**Content Specification for IGCSE Biology, Single and Dual award**

**Content in bold is for single award only, for example 2.10, 2.32. Other material is common to both single and dual award.**

**Qualification content**

Paper 1 will assess only content which is not in bold.

Paper 2 will assess all content including content in bold.

**Section 1: The nature and variety of living organisms**

a) Characteristics of living organisms

b) Variety of living organisms

a) Characteristics of living organisms

*Students will be assessed on their ability to:*

1.1 Recall that living organisms share the following basic characteristics:

• they require nutrition

• they respire

• they excrete their waste

• they respond to their surroundings

• they move

• they control their internal conditions

• they reproduce

• they grow and develop.

b) Variety of living organisms

*Students will be assessed on their ability to:*

1.2 Describe the common features shared by organisms within the following main groups,

plants, animals, fungi, bacteria, protoctists and viruses, and for each group describe

examples and their features as follows (details of life cycle and economic importance are

**not** required).

**Plants**: These are multicellular organisms; they contain chloroplasts and are able to carry

out photosynthesis; they have cellulose cell walls; they store carbohydrates as starch or

sucrose.

Examples include flowering plants, such as a cereal (for example maize) and a herbaceous

legume (for example peas or beans).

**Animals**: These are multicellular organisms; they do not contain chloroplasts and are not

able to carry out photosynthesis; they have no cell walls; they usually have nervous

coordination and are able to move from one place to another; they often store

carbohydrate as glycogen.

Examples include mammals (for example humans) and insects (for example housefly and

mosquito).

**Fungi**: These are organisms that are not able to carry out photosynthesis; their body is

usually organised into a mycelium made from thread like structures called hyphae, which

contain many nuclei; some examples are single-celled; they have cell walls made of

chitin; they feed by extracellular secretion of digestive enzymes on to food material and

absorption of the organic products; this is known as saprotrophic nutrition; they may store

carbohydrate as glycogen.

Examples include *Mucor*, which has the typical fungal hyphal structure, and yeast which

is single-celled.

**Bacteria**: These are microscopic single-celled organisms; they have a cell wall, cell

membrane, cytoplasm and plasmids; they lack a nucleus but contain a circular

chromosome of DNA; some bacteria can carry out photosynthesis but most feed off other

living or dead organisms.

Examples include *Lactobacillus bulgaricus*, a rod-shaped bacterium used in the

production of yoghurt from milk, and *Pneumococcus*, a spherical bacterium that acts as

the pathogen causing pneumonia.

**Protoctists**: These are microscopic single-celled organisms. Some, like *Amoeba,* that live

in pond water, have features like an animal cell, while others, like *Chlorella,* have

chloroplasts and are more like plants. A pathogenic example is *Plasmodium*, responsible

for causing malaria.

**Viruses**: These are small particles, smaller than bacteria; they are parasitic and can

reproduce only inside living cells; they infect every type of living organism. They have a

wide variety of shapes and sizes; they have no cellular structure but have a protein coat

and contain one type of nucleic acid, either DNA or RNA.

Examples include the tobacco mosaic virus that causes discolouring of the leaves of

tobacco plants by preventing the formation of chloroplasts, the influenza virus that causes

‘flu’ and the HIV virus that causes AIDS.

1.3 Recall the term ‘pathogen’ and know that pathogens may be fungi, bacteria, protoctists or

viruses.

**Section 2: Structures and functions in living organisms**

a) Levels of organisation

b) Cell structure

c) Biological molecules

d) Movement of substances into and out of cells

e) Nutrition

f) Respiration

g) Gas exchange

h) Transport

i) Excretion

j) Coordination and response

a) Levels of organisation

*Students will be assessed on their ability to:*

2.1 describe the levels of organisation within organisms: organelles, cells, tissues, organs and

systems.

b) Cell structure

*Students will be assessed on their ability to:*

2.2 recognise cell structures, including the nucleus, cytoplasm, cell membrane, cell wall,

chloroplast and vacuole

2.3 describe the functions of the nucleus, cytoplasm, cell membrane, cell wall, chloroplast and

vacuole

2.4 describe the differences between plant and animal cells.

c) Biological molecules

*Students will be assessed on their ability to:*

2.5 recall the chemical elements present in carbohydrates, proteins and lipids (fats and oils)

2.6 describe the structure of carbohydrates, proteins and lipids as large molecules made up

from smaller basic units: starch and glycogen from simple sugar; protein from amino

acids; lipid from fatty acids and glycerol

2.7 describe the tests for glucose and starch

2.8 understand the role of enzymes as biological catalysts in metabolic reactions

2.9 understand how the functioning of enzymes can be affected by changes in temperature

**2.10 understand how the functioning of enzymes can be affected by changes in pH**

2.11 describe how to carry out simple controlled experiments to illustrate how enzyme activity

can be affected by changes in temperature.

d) Movement of substances into and out of cells

*Students will be assessed on their ability to:*

2.12 recall simple definitions of diffusion, osmosis and active transport

2.13 understand that movement of substances into and out of cells can be by diffusion, osmosis

and active transport

**2.14 understand the importance in plants of turgid cells as a means of support**

2.15 understand the factors that affect the rate of movement of substances into and out of cells

to include the effects of surface area to volume ratio, temperature and concentration

gradient

2.16 describe simple experiments on diffusion and osmosis using living and non-living

systems.

e) Nutrition

*Students will be assessed on their ability to:*

Flowering plants

2.17 describe the process of photosynthesis and understand its importance in conversion of

light energy to chemical energy

2.18 recall the word equation and the balanced chemical symbol equation for photosynthesis

2.19 understand how carbon dioxide concentration, light intensity and temperature affect the

rate of photosynthesis

2.20 explain how the structure of the leaf is adapted for photosynthesis

2.21 recall that plants require mineral ions for growth and that magnesium ions are needed for

chlorophyll and nitrate ions are needed for amino acids

2.22 describe simple controlled experiments to investigate photosynthesis, showing the

evolution of oxygen from a water plant, the production of starch and the requirements of

light, carbon dioxide and chlorophyll

Humans

**2.23 understand that a balanced diet should include appropriate proportions of**

**carbohydrate, protein, lipid, vitamins, minerals, water and dietary fibre**

2.24 recall sources and describe functions of carbohydrate, protein, lipid (fats and oils),

vitamins A, C and D, and the mineral ions calcium and iron, water and dietary fibre as

components of the diet

**2.25 understand that energy requirements vary with activity levels, age and pregnancy**

2.26 recognise the structures of the human alimentary canal and describe in outline the

functions of the mouth, oesophagus, stomach, small intestine, large intestine, and pancreas

2.27 understand the processes of ingestion, digestion, absorption, assimilation and egestion

2.28 explain how and why food is moved through the gut by peristalsis

2.29 understand the role of digestive enzymes to include the digestion of starch to glucose by

amylase and maltase, the digestion of proteins to amino acids by proteases and the

digestion of lipids to fatty acids and glycerol by lipases

2.30 recall that bile is produced by the liver and stored in the gall bladder, and understand the

role of bile in neutralising stomach acid and emulsifying lipids

2.31 explain how the structure of a villus helps absorption of the products of digestion in the

small intestine

**2.32 recall how to carry out a simple experiment to determine the energy content in a**

**food sample**.

f) Respiration

*Students will be assessed on their ability to:*

2.33 recall that the process of respiration releases energy in living organisms

2.34 describe the differences between aerobic and anaerobic respiration

2.35 recall the word equation and the balanced chemical symbol equation for aerobic

respiration in living organisms

2.36 recall the word equation for anaerobic respiration in plants and in animals

**2.37 describe simple controlled experiments to demonstrate the evolution of carbon**

**dioxide and heat from respiring seeds or other suitable living organisms**.

g) Gas exchange

*Students will be assessed on their ability to:*

2.38 understand the role of diffusion in gas exchange

Flowering plants

2.39 understand gas exchange (of carbon dioxide and oxygen) in relation to respiration and

photosynthesis

**2.40 understand that respiration continues during the day and night, but that the net**

**exchange of carbon dioxide and oxygen depends on the intensity of light**

2.41 explain how the structure of the leaf is adapted for gas exchange

2.42 describe the role of stomata in gas exchange

**2.43 describe simple controlled experiments to investigate the effect of light on net gas**

**exchange from a leaf, using hydrogen-carbonate indicator**

Humans

2.44 describe the structure of the thorax, including the ribs, intercostal muscles, diaphragm,

trachea, bronchi, bronchioles, alveoli and pleural membranes

2.45 understand the role of the intercostal muscles and the diaphragm, in ventilation

2.46 explain how alveoli are adapted for gas exchange by diffusion between air in the lungs

and blood in capillaries

2.47 understand the biological consequences of smoking in relation to the lungs and the

circulatory system

2.48 describe a simple experiment to investigate the effect of exercise on breathing in humans.

h) Transport

*Students will be assessed on their ability to:*

2.49 understand why simple, unicellular organisms can rely on diffusion for movement of

substances in and out of the cell

2.50 understand the need for a transport system in multicellular organisms

Flowering plants

**2.51 describe the role of phloem in transporting sucrose and amino acids between the**

**leaves and other parts of the plant**

2.52 describe the role of the xylem in transporting water and mineral salts from the roots to

other parts of the plant

2.53 explain how water is absorbed by root hair cells

2.54 recall that transpiration is the evaporation of water from the surface of a plant

2.55 explain how the rate of transpiration is affected by changes in humidity, wind speed,

temperature and light intensity

2.56 describe experiments that investigate the role of environmental factors in determining the

rate of transpiration from a leafy shoot

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Humans

2.57 recall the composition of the blood: red blood cells, white blood cells, platelets and plasma

2.58 understand the role of plasma in the transport of carbon dioxide, digested food, urea,

hormones and heat energy

2.59 describe the adaptations of red blood cells for the transport of oxygen, including shape,

structure and the presence of haemoglobin

2.60 describe how the immune system responds to disease using white blood cells, illustrated

by phagocytes ingesting pathogens and lymphocytes releasing antibodies specific to the

pathogen

**2.61 understand that vaccination results in the manufacture of memory cells, which**

**enables future antibody production to the pathogen to occur sooner, faster and in**

**greater quantity**

**2.62 recall that platelets are involved in blood clotting, which prevents blood loss and the**

**entry of microorganisms**

2.63 describe the structure of the heart and how it functions

2.64 understand that the heart rate changes during exercise and under the influence of

adrenaline

2.65 describe the structure of arteries, veins and capillaries and understand their roles

2.66 recall the general plan of the circulation system to include the blood vessels to and from

the heart, the lungs, the liver and the kidneys.

i) Excretion

*Students will be assessed on their ability to:*

Flowering plants

2.67 recall the origin of carbon dioxide and oxygen as waste products of metabolism and their

loss from the stomata of a leaf

Humans

2.67 recall that the lungs, kidneys and skin are organs of excretion

2.68 understand how the kidney carries out its roles of excretion and of osmoregulation

2.69 describe the structure of the urinary system, including the kidneys, ureters, bladder and

urethra

2.70 describe the structure of a nephron, to include Bowman’s capsule and glomerulus,

convoluted tubules, loop of Henlé and collecting duct

2.71 describe ultrafiltration in the Bowman’s capsule and the composition of the glomerular

filtrate

2.72 understand that water is reabsorbed into the blood from the collecting duct

2.73 understand that selective reabsorption of glucose occurs at the proximal convoluted tubule

2.74 describe the role of ADH in regulating the water content of the blood

2.75 recall that urine contains water, urea and salts.

j) Coordination and response

*Students will be assessed on their ability to:*

2.76 understand that organisms are able to respond to changes in their environment

2.77 understand that homeostasis is the maintenance of a constant internal environment and

that body water content and body temperature are both examples of homeostasis

2.78 understand that a coordinated response requires a stimulus, a receptor and an effector

Flowering plants

2.79 understand that plants respond to stimuli

2.80 describe the geotropic responses of roots and stems

2.81 describe positive phototropism of stems

Humans

2.82 describe how responses can be controlled by nervous or by hormonal communication and

understand the differences between the two systems

2.83 recall that the central nervous system consists of the brain and spinal cord and is linked to

sense organs by nerves

2.84 understand that stimulation of receptors in the sense organs sends electrical impulses

along nerves into and out of the central nervous system, resulting in rapid responses

2.85 describe the structure and functioning of a simple reflex arc illustrated by the withdrawal

of a finger from a hot object

2.86 describe the structure and function of the eye as a receptor

**2.87 understand the function of the eye in focusing near and distant objects, and in**

**responding to changes in light intensity**

**2.88 describe the role of the skin in temperature regulation, with reference to sweating,**

**vasoconstriction and vasodilation**

2.89 understand the sources, roles and effects of the following hormones: ADH, adrenaline,

insulin, testosterone, progesterone and oestrogen.

**Section 3: Reproduction and inheritance**

a) Reproduction

b) Inheritance

a) Reproduction

*Students will be assessed on their ability to:*

3.1 describe the differences between sexual and asexual reproduction

3.2 understand that fertilisation involves the fusion of a male and female gamete to produce a

zygote that undergoes cell division and develops into an embryo

Flowering plants

3.3 describe the structures of an insect-pollinated and a wind-pollinated flower and explain

how each is adapted for pollination

3.4 understand that the growth of the pollen tube followed by fertilisation leads to seed and

fruit formation

**3.6 recall the conditions needed for seed germination**

**3.7 understand how germinating seeds utilise food reserves until the seedling can carry**

**out photosynthesis**

3.8 understand that plants can reproduce asexually by natural methods (illustrated by runners)

and by artificial methods (illustrated by cuttings)

Humans

3.9 recall the structure and function of the male and female reproductive systems

3.10 understand the roles of oestrogen and progesterone in the menstrual cycle

**3.11 describe the role of the placenta in the nutrition of the developing embryo**

**3.12 understand how the developing embryo is protected by amniotic fluid**

3.13 recall the roles of oestrogen and testosterone in the development of secondary sexual

characteristics.

b) Inheritance

3.14 recall that the nucleus of a cell contains chromosomes on which genes are located

3.15 understand that a gene is a section of a molecule of DNA

3.16 describe a DNA molecule as two strands coiled to form a double helix, the strands being

linked by a series of paired bases: adenine (A) with thymine (T), and cytosine (C) with

guanine (G)

3.17 understand that genes exist in alternative forms called alleles which give rise to

differences in inherited characteristics

3.18 recall the meaning of the terms: dominant, recessive, homozygous, heterozygous,

phenotype, genotype and **codominance**

3.19 describe patterns of monohybrid inheritance using a genetic diagram

3.20 understand how to interpret family pedigrees

3.21 predict probabilities of outcomes from monohybrid crosses

3.22 recall that the sex of a person is controlled by one pair of chromosomes, XX in a female

and XY in a male

3.23 describe the determination of the sex of offspring at fertilisation, using a genetic diagram

3.24 understand that division of a diploid cell by mitosis produces two cells which contain

identical sets of chromosomes

3.25 understand that mitosis occurs during growth, repair, cloning and asexual reproduction

3.26 understand that division of a cell by meiosis produces four cells, each with half the

number of chromosomes, and that this results in the formation of genetically different

haploid gametes

3.27 understand that random fertilisation produces genetic variation of offspring

3.28 recall that in human cells the diploid number of chromosomes is 46 and the haploid

number is 23

3.29 understand that variation within a species can be genetic, environmental, or a combination

of both

3.30 recall that mutation is a rare, random change in genetic material that can be inherited

3.31 describe the process of evolution by means of natural selection

3.32 understand that many mutations are harmful but some are neutral and a few are beneficial

3.33 understand how resistance to antibiotics can increase in bacterial populations

**3.34 understand that the incidence of mutations can be increased by exposure to ionising**

**radiation (for example gamma rays, X-rays and ultraviolet rays) and some chemical**

**mutagens (for example chemicals in tobacco)**.

**Section 4: Ecology and the environment**

a) The organism in the environment

b) Feeding relationships

c) Cycles within ecosystems

d) Human influences on the environment

a) The organism in the environment

*Students will be assessed on their ability to:*

4.1 understand the terms: population, community, habitat and ecosystem

4.2 recall the use of quadrats to estimate the population size of an organism in two different

areas

4.3 describe the use of quadrats as a technique for sampling the distribution of organisms in

their habitats.

b) Feeding relationships

*Students will be assessed on their ability to:*

4.4 recall the names given to different trophic levels to include producers, primary, secondary

and tertiary consumers and decomposers

4.5 understand the concepts of food chains, food webs, pyramids of number, pyramids of

biomass and pyramids of energy transfer

4.6 understand the transfer of substances and of energy along a food chain

4.7 explain why only about 10% of energy is transferred from one trophic level to the next.

c) Cycles within ecosystems

*Students will be assessed on their ability to:*

**4.8 describe the stages in the water cycle, including evaporation, transpiration,**

**condensation and precipitation**

4.9 describe the stages in the carbon cycle, including respiration, photosynthesis,

decomposition and combustion

**4.10 describe the stages in the nitrogen cycle, including the roles of nitrogen fixing**

**bacteria, decomposers, nitrifying bacteria and denitrifying bacteria (specific names**

**of bacteria are not required)**.

d) Human influences on the environment

*Students will be assessed on their ability to:*

4.11 understand the biological consequences of pollution of air by sulphur dioxide and by

carbon monoxide

4.12 recall that water vapour, carbon dioxide, nitrous oxide, methane and CFCs are greenhouse

gases

4.13 understand how human activities contribute to greenhouse gases

4.14 understand how an increase in greenhouse gases results in an enhanced greenhouse effect

and that this may lead to global warming and its consequences

**4.15 understand the biological consequences of pollution of water by sewage including**

**increases in the number of microorganisms causing depletion of oxygen**

4.16 understand that eutrophication can result from leached minerals from fertiliser

4.17 understand the effects of deforestation, including leaching, soil erosion, disturbance of the

water cycle and of the balance in atmospheric oxygen and carbon dioxide.

**Section 5: Use of biological resources**

a) Food production

b) Selective breeding

c) Genetic modification

d) Cloning

a) Food production

*Students will be assessed on their ability to:*

Crop plants

5.1 describe how glasshouses and polythene tunnels can be used to increase the yield of

certain crops

5.2 understand the effects on crop yield of increased carbon dioxide and increased

temperature in glasshouses

5.3 understand the use of fertiliser to increase crop yield

5.4 understand the reasons for pest control and the advantages and disadvantages of using

pesticides and biological control with crop plants

Microorganisms

5.5 understand the role of yeast in the production of beer

5.6 describe a simple experiment to investigate carbon dioxide production by yeast, in

different conditions

**5.7 understand the role of bacteria (*Lactobacillus*) in the production of yoghurt**

5.8 interpret and label a diagram of an industrial fermenter and explain the need to provide

suitable conditions in the fermenter, including aseptic precautions, nutrients, optimum

temperature and pH, oxygenation and agitation, for the growth of microorganisms

Fish farming

5.9 explain the methods which are used to farm large numbers of fish to provide a source of

protein, including maintenance of water quality, control of intraspecific and interspecific

predation, control of disease, removal of waste products, quality and frequency of feeding

and the use of selective breeding.

b) Selective breeding

*Students will be assessed on their ability to:*

5.10 understand that plants with desired characteristics can be developed by selective breeding

5.11 understand that animals with desired characteristics can be developed by selective

breeding.

c) Genetic modification (genetic engineering)

*Students will be assessed on their ability to:*

5.12 describe the use of restriction enzymes to cut DNA at specific sites and ligase enzymes to

join pieces of DNA together

5.13 describe how plasmids and viruses can act as vectors, which take up pieces of DNA, then

insert this recombinant DNA into other cells

5.14 understand that large amounts of human insulin can be manufactured from genetically

modified bacteria that are grown in a fermenter

5.15 evaluate the potential for using genetically modified plants to improve food production

(illustrated by plants with improved resistance to pests)

**5.16 recall that the term ‘transgenic’ means the transfer of genetic material from one**

**species to a different species**.

d) Cloning

*Students will be assessed on their ability to:*

5.17 describe the process of micropropagation (tissue culture) in which small pieces of plants

(explants) are grown *in vitro* using nutrient media

5.18 understand how micropropagation can be used to produce commercial quantities of

identical plants (clones) with desirable characteristics

5.19 describe the stages in the production of cloned mammals involving the introduction of a

diploid nucleus from a mature cell into an enucleated egg cell, illustrated by Dolly the

sheep

**5.20 evaluate the potential for using cloned transgenic animals, for example to produce**

**commercial quantities of human antibodies or organs for transplantation**.

**Assessment**

**Assessment summary**

**Biology Paper 1**

This paper will assess biology across all the assessment objectives. All the content in this

specification which is not in bold will be assessed in Paper 1. The maximum mark for this paper

is 120.

**Biology Paper 2**

This paper will assess biology across all the assessment objectives. All the content in this

specification, whether bold or not, will be assessed in Paper 2. The maximum mark is 60.

There will be a range of compulsory, short-answer structured questions in both papers which are

ramped to ensure accessibility for less-able students, as well as to stretch more-able students.

Students may be required to perform calculations, draw graphs and describe, explain and

interpret biological phenomena. Some of the question content will be unfamiliar to students;

these questions are designed to assess data-handling skills and the ability to apply biological

principles to unfamiliar information. Questions targeted at grades A\* – B will include questions

designed to test knowledge, understanding and skills at a higher level, including some questions

requiring longer prose answers.