from a butcher including long bones, joints, cartilage and ligaments; a scalpel or sharp knife; a board or plate; paper towel or a cloth; soap; latex gloves; micrographs, photographs and X-rays of bones (if possible); relevant websites such as
https://www.youtube. com/watch?v=jsikuuWpxPU
http://www. dynamicscience.com.au/tester/solutions1/biology/bonedissection/bonedissection.htm
https://askabiologist.asu.edu/bone-lab

Guidelines

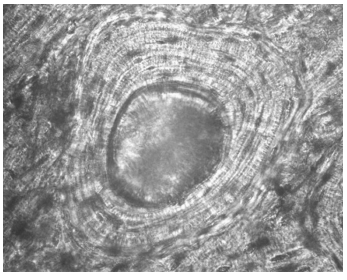
Some students may be squeamish at the thought of a dissection. They should sit quietly at their desks and try to find out information about the structure of bones from reference books and/or relevant websites.

Answers

1. Examine long bones

c) Students will see the features of the long bone in cross section. Let them examine Figure 11.1 on page 92 of the Student's Book

d) Students can draw a cross section of the bone if you have a prepared slide or micrograph, such as the one below.



e) The bones are hard and inflexible, so they cannot be bent.

2. Examine bone, cartilage, tendons and ligaments

Students will identify the features of the bones they have brought from the butcher.

3. Examine ligaments and tendons

a)

	Ligament	Tendon
Structural	Has a large number of yellow elastic fibres.	Has a large number of white non-elastic fibres.
Functional	Joins bone to bone at joints.	Attaches muscle to bone.

b) Ligaments need to be elastic so that they can stretch a little to allow bones to move at the joints. Tendons cannot stretch because they have to be able to transmit the contraction and relaxation of the muscles to the bones so that movement can take place.

c) Tendons would not be able to transmit the contraction and relaxation of the muscles to the bones, and so no movement would take place.

d) When a dislocation occurs, ligaments are also damaged, stretched or torn. Therefore, it becomes easier for bones to move out of position.

e) You would be unable to move your foot because the Achilles tendon attaches the muscles of the leg to the heel of the foot.

Assessment

Informal: Self-assessment – check the observations and answers to the activity with the class.

Teacher assessment – evaluate the diagrams in terms of accuracy, proportion, labels, neatness and headings.

Activity 11.3: Investigate the role of joints in locomotion

INDIVIDUAL (SB p.96)

Resources

The textbook

Guidelines

This activity can be done as a homework task.

Answers

1. The synovial membrane secretes synovial fluid, which lubricates the joint and reduces friction between bones in joints.
2. The elbow joint is a hinge joint so it permits movement in one plane only. Two other hinge joints are the knee joint and the joints in the ankle.
3. The hip joint is also a ball-and-socket joint.

Assessment

Informal: Self-assessment – check the answers to the activity with the class.

Answers to Revision questions

1. Hydrostatic skeletons are found in invertebrates such as earthworms. This type of skeleton is made up of a fluid-filled cavity that is surrounded by muscles. It provides support and is flexible.
2. Animals with a hydrostatic skeleton cannot grow very large.
3. The vertebrate skeleton provides support, protection, movement, blood cell formation and mineral storage:
   - *Support*: The skeleton supports and anchors the muscles in the body. The vertebral column and leg bones are especially important for support.
   - *Protection*: It protects some of the soft tissues and organs inside the body. The bones of the skull, the vertebral column and rib cage all protect soft tissues and organs inside them.
   - *Movement*: The bones give the muscles something to pull on, and so the skeleton helps the body to move.
   - *Blood cell formation*: Some bones contain regions in which red blood corpuscles and white blood cells are produced. The ribs, skull, sternum and pelvis contain specific regions for producing blood components.
   - *Mineral storage*: Bones are a reservoir for calcium and phosphorus, the deposits and withdrawals of which help maintain the iron concentrations in body fluids, especially blood.
4. Both cartilage and bone make up the endoskeleton (the skeleton found on the inside of mammals). Both are living tissues and are composed of cells (chondrocytes in cartilage and osteocytes in bone), which secrete the intercellular matrix. Bone is very hard and rigid, while cartilage is tough and flexible. This is because of the difference in the composition of the intercellular matrix. The intercellular matrix in bone is hard and stiff because it contains a chemical called calcium phosphate. The intercellular matrix in cartilage, on the other hand, is not rigid because it does not contain calcium phosphate.
5. The axial skeleton and the appendicular skeleton
6. The axial skeleton consists of:
   - the skull: cranial bones and facial bones
   - the rib cage: sternum (breastbone) and ribs (12 pairs)
   - the vertebral column: vertebrae (26) and intervertebral discs.
7. The appendicular skeleton is divided into two sections: the pectoral (shoulder) girdle and the pelvic (hip) girdle. The upper (anterior) limbs are attached to the pectoral girdle and the lower (posterior) limbs are attached to the pelvic girdle.
   - The pectoral girdle consists of the following:
     - clavicle (collarbone) and scapula (shoulder blade)
     - arm bones: humerus, radius and ulna
     - hand bones: carpals, metacarpals and phalanges (fingers).
   - The pelvic girdle consists of the following:
     - fused bones at the hip
     - leg bones: femur (thigh bone), patella (kneecap), tibia and fibula
     - foot bones: tarsals, metatarsals and phalanges (toes).
8. The pectoral girdle.

Assessment

Informal: Teacher assessment

How are you doing? SB p.98

Students should summarise this topic using headings and sub-headings. Key words and concepts can be added under these headings. Prepare a short class test to check the students' knowledge of the diagram labels. Students must learn the scientific names of the bones such as *clavicle* instead of *collarbone*. Explain anything in this topic that students do not understand.

Key words

appendicular skeleton – part of the skeleton that consists of the pectoral (shoulder) girdle and the pelvic (hip) girdle

axial – of, forming, or relating to an axis

bone – any of the pieces of hard, whitish tissue making up the skeleton in humans and other vertebrates

cartilage – firm, whitish, flexible connective tissue found in various forms in the larynx and respiratory tract, in structures such as the external ear, and in the articulating surfaces of joints

chitin – a fibrous substance forming the major constituent in the exoskeleton of arthropods and the cell walls of fungi

endoskeleton – an internal skeleton, such as the bony or cartilaginous skeleton of vertebrates

exoskeleton – a rigid external covering for the body in some invertebrate animals, providing both support and protection

hinge joints – bone joints in which the articular surfaces are moulded to one another in such a way that they permit motion in one plane only

hydrostatic skeleton – a structure found in many ectothermic organisms and soft-bodied animals consisting of a fluid-filled cavity, the coelom, surrounded by muscles

joints – structures in the bodies of humans or animals at which two parts of the skeleton are fitted together

ligaments – short bands of tough, flexible, fibrous connective tissue that connects two bones or cartilages or holds together a joint

pectoral girdle – the skeletal framework that provides attachment for the forelimbs or pectoral fins, usually consisting of the scapulae and clavicles

pelvic girdle – the enclosing structure formed by the pelvis, providing attachment for the hind limbs or pelvic fins

ribs – the curved bones of the chest that are joined to the backbone and help to stiffen the body wall and protect the organs

skeleton – an internal or external framework of bone, cartilage, or other rigid material supporting or containing the body of an animal or plant

skull – a framework of bone or cartilage enclosing the brain of a vertebrate; the skeleton of a person's or animal's head

striated muscle – muscle tissue in which the contractile fibrils in the cells are aligned in parallel bundles, so that their different regions form stripes visible under a microscope

synovial joints – joints in which the opposing bony surfaces are covered with a layer of cartilage, which allows some degree of free movement

tendons – flexible but inelastic cords of strong fibrous collagen tissue attaching a muscle to a bone

vertebrae – each of the series of small bones forming the backbone, having several projections for articulation and muscle attachment, and a hole through which the spinal cord passes

vertebral column – the series of vertebrae that forms the supporting axis of the body in vertebrate animals

TOPIC 12: Supporting tissues in plants

Performance objectives

12.1 State the different types of supporting tissue in plants and the arrangement of these supporting tissues.
12.2 Describe the structure and function of parenchyma, collenchyma and sclerenchyma and secondary xylem as supporting tissues.
12.3 State the functions of supporting tissues in plants and how these functions are performed.
12.4 Describe the basic structure of the roots and stems of herbaceous plants.

Introduction

The word *support* means to hold upright or to give strength. Aquatic organisms get support from water. Plants and animals living on land require stronger support systems as air offers their bodies little support against gravity. Topic 11 covered supporting tissues in animals, with particular emphasis on humans. This topic is about support and strengthening tissues in plants.

Activity 12.1: Examine root and stem structure

GROUPS (SB p.102)

Resources

The textbook; microscope; micrographs of cross sections of roots and stems; a sharp HB pencil and drawing paper; coloured ink/food colouring; microscope slides; cover slips; a scalpel; specimens of celery or pumpkin stalks; iodine

Guidelines

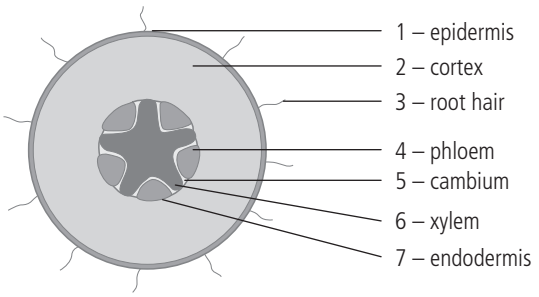
This activity allows students to see root and stem structure under the microscope or using photomicrographs. You can use the following websites and others to help you prepare for this practical:
http://cnx.org/contents/KEw8cK8O@3.1:pPKTz_LG@1/211---Anatomy-of-dicotyledenou
http://www.d.umn. edu/~lshannon/biol1012/lab/exercises/documents/Ex3-plantstructure.pdf
http://www.ocr.org.uk/Images/231594-transport-systems-in-plants-delivery-guide.pdf.

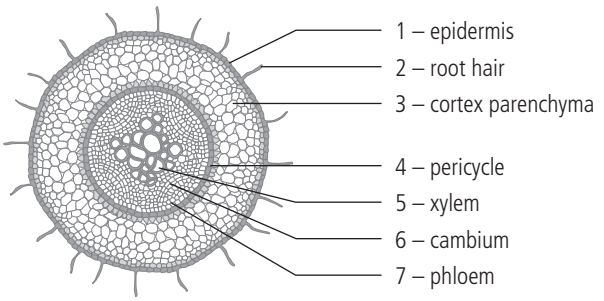
Try to get some micrographs from a Botany department at a university or download some from the Internet. Also try to refer to drawings in a plant anatomy book.

Assessment

Informal: Teacher assessment – use the diagrams in the topic to check the students' drawings. Also evaluate them in terms of accuracy, proportion, neatness, labels and headings. The diagrams must be large and clear.

Answers to Revision questions

1. Plant supporting tissue includes parenchyma, collenchyma and sclerenchyma.
2. Sclerenchyma is the main supporting tissue in plants.
3. Collenchyma is the supporting tissue that is found more in plants growing in windy conditions.
4. 

5. 

Assessment

Informal: Teacher assessment

How are you doing? SB p.103

Students should make a table that includes the following: name of tissue; a labelled diagram of a few cells of the tissue; a description of the tissue; functions of the tissue. Students must be able to identify parenchyma, sclerenchyma and collenchyma in a transverse section of a dicotyledonous root and stem. Explain anything in this topic that students do not understand.

Key words

cellulose – an insoluble substance that is the main constituent of plant cell walls and of vegetable fibres such as cotton

collenchyma – the supportive tissue of plants, consisting of elongated living cells with unevenly thickened, non-lignified walls

lignin – a complex organic polymer deposited in the cell walls of many plants, making them rigid and woody

parenchyma – the functional tissue of an organ as distinguished from the connective and supporting tissue

root – the part of a plant that attaches it to the ground or to a support, typically underground, carrying water and nourishment to the rest of the plant via numerous branches and fibres

sclereids – types of sclerenchyma cells that are irregular in shape; the cell walls are thick, hard and lignified, which makes the lumen very small

sclerenchyma – a protective or supporting tissue in higher plants composed of cells with thickened and often lignified walls

secondary xylem – xylem laid down by a meristem called the vascular cambium in woody plants

stem – the main body or stalk of a plant or shrub, rising above ground but occasionally subterranean

TOPIC 13: Nutrition in animals

Performance objectives

13.1 Define what food substances are.
13.2 List types of food substances.
13.3 Discuss the importance of a balanced diet.
13.4 Name the digestive enzymes and their characteristics, classes and functions.

Introduction

This topic covers the five food groups that are necessary for a balanced diet. Students should enjoy the food tests in this topic. Allow them to do these in small groups, but if your budget/equipment is limited, do demonstrations instead.

Note: Gather all of the resources for the activities before you start the topic.

Activity 13.1: Test for the presence of fats and oils (the translucent spot test)

GROUPS (SB p.104)

Resources

A small amount of oil; ethanol; test tubes; filter paper; a test tube rack

Guidelines

Facilitate: Help students to understand why it is necessary to have a control in this test (a drop of ethanol solution only – no oil).

Answers

1. Light can pass through the paper, but it is not transparent.
2. ether/methylated spirits

Assessment

Informal: Self-assessment – check the observations and answers to the questions with the class.

Activity 13.2: Test for the presence of proteins (Millon's reagent test)

GROUPS (SB p.105)

Resources

Egg white; water; test tubes; Millon's reagent; a water bath; a heat source; a test tube rack

Guidelines

Facilitate: Millon's reagent is highly toxic and corrosive. As it is considered hazardous waste, it needs to be disposed of correctly. Therefore, this activity should be discussed as a theoretical exercise or be conducted under tightly controlled conditions.

Assessment

Informal: Self-assessment – discuss this experiment with the class.

Activity 13.3: Carry out an alternative test for proteins (the Biuret test)

GROUPS (SB p.106)

Resources

Dilute solutions of sodium hydroxide and potassium hydroxide; test tubes; copper sulphate; egg white; a pipette; a test tube rack; different food substances (optional)

Guidelines

Students must exercise caution with the chemicals in this experiment, even though they are dilute. This is a qualitative test enabling comparison of the protein content in foods. A darker blue shows the presence of more protein. You can show the class a video clip of this experiment such as
https://www.youtube. com/watch?v=ufec89A47uM
https://www. youtube.com/watch?v=L4Rjpp8x9-A
https://www.youtube.com/watch?v=dVTFknTPJY0.

Facilitate: Help students to follow the instructions in this test and to understand why it is necessary to have a control (a solution with no egg white).

Answers

1. albumin
2. milk or any meat

Assessment

Informal: Self-assessment – discuss the observations and answers to the questions with the class.

Activity 13.4: Test for the presence of reducing sugars

GROUPS (SB p.106)

Resources

Fehling's A solution; Fehling's B solution (You can use Benedict's solution instead of Fehling's); glucose; test tubes; a source of heat – a water bath; chalk; a test tube rack; a pipette

Guidelines

Refer students to the following websites: https://www.youtube.com/watch?v=Lt7RCIfudYQ; http://assets.cambridge.org/97805217/21752/excerpt/9780521721752_excerpt.pdf

Facilitate: Help students to interpret the results.

Answers

1. So that the heat is evenly distributed.
2. fructose, lactose and maltose

Assessment

Informal: Self-assessment – discuss the observations and answers to the questions with the class.

Activity 13.5: Test for the presence of starch

GROUPS (SB p.107)

Resources

Starch solution; iodine solution; test tubes; glucose; a test tube rack; a pipette

Guidelines

Facilitate: Help students to understand why it is necessary to have a control in this test (non-starch solution).

Answers

1. Bread, rice, yams, maize meal, and so on.
2. Chalk, glucose, egg albumin, and so on.
3. Add some starch to the solution. If a blue-black colour is produced, then iodine is present in the solution.

Assessment

Informal: Self-assessment – discuss the observations and answers to the questions with the class.

Activity 13.6: Classify different foods

GROUPS (SB p.107)

Resources

A paper plate; different kinds of food such as yams, *garri*, butter, cooking oil, salt, fish, prawns, pepper, cowpeas, crabs and onions

Guidelines

Ensure that you use a variety of foods for each group. Place a small amount of each food on a large paper plate. Label foods that are difficult to identify by writing on the plate.

Answers

1. The answer depends on the foods used.
2. Students will make a table depending on the types of food provided for them.

Assessment

Informal: Self-assessment – make a table on the board and add the foods to different columns. Students must check their answers.

Activity 13.7: Study the nutritional composition of foods

INDIVIDUAL (SB p.110)

Resources

The textbook; a calculator

Guidelines

Facilitate: Help students by going through the rules for drawing pie charts before they do the activity. Refer to a website for this information. A suggested example is: as http://www.bbc.co.uk/schools/gcsebitesize/maths/statistics/representingdata1rev2.shtml. Assist students with the calculations.

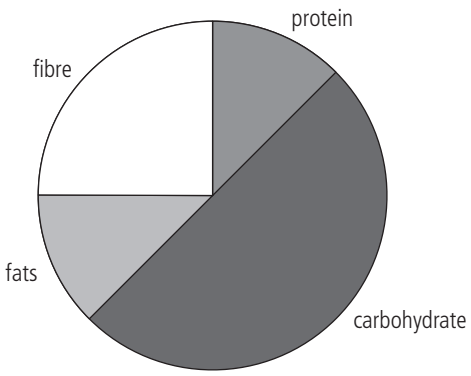
Answers

1. a) Protein is an important component of cell membranes; enzymes are special proteins; it is an important component of chromosomes; it is an important

component of protoplasm; it serves as a reserve energy source; is a component of hormones (any two)

b) Fibre reduces the transit time of food in the alimentary canal; it adds bulk to the undigested material in the colon; it absorbs and retains water; it reacts with various poisonous substances and prevents it from being absorbed into the blood; it encourage peristalsis; reduces forming of haemorrhoids (any two)

2. $\frac{100\text{ g} \times 5\,500\text{ kJ}}{2\,000}$
   = 275 g/0,275 kg

3. 

Assessment

Informal: Self-assessment – show the workings for Question 2 and draw the pie chart in Question 3 on the board.

Activity 13.8: Break down starch

GROUPS (SB p.111)

Resources

Bread or crackers; something to break up the bread or crackers, such as a pestle and mortar; test tubes and dropping pipettes; iodine; a test tube rack

Guidelines

Facilitate: Help students to understand why it is necessary to have a control in this test (the test tube without saliva). Do not force students to add their saliva if they are not comfortable doing this.

Assessment

Informal: Self-assessment – discuss the observations with the class.

Activity 13.9: Observe the effect of pH on salivary amylase

GROUPS (SB p.111)

Resources

Bread or crackers; something to break up the bread or crackers, such as a pestle and mortar; test tubes; dropping pipettes; hydrochloric acid; sodium hydroxide; iodine

Guidelines

Students must exercise caution with the chemicals in this experiment, even though they are dilute.

Facilitate: Help students to follow the instructions. Do not force students to add their saliva if they are not comfortable doing this.

Answers

1. Salivary amylase cannot function if conditions are too acidic (below pH 5.6).
2. Salivary amylase functions in slightly alkaline conditions, but does not work if alkalinity is too high.
3. Amylase works in neutral conditions.
4. Students will find that salivary amylase works best in slightly alkaline conditions – pH 7.4, which is consistent with saliva.

Assessment

Informal: Self-assessment – discuss the observations and answers to the activity with the class.

Activity 13.10: Observe the effect of temperature on salivary amylase

GROUPS (SB p.111)

Resources

Bread or crackers; something to break up the bread or crackers, such as a pestle and mortar; test tubes; dropping pipettes; spotting tiles; ice; iodine; a source of heat such as a Bunsen burner; safety goggles

Guidelines

Facilitate: Help students to follow the instructions. Ensure that they follow safety rules when heating a substance. Do not force students to add their saliva if they are not comfortable doing this.

Answers

1. There was no reaction with iodine when the enzyme was boiled, showing that it did not break down starch – the enzyme denatures.
2. In very cold conditions, there was no reaction with iodine when the enzyme was boiled, showing that it did not break down starch.
3. Room temperature is getting closer to body temperature so it is nearly as effective as 37 °C – at room temperature, there may have been some breakdown of starch and so a slight reaction with the iodine, but if the room is cool enough, there will be no reaction.
4. Best reaction – most starch was broken down. At body temperature, the starch was broken down and the solution turns blue-black with the addition of iodine.
5. 37 °C (36,9 °C) – is body temperature. The action of enzymes is affected by pH and temperature. Enzymes work best at the pH and temperature that is found in living organisms.
6. The action of the enzyme increases in rate until a certain temperature and then the enzyme denatures.

Assessment

Informal: Self-assessment – check the observations and answers to the questions with the class.

Answers to Revision questions

1. Your body needs nutrients to survive and to stay healthy.
2. Fats provide energy. One gram of a lipid provides more than twice the amount of energy of one gram of carbohydrate. But, because the biological processes that are needed to release energy from fats in the cell are long and complicated, cells use carbohydrates for energy more easily than they use fats. Fat provides a layer of insulation under the skin for warmth. Fats are also found in the myelin sheaths that surround nerve cells. Fats in the diet also allow the body to use fat-soluble vitamins.
3. Proteins are part of the building materials of all cell membranes, chromosomes, cytoplasm and cell organelles. All enzymes and some hormones are made up of proteins. Proteins are also necessary for the immune system to work properly.
4. Calcium is essential for bones and teeth. Calcium ions are needed in the blood for clotting and calcium is important in cell membrane permeability.
5. The disease is anaemia.
6. The disease is rickets.
7. Two common forms of malnutrition are kwashiorkor and marasmus. Kwashiorkor is the result of a high intake of carbohydrate with too little protein. Marasmus is a severe lack of nutrients in all food groups. These two nutrition disorders are usually seen in children in resource-poor areas.
8. Fats: chips, olive oil, avocado pear, nuts, olive
   Protein: fish, chicken, meat, lentils, beans
   Carbohydrate: bread, potatoes, pasta, rice, some vegetables and fruit
9. An enzyme is a protein molecule that acts as a biological catalyst because it speeds up biochemical reactions. Enzymes are specific to the substrates that they act on. For example, all enzymes that act on proteins are called proteases. So proteases will not be able to break down carbohydrates. In addition, they work best at particular environmental conditions such as pH and temperature.
10. Salivary amylase breaks down starch.

How are you doing? SB p.112

Take this opportunity to ask students if there is anything that they do not understand. Go over the purpose (aim), method, results and conclusion of each experiment. Explain anything that students do not understand.

Key words

carbohydrates – substances consisting mainly of sugars and starches, one of the main energy-providing nutrients

enzymes – proteins that enable chemical reactions to take place

fats and oils – organic substances that serve as essential nutrients in the body by providing energy

lipids – the term used for both fats and oils. A fat is a lipid that is solid at room temperature. An oil is a lipid that is liquid at room temperature.

mineral – an inorganic substance that is essential to the functioning of the body and is obtained from foods

proteins – a substance found in foods such as milk, meat, cheese, eggs and beans

vitamins – organic substances found in small amounts in some food

TOPIC 14: Modes of nutrition

Performance objectives

14.1 List types of heterotrophic nutrition and feeding mechanisms in holozoic organisms.
14.2 Describe the feeding mechanism in holozoic organisms (including filter feeding and fluid feeding).
14.3 List types of mammalian teeth and describe their structure.
14.4 State the dental formula and adaptations of dentition to mode of nutrition.

Introduction

This topic covers different ways of feeding. Organisms that make their own food are autotrophic, while heterotrophs depend on autotrophs for food, either directly or indirectly. Holozoic organisms are heterotrophs that use the processes of ingestion, digestion and assimilation to obtain nutrition. Holozoic animals also have specialised structures for feeding, as well as mechanisms to obtain their food. Most animals are holozoic.

Activity 14.1: Find out how different types of teeth are related to lifestyle

INDIVIDUAL (SB p.116)

Resources

The textbook; different types of skulls or pictures/images of skulls

Guidelines

Set out some workstations of skulls as well as information relating to teeth adaptation and feeding. You can also prepare a short worksheet on how dentition is related to diet.

Answers

1. Plant material. They have sharp incisors for cutting blades of grass, large flat premolars and molars to grind the plant material, a large toothless gap (diastema) to assist in moving the food around the mouth, storing the food and eating a greater amount of food.
2. Meat. Their teeth are suited to tearing meat: pointed incisors; well-developed canines; sharp edges on premolars and molars.

Assessment

Informal: Self-assessment – discuss the answers to the questions with the class.

Answers to Revision questions

1. a) Autotroph: an organism capable of making its own food from inorganic substances using light or chemical energy
   b) Heterotroph: an organism that cannot make its own food and depends on other organisms for food
   c) Symbiotic: living in symbiosis, or having an interdependent relationship
   d) Parasite: an organism that lives on or in an organism of another species, from which it obtains food
   e) Saprophyte: any organism that lives on dead organic matter
2. a) Autotroph: green plants, algae, and certain bacteria
   b) Heterotroph: animals
   c) Symbiotic: sea anemones and hermit crabs
   d) Parasite: ticks
3. All animals, fungi, protozoa and some bacteria are heterotrophic. They depend on autotrophs for food, either directly by eating the plants, or indirectly by eating animals that have eaten the plants. Heterotrophs may be holozoic, which means that they take in complex organic food, which is digested and then used by their own bodies.
4. Dentition is the development of teeth and their arrangement in the mouth. In particular, it is the characteristic arrangement, kind, and number of teeth.
5. Incisors are at the front of the mouth and have a sharp edge, which is used for biting off pieces of food.

Canines are on either side of the incisors and are sharply pointed and used for biting and tearing food.
Premolars and molars are large teeth at the back of the mouth, which are used for crushing and chewing food.

6. Herbivores eat plants; carnivores eat animals and omnivores eat plants and animals.

How are you doing? SB p.118

Check that students understand the two main types of nutrition. They must be able to explain these concepts and support them with examples. Students must understand how the feeding structures in holozoic animals relate to their function. Explain anything that students do not understand.

Key words

autotroph – an animal that makes its own food
filter feeders – animals that feed on suspended matter
fluid feeders – organisms that feed on fluids only
heterotrophs – animals that cannot make their own food
holozoic – feeding on solid food particles
parasite – an organism that lives on or in another organism, often harming it
phagocytosis – the engulfing of food particles by means of a pseudopodium
saprophyte – an organism that lives on dead organic matter
symbiotic – a feeding relationship that is interdependent

THEME 3

The organism and its environment

TOPIC 15: Basic ecological concepts

Performance objectives

15.1 Name components of any ecosystem.
15.2 Mention major local biotic communities.
15.3 Give names of organisms typical of each community.
15.4 Briefly describe different types of communities in tropical and temperate regions.
15.5 Name ecological factors common to all habitats.
15.6 Briefly describe each of the factors pointing out their relative importance.
15.7 Mention the factors that affect water-retentivity of soil types and determine the amount of water each soil type can hold.
15.8 Understand how local biome communities operate (tropical rainforests, southern Guinea savannah, northern Guinea savannah, Sahel savannah, deserts, swamps, etc.)

Introduction

This topic is about ecology. The introduction explains the meaning of ecology, thereafter the meaning of some important ecological terms, and then explanations of biotic and abiotic factors. This topic is also about biomes and focuses on the biomes of Nigeria. These include tropical rainforests, swamp forests, the savannah and deserts.

Activity 15.1: Answer questions about levels of organisation

INDIVIDUAL (SB p.121)

Resources

The textbook

Guidelines

Facilitate: Help students to answer any questions that they do not understand.

Answers

1.

Organism	My grandfather told me about a genet (wild cat) that sometimes raids the chickens on his neighbour's property.
Population	There was a family of mongoose sniffing around his yard.
Community	I came across a lot of millipedes, termites and flies in the field.
Ecosystem	We went for a walk to a small forest, which was full of birds and antelope, with a cool, clear stream running through it.

2. Organism, community, population, ecosystem, biome
3. Students should include basic concepts such as 'self-contained area or unit'; they should recognise that in an ecosystem, all living organisms interact with one another and with the non-living components of the physical environment. Many different species usually live together in the same place and they all need energy and resources from the environment to survive.
4. B
5. a) biosphere
   b) synecology
   c) niche
   d) community
   e) species

6. D
7. B

Assessment

Informal: Self-assessment – check the answers to the activity with the class.

Activity 15.2: Identify the components of an ecosystem

PAIRS (SB p.123)

Resources

The textbook

Guidelines

Facilitate: Students must discuss the answers with their partners. Thereafter, check the answers with the class and discuss anything that they do not understand.

Answers

1. Living things: human; eagle; dragonfly; trees; fish; hippopotamus; frog; grass; water plants
   Non-living things: water, soil, air
2. Animals are dependent on plants for food. All living organisms are dependent on the abiotic factors in the ecosystem, for example, animals in the river require dissolved oxygen and certain pH levels and temperature ranges.
3. Animals breathe out carbon dioxide. Plants need carbon dioxide for photosynthesis. Plants give off oxygen, a by-product of photosynthesis. Animals breathe in oxygen. There are feeding relationships in ecosystems, for example, the frog eats the dragonfly, the man eats the fish, the hippopotamus eats the grass.
4. wind, rain

Assessment

Informal: Self-assessment – check the answers to the activity with the class.

Activity 15.3: Revise what you know about ecosystems

INDIVIDUAL (SB p.123)

Resources

The textbook

Guidelines

Facilitate: Set this as a homework task so that students can research any questions that they do not understand.

Answers

1. A. primary consumer, herbivore
   B. secondary consumer, carnivore
   C. autotroph
   D. secondary consumer, omnivore
   E decomposer
2. a) tertiary
   b) producers
   c) heterotrophs
3. Herbivores eat plants and are primary consumers. Examples are giraffes and buffaloes. Carnivores eat meat (they prey on other animals), and they are secondary/tertiary/quaternary consumers (depending on the food chain/web). Examples are lions and eagles.
4. A decomposer (such as a termite, earthworm or dung beetle) breaks down dead organic matter (leaves, rotten wood etc.) and, in so doing, returns important nutrients to the soil.
5. D
6. B
7. A

Activity 15.4: Answer questions about biomes

INDIVIDUAL (SB p.128)

Resources

The textbook

Guidelines

Facilitate: Set this as a homework task so that students can research any questions that they do not understand.

Answers

1. A biome is a large, natural geographical area characterised by a specific type of climate, for example, desert biomes are hot and dry. The vegetation in the biomes is suited to the abiotic factors.
2. climate, soil, landform, fire
3. Tropical rainforests – large amounts of rain in the year, about 2 000 mm
   Swamp forests – high humidity
   Savannah – made up of grasses and trees
   Desert – extremely hot in the day and very cold at night
4. a) True
   b) False. Biomes blend into one another naturally. Animals often migrate between biomes, for example, antelope and bird species.
   c) False. The average rainfall can be 500 mm per annum. Grasses do not require a lot of rainfall to survive and have adaptations such as bulbs and corms to survive dry periods.
   d) True

Activity 15.5: Investigate the water-holding capacity of soil GROUPS (SB p.128)

Resources

The textbook; three plastic pots; three plastic containers; three sheets of fine wire mesh, slightly larger than the size of the cover of the plastic container; 600 ml of water; a sack of sand; a sack of clay; a sack of loamy soil; a weighing machine; a measuring cylinder; a marker pen

Guidelines

Revise the scientific method before starting this experiment. Students can write an aim and a hypothesis for the investigation. They should also list the factors that must be controlled so not to interfere with the results. These factors include things such as using the same amount of soil (up to 20 mm from the top) and the same amount of water (600 ml). Each group should appoint one person to weigh the pots and add the 200 ml of water to the pot on the second day.

Facilitate: Help the groups to follow the instructions.

Answers

The sandy soil will lose the most amount of water, then the loam soil. The clay soil retains the most amount of water.

Assessment

Informal: Self-assessment – check the observations and answers to the activity with the class.

Answers to Revision questions

1. a) Autecology is a sub-field of ecology dealing with the dynamics of species populations and their interaction with the environment.
   b) Autecology looks at how population sizes change over time and space. Synecology is the branch of ecology that deals with the interrelationships among communities of organisms at the community level. It investigates the relationships between different species that form a community and their interactions with the surrounding environment.
2. a) biosphere
   b) population
   c) species
   d) community
   e) biome
   f) habitat
   g) abiotic
   h) edaphic
3. 1 D; 2 C; 3 A; 4 B
4. Sandy soil has very coarse grains. This makes it difficult for it to hold water. Therefore, sandy soils are dry and very light.

   Clay soil is typically very fine-grained and is able to retain water very easily. Water drainage properties are very poor.

   Loam is typically very rich in nutrients and water. It is considered a very fertile soil. It has very good drainage properties and is also able to retain water.

How are you doing? SB p.130

Take this opportunity to ask students if there is anything that they do not understand. This topic serves as a foundation for topics that will be covered in Term 3 and in SS2. It is therefore important that students consolidate this material and understand the concepts.

Key words

abiotic – the non-living components of an ecosystem
atmosphere – the gaseous envelope surrounding the Earth
autecology – the branch of ecology that deals with the individual organism or species in relation to its environment
biome – a complex biotic community with distinctive plant and animal species under very specific climatic conditions
biosphere – the part of the Earth and its atmosphere in which living organisms exist or that is capable of supporting life
biotic – the living components of an ecosystem
community – a group made up of all the populations of various organisms in a particular area
consumer – an organism that feeds on another organism (usually plants or other animals)
desert – a dry, sandy region with little rainfall, extreme temperatures, and sparse vegetation
ecology – a branch of Biology that deals with the relations and interactions between organisms and their environment
ecosystem – the interaction of a community of organisms with the environment
environment – everything surrounding an organism that could influence it
habitat – the natural environment of an organism, where it lives, grows and reproduces
hydrosphere – the water on or surrounding the surface of the globe, including the water of the oceans and the water in the atmosphere
lithosphere – the outer part of the Earth, consisting of the crust and upper mantle, about 100 km thick
niche – a position or function of an organism within a plant or animal community
population – a group of organisms of one species that interbreed and live in the same place at the same time
producer – an organism that is able to produce its own food (plants)
precipitation – any form of water, such as rain, snow, sleet, or hail, that falls to the Earth's surface
rainforest – a tropical forest that receives a lot of rain and that has very tall trees
saline – consisting of or containing salt
savannah – a plain characterised by coarse grasses and scattered tree growth, especially on the margins of the tropics where the rainfall is seasonal
swamp – land that is always wet and often partly covered with water, and is often unsuited to cultivation
synecology – the branch of ecology that deals with the relations between natural communities and their environments
wetlands – areas where water covers the soil, or is present either at or near the surface of the soil

TOPIC 16: Population ecology

Performance objectives

16.1 Measure or estimate sizes of some ecosystems.
16.2 Relate the dynamic nature of an ecosystem to its size.
16.3 Define the concepts of population size, population dominance and population density.
16.4 Explore different methods of population study (the use of quadrants, transects, mark re-capture).
16.5 Identify factors that affect population (food supply, mortality, natality, migration, etc.).
16.6 Apply simple measurement practices of ecological factors.

Introduction

A population refers to the number of individuals of the same species living in a definite area. The members of a population interbreed with one another. This topic is about populations, with a focus on the factors affecting the size of populations and the methods used by biologists to measure the size of populations.

Activity 16.1: Answer questions about population

INDIVIDUAL (SB p.133)

Resources

The textbook

Guidelines

Facilitate: Students must discuss the questions with their partners. Give them time to do this. Thereafter, check the answers with the class.

Answers

1. Students provide their own explanations. They must include: same species and same area.
2. a) Trout in a lake – one species in an environment
   b) Each species of bird in the tree is a separate population.
   c) Each species of butterfly in the garden is a separate population. Each species of ladybird in the garden is a separate population.
   d) Students in a school – all humans in an environment
3. The elephants are all the same species in a particular defined area. They are thus considered a population.
4. The term *antelope* refers to various species (impala, duiker, suni, etc.), not to a single species
5. Natality is the term for births. If the natality increases, the population increases, and vice versa.
6. Mortality is the term for deaths. If the mortality increases, the population decreases. If mortality rates decrease, populations increase.
7. When there is limited space, limited resources and mortality rates decrease. This leads to a population explosion.
8. When too many individuals die and there are not enough individuals to continue producing more of the species. This could result in extinction of a population.

Assessment

Informal: Self-assessment – check the answers to the questions with the class.

Activity 16.2: Use beans to practise the mark-recapture method

GROUPS (SB p.134)

Resources

Two cups of dried beans; two trays/large plates; a marker pen; a calculator

Guidelines

Facilitate: Help students to link the beans with individuals of a population and the same type of substance (bean) with the same species. Explain that it is necessary to repeat this three times for an accurate count.

Answers

10. Students' answers should be close to 500 if they have followed the instructions carefully.

Assessment

Informal: Self-assessment – discuss the activity with the class, ensuring that they understand the relevance to a method to measure a population.

Activity 16.3: Measure the photoperiod (light) of an ecosystem

GROUPS (SB p.136)

Resources

A pen; paper; graph paper

Guidelines

Depending on the flowers in your local area, you can allocate different flowers to the partners. Students can share their results and draw the line graphs in class. Revise the skill of drawing a line graph. You can refer students to websites such as: https://www.sedl.org/afterschool/toolkits/science/pdf/ast_sci_line_graphs_guidelines.pdf.

Facilitate: Help students to draw the graphs and interpret their results.

Assessment

Informal: Self-assessment – discuss the activity with the class, ensuring that they understand that the photoperiod is the length of time in a 24-hour day when an organism is exposed to light. They should be able to determine the number of hours that the flower they observed is exposed to light and dark. They should be able to determine whether this is the same each day. They can compare their results with other pairs in the class.

Activity 16.4: Measure the plant and animal diversity in an ecosystem

GROUPS (SB p.136)

Resources

A pencil; paper; crayons/Kokis; wooden sticks; string; a metre stick or measuring tape or string; a field guide to plants and animals in your ecosystem (if necessary)

Guidelines

Make wooden quadrats of 4 or 5 m^2. Prior to the activity, identify five or six suitable areas in or close to the school grounds. Emphasise to the groups that the ecosystems need to be left as they found them – they must not damage or harm any organisms.

Facilitate: The main focus of the activity is to determine the diversity of species in the area. However, you can assist the groups to identify some of the organisms.

Answers

Answers will vary according to the ecosystem investigated.

Assessment

Informal: Self-assessment – discuss the activity and the answers to Questions 10 and 11 with the class.

Answers to Revision questions

1. a) The size of a population changes all the time. Factors that increase the size of a population are natality and immigration.
   b) Factors that lead to a reduction in the size of a population are mortality and emigration.
   c) A population will grow when the birth rate exceeds the death rate. The three population sampling methods commonly used by ecologists are: quadrat sampling, transect sampling and the mark-recapture method.
2. Students can list any four of the following:
   - quadrat – used to estimate the density of a population in an area
   - caliper – used to estimate the size of an organism
   - soil pH meter – used to measure the acidity of the soil
   - temperature probe – used to measure the soil temperature
   - thermometer – used to measure the air temperature
   - wind vane – used to measure wind direction
   - light meter – used to measure light intensity
   - soil moisture probe – used to measure soil moisture
   - rain gauge – used to measure the amount of rain that has fallen in an area

Assessment

Informal: Teacher assessment

How are you doing? SB p.137

Take this opportunity to go over the measuring techniques used by ecologists. Check that students understand how to do these and how to calculate the mark-recapture population estimates. You can check their understanding by asking them some questions about the information covered in the topic. Explain anything that students do not understand.

Key words

emigration – the movement of organisms out of a habitat into another

immigration – the movement of organisms into a habitat from another habitat

migration – the movement of organisms from one habitat to another

mortality – the number of deaths in a given population

natality – the ratio of the number of births to the size of the population

population – all the organisms of the same group or species, which live in a particular geographical area

population density – the average number of individuals of a species in a particular unit or area of habitat

population dominance – when some species exert a bigger influence on the habitat than others

population dynamics – the study of the interaction between biotic and abiotic factors that leads to changes in the size of a population

population ecology – the study of populations in an environment

TOPIC 17: The functioning ecosystem

Performance objectives

17.1 Define the terms autotrophy and heterotrophy.
17.2 Recognise that food relationships exist among living things.
17.3 Recognise that chemical energy and nutrients are transferred among producers, consumers and decomposers.
17.4 Identify trophic levels.
17.5 Describe the role of food chains and food webs.
17.6 Describe how energy flows along trophic levels (pyramids of number, energy and biomass).
17.7 State that there is a progressive diminution of energy in the feeding chain.
17.8 Recognise a definite change in the number of individuals from one feeding level to another, especially between producers and consumers.

Introduction

This topic covers feeding relationships between organisms in an ecosystem. This includes food chains, food webs and food pyramids.

Activity 17.1: Identify how ecosystems function INDIVIDUAL (SB p.139)

Resources

The textbook

Guidelines

Facilitate: Teach the class the ecological terms and concepts related to this activity using one or more of the following options: a black/whiteboard, charts, videos, PowerPoint presentation or workstations. Thereafter, students should answer the questions with their partners. Check the answers with the class.

Answers

2. A – primary consumer, herbivore
   B – secondary consumer, carnivore
   C – autotroph
   D – decomposer
   E – omnivore
3. a) When a bigger animal eats a smaller one, it is called a carnivore.
   b) Organisms, such as plants, that produce their own food are called autotrophs.
   c) Organisms that feed on secondary consumers are tertiary consumers.
   d) The producers drink water and use energy from the Sun and produce their own food.
   e) Organisms that feed on primary consumers are called secondary consumers.
   f) Organisms that cannot make their own food (and need producers) are called heterotrophs.
4. A carnivore at the topmost level in a food chain that feeds on other carnivores; an animal that feeds only on secondary consumers
5. Herbivores eat plant material, for example, zebras and buck.
   Carnivores eat meat (other animals), for example, lions and cheetahs.
6. Omnivores are adapted to eat both plants and meat, for example, humans and baboons.
7. A scavenger is a carnivore that feeds on dead and decaying animals.
8. Decomposers feed on dead and decaying organisms and, in so doing, return nutrients to the environment, for example, bacteria and fungi.
9. Scavengers are carnivores that have characteristics suitable for meat eating, for example, sharp beaks or teeth.
   Decomposers do not have characteristics suited for meat eating.
10. a) biosphere
    b) biotic factors
    c) ecological niche
    d) abiotic factors

11. a) They are organisms that can make their own food.
    b) They are organisms that cannot make their own food. They are dependent on other organisms or substances for their nutrients.

Assessment

Informal: Self-assessment – check the answers to the activity with the class.

Activity 17.2: Study food webs

INDIVIDUAL (SB p.143)

Resources

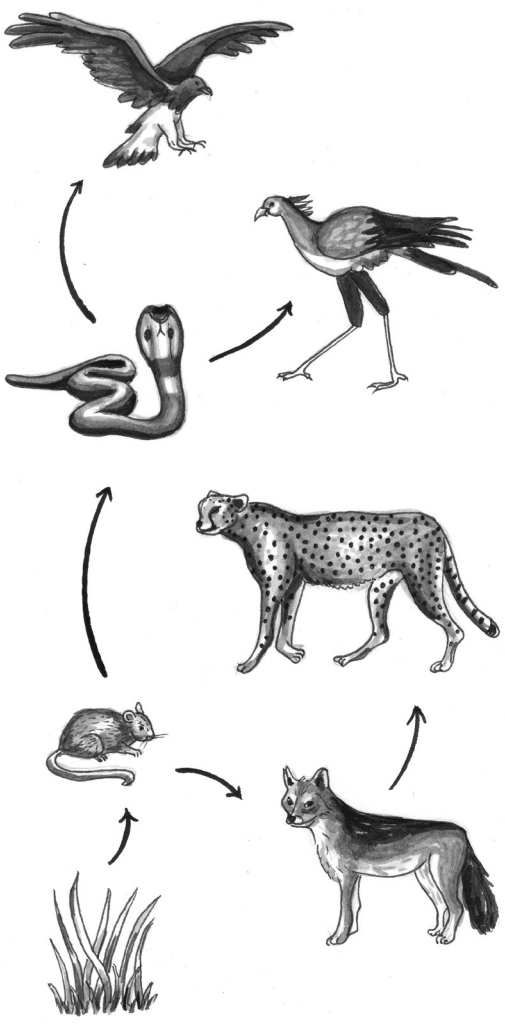
The textbook

Guidelines

Facilitate: Ensure that they understand that the arrow points in the direction of feeding.

Answers

1.



2. primary consumer – mouse
   secondary consumers – cobra, cheetah, secretary bird
3. a) The jackal population will not be negatively affected initially – they will merely have more to feed on. If the mouse population gets excessively large, the grass habitat will suffer, which will result in a depletion of the mouse population and then all the organisms that depend on the primary consumer (mouse), including the jackal, will suffer.
   b) The secretary birds will be negatively affected as one of their food sources has been removed.
   c) If there is habitat loss (grass loss in a fire), the mouse and snake populations are impacted negatively, which will, in turn, impact negatively on the martial eagle population as its chief food source has been removed.

Assessment

Informal: Self-assessment – check the answers to the activity with the class.

Activity 17.3: Study ecological pyramids

PAIRS (SB p.144)

Resources

The textbook

Guidelines

Facilitate: It is important that students realise that organisms in a food web are interdependent. Allow the students time to discuss the questions with their partners and then check the answers with the class.

Answers

2. A – Food chain 2
   B – Food chain 4
   C – Food chain 1
   D – Food chain 3

Assessment

Informal: Self-assessment – discuss the answers to the questions with the class.

Answers to Revision questions

1. a) A pyramid of numbers shows the size of the population at each level.
   b) A pyramid of energy shows the energy retained or held at each level.
   c) A pyramid of biomass shows the total mass of organisms at the different trophic levels.
2. D
3. Radiant energy is captured by the producers and passed from the primary consumers to the secondary consumers and tertiary consumers. Energy flows back to the environment as heat energy once decomposition of the organisms has taken place.

Assessment

Informal: Teacher assessment

How are you doing? SB p.145

Help the class to conceptualise the flow of energy through ecosystems starting with the autotrophs. The main source of energy is sunlight. Energy is transferred from one member of the food chain/web to another. Explain anything that students do not understand.

Key words

autotrophs – green plants that make their own food in photosynthesis
consumers – organisms that eat other organisms (producers or other consumers) for energy
decomposers – organisms that break down dead or decaying plant and animal matter
food chain – a feeding sequence in which each organism depends on the next for survival
food web – many food chains together in an ecosystem
heterotrophs – organisms that depend on autotrophs or other consumers for their nutrients
producers – green plants that make their own food
trophic levels – feeding levels or steps between organisms based on the different food sources available in a particular ecosystem

TOPIC 18: Energy transformation in nature

Performance objectives

18.1 Understand energy loss in the ecosystem (solar radiation, energy loss in the biosphere).
18.2 Use the knowledge of energy loss in the ecosystem to explain the pyramidal shape of feeding relationships.
18.3 State that only a small percentage of the radiant energy actually gets to the plants.
18.4 Identify measures of primary production.
18.5 Identify the laws of thermodynamics (first and second laws).
18.6 Apply the laws of thermodynamics to ecological phenomena.

Introduction

This topic links to the previous topic that covered energy flow in ecosystems. This topic is about sources of energy and energy losses in the ecosystem/biosphere.

Activity 18.1: Understand how energy flows through an ecosystem

INDIVIDUAL (SB p.148)

Resources

The textbook

Guidelines

Facilitate: Help students to answer these questions.

Answers

1. When the Sun's energy reaches the Earth, about 20% is reflected back by vegetation into the atmosphere. Some 39% is used in transpiration in evaporating water from leaves in transpiration, 40% warms up the soil, air and plants, and 1% is left to be used in photosynthesis.
2. Diagram B shows how energy in the grass is transferred to the cow: 60% passes through the cow undigested; 30% is used in respiration to provide energy for life processes, and 10% is converted to new tissue for growth.

Assessment

Informal: Self-assessment – discuss the answers to these questions with the class.

Answers to Revision questions

1. The three main sources of energy in ecosystems are solar energy, energy from photosynthesis and energy in animals.
2. The Sun is the main source of energy for all life on Earth. It is called solar energy.
3. Energy is acquired from the food an organism eats. Some of this energy is stored as fat and some is lost through waste in the form of urine and faeces. Most of the energy escapes as heat. Heat is formed when energy is transferred from one form to another.
4. a) The first law of thermodynamics is often called the Law of Conservation of Energy. This law suggests that energy can be transferred from one system to another in many forms. It cannot be created or destroyed. The total amount of energy available in the universe is therefore constant.
   b) The second law of thermodynamics states that when energy is converted from one form to another, some is lost as heat, and once this happens, it is no longer available for use in biological processes. Heat cannot be transferred from a colder to a hotter body. Natural processes that involve energy transfer generally move in one direction and all natural processes are irreversible.
5. The transfer of energy in ecosystems is inefficient. This is the reason why consumers at the top of the food chain must eat a lot of food (less and less energy is available further down the food chain).

Assessment

Informal: Teacher assessment

How are you doing? SB p.149

Some students may experience difficulty with this topic as it touches on Physical Science. Ask students questions like: What is Energy? How do we know whether an object/organism has lots of energy? What happens to energy when it is lost from an object? Which component of a food chain/web has the greatest amount of energy? Explain anything that students do not understand about this topic.

Key words

first law of thermodynamics – the law that states that energy can be transferred from one system to another in many forms, but cannot be created or destroyed

heat energy – a form of energy that is transferred among particles in a substance (or system) by means of the kinetic energy of those particles

kinetic energy – the energy of motion

light energy – a form of energy that can be seen with the naked eye

potential energy – energy that is stored within an object, not in motion, but capable of becoming active

primary production – any green plant or any of various micro-organisms that can convert light energy or chemical energy into organic matter

radiant energy – the energy that travels by waves or particles, particularly electromagnetic radiation such as heat or X-rays

second law of thermodynamics – the law that states that when energy is converted from one form to another, some is lost as heat

solar energy – energy from the Sun

solar radiation – energy radiated from the Sun in the form of electromagnetic waves, including visible and ultraviolet light and infrared radiation

TOPIC 19: The relevance of Biology to agriculture

Performance objectives

19.1 Classify plants using botanical and agricultural techniques of classification.
19.2 Describe the effects of various agricultural activities on ecological systems.
19.3 Identify pests of certain crops and indicate their control.
19.4 Describe some common diseases caused by pests and their control.
19.5 Identify factors that affect the production of crops.
19.6 Identify some methods of preserving and storing foodstuff.
19.7 List the factors that affect population growth and the availability of food.

Introduction

In agricultural systems, plants are removed from the land and so the soils are not naturally replenished by plant decomposition. Farmers therefore need to add fertilisers to the soil to ensure that there are sufficient nutrients for crop production. Farmers use this method and others to sustain the environment. This topic covers the advantages and disadvantages of some methods/techniques, as well as sustainable approaches to agriculture. This includes the improvement of food storage so that Nigeria can be less reliant on food imports and more reliant on agriculture.

Activity 19.1: Observe moisture loss in food

CLASS (SB p.155)

Resources

The textbook; a variety of fruit and vegetables

Guidelines

Do this activity, either as a class demonstration or let students do it as a homework task.

Facilitate: Help students to record observations in the physical appearance of the fruit and vegetables, especially the moisture loss.

Assessment

Informal: Self-assessment – discuss the observations with the class.

Answers to Revision questions

1. Annuals: plants that live for one growth season, which can be a few weeks or months
   Biennials: plants whose life cycle occurs within two years
   Perennials: plants that live for many seasons
2.

Pests	Diseases
whiteflies	cassava mosaic
whiteflies	leaf curl
mealybugs	cocoa swollen shoot virus
aphids	groundnut rosette virus

3. Soil erosion can be prevented by: covering the soil with a canopy; adding organic matter (green manure) to the soil; adding irrigation canals; using modern tools and implements; protecting the crops from weeds and pests; using herbicides and pesticides; using drought-resistant crops (any three)
4. Drying; smoking; salting; fermentation; roasting; blanching; canning; bottling; refrigeration; freezing (any four)

Assessment

Informal: Teacher assessment

How are you doing? SB p.165

Students can review this topic by making a mind map. They can work with a partner or do it at home. Check that they understand the link between Biology and agriculture by asking questions. Explain anything that students do not understand about this topic.

Key words

annuals – plants that have one growing season
biennials – plants whose entire life cycle occurs within two years
fertilisers – any material of natural or synthetic origin applied to soils or to plant tissues (usually leaves) to supply one or more plant nutrients essential to the growth of plants
herbicides – substances used to control unwanted plants
organic farming – a form of agriculture that relies on natural techniques such as crop rotation, green manure, compost, and biological pest control
perennials – plants/trees that live for many seasons
pesticides (insecticides) – toxic substances used to kill pests
slash and burn farming – a form of shifting agriculture in which the natural vegetation is cut down and burnt as a method of clearing the land for cultivation and releasing nutrients into the soil
soil erosion – a naturally occurring process on all land brought about by water and wind, leading to a loss of soil
tillage – the activity or process of preparing land for growing crops, using either mechanical or manual means

TOPIC 20: Micro-organisms around us

Performance objectives

20.1 Define micro-organisms.
20.2 Identify some micro-organisms found in air and water.
20.3 Grow micro-organisms.
20.4 Identify micro-organisms in our bodies and food.
20.4 Describe the effects of micro-organisms on the human body.

Introduction

This topic serves as an introduction to micro-organisms, namely, organisms that are too small to be seen with the naked eye. There are four main types of micro-organisms – viruses, bacteria, algae (protists) and fungi. This topic covers the following practical work: growing bacteria in nutrient agar or gelatine; identifying the structure of bread mould and microscopic observations of pond organisms. The topic ends with a section on micro-organisms in our bodies and food.

Activity 20.1: Grow bacteria cultures on agar plates

GROUPS (SB p.161)

Resources

Gelatine or agar; six sterile petri dishes; marker pens; cotton wool buds

Guidelines

Students must not open the petri dishes when observing the bacteria as some bacteria can be dangerous to their health.

Answers

1. The ways in which you could sterilise a petri dish are to: autoclave it; boil it in a pressure cooker; use a disinfectant.
2. The petri dish plates must be closed or covered immediately after inoculation to prevent air-borne bacteria from contaminating the plates.
3. An aim for this activity could be to determine the presence of bacteria in different parts of the body or on different types of surfaces in the school building.
4. The conclusion is dependent on the results. A conclusion could be stated in the following ways:
   - From our observations, we can conclude that different parts of the body host a variety of bacteria; OR
   - From our observations, we can conclude that different parts of the school host a variety of bacteria.

Assessment

Informal: Self-assessment – discuss the observations and answers to the questions with the class.

Activity 20.2: Learn about the structure of fungus

GROUPS (SB p.162)

Part 1

Resources

Half a slice of bread; a saucer or container; a dusty area; water; a hand lens

Guidelines

Facilitate: Help students grow and identify the structures of the mould.

Answers

1. Answers will vary. There is no right or wrong answer. The students must describe what they smell – this is their opinion.
2. a) The colour of the threads could be anything between grey, white or green.
   b) The threads are called hyphae. Hyphae are collectively called mycelium.
   c) No, the threads do not contain chlorophyll. Chlorophyll is a green pigment.
   d) Students should be able to identify three types of mycelium – stolon, sporangiophore and rhizoid.

e) Mycelium can be found on the surface of the bread (stolon); growing upwards into the atmosphere (sporangiophore); growing into the bread (rhizoid).
f) Stolon gives rise to more sporangiophores and rhizoids. Sporangiophores are the reproductive hyphae; they produce spores. Rhizoids anchor the mould, and also digest and absorb nutrients from the substrate.
g) The tips are swollen to form a sporangium, which forms spores.

3. Saprophytic, because it absorbs its nutrients from decaying organic matter.

Part 2

Resources

A slide of bread with mould; a microscope; a dropper; water; methylene blue (optional)

Guidelines

Facilitate: Help students to prepare the slide for the microscope and identify the structures of the mould. It will be useful to give each group a labelled diagram of the structures.

Answers

6. No cross walls exists in the hyphae.
7. It has rhizoids to anchor it to the substrate. It does not photosynthesise. Therefore, it does not require moisture (water). Its sporangiophores are long and efficiently exposed to the air for the dispersal of spores by air currents. A large number of spores are produced, thereby facilitating its survival. Spores are light and can therefore be carried easily by the air currents. (any four)

Assessment

Informal: Self-assessment – discuss the observations and answers to the questions with the class.

Activity 20.3: Observe micro-organisms in pond or river water

CLASS (SB p.163)

Resources

Small jars – glass or plastic; pipettes or droppers; microscopes; microscope slides; cover slips

Guidelines

Facilitate: The water should be collected before the lesson by either you or some of the students so not to impact on teaching time.

Answers

Students must use the correct technique to place samples on glass slides under cover slips. They should describe this technique (verbally or in writing) and draw what they see. There are several good videos on YouTube showing microscopic observations of pond water.

Assessment

Informal: Self-assessment – discuss the observations with the class.

Teacher assessment – evaluate the diagrams for accuracy, proportion and neatness. Diagrams must be labelled, and have headings that include magnification.

Answers to Revision questions

1. Viruses: examples are viruses that cause the common cold and influenza (flu) and measles
   Bacteria: examples are bacteria species that cause pneumonia (*Pneumococci*) and skin infections (*Staphylococci*) and tuberculosis (*Mycobacterium tuberculosis*).
   Fungi: examples are fungal species that cause bread mould (*Penicillium* – blue-green, green mould)
2. A coccus – the cell wall is ball-shaped or spherical; a rod or bacillus – the cell wall is cylindrical; a spirillum – the cell wall is spiral.

3. A symbiotic relationship is one in which each organism benefits from its relationship to the other. They do not cause harm.
4. Make food products; used in genetic engineering to produce substances such as insulin
5. They cause diseases.

Assessment

Informal: Teacher assessment

How are you doing? SB p.166

Check that students can name and describe the groups of micro-organisms. Take this opportunity to ask students if they understand the practical work covered in this section. Ask whether they found it easy to follow the instructions and whether they were able to grow the micro-organisms or identify the micro-organisms and their structures under the microscope. Ask them questions to test their understanding and to consolidate this topic. Explain anything that students do not understand.

Key words

algae – a single or multicellular organism that has no roots, stems or leaves and is often found in water

bacteria – microscopic living organisms that are usually single-celled, that can be found everywhere and can be harmful

disease – an illness that affects a person, animal, or plant: a condition that prevents the body or mind from working normally

food poisoning – eating foods contaminated by bacteria

fungi – any one of a group of plants (such as moulds, mushrooms, or yeasts) that live on dead or decaying matter

micro-organism – a living thing that is too small to be seen with the naked eye

pasteurisation – a process in which liquids (such as milk or cream) are heated and quickly cooled so that harmful micro-organisms are killed

protozoa – a diverse group of unicellular organisms

sterilisation – a process that removes or kills all forms of life, including transmissible agents (such as fungi, bacteria, viruses, spore forms, etc.)

vector – an organism, such as a mosquito or tick, that carries disease-causing micro-organisms from one host to another

virus – a micro-organism that cannot grow or reproduce apart from a living cell

TOPIC 21: Micro-organisms in action

Performance objectives

21.1 Identify micro-organisms.
21.2 Measure the rate of growth of microbes.
21.3 Identify the harmful and beneficial effects of micro-organisms.
21.4 Recognise that some micro-organisms cause diseases.
21.5 Identify the diseases caused by micro-organisms (symptoms, mode of transmission and control of diseases).
21.6 Recognise that some disease-causing micro-organisms are air-borne, water-borne and spread through our food.

Introduction

This topic focuses on the growth of micro-organisms. It then deals with the beneficial effects of micro-organisms to people and to the environment and concludes with a detailed section on diseases caused by micro-organisms, namely rabies; cholera; TB; malaria; thrush and ringworm.

Activity 21.1: Measure and record growth from a culture of bacteria

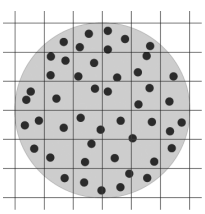
GROUPS (SB p.168)

Resources

A nutrient broth that has been inoculated with bacteria; pipettes or droppers; glass jars; petri dishes; agar gel; a grid and a marking pen

Guidelines

Facilitate: Refer to relevant reference books on microbiology or do a Google search on the Internet for help with dilution techniques. Remember that the petri dish must be kept sealed as some bacteria can be harmful. Help the students to count the colonies and to plot the graph from their results. Place the petri dish on a gridded background and count the colonies in each grid cell, moving in a methodical pattern through all of the cells. Mark counted colonies with a marking pen on the back of the petri dish. You may prefer to do this activity as a demonstration.



Assessment

Informal: Self-assessment – discuss the method with the class and draw a growth curve on the board using one of the group's results.

Activity 21.2: Make yoghurt

GROUPS (SB p.170)

Resources

Live yoghurt; fresh milk; beakers; clingfilm; a Bunsen burner or stove (optional); a pot (optional)

Guidelines

Facilitate: There are several YouTube videos on making yoghurt, for example, https://www. youtube.com/watch?v=NVN97rve_iY

You can watch some clips with the class if there is time. Otherwise, students can watch this clip or other similar videos at home in preparation for the lesson. If you want to use a stove to heat the milk, prepare the yoghurt at home (unless there is one accessible at school).

Assessment

Informal: Self-assessment – discuss the activity with the class.

Activity 21.3: Ferment fruit juice using yeast

GROUPS (SB p.170)

Resources

Warm water; fast-acting yeast; fruit juice or glucose water; cotton wool; a boiling tube; limewater (calcium hydroxide)

Guidelines

Facilitate: The end result contains alcohol so students should not drink the fermented juice.

Answers

6. The liquid should smell of alcohol.

Assessment

Informal: Self-assessment – discuss this activity with the class, as well as the answers, to Question 6.

Activity 21.4: Study global TB issues

INDIVIDUAL (SB p.174)

Resources

The textbook

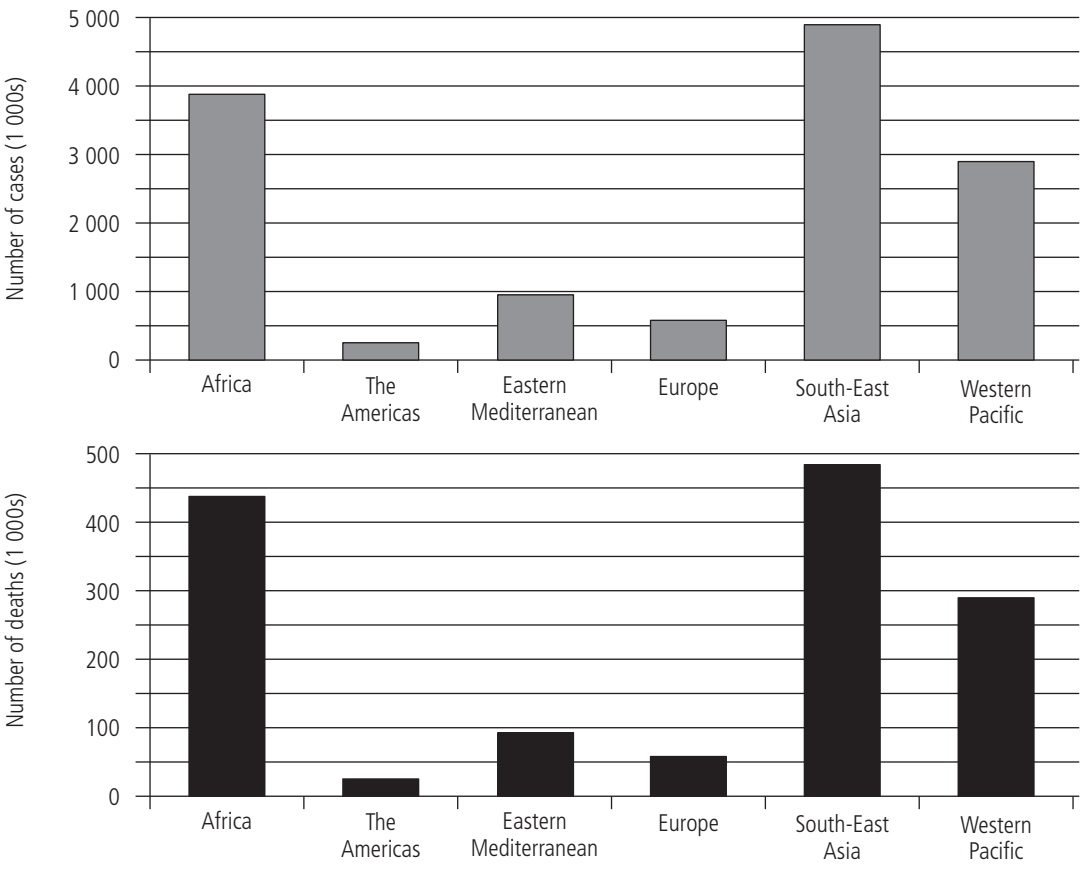
Guidelines

Revise the rules for drawing bar graphs and calculating percentages before you do this activity.

Facilitate: Students must be given time to think about the questions. Allow them some time to do this before assisting them. Check the answers with the class.

Answers

1.



2.

Region	Number of cases (% of total)	Number of deaths (% of total)
Africa	27,85	33,00
The Americas	25,00	1,50
Eastern Mediterranean	7,00	7,60
Europe	4,00	4,60
South-East Asia	35,00	36,92
Western Pacific	20,70	18,46

3. South-East Asia was the region with the highest number of TB cases in 2009.
4. South-East Asia had the highest number of deaths from TB in 2009.
5. Europe and the Americas are developed countries with low levels of poverty, and good health and social infrastructure. TB is an uncommon disease in places where most people are well-nourished and do not live in crowded conditions.
6. Europe may have more cases of TB than the Americas because Europe receives more immigrants from areas of the world where there are high levels of TB.

Assessment

Informal: Self-assessment – discuss the answers to the activities with the class.

Activity 21.5: Understand malaria

INDIVIDUAL (SB p.176)

Resources

The textbook

Guidelines

This activity can be completed as a homework task.

Answers

1. There are four species that cause malaria in human beings: *Plasmodium vivax* and *Plasmodium falciparum* are responsible for 95% of infections worldwide. *Plasmodium malariae* and *Plasmodium ovale* are the other two species of protists that cause malaria.
2. Malaria is spread/transmitted by the female *Anopheles* mosquito.
3. Malaria is rife in the African savannah and forests, Ethiopia, Madagascar, Papua New Guinea, the Amazon rainforests, and Central America.
4. High temperatures and moisture (humidity) promote the spread of malaria.

Assessment

Informal: Self-assessment – check the answers with the class.

Activity 21.6: Understand ringworm

INDIVIDUAL (SB p.176)

Resources

The textbook

Guidelines

Students can do Question 1 for homework.

Answers

1. Ringworm results in the development of a raised red welt (striped mark) on the skin. This led people to believe that an earthworm had crawled under the skin and coiled up in a ring. There is a characteristic red ring that appears on infected skin.
2. Athlete's foot is often associated with the high moisture levels and bare feet of athletes in a change room. *Pedis* means foot in Latin.
3. Athlete's foot may be transmitted by direct contact through abrasions on the skin from change rooms, socks and shoes.
4. High moisture and warmth are required for growth of the fungi that cause athlete's foot.

Assessment

Informal: Self-assessment – check the answers with the class.

Answers to Revision questions

1. Pathogens are disease-causing organisms. They can enter the body through the mouth; nose; direct skin contact; body fluids; vectors like mosquitoes and houseflies.
2. Bacteria and fungi are important decomposers in nature because they get their food from dead plants and animals by breaking down the remains using enzymes. These bacteria and fungi are called saprophytic. Decomposition breaks down complex organic compounds and releases nutrients into the soil. Saprophytic bacteria also break down foods such as milk and also urine and faeces, releasing water and carbon dioxide into the environment.

3. Mosquitoes; houseflies
4. Rabies: a virus passed on by saliva of infected animals
   Cholera: a bacterium, transmitted by contaminated drinking water or food
   TB: bacterium spread through coughing, spitting, sneezing, close contact with an infected person
   Malaria: caused by a protozoan called *Plasmodium* and spread by a vector, the *Anopheles* female mosquito
   Thrush: caused by a fungus, *Candida albicans*; thrush is usually present in small amounts in the body and spreads under certain conditions in people with a weakened immune system
   Ringworm: different species of fungus

Assessment

Informal: Teacher assessment

How are you doing? SB p.177

There is a lot of content in this topic so it is recommended that students summarise the information. One way is for them to write down all the main headings and sub-headings. They then fill in short phrases and/or terms under each heading. Explain anything that students do not understand.

Key words

biotechnology – the use of biological processes, organisms, or systems to manufacture products intended to improve the quality of human life

cholera – an infectious disease that causes severe watery diarrhoea, which can lead to dehydration and even death if untreated; caused by eating and drinking contaminated food and water

decomposer – an organism, usually a bacterium or fungus that breaks down the cells of dead plants and animals into simpler substances

fermentation – a process involving yeast or other micro-organisms that break down a substance

malaria – a life-threatening blood disease caused by a parasite that is transmitted to humans by the *Anopheles* mosquito

rabies – a very serious and often fatal disease that affects animals (such as dogs) and that can be passed on to people if an infected animal bites them

ringworm – any of a number of contagious skin diseases caused by certain parasitic fungi and characterised by the formation of ring-shaped patches

saprophyte – any organism that lives on dead organic matter, such as certain fungi and bacteria

tuberculosis – a potentially fatal contagious disease that can affect almost any part of the body, but is mainly an infection of the lungs

TOPIC 22: Towards better health

Performance objectives

22.1 Discuss some ways by means of which disease-causing micro-organisms can be controlled.
22.2 Define vectors.
22.3 State ways of controlling vectors.
22.4 List ways of protecting ourselves from diseases caused by micro-organisms spread by vectors.
22.5 Describe some methods used in the disposal of refuse and sewage.
22.6 State the roles individuals should play to ensure good health.
22.7 Name some national and international health organisations and provide some descriptions of what they do.

Introduction

The first part of the topic deals with methods of controlling harmful micro-organisms. The next section is on vectors and how to control them. The last part is about personal health and the role of health organisations.

Activity 22.1: Control micro-organisms

GROUPS (SB p.179)

Resources

Petri dishes and agar gel; sterile loops; a Bunsen burner; a disinfectant such as carbolic acid; filter paper; a cotton wool swab; an antibiotic such as penicillin; safety goggles

Guidelines

Facilitate: Divide the class into three groups. Each group must do one experiment. The groups must share their results with the rest of the class after the two-week period. Ensure that students adhere to safety precautions when heating substances. They must wear safety goggles.

Answers

Experiment 1

6. Students should see that there are no bacterial colonies growing in the dish that was inoculated with the sterile wire loop.

Experiment 2

7. Students will see that there is less bacterial growth/no bacterial growth in the petri dish that was inoculated with washed hands.

Experiment 3

8. Students will see that there is a ring around the antibiotic-soaked disc where there is no bacterial growth.

Assessment

Informal: Self-assessment − discuss the observations and answers to the questions with the class.

Activity 22.2: Control mosquito populations

GROUPS OR INDIVIDUAL (SB p.181)

Resources

A body of stagnant water; oil; a spray bottle

Guidelines

Discuss with the class whether harming the mosquito larvae is ethically correct. They should present arguments for and against this.

Facilitate: Students can complete these experiments at home or in groups on a school outing.

Answers

Students must record and discuss their observations.

Assessment

Informal: Self-assessment – discuss the observations with the class.

Activity 22.3: Understand herd immunity

INDIVIDUAL (SB p.183)

Resources

The textbook

Guidelines

Facilitate: Students must read the passage twice and look up the meaning of any words that they do not understand in a dictionary. Help students to answer these questions. Question 2 can be completed at home.

Answers

1. From the information given, it can be seen that when only a few individuals are immune, a pathogen can spread rapidly within a population, resulting in an epidemic. However, when more than 70% of a population is immune, the transmission of the pathogen from one individual to another is prevented and therefore epidemics do not occur. This is due to the fact that many of these individuals would have developed a secondary response. It is also important to discuss the scientific basis of immunisation, for example:
   - Any macromolecule associated with a pathogen can serve as an antigen – it does not have to be the entire micro-organism. Hence, specific target antigens associated with pathogens may be used to elicit the immune response without causing disease.
   - After exposure to the antigen, the body may develop a memory response. Hence, subsequent exposure to the antigen will bring about a rapid and enhanced response that will prevent the increase in the pathogen population and prevent the manifestation of the disease.
   - When a large percentage of the population is immune to a disease, there is no fear of an epidemic, since individuals are no longer susceptible and thus no longer participate in the chain of disease transmission.
   - When approximately 70% of the population is immune, it is safe to say that the entire population is safe/protected. This concept is referred to as herd immunity. Herd immunity is established by artificially stimulating the immune system through the use of vaccines, thus providing protection to the entire population against particular diseases.
2. Students should also discuss the near elimination of a number of contagious diseases such as bubonic plague, measles, chickenpox, polio, and so on.

Example of a disease – The eradication of smallpox:

Smallpox is a highly infectious disease caused by the *Variola* virus that is transmitted by direct contact. Smallpox killed as many as 12–30% of its victims. The World Health Organization (WHO) began a programme to eradicate it in 1956. By 1967, its intention was to rid the world of this disease within ten years. There were two main aspects of the programme, namely, vaccination and surveillance. Successful attempts were made across the world to vaccinate more than 80% of populations at risk of smallpox. Whenever a case of the disease was reported, everyone in the household and surrounding households, as well as relatives and possible contacts in the area, were vaccinated. This procedure, known as ring vaccination, protected everyone who could possibly have come into contact with the infected person. This served to reduce the chance of transmission and the spread of the disease. In 1989, the WHO declared the world free of smallpox. The following reasons may be attributed to the successful programme:

- The vaccine was cheap to produce and the same vaccine was used throughout the world. This was largely due to the fact that the *Variola* virus is relatively stable, and changes its surface antigens.
- The vaccine was effective because it was created from a similar strain of virus that was harmless, that is, it was a 'live' vaccine.
- The vaccine was freeze-dried and this meant that it could be kept for as long as six months, making its use in the tropics viable.
- Infected people were easy to identify.
- It was easy to administer because of the development of a stainless steel, bifurcated (two-pronged), reusable needle.
- The virus did not remain in the body after infection so that it could become active at a later time or form a reservoir of infection.

- Human beings are the only known hosts for the virus and it has a relatively short survival time outside the human host. This meant that the cycle could be easily broken.
- Many teenagers became enthusiastic vaccinators and suppliers of information about cases – this was especially valuable in remote areas.

Smallpox is the only infectious human disease known to be permanently eliminated through human intervention, ingenuity and co-operation.

In 1991, the WHO declared the Americas free of polio. In 2011, India also became free of polio, but at the time of writing an official declaration had not been made.

Assessment

Informal: Self-assessment – check the answers with the class. Write the main points for each question on the board.

Answers to Revision questions

1. There are many ways in which harmful micro-organisms can be controlled. Some common methods are: high temperature; antiseptics; antibiotics; high salinity; and dehydration.
2. A vector is something that carries and transmits an infectious pathogen, usually a micro-organism, into another organism. Important vectors of human disease are mosquitoes, flies and other household insects, and rats.
3. Houseflies: typhoid, cholera; *Anopheles* mosquito: malaria; rats: typhus
4. A vaccine is something that is put into the body to improve immunity to a particular disease. A vaccine usually contains a weakened or killed form of a micro-organism or the toxins produced by a micro-organism. This stimulates the body's immune system so that it produces antibodies against a particular disease without making the person ill.
5. *International*:
   - WHO: to improve the health of people in all countries including vaccination programmes; to improve water supplies and sanitation; and health education.
   - United Nations Children's Fund (UNICEF): to help countries design and implement health, nutrition and welfare programmes for their children and maternal and child health programmes generally; to support government programmes for the control of major diseases affecting mothers and children; to support vaccination services and feeding programmes.

   National:
   - Nigerian Red Cross Society: http://www.redcrossnigeria.org/home.html
   - National Ambulance Service: http://allafrica.com/stories/201502161467.html

Assessment

Informal: Teacher assessment

How are you doing? SB p.184

Since there is a lot of content in this topic, take time to review it with the class by breaking it up into manageable portions. Take this opportunity to ask students if there is anything that they do not understand. You can check their understanding by asking them some questions about the information covered in the topic. Explain anything that they experience difficulty with.

Key words

antibiotics – medications that destroy or slow down the growth of bacteria

antiseptic – a substance used to control the spread of infections

disinfectant – an agent that is applied to non-living objects to destroy micro-organisms living on it

sterilisation – methods used to destroy micro-organisms by exposing them to high temperatures by means of steam, dry heat, or boiling liquid

pasteurisation – a process in which a liquid (such as milk or cream) is heated to a temperature that kills harmful micro-organisms and then cooled quickly

vector – an insect or animal that carries disease-causing micro-organisms

vaccine – a substance that is usually injected into a person or animal to protect against a particular disease

TOPIC 23: Marine habitats

Performance objectives

23.1 Describe the characteristics of marine habitats.
23.2 Describe the pattern of distribution of plants and animals in marine habitats, noting dominant ones.
23.3 Recognise some adaptive features of the plants and animals in these habitats.
23.4 Infer the food chain of the organisms.
23.5 Determine some of the physical factors that affect plants and animals in the marine environment.

Introduction

This topic is about the characteristics of marine habitats, the four ecological zones of marine ecosystems, and the challenges that marine organisms face.

Marine habitats have specific characteristics related to the following factors: waves, currents and tides; chemical composition; oxygen concentration; light penetration; temperature; and density and pressure.

Marine ecosystems are divided into four ecological zones: intertidal; neritic; oceanic and benthic. Marine organisms face a variety of challenges that land organisms do not encounter.

Activity 23.1: Make a marine poster and do a presentation

GROUPS (SB p.189)

Resources

The textbook; manila paper; Kokis/crayons; reference books; magazines; relevant websites; images/pictures/charts of organisms that live in marine habitats, especially along the coast of Nigeria and in the Atlantic ocean. Relevant websites and video clips such as https://www. youtube.com/watch?v=EKihcc_AdyA

Guidelines

Contact the school or local librarian to source relevant books for this project. Photocopy information about the marine zones for each group. Each group must select one zone. The orals should not be longer than two minutes.

Facilitate: Divide the class into mixed-ability groups. Help the groups to prepare their posters and orals. Each member of the group must be involved in the poster and oral presentation.

Assessment

Informal: Teacher assessment – use the following rubrics to evaluate the poster and oral presentations.

Rubric for the poster

Criteria				
Followed instructions	More than 1 not followed 0 marks	1 not followed 1 mark	All followed 2 marks	
Presentation	Poor 0–1 mark	Average 2 marks	Good 3 marks	Excellent 4 marks
Effectiveness	Poor 0–1 mark	Average 2 marks	Good 3 marks	Excellent 4 marks
Total marks: out of 10				

Rubric for the oral

Criteria	Poor	Average	Good	Excellent
Style: fluency and eye contact, expression, speed, reading, timing.	0–1	2–2,5	3–3,5	4–5
Use of media: posters, pictures, etc.	0–1	2–2,5	3–3,5	4–5
Total marks: out of 10				

Answers to Revision questions

1. 1 d)
   2 c)
   3 b)
   4 a)
2. Plants and animals have to adapt in the following ways: regulating salt intake; obtaining oxygen; coping with water pressure; coping with changes in wind strength, wave action, changing temperatures and receiving enough sunlight.
3. Answers to include any five well-explained points. Suggestions are as follows:
   - Fish are able to drink salt water and eliminate salt through their gills.
   - Marine birds drink salt water and eliminate excess salt through their nasal cavities.
   - Whales do not drink salt water. Instead they obtain their water from their food.
   - Fish and other marine organisms obtain oxygen from the water through either their gills or their skin.
   - Mammals that live in the sea come to the surface in order to breathe.
   - Whales are able to stay underwater for an hour as they have the capacity to use their lungs efficiently.
   - Whales can store high volumes of oxygen in their blood and muscles when diving.
   - Some larger mammals migrate in order to cope with temperature changes. Many marine mammals have either a thick layer of blubber (fat) or very thick fur, which enables them to do this.
   - Whales, seals and turtles often travel between shallow and deep waters several times a day.
   - Whales, which dive deep in the ocean, have collapsible lungs and rib cages to enable them to tolerate increased pressure.
   - Many marine organisms are able to cling to rocks or other surfaces to prevent being washed away.
   - Many marine organisms have hard, tough shells to protect their soft parts from damage.
   - Seaweed have special attachments so they can attach themselves firmly to rocks.
   - The fronds of seaweed are tough and leathery and this helps prevent tearing or desiccation when the tide is low.
   - Marine organisms that need light tend to live in shallow, clear water so that sunlight penetrates the water and reaches them.
   - Larger marine mammals, such as whales, do not rely on sight to find their food. They find their prey using echolocation.
   - Some marine organisms are bioluminescent, which means they create and emit light to lure either prey or a mate.

Assessment

Informal: Teacher assessment

How are you doing? SB p.190

Revise the topic in sections such as characteristics of marine habitats. Students can make summary notes on each section.
Check their understanding by asking them some questions about the information covered in each section. Explain anything that they experience difficulty with.

Key words

benthic – the zone that includes the bottom sediments and other surfaces of a body of water such as an ocean or a lake

bioluminescent – the ability of certain living things to emit light through chemical reactions in their bodies

echolocation – a sensory system in certain animals, such as bats and dolphins, in which high-pitched sounds are emitted and their echoes are interpreted to determine the direction and distance of objects

gravitational pull – the attraction caused by gravity, which is the force of attraction by which terrestrial bodies fall towards the centre of the Earth

intertidal – the zone/area between the land and sea that is covered by water at high tide and uncovered at low tide

neritic – the topmost layer of the ocean

oceanic – the zone of the ocean that extends from the bottom edge of the neritic zone, where sunlight does not reach

TOPIC 24: Estuarine habitats

Performance objectives

24.1 Describe the characteristics of estuarine habitats.
24.2 Describe the pattern of distribution of plants and animals in estuarine habitats, noting dominant ones.
24.3 Recognise some adaptive features of the plants and animals in the habitat.
24.4 Infer the food chain of the organisms.
24.5 Determine some of the physical characteristics.
24.6 Consider the threats to estuaries and look at environmental considerations to help conserve estuaries.

Introduction

An estuary is the place where fresh water from rivers and streams meets and mixes with salty water from the ocean. An estuary typically forms at the mouth of a river. Estuaries have different shapes, sizes and geological characteristics. Within estuaries, there are a range of different types of habitats. Salinity and water levels are the main features of estuaries. This topic deals with estuaries, including those in Nigeria, their features, different types, the distribution and adaptation of plants and animals in estuaries, the importance of estuaries and threats to them.

Activity 24.1: Play the save your estuary game

GROUPS (SB p.196)

Resources

The textbook; images/pictures/charts of organisms that live in estuaries, especially along the Nigerian coast. Relevant websites and videos such as http://oceanservice.noaa.gov/facts/estuary.html; a large sheet of paper with a simple drawing of a large estuary showing a river flowing in and a clear outflow into the ocean; a set of cards with the following names written on them:

- shopping centre
- roosting site for rare migratory waterbirds
- petrol station
- restaurant
- chemical factory
- new housing development
- dairy farm
- fish eagle nest
- indigenous coastal forest
- breeding pond for endangered estuarine toad
- gravel road
- motorway
- forest

Guidelines

You can use some books or websites to help you prepare this activity such as https://tpwd.texas.gov/education/water-education/tas/texas-aquatic-science-chapter- 11-nak.pdf https://www.giz.de/fachexpertise/downloads/Fachexpertise/giz2012-en-land-use-planning-manual.pdf.

Set out steps for a land-use plan on the board, for example: Identify a problem, formulate a plan, evaluate the plan, suggest alternatives, make decisions, and accept the decisions.

Before the groups start the activity, check that the class understands the meaning of a land-use plan. Ask questions such as: How can people use the estuary (land)? What problems may arise from these uses? What factors must be taken into account?

The land-use plans can be completed at home and presented in a later lesson.

Facilitate: Divide the class into mixed-ability groups. Help the groups to follow the instructions of the game and to make a land-use plan for the estuary.

Assessment

Informal: Teacher assessment – evaluate the land-use plans according to whether they have taken into account the needs of the stakeholders and the environment. You can give verbal feedback after the presentation.

Answers to Revision questions

1. Salinity; water level fluctuations; substratum habitat/sedimentation; turbidity
2. Salt wedge, partially mixed, vertically homogenous, hyper saline, coastal plain, tectonic, fjord (any four)
3. They must be able to respond quickly to drastic changes in salinity and deal with strong tides, variable sunlight exposure, wind and anaerobic condition in the substratal mud.
4. Osmoregulation is the ability to regulate the salt balance of the body. It is important as a dramatic fluctuation in salt levels is likely to kill the organism.

Assessment

Informal: Teacher assessment

How are you doing? SB p.197

Check that students understand the following: What is an estuary? Why are estuaries useful to people? Why is it important to conserve estuaries? How are plants and animals suited to living in estuaries?

Students can make a mind map of this topic. Explain anything that they do not understand.

Key words

anaerobic – living or occurring in the absence of free oxygen

euryhaline – organisms are able to adapt to a wide range of salinities

geomorphology – the study of the characteristics, origin, and development of landforms

osmoregulate – to maintain an internal balance of salt and water in a fish's body

saline – consisting of or containing salt

salinity – the saltiness or dissolved salt content of a body of water

stenohaline – an organism, usually a fish, that cannot tolerate a wide fluctuation in the salinity of water

substratal mud – mud that loses its water while in a buried state

TOPIC 25: Freshwater habitats

Performance objectives

25.1 Recognise the variety and size of freshwater habitats.
25.2 Recognise the variety, quantity and distribution of various organisms in freshwater habitats.
25.3 Recognise seasonal changes in the size and population of the habitat.
25.4 Recognise the adaptation of the animals and plants in the chosen freshwater habitat.
25.5 Estimate the proportion of mineral salt present in the freshwater habitat.
25.6 Infer the food chain in the chosen freshwater habitat.

Introduction

Freshwater habitats are found inland. They contain no salt. They are small water bodies and isolated from one another. Freshwater habitats include large ponds, lakes, rivers and streams. This topic is about freshwater habitats, the types of organisms that live in them and the threats to these water bodies.

Activity 25.1: Estimate the proportion of mineral salt in fresh water

GROUPS (SB p.204)

Resources

The textbook; images/pictures/charts of organisms that live in freshwater habitats, especially in Nigeria; relevant websites and videos such as: http://study.com/academy/lesson/freshwater-biomes-climate-locations-plants-animals.html; four glass canning jars with lids; a metric measuring cup; a metric scale; tray; water samples from three different areas, for example, the sea, a river, a pond, a lake; distilled water.

Guidelines

Collect the water samples for the class. Students can assist, especially if they live near a water body. Ensure that you have at least one sample from a salty water body. You can do this as a class demonstration.

Answers

8. Results will vary according to the water samples. There should be no salt in the freshwater systems.

Assessment

Informal: Self-assessment – discuss the results with the class.

Activity 25.2: Answer questions about freshwater habitats

INDIVIDUAL (SB p.206)

Resources

The textbook

Guidelines

This activity can be done as a homework task.

Answers

1. a) Lotic system: temperatures are lower at the source, the water is clearer and oxygen levels are higher; at the mouth, the water is more laden with sediment, has less light, and diversity levels are lower; organisms are affected by water flow, and distance from the river source
   b) Lentic system: organisms are distributed according to depth, distance from shore, light penetration and density
2. Littoral zone: warmest, shallow, supports high levels of biodiversity
   Benthic zone: colder, less light penetrates; productivity depends on sediment levels, organic content
3. Industrial and agricultural effluent, dam building, over extraction for irrigation
4. Students should recognise that solid waste in any form or quantity has a negative impact on freshwater ecosystems. The more bottles, the greater the impact.
5. Students should be aware of the impact of pollutants on the health of freshwater ecosystems, how the nutrient levels are affected, how this impacts on oxygen availability to plants and animals, etc.

Assessment

Informal: Self-assessment – discuss the answers to the activity with the class.

Answers to Revision questions

1. Littoral, limnetic, profundal, benthic
2. Light and oxygen
   Accept any three possible answers.
3. • To cope with having concentrations of water higher than that in their external environment, organisms such as protozoans have something called a contractile vacuole. This allows them to shed excess water through osmoregulation.
   • Freshwater organisms have flattened streamlined bodies, which helps them cope with the rigors of water currents by fitting under rocks, etc.
   • Many have specialised body parts such as hooks or suckers to grip things and prevent being swept away.
   • Some larvae build themselves protective cases out of stones or debris to prevent being washed away.
   • To move efficiently in water, many freshwater organisms have fins (pectoral, tail and pelvic) to help propel them forward in their aquatic environment.
   • Frogs and other animals have webbed feet to help them move through the water.
   • Certain invertebrates have long, thin appendages, which they use to 'skate' along the water surface.
   • Freshwater organisms have gills, which they use for gaseous exchange. Fish, prawns, crabs and crayfish have gills for this purpose.
   • Certain species have the ability to carry an air bubble to the bottom of the water body, which they use to breath at great depths where oxygen concentrations are low. Others have breathing tubes.

Assessment

Informal: Teacher assessment

How are you doing? SB p.206

Students should be able to compare the adaptations of organisms that live in different types of water body – marine, estuary and freshwater habitats. Students can make a mind map summarising the key points. Explain anything that they do not understand.

Key words

benthic – the ecological region at the lowest level of a body of water such as an ocean or a lake

lentic – static water habitats such as ponds, lakes swamps and marshes

limnetic – the well-lit, open surface waters in a lake, away from the shore.

littoral – the part of a sea, lake or river that is close to the shore

lotic – dynamic water habitats such as rivers, brooks, etc.

profundal zone – below the depth of effective light

TOPIC 26: Marshes

Performance objectives

26.1 Recognise types of marshes.
26.2 Correlate the effect of rainfall or any other source of water and evaporation with changes in a marsh.
26.3 Recognise the adaptations of organisms in marshy habitats.
26.4 Appreciate the marsh as being transitional between aquatic and terrestrial habitats.
26.5 Infer the food chain in a marsh environment.

Introduction

A marsh (wetland) is an inland area of low-lying land that is periodically or permanently waterlogged. The water is rich in decaying organic matter and is therefore one of the more productive ecosystems on Earth, being valuable to plants, animals and humans. In the dry season, the water is stagnant. Marshes are completely waterlogged in the rainy season. This topic covers the characteristics of marshes, types of marshes and adaptive features of organisms that live in marshes.

Activity 26.1: Play the marsh food web game

CLASS (SB p.211)

Resources

The textbook; images/pictures/charts of organisms that live in wetland habitats, especially those in Nigeria; relevant websites and video clips such as https://www.youtube. com/watch?v=BeUPbGWg2KU
cards with names of various wetland organisms; cards labelled Sun, water, oxygen, chemical spill, string or wool

Guidelines

Prepare the cards for the activity using the organisms shown in this topic, for example, Figure 26.5. Ensure that you know how the organism gets its food. Think of a few instructions to guide the class through the game. You will need an open area to position the students that does not disturb other classes.

Assessment

Informal: Self-assessment – discuss the game with the class.

Answers to Revision questions

1. Marshes are in low-lying areas where the ground is permanently or periodically waterlogged; are rich in decaying organic matter and there is usually a predominance of stagnant pools; marsh ecosystems are some of the more productive on Earth.
2. They need to be able to withstand the low oxygen levels that are characteristic of anaerobic conditions. They must be adapted to withstand fluctuating salt levels in the water; some plants, the hydrophytes, have to be totally adapted to life in water as they are totally submerged. Many have special air spaces or large pores in both their roots and stems. They are called aerenchyma and oxygen enters the plant and is transported to its roots through them. Some marsh plants even have completely hollow stems that transport oxygen to the roots. (any three)
3. Marsh and wetland animals have adapted to conditions in their waterlogged world in the following ways:
   - In order to move across the water quickly, many marsh animals (amphibians particularly) have webbed feet.
   - Insects have special paddle-like legs to glide or skate over the surface of the water.
   - Many have special camouflage to protect themselves from predators.
   - Some species of birds have long legs for wading, or very broad feet and toes to skip across the water plants or lily pads.
4. Marsh mongoose, civets, genets, otters, Nile crocodiles, as well as many species of birds, fish, frogs and toads (any three)

Assessment

Informal: Teacher assessment

How are you doing? SB p.211

Students should be able to describe the characteristics of a marsh; list the types of marshes and describe some adaptive features of organisms to the marsh. They must relate the structures and/or behaviours of the organisms to the marshy habitat. Students can make a mind map summarising the key points. Explain anything that they do not understand.

Key words

aerenchyma – a spongy tissue with large intercellular air spaces that is found in aquatic plants; it provides buoyancy and allows the circulation of gases.

anaerobic respiration – a process that takes place in plants and some microbial cells in the presence of little or no oxygen

food web – many food chains together in an ecosystem

freshwater marsh – a marsh that contains fresh water

halophyte – a plant that grows in waters of high salinity

hydrophyte – an aquatic plant that has adapted to living in aquatic environments (salt water or fresh water)

saltwater marsh – a marsh that contains salty water

stagnant – not flowing or moving, and often foul-smelling or stale

swamp – land that is always wet and often partly covered with water, and is often unsuited to cultivation

waterlogged – to be saturated with water

wetlands – areas of land where water covers the soil, or is present either at or near the surface of the soil all year or for varying periods of time during the year

TOPIC 27: Forest biomes (rainforests)

Performance objectives

27.1 Identify the characteristics of the forest habitat.
27.2 Recognise trophic levels and the distribution of animals in a forest.
27.3 Recognise the stratification of plants in a forest.
27.4 Recognise the adaptive features of animals and plants in a forest.
27.5 Identify and construct food chains that exist in a forest.

Introduction

Tropical rainforests are situated close to the equator and so experience high temperatures. The term 'rain' is used in their name because they can receive 1 500 mm of rain a year, or even more. Rainforests are lush and dense habitats. They support a high diversity of plants and animals. This topic covers the characteristics of rainforests; the different layers of plants in the forest; and the adaptive features of organisms associated with this biome.

Activity 27.1: Study forest food chains

GROUPS (SB p.216)

Resources

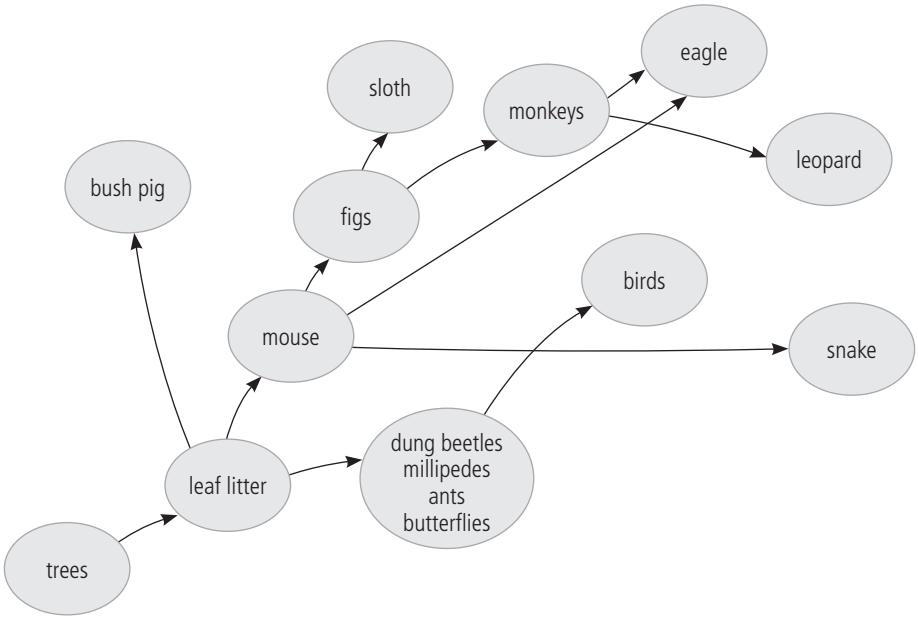
The textbook; images/pictures/charts of rainforest organisms; relevant websites and videos such as https://www.youtube.com/watch?v=OS2VrgRFCzc

Guidelines

Students must discuss the answers with their groups and then write their own answers in their workbook.

Facilitate: Divide the class into mixed-ability groups. Help the groups to answer the questions.

Answers

1. Tropical, high biodiversity, decomposition levels high, many decomposers, low light levels on forest floor, high rainfall throughout the year
2. Low in nutrients because the rainwater leaches nutrients out of the soil very rapidly, but decomposition levels are high; occasionally waterlogged
3. Primary consumers: birds, sloth, mouse, spider monkey, bush pig
   Secondary consumers: leopard, eagle, snake
   Decomposers: dung beetle, millipede
4. 

5. Plant adaptations: climbing plants, thick buttress roots for tall trees, strata/levels of vegetation adapted to light availability, tall trees in canopy
   Animal adaptations: camouflaged predators (snake and leopard), limbs and tails for climbing and jumping (arboreal habitat)
6. Students should be aware that the loss of the trees would impact negatively on every element in the food web and that soil loss and degradation would occur, similarly that if one of the species of plants or animals were to be over-exploited, there would be an imbalance in the system, with negative consequences at a broader level.
7. Human activity, deforestation, development, bush meat trade, hunting, etc.

Assessment

Informal: Self-assessment – discuss the answers to the activity with the class.

Answers to Revision questions

1. Forest floor, understorey, canopy, emergent
2. Deforestation
3. Forest floor level: mosses
   Understorey layer: smaller trees and low-growing ferns, climbing plants and shrubs – plants are not taller than 3–4 m; the flowers are often brightly coloured or have a very strong odour in order to attract pollinators; the young trees found here have thin trunks and moss; fungi and algae grow prolifically on the trunks of trees; climbing plants make the most of tree trunks by climbing up them to reach sunlight
   Canopy layer: tall trees, range from 5–30 m
   Emergent layer: very tall trees, range from 30–80 m. The diameters of tree trunks are also vast. In Nigerian forests, this layer contains trees such as mahogany, iroko, obeche, sapele and walnut.

Assessment

Informal: Teacher assessment

How are you doing? SB p.217

Students should be able to describe the characteristics of a rainforest; list the strata in the forest and types of plants in these layers; and describe some adaptive features of plants and animals found in rainforests. Students can make a mind map summarising the key points. Explain anything that they do not understand.

Key words

arboreal – of or relating to trees
disturbance agents – agents such as wind, water, drought, fire and pollution that bring about a temporary change in environmental conditions that can have a profound effect on the ecosystem
regeneration agents – agents such as small animals that stimulate the regrowth of plants through pollination and seed dispersal
strata – a layer of material, naturally or artificially formed, often formed one upon another
stratification – the formation or deposition of layers, as of rock or sediments
tropical – pertaining to, characteristic of, occurring in, or inhabiting the tropics, the warm, hot areas located between the Tropic of Cancer and the Tropic of Capricorn

TOPIC 28: Grasslands

Performance objectives

28.1 Recognise the dominant climatic factors in grasslands.
28.2 Describe the soil structure of grasslands.
28.3 Describe the structural and other adaptations of grassland plants and animals.
28.4 Identify the predominant plant and animal species and the energy relations between them.
28.5 Describe the soil structure.

Introduction

Grassland biomes are generally found in the middle latitudes and in the interiors of continents. There are two types of grasslands – temperate grasslands and tropical savannahs. Grass species dominate the biome because they are well-adapted to the icy winter frosts, regular fires and grazing. This topic covers the characteristics of these grasslands, as well as the distribution and adaptation of plants and animals in this biome. The final section of this topic is about types of savannah in Nigeria.

Activity 28.1: Answer questions about grasslands

INDIVIDUAL (SB p.223)

Resources

The textbook; images/pictures/charts of grassland organisms; relevant websites and videos such as https://www.youtube.com/watch?v=SenNsQR03Zw http://geography. about.com/od/locateplacesworldwide/a/latitude.htm (definition of latitudes)

Guidelines

Facilitate: Students must read the information in the topic before answering these questions. Help students to answer these questions.

Answers

1. B
2. C
3. C
4. C
5. B
6. C

Assessment

Informal: Self-assessment – discuss the answers to the activity with the class.

Answers to Revision questions

1. Temperate grasslands:
   - Average rainfall per year ranges from 25−75 mm/year (spring and summer).
   - Summer temperatures can be well over 38 °C, while winter temperatures can be as low as -40 °C.
   - Seasonal drought and occasional fires are important to biodiversity.
   - Temperate grasslands can be further divided as follows: prairies are grasslands with tall grasses while steppes are grasslands with short grasses.
   - Grasses are the dominant vegetation.
   - Annual rainfall influences the height of grassland vegetation, with taller grasses in wetter regions.
   - Trees and large shrubs are generally absent.
   - Seasonal drought, occasional fires, and grazing by large mammals prevents woody shrubs and trees from becoming mature.
   - (Any two points)

   Tropical grasslands:
   - Hot all year round, and closer to the Equator
   - Savannahs receive an average annual rainfall of 100 mm/year.
   - Tropical grasslands have both a dry and a rainy season.
   - Seasonal (dry season) fires play a vital role in the tropical grassland's biodiversity.
   - Dominant vegetation consists of grasses and forbs (small broad-leaved plants that grow with grasses).
   - Different savannahs support different grasses due to different rainfall patterns and soil conditions.

- Frequent fires and large grazing mammals kill seedlings, which keeps the density of trees and shrubs low.
- (Any two points)

2. Thick bark to reduce water loss to transpiration and to help prevent the intense heat of fires from reaching the sensitive inner plant tissue
   - Long root systems that are able to absorb as much water as possible in very dry periods
   - Large succulent stems and trunks to store water
   - The ability to shed leaves in the dry season to help reduce water loss
   - (Any three points)
3. Rodents like to burrow to escape the heat of the day and a tendency to be nocturnal.
   - Some are grazers, others are browsers.
   - Larger ungulates have the ability to outrun their predators.
   - Many have excellent sight and hearing ability to help detect predators.
   - They tend to flock or herd so that they have safety in numbers.
   - They move or migrate over large distances in search of water and better grazing (this is seasonally driven).
   - They have camouflage or patterning to help blend in with grassland surroundings (stripes, colouration to blend in with green/brown surrounds).

Assessment

Informal: Teacher assessment

How are you doing? SB p.224

Students should be able to describe the characteristics of temperate and tropical grasslands, as well as the distribution and adaptations of plant and animal species in this biome. Students can make a mind map summarising the key points. Explain anything that they do not understand.

Key words

dominate – any of one or more types of plants, or sometimes animals, that by virtue of abundance, size, or habits exert an influence on the conditions of an area and determine/influence what other organisms live there

prairies – grasslands with tall grasses

savannah – an ecological zone made up of a grassy layer and an upper layer of deciduous or evergreen trees.

steppes – grasslands with short grasses

TOPIC 29: Arid lands/deserts

Performance objectives

29.1 Recognise arid lands as places where water is not available to organisms because it is scarce or frozen.
29.2 Understand that exposure to sun, extremes of temperature and water scarcity are factors that desert organisms have to cope with
29.3 Differentiate cold deserts (tundra) from hot deserts.
29.4 Describe adaptations of organisms to arid lands.

Introduction

The desert biome covers a large amount of the Earth's surface. These are habitats where the annual rainfall is less than 250 mm per annum. There are four major types of deserts: hot and dry; semi-arid; coastal and cold. This topic is about these, as well as the distribution and adaptation of plants and animals in the desert.

Activity 29.1: Answer questions on how plants and animals adapt to aridity

INDIVIDUAL (SB p.228)

Resources

The textbook; magazines, books, relevant websites for research; images/pictures/charts of desert organisms; videos such as http://study.com/academy/lesson/desert-biomes-facts-climate-locations.html

Guidelines

Facilitate: Assist students to answer these questions.

Answers

1. Climate: very low rainfall; short bursts with long dry periods inbetween; warm throughout the year, but extremely hot in the summer, with dry winters; mean annual temperatures range from 20–25 °C, maximums hitting 49 °C, minimum temperatures as low as -18 °C.
   - Soils: coarse-textured, shallow, rocky or gravely with good drainage; fine dust and sand particles blown elsewhere, leaving heavier pieces behind.
   - Plants are succulents, specialised leaves, adaptations to cope with sandblasting, no leaves or spines to prevent water loss, sunken stomata, extensive root systems, and thick waxy cuticles on leaves.
2. Burrow, forage at night (nocturnal), special features in their ears and eyes to help protect these organs from high winds and sandblasting (eye shields, longer eyelashes, fringed ears); have small or very well-covered ears to minimise heat loss; some (like the a small species of fox in North Africa), have very large flat ears, which act like radiators and help keep the animal cool; lay eggs that remain dormant until conditions are suitable for hatching (certain insect species).
3. Hard body coverings to help reduce water loss from the body (sometimes scales on reptiles or hard waxy surfaces on insects); may seal themselves in burrows and remain inactive for eight or nine months until a heavy rain occurs (toads, for example); may have the ability to survive on the water content of foods they eat as opposed to drinking water and they also produce very concentrated urine; have shells which they use to withdraw their bodies to prevent desiccation (drying out); have very efficient excretory systems, which produce a highly concentrated urine, so as to reduce water loss from the body.
4. Hibernate, roll into balls to prevent heat loss.

Assessment

Informal: Teacher assessment – discuss the answers to the activity with the class. Use the following rubric to help you evaluate the oral.

Rubric for the oral

	Poor	Average	Good	Excellent
Research & content: background research and acknowledge sources	0–1	2–2,5	3–3,5	4–5
Style: fluency and eye contact, expression, speed, reading, timing	0–1	2–2,5	3–3,5	4–5
Use of media: posters, pictures, etc.	0–1	2–2,5	3–3,5	4–5
Total marks: out of 15				

Answers to Revision questions

1. Hot and dry, semi-arid, cold, coastal
2. Any three answers:
   - have fleshy, succulent leaves and stems to help store water
   - have ribbed surfaces to allow for expansion (like a concertina) when they absorb water (cactus species)
   - specialised leaves that allow the plant to take in tiny droplets of ocean fog
   - have special adaptations to prevent sandblasting in sand storms
   - have no leaves, which helps prevent water loss to transpiration
   - possess very deep and extensive root system to help find water deep down underground
   - have leaves with sunken stomata to reduce transpiration and water loss
   - have the ability to grow in spurts in the rainy season and complete their life cycle quickly to then live through the dry season in seed form
   - may have leaves with a waxy layer or a thick layer of hairs, again to prevent water loss
   - are mainly ground-hugging shrubs and short woody trees
   - have leaves with water-conserving characteristics (small, thick with a thick cuticle outer layer)
   - have spines to provide protection in a hazardous environment and to prevent transpiration
   - many have silvery or glossy leaves (reflect more radiant energy).
   - (Any three points)
3. The animals are generally nocturnal (forage at night) so as to avoid the heat of the day when temperatures are lower and heat loss is minimised. They may make use of burrows to avoid the high temperatures during the day.
4. The answers are as follows:
   - animals may have hard body coverings to help reduce water loss from the body (sometimes scales on reptiles or hard waxy surfaces on insects)
   - have shells, which they use to draw their bodies into to prevent desiccation (drying out)
   - have very efficient excretory systems which produce a highly concentrated urine, so as to reduce water loss from the body
   - may have the ability to survive on the water content of foods they eat as opposed to drinking water and they also produce very concentrated urine.

Assessment

Informal: Teacher assessment

How are you doing? SB p.229

Students should be able to describe the characteristics of desert biomes, as well as the distribution and adaptations of plant and animal species in this biome. Students can make a mind map summarising the key points. Explain anything that they do not understand.

Key words

arid – land that is barren or unproductive because of lack of moisture
dormant – not active but able to become active
radiator – used to transfer energy from one medium to another for the purpose of cooling and heating

THEME 4

Continuity of life

TOPIC 30: Reproduction in unicellular organisms and invertebrates

Performance objectives

30.1 Define reproduction.
30.2 List the different types of reproduction.
30.3 Describe the forms of asexual reproduction.
30.4 Describe sexual reproduction.
30.5 Describe reproduction in unicellular organisms and invertebrates, in *Amoeba*, in *Paramecium*, in the earthworm, in the cockroach, in the housefly and in the snail.
30.6 Differentiate between complete and incomplete metamorphosis.

Introduction

This topic covers the differences between asexual and sexual reproduction. As the chromosome number must be reduced in sexual reproduction, meiosis is described in detail. Meiosis is a type of nuclear division that ensures that there are a constant number of chromosomes within the cells of a particular organism. In other words, in this type of division a diploid (2n) body cell divides to form four different haploid (n) sex cells.

Activity 30.1: Reproduce bread mould

GROUPS (SB p.232)

Resources

Bread; an empty jar; a hand lens; microscope; slides; coverslip; dissecting needle; water; dropper

Guidelines

Facilitate: Check that students wash their hands after touching the mould. They should not eat the mouldy bread as it can cause serious food poisoning. Students can place some bread mould in a drop of water on a clean slide and tease out the strands.

Answers

Students will observe the mould and make notes.

Assessment

Informal: Self-assessment – discuss the observations with the class.

Activity 30.2: Answer questions about the process of meiosis

PAIRS (SB p.234)

Resources

The textbook

Guidelines

Facilitate: Revise the stages of mitosis before doing this activity. Students must discuss the questions with their partners. Thereafter check the answers with the class.

Answers

1. There are four chromosomes present in the parent cell.
2. In a diploid cell, chromosomes occur in pairs. The members of each pair are called homologous chromosomes or homologues. The homologues: look alike; have the same length and centromere position; contain the same types of genes; have a gene for a particular trait (for example, hair colour) located at similar loci (positions or locations on the chromosome) for each chromosome. However, the gene on one chromosome could be dominant and the gene on the other chromosome could be recessive.

3. Two cells are formed at the end of meiosis I.
4. Homologous chromosomes separate and move to opposite poles. This results in two sets of chromosomes, one set at each pole. The cytoplasm then divides to form two cells.
5. At the end of meiosis I, the cells have half the number of chromosomes compared to the parent cell.
6. Four daughter cells are produced at the end of meiosis II.
7. Each daughter cell has a member of the homologous chromosome from the parent cell.
8. The daughter cells differ from the parent cell because each cell has half the chromosome number of the parent cell.

Assessment

Informal: Self-assessment – check the answers to the activity with the class.

Activity 30.3: Study meiosis

PAIRS (SB p.235)

Resources

The textbook

Guidelines

Facilitate: This activity serves to develop the students' ability to observe. It is therefore important to assess their drawings for accurate representation. Check that students draw and label only what they see. Take into account aspects such as size, shape and proportion.

Answers

1. & 2. Students will observe and draw diagrams. They must pay attention to accuracy and proportion. The diagrams must be given a clear heading and neatly labelled on the right-hand side.
3. During prophase I, the chromosomes coil up and spindle fibres form. The homologous chromosomes come together to form bivalents or tetrads. Crossing over takes place with the exchange of genetic material. During this stage, the nuclear membrane also disintegrates. The spindle fibre is broken down in telophase I. The chromosomes uncoil and the cytoplasm begins to divide, resulting in the formation of two cells. Each cell has only half the genetic make-up of the original cell because it has only one chromosome from each homologous pair. Therefore another division is needed since the chromosome is still doubled, containing two identical sister chromatids. During anaphase II, the centromere of each chromosome splits, allowing the sister chromatids to separate and move to opposite poles. The sister chromatids are now called chromosomes. The nuclei reform in telophase II, the spindle fibres break down and the cytoplasm divides.

   At the end of meiosis II, four haploid cells are formed from the original diploid cell. Each haploid cell contains one chromosome from each homologous pair.

Assessment

Informal: Teacher – check the drawings and labels of the diagrams of each student.

Activity 30.4: Understand how cells are formed at the end of meiosis

INDIVIDUAL (SB p.238)

Resources

The textbook

Guidelines

This activity can be given as a homework task.

Answers

1. No – exchange of genetic material between non-sister chromatids took place.
2. No – they have half the number of chromosomes, and the chromosomes are also different from the original cell due to exchange of genetic material.

Assessment

Informal: Self-assessment – check the answers to the activity with the class.

Activity 30.5: Understand the meiotic cell cycle

GROUPS (SB p.238)

Resources

A set of cards with drawings of the different stages of meiosis; a sheet of flip chart paper, which may be stuck on the wall of your classroom; Koki pens; sticky tape or Prestik

Guidelines

The purpose of this activity is to consolidate the understanding of cell division. Prepare sets of cards with copies of Figure 30.9 and Figure 30.10 from the Student's Book. Each card is to contain only one picture depicting the relevant stage of cell division, for example one card for prophase I, another card for metaphase I, and so on. Include also in each set or pack of cards, pictures of the stages of mitosis.

If possible, laminate the cards so that they can be used in future years.

Answers

5. a) Yes. The cells have twice the number of chromosomes in the first card compared to the cells in the last card. The type of chromosomes are also different in both cards. This is due to crossing over.
   b) Two cells are formed at the end of meiosis I.
   c) The cells are haploid (n).
   d) There will be 39 chromosomes in the egg.
   e) A pair of homologous chromosomes: look alike; have the same length and centromere position
   f) To provide genetic diversity in a population. This contributes to the survival of the organism.

(Refer to reference books or relevant websites about natural selection and variation such as http://study.com/academy/lesson/what-is-genetic-variation-sources-definition-types.html).

Assessment

Informal: Self-assessment – check the answers to the activity with the class.

Answers to Revision questions

1. Asexual reproduction takes place when the whole or part of an organism can produce a new organism. The advantages of asexual reproduction are: only one parent is needed, there are no gametes to join, the new organisms that are formed are identical to the parents and to each other, and there are usually large numbers of offspring produced.
2. In asexual reproduction spores are formed by budding, for example, in yeast. Spores are formed in special fruiting bodies, such as sporangia.
3. Sexual reproduction takes place when male and female gametes join together. In flowering plants, pollen contains the male gamete and the female gametes are in the ovary. In animals, the males and females look different. The male produces sperm (male gamete) and the female produces eggs (female gamete). When the male and female gamete join together ,this is called fertilisation. Fertilisation produces a fertilised egg called a zygote. The zygote divides to form an embryo, which grows into a new organism.
4. The gametes are produced through a process called meiosis. This type of cell division is called reduction division because each of the gametes has half the number of chromosomes that the parent cell had. To understand the importance of reduction division you need to understand about life cycles in different organisms. The word life cycle means all the reproductive stages or events that take place from one generation to the next.

   The zygote has the diploid (2n) number of chromosomes. All body cells or somatic cells of an organism will have the diploid number of chromosomes. Diploid (2n) cells have two sets of chromosomes, which are called homologous pairs of chromosomes. This means that for each homologous pair of chromosomes, one chromosome comes from the mother and the other chromosome comes from the father. In addition, each member of a homologous pair of chromosome is similar in size, and carry similar types of genes.

In this type of cell division, a diploid (2n) body cell divides to form four different haploid (n) sex cells. Haploid cells only have one set of chromosomes. They have no homologous partner. The haploid (n) number is half the diploid number. Sex cells or gametes have the haploid number of chromosomes.

The process of meiosis occurs at different points during the life cycle of different organisms (see Figure 30.6). For example, in animals, it takes place during the production of gametes. In plants, meiosis occurs during the production of spores, which will divide by mitosis to produce the haploid generation. In some fungi, meiosis takes place immediately after the production of the zygote.

5. Sexually and asexually
6. Earthworms reproduce by sexual reproduction and are hermaphrodites. The body of earthworms is divided into segments and the sexual organs are found in segments 9 to 15. Earthworms have one or two testes in sacs and sperm are released through male pores. The ovaries and oviducts in segment 13 release eggs through female pores on segment 14. Sperm is excreted through segment 15.

   When earthworms mate – usually at night – two worms copulate so that segment 15 of one worm releases sperm into segments 9 and 10 of its mate. Each earthworm releases eggs, which are fertilised by another individual's sperm. The eggs develop into cocoons. Inside these cocoons tiny earthworms are formed, which come out of the cocoon as small, fully formed earthworms.
7. Complete metamorphosis: stages in an insect life cycle where the larva does not resemble the adult stage; the stages in the life cycle are egg – larva – pupa – adult
   Incomplete metamorphosis: stages in an insect life cycle where the larval stage/s looks similar to the adult; the stages in the life cycle are egg – larva- adult
8. The cockroach has incomplete metamorphosis so has no pupa stage like the housefly.
9. Although snails exchange sperm, all snails can lay eggs as they are hermaphrodites. This increases the chance of survival.

Assessment

Informal: Teacher assessment

How are you doing? SB p.242

There is a large amount of content in this topic. Break it up into manageable portions for the weaker students. Check that they understand the terminology and concepts by asking them questions. Explain anything that students do not understand.

Key words

binary fission – a method of asexual reproduction that involves the splitting of a parent cell into two approximately equal parts

budding – a form of asexual reproduction in which a new organism develops from an outgrowth or bud due to cell division at one particular site

complete metamorphosis – stages in an insect life cycle where the larva does not resemble the adult and changes in a pupa stage; the stages in the life cycle are: egg – larva – pupa – adult

gamete – a cell that fuses with another cell during fertilisation in organisms that sexually reproduce

hermaphrodite – an individual in which reproductive organs of both sexes are present

incomplete metamorphosis – stages in an insect life cycle where the larval stage/s looks similar to the adult; the stages in the life cycle are egg – larva – adult

meiosis – cell division in the sex cells, when four haploid daughter cells are formed

metamorphosis – a change in form from one stage to the next in the life history of an organism

multiple fission – a process during which the parent cell divides into many daughter cells during unfavourable conditions

spore – a reproductive cell capable of developing into a new individual without fusion with another reproductive cell

vegetative propagation – a form of asexual reproduction in plants by which new organisms arise without production of seeds or spores

zygote – a fertilised egg; a cell that is formed when an egg and a sperm combine

SS1 Examination

Marks: 220 **Time: 2 hours**

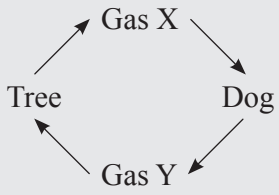
Section A

Multiple-choice questions (60)

Each question is followed by four options (A–D). Choose the correct option. Give *one* answer only to each question.

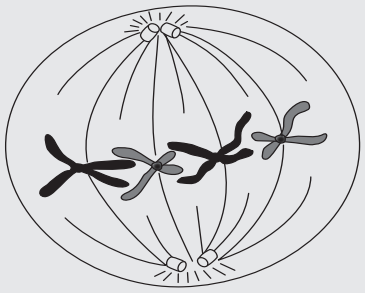
1. The study of the relationships between plants and animals, and the environment is called:
   A Botany
   B Ecology
   C Palaeontology
   D Ethology
2. A factor that is used for comparison in an experiment is:
   A a procedure
   B a hypothesis
   C a control
   D an aim
3. All members of the Phylum Arthropoda have:
   A two body regions, jointed legs, an exoskeleton
   B three body regions, three pairs of legs, wings
   C an exoskeleton, jointed legs
   D a fluid skeleton, one or two shells
4. Ojama observed the following organism under a light microscope. She correctly identified it as:

   A *Euglena*
   B *Volvox*
   C *Amoeba*
   D *Chlamydomonas*
5. An example of the Phylum Annelida is:
   A an earthworm
   B a mushroom
   C a sponge
   D a frog
6. A group of tissues that work together to perform a specific function is called:
   A an organism
   B an organ
   C a tissue
   D a system
7. The gas/gases taken in through the pores in leaves during photosynthesis is/are:
   A oxygen
   B carbon dioxide
   C water vapour
   D carbon dioxide and water vapour
8. The food molecule produced by photosynthesis consists of:
   A fat
   B glucose
   C acids
   D DNA
9. Gas X and Y in the following cycle are:



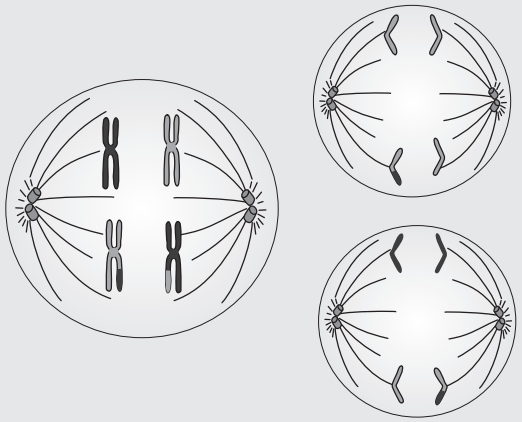
   A X – oxygen; Y – carbon dioxide
   B X – oxygen; Y – oxygen
   C X – carbon dioxide; Y – carbon dioxide
   D X – carbon dioxide; Y – oxygen
10. A good example of a food that contains fat is:
    A margarine
    B fish
    C beans
    D yoghurt
11. Which vitamin is required for bone formation?
    A Vitamin C
    B Vitamin D
    C Vitamin B
    D Vitamin A

12. A type of nutrition in which organisms obtain their food from dead or decaying matter is:
    A autotrophic nutrition
    B parasitic nutrition
    C saprophytic nutrition
    D holozoic nutrition
13. Which enzyme is found in saliva?
    A maltase
    B protease
    C lipase
    D amylase
14. Which of the following is an autotroph?
    A *shoko yokoto* (Lagos spinach)
    B a crocodile
    C a hippopotamus
    D a puffadder
15. Identify the stage of mitosis shown in the illustration:



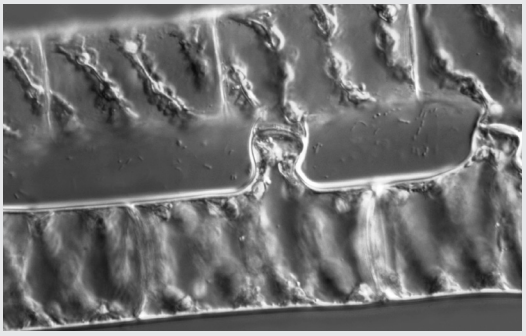
    A prophase
    B metaphase
    C anaphase
    D telophase
16. Movement of the liquid part of the cell is called:
    A assimilation
    B locomotion
    C irritability
    D cyclosis
17. Secondary growth causes plants to:
    A increase in height
    B live longer
    C increase in width
    D increase in height and width
18. Choose the correct statement:
    A Stems are negatively phototropic and negatively geotropic.
    B Stems are positively phototropic and positively geotropic.
    C Roots are positively geotropic and stems are positively phototropic.
    D Roots are negatively phototropic and positively geotropic.
19. Hormones are:
    A only found in plants
    B cells in the tips of plant organs
    C chemical messengers
    D responses to stimuli
20. The biome made up of a grassy layer and an upper layer of deciduous or evergreen trees is:
    A a tropical rainforest
    B a swamp forest
    C grassland
    D savannah
21. Which statement/s apply to the desert biome?
    A It receives very little rainfall.
    B It is extremely hot in the day and very cold at night.
    C Humidity is often below 25 °C.
    D It receives very little rainfall, is extremely hot in the day and very cold at night, and humidity is often below 25 °C.
22. Which method does not help prevent the loss of topsoil?
    A planting windbreaks
    B contour ploughing
    C using mulch
    D deforestation

Refer to the following diagram for Questions 23 and 24.



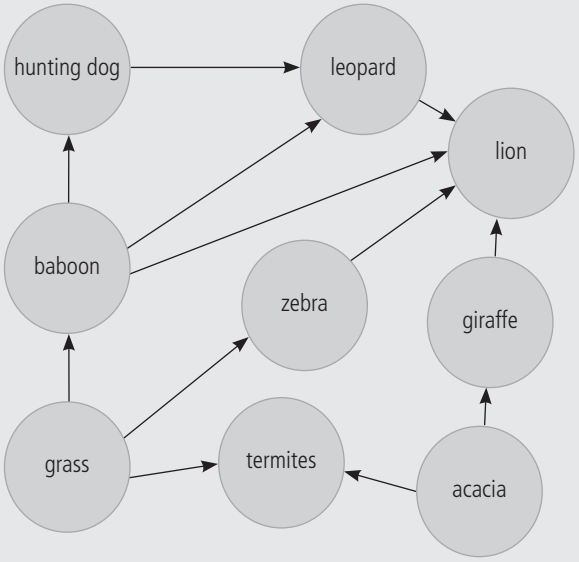
S T

23. The stages of meiosis are:
    A metaphase I and metaphase II
    B anaphase I and anaphase II
    C metaphase I and anaphase II
    D prophase I and prophase II
24. Which stage/s have homologous chromosomes?
    A S and T
    B only S
    C only T
    D neither stage
25. How many cells are present at the end of meiosis I?
    A 1
    B 2
    C 3
    D 4
26. How many cells are present at the end of meiosis II?
    A 1
    B 2
    C 3
    D 4
27. Binary fission occurs in:
    A birds
    B bacteria
    C cats
    D frogs
28. Animal X has 40 chromosomes. How many chromosomes are found in the gametes of animal X?
    A 40
    B 10
    C 4
    D 20
29. Which statement is correct for earthworms?
    A Baby earthworms are formed in cocoons.
    B They reproduce by budding.
    C They are hermaphrodites.
    D Both A and C are correct.
30. The larvae of houseflies are called:
    A pupae
    B maggots
    C baby flies
    D midges
31. Which statement does not apply to snail reproduction?
    A The young do not look like the adults.
    B Snails are hermaphrodites.
    C Snails lay eggs.
    D Fertilisation is internal.
32. This photograph below shows:



    A binary fission
    B conjugation canals between two filaments of *Spirogyra*
    C meiosis
    D two earthworms exchanging sperm
33. Which of the following food chains is correct?
    A herbivores → carnivores → carnivores
    B producers → carnivores → carnivores
    C producers → primary consumers → secondary consumers
    D producers → secondary consumers → tertiary consumers
34. In a food chain, a buzzard eats a snake; the snake eats a frog; the frog eats a predaceous insect; the predaceous insect eats a herbivorous insect. The frog is an example of a:
    A a producer
    B a secondary consumer
    C a primary consumer
    D a tertiary consumer

35. This question relates to the African food web shown here:



What will be the effect on the food web if the baboons are removed?

A The population of lion will increase.
B The populations of leopard, hunting dog and lion will decrease.
C The populations of leopard, hunting dog and lion will decrease. The amount of grass in the area will increase.
D The populations of leopard, hunting dog and lion will decrease. The amount of grass in the area will increase. The populations of zebra and giraffe will decrease.

36. What is the original source of energy in food chains?
A carbohydrates
B sunlight
C water
D carbon

37. The name given to an interconnected food chain in an area is:
A an ecosystem
B a community
C a niche
D a food web

38. Humans are best characterised as:
A carnivores
B omnivores
C decomposers
D herbivores

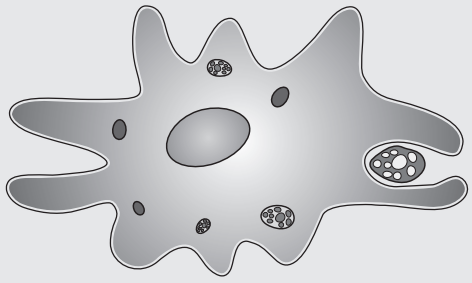
39. Look at the food chain shown below:
X → grasshopper → lizard → puff adder → Congo serpent eagle
X could be:
A grass
B a frog
C a human
D a duck

40. Organisms that break down dead organic matter are known as:
A producers
B consumers
C herbivores
D decomposers

41. Which of the following is not strictly classified as a micro-organism?
A Tuberculosis bacteria
B the malaria parasite (*Plasmodium vivax*) – Kingdom Protista
C hair lice
D yeast

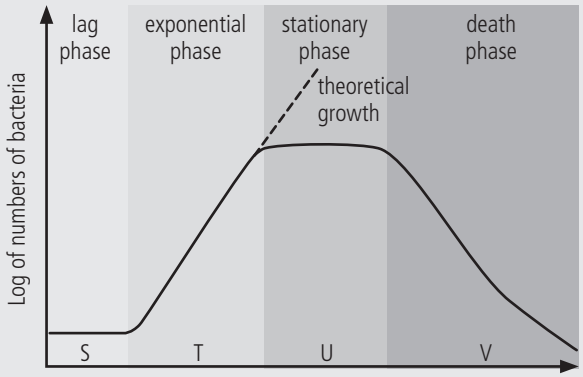
42. An example of a microscopic decomposer is:
A a bacterium
B a virus
C algae
D an earthworm

43. The name of this unicellular micro-organism that is eating a food particle is:
A HIV
B Trypanosome
C *Amoeba*
D *Rhizopus nigricans* (bread mould)



44. Which method is not used to control micro-organisms?
A low temperature
B antiseptics
C antibiotics
D high salinity

The following diagram relates to Questions 45 and 46.



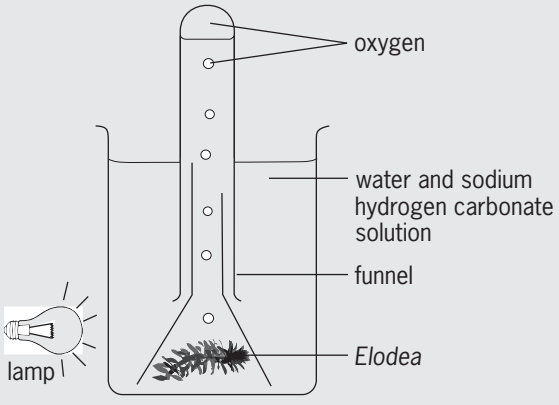
45. Which phase is T?
    A lag phase
    B exponential phase
    C stationary phase
    D death phase
46. Which phase is V?
    A lag phase
    B exponential phase
    C stationary phase
    D death phase
47. Which disease is not caused by an animal vector?
    A cholera
    B malaria
    C flu
    D food poisoning
48. Which organism is the primary consumer in the following food chain?
    phytoplankton → tadpole → small fish → big fish → kingfisher
    A the tadpole
    B the small fish
    C the phytoplankton
    D the kingfisher
49. Which organism occupies the second trophic level in the following food chain:
    phytoplankton → tadpole → small fish → big fish → kingfisher
    A the tadpole
    B the small fish
    C the phytoplankton
    D the kingfisher
50. Which organism is a decomposer?
    A a vulture
    B a hyena
    C a mushroom
    D a bat
51. Adeshola is going on holiday to an area that has the malaria mosquito. Which option will be best for her to follow to prevent getting malaria?
    A having the malaria vaccine
    B improving her diet
    C taking anti-malarial tablets
    D drinking 2 litres of water a day
52. The basic unit of life is the:
    A cell
    B atom
    C organ
    D tissue
53. The kingdom containing only organisms that can make their own food is:
    A the animal kingdom
    B the plant kingdom
    C bacteria
    D fungi
54. An area that is made up of living (biotic) and non-living (abiotic) components is:
    A an ecosystem
    B a habitat
    C a niche
    D a population
55. Placing things into groups based on similar characteristics is called:
    A ecology
    B synecology
    C taxonomy
    D classification
56. The cell that forms when an egg cell and a sperm cell combine is called:
    A a sperm
    B an egg
    C a zygote
    D an embryo
57. An example of an organism that has both male and female reproductive organs is:
    A an earthworm
    B a frog
    C a snail
    D an earthworm and snail
58. A complete metamorphosis includes the following stages:
    A egg, larva, adult
    B egg, nymph, adult
    C egg, larva, pupa, adult
    D egg, adult

59. The average number of individuals of a species in a particular unit or area of habitat is:
    A a community
    B a population
    C an ecosystem
    D a biosphere
60. Adeleke noticed a ring-shaped patch on her skin. The doctor said it was a contagious skin disease caused by:
    A a fungus
    B a bacterium
    C a virus
    D a dog

Section B

Structured questions (160)

1. a) Name five characteristics that all living organisms share. (5)
   b) State two distinguishing characteristics of the Fungi Kingdom. (2)
2. Read the following experiment and answer the questions that follow:
   Elodea (Canadian Pondweed) is often used to investigate the speed of photosynthesis. As plants produce food by photosynthesis, they also give out oxygen. The more starch produced, the greater the amount of oxygen produced. As *Elodea* is a pond plant, the oxygen given off can be seen as bubbles. These can either be counted directly or, for accuracy, the volume of oxygen released can be measured.



   a) Write a suitable aim for the experiment. (1)
   b) What is the function of the sodium hydrogen carbonate solution in the experiment? (2)
   c) What is the function of the light bulb in this experiment? (1)
   d) The numbers of oxygen bubbles were counted over a certain number of minutes as shown below:
   Note: Rate means the number of bubbles per given time.
   Rate per 1 minute: 100 bubbles
   Rate per 2 minutes: 150 bubbles
   Rate per 3 minutes: 200 bubbles
   Rate per 4 minutes: 250 bubbles
   Rate per 5 minutes: 300 bubbles
   Rate per 6 minutes: 350 bubbles
   Rate per 7 minutes: 250 bubbles
   Rate per 8 minutes: 150 bubbles
   Rate per 9 minutes: 50 bubbles
   Rate per 10 minutes: 10 bubbles
      i) Draw a table to show this information. (6)
      ii) Suggest a conclusion for these results. (2)
3. Describe the carbon cycle. Use your own words. (10)
4. Choose the word from the following list that matches the type of nutrition described below: (5)
   flamingo bacteria tick *Amoeba* mosquito
   a) a parasite
   b) chemosynthesis
   c) a filter feeder
   d) phagocytosis
   e) a blood feeder
5. Study the picture of the game park and answer the questions that follow:

a) Name two biotic factors visible in the game park. (2)
b) Name one abiotic factor visible in the game park. (1)
c) Explain why this is an ecosystem. (3)

6. Aghedo and Zinachimdi set up the following experiment:

Method

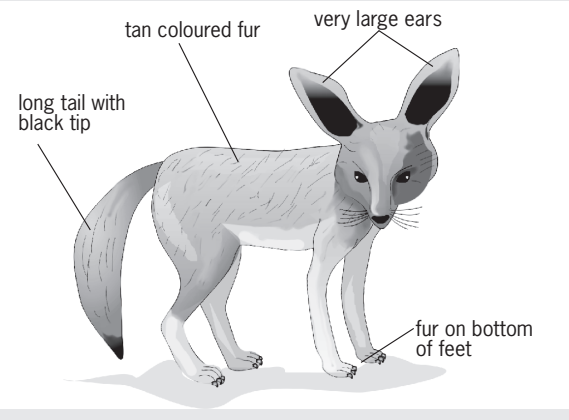
- Take two identical potted plants and put one (plant A) on the turning disc of a horizontally placed wound clinostat, and the other (plant B) on a second unwound clinostat.
- Cover each plant with a cardboard box that has a small opening on the one side.
- Place both apparatus in the sunlight so that the openings are directed towards the sun.
- Leave the apparatus for a few days.

a) Suggest a suitable aim for the experiment. (1)
b) Suggest a suitable hypothesis for the experiment. (1)
c) Describe the expected results of the experiment. (2)
d) Which plant is the control? What is the purpose of the control? (2)
e) What is the role of the clinostat? (2)

7. a) What is the purpose of mitosis? (4)
b) Draw and label a diagram showing anaphase in mitosis. (7)

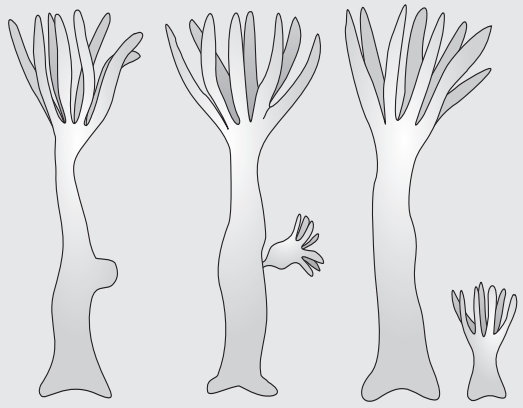
8. a) Explain the term *biome*. (3)
b) Describe the tropical rainforest biome in Nigeria. (5)

9. The Fennec fox lives in hot, dry regions of North Africa. Its ears are large, sometimes up to half the length of its body.



a) What type of environment is the Fennec fox adapted to live in? (2)
b) Suggest three ways in which the Fennec fox is adapted to live in the desert. (3)

10. a) Give three advantages of asexual reproduction. (3)
b) Study the diagram below and answer the questions that follow:



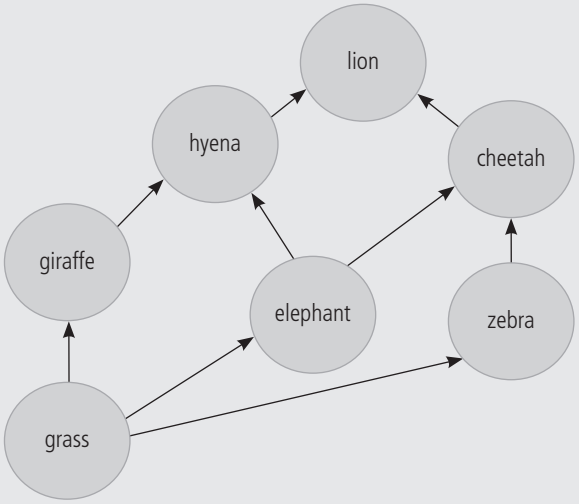
i) Name this type of reproduction. (1)
ii) Is it a form of sexual or asexual reproduction? Support your answer with two reasons. (3)

11. Mrs Azikiwe grows African violets, *Saintpaulia*, as a hobby. She can grow new plants easily by removing a mature leaf and placing the stalk in water. When roots grow, she places the leaf in soil. African violets live in rainforests, which provide shade from the hot sun. In their natural habitat, they are threatened with extinction. Local people are cutting down the trees for fuel and they need the land for cash crops.

a) What form of reproduction is described in the above passage? (2)
b) Do you think more people should grow African violets in their homes, like Mrs Azikiwe does? Support your answer with two reasons. (2)

12. State the first and second law of thermodynamics. (4)
13. Draw a simple food chain with the following organisms: eagle, field mouse, snake, seeds. (4)

14. Look at the food web below and answer the questions that follow:



Give an example of each of the following from the food web:

a) a producer (1)
b) a scavenger (1)
c) a carnivore (1)
d) a primary consumer (1)
e) a secondary consumer (1)
f) Construct one food chain with four links from the food web. (4)
g) Explain why food chains usually begin with green plants. (2)
h) What would be the effect on the food web if all the elephants died? (2)

15. Name the four groups of micro-organisms. (4)

16. Read the information below and answer the questions that follow:

In 1928, a bacteriologist called Alexander Fleming was growing bacteria on dishes of agar. Normally Fleming covered his bacterial colonies with a lid to prevent them from getting contaminated. But on one occasion, he accidentally left a dish uncovered. When he examined the dish after some time, he found that a mould (fungus) was growing on the agar. The interesting thing was that close to the mould, no bacterial colonies were present. Fleming went on to discover that the substance produced by the fungus had the power of destroying all kinds of bacteria that cause human disease. He identified the mould as *Penicillium notatum*. It took scientists about 10−12 years to produce the substance in a usable form. The substance was called penicillin, the first antibiotic.

a) i) Name the biologist in the article. (1)
ii) This biologist cultured micro-organisms. Explain the meaning of the word *cultured*. (1)
ii) What nutrient did he use to culture the bacteria? (1)
iii) What important discovery did he make? (2)
iv) It is often said that he made this discovery by accident. However, his discovery required scientific skills. Mention two of these skills. (2)
b) Name the antibiotic mentioned in this article. (1)
c) What is an antibiotic? (2)
d) Name two micro-organisms mentioned in this article. (2)
e) i) What causes TB? (1)
ii) Why do people often stop taking the TB antibiotic before the course has ended? (2)
iii) What is the DOTS programme? (2)
f) State three characteristics of bacteria. (3)

17. Onyedi took two pieces of the same type of white bread that were exactly the same size. He sprinkled one piece with water and the other piece was kept dry. He covered both pieces with cling wrap and placed them on the side surface of his Biology classroom. Onyedi recorded the growth of mould over two weeks. He noticed mould grew on the bread that was damp.

a) Give a suitable aim for this investigation. (1)
b) Give a suitable hypothesis for this investigation. (1)
c) Which was the control in this investigation? (1)
d) Mention two variables (factors) that were controlled in this investigation. (2)

e) Give one way that Onyedi can record his results to show other people what happened. (1)
f) Give a conclusion for his investigation. (1)
g) Suggest one improvement for Onyedi's investigation. (1)

18. When Esther and Abigail were in SS1, they wanted to try out the mark-release-recapture method. They found a used plastic colddrink bottle and cut off the top portion. Then they placed 5 cm of moist sand in the bottom and cut some netting from a bag that had held fruit to put over the top of the bottle. Esther and Abigail woke up early in the morning even though it was raining and went to an open field near where they lived. Using a small fishing net, they managed to catch 21 locusts. They placed them in a colddrink bottle and gave them some fresh grass to eat and took them to school. Here they carefully marked the locusts with bright yellow non-toxic paint, and after school, they went to the same field and released them. Three days later, Esther and Abigail went to the field and once again tried to capture the locusts. They were disappointed as this time; they managed to catch two locusts only, one of which was marked with paint. It had been a very hot week and the girls wondered if the weather had affected the results.
    a) Calculate the population size of locusts in this field. (3)
    b) Do you think this is an accurate estimate of the population size? Explain your answer. (3)
    c) Do you agree with Abigail and Esther's sampling method? Suggest one improvement. (1)

19. a) Define the term *population*. (2)
    b) Give four factors that affect the growth and size of populations and explain the meaning of these terms. (8)
    c) How will a food shortage affect a population? (3)
    d) State two effects of overpopulation in an area. (2)
    e) An ecologist wants to determine the variety of grasses on a field in Nigeria.
        i) What instrument should the ecologist use? (1)
        ii) Briefly explain this method. (3)

SS1 Exam paper memo

Section A (60)

1. B	16. D	31. A	46. D
2. C	17. C	32. B	47. B
3. C	18. D	33. C	48. A
4. D	19. C	34. D	49. A
5. A	20. D	35. C	50. C
6. B	21. D	36. B	51. C
7. B	22. D	37. D	52. A
8. B	23. B	38. B	53. B
9. A	24. B	39. A	54. A
10. A	25. B	40. D	55. D
11. B	26. D	41. C	56. C
12. C	27. B	42. A	57. D
13. D	28. D	43. C	58. C
14. A	29. D	44. A	59. B
15. B	30. B	45. B	60. A

Section B (160)

1. a) Any 5 – reproduction, nutrition, excretion, sensitivity to the environment, growth, respiration, movement (5)
   b) Any 2 – eukaryotes, cell walls contain cellulose, heterotrophs, reproduce sexually and asexually, most respire aerobically (2)
2. a) To show that oxygen is given off as a by-product in photosynthesis (1)
   b) To provide carbon dioxide, which is required for photosynthesis (2)
   c) Photosynthesis takes place in the presence of light. (1)
   d) i) (6)

Rate per minute (1)	Number of oxygen bubbles (1)
1	100
2	150
3	200
4	250
5	300
6	350
7	250
8	150
9	50
10	10

(2 marks for the correct recording of information in each column)

ii) Photosynthesis increases up to a certain point due to the availability of carbon dioxide. (1) When all the carbon dioxide is used up, it starts to decrease. (1) [2]

3. Carbon is found in the atmosphere (1) as carbon dioxide (1). Carbon dioxide is found dissolved in water bodies. (1) Micro-organisms decompose dead organisms (1) releasing carbon dioxide in the process of respiration. (1) Plants and animal release carbon dioxide (1) in the process of respiration. (1) Burning of wood or fuel (1) releases carbon dioxide (1) in the process of combustion (1). Plants use carbon dioxide (1) in the process of photosynthesis (1). (Any 10) [10]
4. a) tick (1)
   b) bacteria (1)
   c) flamingo (1)
   d) *Amoeba* (1)
   e) mosquito (1)
   [5]
5. a) elephants, grass, trees – any 2 (2)
   b) water (1)
   c) plants and animals (2), interactions between biotic and abiotic factors (1)
   [3]
6. a) To prove that a plant grows towards a unilateral light source (1)
   b) The plant on the unwound clinostat grows towards the unidirectional light source. (1)
   c) The plant on the unwound clinostat grows towards the unidirectional light source.

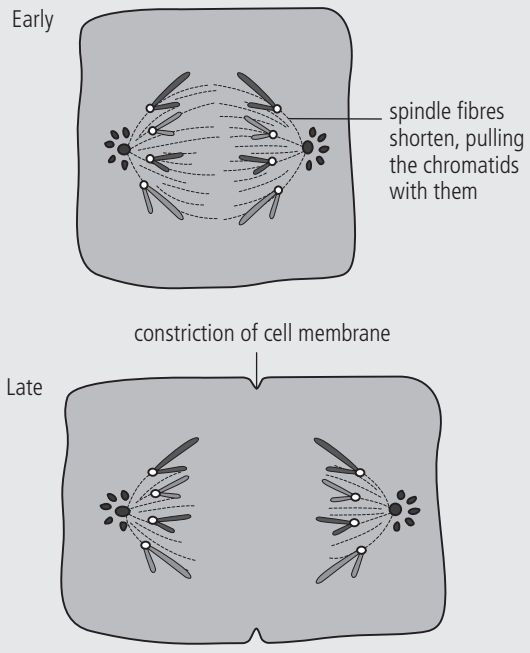
The plant on the wound clinostat does not grow towards the unidirectional sunlight. (2)

d) The one on the wound-up clinostat – the unilateral stimulus is negated by the turning of the clinostat. To provide a comparison for the experiment. (2)

e) A clinostat is a device that prevents the effects of a stimulus from one side from having an effect on the plant. The entire plant is given the same amount of the stimulus. (2)

7. a) Mitosis is the form of cell division that makes it possible for growth to take place. (1) Mitosis is the way that our bodies repair (1) and replace themselves (1). Mitosis produces new individuals during asexual reproduction (1), [4]

b)



Award marks on the following basis: Labels (3) Accuracy of diagram (2) Neatness (1) Heading (1) [7]

8. a) A large natural area where certain types of plants grow. Every biome is influenced by key factors such as climate, soil, landform, fire or frost. These factors help to determine the types of plants that grow in a biome and, in turn, the kinds of animals that make it their home. (Any 3) (3)

b) The average rainfall is 2 000 mm per year; the rains usually last about 10 months; humidity is at 70%; strip of tall trees with a dense undergrowth of climbing plants – top, middle and lower layers; evergreen forest; dense human population. (Any 5) (5)

9. a) Hot, dry, sandy (2)

b) Sandy coloured fur for camouflage; fur under the feet to protect them from heat; small body so as not to lose too much heat; long tail with black tip for communication with other animals (3)

10. a) Only one parent is needed; there are no gametes to join; the new organisms that are formed are identical to the parents and to one another; there are usually large numbers of offspring produced. (Any 3) (3)

b) i) budding (1) ii) asexual (1) one parent, offspring looks identical to the parent (2) [3]

11. a) vegetative, asexual (2)

b) Yes, this will help increase the numbers of individuals – preventing extinction. It is an easy method to grow plants. (2)

12. The first law: the law that states that energy can be transferred from one system to another in many forms, but cannot be created or destroyed (2)
The second law: the law that states that when energy is converted from one form to another, some is lost as heat (2)

13. seeds → field mouse → snake → eagle (4)

14. a) grass (1)
b) hyena (1)
c) carnivore (any 1 – lion, cheetah, hyena) (1)
d) giraffe, elephant, zebra (any 1) (1)
e) cheetah, hyena (any 1) (1)
f) Accept any correct food chain, for example, grass → zebra → cheetah → lion (4)

g) Green plants trap energy for photosynthesis. Animals in the food chain utilise this energy – energy is transferred. (2)

h) There would be more grass, but less food for the cheetah so the cheetah would have to look for a new food source. (2)

15. viruses, bacteria, fungi, protozoa/algae (4)

16. a) i) Fleming (1)
ii) to grow (1)
ii) agar (1)
iii) That bacterial growth could be stopped with a mould/fungus (2)
iv) careful observation, interpretation of observations (2)

b) penicillin (1)

c) a medicine/drug that kills bacteria (2)

d) penicillin/mould/fungus, bacteria (2)

e) i) bacteria (1)
ii) They feel better, the course is long – 6 months. (2)
iii) It is a programme in which a patient is partnered with someone who will ensure that they complete their medication. (2)

f) microscopic, reproduce by simple cell division, unicellular (3)

17. a) To determine whether bread mould grows better when the bread is moist or dry (1)

b) Bread mould grows best in moist conditions. (1)

c) The dry bread (1)

d) The same type of breads; same classroom; same size of bread (Any 2) (2)

e) diagrams, photographs (Any 1) (1)

f) Bread mould grows in moist conditions and does not grow in dry conditions. Moist, warm conditions are suitable for fungal growth. (1)

g) He should do three of each for accuracy. (1)

18. a) $\frac{21 \times 2}{2} = 42$ (3)

b) No, the first time that the girls caught the locusts, they did so on a rainy day. This means that they should also have captured locusts the second time on a rainy day to get an accurate result. Also, the girls would need to repeat the recapturing more than once. The more times they repeat this, the more accurate their results will be. (3)

c) They must ensure that the paint does not increase the locusts' visibility to predators. The heat will have affected their results. If they initially caught the locusts when it was raining, recapturing should also take place on a rainy day in order to compare the numbers accurately. (1)

19. a) number of species living in a designated area (2)

b) Emigration – the movement of organisms out of a habitat into another
Immigration – the movement of organisms into a habitat from another habitat
Mortality – the number of deaths in a given population
Natality – the ratio of the number of births to the size of the population (8)

c) Increased competition, starvation, animals will move to a new (3)

d) disease, increased competition (2)

e) i) quadrat (1)
ii) A quadrat is a square frame (that varies in size) and that is used to define a small area to sample plants or animals. With the data from the quadrat, an estimate is made of what is likely to be found in a larger area. Some quadrats are divided into grids. The quadrat method involves counting the number of individuals in small, measured areas (these are also called quadrats). This information is then used to calculate the population size. Samples are taken at random from different parts of the habitat.
(Any 3) (3)

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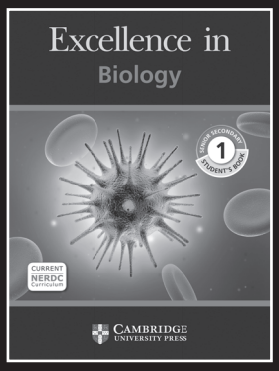

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