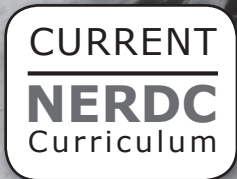
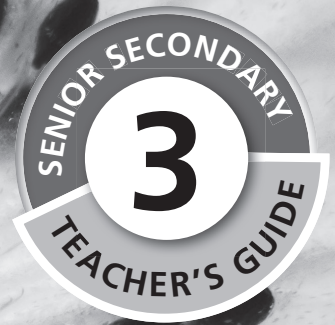
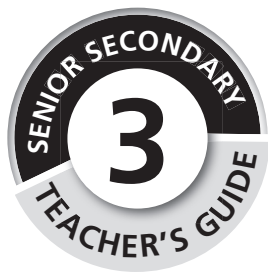


Excellence in Biology



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Contents

Introduction	v
The purpose of the curriculum	v
The goals	v
Time allocation	v
The role of the teacher	v
How to use the book	vi
How to use the scheme of work	vi
Scheme of work	viii

Please note that the Year 3 syllabus does not cover Theme 1:
Organisation of life, which is completed in Year 1 and Year 2.

Theme 2 The organism at work	1
Topic 1 Regulation of the internal environment	1
Topic 2 The endocrine system	3
Topic 3 The skin	5
Topic 4 The nervous system	7
Topic 5 Sense organs	11

Theme 3 The organism and its environment	14
Topic 6 Ecology of populations	14
Topic 7 Overcrowding and food shortages	16

Theme 4 Continuity of life	18
Topic 8 Human reproduction and family planning	18
Topic 9 Sexual reproduction in flowering plants	20
Topic 10 Reproductive behaviour in animals	23
Topic 11 Genetics	24
Topic 12 Variation	26
Topic 13 Biological evolution and adaptation	28
Topic 14 Theories of evolution	30

SS3 Exam	34
Solutions	49

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
- the 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 three 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 objectives 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 five). 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 or **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 builds on concepts taught in SS1 and SS2.

You need to be familiar with the key features of the book. The book is divided into 14 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 viii to xii.

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 two terms. Each term is divided into 13 weeks. There are 10 topics in Term 1 and four topics in Term 2. 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.

Start each topic with a short, exciting and informative introduction. You should also explain the meaning of the topic, for example: What is Biology? What is Classification? What is Pollution? What is Conservation? What is a Biome?

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.

Table 1: Scheme of work Biology SS3

Term	Week	Theme	Topic	Performance objectives (students should be able to:)	Content (3 lessons per topic)
Term 1	1	2. The organism at work	1. Regulation of the internal environment	1.1 List the main organs and substances involved in homeostasis (control mechanism) 1.2 Describe the structure and functions of these organs: kidney and liver 1.3 Name some kidney diseases and explain their symptoms and effects 1.4 Name some liver diseases and briefly explain their symptoms and effects 1.5 Discuss the remedy for unhealthy conditions of the kidney and liver.	1. Homeostasis. The kidneys. 2. The liver. 3. Activity 1.1 and Revision.
	2		2. The endocrine system	2.1 Describe the endocrine system 2.2 List some endocrine glands, their positions in the body and their functions 2.3 Describe the role that hormones play in homeostasis in the body 2.4 Describe where the glands are and which hormones they produce 2.5 Describe the function of these hormones 2.6 State the effect of over-production and under-production of these hormones.	1. Endocrine glands and hormones. 2. Effects of over- and under-production of major hormones. Activity 2.1. 3. Plant hormones and Revision.
Term 1	3		3. The skin	3.1 Draw and label the main structures of the skin 3.2 State and explain the functions of the skin 3.3 Describe some diseases of the skin 3.4 State a few ways to care for the skin.	1. Structure of the skin. Function of the skin. 2. Diseases of the skin. 3. Care of the skin. Activity 3.1 and Revision.
	4		4. The nervous system	4.1 Describe the make-up of the nervous system 4.2 Describe the structure of the brain and explain the functions of its various parts 4.3 Describe the spinal cord and explain its functions 4.4 State the structural difference between the brain and the spinal cord 4.5 Identify the PNS (peripheral nervous system) and describe its functions 4.6 Describe the somatic nervous system 4.7 Describe the autonomic nervous system 4.8 Describe a typical neuron 4.9 List and describe the three different types of neurons 4.10 Group neurons according to functions as found in vertebrates and explain their functions 4.11 Describe the three different types of nerves 4.12 Explain the process of impulse transmission 4.13 Describe the reflex arc and reflex action 4.14 Distinguish between a reflex action and a conditioned reflex.	1. The nervous system overview. Activity 4.1. 2. The neurons. Activity 4.2. 3. The reflex arc and reflex actions. Activity 4.3 and Revision.

NB: There is no Theme 1: Organisation of life in the Year 3 syllabus.

Term	Week	Theme	Topic	Performance objectives (students should be able to:)	Content (3 lessons per topic)
Term 1	5	2. The organism at work	5. Sense organs	5.1 List the major sense organs and their locations 5.2 Describe the organs of smell and taste 5.3 Identify the different parts of the tongue associated with sweetness, bitterness, salty taste and sour taste 5.4 Describe the mammalian eye and explain the functions of its various parts 5.5 Explain the functions of the eye – image formation and accommodation 5.6 Discuss some disorders of the eye 5.7 Describe the structure of the mammalian ear 5.8 Explain the functions of the ear – hearing and balance.	1. Sense organs introduction. Activity 5.1. The eye. 2. Activity 5.2. Some disorders of the eye. 3. The ear and Revision.
	6	3. The organism and its environment	6. Ecology of populations	6.1 Define the term succession 6.2 Distinguish between primary and secondary succession 6.3 Describe the series of changes that often culminate in a stable ecosystem 6.4 Describe the characteristics of a stable community and recognise the climax of succession.	1. Ecological succession introduction. Primary and secondary succession. 2. Characteristics of a climax community. 3. Activity 6.1 and Revision.
	7		7. Overcrowding and food shortages	7.1 Define the term overcrowding 7.2 State factors that may cause overcrowding 7.3 State the effects of overcrowding 7.4 State measures adopted in nature to avoid overcrowding 7.5 State causes of food shortage 7.6 List the effects of food shortage 7.7 Infer that food has a direct influence on the mortality of animal populations.	1. Population size. Factors that cause overcrowding. Effects of overcrowding. Adaptations/responses to overcrowding 2. Activity 7.1. Activity 7.2. 3. Factors affecting the size of a population. Factors that cause food shortages. Effects of food shortage and Revision.

Term	Week	Theme	Topic	Performance objectives (students should be able to:)	Content (3 lessons per topic)
Term 1	8	4. Continuity of life	8. Human reproduction and family planning	8.1 Identify the structure and function of the male and female reproductive systems in humans 8.2 Draw, label and describe the structures of the male and female reproductive systems 8.3 Draw, label and describe the structure of the male and female gametes (sperm and ovum) 8.4 Explain the process of fertilisation 8.5 List the conditions necessary for the survival of the foetus 8.6 List some family planning methods in humans.	1. The male reproductive system. The female reproductive system. 2. The gametes. Fertilisation. Implantation. Gestation. The development of the embryo. Activity 8.1. 3. Family planning. Activity 8.2. and Revision.
	9		9. Sexual reproduction in flowering plants	9.1 Define fertilisation 9.2 Draw and label the male and female parts involved in fertilisation 9.3 Distinguish between fruit and seed 9.4 State various types of fruits 9.5 Classify fruits 9.6 State how fruits are dispersed.	1. The structure of the flower. Male reproductive parts. Female reproductive parts. Pollination. Fertilisation. 2. Activity 9.1. Fruit development and structure. Types of fruit. Activity 9.2. 3. Dispersal of fruits and seeds. Seed structure. Seed germination. Activity 9.3 and Revision.
	10		10. Reproductive behaviour in animals	10.1 Describe the different types of courtship behaviours in animals 10.2 Explain the terms courtship and territoriality in animals 10.3 Explain seasonal migration.	1. Courtship behaviour. Territoriality and courtship behaviour. Seasonal migration. 2. Activity 10.1. 3. Revision.
	11	Revision			
	12/13	Examination			

Term	Week	Theme	Topic	Performance objectives (students should be able to:)	Content (3 lessons per topic)
Term 2	1	4. Continuity of life	11. Genetics	<p>11.1 Describe the transmission of characteristics from one generation to another</p> <p>11.2 Identify the dominant/recessive characteristics</p> <p>11.3 Describe how chromosomes are involved in the transmission of characteristics from one generation to another</p> <p>11.4 Note that chromosomes carry genes that are responsible for inherited characteristics</p> <p>11.5 Define genes, alleles, genotype, phenotype, and dominant and recessive alleles</p> <p>11.6 Explain the part Gregor Mendel played in our understanding of genetics</p> <p>11.7 Describe monohybrid and dihybrid crosses and how they can be used to select for particular characteristics using a particular genetic format.</p>	<p>1. Genetics and inheritance. DNA and chromosomes. Understanding genetics.</p> <p>2. Mendelian genetics. Activity 11.1.</p> <p>3. Sex chromosomes and sex-linked alleles. Probability. Cross- and self-fertilisation. Sexual and asexual reproduction. Fertilisation and Revision.</p>
	2		12. Variation	<p>12.1 Define the term variation in relation to living organisms</p> <p>12.2 Describe continuous and discontinuous variation</p> <p>12.3 Identify the relationship between variation and evolution</p> <p>12.4 Recognise that variation could be morphological or physiological</p> <p>12.5 List different ways that individuals vary in their behaviours and functions</p> <p>12.6 State the human blood groups and explain how they can be used in paternity testing</p> <p>12.7 Explain the application of genetic variation to solving crimes.</p>	<p>1. Genetic variation. Different types of variation. Morphological variation. Activity 12.1.</p> <p>2. Physiological variation. Blood groups and paternity. Application of variation.</p> <p>3. Revision.</p>
	3		13. Biological evolution and adaptation	<p>13.1 Define the term biological evolution</p> <p>13.2 Discuss the progressive change in anatomy of organisms from water to land</p> <p>13.3 Explain the terms structural adaptation and adaptive colouration</p> <p>13.4 Describe mimicry</p> <p>13.5 Explain behavioural adaptation in termites.</p>	<p>1. Biological evolution. From water to land.</p> <p>2. Adaptation to different pollinators. Mimicry.</p> <p>3. Social behaviour and adaptation. The termite. Activity 13.1 and Revision.</p>

Term	Week	Theme	Topic	Performance objectives (students should be able to:)	Content (3 lessons per topic)
Term 2	4	Continuity of life	14. Theories of evolution	<p>14.1 Discuss the development of our understanding of evolution through the history of the different theories of evolution</p> <p>14.2 State the law of use and disuse according to Jean-Baptiste Lamarck</p> <p>14.3 Explain why Darwin's theory of natural selection is central to the modern understanding of evolution</p> <p>14.4 Explain how natural selection is the mechanism that allows selected genetic traits to become more common in successive generations of a population</p> <p>14.5 Describe the importance of variation in the mechanism of natural selection</p> <p>14.6 Discuss the evidence for evolution that can be found in many branches of science</p> <p>14.7 Describe the concept of speciation – the evolution of new species</p> <p>14.8 State other occurrences apart from natural selection that may bring about evolution.</p>	<p>1. A brief history of theories of evolution.</p> <p>2. Darwin's theory of natural selection. Variation and evolution. Activity 14.1.</p> <p>3. Evidence for biological evolution. Formation/emergence of new species and Revision.</p>
	5-11	Revision of year's work			
	12/13	Examination			

TOPIC 1: Regulation of the internal environment

Performance objectives

- 1.1 List the main organs and substances involved in homeostasis (control mechanism)
- 1.2 Describe the structure and functions of these organs: kidney and liver
- 1.3 Name some kidney diseases and explain their symptoms and effects
- 1.4 Name some liver diseases and briefly explain their symptoms and effects
- 1.5 Discuss the treatment for diseases of the kidney and liver.

Introduction

The body is exposed to many changes from the external, as well as its own internal, environment. It is therefore important for the body to make continuous adjustments to keep its internal environment stable. This constant adjustment by the body is called homeostasis. Homeostasis is essential for optimal body functioning by maintaining body temperature as well as the correct level of glucose, water and gases, such as oxygen and carbon dioxide, in the blood. This topic concentrates on the kidneys and liver, and the role these organs play in homeostasis.

Activity 1.1: Dissection of the rat to show the liver and other organs

GROUPS (SB p. 8)

Resources

- rat
- dissecting tray
- scalpel
- scissors
- forceps
- dissecting pins
- probe

websites including

<https://www.youtube.com/watch?v=o5swkLgQANw>http://www.biologycorner.com/worksheets/rat_dissection06.html

<http://media.wiley.com/CurrentProtocols/PH/ph0701/ph0701-fig-0001-1-full.jpg>
http://www.biologycorner.com/worksheets/rat_head.html
<http://www.emsisd.com/cms/lib/TX21000533/Centricity/Domain/4325/Rat%20Dissection%20Student%20Version.docx>

Guidelines

Contact a university or biological company to get rats. The dissection can be done as a class demonstration if you cannot get sufficient rats. Be sensitive to the fact that some students are squeamish and will not be comfortable doing or observing a dissection. Do not force them to participate. They can quietly work at their desks, either watching a virtual dissection on the Internet or they can label a diagram of a dissected rat. (See resources for examples to use.)

Answers

Students should carefully and accurately draw a diagram of the dissection.

Assessment

Informal: You can evaluate the diagram that students draw from the dissection. It should be a full page in size, the parts must be labelled and a detailed heading provided. Students must pay attention to accuracy and proportion.

Answers to Revision questions

1. The internal environment of an organism needs to remain within limits so that the complex interacting set of metabolic chemical reactions can take place. The word homeostasis is used to describe this process. Homeostasis is a property of any system (in this case, the human body and specific organs or systems in the body) that allows internal conditions to remain stable and relatively constant.
2. Homeostatic processes act at the level of the cell, the tissue, the organ and for the organism as a whole. The main homeostatic processes include:
 - maintenance of body temperature – warm-blooded or endothermic animals, such as mammals and birds, maintain a constant body temperature. All other animals show wide temperature variation. In endothermic animals, as body temperature rises, the body loses heat by panting or sweating. If the body temperature falls, there is increased metabolic action through shivering.
 - regulation of the pH of the blood at 7.35
 - regulation of blood glucose concentration – in mammals, this takes place through the hormones insulin and glucagon. Humans maintain their glucose concentrations at a relatively constant level.
 - the kidneys regulate the levels of water and electrolytes in the blood – the function of the kidneys was covered in SS2 in the Topic Excretion.
 - behaviours such as drinking in response to thirst are also part of homeostatic mechanisms because the animal is responding to a fall in the water content of the blood.
3. The kidneys maintain homeostasis by:
 - regulating the water content of the body through the action of the hormone ADH (osmoregulation)
 - controlling the pH of the blood
 - removing various cellular wastes and substances that are in excess, for example salts, urea and uric acid.
4. The liver is a large organ that has a wide range of functions. Its functions include:
 - detoxification of various products of metabolism
 - protein synthesis
 - production of substances that are necessary for digestion
 - regulation of glycogen storage
 - breakdown of red blood cells
 - hormone production (which makes it a gland)
 - breakdown of insulin and other hormones
 - gluconeogenesis – the synthesis of glucose from certain amino acids, lactate or glycerol
 - cholesterol and triglyceride synthesis
 - detoxification of a wide range of substances.
5. Two diseases of the kidney – kidney stones, chronic kidney failure.
Two diseases of the liver – fasciolosis, hepatitis, alcoholic liver disease, liver cancer. Any two.

Assessment

Informal: Teacher assessment

How are you doing?

SB p. 9

Homeostasis is a very important concept in Biology. Check that students understand that the internal environment needs to remain within certain limits so that cells, tissues, organs and systems can function. Take this opportunity to ask students questions about the kidney and liver. They can draw a mind map recording required information for each of these organs. Explain anything that students do not understand.

Key words

bilharzia – also called schistosomiasis, caused by parasitic flatworms that burrow through the skin when swimming in contaminated water, where there is no proper sanitation

cirrhosis – the scarring of liver tissue that results from excess alcohol and other toxin ingestion

fatty liver disease – a form of liver disease in which the organ is infiltrated with fatty deposits that prevent it from functioning correctly

hepatitis – hepatitis is an inflammation of the liver that can be caused by viruses and some toxins such as alcohol

homeostasis – the process by which the internal environment of an organism remains relatively constant to allow the complex processes of metabolism to take place

kidney – the organ that is responsible for regulating the water content of the body through the action of ADH, controlling the pH

of the blood and removing various cellular wastes and excess substances through a process of filtration

kidney failure – a disease process in which the kidney is no longer able to perform its correct function

kidney stones – a solid mass that forms in the kidney from minerals in the diet, which can contain calcium, uric acid or other solid compounds

liver – the liver is the largest solid organ in the body and has many different functions, such as detoxification of a wide range of substances, synthesis of lipids, regulation of glycogen storage and synthesis of glucose (gluconeogenesis)

lobes of liver – the liver is divided into four lobes or parts – the median lobe, the right and left lateral lobe, and the caudate lobe

TOPIC 2: The endocrine system

Performance objectives

2.1 Describe the endocrine system

2.2 List some endocrine glands, their positions in the body and their functions

2.3 Describe the role that hormones play in homeostasis in the body

2.4 Describe where the glands are and which hormones they produce

2.5 Describe the function of these hormones

2.6 State the effect of over-production and under-production of these hormones.

Introduction

The endocrine system helps with homeostasis, for example maintaining the correct balance of blood sugar. This system consists of a number of endocrine glands and the hormones that they produce. The hormones pass directly into the bloodstream, which distributes them to all parts of the body where they will have an effect on certain cells and organs. Hormones are chemicals that carry messages around the body in order to co-ordinate the activities of the body, regulate the internal environment of the body and act as control mechanisms over glands or muscles.

So the endocrine system responds to various stimuli in the environment and uses hormones to bring about changes. This topic is about the endocrine glands and their hormones.

Activity 2.1: The control of blood glucose

INDIVIDUAL (SB p. 13)

Resources

- long ruler to accurately read the graph

Guidelines

Facilitate: Assist the students to answer these questions. Check the answers with the class.

Answers

1. The blood glucose concentration drops. Insulin stimulates the body to take up glucose and the synthesis of glucose in the liver is stopped by the action of insulin.
2. Glucagon and adrenaline
3. It takes 120 minutes
4. The pancreas

Assessment

Informal: Self-assessment

Answers to Revision questions

1. The endocrine system is made up of endocrine glands, which produce hormones. Endocrine glands release hormones directly into the blood supply, from where they are transported to what are called target organs. The hormones have specific effects.
2. Hormones are organic chemical substances. They are only essential in living organisms. Hormones are made up of signalling molecules. Signalling molecules are responsible for the transmission of messages between cells, tissues and organs in the body. Hormones travel all around the body but only affect certain cells or organs that are called target cells or target organs. A target organ or cell responds to instructions from their particular hormones and is not affected by other hormones. Hormones are used to communicate between organs

and tissues to regulate physiological and behavioural activities. Examples are digestion, metabolism, respiration, sensory perception, sleep, lactation, growth and development, and reproduction.

3. Antidiuretic hormone promotes reabsorption of water in the kidneys and it is produced in the posterior pituitary lobe.
4. In the beta cells of the islets of Langerhans in the pancreas
5. Insulin lowers blood glucose level and stimulates the absorption of glucose by body cells. Insulin also stimulates the conversion of glucose into glycogen for storage in the liver and muscles.
6. Diabetes mellitus – type 1 and type 2

Assessment

Informal: Teacher assessment

How are you doing?

SB p. 14

Check that the students understand the role of the endocrine system in the body. They must learn the endocrine glands and hormones in Table 2.1. You can set a short class test to test their knowledge on this information. Students must also know the effects of under- and over-production of the thyroid hormones, and insulin and glucose. Students must be able to differentiate between animal and plant hormones. Explain anything that they do not understand.

Key words

diabetes mellitus – a disease of insulin production and glucose metabolism, split into type 1 diabetes and type 2 diabetes

endocrine gland – a gland that produces hormones

endocrine system – the system in the body that is made up of endocrine glands that produce hormones that are released directly into the blood and transported to target organs around the body

glucagon – a hormone that is produced in response to low glucose levels in the body, which stimulates conversion of glycogen into glucose in the liver

goitre – an enlargement of the thyroid gland seen in people who do not receive enough iodine in their diet and so do not produce enough thyroxine

hormone – hormones are organic chemical substances that are made up of signalling molecules

Key words (cont.)

insulin – a hormone that is produced in response to high glucose levels in the body, which stimulates absorption of glucose by body cells, so lowering the glucose levels in the blood

islets of Langerhans – the cells in the pancreas that produce insulin and glucagon

pancreas – an organ found in the abdomen that contains cells that produce insulin (from the beta cells of the islets of Langerhans) and glucagon (from the alpha cells of the islets of Langerhans)

pituitary gland – a small gland found at the base of the brain, divided into anterior and posterior lobes

thyroid gland – a gland found in the neck that produces thyroxine, a hormone that controls basal metabolic rate, regulates tissue growth and development, and accelerates heartbeat

thyroid-stimulating hormone (TSH) – a hormone that regulates the growth of the thyroid gland and the secretion of the hormone thyroxine

thyroxine – a hormone produced by the thyroid gland, controlled by production of thyroid-stimulating hormone (TSH) by the pituitary, which controls basal metabolic rate, regulates tissue growth and development, and accelerates the heartbeat

TOPIC 3: The skin

Performance objectives

- 3.1 Draw and label the main structures of the skin
- 3.2 State and explain the functions of the skin
- 3.3 Describe some diseases of the skin
- 3.4 State a few ways to care for the skin.

Introduction

The skin is the largest organ in the body and is one of the body's sensory organs. The skin consists of the epidermis and the dermis. The epidermis is the layer on the outside that is continuously being regenerated. The dermis contains blood capillaries, sweat glands, sebaceous glands, hair follicles, sensory nerve endings and receptors. The skin has many functions – protection, temperature regulation, immune response, provides a protective barrier against injury, production of vitamin D and sensitivity. There are many disorders and diseases of the skin including psoriasis and acne. This topic is about the structure, function and diseases of the skin.

Activity 3.1: The skin

INDIVIDUAL (SB p. 19)

Resources

- textbook

Guidelines

Facilitate: Assist the students to answer these questions.

Answers

1. When it is hot, blood capillaries close to the skin surface dilate. The capillaries deep down in the epidermis constrict. This makes blood flow to the surface of the skin, which helps excess heat leave the body through convection and radiation. The hair erector muscles relax and the hair flattens against the skin. This minimises the insulation effect and more heat is lost from the body. Sweat glands become active in the heat. Sweat evaporates off the skin, which has a cooling effect.
2. With heat leaving the body, the body cools down. The hairs relax against the skin, which means air is not trapped against the skin and so heat leaves the body. Sweat

glands produce moisture against the skin, which serves to cool the body down.

3. We sweat very little when we are cold as the sweat glands are not stimulated to produce sweat.
4. The skin is a sense organ. It responds to the external stimuli of pressure, touch and temperature. The skin is made up of two layers: the dermis and the epidermis. The dermis is thicker than the epidermis, and it consists of connective tissue, within which are found capillaries, sweat glands, hair follicles and sebaceous glands. Blood capillaries close to the skin surface dilate with vasodilation and the capillaries deep down in the epidermis constrict. This makes blood flow to the surface of the skin, which helps excess heat leave the body through convection and radiation.

Assessment

Informal: Self-assessment

Answers to Revision questions

1. c) 2. a)
3. a) 4. a)
5. a) 6. b)

Assessment

Informal: Teacher assessment

How are you doing?

SB p. 20

Check that the students understand that the skin is divided into two layers, the epidermis and dermis. They can divide a page in their book into two parts, the epidermis and dermis. They can write consolidation notes under each section including structure and function. Prepare a short test on the labelling of the skin (see Figure 3.1). Check that they understand the diseases of the skin by asking questions. Explain anything that they do not understand.

Key words

cornified layer – the outermost layer of the epidermis is also called the horny layer and it is made up of dead cells

dermis – the name given to the connective tissue layer found below the epidermis of the skin; contains nerve endings, sebaceous and sweat glands as well as blood vessels

epidermis – the outer, protective layer of the human skin

hair follicle – a deep, narrow pit based deep down in the dermis that encloses the root of the hair

Malpighian layer – deepest layer of the epidermis of the human skin, found below the

granular layer; site where cells actively divide and produce new cells

sensory organs – the organs of the body that contain sense receptors; the eyes, ears, nose, skin, tongue are all sensory organs

vasoconstriction – when the skin's capillaries close to the surface constrict and the ones deeper down dilate, heat loss through radiation or convection is reduced

vasodilation – blood capillaries close to the skin surface dilate and capillaries deep down in the epidermis constrict; helps excess heat leave the body through convection and radiation

TOPIC 4: The nervous system

Performance objectives

- 4.1 Describe the make-up of the nervous system
- 4.2 Describe the structure of the brain and the function of its different parts
- 4.3 Describe the spinal cord and explain its functions
- 4.4 State the structural difference between the brain and the spinal cord
- 4.5 Identify the PNS (peripheral nervous system) and describe its functions
- 4.6 Describe the somatic nervous system
- 4.7 Describe the autonomic nervous system
- 4.8 Describe a typical neuron
- 4.9 List and describe the three different types of neurons
- 4.10 Group neurons according to functions as found in vertebrates and explain their functions
- 4.11 Describe the three different types of nerves
- 4.12 Explain the process of impulse transmission
- 4.13 Describe the reflex arc and reflex action
- 4.14 Distinguish between a reflex action and a conditioned reflex.

Introduction

The nervous system, together with the endocrine system, enables humans to respond to external changes and to control changes inside our bodies. The nervous system is divided into the central nervous system (CNS) and the peripheral nervous system (PNS). The CNS and PNS together serve to co-ordinate and regulate body functions. The CNS consists of the brain and spinal cord, which together form the control centre that receives information from all other parts of the body. Once received by the CNS, the information is interpreted and messages are sent out to the body parts, telling them what to do. The PNS is the system of nerves outside of the CNS. These nerves consist of both sensory and motor nerves. Part of the PNS is not controlled by our will – it is under involuntary control. This is called the autonomic nervous system (ANS). This topic covers the CNS, PNS and ANS.

Activity 4.1: Dissection of a sheep's brain

CLASS/GROUPS SB p. 23

Resources

- model of the human brain
- model of the brain or a sheep's brain sawn in half
- whole neck of a sheep

- a dissection board or newspaper to work on
- soap
- model of a spinal cord or a cross-section of the vertebrae of sheep

websites including

http://www.biologycorner.com/anatomy/sheepbrain/sheep_dissection.html

https://www.youtube.com/watch?v=vE3Yf_xy_mE

<http://www2.palomar.edu/users/rmorrissette/Physio/Labs/BrainDissection/210BrainDissection2013.htm>

http://fullfrontalanatomy.com/images/F13/NS/Lab%20NS/077_spinal-cord-section_lab.jpg

Guidelines

For the brain:

- You can do a dissection for the class.
- If students are squeamish they can sit quietly in their desks and work through a virtual brain dissection. If they find this too much, they should draw a diagram of a sheep's brain and label the different parts.

For the neck:

- Boil the sheep's neck for about two hours until the meat comes away from the bone.
- Allow it to cool down and then place it on the board.
- Remove the meat from the bones, taking care not to separate the bones.
- Students can study the neck and how the bones fit together. Tell them that the spinal

cord is found in the centre of the vertebrae. They should notice the protection that the vertebrae give the spinal cord.

- Students can study one of the vertebrae, separating it from the neck. They must find the spinal cord and notice how well it is protected. Ask them to identify the colour of the spinal cord.

Answers

Students must draw and label accurate diagrams of the brain and spinal cord.

Assessment

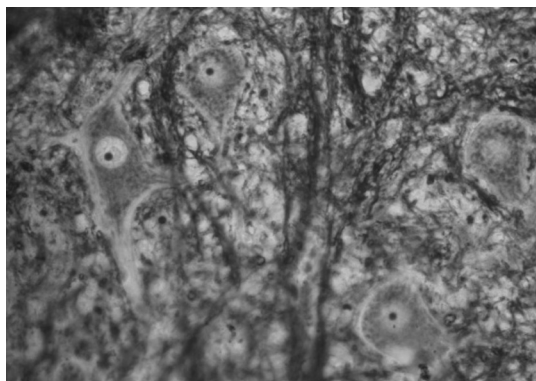
Informal: Teacher assessment – evaluate their diagrams according to accuracy, proportion, labels and neatness. They must also provide a detailed heading.

Activity 4.2: Observing and drawing nervous tissue

GROUPS SB p. 26

Resources

- microscope slides of nervous tissue
- microscopes
- micrographs of nervous tissue – print these from the Internet or ask a university if they have some that you can use. Universities also have programmes on computers to photograph an image viewed through a microscope. These images can be printed. For example, the following image of nerve tissue was taken using a computer that was attached to a microscope. The magnification of the image is $400\times$. The slide was obtained from the anatomy department at a university.



- sharp pencil
- ruler
- blank paper

Guidelines

Assist students in identifying the cells under the microscope. You can draw a diagram on the board of what they should see, provided they only use it to guide them. Include the magnification with the heading.

Answers

Students must draw and label accurate diagrams of the neurons.

Assessment

Informal: Teacher assessment – evaluate their diagrams according to accuracy, proportion, labels and neatness. They must also provide a detailed heading and magnification.

Activity 4.3: Reflex actions

PAIRS SB p. 27

Resources

- textbook

Guidelines

Facilitate: Assist the students in following the instructions.

Answers

1. Eye blink reflex
2. Startle reaction – eyes will close more tightly and head will move away from noise

Assessment

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

Answers to Revision questions

1. The central nervous system, the peripheral nervous system and the autonomic nervous system
2. The brain and the spinal cord

3. The cerebellum:
 - controls the co-ordination of voluntary muscular movement – walking and running
 - contains the centres that control balance, muscle tone and equilibrium.
4. The hypothalamus controls:
 - body temperature
 - hunger
 - thirst
 - fatigue
 - sleep
 - circadian rhythms.
5. The somatic nervous system is the part of the peripheral nervous system that is associated with skeletal muscle voluntary control of body movements. It is made up of afferent and efferent nerves. Afferent nerves carry sensation to the central nervous system. Efferent nerves stimulate muscle contraction, so they carry messages from the CNS to muscles or glands.
6. The sympathetic nervous system and the parasympathetic nervous system
7. The neuron
8. Sensory, motor and connector (interneurons) neurons
9. The functional unit of the nervous system is the reflex arc. The reflex arc is the path than an impulse travels along to bring about a response to a stimulus during a reflex action. A reflex action is a rapid automatic response to a stimulus by an organ or receptor.
10. It's function is to ensure that the body responds fast to a harmful stimulus so that the body is not injured.

Assessment

Informal: Teacher assessment

How are you doing?

SB p. 28

Take this opportunity to ask students if there is anything that they do not understand about the nervous system. Students must be able to differentiate between the three parts – CNS, PNS and ANS. They can make a summary of the topic by writing down the three headings and add key words or phrases under each heading. Explain anything that students do not understand.

Key words

autonomic nervous system – a part of the nervous system made up of the sympathetic and the parasympathetic nervous systems

brain – the enlarged top (anterior) part of the spinal cord, made up of the cerebrum, cerebellum, midbrain and hypothalamus

central nervous system – that portion of the nervous system that is made up of the brain and the spinal cord

cerebellum – the second largest part of the brain, which controls the co-ordination of voluntary muscular movement, balance, muscle tone and equilibrium

cerebrum – the largest part of the brain that controls all voluntary actions, contains centres of vision, taste, hearing, smell and touch, and contains the areas where higher functions lie

conditioned reflex – a reflex action in response to a stimulus that has been repeated several times, such a salivation by a dog in response to a bell that marks meal times

connector neurons – the neurons that link sensory neurons to motor neurons via synapses

grey matter – the tissue in the nervous system that is made up mainly of cell bodies and very few myelinated axons

hypothalamus – the portion of the brain responsible for certain metabolic processes and activities of the autonomic nervous system

medulla – found at the base of the brain at the start of the spinal cord; controls reflexes such as breathing and heartbeat, and transmits nerve impulses to and from the brain

Key words (cont.)

mixed nerves – nerves that are made up of both sensory and motor nerves, which conduct impulses to and from the brain and spinal cord

motor nerves – the nerves that conduct impulses from the brain and the spinal cord to muscles or glands

motor neurons – the neurons that conduct impulses from the central nervous system to the effector organs (muscles or glands)

myelin sheath – a fatty sheath that is found around the axon of a neuron and which is essential for the proper functioning of the nervous system

nerve – a nerve is a bundle of axons (the projections of neurons) in the peripheral nervous system, which provides a pathway for the transmission of nerve impulses

nerve fibres – bundles of nerves that make up a single nerve fibre in the peripheral nervous system

neurotransmitter – a chemical substance found in synapses that transmits impulses from one nerve to another

node of Ranvier – the un-myelinated gap that is formed between the myelin sheath as it wraps around the axon, where electrical impulses can be transmitted

parasympathetic nervous system – the part of the autonomic nervous system that is responsible for activities that occur while the body is at rest, such as digestion

peripheral nervous system – that portion of the nervous system that is made up of the spinal nerves and the cranial nerves

reflex action – a rapid, automatic response to a stimulus by an organ or receptor

reflex arc – the functional unit of the nervous system; a path that an impulse travels along to bring about a response to a stimulus during a reflex action

sensory nerves – the nerves that conduct impulses from receptor cells to the brain and spinal cord, for example the optic nerve

sensory neurons – the neurons that conduct impulses from the sense organs to the central nervous system

somatic nervous system – the part of the peripheral nervous system that is associated with skeletal muscle voluntary control of body movements

spinal cord – a bundle of nervous tissue and support cells that extends from the medulla to the lumbar region of the vertebral column; serves as a pathway for impulses to and from the brain and from sense organs and as a reflex centre for actions such as blinking

sympathetic nervous system – the part of the autonomic nervous system that stimulates the body's fight-or-flight responses, for example it speeds up heartbeat

synapse – the junction between two or more neurons, which is a small gap, filled with neurotransmitter that chemically transmits an impulse from one neuron to another

white matter – the tissue in the nervous system that is found in the brain and spinal cord, made up mainly of a certain type of cell and myelinated axons that transmit signals from one area of the cerebrum to another and between the cerebrum and brain centres below it

TOPIC 5: Sense organs

Performance objectives

- 5.1 List the major sense organs and their locations
- 5.2 Describe the organs of smell and taste
- 5.3 Identify the different parts of the tongue associated with sweetness, bitterness, salty taste and sour taste
- 5.4 Describe the mammalian eye and explain the functions of its various parts
- 5.5 Explain the functions of the eye – image formation and accommodation
- 5.6 Discuss some disorders of the eye
- 5.7 Describe the structure of the mammalian ear
- 5.8 Explain the functions of the ear – hearing and balance.

Introduction

Sense organs act as the receptors for the physical sensations of touch, taste, smell, sight and hearing. Sense organs are divided into different types of receptors according to these sensations – thermoreceptors, chemoreceptors, photoreceptors and mechanoreceptors. This topic covers the eye and ear in detail, and briefly mentions the nose and tongue.

Activity 5.1: Smell and taste

GROUPS (SB p. 30)

Resources

- variety of substances to smell
- variety of substances to taste
- blindfold

Guidelines

You can use blindfolds so that the students can guess the substances.

Assessment

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

Activity 5.2: The mammalian eye

CLASS/GROUPS (SB p. 31)

Resources

- model of a human eye

Guidelines

Try to borrow a few human eye models from neighbouring schools so that you can do this activity in groups.

Facilitate: Assist the students with the answers.

Answers

1. a) Six (three pairs) of muscles hold the eyeball in position.
- b) The muscles move the eyeball in all directions: up and down, from side to side and diagonally.
- c) The three layers of the wall of the eyeball are the outer fibrous layer, the middle vascular layer and the inner layer of the retina.
 - (i) The outer fibrous layer:
 - The sclera is a tough, white, opaque, non-elastic coat of dense fibrous connective tissue.
 - Anteriorly, the opaque sclera becomes transparent, allowing light rays to enter the eye.
 - This part of the sclera is known as the cornea. It is convex anteriorly and contains no blood vessels.
 - (ii) The middle vascular layer:
 - This is a spongy and pigmented layer, richly supplied with blood vessels.
 - The choroid is a thin, darkly pigmented membrane that lines the inner surface of the sclera and is richly supplied with blood vessels.

- The ciliary body is the anterior thickened part of the choroid. It connects the iris to the choroid. The ciliary body is circular and consists of about 70 ciliary processes (projections) and a circular band of ciliary muscle. Suspensory ligaments that radiate from the edge of the ciliary body hold the lens in position.
 - The iris is the foremost extension of the choroid and is a coloured opaque disc. The free edge of the iris forms the frame of a circular opening, the pupil. The iris contains one set of involuntary radial muscles and one set of involuntary circular muscles.
- (iii) The inner layer or retina:
- The retina forms the innermost layer of the eyeball and is actually part of the brain. It is composed mainly of light sensitive nerve cells (receptors).
 - The pigmented layer consists of cuboidal epithelial cells containing melanin granules (dark pigment).
 - The layer of photosensitive receptors consists of rods and cones.
 - The layer of rods and cones is followed by a layer of sensory neurons, each with only one axon and one dendrite.
 - The cones are packed closely in the yellow spot (fovea).
 - The optic nerve leaves the eyeball where there are no light sensitive cells (the blind spot).
- d) It is advantageous for the retina to be situated at the back of the eyeball because:
- It is well protected from the inside by the vitreous humour and from the outside by the choroid and sclera.
 - There is no obstruction for light rays entering the eye until they are focused onto the retina – the cornea, lens, aqueous and vitreous humours are all transparent.
 - Light rays can be focused onto the retina to obtain a sharp, clear image with no (or little) effort.
 - The retina contains the sensitive photoreceptors (rods and cones).
- e) Rods and cones function under dim and bright light, respectively. Rods are sensitive to dim light and movements. Cones are responsible for bright light and colour vision.

Assessment

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

Answers to Revision questions

1. Touch, taste, smell, sight and hearing
2. They are called taste buds. They contain chemoreceptors for different tastes – sour, sweet, salty and sharp.
3. Sclera – protects the inner layers; cornea – allows light to enter the eyeball, helps to refract the light rays to converge on the retina; lens – assists the cornea in bending the light rays to focus them on the retina; iris – regulates the amount of light entering the eye; optic nerve – transmits impulses from the retina to the cerebrum of the brain. Any five parts.
4. This occurs when you can see objects in the distance very clearly, but cannot focus on objects close to your eyes. The reason for this is that the eyeball is shorter than normal and even when the lens is bulging (becomes more convex), the lens cannot bend diverging light rays sufficiently sharply to focus them onto the retina. The light rays are focused somewhere behind the retina.
5. The ear consists of three regions:
 - the air-filled outer ear
 - the air-filled middle ear
 - the fluid-filled inner ear.
6. The semi-circular canals, utricle and saccule

Assessment

Informal: Teacher assessment

How are you doing?

SB p. 38

Check that the students understand the sense organs, especially the eye and ear. Students can make mind maps of the eye and ear. You can set a short class test to check the class's knowledge of these organs. Explain anything that they do not understand.

Key words

ampullae – the base of the semi-circular canals of the ear, which are enlarged into hollow, round areas

chemoreceptor – a receptor that senses chemical stimulus, such as the tongue

choroid – the layer of the eye that contains the blood tissue and connective tissue, found between the retina and the sclera; supplies food and oxygen to the eye

cochlea – the spiral-shaped cavity of the inner ear containing the organ of Corti, which contains the sense receptors for hearing

conjunctiva – the tissue that lines the inside of the eyelids and covers the sclera (white part of the eye)

converging lenses – a lens for people who are long-sighted that allows them to see close objects; bends light rays inwards to focus on the retina

diverging lenses – a lens for correcting short sight; bends light rays outwards to focus on the retina

ear drum/tympanic membrane – the membrane that separates the middle ear and outer ear; which vibrates in response to sound waves, which are transmitted by the ear ossicles to the oval window

endolymph – fluid found in the membranous labyrinth of the ear

Eustachian tube – a tube from the pharynx to the middle ear that equalises pressure on either side of the ear drum/tympanic membrane

hearing – the sensation that is felt through the ears

incus – one of the bony ossicles found in the inner ear, also called the anvil

malleus – one of the bony ossicles found in the inner ear, also called the hammer

mechanoreceptor – a receptor that senses movement such as the receptors in joints and muscles

organ of Corti – part of the ear that responds to sound; contains sense receptors for hearing and is found in the cochlea

perilymph – fluid found in the bony labyrinth of the ear

photoreceptor – a receptor that senses light stimulus, such as the eye

pinna – the outer portion of the ear, made up of cartilage

proprioceptor – a receptor, linked to the nervous system, that detects internal changes, particularly around joints, in tendons and in muscles

retina – layer of cells at the back of the eye that contains photoreceptor cells, the rods (sensitive to dim light), cones (sensitive to bright light and colour vision) and the blind spot, which is the region where the receptors converge into the optic nerve

sclera – the white part of the eye, which maintains the shape of the eye

sense organs – the receptors for the physical sensations of touch, smell, sight and hearing, for example the eyes and the ears

sight – the ability to see with the eyes

smell – the sensation that is felt through the nose

stapes – one of the bony ossicles found in the inner ear, also called the stirrup

taste – the sensation such as salty or sweet, felt through the tongue

thermoreceptor – a receptor that senses temperature, such as those found in the skin

touch – the sensation felt by the skin in response to feelings of heat, cold and different surfaces

TOPIC 6: Ecology of populations

Performance objectives

- 6.1 Define the term succession
 6.2 Distinguish between primary and secondary succession
 6.3 Describe the series of changes that often culminate in a stable ecosystem
 6.4 Describe the characteristics of a stable community and recognise the climax of succession.

Introduction

Communities do not just appear. They gradually develop over time. Species are replaced by other species in such a way that there is a gradual change until a stable or climax community is reached. Succession is the process of the changes in a community in a particular area. The end point of succession is the climax community, which is stable and unchanging, with a diversity of mature populations. Primary succession occurs in areas that never had a pre-existing community. Secondary succession occurs in areas that have partially or completely lost a community, for example due to a forest fire. This topic is about succession.

Activity 6.1: Succession INDIVIDUAL (SB p. 42)

Resources

- textbook

Guidelines

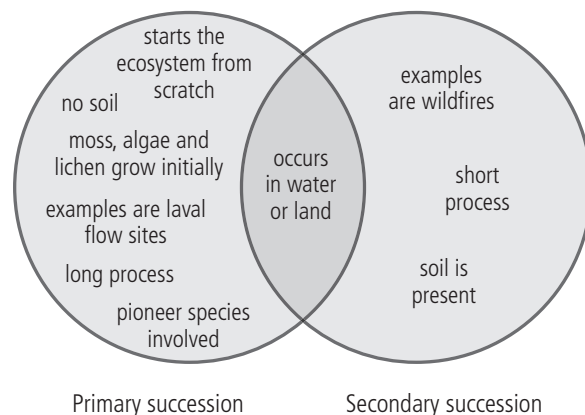
Facilitate: Help the students answer the questions in this activity.

Answers

- R – pioneer plants; S – succession; T – climax community
 - pioneer plants
 - A

- Succession is the progressive development of a stable community starting out with no organisms or a partial community. As new species enter a community, they modify the habitat so that other species can live in the community. The plants in an area determine the animal species. This is because each plant species will have associated animals that can feed on it. The presence of herbivores will then determine the carnivores present in the community. Succession also affects abiotic factors such as soil moisture, pH and humus.

3.



- secondary succession

Assessment

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

Answers to Revision questions

1. Primary succession – occurs in areas that never had a pre-existing community; secondary succession – occurs in areas which have partially or completely lost a community, for example due to a fire
2. Pioneer plants start to grow. Pioneer plants die, decompose and form soil. Seeds of more complex plants begin to grow. These include grasses, small shrubs and herbs. The soil depth increases, and the soil moisture and nutrients are soon able to support larger shrubs and small trees. These species continue the process of increasing the soil structure so that woody shrubs and larger trees become established.
3. Well-developed root systems; large body size; few offspring per generation; one generation per annum or season. Any three.
4. Primary colonisers
5. As the community is changing, there will be species that are better suited to the changes that will out-compete species that are less suited to the changes.

Assessment

Informal: Teacher assessment

How are you doing?

SB p. 43

Students must be able to explain: what succession is; the difference between primary and secondary succession; and a climax community. Check that they understand these concepts by asking questions. Explain anything that they do not understand.

Key words

climax community – a stable, self-perpetuating set of organisms that experiences very little fluctuation with regards to species composition over a long period of time

ecological succession – the process of change in which a set of natural communities are established and then replaced over a period of time; looks at the structure of a community and how it evolves over time

primary colonisers – the first plants to appear on the barren land

primary succession – occurs in what was previously a barren, lifeless area, where the soil has not yet formed

secondary succession – takes place in areas where a community of plants and animals that existed in the past has been destroyed either by a natural event or by human activity

TOPIC 7: Overcrowding and food shortages

Performance objectives

- 7.1 Define the term overcrowding
- 7.2 State factors that may cause overcrowding
- 7.3 State the effects of overcrowding
- 7.4 State measures adopted in nature to avoid overcrowding
- 7.5 State causes of food shortage
- 7.6 List the effects of food shortage
- 7.7 Infer that food has a direct influence on the mortality of animal populations.

Introduction

Individuals in a population need resources in order to survive. Survival is determined by each individual's access to these ecological resources. Stronger individuals out-compete the weaker members of a population. Resources they require are light, food, shelter, mates, breeding sites, and space. This topic focuses on overcrowding and food as limiting factors to population size.

Activity 7.1: Overcrowding of plants

PAIRS/GROUPS (SB p. 47)

Resources

- polystyrene cups
- pencil
- shallow dish
- measuring cup or beaker
- ruler
- marker
- tap water
- radish seeds

Guidelines

Ensure that the cups are placed in identical conditions so that there is only one independent variable so that you can compare them accurately. You can also use other seeds that are easy to grow, such as beans. You can do this as a class demonstration, but it is better to get the students to do the experiment themselves. Students can set up this experiment at home, although you may have to give them the apparatus.

Facilitate: Help the students to follow the instructions.

Answers

Students must observe carefully and record their measurements in a table, one column for 5 seeds and one column for 20 seeds.

- 7. a) The cup with 5 seeds
- b) The cup with 20 seeds
- c) The cup with 5 seeds
- d) The cup with 5 seeds
- e) Students own observations
- f) The plants will start to die
- g) Disease spreads easily when people live in crowded conditions. The life expectancy is lower – especially for the elderly, babies and people who have a low immunity.

Assessment

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

Activity 7.2: Population and overcrowding

INDIVIDUAL (SB p. 47)

Resources

- textbook

Guidelines

This activity can be done as a homework exercise.

Answers

- 1. dependent 2. d)
- 3. d) 4. d)

Assessment

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

Answers to Revision questions

1. Overcrowding is where organisms occupy a limited amount of space to support the number of organisms and so resources such as light, water and food, are limited.
2. Increased natality; decreased mortality; absence or removal of predators; immigration
3. Overcrowding refers to a situation where there are too many organisms (same or different populations) living in a space that is too small to support the organisms and therefore resources are limited. Some negative effects of overcrowding are: a shortage of food, space and water; rapid spread of disease; an increase in competition for resources; and reduced rate of reproduction in overcrowded conditions. As a result, the number of deaths will increase and population sizes will decrease

or animals will move to new areas that have more resources (emigration).

4. Four causes of food shortages: population explosion; drought; natural disasters; war; pests and diseases. Any four.
Three effects on a human population: lower immunity therefore higher rate of spread of disease; increased death rate; starvation; disorders related to malnutrition; emigration; decline in reproduction rate. Any three.

Assessment

Informal: Teacher assessment

How are you doing?

SB p. 50

Students must be able to define overcrowding and state its effects. They must also be able to identify the effects of food shortages on populations, including humans. Check that they understand the concepts in this topic by asking questions. Explain anything that they do not understand.

Key words

allelopathy – a chemical process used by plants that helps prevent other plants from germinating or growing too close to the next plant, overcrowding it

exponentially – something that is increasing very rapidly in large amounts or numbers

overcrowding – when there are more inhabitants in a region than can be supported locally with the essentials needed to live (food, shelter, water, space, etc.)

TOPIC 8: Human reproduction and family planning

Performance objectives

- 8.1 Identify the structure and function of the male and female reproductive systems in humans
- 8.2 Draw, label and describe the structures of the male and female reproductive systems
- 8.3 Draw, label and describe the structure of the male and female gametes (sperm and ovum)
- 8.4 Explain the process of fertilisation
- 8.5 List the conditions necessary for the survival of the foetus
- 8.6 List some family planning methods in humans.

Introduction

This topic covers the structure and functions of the human male and female reproductive systems. The purpose of these systems is to further the species through the production of offspring. The topic also deals with fertilisation, implantation, the development of the embryo (foetus after eight weeks), and structures related to pregnancy – the placenta and amnion. The last part of the topic is about methods of birth control.

Note: Be aware that some students may be uncomfortable discussing this topic. Ensure that students are respectful when their peers ask questions. Do not allow them to laugh as this will prevent students from asking questions that may be very important to clarify misconceptions. This topic should be taught from a biological perspective. However, be aware that students may open up to you about experiences or fears. So be prepared to guide them with their queries or refer them to someone else who has the experience to assist them, such as a counsellor.

Activity 8.1: Observing embryonic development and the stages of pregnancy

GROUPS (SB p. 59)

Resources

- photomicrographs or ultrasound pictures to show the different stages of embryo/foetal development – contact a gynaecologist, hospital or ask students if their parents have examples that you can use. You can also download images from the Internet. websites showing the stages of embryo/foetal development including
<http://study.com/academy/lesson/prenatal-stages-and-development-germinal-embryonic-fetal-period.html>
<https://www.youtube.com/watch?v=g0v6T0GDp20>
<https://www.youtube.com/watch?v=dgPCDXmcQjM>

Guidelines

Facilitate: Divide the class into mixed ability groups. Students can sort the pictures into sequential stages. They can write notes and draw sketches for each stage in their books.

Assessment

Informal: Self assessment – go over the stages with the class.

Activity 8.2: Making a chart to show different contraceptive methods

GROUPS (SB p. 63)

Resources

- brochures and posters about contraceptives

websites on contraceptives including
[http://www.cdc.gov/reproductivehealth/
unintendedpregnancy/contraception.htm](http://www.cdc.gov/reproductivehealth/unintendedpregnancy/contraception.htm)

[http://www.contraceptivetechnology.org/the-
book/take-a-peek/contraceptive-efficacy/](http://www.contraceptivetechnology.org/the-book/take-a-peek/contraceptive-efficacy/)

- type 'contraceptives' in Google and click on Images
- manila paper or cardboard
- kokis and/or crayons
- glue

Guidelines

Facilitate: Divide the class into mixed ability groups. Help the students to access the information and arrange it on the posters.

Assessment

Informal: Teacher assessment – assess the posters according to layout, neatness, variety of contraceptives, information, teamwork and effort.

Answers to Revision questions

1. Students must copy the diagram and add on labels using Figure 8.1.
The male reproductive system is suited to produce sperm and transfer it to the female. The testes make the sperm. The sperm is transported along the sperm

duct where fluids are added from the male glands (prostate gland and seminal vesicles) to form semen. The semen is ejaculated out of the erect penis into the vagina.

2. Students must copy the diagram and add on labels using Figure 8.4.
3. There are four main types of birth control: natural; chemical; mechanical or barrier; surgical.
4. hormonal injection; implant; oral contraceptive pill; spermicide; (also hormone patches, slow release under the skin and vaginal rings). Any three.
5. vasectomy, tubal ligation

Assessment

Informal: Teacher assessment

How are you doing?

SB p. 64

There are a large quantity of facts in this topic. Students should summarise the different sections using a method they find useful, such as using headings and sub-headings or mind/concept maps. Set a short class test to check their knowledge, for example labelling the male and female reproductive system diagrams and stating functions for the parts. Explain anything that they do not understand.

Key words

abstinence – a method of contraception in which the couple do not have sexual intercourse; 100% effective

amnion – the embryonic membrane that secretes the amniotic fluid, which is the fluid in which the embryo is supported during development

birth control – the practice of preventing unwanted pregnancies, especially by use of contraception

blastocyst – the early stage of an embryo when it is made up of a hollow ball of cells; the next stage from the morula

condom – a barrier method of contraception; a sheath that is placed over the erect penis to prevent sperm from entering the vagina and so the Fallopian tubes

contraceptive implant – an implant under the skin that contains hormones that are slowly released

over time that prevent ovulation, which lasts for varying lengths of time and must be replaced when no longer effective

contraceptive injection – an injection that contains a hormone that prevents ovulation for a period of two to three months, depending on the formulation; needs to be repeated every two to three months

contraceptive patch – a patch that contains hormones that prevent ovulation that sticks to the skin and releases hormones over time, which must be replaced when no longer effective

contraceptive pill – a pill that contains a combination of hormones, or one hormone, that prevents ovulation and so pregnancy as long as it is taken strictly as directed, usually for 23 days a month, with a break for a withdrawal bleed

Key words (cont.)

corpus luteum – what is left of the follicle after a woman ovulates

Cowper's gland – a pair of glands that secrete a mucous substance into the male urethra

diaphragm – a barrier method of contraception, a diaphragm that is placed high up in the vagina, preventing sperm from getting through the cervix and into the Fallopian tubes

femidom – a barrier method of contraception; a sheath that is inserted into the vagina, which also covers the external genitalia in a woman to prevent sperm from entering the vagina and so the Fallopian tubes

fertilisation – in human reproduction, the process by which the male's sperm unites with the female's oocyte, creating a new life

fertility – the ability to conceive children or young

gametes – the ova and sperm or sex cells in an organism

gestation – the time between fertilisation and the birth of a baby

Graafian follicle – a mature follicle in the ovary that contains a liquid-filled cavity and that ruptures during ovulation to release an egg

meiosis – a type of cell division that results in four daughter cells, each with half the number of chromosomes of the parent cell

morula – the stage of embryonic development in which the zygote divides into two cells, four cells and so on, until a ball of cells is formed

oogenesis – the process that occurs when egg cells are made in the ovary

ovaries – the paired organs in the female reproductive system that produce ova

ovulation – the part of the female menstrual cycle where a mature ovarian follicle (part of the ovary) discharges an egg (also known as an ovum, oocyte, or female gamete)

placenta – the structure, provided by the outer layer of embryo cells and by the lining of the uterus, which provides nourishment for the developing embryo, by allowing maternal blood and foetal blood to exchange nutrients and waste products, although the two circulations do not mix

prostate gland – a walnut-sized gland located between the bladder and the penis; secretes fluid that nourishes and protects sperm

rhythm method – a method of contraception in which the couple only have sexual intercourse when the woman is not ovulating, determined either by changes in the woman's temperature or by changes in the consistency of her cervical mucus

spermatids – immature sperm cells

spermicide – a chemical gel that kills sperm that is used along with barrier methods of contraception

testes – the two organs in the male reproductive system that produce sperm and testosterone

tubal ligation – a permanent method of contraception in which the female Fallopian tubes are cut to prevent the sperm and ovum from meeting

umbilical cord – the vascular structure that attaches the placenta to the developing embryo

vasectomy – a permanent method of contraception in which the male vas deferens is cut to prevent sperm from being ejaculated from the penis

TOPIC 9: Sexual reproduction in flowering plants

Performance objectives

9.1 Define fertilisation

9.2 Draw and label the male and female parts involved in fertilisation

9.3 Distinguish between fruit and seed

9.4 State various types of fruits

9.5 Classify fruits

9.6 State how fruits are dispersed.

Introduction

Flowering plants (Angiosperms) are plants that have flowers and seeds. The anther

makes male sex cells called pollen. The ovary makes female sex cells. Pollen must be carried from the anther to the egg cell so that fertilisation can take place and seeds can

form. Fertilisation happens when the egg cell and the male cell or sperm join. The pollen lands on the stigma and starts to grow a pollen tube. The pollen tube grows down the style and enters the ovule where it releases the male cell. The fertilised ovule grows and becomes the seed, and the ovary wall develops and becomes the fruit. Fruits and seeds are dispersed by wind, animals, water or by self-dispersal. With the correct conditions germination will occur. This topic is about flowers, fruits and seeds.

Activity 9.1: Dissect a flower

GROUPS (SB p. 68)

Resources

- hibiscus, primrose or lily flower
- sharp knife or blade
- chopping board/surface
- pencil and paper
- cellotape

Guidelines

Facilitate: Divide the class into groups. The number in the group will depend on the availability of flowers. If you cannot get sufficient flowers, try to get detailed photographs and diagrams.

Answers

- 1 – pedicel, 2 – receptacle, 3 – sepal, 4 – petal, 5 – calyx, 6 – filament, 7 – anther, 8 – stamen, 9 – ovary, 10 – ovule, 11 – style, 12 – stigma, 13 – pistil

Assessment

Informal: Teacher assessment – evaluate this activity according to neatness of working area; neatness of the flower; following of instructions; and accurate labels.

Activity 9.2: Comparing two fruits

PAIRS (SB p. 71)

Resources

- an apple
- a knife to cut the apple

- walnuts (optional)
- Internet and/or reference books

Guidelines

Facilitate: Help the students answer the questions. Allow them to use the Internet and/or reference books to look up some of the answers.

Answers

- In the apple, the endocarp is the core. The fleshy, juicy part of the apple is the pericarp. In the walnut, the endocarp is the hard layer that surrounds the seed. The pericarp is the shell.
- The edible part is formed from the receptacle of the flower.
- The stalk is the pedicel. The remains of the style, stamens and sepals are found at the bottom end of the apple.

Assessment

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

Activity 9.3: Demonstrate the conditions necessary for germination

GROUPS (SB p. 72)

Resources

- cups or the bottoms of cooldrink bottles cut off (with drainage holes at bottom)
- soil
- 12 bean seeds
- water
- ice (daily supply) or iced water
- desk lamp
- newspaper

Guidelines

Plant 3 seeds in each cup so that the results are more accurate. Allocate some time during the following few lessons for the students to observe their plants and to record any changes. Students can draw a table to record their results.

Table showing the conditions required for germination:

	Cup A no water	Cup B water daily with water at room tempera- ture	Cup C water daily with ice water	Cup D water with water at room temperature, cup wrapped in aluminium foil
Day 1				
Day 2				
Day 3				
Day 4				
Day 5				

Facilitate: Divide the class into mixed ability groups and help them to follow the instructions.

Answers

- Seeds require water to germinate. For Cup B, C and D students must draw conclusions according to their results.
- Seeds require an optimum temperature and water for germination.

Assessment

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

Answers to Revision questions

- c)
- c)
- c)
- 1 – pedicel, 2 – receptacle, 3 – sepal, 4 – petal, 5 – calyx 6 – filament, 7 – anther, 8 – stamen, 9 – ovary, 10 – ovule, 11 – style, 12 – stigma, 13 – pistil
- Seeds are the part of a plant that contains the plant's embryo. The fruit is the ovary of a flowering plant that nourishes and protects developing seeds.
- Wind – small light seeds like dandelions; water – seeds that float like coconuts, mangrove tree seeds, water lilies; animal – seeds that are eaten by animals like nuts; explosion – seed pods that split open like beans and peas, geraniums.

Assessment

Informal: Teacher assessment

How are you doing?

SB p. 73

Divide the topic into three sections: flowers, fruits and seeds. Students must write summary notes on each of these sections. Check that they understand the work by asking them questions. Explain anything that they do not understand.

Key words

androecium – male part of a flower

epigeal – where the seed leaves are taken above the surface of the ground

fertilisation – in plants, the process where pollen is transferred from the anther to the stigma of a plant

floral whorls – part of the flower that includes the calyx, corolla, androecium and gynoecium (all attached to the receptacle)

gametes – the ova and sperm or sex cells in an organism

gynoecium – female part of a flower

hypogeal – where the seed remains under the surface

micropyle – a very small opening in the ovule of a seed plant through which the pollen tube penetrates

pedicel – a small stalk in the flower that supports the male and female reproductive parts

pericarp – walls of a ripened fruit, sometimes consisting of the epicarp, mesocarp and endocarp

receptacle – enlarged/modified tip of the flower stalk that bears the male and female parts of the flower

TOPIC 10: Reproductive behaviour in animals

Performance objectives

- 10.1** Describe the different types of courtship behaviours in animals
- 10.2** Explain the terms courtship and territoriality in animals
- 10.3** Explain seasonal migration.

Introduction

The purpose of reproduction is to ensure the survival of a species for future generations. Sexual reproduction involves the joining of the male and female gametes to produce a zygote, which develops into the new individual. In order for this to occur, the two gametes must be brought into contact. Organisms employ various strategies to ensure that this occurs. Courtship in animals is a type of behaviour that is used by different species to select partners for reproduction. This short topic is about courtship behaviours, courtship and territoriality, and seasonal migration.

Activity 10.1: Make a chart of courtship behaviour

GROUPS (SB p. 76)

Resources

- reference books and/or relevant websites
- manila paper or cardboard
- glue

Guidelines

Give the groups an opportunity to present their charts to the class before putting them up in the classroom.

Assessment

Informal: Teacher assessment – give verbal feedback to the groups on their presentation, accuracy of content and effort.

Answers to Revision questions

1. The male
2. Great Crested Grebe – male puts up his head feathers and ruff (neck feathers) when greeting the female.
Male frogs sing to attract the females. Each species has a different mating call.
Male turkeys are larger and more colourful than the female. The males puff out their feathers, spreading their tail and drag their wings to attract the attention of the female. Their heads and necks are colourful. They use vocalisations – gobbling and booming – to attract the attention of the females.
3. The agama lizard has colourful skin patterns that are shown off in courtship displays. The male is very brightly coloured. He has a breeding territory and may keep as many as six or more females in his territory for breeding. During courtship, the male bobs his head to impress the female.

Assessment

Informal: Teacher assessment

How are you doing?

SB p. 77

Students can read through this topic twice and make notes about the important points. They should then explain the topic to a partner. Check that the class understands courtship and can give examples of courtship behaviours. They should also be able to give examples of animals that have breeding territories and those that migrate to specific areas to breed.

Key words

courtship – a type of behaviour used to select partners for reproduction

courtship colours – colours that may only appear in a particular species during the breeding season that form part of courtship displays, usually in males only

displays – ritual displays used by different species of animals during the courtship process

mate-selection rituals – also called courtship rituals, complicated dances, touches, vocalisations and displays used during the process of courtship

migration – the movement of species to different areas for breeding, often during a particular season of the year

territoriality – the defence of a particular area by a species, often the male of the species, for reproduction and/or feeding

TOPIC 11: Genetics

Performance objectives

11.1 Describe the transmission of characteristics from one generation to another

11.2 Identify the dominant/recessive characteristics

11.3 Describe how chromosomes are involved in the transmission of characteristics from one generation to another

11.4 Note that chromosomes carry genes that are responsible for inherited characteristics

11.5 Define genes, alleles, genotype, phenotype, and dominant and recessive alleles

11.6 Explain the part Gregor Mendel played in our understanding of genetics

11.7 Describe monohybrid and dihybrid crosses and how they can be used to select for particular characteristics using a particular genetic format.

Introduction

Genetics is a branch of Biology that deals with heredity in organisms. Heredity refers to the passing of traits from one generation to another. A trait (hereditary characteristic) is a genetically determined characteristic, such as eye colour, or a condition such as a disease. The fundamental unit of heredity is the gene. Genes determine the inherited traits. Genetics is a rapidly developing and important field of scientific study. Cloning, genetic engineering and genetically modified foods are all applications of genetics. Although these are recent developments, people have always been interested in inheritance and its importance in breeding plants and animals. Early farmers bred the best plants with each other to produce the best crops. They were using the principles of inheritance, even though they did not understand the theory

behind it. Modern genetics is based on simple ideas that were formulated by Gregor Mendel. This topic is about genetics. The last section covers the differences between sexual and asexual reproduction, which is important for the next topic – variation.

Activity 11.1: Solving monohybrid problems

PAIRS (SB p. 83)

Resources

- textbook

Guidelines

Students should use the Punnett square to show the results.

Facilitate: Allow students time to solve the problems with their partner and thereafter check the answers with the class.

Answers

1. a) P b) P and p
 c) W and w d) T
 e) T and t
2. a) genotype b) gamete
 c) gamete
3. c) bb

Assessment

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

Answers to Revision questions

1. The science of genetics is the study of how characteristics are transmitted from one generation to another.
2. Chromosomes are made of long strands of DNA and proteins.
3. Each nucleotide is made up of:
 - a sugar molecule called deoxyribose
 - a phosphate group
 - a base – there are four of these bases: adenine (A), thymine (T), guanine (G) and cytosine (C).
4. Each gene exists in many different forms and different forms of the same gene are called alleles.
5. The genotype is the sum of the alleles that an individual receives at fertilisation. In other words, the genetic potential of an organism. The name given to all these alleles is the genotype. Your genotype determines your genetic characteristics, controlled by the sequence of bases in your DNA.

In monohybrid crosses the genotype is the genetic information carried by a pair of alleles. For example, BB or Bb are two different genotypes of rabbits – the first is homozygous for black fur and the latter is heterozygous for black fur (B is the dominant allele). White rabbits have the genotype bb. In dihybrid crosses, the genotype is the genetic information carried by two pairs of alleles, for example

RRYY, RRYy, RrYY, RrYy are different genotypes for a pea plant which has round yellow seeds.

6. The physical appearance of the genotype is called the phenotype. These are the visible features of an organism, for example eye colour. In the example in question 5, the rabbits with the genotypes BB and Bb both have the phenotype (physical appearance) of black fur, even though their genotypes are different.
7. A monohybrid cross is made between organisms when geneticists are studying one characteristic. An example is the height of plants. A dihybrid cross is a cross made between organisms that have two characteristics that are different, instead of only one. An example is height of the plant, H for tall plants and h for dwarf plants. The second characteristic is flower colour so P for purple flowers and p for white flowers. So an example of a cross between parents heterozygous for these traits is HhPp × HhPp.
8. The sex chromosomes carry genes for different characteristics. These are called sex-linked genes or alleles. The term sex-linked or X-linked is used for these genes that are carried on the X chromosome. The Y chromosome is blank for these alleles.

Assessment

Informal: Teacher assessment

How are you doing?

SB p. 87

Students may find some concepts in this topic challenging. Check that they understand the material covered by asking questions. Set a worksheet with examples of genetic problems to solve that involve monohybrid and dihybrid crosses. Students should consolidate the new words in this topic. Explain anything that they do not understand.

Key words

allele – a particular form of a gene that usually occurs in pairs, one of each homologous chromosome in a diploid cell nucleus

chromosome – a coiled structure that is found in the nucleus of cells that contains DNA and basic proteins

dihybrid cross – a dihybrid cross is a cross made to study the inheritance of two traits (instead of one) at the same time

DNA – a nucleic acid found in the chromosomes of almost all organisms and which is the primary genetic material

gene – a sequence of nucleotides that codes for the amino acid sequence of an enzyme or other protein

genetics – the study of how characteristics are transmitted from one generation to another

genotype – the alleles that an individual receives at fertilisation

inheritance – transmission of genetically controlled characteristics

monohybrid cross – a cross made between organisms when geneticists are studying one characteristic, for example height in plants

phenotype – the physical appearance of the genotype

TOPIC 12: Variation

Performance objectives

12.1 Define the term variation in relation to living organisms

12.2 Describe continuous and discontinuous variation

12.3 Identify the relationship between variation and evolution

12.4 Recognise that variation could be morphological or physiological

12.5 List different ways that individuals vary in their behaviours and functions

12.6 State the human blood groups and explain how they can be used in paternity testing

12.7 Explain the application of genetic variation to solving crimes.

Introduction

Variation is about the differences that exist between members of the same species. This topic is about continuous and discontinuous variation. Variation is an important concept for evolution through natural selection in Topic 14. In any population, each individual is slightly different. These differences are called variations. They occur by chance. Sometimes a variation may help an organism to survive better. Then this individual is more likely to reproduce and to pass on this characteristic. But not all variations are useful to an individual. A variation can make it difficult for an animal to survive and sometimes a variation can have no effect at all.

Students should enjoy the last part of this topic as it covers applications of variation in humans – blood groups, paternity testing and solving crimes using genetic variation.

Activity 12.1: Measuring height

INDIVIDUAL (SB p. 88)

Resources

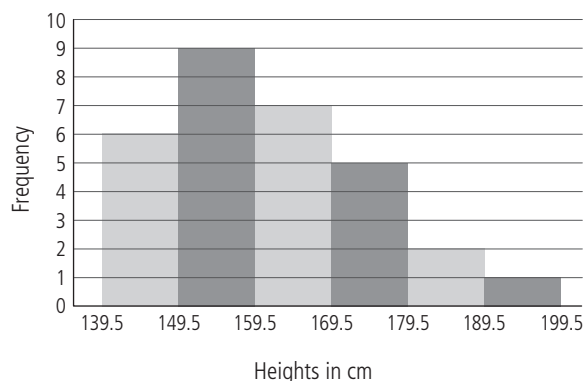
- textbook
- tape measure or ruler
- flat book or piece of card
- wall or door
- pencil and notebook
- graph paper
- websites on how to draw histograms such as:
<https://www.khanacademy.org/math/cc-sixth-grade-math/cc-6th-data-statistics/histograms/v/histograms-intro>

Guidelines

Students should measure at least 20 people. They should do this during breaks or after school. Facilitate: Revise the skill of drawing a histogram with the class before they do this activity.

Answers

Use the following example to guide the class in drawing their histogram.



Assessment

Informal: Self-assessment – draw an example of a histogram on the board.

Answers to Revision questions

1. Variation can be continuous or discontinuous.

2. Continuous variation is a smooth gradation in the differences between individuals. Examples include height and weight. Discontinuous variation is found where organisms either do, or do not, have certain characteristics. You are either male or female, for example.
3. Anyone of any blood group can receive blood group O in an emergency.
4. No, blood groups can only show who is *not* the father of a child. DNA testing is needed to prove that a man is the father of a particular child.

Assessment

Informal: Teacher assessment

How are you doing?

SB p. 92

Students need to know the difference between continuous and discontinuous variation. They must be able to accurately draw a histogram using data showing continuous variation, for example the size of leaves on a tree. Students must also understand the use of blood groups in paternity testing and how genetic variation can be used to solve crimes. Check that they understand these concepts by asking questions. Explain anything that they do not understand.

Key words

blood groups – in humans there are four blood groups, A, AB, B and O – these are the ABO blood groups; there are also many other types of blood groups in humans, such as Rhesus grouping and the Kell system

blood typing – humans can be typed into their different blood groups in the ABO and Rhesus systems using tests that distinguish which person is which group, used before a blood transfusion

continuous variation – the smooth gradation in the differences between individuals in a population, for example variations in height

discontinuous variation – a form of variation where organisms either have or do not have a

particular characteristic, for example male or female

DNA profile – a technique used to identify individuals by characteristics of their DNA

gene pool – the sum total of all the alleles that are found in the breeding population of a particular species

paternity testing – the use of either blood groups or DNA to work out whether a man is, or is not, the father of a child

variation – in genetics, the term used to describe the variation in alleles of genes in a gene pool in a population of individuals

TOPIC 13: Biological evolution and adaptation

Performance objectives

- 13.1 Define the term biological evolution
- 13.2 Discuss the progressive change required in anatomy of organisms from water to land
- 13.3 Explain the terms structural adaptation and adaptive colouration
- 13.4 Describe mimicry
- 13.5 Explain behavioural adaptation in termites.

Introduction

A population is defined as a group of organisms of the same species living in the same geographical area and sharing a common gene pool, such as a population of lions living in the Yankari Game Reserve in Nigeria. Biological evolution is defined as the change in the gene pool of the population over many generations. The recorded genetic changes in living organisms over many generations are the main source of evidence that scientists have for evolution. This topic is about biological evolution.

Note:

1. An important concept in this topic is adaptation. Students need to understand this term in an evolutionary context in order to prevent misconceptions.
2. This topic should be taught from a biological context. Some students may feel uncomfortable due to their religious beliefs conflicting with evolution, so be sensitive to their feelings.

Activity 13.1 Newspaper camouflage

GROUPS (SB p. 97)

Resources

- the classified ads from a newspaper
- a piece of white construction paper
- a piece of black construction paper
- a hole punch
- notebook or graph paper
- pencil
- ruler
- stop-watch or someone to count seconds

Guidelines

Divide the class into smaller groups and provide each group with the equipment. Instruct the groups on how to carry out the activity. Each group can pick out and count the circles they pick up. Ask the class to pool their answers and construct the bar graph from the full class answers. This will give a better bar graph that is easier to interpret. The class should discuss their results and the reasons for camouflage.

Facilitate: Revise the skill of drawing a bar graph with the class before they do this activity.

Answers

Organisms need camouflage to avoid being seen and eaten by predators.

Answers to Revision questions

1. Biological evolution means the genetic changes that take place over time and ultimately lead to new types of organisms (species).
2. In evolutionary biology, mimicry is a similarity of one species to another that protects both species. In species that are eaten by predators, it is a type of antipredator adaptation. The similarity can be in appearance, behaviour, sound, scent or locations.
3. Structural adaptation is the physical features of an organism that help it survive such as the shell on a tortoise, beak of a bird, showy flowers on a plant to attract pollinators.
4. Hoverfly, wasp beetle or any other suitable answer.

5. Students must describe the reproductives, soldiers and workers and breeding queen in detail.

Assessment

Informal: Teacher assessment

How are you doing?

SB p. 98

Students may experience some difficulty understanding the concepts in this topic. Check that students understand the meaning of evolution and biological evolution by asking questions. Divide the class into pairs – one member of the pair should have a greater understanding of the topic and should try to teach it to the other member. Together they should make a summary of the topic using headings and sub-headings. They can add key concepts and words where applicable. Explain anything that they do not understand.

Key words

adaptation – in evolutionary biology, a feature that is common in a population because it provides some improved function

adaptive radiation – the process in which organisms diversify rapidly into a multitude of new forms, particularly when a change in the environment makes new resources available, creates new challenges or opens new environmental niches

biological evolution – the genetic changes that take place over time and lead to new species of organisms

camouflage – a disguise in the form of either colour or shape, which allows an organism to blend in with its environment to avoid predators

mimicry – in evolutionary biology, mimicry is the similarity of one species to another that protects one or both

social organisation – the grouping of individuals in a species into organised groups, such as breeding females; a pattern of relationships between individuals in a group that allows the group to function effectively

species – a group of populations that have the potential to interbreed to produce fertile offspring

structural adaptation – the adaptation of physical structures, such as fur or bird beaks, for a particular function

termite castes – the different forms of the termite species that are adapted for particular functions within a termite nest, for example the breeding queen, workers and soldiers

tetrapod – a land creature with four legs

TOPIC 14: Theories of evolution

Performance objectives

- 14.1 Describe the development of our understanding of evolution through the history of the different theories of evolution
- 14.2 State the law of use and disuse according to Jean-Baptiste Lamarck
- 14.3 Explain why Darwin's theory of natural selection is central to the modern understanding of evolution
- 14.4 Explain how natural selection is the mechanism that allows selected genetic traits to become more common in successive generations of a population
- 14.5 Describe the importance of variation in the mechanism of natural selection
- 14.6 Describe the evidence for evolution that can be found in many branches of science
- 14.7 Describe the concept of speciation – the evolution of new species
- 14.8 State other occurrences apart from natural selection that may bring about evolution.

Introduction

This topic is about how scientists, like Darwin, Lamarck and Weismann, try to make sense of the changes in life over billions of years. Evolution is the word used to describe this kind of slow change. Evolutionary theory is based on all the evidence that scientists have used to build up the picture that we have of life that has existed on Earth for billions of years. Scientific evidence for evolutionary theory includes how life has changed over time since living things first appeared on Earth. Evolution involves changes to a population's gene pool. Natural selection is the main driving force of evolutionary change. Evidence for evolution comes from the fossil record, comparative anatomy and embryology, biogeography and genetics. Speciation refers to the evolution of a new species. There are several environmental and other conditions that are necessary to produce a new species from an existing species. The most common environmental condition that leads to formation of a new species is the process of geographical isolation. This topic requires students to use the knowledge that they have learnt about genetics and variation.

Note:

This topic should be taught from a biological context. Some students may feel uncomfortable due to religious beliefs, so be sensitive to their feelings.

Activity 14.1: A game to explore natural selection

GROUPS (SB p. 104)

Resources

- container, e.g. a 2-litre plastic ice-cream container
- some substrate material, e.g. sand, sawdust, strips of cloth to represent the habitat (grassland, forest, desert, ocean, etc.)
- 50 beads or beans or marbles or any suitable small objects to represent a prey species of your choice. These must be two colours – 25 of each colour. One of the colours should be very similar to the colour of the substrate that you have selected (camouflage)
- tweezers
- stop-watch
- recording table (see the result sheet in the SB p. 105)
- websites with similar games including <http://fog.ccsf.cc.ca.us/ldigirol/documents/SimulatingSelectiongamespring12forstudents.pdf>

http://www.crsceience.org/lessonplans/3_NaturalSelectioninPredatorsandPrey_IBHammond_1112.pdf

<http://www.woodsendproducts.com/files/classroom/Biology%20&%20%20Life%20Selection.pdf>

Guidelines

- Students are required to act out the mechanism of natural selection and its impact on the phenotype of prey populations.
- Allow students to contribute to the materials required for this activity. This is a good opportunity to recycle waste for a learning opportunity. The school's sport coaches may be able to provide stop-watches.
- Check that students know the meaning of the term hypothesis.
- Divide the class into mixed ability groups.

Facilitate: Students may need assistance to get started on this activity. Check that they understand the purpose of the game and how it links to natural selection. Help the groups to follow the instructions and to answer the questions. Groups must allocate roles such as: predator, timer, recorder, distributor of beads.

Answers

1. The hypothesis will depend on the materials (simulated organisms) that are selected. In a case where red and green beads are used to simulate red and green butterflies on the soccer field (green wool as substrate), the hypothesis may be: 'More red beads will be caught than the green beads' or 'The red butterflies are more frequently preyed upon than the green butterflies'.
- 2.–4. Follow the procedures outlined in the Student Book.
5. Base the conclusions on the results obtained from steps 2–4.
6. In terms of genetics:
 - a) The greater the variation among alleles in a gene pool, the greater the opportunity for individuals in a population to adapt to changes in the environment.
 - b) No. Some adaptations may be neutral (neither an advantage or disadvantage) or they may even be lethal.
 - c) No. Variations that do not exist cannot be selected. If a changing

environment exerts pressure on a population to adapt but no suitable gene alleles are available to select, then natural selection cannot occur and the population cannot adapt.

- d) The hypothesis is either rejected or accepted on the basis of the results obtained.
 - e) Repeat the investigation several times to confirm the overall trend.
7. a) 'Natural selection' and 'variations exist among individuals of a population'.
b) 'Breeding patterns in a population', 'carrying capacity of the habitat' that is, limited resources and 'inheritance of characters'

Brain teaser:

1. Alleles that code for thicker and longer fur. Also alleles that code for a thick layer of subcutaneous fat (fat layer under the skin).
2. Thick fur coat and that nature will provide. This assumption is wrong because natural selection depends on gene allele variation and not deliberate desires for change.

Assessment

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

Answers to Revision questions

1. Jean-Baptiste Lamarck
2. This is the concept that germ cells produce body cells and are not affected by anything the body cells 'learn' or acquire during their life. This shows that Lamarck's theory cannot work.
3. Two ideas central to Darwin's theory of evolution:
 - Species were not 'created' in their present form, but evolved from ancestral species.
 - Natural selection is the mechanism that drives the process of evolution. Natural selection has given rise to the enormous variety of species present on Earth.

4. Natural selection is the mechanism that allows selected genetic traits to become more common in successive generations of a population. This is the way that sexually reproducing organisms adapt to new environmental challenges.
5. Evidence to support the theory of biological evolution can be found in many fields of science:
 - the fossil record (palaeontology)
 - modification by descent (comparative anatomy)
 - biogeography (distribution of plant and animals on Earth)
 - genetics (including molecular genetics).

Assessment

Informal: Teacher assessment

How are you doing?

SB p. 111

Consolidate this topic by doing some role plays/presentation:

1. In groups, students must pretend they are one of the scientists that contributed to the theory of evolution – Lamarck; Weismann; Darwin; Elredge/Gould. They must present their findings to the group.
2. Students must give one-minute orals to the group explaining Darwin's theory of evolution by natural selection. They can use the peppered moth as an example.
3. Students can give a short persuasive speech on evidence for biological evolution. Check that students understand the concepts in this topic by making a worksheet or test on the content. Explain anything that they do not understand.

Key words

adaptive radiation – the process in which organisms diversify rapidly into a multitude of new forms, particularly when a change in the environment makes new resources available, creates new challenges or opens new environmental niches

analogous structures – structures that are found in different species that look the same or have the same function, but which did not evolve from a common ancestor, for example wings in birds and bats

comparative anatomy – the study of similarities and differences in the anatomy of different species, to show relationships during evolution

comparative embryology – a branch of embryology that compares and contrasts embryos of different species to look at evolutionary relationships

continuous variation – the smooth gradation in the differences between individuals in a population, for example variations in height

Darwin – Charles Darwin, an English naturalist, the 'father of evolution', who published *On the origin of species by means of natural selection* and who is responsible for the modern theory of evolution

discontinuous variation – a form of variation where organisms either have or do not have a particular characteristic, for example male or female

evolution – the changes that take place in organisms, often over millions of years but also in recent time, to form new species

fossil record – a term used by people who study fossils and evolutionary biology to refer to the total number of fossils that have been discovered as well as the information derived from them

gene pool – the sum total of all the alleles that are found in the breeding population of a particular species

genome – an organism's entire hereditary information, encoded either in DNA or RNA (in many types of virus)

geographic barrier – a feature, such as a river, a sea or a mountain, which stops species from meeting

geographic isolation – isolation of organisms by features such as rivers, mountains or seas

homologous structures – structures that look like one other and come from the same line of ancestors

Key words (cont.)

Lamarck – Jean-Baptiste Lamarck, a French naturalist, who developed a formal theory of evolution, the principle of inheritance of acquired characteristics – useful characteristics acquired during a lifetime would be passed on to offspring

macro-evolution – the evolution of one species into another species

micro-evolution – evolutionary changes below species level

natural selection – the mechanism of evolutionary change; organisms that are better adapted for their environments are more likely to produce young that survive to reproduce, so increasing the proportion of individuals with that particular make-up in the population

palaeontology – the study of the fossil record

population – a localised group of individuals that belong to the same species

regulatory gene – a gene that controls the expression of one or more genes in an organism; all animals share regulatory genes

reproductive isolation – isolation of a group from a parent species for a long period during which no gene alleles are exchanged between the two groups; results in the formation of a new species if continuous

speciation – the evolution of a new species from a subspecies that can no longer interbreed with the parent species

species – a group of populations that have the potential to interbreed to produce fertile offspring

therapsids – mammal-like reptiles that are the intermediate stage between reptiles and mammals

Weismann – August Weismann, a German evolutionary biologist, who contributed the germ plasma theory, showing that the gametes were the only means of passing on genetic material, so ruling out Lamarck's theory

SS3 Exam

Marks: 180

Time: 2 hours

Theory Section A

Multiple Choice Questions

Each question is followed by four options lettered A to D. Choose the correct option for each question. Give only one answer to each question.

1. Fertilisation in humans take place in the ...
A. ovary
B. Fallopian tube
C. uterus
D. vagina

Questions 2 and 3 relate to the following information: An experiment was set up to investigate germination of radish seeds: seeds were planted in 4 polystyrene containers (W, X, Y and Z). W and X were placed on a sunny windowsill. W was given 1 teaspoon of water every day. X was given no water. Y and Z were placed in a dark cupboard. Y was given 1 teaspoon of water every day. Z was given no water.

2. Which factor must be kept the same for an accurate comparison?
A. amount of soil
B. water
C. number of seeds germinating in each container
D. sunlight

3. The expected results are:

Table of results showing average growth of radish seedlings over 10 days

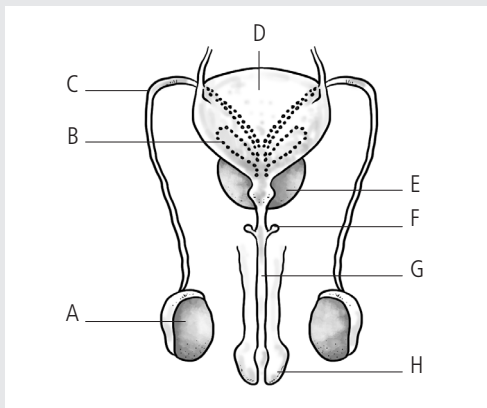
	Container W	Container X	Container Y	Container Z
A.	no growth	no growth	no growth	no growth
B.	no growth	5 mm in height	no growth	no growth
C.	5 mm in height	no growth	7 mm in height, thin, unhealthy	no growth
D.	no growth	no growth	5 mm in height, normal growth	no growth

4. Determine which statements about the female reproductive tract are true:

- (i) ova are produced in the Fallopian tubes
- (ii) the embryo develops in the uterus
- (iii) the urethra connects to the cervix
- (iv) the menstrual flow is from the walls of the vagina
- (v) the follicle is in the ovary

- A. (i) and (iii)
- B. (ii) and (v)
- C. (ii) and (iv)
- D. (i), (ii) and (iv)

Use the diagram below to answer questions 5 and 6.



5. Which sequence represents the path of sperm leaving the body?

- A. $A \rightarrow C \rightarrow G$
- B. $E \rightarrow F \rightarrow H$
- C. $A \rightarrow C \rightarrow B$
- D. $D \rightarrow F \rightarrow G$

6. If an injury occurred to the structure labelled C, the most likely result would be a problem with ...

- A. delivery of sperm
- B. production of gametes
- C. production of hormones
- D. excretion of urine

7. Which scientist believed that change was brought about through use and disuse and inheritance of acquired characteristics?

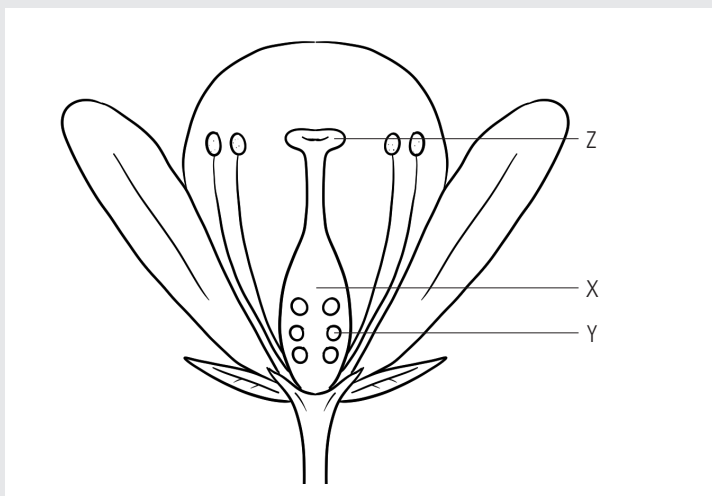
- A. Alfred Wallace
- B. Stephen J. Gould
- C. Charles Darwin
- D. Jean-Baptiste Lamarck

8. The _____ allows light to enter the eyeball and helps to refract light rays.

- A. lens
- B. cornea
- C. retina
- D. sclera

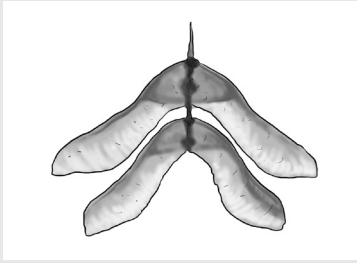
9. Intelligence and learning in mammals is due mainly to the possession of ...
- A. large cerebral hemispheres
 - B. efficient sensory mechanisms
 - C. well-developed cerebellum
 - D. efficient sensory mechanisms
10. Which hormone is produced by the adrenal cortex?
- A. aldosterone
 - B. adrenaline
 - C. thyroxine
 - D. antidiuretic hormone (ADH)
11. Purple flowers (PP) are crossed with white flowers (pp). Purple flowers is the dominant trait and white flowers the recessive trait. The flowers of the F₁ generation will be ...
- A. purple
 - B. white
 - C. very light purple
 - D. purple with white streaks
12. The point where two nerve cells meet is called the ...
- A. fibre
 - B. spinal cord
 - C. synapse
 - D. neurone
13. A farmer bred cattle with humps (H) with cattle with no humps (h), with humps being the dominant gene. Which would be the correct prediction for the F₂ generation?
- A. humps 25%; no humps 75%
 - B. humps 75%; no humps 25%
 - C. humps 50%; no humps 50%
 - D. humps 25%; slight hump 50%; no humps 25%
14. Which is an example of continuous variation?
- A. eye colour
 - B. height of the students in your school
 - C. fingerprints
 - D. different blood groups
15. Damage to the inner ear may affect, in addition to hearing, the sense of ...
- A. smell
 - B. taste
 - C. touch
 - D. balance
16. Where is the blind spot located in your eye?
- A. retina
 - B. lens
 - C. pupil
 - D. cornea

17. A baby's blood and a mother's blood mix together ...
- A. during the last 3 months of pregnancy
 - B. at no time during the pregnancy
 - C. during the first 3 months of pregnancy
 - D. during the first 6 months of pregnancy
18. Which of the following characteristics are not inherited?
- A. eye colour
 - B. religion
 - C. shoe size
 - D. blood group
19. Natural selection occurs due to ...
- A. extinctions
 - B. variation in populations
 - C. human intervention
 - D. mutations
20. The parts that make up the stamen in a flower are ...
- A. sepals and petals
 - B. stigma and style
 - C. filament and anther
 - D. carpel and anther
21. Seed dispersal is important so that the seedlings ...
- A. stay close to the parent plant
 - B. will not be overcrowded
 - C. will be pollinated
 - D. will be fertilised
22. The diagram shows a flower. What do labels, X, Y and Z become after fertilisation has occurred?



- A. X: seeds Y: fruit Z: dies
- B. X: dies Y: fruit Z: seeds
- C. X: ovary Y: ovules Z: stigma
- D. X: fruit Y: seeds Z: dies

23. The following seeds are dispersed by:



- A. wind
- B. dogs
- C. birds
- D. water

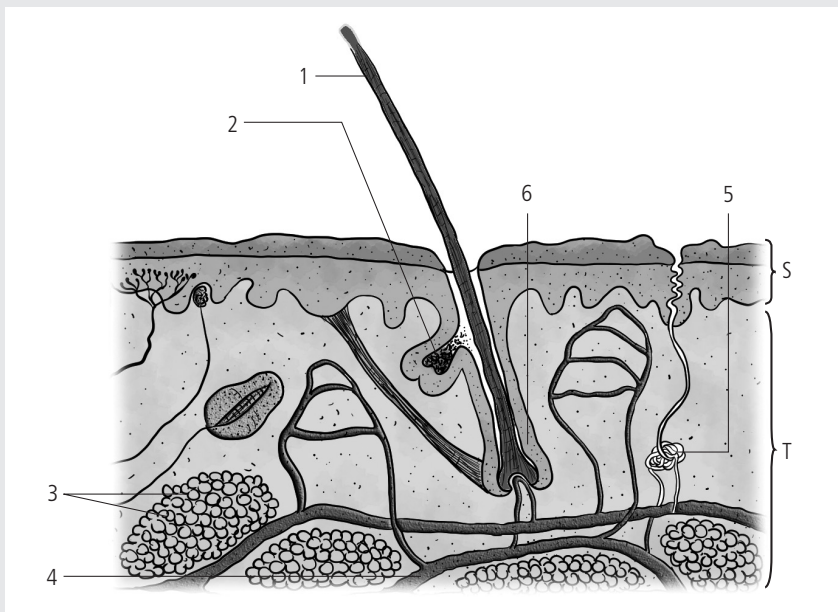
24. The part of the flower that produces the pollen is the ...

- A. ovary
- B. petal
- C. sepal
- D. anther

25. The maintenance of a constant internal environment is called ...

- A. diffusion
- B. vasodilation
- C. homeostasis
- D. succession

Refer to the following diagram for questions 26 and 27.

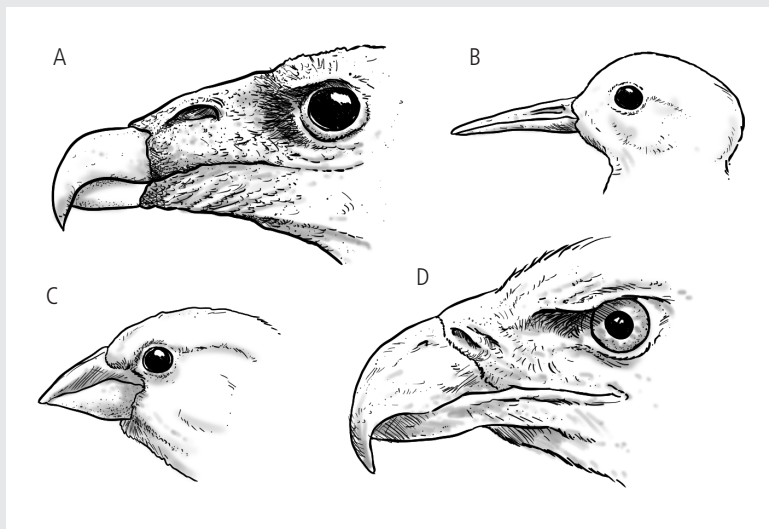


26. The sebaceous gland is represented by label ...

- A. 2
- B. 3
- C. 5
- D. 6

27. Olawale ran in the 100 m athletics event. Which part of his skin helped his body cool down?
- A. 2
 - B. 3
 - C. 5
 - D. 6
28. Which is not a function of the skin?
- A. excretion
 - B. temperature regulation
 - C. protection
 - D. hormone production
29. Which contraceptive may contain oestrogen?
- A. oral contraceptive pill
 - B. condom
 - C. diaphragm
 - D. all of the above
30. Which contraceptive may prevent the transmission of HIV?
- A. oral contraceptive pill
 - B. condom
 - C. diaphragm
 - D. all of the above
31. The duct that is used by both the reproductive and excretory system in males is the ...
- A. ureter
 - B. urethra
 - C. sperm duct
 - D. vagina
32. The function of the blood lining of the uterus is to ...
- A. carry the eggs to the uterus
 - B. release an egg once a month
 - C. provide nourishment for the developing embryo
 - D. protect the developing embryo
33. Menstruation is the discharge (getting rid) of ...
- A. semen
 - B. cells in the vagina
 - C. unused eggs
 - D. the uterus lining
34. Which of the following structures is an organ of excretion?
- A. skin
 - B. stomach
 - C. heart
 - D. small intestine

35. A penis becomes erect due to ...
- A. blood filling the spongy tissue
 - B. a muscle
 - C. a bone
 - D. ejaculated semen
36. An advantage of sexual reproduction is:
- A. Offspring mature slowly.
 - B. The strength of the succeeding generation is reduced.
 - C. The individuals produced show variation from the parents.
 - D. Reproduction is easy and fast.
37. Which of the following is not an example of natural selection?
- A. bacteria developing a resistance against antibiotics
 - B. peppered moth's colouring
 - C. chameleon's long sticky tongue
 - D. Great Dane dogs bred for their size
38. Which one of the following is a factor that prevents individuals from surviving?
- A. birth
 - B. nutrition
 - C. predation
 - D. territory
39. Which beak is most suited to cracking seeds?



40. The elaborate and decorative tail of the male Lyre bird found in Australia (pictured below) evolved through a process called ...



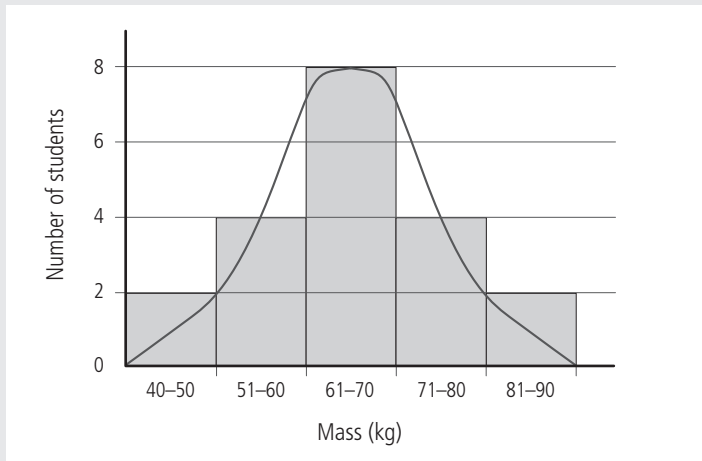
- A. mating
 - B. fertilisation
 - C. natural selection
 - D. acquired characteristics
41. Which factor increases the numbers in a population?
- A. birth
 - B. migration
 - C. disease
 - D. increase of predators
42. Darwin's theory of evolution was called:
- A. the theory of relativity
 - B. the theory of Natural Selection
 - C. the Big Bang theory
 - D. the theory of acquired characteristics
43. Which of the following is a source of evidence for evolution?
- A. depth of water levels
 - B. fossils
 - C. differences in organisms
 - D. coal
44. The structural and functional unit of the kidney is the ...
- A. glomerulus
 - B. nephron
 - C. renal tubule
 - D. loop of Henle
45. Which of the following is not a role of water in the human body?
- A. It regulates the body temperature.
 - B. It keeps the vacuoles firm, giving the cells support.
 - C. It transports wastes.
 - D. It keeps the body hydrated.

46. Which disease/s may occur due to drinking too much alcohol?
- A. cirrhosis
 - B. hepatitis
 - C. fasciolosis
 - D. cirrhosis and hepatitis
47. The (i) _____ is the structural unit of the nervous system. The functional unit of the nervous system is the (ii) _____.
- A. (i) nephron (ii) neuron
 - B. (i) reflex arc (ii) neuron
 - C. (i) neuron (ii) reflex arc
 - D. (i) reflex arc (ii) reflex action
48. Which of the following is found in the middle ear?
- A. pinna
 - B. tympanic membrane
 - C. cochlea
 - D. stirrup
49. Which factor does not cause overcrowding?
- A. decreased natality
 - B. decreased mortality
 - C. absence of predators
 - D. immigration
50. The natural defence mechanisms in plants that prevent overcrowding are called _____.
- A. allelopathy
 - B. thorns
 - C. tropisms
 - D. seed dispersal
51. An apple is a ...
- A. pome
 - B. drupe
 - C. legume
 - D. achene
52. A male animal that uses colours to attract the female during the courting season is the ...
- A. African elephant
 - B. Great Crested Grebe
 - C. agama lizard
 - D. agama lizard and turkey
53. Which base is not found in DNA?
- A. uracil
 - B. thymine
 - C. guanine
 - D. cytosine

54. Different forms of the same gene are called ...

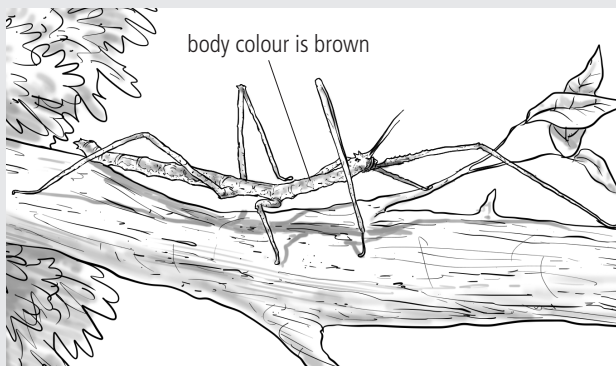
- A. recessive traits
- B. alleles
- C. dominant traits
- D. loci

55. Which statement is not correct for this graph?



- A. It represents continuous variation.
- B. The mean mass is 61– 70 kg.
- C. The total number of students tested is 20.
- D. Histograms are used to show discontinuous variation and bar graphs represent continuous variation.

56. The stick insect is an example of ...

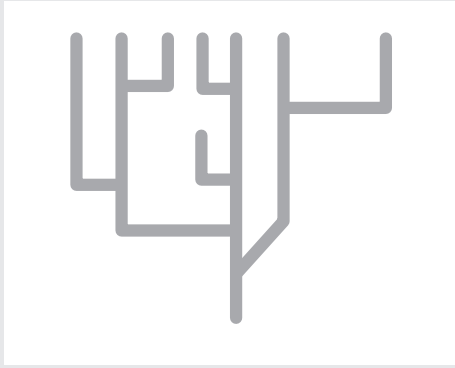


- A. mimicry
- B. camouflage
- C. mimicry and camouflage
- D. defence

57. Which is not true for a termite colony?

- A. Soldiers defend the colony with their powerful jaws.
- B. Workers build the nests and galleries.
- C. The king is the main reproductive individual in the colony.
- D. The queen lives a long time, up to 50 years.

58. The following diagram shows a theory of evolution called ...

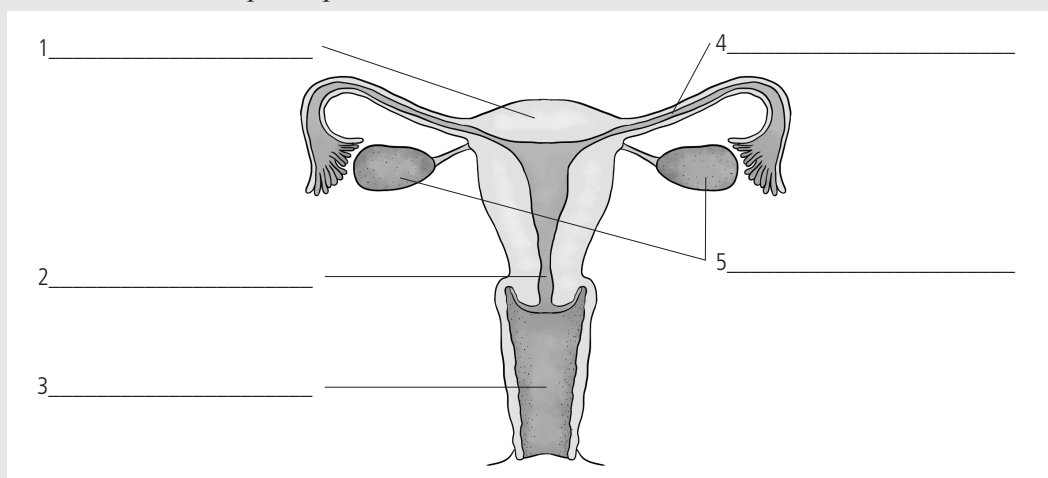


- A. punctuated equilibrium
 - B. natural selection
 - C. phyletic gradualism
 - D. Lamarckism
59. The front limbs of vertebrates are an example of ...
- A. homologous structures
 - B. analogous structures
 - C. biogeography
 - D. geographic isolation
60. Insulin ...
- A. raises blood glucose levels
 - B. prepares the body for fight or flight
 - C. promotes reabsorption of water
 - D. lowers blood glucose levels

Total marks: 60

Theory Section B

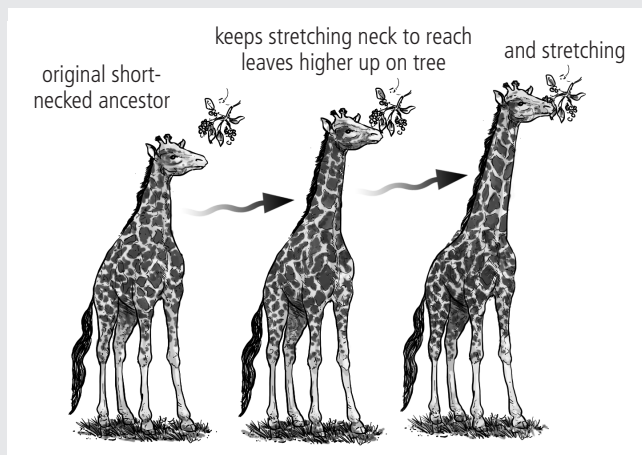
1. Explain the advantages of courtship patterns. (3)
2. Write a paragraph describing the role of the placenta, amnion and umbilical cord in pregnancy. (9)
3.
 - a) State one advantage of asexual reproduction. (1)
 - b) State one disadvantage of asexual reproduction. (1)
 - c) State two ways in which the structure of the sperm is suited to its function. (2)
4. a) Label 1 to 5 in the spaces provided. (5)



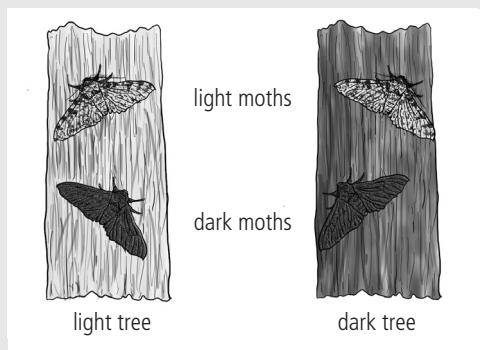
- b) Give one function of each of the labelled parts. (5)
 - c) State three methods of preventing pregnancy. (3)
 - d) Imagine that a government in country X has made a decision to allow children as young of 12 to decide on matters of sexual health. This will enable them to have access to condoms, other contraceptives such as the pill and get an HIV test. Give your opinion on this law. Should this be allowed in country X? Explain why or why not. (4)
5. Study the following experiment that was set up by two SS3 students, Chinasa and Hadiza, to investigate the conditions needed for germination to take place. Four test tubes were set up with different conditions:

Test tube A	wet cotton wool at the bottom, 3 bean seeds on the cotton wool, the top of the test tube was covered with a cork, kept at room temperature
Test tube B	dry cotton wool at the bottom, 3 bean seeds on the cotton wool, the top of the test tube was covered with a cork, kept at room temperature
Test tube C	wet cotton wool, 2 bean seeds on the cotton wool, 3 cm of boiled water on top of the cotton wool, a layer of oil on top of the boiled water and a cork on top of the test tube, kept at room temperature
Test tube D	wet cotton wool at the bottom, 2 bean seeds on the cotton wool, a cork on top of the test tube, placed in the fridge at 4 °C

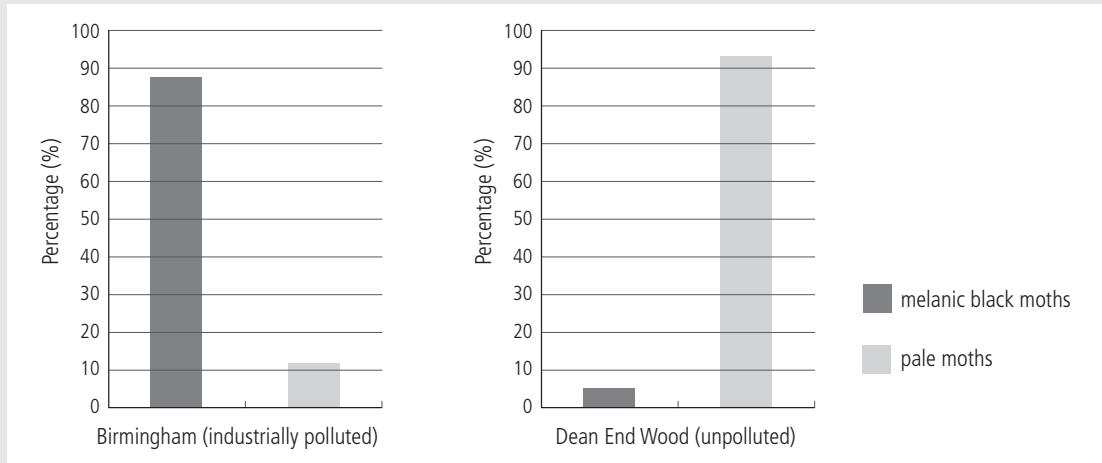
- a) Draw labelled diagrams to show how this experiment was set up. (8)
 - b) State the aim of this experiment. (1)
 - c) Give a suitable hypothesis for this experiment. (2)
 - d) Chinasa and Hadiza repeated this investigation. Why is it important to repeat an experiment several times? (1)
6. a) Use the diagram as an example to describe Lamarck's hypothesis that evolutionary change occurs due to the inheritance of acquired characteristics. (5)



- b) Has this hypothesis been proven true or false by evidence? Justify your answer. (3)
7. a) Define the term variation. (3)
- b) Use your knowledge on natural selection to argue whether a larger or smaller population would have a better chance of survival. (7)
8. The peppered moth (*Biston betularia*) is a well-known example of natural selection. This moth is found in many areas of England. Within any population there is variety, but the focus in this example is on the pale speckled moths and black (melanic) moths. The peppered moth is nocturnal and during the day rests on tree trunks. Before the 1850s, the pale moth was well camouflaged as it blended in well with the lighter trees and their lichen covering. The black moths stood out on this background and were therefore rarely found due to predation. By 1895, most of the moths were black. The pollution from the industrialisation of this time period caused the lichens to die and the trees to become coated with soot. The pale speckled variety was now vulnerable to predators. The black moths survived better and, in turn, had more young that also had the adaptive trait; they were black. When people implemented measures to control the air pollution from the factories, the situation reversed.
- a) The diagram shows the two colours of peppered moth.

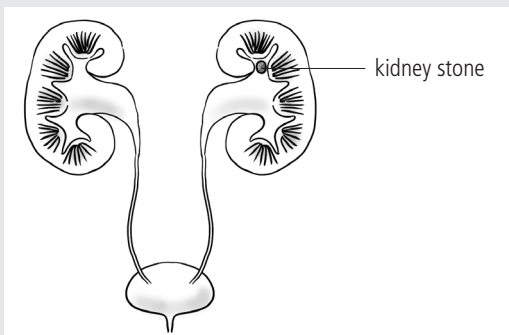


- i) Which moth is more likely to be eaten by birds on the trees covered by lichens?
Justify your answer. (2)
- ii) Which moth is less likely to be eaten by birds on the trees covered by soot?
Justify your answer. (2)
- b) A scientist determined the numbers of pale and black (melanic) moths in two different areas of England.

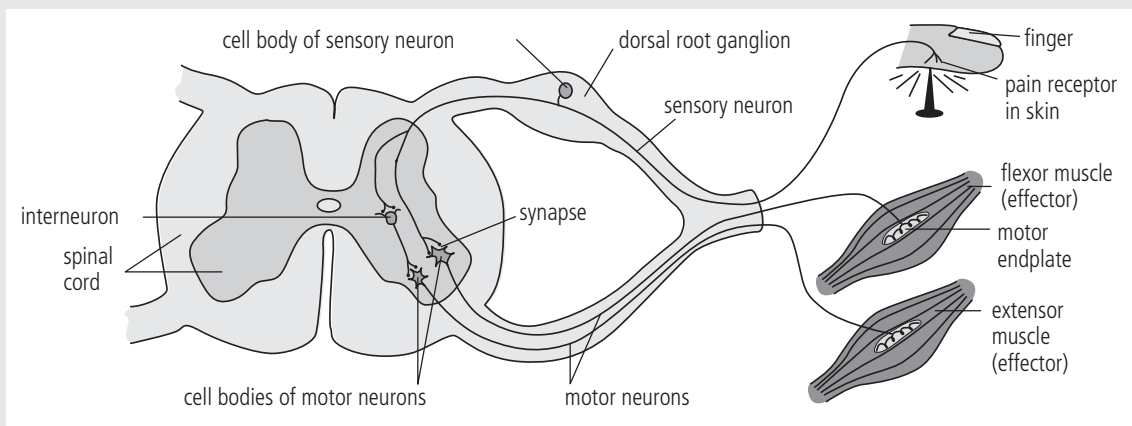


Write a paragraph explaining these results in terms of natural selection. (11)

9. a) What is a kidney stone? (2)
- b) How are kidney stones formed? (2)
- c) The diagram shows a kidney stone. What problem do you think will be caused by the kidney stone? Note: Use the diagram to answer the question. (1)



10. Use the diagram and the example of a hand being pricked by a drawing pin to explain the mechanism of a reflex action. (8)



11. A teacher went to have her eyes tested as she was having headaches. She was told that she had a regular astigmatism in both of her eyes. She was told that she was long-sighted.
- a) Explain the meaning of regular astigmatism. (2)
 - b) Explain the meaning of long-sighted. (2)
 - c) How do you think her problem was corrected? (2)
12. Write a paragraph explaining how the ear hears a sound. (8)
13. a) Explain the difference between primary and secondary succession. (4)
- b) Give two characteristics of a climax community. (2)
14. Black wool of sheep is due to a recessive allele (b) and white wool is due to a dominant allele (B). What are the chances (expressed as percentages) of a farmer producing a white lamb when two heterozygous parents are crossed? (9)

Total marks: 120

Solutions

Theory Section A

Multiple Choice

1. B, 2. A, 3. C, 4. B, 5. A, 6. A, 7. D, 8. B, 9. A, 10. A, 11. A, 12. C, 13. B, 14. B, 15. D, 16. A, 17. B, 18. B, 19. B, 20. C, 21. B, 22. D, 23. A, 24. D, 25. C, 26. A, 27. C, 28. D, 29. A, 30. B, 31. B, 32. C, 33. D, 34. A, 35. A, 36. C, 37. D, 38. C, 39. C, 40. C, 41. A, 42. B, 43. B, 44. B, 45. B, 46. D, 47. C, 48. D, 49. D, 50. A, 51. A, 52. C, 53. A, 54. B, 55. D, 56. C, 57. C, 58. A, 59. A, 60. D

Total marks: 60

Theory Section B

1. Courtship patterns help to bring animals that are ready to reproduce together. ✓ Animals of the correct age and species are more likely to mate ✓ and this increases the chance of fertilisation occurring. ✓ (3)
2. The placenta allows for the exchange of substances such as oxygen, nutrients and waste substances between the mother and baby ✓✓ – it is suited for this role as the placenta has a large surface area and is supplied with many blood vessels. ✓ The barrier between the placenta and the capillaries of the foetus or baby is very thin, allowing for rapid diffusion of substances. ✓ The barrier prevents the movement of some chemicals and bacteria across the placenta and to the baby. ✓ The amnion is a bag that encloses a fluid called amniotic fluid. ✓ The fluid is mainly water and protects the developing baby from dehydration, temperature changes and provides protection from mechanical injury. ✓✓ The umbilical cord contains an artery that carries blood from the foetus to the placenta and a vein that carries blood from the placenta to the foetus. ✓✓ Blood between the mother and the foetus never mix. ✓ Any 9 points. (9)
3. a) offspring are produced at a faster rate; offspring look identical to the parents. Any one. (1)
b) no variation so the population can be wiped out with a change such as introduction of disease or drought ✓ (1)
c) tail to swim; mitochondria in the neck region for energy; streamlined shape to move quickly. Any two. (2)
4. a) 1 – uterus; ✓ 2 – cervix; ✓ 3 – vagina; ✓ 4 – Fallopian tube; ✓ 5 – ovaries ✓ (5)
b) 1 – house and nourish the developing embryo/foetus 2 – expands during childbirth 3 – birth canal; penis is placed in the vagina during intercourse. Any one. 4 – fertilisation occurs in the Fallopian tube; egg is released into the tube. Any one. 5 – produce eggs; ripening of the eggs occur in the ovary; contain oestrogen. Any one. (5)
c) oral contraceptive pill, diaphragm, female condom, male condom, IUD, implant, hormonal injection, behaviour methods e.g. calendar, abstinence. Any three. (3)

- d) Students must motivate their answers with three reasons. Some points can be:
allowed – reduction of pregnancy; reduction of HIV; teaches children responsibility
not allowed – encourages children to have sex; can lead to promiscuity; children may not use contraceptives responsibly; possible side effects from taking hormonal contraceptives so early (4)
5. a) Allocate two marks to each diagram. Students must draw these accurately as stated in the description. (8)
 b) To determine the best conditions for germination. ✓ (1)
 c) Seeds require moisture, oxygen and room temperature to germinate. ✓✓ (2)
 d) For accuracy ✓ (1)
6. a) Over generations, short-necked giraffes had to stretch their necks to reach the leaves from the top branches for food. ✓ All this stretching caused their necks to grow longer and longer. ✓ The long necks were passed onto the next generation. ✓ The long necks are termed the acquired characteristic or trait. ✓ This resulted in giraffes today having long necks. ✓ (5)
 b) False. ✓ The long neck in giraffes is a genetic trait. ✓ It is not acquired during the giraffes' life time. ✓ (3)
7. a) Term used to describe the variation in alleles of genes ✓ in a gene pool ✓ in a population of individuals. ✓ (3)
 b) A larger population; ✓ there is more variation; ✓ therefore more chance of individuals having the required heritable traits; ✓ more individuals will be reproductively fit; ✓ therefore more offspring; ✓ increased frequency of the adaptive trait; ✓ greater chance of population survival ✓ (7)
8. a) i) Dark moths; ✓ more noticeable to predators as they stand out on the light background. ✓ (2)
 ii) Dark moths; ✓ they blend in with the background and are therefore less noticeable to predators. ✓ (2)
 b) Students must write the answer in a paragraph format. If they give points, subtract a mark. Answers are given in point form as a guideline for marking:
 • There is genetic variation in a natural population of peppered moths – black and pale moths.
 • The moths are nocturnal and rest on the trunks of the trees during the day.
 • In unpolluted areas, lichens cover the trees and there is no soot to coat the trees.
 • The pale moths are well camouflaged and thrive. The black moths are easily noticeable by the birds.
 • As the pale moths have the adaptive trait, they breed successfully and pass this characteristic onto their offspring.
 • The population of pale moths increase and that of the black moths decrease.
 • This is called reproductive fitness/survival of the fittest.
 • In polluted areas, the trees become covered in soot and the lichens, which are sensitive to pollution, die out. The trees are dark in colour.
 • The black moths have the advantageous characteristic and blend in with the background. The light moths are easily noticed by the birds.
 • The black moths breed and their population increases.
 • If the pollution in these areas is controlled the situation would reverse.
 Award one mark for any relevant point. (11)

9. a) Solid that forms in the kidneys ✓✓ (2)
 b) Minerals in the diet ✓✓ (2)
 c) It can block the flow of urine out of the kidney/cause an obstruction. ✓ (1)
10. A reflex action is a rapid automatic response to a stimulus by an organ or receptor. ✓ An example of a reflex action is the reflex withdrawal of the hand after being pricked by a drawing pin. ✓ The pain receptors in the skin of the finger receive the pain stimulus and convert this into a nerve impulse. ✓ The nerve impulse travels along the sensory neuron towards the spinal cord. ✓ The sensory neuron enters the spinal cord along the dorsal root of the spinal nerve. ✓ In the grey matter of the spinal cord, the sensory neuron makes synaptic contact with the connector neuron, which in turn makes synaptic contact with the motor neuron. ✓✓ The impulses are then transmitted along the axon of the motor neuron, which leaves the spinal cord via the ventral root of the spinal nerve to the effector organ, for example a muscle that contracts and pulls the finger away. ✓✓ The brain is made aware of the reflex action by an impulse that travels from the spinal cord to the brain (only after the finger has been withdrawn). ✓ Any eight points. (8)
11. a) Regular astigmatism – where the cornea is curved more in one direction than the other. ✓✓ (2)
 b) Long-sighted – when you can see objects in the distance clearly, but you cannot focus on objects close to the eye. ✓✓ (2)
 c) Contact lenses or glasses; ✓ lenses must have converging lenses ✓ (2)
12. Sound waves are directed by the pinna through the auditory canal to the ear drum (tympanum), causing the ear drum to vibrate. ✓
 The vibrations of the ear drum are transferred to the ossicles of the middle ear. ✓
 The footplate of the stirrup causes the membrane of the oval window to vibrate. ✓
 This sets up pressure waves in the perilymph of the vestibular canal. ✓
 The pressure waves are transferred to the endolymph of the cochlea canal. ✓
 The pressure waves stimulate the hair cells in the organ of Corti. ✓
 The hair cells convert the stimulus to an impulse. ✓
 The impulse is transmitted along the auditory nerve to the cerebrum of the brain where the sound is interpreted. ✓ (8)
13. a) Primary succession occurs in what was previously a barren, lifeless area, where the soil has not yet formed. ✓✓ Secondary succession is more common in ecosystems and it takes place in areas where a community of plants and animals that existed in the past has been destroyed either by a natural event or by human activity. ✓✓ (4)
 b) Large body size; few offspring per generation; one generation per annum or season; reduced competition. Any two. (2)

14. Black wool = b
 White wool = B

Two heterozygous parents = White wool × White wool ✓
 Bb × Bb ✓

Gametes ✓

	B	b
B	BB✓	Bb✓
b	Bb✓	bb✓

F1 phenotypic ratio: 3 white : 1 black ✓

F1 genotypic ratio: 1BB : 2Bb : 1bb ✓

The chance is 75% to produce a white lamb. ✓

(9)

Total marks: 120

Grand total: 180

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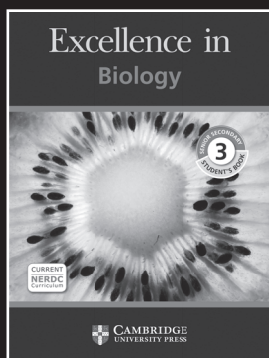
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