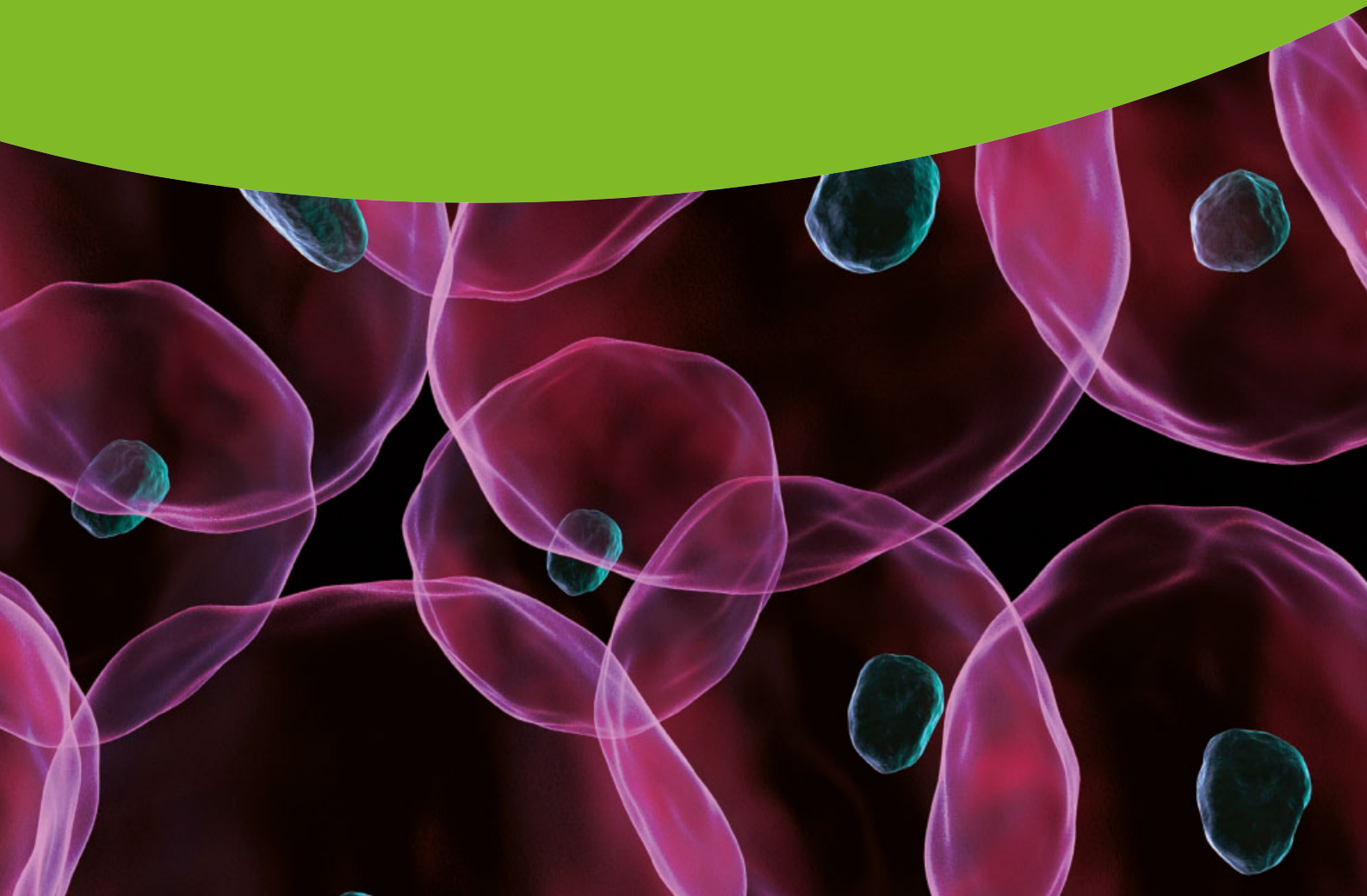
GCE

AS and A Level Specification

Human Biology

For exams from June 2014 onwards
For certification from June 2014 onwards



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Vertical black lines indicate a significant change or addition to the previous version of this specification.

1 Introduction

1.1 Why choose AQA?

It's a fact that AQA is the UK's favourite exam board and more students receive their academic qualifications from AQA than from any other board. But why does AQA continue to be so popular?

- **Specifications**

  Ours are designed to the highest standards, so teachers, students and their parents can be confident that an AQA award provides an accurate measure of a student's achievements. And the assessment structures have been designed to achieve a balance between rigour, reliability and demands on candidates.

- **Support**

  AQA runs the most extensive programme of support meetings; free of charge in the first years of a new specification and at a very reasonable cost thereafter. These support meetings explain the specification and suggest practical teaching strategies and approaches that really work.

- **Service**

  We are committed to providing an efficient and effective service and we are at the end of the phone when you need to speak to a person about an important issue. We will always try to resolve issues the first time you contact us but, should that not be possible, we will always come back to you (by telephone, email or letter) and keep working with you to find the solution.

- **Ethics**

  AQA is a registered charity. We have no shareholders to pay. We exist solely for the good of education in the UK. Any surplus income is ploughed back into educational research and our service to you, our customers. We don't profit from education, you do.

If you are an existing customer then we thank you for your support. If you are thinking of moving to AQA then we look forward to welcoming you.

1.2 Why choose Human Biology?

- Specification conforms fully to the GCE AS and A level subject criteria for Biology
- Content up-dated and themed, but retains "best" features of current Biology A and B specifications. Much of teachers' present teaching material will still be relevant.
- Thematic approach - principles related to contemporary issues, emphasising factors that may affect people's health and how they interact with and affect their own environment. Emphasis on UK and urban perspectives and "real-life" contexts. Examination questions reflect up-to-date concerns and issues in our society. Should provide greater stimulus and interest for students.
- Detailed amplification of the expected knowledge, understanding and skills required. Biological principles and areas in which candidates will be expected to have undertaken practical investigations listed at the end of each unit.
- There are two routes for internal assessment: centre marked or AQA marked. This provides flexibility to meet the needs of individual centres and candidates.
- Route T, centre marked, is developed from AQA's GCSE PSA/ISA assessment. The AQA set tasks are designed to be flexible and won't impose excessive demands on either time or budget.
- Route X, AQA marked, involves verification of candidates' practical skills by the teacher in the PSV and an Externally Marked Practical Assignment set and marked by AQA.
- Excellent, dedicated Teacher Support via Assessment Advisers and a wide range of resources. We are working with Nelson Thornes to provide a blend of print and electronic resources for teaching and learning.
- Specification builds on concepts and skills previously developed in the new GCSE Science specifications. The specification encourages candidates to acquire essential knowledge and develop understanding of concepts in both Human Biology and *How Science Works*.
- Scheme of assessment allows for stretch and challenge for 'most able', and time for other students to demonstrate their knowledge and understanding.

1.3 How do I start using this specification?

Already using the existing AQA Biology/ Biology (Human) Specification A or Biology Specification B?

- Register to receive further information, such as mark schemes, past question papers, details of teacher support meetings, etc, at **http://www.aqa.org.uk/rn/askaqa.php** Information will be available electronically or in print, for your convenience.
- Tell us that you intend to enter candidates. Then we can make sure that you receive all the material you need for the examinations. This is particularly important where examination material is issued before the final entry deadline. You can let us know by completing the appropriate Intention to Enter and Estimated Entry forms. We will send copies to your Exams Officer and they are also available on our website **http://www.aqa.org.uk/exams-administration/entries/early-entry-information**

Not using the AQA specification currently?

- Almost all centres in England and Wales use AQA or have used AQA in the past and are approved AQA centres. A small minority are not. If your centre is new to AQA, please contact our centre approval team at **centreapproval@aqa.org.uk**

1.4 How can I find out more?

Ask AQA

You have 24-hour access to useful information and answers to the most commonly-asked questions at **http://www.aqa.org.uk/rn/askaqa.php**

If the answer to your question is not available, you can submit a query for our team. Our target response time is one day.

Teacher Support

Details of the full range of current Teacher Support and CPD courses are available on our website at **http://web.aqa.org.uk/qual/cpd/index.php**

There is also a link to our fast and convenient online booking system for all of our courses at **http://events.aqa.org.uk/ebooking/**

Latest information online

You can find out more, including the latest news, how to register to use Enhanced Results Analysis, support and downloadable resources, on our website at **www.aqa.org.uk**

2 Specification at a Glance

AS Examinations

AS Award 1406

Unit 1 – HBIO1 **The body and its diseases**

Examination paper (80 raw marks/120 UMS). 7 – 10 short-answer questions plus 1 longer question, involving a short comprehension/case study

1 hour 30 minutes

40% of the total AS marks

20% of the total A Level marks

Available in June only

Unit 2 – HBIO2 **Humans – their origins and adaptations**

Examination paper (80 raw marks/120 UMS). 7 – 10 short answer questions plus 1 longer question, involving a short comprehension/case study

1 hour 30 minutes

40% of the total AS marks

20% of the total A Level marks

Available in June only

Unit 3 – Internal Assessment **Investigative and practical skills in AS Human Biology**

EITHER **NHBI3T,** Centre Marked Route T (50 raw marks/60 UMS)
Practical Skills Assessment (PSA – 6 raw marks)
Investigative Skills Assignment (ISA – 44 raw marks)

OR **NHBI3X,** Externally Marked Route X (50 raw marks/60 UMS)
Practical Skills Verification (PSV – teacher verification)
Externally Marked Practical Assignment (EMPA – 50 raw marks)

20% of total AS marks

10% of total A Level marks

Available in June only

A2 Examinations

A Level Award 2406

Unit 4 – HBIO4 **Bodies and cells in and out of control**

Examination paper (90 raw marks/120 UMS). 9 – 11 short-answer questions plus 1 longer question, involving methodology and data interpretation. Some of the questions will have synoptic elements.

2 hours

20% of the total A Level marks

Available in June only

Unit 5 – HBIO5 **The air we breathe, the water we drink, the food we eat**

Examination paper (90 raw marks/120 UMS). 7-9 short-answer questions plus 1 longer question that will offer a choice of two essay topics. Some of the questions will have synoptic elements.

2 hours

20% of the total A Level marks

Available in June only

Unit 6 – Internal Assessment **Investigative and practical skills in A2 Human Biology**

EITHER **NHBI6T,** Centre Marked Route T (50 raw marks/60 UMS)
Practical Skills Assessment (PSA – 6 raw marks)
Investigative Skills Assignment (ISA – 44 raw marks)

OR **NHBI6X,** Externally Marked Route X (50 raw marks/60 UMS)
Practical Skills Verification (PSV – teacher verification)
Externally Marked Practical Assignment (EMPA – 50 raw marks)

10% of total A Level marks

Available in June only

AS + A2 = A Level

3 Subject Content

3.1 Unit 1 HBIO1 The body and its diseases

The human body is composed of many different cell types. To maintain a healthy body, humans need to eat a balanced diet containing a variety of different molecules. Human food is composed of cells of other living organisms. Humans also need to exchange gases with their surroundings. Nutrients and dissolved gases are transported around the body in the blood.

Disease may result from infection by microorganisms, or from changes in the structure of organs or cells. Some diseases are linked with lifestyle.

It is anticipated that this unit will allow opportunity for the development of the skills of application and analysis as well as for the acquisition of the investigatory skills associated with *Investigative and practical skills* detailed in Unit 3.

3.1.1 We are what we eat - the biochemical basis of life is similar for all living organisms.	
A balanced diet	The basis of a balanced diet. **Candidates should understand** the roles of fibre, water, carbohydrates, fats, proteins, vitamins and mineral salts in a balanced diet. **Candidates should be able to** explain why current dietary advice is that a healthy diet should be • high in fruit and vegetables • low in salt and fat. Glycaemic Index (GI) and Glycaemic Load (GL). Type 2 diabetes and obesity are conditions that have been linked to the increased consumption of processed foods. The role of gut bacteria. The production of vitamin K by gut bacteria. Isotonic sports drinks. When provided with appropriate information, **candidates should be able to** evaluate • the evidence for, and make balanced judgements about, links between diet and diseases or conditions • the nutritional value of processed food. When provided with appropriate information, **candidates should be able to** evaluate the nutritional value of processed food.
What is food and what happens to it?	Food consists largely of parts of other organisms. These organisms are made from the same types of molecules as are humans. Many large biological molecules are polymers, made by joining smaller molecules together in condensation reactions. Large food molecules have to be hydrolysed to smaller molecules or monomers to be absorbed in the gut. Knowledge of large biological molecules limited to carbohydrates, lipids and proteins. (The molecular structures of these molecules are **not** required). Monosaccharides may link together to form disaccharides or polysaccharides. Glucose molecules may link together to form maltose, starch, glycogen and cellulose. Proteins are made of amino acids. The overall shape of a protein molecule (its tertiary structure) is held together by hydrogen and ionic bonds, as well as disulphide bridges. Fats are made of glycerol and fatty acids. Digestive enzymes allow hydrolysis reactions to take place rapidly under the physiological conditions found in the gut. Chromatography and calculation of Rf values is a technique by which the components of a mixture can be identified.

3.1.2 Enzymes – fast, specific catalysts	
Enzymes	The protein nature of enzymes. Enzymes are catalysts that lower activation energy through the formation of enzyme-substrate complexes. The lock-and-key and induced fit models of enzyme action. Description and explanation of the effects on rate of reaction of • temperature • pH • substrate concentration. When provided with appropriate information, **candidates should be able to** use their knowledge of enzyme action to explain differences in the ability to digest different foods. The reasons why humans can digest starch but not cellulose. The causes and symptoms of lactose intolerance.
Enzymes – heroes and villains	Because of their high sensitivity and specificity, enzymes may be used as analytical reagents. The use of glucose oxidase and peroxidase in testing for glucose. Many enzymes are important in medicine. Trypsin in the development of lung disease and treatment with alpha-1-antitrypsin. Enzyme replacement therapy, pancreatic enzyme replacement therapy (PERT) for people with cystic fibrosis. Disease can result in changes in the concentration and distribution of enzymes in the body. Pancreatitis may result in an increased concentration of digestive enzymes in the blood or a decrease in the concentration of these enzymes in the gut.
3.1.3 Cystic fibrosis – just one small change in a protein	
Cystic fibrosis	The structure of the lungs in sufficient detail to understand that gas exchange is impaired in people with cystic fibrosis. Efficient gas exchange requires a large surface area, a short diffusion pathway and a large concentration gradient, maintained by ventilation. **Candidates should be able to** use their knowledge to explain how thick mucus in cystic fibrosis blocks the airways, reducing the efficiency of gas exchange. The fluid-mosaic model of membrane structure. Active transport. Diffusion. The process of osmosis explained in terms of water potential. CFTR is a plasma-membrane protein that actively transports chloride ions out of a cell. In cystic fibrosis, the tertiary structure of this protein is altered, so chloride ions are not transported out of the cell. Faulty chloride ion transport affects the water potential of mucus in the respiratory tract, resulting in thicker mucus. **Candidates should be able to** explain why people with CF are prone to lung infections. The role of ribosomes, endoplasmic reticulum, the Golgi body, and vesicles in producing CFTR protein and mucus. (Details of protein synthesis are **not** required) **Candidates should be aware** that human cells are eukaryotic. The role of mitochondria in supplying ATP for active transport. (No details of the respiratory pathway are required). The effects of thick mucus in the gut of a person with CF, and the need to take enzyme capsules before meals.

3.1.4 Microorganisms use us for food, shelter and their reproduction	
Bacterial diseases	Bacteria may cause infectious diseases. The structure of a prokaryotic cell, and the functions of its organelles, restricted to cell wall, plasma membrane, genetic material, plasmid, capsule, ribosome and flagellum. Microorganisms can cause disease by damaging the cells of the host and by producing toxins. The cause, symptoms and control of • *Salmonella* food poisoning • Tuberculosis. Antibiotics can be used to treat bacterial disease by interfering with bacterial metabolism, limited to prevention of cell wall synthesis and protein production. When provided with appropriate information, **candidates should be able to** evaluate the evidence for the links between use of antibiotics and the development of MRSA and other antibiotic resistant bacteria. (Candidates are **not** required to understand how resistance to antibiotics arises.)
Viruses	Viruses cause disease. The structure of the human immunodeficiency virus (HIV) and its replication. **Candidates should be able to** explain • the development of the symptoms of AIDS • how HIV is spread, and how it may be controlled • why antibiotics are ineffective against viruses.
3.1.5 How the body fights infectious disease	
Our reaction to something foreign	Antigen and antibody. Phagocytosis and the subsequent destruction of ingested pathogens. The role of T-cells and B-cells in the response to antigens. The role of plasma cells and memory cells in producing the primary and secondary response. The functions of cell types other than those specified and the classes of immunoglobulins are **not** required.
Immunity and vaccines	Antibodies may be acquired naturally through the placenta and via lactation, as well as artificially. This is passive immunity. Vaccines containing attenuated or dead microorganisms, or isolated antigens, may be used as the basis for vaccines. Vaccination leads to active immunity. When provided with suitable data, **candidates should be able to** evaluate evidence relating to the risks and benefits of mass vaccination programmes.
Magic bullets	The use of monoclonal antibodies to target specific substances and cells. Targeting medication to specific cell types by attaching a therapeutic drug to an antibody. Monoclonal antibodies can be used in medical diagnosis. Testing for hCG in pregnancy test kits. Details of the production of monoclonal antibodies will **not** be required.

3.1.6 Some diseases are closely linked to life-style	
The heart	The gross structure of the heart in relation to its function. Pressure and volume changes and associated valve movements during the cardiac cycle. Myogenic stimulation of the heart and transmission of a subsequent wave of electrical activity. Roles of sinoatrial node (SAN), atrioventricular node (AVN), bundle of His and Purkyne fibres. The use of artificial pacemakers to regulate heart activity.
Cardiovascular disease	The structure of arteries and veins in sufficient detail to understand atheroma formation. Atheroma and increased risk of angina, aneurysm and thrombosis. Deep vein thrombosis (DVT) may occur as a result of prolonged inactivity, ageing and long-haul flights. Ways of reducing the incidence of DVT. Myocardial infarction and its effects on heart muscle. Treatment of coronary heart disease. Angioplasty, coronary by-pass surgery and betablockers.
Coronary heart disease - personal decisions and consequences	When provided with appropriate information, **candidates should be able to** evaluate evidence for, and make balanced judgements about, the links between lifestyle and cardiovascular disease
Oedema	Over large distances, efficient supply of materials is provided by mass transport in the blood. Individual cells in tissues and organs • obtain nutrients and oxygen from the blood • dispose of metabolic waste to the blood. The structure of capillaries and their importance in metabolic exchange. The formation of tissue fluid and its return to the circulatory system. (Details of the lymphatic system are **not** required.) Oedema results from a build-up of tissue fluid.

Biological principles

After studying the contents of this unit, **candidates should understand**

- that the biochemical basis of all life is the same
- the structure of cells and the functions of their parts
- that the body consists of cells, tissues, organs and systems
- that disease-causing organisms use us for their growth and reproduction
- that other diseases and conditions are a result of life-style decisions.

The examiners may draw on an understanding of these principles in Units 2 and 3. This understanding may also be required in the A2 units where it may contribute to the assessment of synoptic skills.

Investigative and practical skills

Candidates will be expected to have carried out practical investigations in the following areas

- Investigations involving effects of temperature and pH on enzymes.
- **Candidates should be able to** test for disappearance of substrate or formation of product. The use of Benedict's reagent or iodine in potassium iodide solution.
- Investigations involving sterile technique and bacterial growth on agar plates
- Investigations involving water potential and osmosis
- Chromatography. The calculation of Rf values.

3.2 Unit 2 HBIO2 Humans – their origins and adaptations

The variety of life, both past and present, is extensive. Genetic information is copied and transmitted from generation to generation. Errors in transmission of this information may lead to new forms of organisms.

All living organisms interact with each other and their environment. Species exist as one or more populations. There is variation in the phenotypes in a population due to genetic and environmental factors. Mutation is the ultimate source of genetic variation. Natural selection acts on phenotypes in a population, leading to differential survival. The best adapted individuals have a higher probability of surviving to reproduce and pass on their alleles to the next generation. This process leads to evolution, changes in the gene pool of a population. Over time, natural selection and evolution lead to a population becoming adapted to its environment.

According to the theory of evolution, a population can evolve to the point where it becomes reproductively isolated from other populations. This is how a new species comes into existence. This process is also thought to have led to the enormous diversity of living organisms.

It is anticipated that this unit will allow for further development of the skills of application and analysis as well as for the acquisition of additional investigatory skills associated with *Investigative and practical skills* detailed in Unit 3.

3.2.1 The information of life	
Nucleic acids – the keys to life	The structure of DNA in terms of • the components of its nucleotides • the sugar phosphate backbone • base pairing • hydrogen bonding. DNA as genetic material. The structure of RNA in terms of • single polynucleotide strand • ribose replacing deoxyribose • uracil replacing thymine. Details of mRNA and tRNA are **not** required. Differences between DNA and RNA. The structure of nucleic acids should be covered in sufficient detail to provide an understanding • of the roles of nucleic acids in determining the sequence of amino acids in proteins • that RNA is a copied section of DNA used in protein synthesis. Details of protein synthesis are **not** required. **Candidates should be able to** analyse and interpret experimental evidence that DNA is the genetic material. Candidates will **not** be expected to link scientists' names with particular investigations or to be familiar with the details of techniques. Genes are sections of DNA which contain coded information that determines the nature and development of organisms. A gene can exist in different forms called alleles which are positioned in the same relative position (locus) on homologous chromosomes. Enzymes are proteins whose synthesis is controlled by DNA. They control metabolic pathways and thus influence the phenotype of an organism. **Candidates should be able to** explain • how the structures of DNA and RNA are related to their functions • the relationship between genes, proteins and enzymes
Semi-conservative replication of DNA	The semi-conservative mechanism of DNA replication. The role of DNA polymerase in DNA replication. The relationship between DNA replication and the events of the cell cycle. **Candidates should be able to** analyse and interpret experimental evidence for semi-conservative replication of DNA.

3.2.2 Cell division - growth, repair, reproduction and cancer	
Growth and repair	Mitosis increases cell number in growth and tissue repair. During the cell cycle DNA is replicated. In mitosis the cell divides to produce two new cells, each containing an exact copy of the DNA of the parent cell. Because we grow from a single fertilised cell (zygote) by mitosis all the cells in the body contain the same alleles. **Candidates should be able to** • explain the behaviour of chromosomes and chromatids during the stages of mitosis • recognise and name each stage of mitosis from diagrams and photographs. Mitosis is involved in asexual reproduction in some organisms.
Cancer - mitosis out of control	The main characteristics of tumours and tumour cells. The distinction between benign and malignant tumours. Consideration should be given to the following aspects • cell division is controlled by genes • chemical carcinogens and radiation may damage DNA and cause mutations in the genes controlling growth • tumour cells fail to respond to normal growth regulating processes • they undergo metastasis and invade other organs • the role of tumour suppressor genes in preventing tumour growth. When supplied with appropriate data **candidates should be able to** evaluate evidence for genetic and environmental factors increasing the incidence of cancer, including skin, lung and colon cancer. **Candidates should be able to** interpret data showing the occurrence of cancers and links with possible causal factors, both genetic and environmental. **Candidates should be able to** discuss the moral and ethical issues associated with the legality of cigarette smoking and treatment of diseases linked to smoking.
Sex and cell division – Meiosis	During meiosis in humans, cells containing pairs of homologous chromosomes divide to produce gametes containing one chromosome from each homologous pair. In meiosis the number of chromosomes is reduced from the diploid number (2n) to the haploid number (n). When gametes fuse at fertilisation to form a zygote the diploid number is restored. This enables a constant chromosome number to be maintained from generation to generation. (Details of the stages of meiosis are **not** required.) Sometimes there are errors in the process of meiosis leading to inherited conditions. Non-disjunction leads to Down's syndrome.

3.2.3 Where we fit in the world and how we came to be here	
What's in a name?	Classification is a means of organising the variety of life based on relationships between organisms and is built around the concept of species. Taxonomic hierarchy - kingdom, phylum, class, order, family, genus, species, as illustrated by the classification of *Homo sapiens*. Definition of a species as a group of similar organisms able to reproduce to give fertile offspring. Originally classification systems were based on observable features but more recent approaches draw on a wider range of evidence to clarify phylogenetic relationships between organisms. Biochemical, anatomical, embryological, immunological and behavioural evidence is used in classification
Theories of Lamarck and Darwin	Evaluation of the theories of Lamarck and Darwin. Selection and evolution. Species exist as one or more populations. Natural selection • individuals within a population may show a wide range of variation • predation, disease and competition result in differential survival and reproduction • those organisms with a selective advantage are more likely to survive, reproduce and pass on their alleles to the next generation. **Candidates should be able to** interpret data and use unfamiliar information to explain how natural selection may produce change within a population. Speciation **Candidates should be able to** explain how natural selection and isolation may result in changes in the allele and phenotype frequency and lead to reproductive isolation and the formation of a new species. **Candidates should be able to** explain how evolutionary change over a long period of time has resulted in a great diversity of forms among living organisms. The fossil record provides evidence for the process of evolution. Fossil evidence can be dated by stratigraphy, potassium-argon and carbon dating. **Candidates should be able to** analyse, interpret and evaluate evidence for the theory of evolution.
Once there were other humans	Study of hominids - *Australopithecus, Homo erectus, Homo habilis, Homo neanderthalensis* and *Homo sapiens.* • The hominid chronology • The major physical characteristics of early hominids limited to evidence for upright posture and cranial capacity • Evidence of diet • Different interpretations of limited evidence as exemplified by *Ramapithecus*. Cultural evolution accompanied physical change. • Development of early stone tools and the control of fire • Interpretation of archaeological evidence and possible uses of artefacts. The principal characteristics of the hunter-gatherer way of life limited to the size and structure of groups, range about a home base, division of labour and group cooperation.

3.2.4 Adaptations to a way of life	
Humans have evolved adaptations that increase survival	Humans have adaptations to their environment and way of life. These adaptations increase the probability of • survival in their environment • successful reproduction • successful reproduction by their offspring. When supplied with suitable information **candidates should be able to** evaluate adaptations of humans to their environment and the contributions of these adaptations to increased survival.
Adaptations of form	The advantages of anatomical adaptations of humans • bipedalism • opposable thumb • skin colour • surface area to volume ratio in humans from different climates. When supplied with suitable information **candidates should be able to** evaluate how anatomical adaptations contribute to survival.
Adaptations to vigorous exercise	The advantages of physiological adaptations in humans. Increases in breathing and heart rates and changes in the energy sources used by muscles associated with the demands of vigorous exercise. Control of ventilation. The role of the • medulla in the brain and the stretch receptors in the lungs in the maintenance of breathing • medulla in the brain and the receptors in the lungs, aortic bodies and carotid bodies in the response of the breathing system to increased muscular activity. Control of heart rate. The role of the medulla, pressure receptors and chemoreceptors in the walls of the aorta and carotid sinuses in the response of the heart to increased muscular activity Cardiac output as the product of heart rate and stroke volume. Changes in cardiac output with exercise. Changes in energy sources used by muscles during exercise • glucose, glycogen and triglycerides as sources of energy for muscle contraction • ATP as the immediate energy source • comparison of aerobic and anaerobic respiration as sources of ATP for muscle contraction, in terms of amounts of energy released and products • muscle fatigue in terms of increase in blood lactate and decrease in blood pH • the fate of lactate. Biochemical details of pathways are **not** required. The role of haemoglobin in the carriage of oxygen (Oxyhaemoglobin dissociation curve **not** required) Peoples who live at high altitude have adaptations in terms of red blood cells and haemoglobin. When supplied with suitable information **candidates should be able to** evaluate how physiological adaptations contribute to survival.

Adaptations of behaviour	The advantages of behavioural and sociological adaptations of humans • communication using facial expressions • development of language during childhood • extended childhood. When supplied with suitable information **candidates should be able to** evaluate how behavioural adaptations contribute to survival.
Our parasites are adapted to us and our domestic animals	Parasites have evolved adaptations to their environment and way of life. The principal adaptations of parasites. Some parasites are associated with our domestic animals; the adaptations of *Toxocara* that allow it to survive as a parasite in humans. Parasites should be studied in sufficient detail to illustrate how they • are able to survive in the hostile environment within the host • have reduced locomotory and other structures • have modified reproduction and life cycle associated with infecting a new host. When supplied with suitable information **candidates should be able to** evaluate the adaptations of a parasite to its human host.
3.2.5 We have changed and are changing our environment	
The development of settled communities	Evidence for early farming The landscape and ecosystems in the UK are the result of human activities. Deforestation to produce arable and grazing land, creation of the New Forest, draining wetlands When provided with appropriate information, **candidates should be able to** evaluate the influence human activities have had on the landscape.
Making other species work for us	The cultivation of crops and the domestication of animals have led to surplus food and the establishment of larger settlements. Selective breeding illustrated with reference to cereals, dogs and cattle. When provided with appropriate information, **candidates should be able to** evaluate the impact of human activities on biodiversity and the environment

Biological principles

After completion of this unit, **candidates should understand** that

- there is an enormous variety of life
- characteristics are passed on from one generation to the next
- errors in this process can lead to disease
- organisms are changing with time
- we group organisms according to characteristics for our own purpose
- we have our place in the world, and have an enormous impact upon it.

Investigative and practical skills

Candidates will be expected to have carried out practical investigations in the following areas

- Microscopic observations of the stages of mitosis
- Changes in ventilation of the lungs during exercise
- Changes in heart rate during exercise.

3.3 Unit 3 Investigative and practical skills in AS Human Biology

This unit will address the following aspects of the AS subject criteria. The ability to

- demonstrate and describe ethical, safe and skilful practical techniques, selecting appropriate qualitative and quantitative methods
- make, record and communicate reliable and valid observations and measurements with appropriate precision and accuracy.
- analyse, interpret, explain and evaluate the methodology, results and impact of their own and others' experimental and investigatory activities in a variety of ways.

Candidates will be assessed on their understanding of practical work in this Unit and in Units 1 and 2. Guidance on Internal Assessment can be found in Section 3.8.

Opportunities to carry out practical work are provided in the context of material contained in Units 1 and 2.

3.3.1 Investigating biological problems involves changing a specific factor, the independent variable, and measuring the changes in the dependent variable that result.	
Candidates should be able to • use knowledge and understanding from the AS specification to pose scientific questions and define scientific problems • identify the independent variable and describe an appropriate method of varying it in such detail that a student starting an AS course could carry out the suggested procedure without further assistance • identify other variables that might be expected to exert a significant influence on the results, use knowledge from relevant parts of the AS specification to explain why, and describe how these would be kept constant • where necessary, describe how and explain why appropriate control experiments should be established • identify the dependent variable and describe how they would collect a full range of useful quantitative data, measured to an appropriate level of accuracy and precision • distinguish between accuracy and reliability and describe precautions needed to obtain valid, accurate and reliable data.	**Practical work carried out in the context of Units 1 and 2 should enable candidates to gain experience of** • the use of water baths to change or control temperature • the use of buffers to change or control pH • producing an appropriate dilution series when provided with stock solutions of reagents.

3.3.2	**Implementing involves the ability to work methodically and safely, demonstrating competence in the required manipulative skills and efficiency in managing time. Raw data should be methodically collected and recorded during the course of the investigation.**

Candidates should be able to	**Practical work carried out in the context of Units 1 and 2 should enable candidates to gain experience of**
• show full regard for safety and the ethical issues involved with the well-being of living organisms and the environment • carry out an investigation in a methodical and organised way demonstrating competence in the required manipulative skills and efficiency in managing time • take all measurements to an appropriate level of accuracy and precision • collect and present raw data in a suitable table conforming to the conventions specified in the Institute of Biology publication, "*Biological Nomenclature, Recommendations on Terms, Units and Symbols*, 3rd edition (2000)" concerning organisation and presentation of units.	• using an optical microscope, preparing temporary mounts, staining and estimating size • collection of reliable quantitative data where gas is evolved colour change takes place there are changes in mass or length.

3.3.3 Raw data may require processing. Processed data should be used to plot graphs which illustrate patterns and trends from which appropriate conclusions may be drawn. Scientific knowledge from the AS specification should be used to explain these conclusions.

Candidates should be able to	**Practical work carried out in the context of Units 1 and 2 should enable candidates to gain experience of**
• process data by carrying out appropriate calculations • select relevant data to present an effective summary of the results of an investigation and plot this as an appropriate graph conforming to the conventions specified in the Institute of Biology publication, *Biological Nomenclature, Recommendations on Terms, Units and Symbols, 3rd edition (2000)* concerning organisation and presentation of units • describe, concisely but fully, the trends and patterns in data collected, relating these to specific values, quantities and units • recognise correlations and causal relationships • draw valid conclusions, relating explanations to specific aspects of the data collected and by applying biological knowledge and understanding from the AS specification.	• using a standard scientific calculator to calculate mean and standard deviation, rate and percentage change • plotting data as line graphs, bar charts and histograms • plotting data as scatter diagrams and using these to identify correlation.

3.3.4 Limitations are inherent in the material and apparatus used, and procedures adopted. These limitations should be identified and methods of overcoming them suggested.

Candidates should be able to	
• identify the limitations of the material, apparatus and techniques used • discuss the effects of these limitations on the reliability and precision of the data and on the conclusions that may be drawn, resolving conflicting evidence • suggest realistic ways in which the effect of these limitations may be reduced.	

3.4 Unit 4 HBIO4 Bodies and cells in and out of control

Human bodies consist of complex organ systems carrying out different functions. The working of these different systems must be coordinated to ensure the efficient working of the body as a whole. This involves both nervous and hormonal coordination. Both systems involve receptors to detect stimuli, coordinators, and effectors that bring about a response.

At the cellular level, there is a hierarchy of control involving DNA, mRNA and catalysis by enzymes. At all levels, control involves feedback as a means of regulating cellular activity to meet the needs of the cell at a given time. The expression of genes is not as simple as once thought with epigenetic regulation of transcription assuming an increasingly important role. However, the patterns of inheritance of genes still follow Mendelian principles.

It is anticipated that, due to the thematic approach of the specification and the synoptic elements of Unit 5, this unit will be taught before Unit 5. This unit will allow opportunity for the development of the skills of application and analysis as well as for the acquisition of the investigatory skills associated with *Investigative and practical skills* detailed in Unit 6.

3.4.1 IVF – babies for those who cannot conceive naturally

Reproduction and contraception	**Candidates should be familiar with** the male and female reproductive systems in sufficient detail to understand • the structure of the seminiferous tubules and ovaries • the roles of mitosis and meiosis in spermatogenesis and oogenesis emphasising differences between spermatogenesis and oogenesis • copulation and fertilisation - capacitation, acrosome reaction, formation of second polar body, fusion of nuclei and formation of a fertilisation membrane • formation of the blastocyst and its implantation • development of the placenta - its structure and role in transfer of materials between embryo and mother. Birth and lactation. The hormonal control of reproduction in females, the roles of • FSH, LH, oestrogen and progesterone in the menstrual cycle • hCG and progesterone in maintaining a pregnancy • progesterone and oxytocin concentrations in initiating labour • positive feedback controlling the secretion of oxytocin • oxytocin and prolactin in milk production. The use of hormones in contraception. Condoms, IUD, cap and 'morning after' pill as examples of other birth-control mechanisms. **Candidates should be able to** discuss the ethical and moral issues relating to the use of different forms of contraception. When provided with appropriate information, **candidates should be able to** evaluate evidence about the benefits and risks associated with the use of differnet forms of contraception.
IVF	Causes of infertility • low sperm count • blocked oviducts. Use of IVF to treat women with blocked oviducts • using FSH to stimulate multiple ovulation • removal of the ococytes from the oviducts • fertilisation • culture to the 8 – 16 cell stage • re-implantation of some of the embryos. **Candidates should** consider the ethical and moral issues relating to the use of IVF • the fate of embryos that are not implanted • their possible use in scientific experiments • the extent to which IVF should be available.

3.4.2 Growing up, growing old and passing on your genes	
Patterns of human growth	Whole body, reproductive organs and brain from infancy to adulthood. Puberty and the development of the secondary sex characteristics in males and females.
The effects and diseases of ageing	Decline in physiological functions • basal metabolic rate (BMR) • cardiac output • nerve conduction velocity • female reproductive capacity as a result of changes in concentrations of pituitary and ovarian hormones. Diseases associated with old age - Alzheimer's disease and cancer. **Candidates should be able to** discuss the issues facing society in terms of the increasing number of elderly people in the population and treating conditions associated with old age.
Genetic Counselling and Mendelian inheritance	**Candidates should be aware** that many conditions needing treatment, or with the potential to need treatment, are inherited. The terms gene, allele, genotype, phenotype, dominant, recessive, homozygous and heterozygous. Cystic fibrosis as an example of monohybrid inheritance. Sickle cell anaemia as an example of codominant alleles. ABO blood groups as an example of inheritance involving multiple alleles. Rhesus blood groups. The potential dangers inherent in a rhesus negative mother giving birth to rhesus positive babies. **Candidates should be able to** give reasons why experimental results may only approximate to Mendelian ratios. They should be able to apply the chi-squared test to establish the significance of any differences from predicted ratios. Genetic counselling. The use of information from family history and genetic screening to advise parents, the screening of embryos. **Candidates should** consider the ethical and moral issues relating to genetic counselling.
Sex-linked conditions and their inheritance	The roles of the X and Y chromosomes in determining gender. Sex-linked inheritance. Duchenne Muscular Dystrophy. The reasons why these conditions are rare in women.

Variation in the next generation	Features showing discontinuous variation are categoric. ABO blood groups. Features showing continuous variation often involve polygenic inheritance. They often produce a normal distribution, which can be described in terms of mean and standard deviation. Concepts of mode and median . When provided with appropriate information, **candidates should be able to** evaluate evidence about possible genetic predisposition to develop a disease or disorder.
Where variation comes from	Gene mutation produces new alleles; point mutations only, deletion and substitution. In meiosis, crossing over, independent assortment and random fertilisation lead to new combinations of alleles. Interaction of genes and the environment produce the phenotype. Twin studies show the effects of genes and environment. Epigenetic imprinting may be affected by the environment. This may lead to variation in the phenotype. Prader-Willi syndrome. This involves heritable changes in gene function or cell phenotype without changes in the genotype. When supplied with appropriate data, **candidates should be able to** evaluate evidence for the relative influences of genetic and environmental factors on phenotype.
3.4.3 The management structure of cells	
DNA and protein synthesis	The genetic code as a triplet, universal, non-overlapping and degenerate code. Protein synthesis - the transcription of DNA, processing of mRNA, the roles of mRNA, tRNA and ribosomes in translation. The protein formed could be an enzyme, a receptor, or a structural protein. Regulation of transcription of specific genes. • The steroid hormone, testosterone, which forms a complex with its receptor that initiates transcription, as a example of a substance that binds to receptor molecules inside the cytoplasm. • Increased methylation of the DNA or decreased acetylation of associated histones represses transcription. Gene mutation can lead to formation of a non-functional protein. The CFTR protein in cystic fibrosis.
DNA and cancer	Benign and malignant tumours. The role of the following in the development of tumours • tumour suppressor genes and oncogenes • abnormal methylation of tumour suppressor genes and oncogenes • increased oestrogen concentrations in the development of some breast cancers. When provided with appropriate information, **candidates should be able to** evaluate evidence showing correlations between environmental factors and various forms of cancer. **Candidates should be able to** explain that a correlation does not prove a causal link. Further experimental investigation is needed to establish any causal link
Enzymes control the rate of reactions in cells	Enzymes coded for by DNA control cellular reactions. The end-products of a series of reactions can influence the reaction by inhibiting the enzyme, or repressing transcription of a gene.

3.4.4 New genes for old	
Recombinant DNA	The production of recombinant DNA. • The use of DNA probes. • Isolating the gene by – creating the gene in a 'gene machine' or – creating the gene from mRNA or – using restriction enzymes to cut the gene from DNA. • The production of sticky ends. The polymerase chain reaction produces larger quantities of DNA. The transfer of recombinant DNA. The use of • plasmids as vectors • ligases • genetic markers to detect genetically modified organisms. The role of gene libraries. **Candidates should** consider whether or not selective breeding is ethically different from the use of modern gene technologies.
Genetically modified organisms	Selective breeding programmes have been used to create new strains and species of crop plants. The use of gene technology in producing GM organisms. Herbicide-resistant crop plants and cattle with high milk yields. **Candidates should** consider the ethical and moral issues relating to the production of GM organisms • ownership of genes • ownership of the modified organisms • financial benefits. Sanctity of the species.
Genome projects, what they tell us and what they don't.	The human genome has been sequenced. **Candidates should be aware that** • the DNA nucleotide sequences have been determined • this does not translate into a list of genes coding for proteins • there is non-coding DNA • there are regulatory genes. Determining the genome of simpler organisms allows the proteome of the organism to be determined. This may allow vaccines to be produced against pathogens. The work of the Sanger Institute in producing a vaccine against *Plasmodium*.

3.4.5 Drugs can affect how we perceive the world around us	
Perception and drugs	The functioning of the nervous system to appreciate the processes between sensation, the detection of stimuli, and perception due to processing and interpretation by the brain. **Candidates should be able to** use their knowledge of the functioning of the nervous system to explain how drugs can influence the functioning of the brain and so affect mood and perception of reality • LSD and cocaine affecting the actions of monoamine neurotransmitters • marijuana binding to THC receptors • nicotine binding to nicotinic receptors in the brain and sympathetic ganglia.
Neurones and nerve impulses	The structure of myelinated sensory and motor neurones. The role of the neurone membrane in • maintaining a resting potential • the initiation of an action potential and its all-or-nothing nature • the passage of an action potential along non-myelinated and myelinated axons resulting in nerve impulses. The nature and importance of the refractory period in producing discrete nerve impulses. The relationship between intensity of stimulation, size of generator potential and frequency of action potentials.
Synapses – where neurones communicate	The structure of a synapse as revealed by an electron microscope. The sequence of events involved in the action of a cholinergic synapse and a neuromuscular junction. The effect of drugs on synaptic transmission. When provided with information, **candidates should be able to** predict and explain the effects of specific drugs on a synapse.
Detecting light - the eye	The structure of a human eye and its transmissive and refractive properties in focusing an image on the retina. The role of rod cells and cone cells in effecting monochromatic and trichromatic vision. The absorption of light by rhodopsin causes a chemical change leading to the creation of a generator potential. Details of hyperpolarisation are **not** required. The connections between sensory cells and the neurones of the optic nerve which allow sensitivity and acuity of vision.
Perceiving – the brain	Nerve pathways from eye to brain (optic nerve, optic chiasma, lateral geniculate nucleus, visual cortex) used to illustrate lateralisation and localisation of function in the brain. Visual perception by the brain. A brief outline of 'top down' and 'bottom up' theories of visual perception. When provided with information, **candidates should be able to** predict and explain the effects of specific drugs on perception.

3.4.6 Fight or flight – muscles, hormones and nerves working together	
Fight or flight – anger and fear	The nervous and hormonal systems work together to produce coordinated responses to stimuli which we perceive as threatening or frightening. The roles of the hypothalamus, sympathetic nervous system and adrenal gland in bringing about the fight or flight response. A comparison of nervous and hormonal coordination. **Candidates should** appreciate why hormonal control (particularly steroid hormone control) takes longer than nervous control.
The role of the nervous system	Stimuli perceived by the brain can lead to hormonal changes that produce physiological responses. The role of the hypothalamus in mediating such responses. The general role of the sympathetic and parasympathetic components of the autonomic nervous system and their antagonistic effects. The hypothalamus • receives input from the cerebral cortex • sends nerve impulses via the sympathetic nervous system • to effectors which may be muscles or glands (as exemplified by the adrenal glands).
The role of the hormonal system	Information is transferred by hormones released by endocrine glands and affecting the physiological activities of target cells. The physiological actions of adrenaline.
Muscle contraction	**Candidates should be able to** describe movement and maintenance of posture in terms of antagonistic muscle action. Gross and microscopic structure of skeletal muscle. The ultrastructure of a myofibril. The sliding-filament theory of muscle contraction. The roles of actin, myosin, tropomyosin, calcium ions and ATP in myofibril contraction. Muscles as effectors. The structure, location and general properties of slow and fast skeletal muscle fibres.

3.4.7 Hypothermia and diabetes – when controls fail to work	
Homeostasis	Physiological control systems operate in humans to maintain the internal environment within restricted limits. This is homeostasis. The principle of negative feedback and its role in restoring systems to their original levels.
Hypothermia	A condition in which body temperature falls below 35°C. Normal thermoregulatory mechanisms fail. The processes involved in thermoregulation in a mammal. The role of thermoreceptors in the skin and the hypothalamus. The role of positive feedback as temperature continues to fall.
Diabetes – a disease of our times	The regulation of blood glucose. The factors which influence blood glucose concentration. Role of hormones in activating enzymes involved in the interconversion of glucose and glycogen. Details of biochemical pathways and individual enzymes are **not** required. The roles of insulin and glucagon in controlling blood glucose. Type 1 and Type 2 diabetes. Control by insulin, changes of diet and lifestyle. **Candidates should be aware of** the health implications of undiagnosed or untreated diabetes. When provided with appropriate information, **candidates should be able to** evaluate evidence showing correlations between life-style and the incidence of diabetes.

Biological principles

After studying the contents of this unit, **candidates should understand** that

- there is a hierarchy of control at the cellular level, ultimately controlled by the genes
- genes are passed on during reproduction
- meiosis produces sex cells, which are the link between the generations
- implantation and the early stages of development are controlled by hormones
- the human life span has definite stages
- patterns of inheritance of many features can be predicted using Mendelian principles
- nervous and hormonal systems integrate the information detected by receptors and control our responses
- negative feedback systems control homeostatic mechanisms in the body.

Investigative and practical skills

Candidates will be expected to have carried out practical investigations in the following areas

- Measurements relating to patterns of growth
- Microscopic observations of meiosis and comparisons with mitosis
- Mendelian inheritance in suitable organisms
- Perception of stimuli.

3.5 Unit 5 HBIO5 The air we breathe, the water we drink, the food we eat

Human populations do not live in isolation. They are part of communities and ecosystems and depend upon other organisms for their survival. Human activities are changing the biotic and abiotic components of ecosystems. These changes are affecting our climate, and health. They are also changing the selection pressures on populations of other organisms we share ecosystems with. There are conflicts of interest between human demands and conservation of ecosystems.

It is anticipated that, due to the thematic approach of the specification and the synoptic elements of this unit, it should be taught after Unit 4. This unit will allow for further development of the skills of application and analysis as well as for the acquisition of additional investigatory skills associated with *Investigative and practical skills* detailed in Unit 6.

3.5.1 Human impacts on evolution	
Evolution	Evolution involves a change in the allele frequency in a population. Individuals in a population of a species show variation. Phenotypic variation is due to genetic factors, differences in environmental factors or a combination of both. Competition results in differential survival and reproduction. Selection acts on populations. Organisms with a selective advantage are more likely to survive, reproduce and pass on their genes to the next generation. Selection may result in changes in the allele and phenotype frequency in a population. Reproductive isolation of populations and the formation of new species. Allopatric and sympatric speciation. Human activities have altered and are altering the environment of many organisms. This changes the selection acting on populations. This may affect the evolution of populations and species.

3.5.2 People change communities	
Ecosystems and the stability of populations	Humans have introduced species of plants and animals into this country. This has affected the stability of populations of native species, the communities they are part of and the ecosystems they live in. An ecosystem comprises living organisms and the physical and chemical factors which make up their environment. A population is all the organisms of one species in a habitat. Populations of different species form communities. These communities are found in a particular habitat and are based on dynamic feeding relationships. Within a habitat a species occupies a niche governed by adaptation to food availability and/or prevailing abiotic conditions. An ecosystem supports a certain size of population of any one species. This population size may vary as a result of • the effect of abiotic factors • interactions between organisms • inter- and intra-specific competition • predation. Humans have introduced species of plants and animals into this country. This has affected the stability of populations of native species, the communities they are part of and the ecosystems they live in. When provided with appropriate information, **candidates should be able to** evaluate evidence and make balanced judgements between meeting human demands and the need to conserve the environment.
Winners and losers	Domesticated and introduced plants and animals affect natural ecosystems through competition with native species - the effects of domestic cats, grey squirrels and Japanese knotweed. The growth of the urban environment has increased the habitat and niches for foxes, rats, pigeons and other species of wildlife. When provided with appropriate information, **candidates should be able to** evaluate the cost implications of controlling introduced species.
GM organisms	Environmental Impact Assessment. The impact on communities and ecosystems of the large-scale introduction of genetically modified organisms, as exemplified by soya and maize. When provided with appropriate information, **candidates should be able to** evaluate evidence and make balanced judgements between the need to meet the demands for certain crops and the need to conserve the environment.

3.5.3 Humans' health can be affected when they change their environment	
Diet, crops and food allergies	There have been changes in our diet. Vegetable oils are one of the plant products for which there has been a large increase in demand. These changes have been linked to increases in a range of allergies • nut allergy • hay fever. When provided with appropriate information, **candidates should be able to** evaluate evidence and make balanced judgements about meeting demands for certain crops and the impact on human health and well-being.
Allergies	Allergic responses produce illness. Allergens are antigens that produce an abnormal immune response. Hypersensitivity. Detail limited to • Hay fever, food allergies, allergic asthma and hives as examples of allergic reactions involving histamine production • The allergen leads to production of IgE antibody by B cells • IgE binds to mast cells, which produce histamine when exposed to the allergen • Histamine leads to symptoms of allergy • Anaphylaxis is a sudden, acute reaction to an allergen. It can involve oedema in the airways leading to the lungs, or a large and sudden fall in blood pressure. Skin tests for allergies, use of antihistamine to treat allergies and adrenaline to treat anaphylaxis.
Air pollution and respiratory illnesses	When provided with appropriate information, **candidates should be able to** evaluate evidence and make balanced judgements about the claims of links between air pollution and respiratory illnesses, including asthma and bronchitis.
Water pollution and illness	Pollution of water by human activities can lead to illness. Beaches and coliform standards. Coliform bacteria and faecal streptococci, as indicators of pollution by human sewage. Blue Flag beaches meet a water quality test. *Cryptosporidium* is a single-celled parasite. It causes cryptosporidiosis. A resistant form, the oocyst, is in the faeces of infected animals and humans. The oocyst can infect a new host. Pollution of water can occur from slurries from infected farm animals. Sewage discharged into rivers used for drinking water abstraction can carry oocysts released by infected humans. When provided with appropriate information, **candidates should be able to** evaluate the cost implications of controlling water pollution.

3.5.4 Human activities can damage ecosystems and create new ones	
Succession	Ecosystems are dynamic systems, usually moving from colonisation to climax communities in a process known as succession. Communities change with time, because of the interaction between species and their environment. At each stage certain species change the environment so that it becomes more suitable for other species.
Local wildlife	Human activities often produce bare areas of land and water. Wasteland is unmanaged land with vegetation in the early stages of succession. Wasteland includes corridor habitat, such as cuttings and embankments associated with railway tracks and roadsides. Brown-field sites are sites which have previously been developed for human use. These sites can be reclaimed to provide habitats for flora and fauna, as exemplified by species in decline because of urbanisation and intensive agriculture. Ecosystems range in size from the very small to the very large. Increasing area by a factor of ten approximately doubles the number of species present. Larger sites are important in enhancing biodiversity in the urban environment. Corridor habitats are important because they are common in the built environment and allow for the movement of plants and animals between habitats. **Candidates should be able to** describe one example of the habitats on wasteland or a brown-field site. **Candidates should be able to** describe • techniques used to measure the biotic factors in an ecosystem • and the abiotic factors in an ecosystem.
Waste disposal should to be environmentally sustainable	Best Practical Environmental Option (BPEO) as applied to waste management. The BPEO is the option which provides the most benefit or least damage to the environment as a whole, at an acceptable cost in both the long and short term. The waste hierarchy • waste should be prevented or reduced at source • waste materials should be re-used • waste materials should be recycled and used as a raw material • waste that cannot be re-used should be used as a substitute for non-renewable energy sources • only waste which cannot be treated in any of the above ways should go to landfill. Microorganisms decompose organic remains. Anaerobic bacteria produce methane in landfill sites, which can be collected and used as fuel. Polluter Pays Principle. The polluter pays for the direct and indirect environmental consequences of their actions. When provided with appropriate information, **candidates should be able to** evaluate all the cost implications of pollution.

3.5.5 Plants can reduce the impact of the use of fossil fuels on climate change	
Carbon footprint	The carbon footprint is a measure of the impact that human activities have on the amount of greenhouse gases produced, measured in terms of kilograms of carbon dioxide produced per year. **Candidates should be able to** describe • how their primary contributions are calculated • how their secondary contributions are calculated • how household contributions can be reduced • how carbon emissions can be off-set.
Our climate is changing	The burning of fossil fuels produces greenhouse gases. The climate of the United Kingdom is getting warmer. This affects the distribution of plants and animals. **Candidates should be able to** describe the effects of climate warming on • the natural range of species • breeding seasons • the availability of food for some species at key times. When provided with appropriate information, **candidates should be able to** evaluate evidence of links between climate warming and changes in populations of species in the UK.
Plants remove carbon dioxide from the atmosphere	Photosynthesis is the major route by which energy enters an ecosystem. Energy is transferred through the trophic levels in food chains and food webs and is dissipated. Quantitative consideration of the efficiency of energy transfer between trophic levels. In photosynthesis • energy is transferred to produce ATP and reduced NADP in the light-dependent stage • ATP and reduced NADP are utilised during the light-independent stage, to incorporate carbon dioxide into sugars. ATP synthesis is associated with the electron transfer chains in the membranes of chloroplasts. (Details of electron transport and biochemical pathways are **not** required.) Tree planting is used to off-set carbon dioxide emissions. Carbon is sequestered in the biomass of trees.
Biofuels reduce the use of fossil fuels	These are renewable energy sources • biomass from fast-growing plants, used as fuel for burning • vegetable oils used as diesel substitute • ethanol from the fermentation of plant material, used as a petrol substitute or additive. To produce significant reductions in the use of fossil fuels, the plants used have to be grown on a very large scale. This will have impacts on the environment. It will also affect the availability of food for human consumption. When provided with appropriate information, **candidates should be able to** evaluate the environmental and social impacts of the use of biofuels. When provided with appropriate information, **candidates should be able to** evaluate the impact of the use of biofuels on national and global carbon dioxide emissions.

Respiration adds carbon dioxide to the atmosphere	ATP provides the immediate source of energy for biological processes. All cells and organisms respire. In respiration • glycolysis takes place in the cytoplasm • and is anaerobic • the remaining steps take place in the mitochondria • ATP synthesis is associated with the electron transfer chain in the membranes of mitochondria • oxygen is the final electron acceptor • carbon dioxide is a waste product of aerobic respiration.
3.5.6 People and their microorganisms	
The human ecosystem	Ecosystems range in size from the very large to the very small. The human body supports populations of bacteria and fungi. These microorganisms • carry out extracellular digestion of biological molecules • absorb the products of digestion • use these for their own metabolism. This can recycle chemical elements from human cells.
The ecology of the skin	Human skin supports a community of many microorganisms • *Staphylococci* • *Micrococci* • *Corynebacterium* • Fungi, such as yeast Spots and blemishes. A number of skin conditions are caused by bacteria. Acne vulgaris is caused by *Propionibacterium acnes* growing in and near sebaceous glands in the skin. The use of antiseptics and antibiotics to control the populations of these bacteria. When provided with appropriate information, **candidates should be able to** evaluate evidence and make balanced judgements between the claims of makers of different 'spot creams' and antibacterial soaps. **Candidates should be able to** analyse and interpret experimental evidence from microbial growth investigations.

The ecology of the gut	The human gut supports populations of bacterial species which form a bacterial community. Human actions can change this community and adversely affect the functioning of the gut. When provided with appropriate information, **candidates should be able to** evaluate evidence and make balanced judgements about 'probiotic' foods.
Antibacterial resistance	Humans have introduced large amounts of antibacterial agents into the environment of bacteria. Evolution of resistance to antibacterial agents. MRSA. When provided with appropriate information, **candidates should be able to** evaluate evidence relating to the impact of the widespread use of antibacterial agents.

Biological principles

After studying the contents of this unit, **candidates should understand** that human populations

- are part of communities that live in ecosystems
- are part of complex food webs
- affect and are affected by changes in populations of other species
- rely on the energy that moves through communities
- affect and are affected by the abiotic components of the ecosystems they live in
- affect their own health and well-being through their environmental impact.

Investigative and practical skills

Opportunities to carry out practical work should be provided in the context of this unit

- Assessment of the biodiversity of a site, in terms of species and numbers of individuals
- Factors affecting the rate of photosynthesis
- Factors affecting rate of respiration
- The effects of antibacterial agents on the growth of bacterial culture.

3.6 Unit 6 Investigative and practical skills in A2 Human Biology

This unit will address the following aspects of the A2 subject criteria. The ability to

- demonstrate and describe ethical, safe and skilful practical techniques, selecting appropriate qualitative and quantitative methods
- make, record and communicate reliable and valid observations and measurements with appropriate precision and accuracy
- analyse, interpret, explain and evaluate the methodology, results and impact of their own and others' experimental and investigatory activities in a variety of ways.

Candidates will be assessed on their understanding of investigative and practical skills in this unit and in Units 4 and 5. Guidance on Internal Assessment can be found in Section 3.8. Opportunities to carry out practical work are provided in the context of material contained in Units 4 and 5

3.6.1 Investigating biological problems involves changing a specific factor, the independent variable, and measuring the changes in the dependent variable that result.

Candidates should be able to	Practical work carried out in the context of Units 4 and 5 should enable candidates to gain experience of
• use knowledge and understanding from the A level specification to pose scientific questions and define scientific problems • identify the independent variable and describe an appropriate method of varying it in such detail that a student starting an A2 course could carry out the suggested procedure without further assistance • identify other variables that might be expected to exert a significant influence on the results, use knowledge from relevant parts of the A level specification to explain why, and describe how they would be kept constant or monitored • where necessary, describe how and explain why appropriate control experiments should be established • identify the dependent variable and describe how they would collect a full range of useful quantitative data that could be analysed statistically, measured to an appropriate level of accuracy and precision • distinguish between accuracy and reliability and describe precautions needed to obtain valid, accurate and reliable data.	• random sampling • the use of a three-way tap in collecting gas samples • establishing anaerobic conditions.

3.6.2 Implementing involves the ability to work methodically and safely, demonstrating competence in the required manipulative skills and efficiency in managing time. Raw data should be methodically collected and recorded during the course of the investigation.

Candidates should be able to	Practical work carried out in the context of Units 4 and 5 should enable candidates to gain experience of
• show full regard for safety and the ethical issues involved with the well-being of living organisms and the environment • carry out an investigation in a methodical and organised way demonstrating competence in the required manipulative skills and efficiency in managing time • take all measurements to an appropriate level of accuracy and precision • present raw data in a suitable table conforming to the conventions specified in the Institute of Biology publication, *Biological Nomenclature, Recommendations on Terms, Units and Symbols*, 3rd edition (2000) concerning organisation and presentation of units.	• collection of reliable quantitative ecological data involving a specific abiotic factor, frequency, population density and percentage cover.

3.6.3 Data should be analysed by means of an appropriate statistical test. This allows calculation of the probability of an event being due to chance. Appropriate conclusions should be drawn and scientific knowledge from the A Level specification should be used to explain these conclusions.

Statistics

Candidates should be aware that there are

- *tests of difference*: is this group different from that group?
- *tests of relationship*: is one variable associated with another?

Tests of difference typified by t-test for normally distributed data where data are not normally distributed (or this is not known).

Tests of relationship typified by the correlation coefficient (*r*) and Spearman's rank-order correlation.

Candidates should be able to	**Practical work carried out in the context of Units 4 and 5 should enable candidates to gain experience of**
• select and justify the choice of an appropriate statistical test from the following standard error and 95% confidence limits correlation coefficient (*r*) Spearman rank correlation χ^2 t-test • construct an appropriate null hypothesis • calculate the test statistic given a standard scientific calculator • interpret the calculated test statistic in terms of the appropriate critical value at the 5% significance level, making reference to chance, probability and acceptance or rejection of the null hypothesis • draw valid conclusions, relating explanations to specific aspects of the data collected and by applying biological knowledge and understanding from the A Level specification.	• selecting, using and interpreting an appropriate statistical test from the following standard error and 95% confidence limits correlation coefficient (*r*) χ^2 t-test

Candidates will **not** be expected to remember the formulae for these tests.

Candidates will be expected to

- apply the appropriate test
- interpret the results of such tests.

3.6.4 Limitations are inherent in the material and apparatus used and procedures adopted. These limitations should be identified, evaluated and methods of overcoming them suggested.

Candidates should be able to	
• identify the limitations inherent in the apparatus and techniques used • discuss and assess the relative effects of these limitations on the reliability and precision of the data and on the conclusions that may be drawn, resolving conflicting evidence • suggest realistic ways in which the effect of these limitations may be reduced • suggest further investigations which would provide additional evidence for the conclusions drawn.	

3.7 How Science Works

How Science Works is an underpinning set of concepts and is the means whereby students come to understand how scientists investigate scientific phenomena in their attempts to explain the world about us. Moreover, *How Science Works* recognises the contribution scientists have made to their own disciplines and to the wider world.

Further, it recognises that scientists may be influenced by their own beliefs and that these can affect the way in which they approach their work. Also, it acknowledges that scientists can and must contribute to debates about the uses to which their work is put and how their work influences decision-making in society.

In general terms, it can be used to promote students' skills in solving scientific problems by developing an understanding of:

- the concepts, principles and theories that form the subject content
- the procedures associated with the valid testing of ideas and, in particular, the collection, interpretation and validation of evidence
- the role of the scientific community in validating evidence and also in resolving conflicting evidence.

As students become proficient in these aspects of *How Science Works*, they can also engage with the place and contribution of science in the wider world. In particular, students will begin to recognise:

- the contribution that scientists can make to decision-making and the formulation of policy
- the need for regulation of scientific enquiry and how this can be achieved
- how scientists can contribute legitimately in debates about those claims which are made in the name of science.

An understanding of *How Science Works* is a requirement for this specification and is set out in the following bullet points which are taken directly from the *GCE AS and A Level subject criteria for science subjects*. Each bullet point is expanded in the context of Human Biology. The specification references given illustrate where the example is relevant and could be incorporated.

	Use theories, models and ideas to develop and modify scientific explanations
A	Scientists use theories and models to attempt to explain observations. These theories or models can form the basis for scientific experimental work. Scientific progress is made when validated evidence is found that supports a new theory or model.
	Examples in this specification include • *at AS, Unit 2 (3.2.3), Darwin and the theory of evolution* • *at A2, Unit 4 (3.4.3), Management of cells and epigenetics.*
	Use knowledge and understanding to pose scientific questions, define scientific problems, present scientific arguments and scientific ideas
B	Scientists use their knowledge and understanding when observing objects and events, in defining a scientific problem and when questioning their own explanations or those of other scientists. Scientific progress is made when scientists contribute to the development of new ideas, materials and theories.
	Examples in this specification include • *at AS, Unit 1 (3.1.4), HIV and its control* • *at A2, Unit 4 (3.4.1), Contraception.*
	Use appropriate methodology, including ICT, to answer scientific questions and solve scientific problems
C	Observations ultimately lead to explanations in the form of hypotheses. In turn, these hypotheses lead to predictions that can be tested experimentally. Observations are one of the key links between the 'real world' and the abstract ideas of science. Once an experimental method has been validated, it becomes a protocol that is used by other scientists. ICT can be used to speed up, collect, record and analyse experimental data.
	Examples in this specification include • *at AS, Unit 2 (3.2.2), Cancer and environmental causes* • *at A2, Unit 4 (3.4.4), PCR.*
	Carry out experimental and investigative activities, including appropriate risk management, in a range of contexts
D	Scientists perform a range of experimental skills that include manual and data skills (tabulation, graphical skills etc). Scientists should select and use equipment that is appropriate when making accurate measurements and should record these measurements methodically. Scientists carry out experimental work in such a way as to minimise the risk to themselves, to others, and to other organisms and the materials used.
	Examples in this specification include • *at AS, Unit 2 (3.2.4), Adaptations of physiology* • *at A2, Unit 5 (3.5.6), Ecology of the skin.*

	Analyse and interpret data to provide evidence, recognising correlations and causal relationships
E	Scientists look for patterns and trends in data as a first step in providing explanations of phenomena. The degree of uncertainty in any data will affect whether alternative explanations can be given for the data. Anomalous data are those measurements that fall outside the normal, or expected, range of measured values. Decisions on how to treat anomolous data should be made only after examination of the event. In searching for causal links between factors, scientists propose predictive theoretical models that can be tested experimentally. When experimental data confirm predictions from these theoretical models, scientists become confident that a causal relationship exists.
	Examples in this specification include • *at AS, Unit 2 (3.2.3), Once there were other humans* • *at A2 Unit 5 (3.5.5), Climate change.*
	Evaluate methodology, evidence and data, and resolve conflicting evidence
F	The validity of new evidence, and the robustness of conclusions that stem from it, is constantly questioned by scientists. Experimental methods must be designed adequately to test predictions. Solutions to scientific problems are often developed when different research teams produce conflicting evidence. Such evidence is a stimulus for further scientific investigation, which involves refinements of experimental technique or development of new hypotheses.
	Examples in this specification include • *at AS, Unit 1 (3.1.5), Vaccines* • *at A2, Unit 4 (3.4.4), Genetically modified organisms.*
	Appreciate the tentative nature of scientific knowledge
G	Scientific explanations are those that are based on experimental evidence, which is supported by the scientific community. Scientific knowledge changes when new evidence provides a better explanation of scientific observations.
	Examples in this specification include • *at AS, Unit 2 (3.2.3), Theories of Lamark and Darwin* • *at A2, Unit 5 (3.5.3), Air pollution and respiratory illness.*
	Communicate information and ideas in appropriate ways using appropriate terminology
H	By sharing the findings of their research, scientists provide the scientific community with opportunities to replicate and further test their work, thus either confirming new explanations or refuting them. Scientific terminology avoids confusion amongst the scientific community, enabling better understanding and testing of scientific explanations.
	Examples in this specification include • *at AS, Unit 2 (3.2.3), What's in a name?* • *at A2, Unit 5 (3.5.2), Ecosystems and terminology.*

	Consider applications and implications of science and appreciate their associated benefits and risks
I	Scientific advances have greatly improved the quality of life for the majority of people. Developments in technology, medicine and materials continue to further these improvements at an increasing rate. Scientists can predict and report on some of the beneficial applications of their experimental findings. Scientists evaluate, and report on, the risks associated with the techniques they develop and the applications of their findings.
	Examples in this specification include • *at AS, Unit 1 (3.1.6), Treatment of cardiovascular disease* • *at A2, Unit 5 (3.5.5), Biofuels.*
	Consider ethical issues in the treatment of humans, other organisms and the environment
J	Scientific research is funded by society, either through public funding or through private companies that obtain their income from commercial activities. Scientists have a duty to consider ethical issues associated with their findings. Individual scientists have ethical codes that are often based on humanistic, moral and religious beliefs. Scientists are self-regulating and contribute to decision-making about what investigations and methodologies should be permitted.
	Examples in this specification include • *at AS, Unit 2 (3.2.2), Cancer and environmental links* • *at A2, Unit 5 (3.5.4), Local wild life.*
	Appreciate the role of the scientific community in validating new knowledge and ensuring integrity
K	The findings of scientists are subject to peer review before being accepted for publication in a reputable scientific journal. The interests of the organisations that fund scientific research can influence the direction of research. In some cases the validity of those claims may also be influenced.
	Examples in this specification include • *at AS, Unit 1 (3.1.1), Balanced diet and processed foods* • *at A2, Unit 4 (3.4.4), Genetically modified organisms.*
	Appreciate the ways in which society uses science to inform decision-making
L	Scientific findings and technologies enable advances to be made that have potential benefit for humans. In practice, the scientific evidence available to decision-makers may be incomplete. Decision-makers are influenced in many ways, including by their prior beliefs, their vested interests, special interest groups, public opinion and the media, as well as by expert scientific evidence
	Examples in this specification include • *at AS, Unit 1 (3.1.6), Life style and disease* • *at A2, Unit 4 (3.4.1), IVF.*

3.8 Guidance on Internal Assessment

Introduction

The GCE Sciences share a common approach to internal assessment. This is based on the belief that assessment should encourage practical work in science, and that practical work should encompass a broad range of activities. This section must be read in conjunction with information in the Teaching and learning resources web pages.

Investigative and Practical Skills are assessed in Unit 3 and Unit 6, worth, respectively, 20% of the AS Award (and 10% of the A Level Award) and 10% of the full A Level Award.

There are two routes for the assessment of Investigative and Practical Skills

Either

Route T: Practical Skills Assessment (PSA) + Investigative Skills Assignment (ISA) –

Teacher-marked

Or

Route X: Practical Skills Verification (PSV) +

Externally Marked Practical Assessment (EMPA) –

AQA-marked.

Both routes to assessment are available at AS and A2.

Centres can not make entries for the same candidate for both assessment routes [T and X] in the same examination series.

The assessments produced for each of Unit 3 and Unit 6 are common to AQA AS/A Level Biology (2410) and AQA AS/A Level Human Biology (2405). As a result, centres entering the same candidates for both Biology and Human Biology in the same session for both unit 3s and/or both unit 6s must enter these candidates for route T for one subject and route X for the other subject. Candidates can not enter the same route for both qualifications.

3.8.1 Centre Assessed Route T (PSA/ISA)

Each centre assessed unit comprises

- Practical Skills Assessment (PSA)
- Investigative Skills Assignment (ISA).

The PSA consists of the centre's assessment of the candidate's ability at the end of the course to demonstrate practical skills; thus, candidates should be encouraged to carry out practical and investigative work throughout the course. This work should cover the skills and knowledge of How Science Works (Section 3.7) and in Sections 3.3 and 3.6.

The ISA has three stages where candidates

- undertake practical work and collect data
- process the data
- complete a written ISA test.

There are two windows of assessment for the ISA:

- one for the practical work (Stages 1 and 2)
- one for the written test (Stage 3).

Each stage of the ISA must be carried out

- under controlled conditions
- within the windows of assessment stipulated by AQA in the Instructions for Administration of the ISA http://filestore.aqa.org.uk/subjects/AQA-2410-W-TG-ISAADMIN.PDF

All students at a centre must complete the written test in a single uninterrupted session on the same day.

The ISA is set externally by AQA, but internally marked, with marking guidelines provided by AQA.

In a given academic year two ISAs at each of AS and A2 will be provided.

Practical Skills Assessment (PSA)

Candidates following this route must undertake the practical activities outlined in Sections 3.3 for AS or 3.6 for A2 in order to allow candidates suitable opportunities to demonstrate safe and skilful practical techniques and to make reliable and valid observations.

Candidates are assessed throughout the course on practical skills, using a scale from 0 to 6. The mark submitted for practical skills should be judged by the teacher. Teachers may wish to use this section for formative assessment and should keep an ongoing record of each candidate's performance but the mark submitted should represent the candidate's practical abilities at the end of the course.

The nature of the assessment

Since the skills in this section involve implementation, they must be assessed while the candidate is carrying out practical work. Practical activities are not intended to be undertaken as formal tests and teachers can provide the level of guidance that would normally be given during teaching. In order to provide appropriate opportunities to demonstrate the necessary skills, the instructions provided must not be too prescriptive but should allow candidates to make decisions for themselves, particularly concerning the organisation and conduct of practical work, and the manner in which equipment is used.

The assessment criteria

In the context of material specified in the relevant AS or A2 specification, candidates will be assessed in the following skills

- following instructions
- selecting and using equipment
- organisation and safety

The Assessment Criteria

Following instructions	Selecting and using equipment	Organisation and safety
0 marks Able to follow instructions involving standard procedures only when guidance is given.	**0 marks** Able to select appropriate laboratory equipment only when guidance is given. Able to make measurements with assistance.	**0 marks** Works in a disorganised manner. Works safely only with constant supervision.
1 mark Able to follow instructions involving standard procedures but unable to follow instructions involving complex procedures without further guidance.	**1 mark** Able to select appropriate laboratory equipment. Able to make accurate measurements but requires guidance on making repeat measurements.	**1 mark** Works in an organised manner. Works with due regard to safety, but needs occasional guidance or reminders.
2 marks Able to follow instructions involving both standard and complex procedures without guidance.	**2 marks** Able to select appropriate laboratory equipment. Able to make accurate measurements and to recognise when it is appropriate to repeat measurements.	**2 marks** Works in an organised manner. Works with due regard to safety, showing competence in risk management.

Descriptors for these three skills areas are provided for 0, 1 and 2 marks.

Candidates should be awarded marks which reflect their level of performance at the end of the course.

AQA may wish to ask for further supporting evidence from centres in relation to the marks awarded for the PSA. Centres should therefore keep records of their candidates' performances in their practical activities throughout the course. (For example, a laboratory diary, log or tick sheet.)

Further guidance for the awarding of marks for the PSA will be provided in the Teaching and learning resources web pages.

Use of ICT during the PSA

Candidates are encouraged to use ICT where appropriate in the course of developing practical skills, for example in collecting and analysing data.

Investigative Skills Assignment (ISA)

The Investigative Skills Assignment carries 44 marks and has three stages.

Stage 1: Collection of data

Candidates carry out practical work following an AQA task sheet. Centres may use the task sheet as described or may make minor suitable modifications to materials or equipment, following AQA guidelines. Details of any amendments made to the task sheet must be agreed in writing with the AQA Assessment Adviser. The task may be conducted in a normal timetabled lesson but must be under controlled conditions and during the window of assessment for practical work.

For AS, candidates collect raw data and represent it in a table of their own design or make observations that are recorded on the *Candidate Result Sheet*. The candidates' work must be handed to the teacher at the end of the session. The teacher assesses the candidates' work following AQA marking guidelines.

For A2, candidates collect raw data on the *Candidate Result Sheet.* The candidates' work must be handed to the teacher at the end of each session. The raw data is not assessed by the teacher.

There is no specified time limit for this stage.

Stage 2: Processing of data

The teacher returns the candidates' data from Stage 1 (on the *Candidate Result Sheet*).

For AS, the teacher instructs the candidates to process the data (e.g. calculate means or rates of reaction) and plot an appropriate graph. The teacher must not instruct the candidates on the presentation of the data or on the choice of graph or chart.

For A2, the teacher instructs the candidates to process the data and carry out a suitable statistical test. The teacher must not instruct the candidates on the choice, implementation and interpretation of the statistical test.

For both AS and A2, stage 2 may be done in normal lesson time and must be done in a single session under controlled conditions and during the window of assessment for practical work. Both the raw and the processed data must be handed to the teacher at the end of the session. The teacher assesses the candidates' work to AQA marking guidelines.

Stage 1 and Stage 2 may be done in the same session. There is no specified time limit for Stage 2.

Stage 3: The ISA written test

The ISA test should be taken after completion of Stage 2, under controlled conditions and during the window of assessment for the written test. All candidates at a centre must complete the written test in a single uninterrupted session on the same day. Each candidate is provided with an ISA test and their completed material from Stages 1 and 2. The teacher uses the AQA marking guidelines to assess the ISA test.

The ISA test is in two Sections.

Section A

This consists of a number of questions relating to the candidate's own data.

Section B

At the start of this section, candidates are supplied with additional data on a related topic. A number of questions relating to analysis and evaluation of the data then follow.

The number of marks allocated to each section may vary slightly with each ISA test.

Use of ICT during the ISA

ICT may be used during the ISA but teachers should note any restrictions in the ISA marking guidelines or Teachers' Notes. Use of the internet is not permitted.

Candidates absent for the practical work

A candidate absent for the practical work should be given an opportunity to carry out the practical work before they sit the ISA test. This may be with another group or at a different time. In exceptional cases when such arrangements are not possible, the teacher can supply a candidate with class data. In this case the candidate cannot be awarded marks for Stage 1, but may be awarded marks for Stage 2.

Material from AQA

For each ISA, AQA will provide:

- Teachers' Notes
- Task sheet
- ISA test
- Marking guidelines.

This material must be kept under secure conditions within the centre. The centre must ensure the security of the material. Further details regarding this material will be provided.

Security of assignments

All materials including marked ISAs should be treated like examination papers and kept under secure conditions until the publication of results.

General Information

Route T

Administration

In any year a candidate may attempt either or both of the two ISAs. AQA will stipulate windows of assessment during which the ISAs (task and test) must be completed.

For each candidate, the teacher should submit a total mark to AQA comprising:

- the PSA mark
- the better ISA mark (if two have been attempted).

The ISA component of this mark must come from one ISA only, i.e. the marks awarded for individual stages of different ISAs cannot be combined.

Candidates may make only one attempt at a particular ISA. Redrafting is **not** permitted at any stage during the ISA.

The mark must be submitted by the due date in the academic year for which the ISA was published.

Only unit entry codes from the Human Biology specification can contribute towards an AS or A Level Award in Human Biology. **Biology unit entry codes can not be used towards a Human Biology qualification.**

Work to be submitted

For each candidate in the sample the following materials must be submitted to the moderator by the deadline issued by AQA.

- the candidate's data from Stage 1 and 2 (on the *Candidate Result Sheet*)
- the ISA written test, which includes the *Candidate Record Form*, showing the marks for the ISA and the PSA.

In addition each centre must provide

- *Centre Declaration Sheet*
- Details of any agreed amendments to the task sheet with information supporting the changes from the AQA Assessment Adviser.

Working in groups

For the PSA, candidates may work in groups provided that any skills being assessed are the work of individual candidates. For the ISA further guidance about working in groups will be provided in the Teachers' Notes.

Other information

Section 6 outlines further guidance on the supervision and authentication of internally assessed units.

Section 6 also provides information in relation to the internal standardisation of marking for these units. Please note that the marking of both the PSA and the ISA must be internally standardised as stated in Section 6.4.

Further support

AQA supports the units in a number of ways.

- AQA holds annual standardising meetings on a regional basis for all internally assessed components. Section 6 of this specification provides further details about these meetings

- Teaching and learning resources which include Instructions for Administration of the ISA http://filestore.aqa.org.uk/subjects/AQA-2410-W-TG-ISAADMIN.PDF
- Assessment Advisers are appointed by AQA to provide advice on internally assessed units. Every centre is allocated an Assessment Adviser.

The Assessment Advisers can provide guidance on

– issues relating to the carrying out of tasks for assessment
– application of marking guidelines.

Any amendments to the ISA task sheet must be discussed with the Assessment Adviser and confirmation of the amendments made must be submitted to the AQA moderator.

3.8.2 Externally Marked Route X (PSV/EMPA)

The practical and investigative skills will be assessed through

- Practical Skills Verification (PSV) and
- Externally Marked Practical Assignment (EMPA).

The PSV requires teachers to verify their candidates' ability to demonstrate safe and skilful practical techniques and make valid and reliable observations

The EMPA has three stages where candidates

- undertake a themed task and collect data
- process the data
- complete a written EMPA test.

There are two windows of assessment for the EMPA:

- one for the practical work – Task 1 and Task 2 (Stages 1 and 2)
- one for the written test (Stage 3).

Each stage of the EMPA must be carried out

- under controlled conditions
- within the windows of assessment stipulated by AQA in the Instructions for Administration of the EMPA http://filestore.aqa.org.uk/subjects/AQA-2410-W-TG-EMPAADMIN.PDF

All candidates at a centre must complete the written test in a single uninterrupted session on the same day.

The EMPA is set and marked by AQA. Only one EMPA at each of AS and A2 will be provided in a given academic year.

Practical Skills Verification

Candidates following this route must undertake the practical activities outlined in sections 3.3 for AS and 3.6 for A2 in order to allow candidates suitable opportunities to demonstrate safe and skilful practical techniques and to make reliable and valid observations. The teacher will confirm, on the front cover of the written test, for each candidate that this requirement has been met. Failure to complete the tick box will lead to a mark of zero being awarded to the candidate for the whole of this unit.

In the context of material specified in the relevant AS or A2 specification, candidates will be required to demonstrate the following skills

- following instructions
- selecting and using equipment
- organisation and safety.

Practical activities must provide candidates with opportunities to develop the knowledge and skills of *How Science Works* outlined in section 3.3 and 3.6. Teachers can provide the level of guidance that would normally be given during practical activities. However, in order to provide appropriate opportunities to demonstrate the necessary skills, instructions provided must not be too prescriptive but should allow candidates to make decisions for themselves, particularly concerning the organisation and conduct of practical work, and the manner in which equipment is used.

Further guidance for conducting practical activities for the PSV will be provided in the Teaching and learning resources web pages.

ICT

Candidates may use ICT where appropriate in the course of developing practical skills, for example in collecting and analysing data.

Externally Marked Practical Assignment (EMPA)

The Externally Marked Practical Assignment carries 50 marks and has three stages.

Stage 1: Themed task and collection of data

Candidates carry out practical work following AQA task sheets. The tasks may be conducted in a normal timetabled lesson at a time convenient to the centre, but must be under controlled conditions and during the window of assessment for practical work.

For AS, candidates collect raw data and represent it in a table of their own design on *Task Sheet 1*. The candidates' work must be handed to the teacher at the end of each session.

For A2, candidates collect raw data on *Task Sheet 1*. The candidates' work must be handed to the teacher at the end of each session.

Centres may use the task sheets, as described, or may make minor suitable modifications to materials or equipment following AQA guidelines. Any modifications made to the task sheet must be agreed with the Assessment Adviser and details must be provided to the AQA examiner. The task may be conducted in a normal timetabled session.

There is no specified time limit for this stage.

Stage 2: Processing of data

For AS, the teacher instructs the candidates to process data (e.g. calculate means or rates of reaction) and plot an appropriate graph. The teacher must not instruct the candidates on the presentation of the data or on the choice of graph or chart.

For A2, the teacher instructs the candidates to process data and carry out a suitable statistical test. The teacher must not instruct the candidates on the choice, implementation and interpretation of the statistical test.

For both AS and A2, stage 2 may be done in normal lesson time and must be done in a single session under controlled conditions and in the window of assessment for practical work. Both the raw and the processed data must be handed to the teacher at the end of the session.

Stage 1 and Stage 2 may be done in the same session. There is no specified time limit for Stage 2.

Stage 3: The EMPA written test

The EMPA written test should be taken after completion of Stage 2, under controlled conditions. Each candidate is provided with an EMPA written test and the candidate's completed Task Sheet indicated on the front cover of the EMPA Written Test.

The EMPA test is in two Sections.

Section A

This consists of a number of questions relating to the candidate's own data.

Section B

At the start of this section, candidates are supplied with additional data on a related topic. A number of questions relating to analysis and evaluation of the data then follow.

The number of marks allocated to each section may vary with each EMPA test.

Use of ICT during the EMPA

ICT may be used during the EMPA Stages 1 and 2 but teachers should note any restrictions in the Teachers' Notes. Use of the internet is not permitted.

Candidates absent for the practical work

A candidate absent for the practical work (Stage 1) should be given an opportunity to carry out the practical work before they sit the EMPA test. This may be with another group or at a different time. In exceptional cases, when this is not possible, the teacher can supply a candidate with class data. This must be noted on the front cover of the written test. In this case the candidate cannot be awarded marks for Stage 1, collection of data, but can still be awarded marks for Stage 2, processing of data.

Material from AQA

For each EMPA, AQA will provide:

- Teachers' Notes
- Task Sheets 1 and 2
- EMPA test.

When received, this material must be kept under secure conditions. The centre must ensure the security of the material. Further details regarding this material will be provided.

Security of assignments

Completed EMPAs should be treated like examination papers and kept under secure conditions until sent to the AQA examiner. All other EMPA materials should be kept under secure conditions until publication of results.

General Information

Route X

Administration

Only one EMPA will be available in any year at AS and at A2. AQA will stipulate a window of assessment during which the EMPA (themed task and written test) must be completed.

Candidates may make only one attempt at a particular EMPA and redrafting is **not** permitted at any stage during the EMPA.

Only unit entry codes from the Human Biology specification can contribute towards an AS or A Level Award in Human Biology. **Biology unit entry codes can not be used towards a Human Biology qualification.**

Work to be submitted

The material to be submitted to the AQA examiner for each candidate consists of

- the completed *Task Sheet 1* and *Task Sheet 2*
- the EMPA written test which includes the *Candidate Record Form*, including the PSV verification that safe and skilful practical techniques have been demonstrated and reliable and valid observations made.

In addition each centre must provide

- *Centre Declaration Sheet*
- Details of any agreed amendments to the task sheet must be notified to the AQA examiner with information supporting the changes from the Assessment Adviser.

Working in groups

For the PSV, candidates may work in groups provided that any skills being verified are the work of individual candidates. For the EMPA further guidance will be provided but the opportunity for group work will not be a common feature.

Other information

Section 6 of this specification outlines further guidance on the supervision and authentication of Internally assessed units.

Further support

AQA supports centres in a number of ways.

- Teaching and learning resources which include Instructions for Administration of the EMPA http://filestore.aqa.org.uk/subjects/AQA-2410-W-TG-EMPAADMIN.PDF
- Assessment Advisers appointed by AQA to provide advice on internally assessed units. Every centre is allocated an Assessment Adviser.

The Assessment Advisers can provide guidance on issues relating to the carrying out of tasks for assessment. Contact details for your Assessment Adviser can be oblained by e-mailing your centre name and number to alevelscience@aqa.org.uk.

Any amendments to the EMPA task sheet must be discussed with the AQA Assessment Adviser and confirmation of the amendments must be submitted to the AQA examiner.

3.9 Mathematical Requirements

In order to be able to develop their skills, knowledge and understanding in science, candidates need to have been taught, and to have acquired competence in, the areas of mathematics set out below. Material relevant to the second part of the A Level (A2) only is given in bold type.

	Candidates should be able to
Arithmetic and computation	• recognise and use expressions in decimal and standard form • use ratios, fractions and percentages • make estimates of the results of calculations (without using a calculator) • use calculators to find and use mean, standard deviations and x^n, $1/x$, $\sqrt{x}$ • understand the meaning of the symbols =, <, >.
Handling data	• use an appropriate number of significant figures • find arithmetic means • construct and interpret frequency tables, bar charts and histograms • **understand the principles of sampling as applied to biological data** • **distinguish between chance and probability and understand the importance of chance and probability when interpreting data** • understand the terms mean, median and mode and standard deviation • use a scatter diagram to identify positive and negative correlation between two variables • **select and use a simple statistical test (see Teaching and learning resources for further guidance)** • **candidates are not required to recall statistical formulae but will be provided with appropriate data sheet when necessary.**
Algebra	• change the subject of an equation • substitute numerical values into algebraic equations using appropriate units for physical quantities • understand the use of logarithms in relation to quantities that range over several orders of magnitude.
Graphs	• translate information between graphical and numerical forms • plot two variables from experimental or other data using appropriate Institute of Biology conventions • calculate rate of change from a graph showing a linear relationship • draw and use the slope of a tangent to a curve as a measure of rate of change.
Geometry and trigonometry	• visualise three dimensional forms from two dimensional representations of three dimensional objects • calculate circumferences and areas of circles, surface areas and volumes of rectangular blocks and cylinders when provided with appropriate formulae.

4 Scheme of Assessment

4.1 Aims

AS and A Level courses based on this specification should encourage candidates to:

a) develop their interest in and enthusiasm for the subject, including developing an interest in further study and careers in the subject

b) appreciate how society makes decisions about scientific issues and how the sciences contribute to the success of the economy and society

c) develop and demonstrate a deeper appreciation of the skills, knowledge and understanding of *How Science Works*

d) develop essential knowledge and understanding of different areas of the subject and how they relate to each other.

4.2 Assessment Objectives (AOs)

The Assessment Objectives are common to AS and A Level. The assessment units will assess the following Assessment Objectives in the context of the content and skills set out in Section 3 (Subject Content).

AO1: Knowledge and understanding of science and of *How Science Works*

Candidates should be able to:

a) recognise, recall and show understanding of scientific knowledge

b) select, organise and communicate relevant information in a variety of forms.

AO2: Application of knowledge and understanding of science and of *How Science Works*

Candidates should be able to:

a) analyse and evaluate scientific knowledge and processes

b) apply scientific knowledge and processes to unfamiliar situations including those related to issues

c) assess the validity, reliability and credibility of scientific information.

AO3: *How Science Works*

Candidates should be able to:

a) demonstrate and describe ethical, safe and skilful practical techniques and processes, selecting appropriate qualitative and quantitative methods

b) make, record and communicate reliable and valid observations and measurements with appropriate precision and accuracy

c) analyse, interpret, explain and evaluate the methodology, results and impact of their own and others' experimental and investigative activities in a variety of ways.

In the context of these assessment objectives, the following definitions apply.

- Knowledge includes facts, specialist vocabulary, principles, concepts, theories, models, practical techniques, studies and methods.
- Issues include ethical, social, economic, environmental, cultural, political and technological.
- Processes include collecting evidence, explaining, theorising, modelling, validating, interpreting, planning to test an idea, peer reviewing.

Quality of Written Communication (QWC)

In GCE specifications which require candidates to produce written material in English, candidates must:

- ensure that text is legible and that spelling, punctuation and grammar are accurate so that meaning is clear
- select and use a form and style of writing appropriate to purpose and to complex subject matter
- organise information clearly and coherently, using specialist vocabulary when appropriate.

In this specification QWC will be assessed in all units by means of the longer-response [4+ mark] questions. These will include the comprehension-based questions in Units 1 and 2, the "methodology"/ data interpretation question in Unit 4, the essay question in Unit 5, and the questions relating to experimental design in Units 3 and 6. Although specific marks are only awarded for QWC in the essay question in Unit 5, all of the other longer-response questions will require the clear expression of ideas and the use of appropriate terminology, by candidates, in order to access some of the marks on the mark scheme. Specific references to quality of written communication are marked Q in specimen mark schemes.

Weighting of Assessment Objectives for AS

The table below shows the approximate weighting of each of the Assessment Objectives in the AS units.

Assessment Objectives	Unit Weightings (%)			Overall Weighting of AOs (%)
	Unit 1	Unit 2	Unit 3	
AO1	18	19	3	40
AO2	16	16	3	35
AO3	5	6	14	25
Overall weighting of units (%)	40	40	20	100

Weighting of Assessment Objectives for A Level

The table below shows the approximate weighting of each of the Assessment Objectives in the AS and A2 units.

Assessment Objectives	Unit Weightings (%)						Overall Weighting of AOs (%)
	Unit 1	Unit 2	Unit 3	Unit 4	Unit 5	Unit 6	
AO1	9	9	1.5	7	7	1.5	35
AO2	8	8	1.5	10	10	1.5	39
AO3	3	3	7	3	3	7	26
Overall weighting of units (%)	20	20	10	20	20	10	100

4.3 National Criteria

This specification complies with the following.

- The Subject Criteria for Science: Biology.
- The Code of Practice for GCE
- The GCE AS and A Level Qualification Criteria
- The Arrangements for the Statutory Regulation of External Qualifications in England, Wales and Northern Ireland: Common Criteria

4.4 Prior Learning

There are no prior learning requirements. However, we recommend that candidates should have acquired the skills and knowledge associated with a GCSE Additional Science course or equivalent.

It must be emphasised that this is not a requirement for candidates wishing to study the course offered through this specification. Any requirements are set at the discretion of centres.

Candidates will be required to have an understanding of the following terms:

molecule, ion, compound, element, isomer, isotope, oxidation, bond, reduction, hydrolysis, condensation, wavelength.

4.5 Synoptic Assessment and Stretch and Challenge

The definition of synoptic assessment in the context of science is

Synoptic assessment requires candidates to make and use connections within and between different areas of the subject at AS and A2, for example, by:

- applying knowledge and understanding of more than one area to a particular situation or context
- using knowledge and understanding of principles and concepts in planning experimental and investigative work and in the analysis and evaluation of data
- bringing together scientific knowledge and understanding from different areas of the subject and applying them.

Synoptic assessment in Human Biology is covered in the A2 units by the use of structured questions and an essay question.

The thematic approach in which principles are related to contemporary issues will aid synoptic assessment.

In Unit 4, a longer structured question will involve "methodology" and data interpretation, developing a *How Science Works* context and requiring them to apply subject matter, understanding and skills from Unit 4 and the AS specification.

In the essay, in Unit 5, candidates will be required to use knowledge and understanding from across all units.

There will be synoptic elements included in the A2 ISA.

The requirement that Stretch and Challenge is included at A2 will be met in the externally assessed units by:

- using of a variety of stems in questions to avoid a formulaic approach through the use of such words as: analyse, evaluate, compare, discuss
- avoiding assessments being too atomistic, connections between areas of content being used where possible and appropriate
- having some requirement for extended writing
- using a range of question types to address different skills i.e. not just short answer/structured questions
- asking candidates to bring to bear knowledge and the other prescribed skills in answering questions rather than simply demonstrating a range of content coverage.

The requirements for Stretch and Challenge will be met by having sections within the longer, structured questions in Units 4 and 5 that will offer a genuine challenge to the most able candidates. Differentiation by outcome will be used.

4.6 Access to Assessment for Disabled Students

AS/A Levels often require assessment of a broader range of competences. This is because they are general qualifications and, as such, prepare candidates for a wide range of occupations and higher level courses.

The revised AS/A Level qualification and subject criteria were reviewed to identify whether any of the competences required by the subject presented a potential barrier to any disabled candidates. If this was the case, the situation was reviewed again to ensure that such competences were included only where essential to the subject. The findings of this process were discussed with disability groups and with disabled people.

Reasonable adjustments are made for disabled candidates in order to enable them to access the assessments. For this reason, very few candidates will have a complete barrier to any part of the assessment.

Candidates who are still unable to access a significant part of the assessment, even after exploring all possibilities through reasonable adjustments, may still be able to receive an award. They would be given a grade on the parts of the assessment they have taken and there would be an indication on their certificate that not all the competences had been addressed. This will be kept under review and may be amended in the future.

5 Administration

5.1 Availability of Assessment Units and Certification

After June 2013, examinations and certification for this specification are available in June only.

5.2 Entries

Please refer to the current version of *Entry Procedures and Codes* for up to date entry procedures. You should use the following entry codes for the units and for certification.

Unit 1 – HBIO1

Unit 2 – HBIO2

Unit 3 – **Either** NHBI3T **or** NHBI3X

Unit 4 – HBIO4

Unit 5 – HBIO5

Unit 6 – **Either** NHBI6T **or** NHBI6X

Centres can not make entries for the same candidate for both assessment routes [T and X] in either Unit 3 or Unit 6 in the same examination series.

The assessments produced for each of Unit 3 and Unit 6 are common to AQA AS/A Level Biology (2410) and AQA AS/A Level Human Biology (2405). As a result, centres entering the same candidates for both Biology and Human Biology in the same session for both unit 3s and/or both unit 6s must enter these candidates for route T for one subject and route X for the other subject. Candidates can not enter the same route for both qualifications.

AS certification – 1406

A Level certification – 2406

5.3 Private Candidates

This specification is available to private candidates under certain conditions. Because of the nature of the internally assessed units, candidates must be attending an AQA centre which will supervise and assess the internally assessed work. As we will no longer be providing supplementary guidance in hard copy, see our website for guidance and information on taking exams and assessments as a private candidate:

www.aqa.org.uk/exams-administration/entries/private-candidates

Entries from private candidates can only be accepted where the candidate is registered with an AQA registered centre that will accept responsibility for

- supervising the practical components of the PSA and ISA
- supervising the written component of the ISA
- prime marking the internally assessed work.

Candidates wishing to repeat or complete the AS and/or A2 components may only register as private candidates if they already have a previously moderated mark for Units 3 and 6, respectively, or if they can find a centre that will comply with the above requirements.

5.4 Access Arrangements and Special Consideration

We have taken note of the Equality Act 2010 and the interests of minority groups in developing and administering this specification.

We follow the guidelines in the Joint Council for Qualifications (JCQ) document: *Access Arrangements, Reasonable Adjustments and Special Consideration.* This is published on the JCQ website (**http://www.jcq.org.uk**) or you can follow the link from our website (**http://www.aqa.org.uk**).

Section 2.14.5 of the above JCQ document states that "A practical assistant will not normally be allowed to carry out physical tasks or demonstrate physical abilities where they form part of the assessment objectives." However, in order that candidates may obtain experimental results that can be used in either the ISA or the EMPA, practical assistants may be used to carry out the manipulation under the candidate's instructions. An application for a practical assistant should be made via Access arrangements online and cases will be considered individually.

Access Arrangements

We can make arrangements so that candidates with disabilities can access the assessment. These arrangements must be made **before** the examination. For example, we can produce a Braille paper for a candidate with a visual impairment.

Special Consideration

We can give special consideration to candidates who have had a temporary illness, injury or serious problem, such as death of a relative, at the time of the examination. We can only do this **after** the examination.

The Examinations Officer at the centre should apply online for access arrangements and special consideration by following the e-AQA link from our website **www.aqa.org.uk**

5.5 Language of Examinations

We will provide units in English only.

5.6 Qualification Titles

Qualifications based on this specification are

- AQA Advanced Subsidiary GCE in Human Biology, and
- AQA Advanced Level GCE in Human Biology.

5.7 Awarding Grades and Reporting Results

The AS qualification will be graded on a five-point scale: A, B, C, D and E. The full A level qualification will be graded on a six-point scale: A*, A, B, C, D and E. To be awarded an A*, candidates will need to achieve a grade A on the full A level qualification and an A* on the aggregate of the A2 units. For AS and A level candidates who fail to reach the minimum standard for grade E will be recorded as U (unclassified) and will not receive a qualification certificate. Individual assessment unit results will be certificated.

5.8 Re-sits and Shelf-life of Unit Results

Unit results remain available to count towards certification, whether or not they have already been used, as long as the specification is still valid.

Each unit is available in June only. Candidates may re-sit a unit any number of times within the shelf-life of the specification. The best result for each unit will count towards the final qualification. Candidates who wish to repeat a qualification may do so by re-taking one or more units. The appropriate subject award entry, as well as the unit entry/entries, must be submitted in order to be awarded a new subject grade.

Candidates will be graded on the basis of the work submitted for assessment.

6 Administration of Internally Assessed Units: Route T and Route X

The Head of Centre is responsible to AQA for ensuring that work for the Internally Assessed Units is conducted in accordance with AQA's instructions and JCQ instructions.

Centres can not make entries for the same candidate for both assessment routes [T and X] in either Unit 3 or Unit 6 in the same examination series.

The assessments produced for each of Unit 3 and Unit 6 are common to AQA AS/A Level Biology (2410) and AQA AS/A Level Human Biology (2405). As a result, centres entering the same candidates for both Biology and Human Biology in the same session for both unit 3s and/or both unit 6s must enter these candidates for route T for one subject and route X for the other subject. Candidates can not enter the same route for both qualifications.

6.1 Supervision and Authentication of Internally Assessed Units

The GCE Code of Practice requires

- **candidates** to sign the appropriate section on the front cover of the ISA or EMPA written test to confirm that the work submitted is their own, and
- **teachers/assessors** to confirm on the front cover of the ISA or EMPA written test that the work assessed is solely that of the candidate concerned and was conducted under the conditions laid down by the specification.

Candidates and teachers complete the front cover of the ISA or EMPA written test in place of the Candidate Record Form (CRF). Failure to sign the teacher declaration may delay the processing of the candidates' results.

In all cases, direct supervision is necessary to ensure that the work submitted can be confidently authenticated as the candidate's own.

If teachers/assessors have reservations about signing the teacher declaration, the following points of guidance should be followed

- if it is believed that a candidate has received additional assistance and this is acceptable within the guidelines for the relevant specification, the teacher declaration should be signed and information given.
- If the teacher/assessor is unable to sign the teacher declaration for a particular candidate, then the candidate's work cannot be accepted for assessment.
- If malpractice is suspected, the Examinations Officer should be consulted about the procedure to be followed.

Route T

All teachers who have assessed the work of any candidate entered for each unit must sign the *Centre Declaration Sheet*.

The practical work for the PSA and for the ISA should be carried out in normal lesson time with a degree of supervision appropriate for candidates working in a laboratory. The practical work for the ISA should be completed during the window of assessment for practical work. The processing of raw data and the ISA written test should be taken in normal lesson time under controlled conditions and during the window of assessment for the written test.

Redrafting of answers to any stage of the ISA is not permitted. Candidates must **not** take their work away from the classroom.

Material to submit to moderator

For each candidate in the sample, the following material must be submitted to the moderator by the deadline issued by AQA:

- the candidate's data from Stages 1 and 2 (on the *Candidate Result Sheets*)
- the ISA written test which includes the *Candidate Record Form*, showing the marks for the ISA and the PSA

In addition each centre must provide

- *Centre Declaration Sheet*
- details of any amendments to the task sheet with the information supporting the changes from the Assessment Adviser, if there are any significant changes.

Route X

The practical work for the PSV and for the EMPA should be carried out in normal lesson time with a degree of supervision appropriate for candidates working in a laboratory. The practical work for the EMPA should be completed during the window of assessment for practical work. The processing of raw data and the EMPA written test should be taken in normal lesson time under controlled conditions and during the window of assessment for the written test.

Redrafting of answers to any stage of the EMPA is not permitted. Candidates must **not** take their work away from the class.

Material to submit to examiner

For each candidate, the following material must be submitted to the examiner by the deadline issued by AQA:

- the completed *Task Sheet 1* and *Task Sheet 2*
- the EMPA written test which includes the *Candidate Record Form* including the PSV verification of safe and skilful practical techniques and reliable and valid observations.

In addition each centre must provide

- *Centre Declaration Sheet*
- Details of any amendments to the task sheet with the information supporting the changes from the Assessment Adviser, if there are any significant changes.

6.2 Malpractice

Teachers should inform candidates of the AQA Regulations concerning malpractice.

Candidates must **not**

- submit work which is not their own
- lend work to other candidates
- submit work typed or word-processed by a third person without acknowledgement.

These actions constitute malpractice, for which a penalty (eg disqualification from the examination) will be applied.

If malpractice is suspected, the Examinations Officer should be consulted about the procedure to be followed.

Route T

Where suspected malpractice in assessed work is identified by a centre after the candidate has signed the *Candidate Record Form*, the Head of Centre must submit full details of the case to AQA at the earliest opportunity. The form JCQ/M1 should be used. Copies of the form can be found on the JCQ website **(http://www.jcq.org.uk/)**.

Malpractice in internally assessed work discovered prior to the candidate signing the declaration of authentication need not be reported to AQA, but should be dealt with in accordance with the centre's internal procedures. AQA would expect centres to treat such cases very seriously. Details of any work which is not the candidate's own must be recorded on the Candidate Record Form or other appropriate place.

Route X

If the teacher administering the EMPA believes that a student is involved in malpractice, he/she should contact AQA.

If the examiner suspects malpractice with the EMPA, at any stage, he/she will raise the matter with the Irregularities Office at AQA. An investigation will be undertaken, in line with the JCQ's policies on Suspected Malpractice in Examinations and Assessments.

6.3 Teacher Standardisation (Route T only)

We will hold annual standardising meetings for teachers, usually in the autumn term, for the internally assessed units. At these meetings we will provide support in using the marking guidelines.

If your centre is new to this specification, you must send a representative to one of the meetings. If you have told us you are a new centre, either by submitting an estimate of entry or by contacting the subject team, we will contact you to invite you to a meeting.

We will also contact centres if

- the moderation of internally assessed work from the previous year has identified a serious misinterpretation of the requirements,
- inappropriate tasks have been set, or
- a significant adjustment has been made to a centre's marks.

In these cases, centres will be expected to send a representative to one of the meetings. For all other centres, attendance is optional. If you are unable to attend and would like a copy of the materials used at the meeting, please contact the subject team at **alevelscience@aqa.org.uk**.

6.4 Internal Standardisation of Marking (Route T only)

Centres must standardise marking within the centre to make sure that all candidates at the centre have been marked to the same standard. One person must be responsible for internal standardisation. This person should sign the *Centre Declaration Sheet* to confirm that internal standardisation has taken place.

Internal standardisation involves

- all teachers marking some trial pieces of work and identifying differences in marking standards
- discussing any differences in marking at a training meeting for all teachers involved in the assessment
- referring to reference and archive material such as previous work or examples from AQA's teacher standardising meetings.

6.5 Annotation of Centre Assessed Work (Route T only)

The Code of Practice for GCE states that the awarding body must require internal assessors to show clearly how the marks have been awarded in relation to the marking criteria defined in the specification and that the awarding body must provide guidance on how this is to be done.

The annotation will help the moderator to see as precisely as possible where the teacher considers that the candidates have met the criteria in the specification.

Work could be annotated by either of the following methods

- key pieces of evidence flagged throughout the work by annotation either in the margin or in the text;
- summative comments on the work, referencing precise sections in the work.

6.6 Submitting Marks and Sample Work for Moderation (Route T only)

The total mark for each candidate must be submitted to AQA and the moderator on the mark forms provided or by Electronic Data Interchange (EDI) by the specified date. Centres will be informed which candidates' work is required in the samples to be submitted to the moderator.

6.7 Factors Affecting Individual Candidates

Teachers should be able to accommodate the occasional absence of candidates by ensuring that the opportunity is given for them to make up missed assessments (see section 3.8 Guidance on Centre Assessment).

If work is lost, AQA should be notified immediately of the date of the loss, how it occurred, and who was responsible for the loss. Centres should use the JCQ form JCQ/LCW to inform AQA Candidate Services of the circumstances.

Where special help which goes beyond normal learning support is given, AQA must be informed through comments on the CRF so that such help can be taken into account when moderation takes place (see Section 6.1).

Candidates who move from one centre to another during the course sometimes present a problem for a scheme of internal assessment. Possible courses of action depend on the stage at which the move takes place. If the move occurs early in the course the new centre should take responsibility for assessment. If it occurs late in the course it may be possible to arrange for the moderator to assess the work through the 'Educated Elsewhere' procedure. Centres should contact AQA at the earliest possible stage for advice about appropriate arrangements in individual cases.

6.8 Retaining Evidence and Re-using Marks (Route T only)

The centre must retain the work of all candidates, with CRFs attached, under secure conditions, from the time it is assessed, to allow for the possibility of an enquiry about results. The work may be returned to candidates after the deadline for enquiries about results. If an enquiry about a result has been made, the work must remain under secure conditions in case it is required by AQA.

7 Moderation (Route T only)

7.1 Moderation procedures

Moderation of the internally assessed work is by inspection of a sample of candidates' work, sent by post from the centre to a moderator appointed by AQA. The centre marks must be submitted to AQA and to the moderator by the specified deadline (see **http://www.aqa.org.uk/deadlines.php**). We will let centres know which candidates' work will be required in the sample to be submitted for moderation.

Following the re-marking of the sample work, the moderator's marks are compared with the centre marks to determine whether any adjustment is needed in order to bring the centre's assessments into line with standards generally. In some cases it may be necessary for the moderator to call for the work of other candidates in the centre. In order to meet this possible request, centres must retain under secure conditions and have available the centre assessed work and the CRF of every candidate entered for the examination and be prepared to submit it on demand. Mark adjustments will normally preserve the centre's order of merit, but where major discrepancies are found, we reserve the right to alter the order of merit.

7.2 Post-moderation procedures

On publication of the AS/A level results, we will provide centres with details of the final marks for the centre assessed unit.

The candidates' work will be returned to the centre after moderation has taken place. The centre will receive a report with, or soon after, the despatch of published results giving feedback on the accuracy of the assessments made, and the reasons for any adjustments to the marks.

We reserve the right to retain some candidates' work for archive or standardising purposes.

Appendices

A Performance Descriptions

These performance descriptions show the level of attainment characteristic of the grade boundaries at A Level. They give a general indication of the required learning outcomes at the A/B and E/U boundaries at AS and A2. The descriptions should be interpreted in relation to the content outlined in the specification; they are not designed to define that content.

The grade awarded will depend in practice upon the extent to which the candidate has met the Assessment Objectives (see Section 4) overall. Shortcomings in some aspects of the examination may be balanced by better performances in others.

AS Performance Descriptions for Human Biology

	Assessment Objective 1	Assessment Objective 2	Assessment Objective 3
Assessment Objectives	**AO1 Knowledge and understanding of science and of *How Science Works*** Candidates should be able to: • recognise, recall and show understanding of scientific knowledge • select, organise and communicate relevant information in a variety of forms.	**AO2 Application of knowledge and understanding of science and of *How Science Works*** Candidates should be able to: • analyse and evaluate scientific knowledge and processes • apply scientific knowledge and processes to unfamiliar situations including those related to issues • assess the validity, reliability and credibility of scientific information.	**AO3 *How Science Works*** Candidates should be able to: • demonstrate and describe ethical, safe and skilful practical techniques and processes, selecting appropriate qualitative and quantitative methods • make, record and communicate reliable and valid observations and measurements with appropriate precision and accuracy • analyse, interpret, explain and evaluate the methodology, results and impact of their own and others' experimental and investigative activities in a variety of ways.
A/B boundary performance descriptions	Candidates characteristically a) demonstrate knowledge and understanding of most principles, concepts and facts from the AS specification b) select relevant information from the AS specification c) organise and present information clearly in appropriate forms using scientific terminology.	Candidates characteristically a) apply principles and concepts in familiar and new contexts involving only a few steps in the argument b) describe significant trends and patterns shown by data presented in tabular or graphical form; interpret phenomena with few errors; and present arguments and evaluations clearly c) comment critically on statements, conclusions or data d) carry out accurately most of the calculations specified for AS e) translate successfully data that is presented as prose, diagrams, drawings, tables or graphs from one form to another.	Candidates characteristically a) devise and plan experimental and investigative activities, selecting appropriate techniques b) demonstrate safe and skilful practical techniques and comment effectively on ethical issues c) make observations and measurements with appropriate precision and record them methodically d) interpret, explain, evaluate and communicate the results of their own and others' experimental and investigative activities, in appropriate contexts.

AS Performance Descriptions for Human Biology continued

	Assessment Objective 1	Assessment Objective 2	Assessment Objective 3
E/U boundary performance descriptions	Candidates characteristically a) demonstrate knowledge and understanding of some principles and facts from the AS specification b) select some relevant information from the AS specification c) present information using basic terminology from the AS specification.	Candidates characteristically a) apply a given principle to material presented in familiar or closely related contexts involving only a few steps in the argument b) describe some trends or patterns shown by data presented in tabular or graphical form c) identify, when directed, inconsistencies in conclusions or data d) carry out some steps within calculations e) translate data successfully from one form to another, in some contexts.	Candidates should characteristically a) devise and plan some aspects of experimental and investigative activities b) demonstrate safe practical techniques and comment on ethical issues c) make observations and measurements and record them d) interpret, explain and communicate some aspects of the results of their own and others' experimental and investigative activities, in appropriate contexts.

A

A2 Performance Descriptions for Human Biology

	Assessment Objective 1	Assessment Objective 2	Assessment Objective 3
Assessment Objectives	**AO1 Knowledge and understanding of science and of *How Science Works*** Candidates should be able to: • recognise, recall and show understanding of scientific knowledge • select, organise and communicate relevant information in a variety of forms.	**AO2 Application of knowledge and understanding of science and of *How Science Works*** Candidates should be able to: • analyse and evaluate scientific knowledge and processes • apply scientific knowledge and processes to unfamiliar situations including those related to issues • assess the validity, reliability and credibility of scientific information.	**AO3 *How Science Works*** Candidates should be able to: • demonstrate and describe ethical, safe and skilful practical techniques and processes, selecting appropriate qualitative and quantitative methods • make, record and communicate reliable and valid observations and measurements with appropriate precision and accuracy • analyse, interpret, explain and evaluate the methodology, results and impact of their own and others' experimental and investigative activities in a variety of ways.
A/B boundary performance descriptions	Candidates characteristically a) demonstrate detailed knowledge and understanding of most principles, concepts and facts from the A2 specification b) select relevant information from the A2 specification c) organise and present information clearly in appropriate forms using scientific terminology.	Candidates characteristically a) apply principles and concepts in familiar and new contexts involving several steps in the argument b) describe significant trends and patterns shown by complex data presented in tabular or graphical form; interpret phenomena with few errors; and present arguments and evaluations clearly c) evaluate critically any statements, conclusions or data d) carry out accurately most of the calculations specified for A2; and apply the principles of statistical analysis when directed e) translate successfully data that is presented as prose, diagrams, drawings, tables or graphs from one form to another f) select a wide range of facts, principles and concepts from both AS and A2 specifications g) link together appropriate facts principles and concepts from different areas of the specification.	Candidates characteristically a) devise and plan experimental and investigative activities, selecting appropriate techniques b) demonstrate safe and skilful practical techniques and comment effectively on ethical issues c) make observations and measurements with appropriate precision and record these methodically d) interpret, explain, evaluate and communicate the results of their own and others' experimental and investigative activities, in appropriate contexts e) use an appropriate statistical technique to assess the validity of a hypothesis.

A2 Performance Descriptions for Human Biology continued

	Assessment Objective 1	Assessment Objective 2	Assessment Objective 3
E/U boundary performance descriptions	Candidates should characteristically a) demonstrate knowledge and understanding of some principles, concepts and facts from the A2 specification b) select some relevant information from the A2 specification c) present information using basic terminology from the A2 specification.	Candidates should characteristically a) apply given principles or concepts in familiar and new contexts involving a few steps in the argument b) describe, and provide a limited explanation of, trends or patterns shown by complex data presented in tabular or graphical form c) identify, when directed, inconsistencies in conclusions or data d) carry out some steps within calculations e) translate data successfully from one form to another, in some contexts f) select some facts, principles and concepts from both AS and A2 specifications g) put together some facts, principles and concepts from different areas of the specification.	Candidates characteristically a) devise and plan some aspects of experimental and investigative activities b) demonstrate safe practical techniques and comment on ethical issues c) make observations and measurements and record them d) interpret, explain and communicate some of the results of their own and others' experimental and investigative activities, in appropriate contexts e) use a given statistical technique.

B Spiritual, Moral, Ethical, Social and other Issues

European Dimension

AQA has taken account of the 1988 Resolution of the Council of the European Community in preparing this specification and associated specimen units.

The specification is designed to improve candidates' knowledge and understanding of the international debates surrounding new technology and to foster responsible attitudes to such developments.

Environmental Education

AQA has taken account of the 1988 Resolution of the Council of the European Community and the Report "Environmental Responsibility: An Agenda for Further and Higher Education" 1993 in preparing this specification and associated specimen units.

The specification is designed to improve candidates' knowledge and understanding of environmental themes which occur in AS Units 1and 2, and A2 Units 4 and 5. Opportunities for consideration of environmental issues are indicated in the contents of the units.

Avoidance of Bias

AQA has taken great care in the preparation of this specification and specimen units to avoid bias of any kind.

Spiritual, Moral, Ethical, Social and Cultural Issues

The study of Human Biology lends itself to consideration of many spiritual, moral and cultural issues. The immense variety and complexity of living organisms ineluctably evoke awe and wonder, and candidates should be encouraged to appreciate and respect all forms of life.

Consideration of the evidence for evolution and natural selection may lead candidates to reflect on ultimate questions relating to the origin and meaning of life. Many of the potential applications of biological understanding raise moral and ethical issues. Opportunities for discussion of these issues are indicated in the contents of the units.

This specification encourages candidates to appreciate the importance of all aspects of the global environment and the necessity to achieve sustainability to ensure the continuation of the human race.

The following sections of the specification may be particularly apposite for analysis and discussion of the above issues

AS specification

- Risks and benefits of mass vaccination programmes (3.1.5)
- The links between life-style and cardiovascular disease (3.1.6)
- Evidence for genetic and environmental factors increasing the incidence of cancer (3.2.2)
- The legality of cigarette smoking and treatment of diseases linked to smoking (3.2.2)
- The impact of human activities on biodiversity and the environment (3.2.5)

A2 specification

- Use of different forms of contraception (3.4.1)
- Use of IVF (3.4.1)
- Issues facing society in terms of the increasing number of elderly people in the population and treating conditions associated with old age (3.4.2)
- Use of genetic counselling (3.4.2)
- Correlations between environmental factors and cancer (3.4.3)
- The use of modern gene technologies and GM organisms (3.4.4)
- Effect of drugs on perception (3.4.5)
- Links between life-style and incidence of diabetes
- Meeting human demands v need to conserve the environment (3.5.1)
- Links between air pollution and respiratory illnesses (3.5.2)
- Cost implications of pollution (3.5.3)
- Effects of global warming (3.5.4)
- Use of biofuels (3.5.4)
- Widespread use of antibacterial agents (3.5.6)

Terminology

The terminology used in all the written papers will be that described in the Institute of Biology publication *Biological Nomenclature,Recommendation on Terms, Units and Symbols* (3rd edition 2000). The overriding consideration in setting papers will continue to be clarity and lack of ambiguity rather than adherence to strict rules; alternative names or units will be given whenever ambiguity might otherwise arise. The use in a candidate's answer of names, formulae or units other than those included in the above publication will be accepted, provided that the essential biological information is correctly supplied in the answer.

Health and Safety

AQA recognises the need for safe practice in laboratories and tries to ensure that experimental work required for this specification and associated practical work complies with up-to-date safety recommendations.

As centres are primarily responsible for the safety of candidates, an assessment of risks involved in all practical procedures must be made before work commences under the COSHH regulations. Attention is drawn to the hazards associated with many materials and processes associated with the specification. Detailed information may be found in pamphlets on safety issued by the Department for Education and Skills. Centres are advised to consider relevant information from organisations such as CLEAPSS and read Hazcards where appropriate. In addition, all work involving live organisms must be legal and humane.

It is expected that all candidates will be familiar with appropriate standards of safety in all aspects of practical work, in particular the potential hazards of microbiological work.

C Overlaps with other Qualifications

AQA GCE Biology

The Subject Criteria for Biology require that all GCE Biology specifications will have at least fifty percentage overlap in content with each other but the depth of treatment of each topic and the assessment pattern will ensure that each specification is distinctive.

AQA GCE Chemistry

There are minimal overlaps with Chemistry although some aspects of biochemistry are covered in both specifications, for example the structure of organic molecules, bonding and the action of enzymes.

AQA GCE Physics A - Traditional

There is a marginal overlap with Medical Physics.

AQA GCE Science in Society

The following topics are covered to varying depths in both specifications: Cells, Infectious Diseases, Lifestyle and Health, Genetic Diseases, Genetic Engineering, Biodiversity, Human Reproduction, Evolution, Ethical issues in Medical rResearch and Disease Treatment, Human Impact on the Environment, Nervous Coordination.

AQA GCE Psychology A

There is a marginal overlap with Biological basis of sex differences and of perception, and the advantages of behavioural and sociological adaptations of humans.

AQA GCE Applied Science

There are some overlaps with the following units

Unit 2 Energy Transfer Systems

Unit 7 Planning and Carrying out a Scientific Investigation

Unit 8 Medical Physics

Unit 9 Sports Science

Unit 14 The Healthy Body

Unit 16 Ecology, Conservation and Recycling

AQA GCE Environmental Studies

There are some overlaps with all four units with respect to human impact on the environment. However, the approach, breadth and depth of coverage of related topics varies between the specifications.

AQA Applied GCE in Health and Social Care

There are some overlaps with the following units

Unit 3 Health, Illness and Disease

Unit 5 Nutrition and Dietetics

Unit 6 Common Diseases and Disorders

Unit 13 The Role of Exercise in Maintaining Health and Well-Being

Unit 14 Diagnosis and Treatment

Unit 19 Physiological Aspects of Health

Unit 20 Environmental Health

Unit 21 Research Methods and Perspectives

D Key Skills

Key Skills qualifications have been phased out and replace by Functional Skills qualifications in English, Mathematics and ICT from September 2010.

GCE Human Biology (2405) For exams from June 2014 onwards

Qualification Accreditation Number: AS 500/2351/2 - A Level 500/2340/8

For updates and further information on any of our specifications, to find answers or to ask a question: register with ASK AQA at:

http://www.aqa.org.uk/help-and-contacts/ask-aqa

For information on courses and events please visit:

http://www.aqa.org.uk/professional-development

Every specification is assigned a discounting code indicating the subject area to which it belongs for performance measure purposes.

The discount codes for this specification are:

AS RH41

A Level 1010

The definitive version of our specification will always be the one on our website, this may differ from printed versions.

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