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ASSESSMENT and QUALIFICATIONS ALLIANCE

General Certificate of Secondary Education

# Human Physiology and Health
# 3417

2010

# SPECIFICATION

This specification will be published annually on the AQA Website (www.aqa.org.uk). If there are any changes to the specification centres will be notified in print as well as on the Website. The version on the Website is the definitive version of the specification.

Further copies of this specification booklet are available from:

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# Background Information

## 1 The Revised General Certificate of Secondary Education

Following a review of the National Curriculum requirements and the establishment of the National Qualifications Framework, all the unitary awarding bodies have revised their GCSE syllabuses for examination in 2003.

### 1.1 Changes at GCSE

**Key Skills**

All GCSE specifications must identify, as appropriate, opportunities for generating evidence on which candidates may be assessed in the "main" Key Skills of communication, application of number and information technology at the appropriate level(s). Also, where appropriate, they must identify opportunities for developing and generating evidence for addressing the "wider" Key Skills of working with others, improving own learning and performance and problem solving.

**Spiritual, moral, ethical, social, cultural, environmental, health and safety and European Issues**

All specifications must identify ways in which the study of the subject can contribute to an awareness and understanding of these issues.

**ICT**

The National Curriculum requires that students should be given opportunities to apply and develop their ICT capacity through the use of ICT tools to support their learning. In each specification candidates will be required to make effective use of ICT in ways appropriate to the needs of the subject.

**Tiering**

In most subjects the scheme of assessment must include question papers targeted at two tiers of grades, i.e. A* - D and C - G.

A safety net of an allowed Grade E will be provided for candidates entered for the higher tier who just fail to achieve Grade D. The questions will still be targeted at A* - D.

**Citizenship**

From 2002, students in England have been required to study Citizenship as a National Curriculum subject. Each GCSE specification must signpost, where appropriate, opportunities for developing citizenship knowledge, skills and understanding.

### 1.2 Changes to the Science Criteria

Changes made to the GCSE Criteria for Science, which this specification is designed to meet, reflect the changes made to Science in the National Curriculum as part of the National Curriculum review.

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# Specification at a Glance
## *Human Physiology and Health*

This is the only specification in this subject offered by AQA.

There are two tiers of Assessment: Foundation (G-C) and Higher (D-A*).

A candidate can enter for one tier only.

| GCSE Human Physiology and Health (3417) |
|---|
| **Written Paper**<br>Foundation Tier (3417/1F) 2 hours — 80 % of total marks<br>120 marks<br>Compulsory short answer and structured questions including extended writing.<br>**OR**<br>Higher Tier (3417/1H) 2 hours — 80 % of total marks<br>120 marks<br>Compulsory short answer and structured questions including extended writing.<br><br>Covers three themes:<br>Relations between Man, other organisms and the environment<br>Organisation and maintenance of the individual<br>Reproduction, growth and development |
| **Coursework**<br>20 % of total marks<br>30 marks<br>Investigative skills assessed by the centre and moderated by AQA. Common to both tiers.<br><br>The skills assessed are: planning; implementing; analysing, drawing conclusions and evaluating; communicating.<br><br>Evidence can be collected from first hand experience or from secondary sources including ICT. |

| Foundation Tier |
|---|
| 3417F |
| Higher Tier |
| 3417H |

# 3 Availability of Assessment Units and Entry Details

| | | |
|---|---|---|
| 3.1 | Availability of Assessment Units | Examinations based on this specification are available in the June Series only. |
| 3.2 | Entry Codes | Normal entry requirements apply but the following information should be noted.<br><br>The **Subject Code** for entry to the GCSE award is 3417F for Foundation Tier and 3417H for Higher Tier. |
| 3.3 | Classification Codes | Each specification is assigned to a national classification code, indicating the subject area to which it belongs.<br><br>Centres should be aware that candidates who enter for more that one GCSE qualification with the same classification code, will have only one grade (the highest) counted for the purpose of the School and College Performance Tables.<br><br>The classification code for this specification is 1030. |
| 3.4 | Private Candidates | This specification is available for private candidates. Private candidates should write to AQA for a copy of *"Supplementary Guidance for Private Candidates"*. |
| 3.5 | Access Arrangements and Special Consideration | AQA pays due regard to the provisions of the Disability Discrimination Act 1995 in its administration of this specification.<br><br>Arrangements may be made to enable candidates with disabilities or other difficulties to access the assessment. An example of an access arrangement is the production of a Braille paper for a candidate with a visual impairment. Special consideration may be requested for candidates whose work has been affected by illness or other exceptional circumstances.<br><br>Further details can be found in the Joint Council for Qualifications (JCQ) document:<br><br>*Access arrangements and Special Consideration*<br>*Regulations and Guidance relating to Candidates who are Eligible for Adjustments in Examination*<br>*GCE, AEA,VCE, GCSE, GNVQ, Entry Level and Key Skills*<br>This document can be viewed via the AQA website (www.aqa.org.uk)<br><br>Applications for access arrangements and special consideration should be submitted to AQA by the examinations officer at the centre. |

## 3.6 Language of Examinations

All assessment will be through the medium of English. Assessment materials will not be provided in Welsh or Gaeilge.

# Scheme of Assessment

## 4 Introduction

### 4.1 National Criteria

This AQA GCSE in Human Physiology and Health specification complies with the following:

- The GCSE Subject Criteria for Science;
- The GCSE,GCE, VCE, GNVQ and AEA Code of Practice 2007;
- The GCSE Qualification Specific Criteria;
- The Arrangements for the Statutory Regulation of External Qualifications in England, Wales and Northern Ireland: Common Criteria.

### 4.2 Rationale

This specification has been designed to develop a positive attitude to health and emphasises the personal, social, environmental, economic and technological aspects of human biology. Examples of applied aspects of the subject occur throughout.

The approach reflects the style of previous AQA (NEAB) and AQA (SEG) syllabuses, providing continuity for centres wherever possible. It is illustrative; centres are free to organise the material to form a scheme of work in any suitable way. The framework can be used by teachers / lecturers to devise courses which meet their needs and to adapt their courses as their needs change. Extensive cross-referencing of subject content is included for this purpose.

As much continuity as possible is provided in order to conserve the extensive financial and professional resources already invested in the organisation of teaching and assessment and, in its flexibility, for continued development of the quality of schemes of work in centres.

### 4.3 Prior level of attainment and recommended prior learning

No prior learning or level of attainment is necessary for candidates to undertake a course of study based on this specification. However, the specification does build on the knowledge, understanding and skills set out in the National Curriculum Key Stage 3 Programme of Study for Sc2, Science. A level of scientific, literacy and numeracy skills commensurate with having followed a programme of study at Key Stage 3 is expected.

### 4.4 Progression

This qualification is a recognised part of the National Qualifications framework. As such, GCSE provides progression from Key Stage 3 to further studies.

This specification provides an appropriate foundation for further study of Biology/Human Biology or related subjects at AS/A Level and GNVQ. In addition it provides a worthwhile course for

candidates of various ages and from diverse backgrounds in terms of general education and lifelong learning.

# 5 Aims

A course based on this specification should encourage candidates to:

- acquire a systematic body of scientific knowledge and the skills needed to apply this in new and changing situations in a range of domestic, industrial and environmental contexts;
- acquire an understanding of scientific ideas, how they develop, the factors which may affect their development and their power and limitations;
- plan and carry out a range of investigations, considering and evaluating critically their own data and that obtained from other sources, using ICT where appropriate;
- evaluate, in terms of their scientific knowledge and understanding, the benefits and drawbacks of scientific and technological developments, including those related to the environment, personal health and quality of life, and considering ethical issues;
- select, organise and present information clearly and logically, using appropriate scientific terms and conventions, using ICT where appropriate.

# 6 Assessment Objectives

This specification requires candidates to demonstrate the following assessment objectives in the context of the content and skills prescribed. Within each of the assessment objectives the assessment must take account of candidates' ability to communicate clearly and logically, using specialist vocabulary and conventions where appropriate.

## 6.1 Knowledge and Understanding (AO1)

Candidates must be able to:

- recognise, recall and show understanding of specific scientific facts, terminology, principles, concepts and practical techniques;
- demonstrate understanding of the power and limitations of scientific ideas and factors affecting how these ideas develop;
- draw on existing knowledge to show understanding of the benefits and drawbacks of applications of science;
- select, organise and present relevant information.

## 6.2 Application of knowledge and understanding, analysis and evaluation (AO2)

Candidates must be able to:

- describe, explain and interpret phenomena, effects and ideas in terms of scientific principles and concepts, presenting arguments and ideas clearly and logically;
- interpret and translate, from one form into another, data presented as continuous prose or in tables, diagrams and graphs;
- carry out relevant calculations;
- apply principles and concepts to unfamiliar situations, including those related to applications of science in a range of domestic, industrial and environmental contexts;
- evaluate scientific information and make informed judgements from it.

## 6.3 Investigative skills (AO3)

Candidates must be able to:

- devise and plan investigations, drawing on scientific knowledge and understanding in selecting appropriate strategies;
- demonstrate appropriate investigative methods, including safe and skilful practical techniques, obtaining data which are sufficient and of appropriate precision, recording these methodically;
- interpret data to draw conclusions which are consistent with the evidence, using scientific knowledge and understanding, whenever possible, in explaining their findings;
- evaluate data and methods.

## 6.4 Quality of Written Communication

Where candidates are required to produce extended written material in English, they will be assessed on the quality of written communication.

Candidates will be required to:

- present relevant information in a form that suits its purposes;
- ensure that text is legible and that spelling, punctuation and grammar are accurate, so that meaning is clear.

Quality of written communication will be assessed in the written papers and coursework. This assessment is, therefore, included in all three assessment objectives.

# 7 Scheme of Assessment

## 7.1 Assessment Units

The Scheme of Assessment comprises two components.

| Written Paper | 2 hours |
|---|---|
| 80 % of the marks | 120 marks |

There are separate papers for Foundation (3417F) and Higher (3417H) Tiers. The presentation of the content makes clear the topics to be covered in the two papers. Common questions, at the C/D standard, will be used across the two tiers.

All questions will be compulsory, short answer and structured questions.

There will be opportunity for answers written in continuous prose. The marking of candidates' continuous prose answers will take into account the quality of written communication.

| Coursework | |
|---|---|
| 20 % of the marks | 30 marks |

This component assesses investigative skills. It requires candidates to plan, carry out, analyse and evaluate their work and should encourage the use of ICT where appropriate.

It is marked by the teacher and moderated by AQA.

## 7.2 Weighting of Assessment Objectives

The approximate relationship between the relative percentage weighting of the Assessment Objectives (AOs) and the overall Scheme of Assessment is shown in the following table:

| Assessment Objectives | Component Weightings (%) | | Overall Weighting of AOs (%) |
|---|---|---|---|
| | 1 | 2* | |
| 1. Knowledge and understanding | 50 | - | 50 |
| 2. Application, analysis and evaluation | 30 | - | 30 |
| 3. Investigative skills | - | 20 | 20 |
| **Overall Weighting of Units (%)** | 80 | 20 | **100** |

*Centre-assessed coursework
Candidates' marks for each assessment unit are scaled to achieve the correct weightings.

## 7.3 Terminal Examination Requirements

The requirements of the ideas and evidence section of Sc1 Scientific Enquiry need to be met through the teaching of the subject content in this specification.

### Ideas and evidence in Science

The subject content includes classic historical and contemporary contexts selected as being appropriate for the teaching / learning and assessment of ideas and evidence in science. These contexts may also be used to assess knowledge and understanding of relevant scientific ideas from the subject content.

All of these contexts are indicated by .

Through these contexts candidates should be able to apply the following ideas appropriately to information they are given about historically important scientific discoveries and to currently controversial scientific and technological issues:

a. that scientists report their findings to other scientists in special journals. The reports are not published unless the scientific research is of good quality and the findings are not usually accepted unless they can be repeated by other scientists;

b. that members of the public depend on the mass media (TV, newspapers, radio etc.) to keep them informed about issues involving science and technology. These may be biased but have a big influence on:
   - the issues that are discussed;
   - the points of view people take on these issues;
   - decisions about what research should be funded;

c. that to explain their findings, scientists need to use their imaginations so that there can be more than one explanation of the same findings;

d. that scientists, like other people:
   - are reluctant to give up explanations that have served them well in the past;
   - have scientific, moral, religious and social views that are influenced by the views of the society in which they live;

e. that a new explanation is more likely to be accepted if it can be used to make predictions which are then observed to be correct;

f. that scientists may be uncertain about whether or not a factor increases the chance of a particular outcome. This is especially likely:
   - in complex situations;
   - when the evidence is based on a small number of cases;
   - if it is difficult to explain how the factor could cause the outcome;

g. that science-based technology provides people with many of the things they most value in life but can also, usually unintentionally, harm people and the environment so that benefits always need to be weighed against costs (economic, environmental and social);

h. that even when there is full scientific agreement about the likely effects of some technological process, there is always a further (moral) question about whether, on balance, it should be allowed.

## Assessment

Questions designed to assess ideas and evidence through the contexts in the subject content will be included in the terminal examination papers and will contribute 5% to the overall award. Any information needed by candidates to answer these questions, in addition to that which is included in the subject content, will be provided in the questions themselves.

# Subject Content

## 8 Summary of Subject Content

| 10. Relations between Man, other organisms and the environment | | |
|---|---|---|
| Dependence of Man on other organisms | 10.1 | Food chains and webs |
| | 10.2 | The flow of energy |
| | 10.3 | Recycling |
| The importance of hygiene and healthy living | 10.4 | Health of the individual |
| | 10.5 | Healthy food and water |
| The influence of Man on the environment | 10.6 | Implications of rapid human population increase |
| | 10.7 | Pollution |

| 11. Organisation and maintenance of the individual | | |
|---|---|---|
| Structure and functioning of cells | 11.1 | Basic structure of an animal cell |
| | 11.2 | The skin |
| | 11.3 | Principles of enzyme action |
| | 11.4 | Movement of substances in and out of cells |
| | 11.5 | Respiration |
| Life processes | 11.6 | Nutrition |
| | 11.7 | Making food available to the body |
| | 11.8 | The blood circulatory system |
| | 11.9 | Breathing and gaseous exchange |
| | 11.10 | Excretion |
| | 11.11 | Sensitivity and coordination |
| | 11.12 | Homeostasis |
| | 11.13 | The skeletal system, muscles and movement |

| 12. Reproduction, growth and development | | |
|---|---|---|
| Sexual reproduction | 12.1 | The sex organs |
| | 12.2 | The menstrual cycle and ovulation |
| | 12.3 | Gametes and fertilisation |
| Healthy development, pre- and post-natal | 12.4 | Pregnancy |
| | 12.5 | Birth, lactation and parental care |
| | 12.6 | Post-natal growth and development |
| | 12.7 | Cancer |
| Chromosomes, cell division and genetics | 12.8 | Chromosomes and genes |
| | 12.9 | Genetics |
| | 12.10 | Chemical nature of the genetic material |
| Variation, its cause and significance | 12.11 | Types of variation |
| | 12.12 | Genetic engineering |

# 9 Introduction to Subject Content

The content in this specification illustrates how the various topics can be arranged to reflect the distinctive nature of the subject. The arrangement of the specification enables cross-referencing where concepts inter-relate or where topics might be transferred for teaching purposes.

The detailed content inevitably seems quite long. However, it is important to realise that it represents an explicit specification of the knowledge, skills and understanding expected of candidates.

The presentation of the content makes clear the material to be covered in the two terminal examination tiers, as follows:

| | |
|---|---|
| FT and HT | content included in **both** Foundation and Higher Tiers. |
| HT | content included in **only** the Higher Tier. |
|  | denotes the subject content relating to Ideas and Evidence in Science. |

# 10 Relations between Man, other organisms and the environment

## *Dependence of Man on other organisms*

### 10.1 Food chains and webs — FT and HT

Green plants, as producers, capture a small part of the solar energy which reaches them and store it in organic chemicals in the cell. Plants produce organic chemicals from carbon dioxide, water and mineral salts.

### 10.2 The flow of energy — FT and HT

Plants provide food for other organisms. Energy passes along food chains to consumers: herbivores, carnivores, omnivores and predators.

**Pyramids of energy and biomass**

Less material and less energy are stored at each successive stage in a food chain because only part of the materials and energy can be used for growth.

Losses in materials and energy occur

- in the organism's waste materials
- in repair and maintenance of body tissues
- in respiration, some materials are used to supply the energy needed for living processes – e.g. muscle contraction.

Much of this energy eventually ends up being lost to the environment as heat.

| | | | |
|---|---|---|---|
| 10.3 | Recycling | FT and HT | Detritus feeders and decomposers break down the waste products and dead bodies of organisms, releasing energy and recycling materials as inorganic nutrients for plants. (**See 10.5**) |

## *The importance of hygiene and healthy living*

| | | | |
|---|---|---|---|
| 10.4 | Health of the individual | FT and HT | The emphasis of this section is to be on the maintenance of health and the prevention of illness. |
| | Basic standards of personal cleanliness | | Sweat production encourages the growth of bacteria which feed on sweat and produce waste substances which cause body odour (BO), especially in regions such as the armpits, groin and feet. Regular showering or bathing removes sweat and bacteria from the skin.<br><br>Sebum (oil) production is increased during adolescence. Blocked sebaceous glands may lead to the formation of pimples or spots. On the scalp excess sebum causes<br>• greasy hair<br>• dandruff, if it mixes with dead skin cells.<br><br>Greasy hair should be washed frequently with an appropriate shampoo.<br><br>Cleansing of the skin reduces the likelihood of infection by microorganisms. (**See 11.2**) |
| | The importance of exercise and physical fitness | | Regular exercise improves the efficiency of the breathing system and circulatory system. (**See 11.5, 11.8, 11.9**) |
| | The importance of a balanced diet | | Humans need a balanced intake of nutrients. There are problems associated with over-eating and under-eating. (**See 11.6, 11.7**) |
| | The importance of regular dental care | | Tooth decay is caused by acids produced by bacteria which live on food which is stuck to teeth. These acids dissolve the enamel of the teeth. Regular brushing helps to remove the food and bacteria and prevent a build-up of plaque. (**See 11.7**) |
| | Drug use and abuse | | The use of antibiotics, painkillers, depressants and stimulants.<br>• Antibiotics<br>- antibiotics may be used to combat certain diseases caused by bacteria. Danger of over use: this may lead to selection of resistant strains of bacteria. (**See 12.11**)<br>- the discovery of Penicillin by Alexander Fleming emphasising the importance of following up a chance observation:<br>- the mould, Penicillium, was seen to inhibit the growth of bacteria on an agar plate<br>- reasoning that the mould must have released a chemical (an 'antibiotic') which inhibited the growth of the bacteria<br>- culturing the mould to produce a mixture, containing the antibiotic, which was bactericidal and which did not harm human cells. |

- Painkillers
  Painkillers, such as aspirin and paracetamol, act on the nervous system. They may have side-effects such as damaging the gut lining.

- Depressants and stimulants
  Alcohol is a depressant which affects the nervous system and slows down reactions. In larger quantities it can lead to lack of self-control, unconsciousness or even coma. It may also lead to liver and brain damage and harm the unborn fetus.

  Nicotine, as in cigarettes, is a stimulant.

Solvents and drugs affect behaviour and may cause damage to the brain, the liver and the kidneys. Drugs change the chemical processes in the body so that a person may become dependent on or addicted to them and suffer withdrawal symptoms without them. (**See 11.10, 11.11, 12.4**)

Smoking and health

Smoking has physiological effects on the body, and causes illnesses such as lung cancer, bronchitis, emphysema, heart disease and damaged arteries in other parts of the circulatory system. (**See 11.8, 11.9, 12.4, 12.7, 12.11**)

Disease

There are various conditions of the body, resulting in ill-health, which have a variety of causes. These causes include

- inheritance, e.g. haemophilia, cystic fibrosis, red-green colour blindness (**See 12.9**)
- self-abuse, e.g. the effects of smoking, alcohol and over-eating
- dietary deficiency, e.g. vitamin and mineral deficiencies (**See 11.6**)
- degenerative diseases (**See 11.11, 11.13, 12.6**)
- infection with microorganisms.

Microorganisms may cause disease by reproducing rapidly in the body and producing toxins (poisons). Infectious diseases are more likely to occur if large numbers of microorganisms enter the body as a result of unhygienic conditions or contact with infected people.

Infectious diseases may be caused by

- viruses e.g. common cold, influenza, poliomyelitis, rabies, AIDS
- bacteria e.g. cholera, typhoid, tetanus, whooping cough, diphtheria, tuberculosis, Salmonella food poisoning, gonorrhoea, syphilis
- fungi e.g. athlete's foot, thrush
- protoctistans e.g. malaria.

Infectious diseases may be transmitted

- through the air (droplet infection)
- by direct contact, including sexual contact (**See 12.3, 12.4**)
- through food and water (**See 10.5**)
- by vectors.

There are several ways by which the body prevents the entry of pathogens (disease-producing organisms)

- the skin acts as a natural barrier (**See 11.2**)
- mucus and ciliated cells in the respiratory passages trap some pathogens (**See 11.9**)
- acid conditions in the stomach, vagina and urethra kill some pathogens
- scabs form following blood clotting at the site of wounds. (**See 11.8**)

Candidates should be able, when provided with appropriate information, to explain how living conditions and lifestyle affect the spread of disease.

## 10.5 Healthy food and water

### Healthy food

FT and HT

Microorganisms (e.g. Salmonella bacteria) can contaminate food, causing disease or food spoilage.
Careful attention to hygiene in the preparation and storage of food helps to prevent the spread of disease.

Precautions which can be taken to prevent disease caused by microorganisms in food (food poisoning) include

- keeping fresh food in a refrigerator
- preventing animals and insects, such as rats, mice and flies, from reaching food and contaminating it with microorganisms
- disinfecting implements and surfaces used for preparing food
- preparing and storing cooked and uncooked meats separately
- thoroughly cooking meat and meat products
- thoroughly thawing frozen food before cooking
- educating all who handle food in the risks of food poisoning
- excluding known carriers of food-poisoning microorganisms from the food industry.

### Food preservation

Methods of preserving food include

- pasteurisation of milk, which involves heating the milk at 72 °C for 15 seconds then immediately cooling it to 10 °C. This kills most of the microorganisms in milk without affecting the taste
- sterilisation, in which food is heated to a high temperature (often 133 °C) which kills all the microorganisms in it
- freezing, which prevents microorganisms from multiplying in the food but does not kill them
- refrigeration, which slows the multiplication of microorganisms
- dehydrating the food to remove the water which microorganisms need to grow and reproduce
- pickling, in which the food is stored in a weak acid (vinegar) which denatures proteins in microorganisms
- canning, in which initial heat treatment sterilises the food and sealing prevents further entry of living microorganisms.

### Clean water supply

Drinking water needs to be cool, clear and free from contamination by pathogens (e.g. the bacteria which cause cholera or typhoid) and toxic chemicals.

Outline of the operation of a water purification plant, to include
- screening, to remove large floating matter
- settlement, to remove particles of inorganic matter
- filtration, for further removal of organic matter and microorganisms
- chlorination, to kill microorganisms
- transport and storage in the dark to prevent the growth of algae.

Disposal of sewage

Sewage contains organic matter. If organic matter is passed into water, microorganisms feed on it and grow in large numbers. Their respiration reduces the oxygen content of the water, and may make conditions impossible for the survival of other aquatic organisms. One aim of sewage treatment is to reduce the amount of organic material in effluent.

Operation of a sewage treatment plant, to include
- screening, to remove large particles of floating matter
- grit settlement
- primary sedimentation, where organic particles settle out as sludge
- aerobic biological processing, in either a filter bed or by the activated sludge process
- secondary sedimentation of organic particles
- anaerobic biological processing: sludge digestion which releases methane gas.

Refuse disposal

The hygienic disposal of domestic refuse by
- burial in landfill sites, where decomposition due to the activity of soil microorganisms (which produces methane) can occur and where access to vectors such as rats and houseflies is reduced
- incineration, which kills disease-causing microorganisms
- recycling of re-usable materials like paper, glass, metals and plastics. (**See 10.3, 10.4, 10.7**)

## *The influence of Man on the environment*

### 10.6 Implications of rapid human population increase

FT and HT

Natural factors which affect the size of human populations include
- nutrition
- disease.

Other factors affecting human population size include
- birth control
- health measures.

For most of human history, the population has been small and the effects of human activity on the environment have been small and local. In recent centuries the population has been rising rapidly.

This increase in population means that
- raw materials, including non-renewable energy resources (fossil fuels), are rapidly being used up
- increasingly more waste is being produced
- unless waste is properly handled, more pollution will be caused.

| | | | |
|---|---|---|---|
| 10.7 | Pollution | FT and HT | Pollutants have effects on the environment and on personal health. |
| | Sewage, fertilisers and industrial chemicals | | Eutrophication may be caused by pollution of water by sewage or by inorganic fertilisers. (**See 10.5**) Some bacteria and toxic chemicals from agriculture and industry, which are harmful to humans, may be present in drinking water. |
| | Sulphur dioxide, oxides of nitrogen, carbon monoxide, carbon dioxide | | Waste gases, including those from power stations, factories and motor vehicles, are sent into the air and pollute it. These include<br>• sulphur dioxide, oxides of nitrogen and carbon dioxide, which are acidic when dissolved in water; sulphur dioxide and oxides of nitrogen are irritants to living tissues<br>• carbon monoxide, which combines with haemoglobin and reduces the oxygen-carrying capacity of the blood (**See 11.8**)<br>• increases in carbon dioxide in the atmosphere may result in global warming and other consequential climate changes (e.g. rainfall). |
| | Methane | | Increases in the number of cattle, rice-fields and landfill sites for refuse disposal, have increased the amount of methane released into the atmosphere. Methane may also contribute to global warming. (**See 10.5**) |
| | Chlorofluorocarbons (CFCs) | | CFCs can cause ozone depletion in the upper atmosphere and thus lead to exposure of living organisms to UV radiation. This can cause skin cancer in humans. (**See 12.7, 12.11**) |
| | Heavy metals such as lead | | Heavy metals can combine with proteins (e.g. enzymes) and destroy their activity. |
| | Radiation | | Radiation can cause cancer. (**See 12.7, 12.11**) |
| | Pesticides | | Concentrations of certain pesticides can increase by passage up a food chain and being stored in the body rather than being excreted. |

# 11 Organisation and maintenance of the individual

## *Structure and functioning of cells*

| | | | |
|---|---|---|---|
| 11.1 | Basic structure of an animal cell | FT and HT | The human body is made up of cells. Most cells have the following parts<br>• a nucleus which contains the genetic material and controls the activities of the cell<br>• cytoplasm in which most of the chemical reactions take place<br>• a cell surface membrane which controls the passage of substances in and out of the cell.<br>[Candidates are not expected to be familiar with photoelectron-micrographs] |

| | | | |
|---|---|---|---|
| | Tissues | | Cells may be specialised to carry out a particular function. A group of cells with similar structure and function is called a tissue. (**See 11.8, 11.9, 11.11**) |
| | Organs and systems | | Organs are made of tissues. Different organs are combined to form organ systems. Each organ system in the body carries out a particular function. |
| 11.2 | The skin | FT and HT | The structure and functions of skin limited to dermis, epidermis, malpighian layer, hair follicle, erector muscle, sebaceous gland, sweat gland, blood vessels and sense receptors.<br><br>Skin is a layer which protects the underlying tissues from mechanical injury, too much water loss, the effect of ultra-violet light and invasion by microorganisms, and which assists the body in temperature regulation. (**See 10.4, 11.10, 11.12**) |
| 11.3 | Principles of enzyme action | FT and HT | Enzymes are catalysts and are important in both building-up and breaking-down processes.<br><br>Temperature and pH can each affect the functioning of enzymes. Enzymes, due to their protein nature, can be denatured by extremes of heat and pH. (**See 11.7**) |
| 11.4 | Movement of substances in and out of cells | FT and HT | |
| | Diffusion | | Diffusion is the movement of molecules from high to low concentration. (**See 11.7, 11.8, 11.9, 12.4**) |
| | Osmosis | | Osmosis is an example of diffusion of water through a partially permeable membrane. Animal cells are easily damaged by the entry or loss of too much water; hence it is important to regulate the solute-water balance of the blood. (**See 11.10, 11.12**) |
| 11.5 | Respiration | FT and HT | Respiration is the release of energy within a cell from food molecules. All living cells of the body respire. Stored glycogen or the sugar glucose or fats are the body's main energy supplies; these substances may be interconverted within the body.<br><br>Energy is needed for movement, for growth and for keeping warm. |
| | Aerobic respiration | | Aerobic respiration uses oxygen and produces carbon dioxide, releasing a large amount of energy.<br><br>Word equation:<br>glucose + oxygen → carbon dioxide + water + energy |

Anaerobic respiration

Anaerobic respiration may occur during vigorous physical exercise, when insufficient oxygen is available. It releases a limited amount of energy and leads to lactic acid production and muscle fatigue.

Word equation:
glucose → lactic acid + energy

(**See 10.4, 11.7, 11.8, 11.9**)

## *Life processes*

11.6 Nutrition FT and HT

The body needs a balanced diet of carbohydrates, lipids (fats), proteins, vitamins, mineral salts, water and fibre.

Carbohydrates

The sugar, glucose is the main source of energy used by the body's cells. Starch (from plants) is made of glucose molecules. Glycogen is also made of glucose molecules and may be stored in the body, especially in the liver and in muscles. (**See 11.12**)

Good food sources include: potatoes, cereals (and cereal products), confectionery.

Tests for carbohydrates: iodine test for starch
Benedict's test for reducing sugar.

Lipids (fats and cholesterol)

Fats are more energy-rich than carbohydrates and are stored in the body as an energy reserve. Fats are made of fatty acids and glycerol. Fatty acids may be saturated or unsaturated.

Good food sources include: butter, margarine, cheese, vegetable oils.

Test for fat: the emulsion test.

If people eat too much energy-containing food, the surplus is stored as fat. This makes people overweight, which makes movement more difficult and may increase stress on the heart.

Too much animal (saturated) fat and cholesterol in the diet increases the risk of heart and circulatory disorders, such as strokes and heart attacks. This is because these substances may be deposited in the walls of blood vessels and block them. (**See 10.4, 11.8**)

Proteins

Proteins are needed for growth and for replacing cells. Too little protein in the diet stunts growth. Proteins are made of amino acids. Certain proteins have highly specialised functions

- enzymes catalyse specific reactions in body cells and in the gut
- haemoglobin transports oxygen
- antibodies react specifically with antigens on the surfaces of pathogens and transplanted tissue. (**See 11.3, 11.7, 11.8**)

Good food sources include: meat, fish, cheese, eggs, nuts.

Test for protein: the biuret test.

| | | | |
|---|---|---|---|
| | Vitamins | | Vitamins are vital for healthy metabolism in cells. They are needed in small quantities in the diet as they can be re-used.<br>• Vitamin C is needed to keep parts of the skin healthy. Deficiency may lead to scurvy – bleeding gums and wounds do not heal properly. Good food sources include: fresh fruits (especially citrus fruits) and vegetables.<br>• Vitamin D is needed to help the body to absorb calcium from food. Deficiency may lead to rickets – the leg bones cannot support the weight of the body and therefore bend. Good food sources include: milk, cheese, eggs, and also the action of sunlight on the skin. (**See 11.13**) |
| | Mineral salts | | Different mineral ions have a wide range of uses in the body, both structural and in cell metabolism.<br>• Calcium is needed to strengthen growing bones and teeth. Deficiency may lead to rickets. Good food sources include: milk, cheese, cereals, vegetables. (**See 11.13**)<br>• Iron is need to produce haemoglobin. Deficiency may lead to anaemia – reduced number of red blood cells, tiredness. Good food sources include: red meat, liver, eggs, green vegetables e.g. spinach. (**See 11.8**) |
| | Water | | Water is vital for body functioning. Some functions include being<br>• a medium for chemical reactions<br>• a medium for transport of substances around the body<br>• a medium for removal of excretory products<br>• a means of cooling the body by evaporation.<br><br>Water balance is achieved due to water gains and losses by the body being equal. (**See 11.7, 11.8, 11.10, 11.12** ) |
| | Fibre | | Fibre helps the movement of food through the gut. A lack of fibre in the diet may cause constipation and may increase the chance of developing bowel cancer. |
| | Variation in requirements | | Dietary requirements with respect to the amounts of energy, protein, vitamins and mineral salts may increase due to<br>• growth<br>• pregnancy<br>• amount of physical exercise.<br>(**See 10.4, 12.6**) |
| 11.7 | Making food available to the body | FT and HT | Large particles of food are broken down physically by the teeth. Fats, proteins and starch in our food are made of large, insoluble molecules. They are broken down during digestion into soluble substances which can pass through cell surface membranes and can be absorbed into the bloodstream. This chemical breakdown of large molecules into smaller molecules is catalysed by enzymes. (**See 11.3**) |
| | Gross structure of the alimentary canal | | The digestive system includes the mouth, salivary glands, oesophagus, stomach, liver, gall bladder, pancreas, small intestine and large intestine. |

Functioning of the digestive system

- Teeth and mastication
  Teeth have an outside covering called enamel. This is hard and gives a strong surface for biting. Underneath is dentine. This is heavy and solid to help the teeth to grind food. In the middle of teeth is pulp which contains blood vessels to keep the tooth alive, and nerve endings which detect touch and changes in temperature. (**See 10.4**)

  Incisor teeth have sharp edges for cutting food. Canine teeth are pointed for tearing food. Premolar and molar teeth are broad and ridged for grinding food.

- Swallowing and peristalsis
  The tongue, under voluntary control, rolls the food into a bolus and pushes it to the back of the mouth. Involuntary (reflex) muscle action propels the food through the remainder of the alimentary canal. (**See 11.11**)

- Chemical digestion of carbohydrates, fats and proteins
  Carbohydrase enzymes are produced by the salivary glands, the pancreas and the small intestine. These enzymes catalyse the digestion of starch into sugars.

  Protease enzymes are produced by the stomach, the pancreas and the small intestine. These enzymes catalyse the digestion of protein into amino acids.

  Fats are emulsified (broken down into tiny droplets) by bile. Bile is produced in the liver, then stored in the gall bladder, before being mixed with the food in the small intestine. Lipase enzymes, produced by the pancreas and the small intestine, catalyse the digestion of fats into fatty acids and glycerol.

- Absorption
  The soluble products of digestion are absorbed into the bloodstream in the small intestine. Villi and microvilli increase the surface area of the small intestine for efficient absorption. Diffusion is important in absorption. (**See 11.4**)
  Water is absorbed by the large intestine. (**See 11.6**)

- Egestion
  Indigestible food which remains makes up the bulk of the faeces. Faeces leave the body via the anus.

- Assimilation
  Glucose and fats are used for energy release. Excess glucose is converted to glycogen and fat for storage. (**See 10.4, 11.5, 11.11, 11.12**)

  Amino acids are used for protein formation. Excess amino acids are deaminated by the liver and the ammonia produced is converted to urea for excretion. (**See 11.10**)

## 11.8 The blood circulatory system

FT and HT

The functions of the blood include

- being a medium for transport
- defence against disease
- homeostasis.

### Composition of the blood

Blood consists of three types of cells – red blood cells, white blood cells and platelets – suspended in the blood plasma.

- Red blood cells
  Red blood cells are biconcave discs which lack a nucleus. They contain haemoglobin for the transport of oxygen. Haemoglobin combines reversibly with oxygen to form oxyhaemoglobin. (**See 10.7, 11.6, 12.4**)

- White blood cells
  There are two principal kinds of white blood cell
  – phagocytes, which ingest invading pathogens
  – lymphocytes, which produce antibodies which destroy particular pathogens or produce antitoxins which counteract the toxins released by some pathogens.

- Platelets
  Platelets are responsible for blood clotting. Upon contact with a foreign surface (e.g. tissues exposed at the site of a cut, or fatty deposits in an atheroma), the platelets release enzymes which, via a chain of reactions, cause fibrinogen to change into fibrin; blood cells become trapped in a mesh of fibrin to form a blood clot. (**See 10.4**)

- Plasma
  A solution containing
  – digested foods - glucose, fatty acids, glycerol, amino acids
  – waste products - carbon dioxide and urea
  – hormones
  – blood proteins - fibrinogen, antibodies.

### The transport system

The circulatory system consists of blood vessels (arteries, veins and capillaries) and a pump (the heart).

- Arteries
  Arteries carry blood away from the heart. Arteries have thick, elastic, muscular walls.

- Veins
  Veins carry blood towards the heart. Veins have thinner walls than arteries, with less elastic and muscular tissue. Veins contain valves.

- Capillaries
  Capillaries connect small arteries and veins. Their walls are one cell thick and are leaky. Capillaries allow exchange of materials between the blood and the surrounding tissues. (**See 11.4**)

The only names of blood vessels required are the aorta, vena cava, pulmonary artery and vein, coronary arteries, renal artery and vein and hepatic portal vein. (**See 10.4, 11.6**)

- The heart
  The heart is a double pump, with muscular walls. The heart contains oxygenated blood in its left side and deoxygenated blood in its right side.

  The external and internal structure of the heart relates to its functioning. The following terminology will be expected – ventricles, atria, bi- and tricuspid and semilunar valves.

  Blood enters the atria of the heart. The atria contract and force blood into the ventricles. The ventricles contract and force blood out of the heart. Valves in the heart ensure that blood flows in the right direction.

HT The natural resting heart rate is controlled by the pacemaker, located in the right atrium. If this malfunctions then an artificial pacemaker may be fitted (principle only required).

FT and HT The effect of exercise on pulse rate should be understood in terms of the need for increased supplies of oxygen and glucose and increased removal of carbon dioxide, lactic acid and heat. (**See 10.4, 11.5, 11.9, 11.12**)

The blood changes in composition and pressure as it passes through the major organs of the body.

Immunity

Once they have produced antibodies against a particular pathogen, some lymphocytes reproduce to form a clone of cells which can quickly produce antibodies again so that the person is immune to that disease.

HT The immune response involves the production of specific antibodies. It is stimulated by particular antigens. Antigens are foreign substances which are usually protein-based. The response is slow if the body has not previously encountered the relevant antigen. If it has, a rapid response occurs due to the presence of an immunological memory in the form of specific lymphocytes.

FT and HT
- Natural and artificial immunity
  This immunological response may occur naturally through infection, or may be initiated through vaccination.

Active and passive immunity
- A person can be immunised against a disease by introducing a vaccine into the body. A vaccine contains a mild, or dead, form of the infecting organism. The white blood cells respond by producing antibodies which are proteins that will help to defend

the body against a future attack by the infective organism. This is called active immunity.

If a person has already been exposed to a dangerous infective organism, antibodies to combat the infection may be injected to give the person immediate protection. This is called passive immunity.

The discovery of the process of vaccination by Edward Jenner to immunise a person artificially against disease:

- reasoning from observation (immunity of milk maids to smallpox following natural exposure to cowpox) that exposure to a 'mild form' of a disease stimulated the body's immune response
- design of an experiment (attempted immunisation of a human subject) to test the validity of his reasoning.

**Organ transplantation**

Some diseased organs may be replaced by healthy ones. This technique is known as transplantation. However, when a foreign organ is transplanted into a person it may be rejected by the body's immune system. (**See 11.10, 12.12**)

HT To prevent rejection

- a donor organ with a 'tissue-type' similar to that of the recipient is used
- the blood-producing areas may be irradiated with X-rays to inhibit white cell production
- the recipient is kept in sterile conditions for some time after the operation to prevent infection while the body's defence mechanisms are inoperative
- the recipient is treated with immuno-suppressive drugs.

Pioneering work by Christiaan Barnard on organ (heart) transplantation:

- the use of an artificial pump and oxygenating system ('heart-lung machine') to maintain normal blood circulation and oxygenation during surgery
- tissue typing and immunosuppression to overcome the problem of rejection.

**Blood transfusion: the ABO blood groups**

When a patient receives a blood transfusion, it is imperative that the transfused blood is compatible with the patient's own blood. If it is incompatible, naturally occurring antibodies will cause the red cells to agglutinate (stick together).

Candidates should be able to interpret compatibility tables for the ABO blood groups. (**See 12.9**)

## 11.9 Breathing and gaseous exchange

FT and HT The breathing system includes the trachea, lungs, bronchi, bronchioles, alveoli, diaphragm, ribs and intercostal muscles. The breathing system takes air into and out of the lungs so that oxygen from the air can pass into the bloodstream and carbon dioxide can pass from the bloodstream into the air.

The inner surfaces of the trachea, bronchi and bronchioles are covered in ciliated cells which, together with mucus-secreting cells, help to trap and remove particles like dust and microorganisms from the breathing system. (**See 10.4**)

Ventilation mechanism

To inhale air the intercostal muscles contract, pulling the ribcage upwards. At the same time the diaphragm muscles contract, causing the diaphragm to flatten. These two movements cause an increase in the volume of the chest cavity. The consequent decrease in pressure results in atmospheric air entering the lungs.

Gaseous exchange

Gaseous exchange occurs by diffusion across the walls of the alveoli. The alveoli are adapted for efficient gaseous exchange by having

- a large total surface area
- thin walls
- a good blood supply by being covered in blood capillaries.

(**See 11.4, 11.10**)

Tests for gases: test for carbon dioxide with limewater
test for oxygen by its support of combustion.

Effect of exercise

There is a relationship between heart beat, breathing rate and exercise. During exercise, the level of carbon dioxide in the blood rises. The body responds by increasing the rate and depth of breathing and the rate and stroke volume of the heart beat.
These changes have two effects

- increased rate of removal of carbon dioxide, lactic acid and heat from muscle cells
- increased oxygen and glucose supply to the muscles.

(**See 10.4, 11.5, 11.8, 11.12**)

HT Breathing is coordinated by the respiratory centre in the brain.

Artificial ventilation

Expired air, being rich in carbon dioxide, can be used to stimulate breathing of a patient during the mouth-to-mouth method of artificial ventilation.

## 11.10 Excretion FT and HT

Excretion is the removal of waste products which result from metabolism in the body's cells.

The body gets rid of these waste materials it has made

- through the lungs, which release carbon dioxide and water vapour into the air (**See 11.9**)
- through the skin where glands release a liquid called sweat which contains water, urea and mineral salts (**See 11.2, 11.12**)
- through the kidneys which remove waste materials from the blood and help to regulate the composition of the blood. The kidneys produce urine – a solution of urea and mineral salts.

In addition, the liver releases a number of waste products. These include

- urea – excreted via the blood and the kidneys (**See 11.7**)

| | | | |
|---|---|---|---|
| | | HT | • cholesterol and bile pigments – excreted via the gall bladder and bile duct into the gut. |
| | Structure of the urinary system | FT and HT | The position and gross structure of the kidneys and their relationship to the ureters, bladder, urethra and major blood vessels.<br><br>Kidney structure to show cortex, medulla and pelvis, glomerulus, renal capsule and tubule. |
| | Formation of urine | HT | The kidneys produce urine by<br>• first filtering the blood<br>• reabsorbing all the glucose<br>• reabsorbing the dissolved ions as needed by the body<br>• reabsorbing as much water as the body needs<br>• releasing urea, excess ions and excess water as urine.<br>**(See 11.6, 11.11, 11.12)** |
| | | FT and HT | • Removal of toxic materials<br>Toxic materials taken in from the environment, e.g. alcohol, may be excreted by the kidneys. (**See 10.4**) |
| | | HT | • Dialysis<br>Patients suffering from kidney failure may be treated regularly using a dialysis machine that restores the concentrations of dissolved substances in the blood to normal levels.<br><br>In a dialysis machine the patient's blood is separated from the dialysis fluid by a partially-permeable membrane which allows the exchange of water molecules and small solute molecules between the blood and the dialysis fluid. (**See 11.4**)<br><br>Candidates should be able to evaluate the advantages and disadvantages of the use of dialysis machines and kidney transplants. (**See 11.8**) |
| 11.11 | Sensitivity and coordination | FT and HT | Behaviour is coordinated by the nervous system and by hormones. Behaviour can be interpreted in terms of<br><br>stimulus ➔ receptor ➔ coordination system ➔ effector ➔ response. |
| | Structure of the nervous system | | A nerve is a collection of nerve fibres (neurones). Candidates should know the simple structure only of sensory and motor neurones as examples of cells specialised for the conduction of impulses. (**See 11.1**)<br><br>The brain is a centre for coordination with the ability to learn and remember – to include position and simple functions of the cerebral hemispheres, cerebellum, medulla and pituitary gland. |

HT The position of the hypothalamus and its functioning in temperature regulation and osmoregulation. (**See 11.12**)

FT and HT The spinal cord – to include the neurone pathway involved in the coordination of a simple reflex response.

**Reflex actions**

Some responses to stimuli, which are coordinated by the nervous system, are automatic (involuntary) and are called reflex actions. Reflex actions often involve three neurones called sensory, relay and motor neurones.

In such a reflex action

- impulses from a receptor pass along a sensory neurone to the central nervous system
- continuity between a sensory neurone and a relay neurone in the central nervous system occurs at a junction (synapse), a chemical is released to cross the synapse and an impulse is sent along the relay neurone
- a second synapse occurs between the relay neurone and a motor neurone in the central nervous system, resulting in impulses being sent along the motor neurone to the organ (the effector) which brings about the response
- the effector is either a muscle or a gland
- a muscle responds by contracting, a gland by secreting.

**Voluntary actions**

A voluntary action starts with impulses from the cerebral hemispheres of the brain. Unlike a reflex action, it is not automatic. (**See 10.4**)

**Receptors**

Cells called receptors detect stimuli (changes in the environment). These receptors include

- rods and cones in the retina of the eye
- touch receptors (specialised nerve endings) in the skin.

Information in the form of electrical signals (nerve impulses) is sent from receptor cells to the brain (via the spinal cord in the case of many touch receptors).

- The eye
  The eye includes the sclera, cornea, iris, pupil, lens, ciliary muscles, suspensory ligaments, retina and optic nerve.

  The outer covering of the eye is the tough sclera. At the front of the eye a transparent part of the sclera called the cornea allows light to enter the eye. Light is focused on to the retina by the cornea and by the lens. The iris controls the amount of light reaching the retina. The image formed on the retina is inverted. The retina contains light-sensitive cells called rods and cones. The rods and cones are connected to sensory neurones leading to the brain via the optic nerve.

HT There are three types of cone cells which give us our sense of colour vision. (**See 12.9**)

FT and HT

The iris of the eye has two sets of opposing muscles: circular muscles and radial muscles. Contraction of the circular muscles reduces the diameter of the pupil, contraction of the radial muscles increases the diameter of the pupil.

To focus on near objects, the ciliary muscles of the eye contract. This reduces the tension in the suspensory ligaments and the lens becomes thicker. When the ciliary muscles of the eye are relaxed, the lens is thinner and focuses distant objects.

- Long and short sight
  If the lens is unable to thicken sufficiently when viewing a close object, the person is long sighted. This may be corrected with a converging lens in front of the eye.

  If the lens is unable to become sufficiently thin when viewing a distant object, the person is short sighted. This may be corrected with a diverging lens in front of the eye. (**See 10.4, 12.6**)

Hormone action

Hormones are chemicals released by ductless (endocrine) glands and transported to their specific target organs by the blood.

The location in the body of the pituitary and adrenal glands, the pancreas, ovaries and testes should be known.

The functions of the hormones adrenaline, insulin, oestrogen, progesterone, testosterone and growth hormone (GH).

HT The functions of the hormones follicle stimulating hormone (FSH), luteinising hormone (LH) and antidiuretic hormone (ADH).

Candidates should consider the principle of negative feedback mechanisms rather than the abnormal effects of overactivity or underactivity of the glands.
(**See 11.7, 11.10, 11.12, 12.2, 12.12**)

## 11.12 Homeostasis

FT and HT To stay alive, humans must be able to detect and respond to small changes in the internal environment. Nerve impulses or hormones are sent to appropriate organs which respond to maintain a relatively constant internal environment. This is the principle of negative feedback control.

The blood plays a central role in homeostasis due to its function in transport of materials and distribution of heat. (**See 11.8**)

Blood sugar concentration

The blood sugar level is controlled by the pancreas and the liver.

Cells in the pancreas are sensitive to blood glucose levels. If the blood glucose level is too high, the pancreas releases the hormone insulin into the blood. This causes the liver to convert glucose to insoluble glycogen and then store it.

HT Insulin also causes an increase in the rate of uptake of glucose by cells and an increase in the rate of respiration.

If the blood glucose level is too low, the pancreas releases the hormone glucagon into the blood. This causes the liver to convert glycogen to glucose and release it into the blood.

FT and HT The hormone adrenaline, from the adrenal glands, also helps to raise the blood glucose level in times of stress. (**See 11.6, 11.7, 11.9**)

Osmoregulation (water – solute balance of the blood)

The kidneys regulate the water content of the blood by producing dilute urine if there is too much water in the blood, or concentrated urine if there is a shortage of water in the blood.

HT The water content of the blood is controlled by the hypothalamus and pituitary gland.

If the hypothalamus detects that the water content of the blood is too low, the pituitary gland releases a hormone called ADH into the blood. This causes the kidneys to reabsorb more water and results in a more concentrated urine.

If the hypothalamus detects that the water content of the blood is too high, less ADH is released into the blood. There is less reabsorption of water in the kidneys, resulting in a more dilute urine.
(**See 11.4, 11.6, 11.10, 11.11**)

Temperature regulation

FT and HT Body temperature is monitored and controlled by a centre in the brain which sends nerve impulses to the organs which need to act.

HT This centre is in the hypothalamus.

FT and HT If the core temperature of the body rises

- small arteries, which supply blood to the capillaries in the surface layer of the skin, dilate and thus increase the amount of blood flowing through these capillaries. Heat is lost from the blood in the capillaries by radiation
- sweat glands increase their production of sweat. When the sweat reaches the surface of the skin, heat from the body causes it to evaporate.

If the core temperature of the body falls, the small arteries supplying the surface capillaries constrict and sweat production decreases. Muscles may also 'shiver' and release energy as heat. Hairs may also be pulled erect (although this has little effect on insulation in humans).
(**See 11.2, 11.10**)

## 11.13 The skeletal system, muscles and movement

FT and HT

Functions of the skeleton include the following

- to support the body and hence give it shape
- to protect vital organs
- to allow movement.

Bones, and the muscles attached to them, support the body and enable movement. Most muscles are arranged in antagonistic pairs. Muscles do work when they contract – this requires a source of energy.

**Posture**

The gross structure of the vertebral column with its natural curves should be studied in relation to maintaining good posture, especially during bending and lifting, and in pregnancy, to prevent injuries such as a 'slipped' disc. (**See 12.4**)

**Joints**

The structure of the elbow joint (a hinge joint) and hip joint (a ball and socket joint) as examples of simple synovial joints - positions and functions of ligaments, synovial membrane, synovial fluid and surface cartilage on the bones.

**Movement at a hinge joint**

The attachment of the muscles, via tendons, to the skeleton and the principle of antagonistic action of muscles should be studied with specific reference to the biceps and triceps muscles and movement at the elbow:

HT

- the biceps muscle, as a flexor muscle, with its two origins on the scapula and its insertion on the radius
- the triceps muscle, as an extensor muscle, with its three origins (one on the scapula and two on the humerus) and its insertion on the ulna.

**When joints do not work effectively**

FT and HT

The various components of a joint may be damaged by

- physical injury – e.g. sports injuries – such as damaged ligaments, pulled or torn muscles, tendon rupture, torn cartilage, tendonitis, dislocation, or fractured bones
- degenerative diseases – e.g. osteoporosis and arthritis. (**See 10.4, 11.6, 12.6**)

Modern surgery may help to keep the body mobile by

- 'keyhole' surgery, using optical fibres to explore joints such as the knee
- joint replacements – e.g. the hip.

# 12 Reproduction, growth and development

## *Sexual reproduction*

### 12.1 The sex organs

FT and HT

The structure and functioning of the male and female sex organs should be studied. Candidates should recognise and know the functions of the following: ovary, oviduct (fallopian tube), uterus, cervix, vagina, penis, testis, scrotal sac, sperm duct (vas deferens), prostate gland and urethra.

### 12.2 The menstrual cycle and ovulation

FT and HT

In the female, the lining of the uterus builds up and breaks down in a cycle which is repeated approximately every 28 days. This is the menstrual cycle and it occurs from puberty until the menopause.

#### Hormonal control

The menstrual cycle is controlled by hormones

- the ovaries produce hormones called oestrogen and progesterone
- oestrogen causes an egg to mature in the ovary
- oestrogen and progesterone cause the lining of the uterus to thicken so as to be ready to receive a fertilised egg
- if a fertilised egg is not implanted, the ovaries cease producing oestrogen and progesterone, resulting in the breakdown of the extra lining of the uterus, which leaves the body as the menstrual flow
- if a fertilised egg is implanted, the ovaries continue to secrete oestrogen and progesterone. These hormones maintain the lining of the uterus throughout pregnancy and prevent any more eggs reaching maturity during pregnancy.

HT In addition

- the pituitary gland produces a hormone called follicle stimulating hormone (FSH) which stimulates the ovaries
- oestrogen also stimulates the pituitary gland to release luteinising hormone (LH)
- LH causes the follicle to rupture and release the egg (ovulation)
- LH causes the remains of the follicle to develop into the corpus luteum which continues to produce progesterone
- if a fertilised egg is not implanted, the corpus luteum breaks down
- during pregnancy as the placenta develops, it secretes a hormone galled gonadotrophin; this causes the ovaries to continue to secrete oestrogen and progesterone. These hormones inhibit the production of FSH by the pituitary gland, thus preventing any more eggs maturing.

The uses of hormones in controlling fertility include

- giving FSH as a 'fertility drug' to women whose own level of FSH is too low, to stimulate eggs to mature
- giving oestrogen and / or progesterone as an oral contraceptive to inhibit FSH production so that no eggs mature.

(**See 11.11, 12.3**)

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| 12.3 | Gametes and fertilisation | FT and HT | Body cells contain 23 pairs of chromosomes. Gametes contain half this number of chromosomes, the full number being restored when two gametes fuse together, in fertilisation, to form a zygote. (**See 12.8**)<br><br>The testes and ovaries make gametes called sperm and eggs, respectively. A sperm cell has a nucleus containing hereditary information and a tail to enable it to swim towards the egg. An egg has a nucleus containing hereditary information and cytoplasm containing food materials for the first few days of the embryo's growth. |
| | Intercourse (copulation) | | During intercourse, the penis of the male is placed in the vagina of the female. Semen (sperm cells together with fluids produced by the prostate gland and other glands) is released from the penis and the sperm cells swim up through the vagina, uterus and oviducts. Fertilisation may take place in the upper part of the oviduct if ovulation has occurred and an egg is travelling from the ovary to the uterus. |
| | Artificial insemination and *in vitro* fertilisation | | Some cases of infertility are treated by the use of artificial insemination (AI) where semen is inserted artificially into the vagina. Other cases – e.g. when blockages occur in the oviducts – may be treated by surgically removing eggs from the female's abdomen and mixing them with semen in glassware (*in vitro* fertilisation – IVF) before transfer to the uterus. (**See 12.2**) |
| | Contraception | | Fertilisation or, alternatively, implantation of the embryo can be prevented<br>• by restricting intercourse to those times in the menstrual cycle when an egg is unlikely to be present in the oviduct (the 'rhythm method')<br>• by using a condom or a diaphragm to stop the sperm reaching the egg<br>• by taking contraceptive pills containing hormones which prevent ovulation (**See 12.2**)<br>• by cutting, then tying, the sperm ducts in the male or oviducts in the female<br>• by placing a coil or loop in the uterus, which prevents implantation of the fertilised egg.<br><br>Candidates should be able, when provided with additional information, to assess the effectiveness of these different methods of birth control.<br><br>The use of condoms during intercourse also reduces the spread of sexually-transmitted diseases. (**See 10.4**) |

# *Healthy development, pre- and post-natal*

## 12.4 Pregnancy — FT and HT

Pregnancy, or gestation, is the time during which the fetus develops inside its mother's uterus. In humans, it last approximately 40 weeks.

Following fertilisation, the zygote passes down the oviduct and divides many times to form a ball of cells.

### Identical and non-identical twins

Occasionally more than one egg is released and each is fertilised by a different sperm. This will result in non-identical twins, triplets, etc. If a single zygote splits to form two separate embryos, then identical twins will be produced.

### Implantation

The ball of cells then sinks into the lining of the uterus which has become thicker to receive it. Some of these cells divide further to form the fetus.

The rest of the cells divide to form the following structures which will protect the fetus and provide it with all its needs.

- The amnion
  the amnion is a fluid-filled sac surrounding the fetus which protects it from knocks and infection.

- The placenta
  the umbilical cord and placenta grow and attach to the lining of the uterus to exchange materials between the blood of the fetus and the blood of the mother. Oxygen and soluble foods diffuse from mother to fetus, and waste products, such as urea and carbon dioxide, diffuse in the opposite direction. (**See 11.4, 11.8**)

### Problems during pregnancy

During pregnancy, the mother needs to maintain a healthy diet, to take moderate exercise, get sufficient rest and not be subjected to emotional stress. This is to meet the extra demands being put on her body.

Due to increased levels of hormones in her blood, she may experience morning sickness. (**See 12.2**)

Backache may result from the extra load being transmitted to the vertebral column. (**See 11.13**)

If the mother consumes alcohol, or other drugs, during pregnancy then these may pass across the placenta to the fetus and harm it.
(**See 10.4**)

If the mother smokes during pregnancy, harmful chemicals may be passed to the fetus. Carbon monoxide, combined with haemoglobin in the mother's red blood cells, may result in less oxygen being available for the fetus and so reduce its growth. (**See 10.4, 11.8**)

Certain viral infections of the mother during pregnancy – e.g. Rubella, HIV – may result in the virus crossing the placenta and infecting the fetus. (**See 10.4**)

| | | | |
|---|---|---|---|
| 12.5 | Birth, lactation and parental care | FT and HT | In order to give birth, the mother goes through 'labour'. There are three stages<br>1. rhythmic muscular contractions of the wall of the uterus occur with increasing frequency and intensity in order to widen the cervix<br>2. further contractions force the baby out of the uterus and down the vagina. Once the baby has begun to breathe, it is no longer dependent on the placenta for its supply of oxygen and the umbilical cord is cut<br>3. finally, further contractions of the uterus expel the placenta.<br><br>Sometimes the baby may need to be delivered by caesarian section.<br><br>The mammary glands in the mother's breasts secrete milk which provides the initial food supply for the baby. It also contains antibodies to provide passive natural immunity.<br><br>The baby is totally dependent upon its parents for provision of food, shelter, being kept clean, for its emotional stability and early learning. |
| 12.6 | Post-natal growth and development | FT and HT | A human passes through the stages of childhood, adolescence, adulthood and senescence.<br><br>Growth may be represented graphically: changes occur in the growth rate of the whole body and in the relative growth of the head, trunk and limbs throughout development.<br><br>Changes occur during adolescence in both the male and the female in the development of sexual maturity and of the secondary sexual characteristics. These are controlled by the hormones testosterone and oestrogen. (**See 11.11**)<br><br>Examples of degenerative conditions associated with senescence include stiffening of the joints, osteoporosis, arthritis, wrinkling of the skin, greying and loss of hair and impaired mental ability and functioning of eyes. (**See 10.4, 11.6, 11.11, 11.13**) |
| 12.7 | Cancer | FT and HT | Cancer is abnormal, uncontrolled growth. A cancerous growth, or tumour, is a mass of abnormally arranged cells that can appear in almost any part of the body. The cells of a tumour continue to divide in the absence of any need for repair or enlargement of the body. Cells from malignant tumours invade surrounding healthy tissues. Some malignant cells may enter the blood system and circulate to other parts of the body, which they then colonise, forming secondary tumours.<br><br>Causes of cancer include<br>• chemical carcinogens, including distillation products of fossil fuels, which may cause tumours in the bladder, asbestos and chemicals found in tobacco smoke which may cause lung tumours<br>ionising radiations such as UV which may cause skin cancers, or X-rays and gamma-rays which might lead to tumours of the bone marrow resulting in leukaemia, as well as cancers of other organs. (**See 10.4, 10.7, 11.9, 12.11**) |

By accumulation of sufficient data, Richard Doll investigated the correlation between an observable effect and its proposed cause. He thus demonstrated the link between cigarette smoking and lung cancer:

- the use of very large numbers of observations of cases of lung cancer
- the correlation between the incidence of cigarette smoking and the incidence of lung cancer
- the use of data about the incidence of lung cancer in non-smokers (as a type of 'control') to establish a baseline for comparison with the incidence in smokers.

## *Chromosomes, cell division and genetics*

| | | | |
|---|---|---|---|
| 12.8 | Chromosomes and genes | FT and HT | Chromosomes are normally found in pairs in the nucleus of each body cell. Each chromosome carries a large number of genes. Each gene codes for the expression of a certain characteristic. Alleles are different forms of the same gene, resulting in different expressions of the characteristic. |
| | Mitosis | HT | Growth and repair of the body is dependent upon the production of new cells by mitosis. Before a cell divides, copies are made of each of the chromosomes so that each new body cell receives exactly the same genetic information in the form of 23 pairs of chromosomes. |
| | Meiosis | | Gamete cells each contain half the number of chromosomes normally found in body cells. This is achieved by a special type of cell division, meiosis, which occurs only in certain cells in the ovaries and testes. Each gamete cell formed by meiosis is genetically different. (**See 12.3**)<br><br>Behaviour of the chromosomes and chromatids during mitosis and meiosis should be studied. (However, knowledge of cytological details, the names of the stages of division, and knowledge of the process of crossing over will **not** be expected.) |
| 12.9 | Genetics | FT and HT | Children resemble their parents (have similar characteristics) because of genetic information passed on to them in the gametes from which they developed. Different genes control the development of different characteristics. |
| | Monohybrid crosses | | Candidates should be familiar with the terms: allele, genotype, phenotype, homozygous, heterozygous and dominant and recessive alleles (illustrated by any suitable examples).<br><br>Candidates should be able to complete a genetic diagram, including the use of conventional terms and symbols, to show a monohybrid cross.<br><br>[In examination papers, a dominant allele will be represented by a capital letter (e.g. **A**) and its recessive allele by the corresponding lower case letter (e.g. **a**).] |

| | | | |
|---|---|---|---|
| | | HT | Candidates should be familiar with the term codominance.<br><br>[In examination papers alleles showing codominance will be distinguished by the use of superscripts (e.g. $\mathbf{H^A}$ and $\mathbf{H^B}$).]<br><br>Candidates should be able to construct a genetic diagram, including the use of conventional terms and symbols, to show a monohybrid cross. |
| | Inheritance of blood group | | Some genes have more than two alleles. The inheritance of the ABO blood groups illustrates this as well as showing both codominance and dominance, with the alleles $\mathbf{I^A}$ and $\mathbf{I^B}$ showing codominance with one another and both being dominant over the allele $\mathbf{I^O}$. (**See 11.8**) |
| | Sex determination | FT and HT | In human body cells, one of the pairs of chromosomes carries the genes which determine sex.<br><br>In females the sex chromosomes are the same (**XX**), in males the sex chromosomes are different (**XY**). |
| | Sex linkage | HT | Some genes which are located on the X-chromosome are missing from the Y-chromosome. This explains why some recessive characteristics are more common amongst males than females, e.g. red - green colour blindness. (**See 10.4, 11.11**) |
| 12.10 | Chemical nature of the genetic material | HT | Chromosomes contain long molecules of a substance called DNA. DNA contains coded information that determines hereditary characteristics. A gene is a section of a DNA molecule.<br><br>Each DNA molecule is composed of two long strands which coil around each other to form a double helix. The strands are weakly held together by bonds between four different bases which are strung along the inside of each strand. These bases always pair up in the same way.<br><br>When cells divide, the two strands in DNA separate. These strands then each act as a template to make a new DNA molecule. The new DNA is identical to the original and the cells are then able to divide.<br><br>The order of bases in each gene acts as a code which controls the order in which amino acids are assembled into a protein. |

## *Variation, its cause and significance*

| | | | |
|---|---|---|---|
| 12.11 | Types of variation | FT and HT | Variation may occur due to the interaction of genetic and environmental factors in determining the phenotype. |
| | Continuous variation | | Continuous variation is due to the combined influences of polygenic inheritance and the environment. This usually results in variation between individuals across a range – e.g. the determination of human height and weight. |

| | | | |
|---|---|---|---|
| | Discontinuous variation | | Discontinuous variation is due to the inheritance of one or just a few pairs of alleles. This results in distinct phenotypes with no intermediate values – e.g. the inheritance of cystic fibrosis. |
| | Mutation | HT | A mutation is a change in the DNA of a gene or chromosome.<br><br>A mutation can produce a new allele from an existing allele. Mutations occur at random. Exposure to certain chemicals and to ionising radiation can increase the frequency of mutation. Most mutations are harmful. If mutations occur in reproductive cells, the offspring may develop abnormally or die early in development. Mutations later in life can cause cancer. (**See 10.4, 10.7, 12.7**)<br><br>Sometimes a mutation may be due to the loss or duplication of all or part of a chromosome – e.g. Down's syndrome is caused by the inheritance of three copies of chromosome 21.<br><br>Mutations in pathogenic microorganisms can produce strains which are resistant to drugs – e.g. antibiotic resistance in some bacteria. (**See 10.4**) |
| 12.12 | Genetic engineering | HT | Genes from human chromosomes can be 'cut out' and transferred to bacterial cells. The transferred gene continues to be expressed in the bacterial cell. By culturing the bacteria on a large scale, commercial quantities of gene products can be produced in this way. This process of genetic engineering is used in the manufacture of drugs, hormones and vaccines. (**See 11.8, 11.11**)<br><br>In genetic engineering, specific enzymes are used to cut and paste pieces of DNA. [Knowledge of the names of enzymes is **not** required.] |
| | Cloning | | A clone is a large number of cells which all originate by division of a single parent cell. All the cells in a clone are genetically identical. Cloning may be used for the mass production of genetically-engineered cells in fermenters.<br><br>Fermenters may also be used for the mass production of natural products, such as single-cell protein (SCP) and mycoprotein for human food production, or of antibiotics such as Penicillin. |
| | Gene therapy | | Some genetic diseases may be treated by genetic modification of human cells. Non-reproducing, genetically-engineered viruses may be used to introduce a functional gene into such cells, e.g. the treatment of cystic fibrosis or of severe combined immunodeficiency (SCID). |
| | | | Candidates should be able to make informed judgements about the economic, social and ethical issues concerning genetic engineering and cloning that they have studied or from information that is presented to them. |

# Key Skills and Other Issues

## 13 Key Skills – Teaching, Developing and Providing Opportunities for Generating Evidence

### 13.1 Introduction

The Key Skills Qualification requires candidates to demonstrate levels of achievement in the Key Skills of *Communication, Application of Number* and *Information Technology*.

The units for the 'wider' Key Skills of *Improving own Learning and Performance, Working with Others* and *Problem-Solving* are also available. The acquisition and demonstration of ability in these 'wider' Key Skills is deemed highly desirable for all candidates, but they do not form part of the Key Skills Qualification.

Copies of the Key Skills Units may be down loaded from the QCA web site (www.qca.org.uk/keyskills).

The units for each Key Skill comprise three sections:

A What you need to know.

B What you must do.

C Guidance.

Candidates following a course of study based on this Specification for Human Physiology and Health can be offered opportunities to develop and generate evidence of attainment in aspects of the Key Skills of *Communication, Application of Number, Information Technology, Improving own Learning and Performance, Working with Others* and *Problem-Solving*. Areas of study and learning that can be used to encourage the acquisition and use of Key Skills, and to provide opportunities to generate evidence for Part B of the units, are signposted below.

### 13.2 Key Skills Opportunities in Human Physiology and Health

The opportunities to understand theory, concepts and investigations in Human Physiology and Health that necessitate candidates to demonstrate the transferability of their knowledge, understanding and skills, make it an ideal vehicle to assist candidates to develop their knowledge and understanding of Key Skills and to produce evidence of their application.

## Communication Level 1

| What you must do | Signposting of Opportunities for Generating Evidence in Subject Content | | |
|---|---|---|---|
| | Section 10 | Section 11 | Section 12 |
| **C1.1** Take part in discussions | ✓ | ✓ | ✓ |
| **C1.2** Read and obtain information | ✓ | ✓ | ✓ |
| **C1.3** Write different types of documents | ✓ | ✓ | ✓ |

## Communication Level 2

| What you must do | Signposting of Opportunities for Generating Evidence in Subject Content | | |
|---|---|---|---|
| | Section 10 | Section 11 | Section 12 |
| **C2.1a** Contribute to discussions | ✓ | ✓ | ✓ |
| **C2.1b** Give a short talk | ✓ | ✓ | ✓ |
| **C2.2** Read and summarise information | ✓ | ✓ | ✓ |
| **C2.3** Write different types of documents | ✓ | ✓ | ✓ |

## Application of Number Level 1

| What you must do | Signposting of Opportunities for Generating Evidence in Subject Content | | |
|---|---|---|---|
| | Section 10 | Section 11 | Section 12 |
| **N1.1** Interpret information from different sources | ✓ | ✓ | ✓ |
| **N1.2** Carry out calculations | ✓ | ✓ | ✓ |
| **N1.3** Interpret results and present findings | ✓ | ✓ | ✓ |

## Application of Number Level 2

| What you must do | Signposting of Opportunities for Generating Evidence in Subject Content | | |
|---|---|---|---|
| | Section 10 | Section 11 | Section 12 |
| **N2.1** Interpret information from different sources | ✓ | ✓ | ✓ |
| **N2.2** Carry out calculations | ✓ | ✓ | ✓ |
| **N2.3** Interpret results and present findings | ✓ | ✓ | ✓ |

## Information Technology Level 1

| What you must do | Signposting of Opportunities for Generating Evidence in Subject Content | | |
|---|---|---|---|
| | Section 10 | Section 11 | Section 12 |
| **IT1.1** Find, explore and develop information | ✓ | ✓ | ✓ |
| **IT1.2** Present information, including text, numbers and images | ✓ | ✓ | ✓ |

## Information Technology Level 2

| What you must do | Signposting of Opportunities for Generating Evidence in Subject Content | | |
|---|---|---|---|
| | Section 10 | Section 11 | Section 12 |
| **IT2.1** Search for and select information | ✓ | ✓ | ✓ |
| **IT2.2** Explore and develop information and derive new information | ✓ | ✓ | ✓ |
| **IT2.3** Present combined information, including text, numbers and images | ✓ | ✓ | ✓ |

## Working with Others Level 1

| What you must do | Signposting of Opportunities for Generating Evidence in Subject Content | | |
|---|---|---|---|
| | Section 10 | Section 11 | Section 12 |
| **WO1.1** Confirm what needs to be done and who is to do it | ✓ | ✓ | ✓ |
| **WO1.2** Work towards agreed objectives | ✓ | ✓ | ✓ |
| **WO1.3** Identify progress and suggest improvements | ✓ | ✓ | ✓ |

## Working with Others Level 2

| What you must do | Signposting of Opportunities for Generating Evidence in Subject Content | | |
|---|---|---|---|
| | Section 10 | Section 11 | Section 12 |
| **WO2.1** Plan work and confirm working arrangements | ✓ | ✓ | ✓ |
| **WO2.2** Work cooperatively towards achieving identified objectives | ✓ | ✓ | ✓ |
| **WO2.3** Exchange information on progress and agree ways of improving work with others | ✓ | ✓ | ✓ |

## Improving own Learning and Performance Level 1

| What you must do | Signposting of Opportunities for Generating Evidence in Subject Content | | |
|---|---|---|---|
| | Section 10 | Section 11 | Section 12 |
| **LP1.1** Confirm short-term targets and plan how these will be met | ✓ | ✓ | ✓ |
| **LP1.2** Follow plan to meet targets and improve performance | ✓ | ✓ | ✓ |
| **LP1.3** Review progress and achievements | ✓ | ✓ | ✓ |

## Improving own Learning and Performance Level 2

| What you must do | Signposting of Opportunities for Generating Evidence in Subject Content | | |
|---|---|---|---|
| | Section 10 | Section 11 | Section 12 |
| **LP2.1** Help set short-term targets and plan how these will be met | ✓ | ✓ | ✓ |
| **LP2.2** Use plan and support from others, to meet targets | ✓ | ✓ | ✓ |
| **LP2.3** Review progress and identify evidence of achievements | ✓ | ✓ | ✓ |

**Problem Solving Level 1**

| What you must do | Signposting of Opportunities for Generating Evidence in Subject Content | | |
|---|---|---|---|
| | Section 10 | Section 11 | Section 12 |
| **PS1.1** Confirm understanding of given problems | ✓ | ✓ | ✓ |
| **PS1.2** Plan and try out ways of solving problems | ✓ | ✓ | ✓ |
| **PS1.3** Check if problems have been solved and describe the results | ✓ | ✓ | ✓ |

**Problem Solving Level 2**

| What you must do | Signposting of Opportunities for Generating Evidence in Subject Content | | |
|---|---|---|---|
| | Section 10 | Section 11 | Section 12 |
| **PS2.1** Identify problems and come up with ways of solving them | ✓ | ✓ | ✓ |
| **PS2.2** Plan and try out options | ✓ | ✓ | ✓ |
| **PS2.3** Apply given methods to check if problems have been solved and describe the results | ✓ | ✓ | ✓ |

## 13.3 Further Guidance

More specific guidance and examples of tasks that can provide evidence of single Key Skills, or composite tasks that can provide evidence of more than one Key Skill are given in the AQA specification support material, particularly the Teachers' Guide.

# 14 Spiritual, Moral, Ethical, Social, Cultural and Other Issues

## 14.1 Spiritual, Moral, Ethical, Social, Cultural and Other Issues

The study of Human Physiology and Health lends itself to consideration of many spiritual, moral, ethical, social and cultural issues. The immense complexity of Man as a living organism ineluctably evokes awe and wonder. Consideration of the nature of genetic material and the causes of variation 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.

The following subject areas may be particularly apposite for analysis and discussion of these issues:

- hygiene : personal and food and water
- physical fitness
- drug use and abuse, including alcohol, smoking
- implications of rapid human population increase
- pollutants
- reproduction – artificial insemination, *in vitro* fertilisation and contraception
- genetic mutations
- genetic engineering.

## 14.2 European Dimension

AQA has taken account of the 1988 Resolution of the Council of the European Community in preparing this specification and associated specimen papers. The specification is designed to improve candidates' knowledge and understanding of international debates surrounding new technology and to foster responsible attitudes to such developments. The subject of genetic engineering is particularly pertinent.

## 14.3 Environmental Issues

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 papers.

This specification allows responsible attitudes to environmental issues to be fostered. In particular, environmental issues are prominent in the section "The influence of Man on the environment".

## 14.4 Citizenship

This specification allows treatment of aspects of citizenship through the contribution made to candidates' moral, social and cultural development (see 14.1) and through the opportunities to promote an understanding of, and responsible attitudes towards, environmental issues (see 14.3). In this way, the subject contributes to the development of candidates' social and moral responsibility.

## 14.5 Avoidance of Bias

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

## 14.6 Health and Safety

General teaching requirements about health and safety are applicable to science as well as to other subjects.

When working with equipment and materials, in practical activities and in different environments, including those that are unfamiliar, candidates should be taught:

a. about hazards, risks and risk control;

b. to recognise hazards, assess consequent risks and take steps to control the risks to themselves and others;

c. to use information to assess the immediate and cumulative risks;

d. to manage their environment to ensure the health and safety of themselves and others;

e. to explain the steps they take to control risks.

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 Employment. 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.

## 14.7 Use of Organisms

Nothing in this specification requires candidates, teachers or lecturers to kill animals. Live animals brought into the laboratory for study should be kept unstressed in suitable conditions and should, wherever possible, be returned unharmed to their habitats. Studies of animals and plants in their habitats should aim at minimal disturbance.

## 14.8 Use of the Term "Man"

The taxonomically correct term "Man" is used to refer to the species *Homo sapiens* without any implication of gender.

## 14.9 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.

## 14.10 Mathematical Requirements

Candidates are expected to be familiar with the following mathematical skills in each tier:

Number

- The four operations, applied to whole numbers and decimals
- Efficient use of a calculator
- Use of squares and square roots
- Use of decimals, ratios, fractions and percentages
- Estimation and approximation of solutions to numerical problems
- Understand and use direct and inverse proportion

Algebra

- Substitution of numbers into simple formulae and equations expressed in words and symbols
- Transformation of simple equations

Shape, Space and Measures

- Use of appropriate measures of length, mass, time
- Use of area and volume
- Use of scales

Handling Data

- Construction of tables of data
- Select appropriate axes and scales for graph plotting
- Construction of diagrams and graphs, including bar charts and pie charts and use of lines of best fit where appropriate
- Interpretation of tables, diagrams and graphs, and from them draw simple inferences
- Calculation of an arithmetic mean
- Use sampling methods, considering their reliability

**Drawing Graphs**

Additional guidance relating to drawing graphs is given below.

(a) Candidates will be told what type of graph to draw, i.e. bar or line.

(b) Where continuous information is represented and interpolation is theoretically possible, a 'best fit' smooth curve or line graph will be appropriate.

(c) Where interpolation is inappropriate then joining of points is acceptable.

(d) Where there is no indication of the nature of the line required, then candidates can adopt either method.

## 14.11 Information and Communication Technology

Through the teaching of this specification candidates should be given opportunities to apply and develop their ICT capability. Although the scheme of assessment in this specification does not assess directly candidates' effective use of ICT, teaching of the specification can encourage use of ICT. In addition, there are opportunities to generate evidence of attainment in the key skill of information technology.

Candidates should be given opportunities to support their work by being taught to:

a. find things out from a variety of sources, selecting and synthesising the information to meet their needs and developing an ability to question its accuracy, bias and plausibility;

b. develop their ideas using ICT tools to amend and refine their work and enhance its quality and accuracy;

c. exchange and share information, both directly and through electronic media;

Examples of opportunities in the subject content for the use of ICT are as follows.

Candidates could:

- use multimedia sources to see things that cannot readily be observed at first hand (**See 10.4, 11.1, 11.4, 11.8**)
- use data loggers in investigations (**See 11.9**)
- use the internet to find information about commercial applications, current developments, products, processes or uses (**See 10.5, 11.8, 11.13, 12.12**)
- use spreadsheets for modelling or data analysis (**See 10.5, 11.9, 12.11**).

ICT is a useful tool in relation to coursework (**see 18.5**). This could involve data logging, spread sheets and the use of word processors to write up investigations. Spelling and grammar checks in this latter activity will also help to develop writing skills.

ICT can also help the teaching of topics that are difficult to teach interestingly in other ways.

# Centre-Assessed Component

## 15 Nature of the Centre-Assessed Component

Ten individual skills are to be assessed in the context of the subject content. Eight of these address the four skills detailed in the section on experiment and investigation in the subject criteria for GCSE Science. The remaining two assess the ability of candidates to select and organise relevant material in the context of demonstrating an understanding of the ethical, social, economic, environmental and technological implications and applications of Human Physiology and Health. Coursework also provides opportunities for assessment of Key Skills (see Section 13 of this specification.)

Assessment should form part of a candidate's normal programme of coursework as opposed to a series of practical tests. Assistance in explaining the criteria on which work is to be assessed may be given by the teacher but this assistance should be generic rather than relating to the particular task under consideration.

## 16 Guidance on Setting the Centre-Assessed Component

### 16.1 Choice of tasks

It should be decided whether evidence will be collected from first hand experience and/or from secondary sources including ICT.

Investigations may be laboratory based, field based or may involve the use of surveys. The support material provides a number of suggestions for tasks that might be undertaken for assessment purposes but centres are encouraged to develop material that suits the circumstances of their staff and students.

### 16.2 Coursework Advisers

Coursework Advisers will be available to assist centres with any matters relating to coursework. Details will be provided when AQA knows which centres are following the specification.

# 17 Assessment Criteria

## 17.1 Introduction

Centres may assess each of the ten skills on more than one occasion and are required to submit the best marks obtained by the candidate for each skill.

However, the following requirements must be met:

- each skill mark must be obtained from work in the context of the specification content;
- at least one of the skill area marks **must** have been obtained from a **whole investigation** carried out by the candidate.

In consequence, the minimum evidence must be **one** piece of work.

## 17.2 Group 1

### Planning incorporating Skills A, B and C

In order to allow candidates to design investigative approaches for themselves it is essential that they are provided with a genuine opportunity to demonstrate these skills. It is therefore important that they are not provided with a situation with which they are already familiar and are merely required to alter a different variable or factor.

As the skills in this group are experimental and/or investigative skills, planning should be carried out in this context and not merely as a theoretical exercise. If candidates are required to implement their plans, care must be taken that the suggested procedures are safe and ethically and environmentally acceptable. It may, therefore, be necessary for a plan to be amended before a candidate is allowed to proceed.

A plan should provide an indication of the intended investigative procedure and should therefore be written in the future tense. Formal accounts of investigations written after completion of the work are not acceptable as plans.

### Planning

Within this section, candidates should:

a. carry out pilot experiments or pilot surveys;

b. define the nature of a question or problem using available information and knowledge of human physiology and health;

c. choose effective procedures, selecting suitable apparatus and materials if appropriate, and deciding the measurements and/or observations likely to generate useful and reliable results;

d. consider ethical implications and the environmental and safety aspects of the proposed procedures.

| SKILL | PERFORMANCE LEVEL | | | |
|---|---|---|---|---|
| Planning | 0 marks | 1 mark | 2 marks | 3 marks |
| **A Carrying out pilot experi-ments or surveys** | Pilot procedure not relevant to problem under investigation. | Pilot procedure relevant to the problem under consideration but does not yield information which has a significant effect on the procedure eventually adopted. | Pilot procedure relevant to the problem under consideration and yields information which defines some of the factors to be controlled during the procedure eventually adopted. | Pilot procedure relevant to the problem under consideration and yields information which defines all of the factors able to be controlled during the procedure eventually adopted. |
| **B Consider-ing the factors to be taken into account when collecting evidence** | Description of procedure not relevant to problem under investigation. | Description of simple procedure relevant to the problem under consideration but would not allow implementation without considerable further detail. | Description of procedure relevant to the problem under consideration and would allow implementation with minor clarification of detail. Consideration given to the key factors that need to be taken into account when collecting evidence. | Description of procedure relevant to the problem under consideration and would allow implementation without further detail. Recognition of factors which cannot readily be controlled when collecting evidence. |
| **C Deciding the extent and range of data to be collected** | Method unlikely to generate useful quantitative data. | Method would generate an inadequate range of quantitative data. | Method would generate a full range of quantitative data but with some limitations concerning reliability. | Method would generate a full range of useful and reliable quantitative data. |

## 17.3 Group 2

### Implementing incorporating Skills D and E

Since the skills assessed in this group involve implementation, **Skill D** should be assessed while the candidate is carrying out practical work in the laboratory or field. The mark submitted for this skill may be based on an independent activity i.e. a candidate who plans and implements a survey may be assessed for this skill on a given piece of experimental work.

In order to provide appropriate opportunities to demonstrate the necessary skills, instructions provided should not be prescriptive but should allow candidates to make decisions for themselves, particularly concerning the conduct of the work and the collection of data.

A high performance level for **Skill D** should reflect the ability to work methodically and safely, demonstrating competence in the required manipulative skills and efficiency in managing time.

The emphasis with **Skill E** is placed on methodical collection of raw data.

To gain maximum credit data should be recorded logically, preferably in tabular form. If ICT is used in the collection of data, the same criteria should apply.

**Implementing**

Within this section, candidates should:

a. use apparatus and materials in an appropriate and safe way;

b. carry out work in a methodical and organised way with due regard for safety and with appropriate consideration for the well-being of living organisms and the environment;

c. make and record detailed observations in a suitable way and make measurements to an appropriate degree of precision, using ICT where appropriate.

| SKILL | PERFORMANCE LEVEL | | | |
|---|---|---|---|---|
| Imple-menting | 0 marks | 1 mark | 2 marks | 3 marks |
| D Using apparatus in an appro-priate and safe way | Experiment conducted in total disorder or candidate unable to use the apparatus involved. | Experiment conducted in considerable disorder with insufficient regard to safety, a failure to approach the work methodically or major failings in using apparatus. | Experiment conducted adequately but with a lack of full regard to minor aspects of safety, approach or use of apparatus. | Experiment conducted in a well organised manner. Apparatus used skilfully with full regard to safety. |
| E Collecting and presenting raw data | Appropriate raw data not collected. | Insufficient appropriate raw data collected and presented in an appropriate form. | Sufficient appropriate raw data collected but presented in an inappropriate form. | Sufficient appropriate raw data collected and presented in an appropriate form. |

## 17.4 Group 3

**Analysing, drawing conclusions and evaluating incorporating Skills F, G and H**

These three skills should be assessed on investigative work completed by the candidate, this is particularly important in providing candidates with the opportunity to recognise the limitations of the apparatus and/or techniques adopted and to be able to assess the reliability of the data collected.

**Skill F** requires candidates to select relevant data to produce an effective summary of the results of an investigation. An appropriate graph should be drawn and, to this end, they should be familiar with line graphs, bar charts and histograms.

**Skill G** involves the interpretation of results. Since maximum credit can only be obtained where the candidate produces an appropriate description of the trends and patterns in the data obtained and accompanies this with detailed conclusions related to human physiology and health knowledge, it is important that the task chosen offers sufficient opportunity. It is recommended that consideration be given to pooling the results of group work so that candidates are not required to spend excessive time collecting sufficient data for analysis.

The evaluation of the work in **Skill H** requires substantially more than a list of avoidable errors. Credit should only be given where candidates are able to identify the main sources of experimental error or limitations in the data collected.

**Analysing evidence and drawing conclusions and evaluating**

Within this section candidates should:

a. communicate human physiology and health ideas in appropriate ways, including tabulation, line graphs, histograms, continuous prose, annotated drawings and diagrams;

b. recognise and comment on trends and patterns in data;

c. draw valid conclusions by applying human physiology and health knowledge and understanding;

d. assess the reliability and precision of investigative activity and the conclusions drawn from it;

e. evaluate the techniques used in the investigative activity recognising their limitations.

| SKILL | PERFORMANCE LEVEL | | | |
|---|---|---|---|---|
| Analysing | 0 marks | 1 mark | 2 marks | 3 marks |
| F Use of graphical techni-ques | Graph plotted from inappropriate data or technique selected entirely inappro-priate. | Line graph, bar chart or histogram appropriately selected and relevant information plotted but major errors such as those involving scaling or accuracy of plotting. | Line graph, bar chart or histogram appropriately selected and relevant information plotted but minor errors such as those involving units or labelling. | Line graph, bar chart or histogram appropriately selected and relevant information plotted, all conventions followed and no errors. |
| G Interpreta-tion of results | Comment confined to translating data into continuous prose. | Trends and patterns in data recognised and described. | Trends and patterns in data recognised and described. Some valid conclusions drawn, supported by appropriate results and partly related to human physiology and health knowledge. | Trends and patterns in data recognised and described. Detailed conclusions drawn, fully supported by appropriate results and related to human physiology and health knowledge. |
| H Evalua-tion of investiga-tive work | Little worthwhile comment or comment confined to listings of personal failings. | Main sources of error in investigative procedure identified **or** limitations of/and anomalies in results recognised. | Main sources of error in investigative procedure identified **and** limitations of/and anomalies in results recognised. | Evaluation made of the influence of main sources of error in investigative procedure and limitations of/and anomalies in results. |

## 17.5 Group 4

**Communicating incorporating Skills I and J**

The task chosen for this exercise may be a related part of an investigation (e.g. the introduction) or a separate piece of written work. It should be between approximately 500 and 1000 words in length. Alternatively, consideration may be given to other means of presentation such as a suitably informative poster or an oral presentation. The purpose of this exercise is to assess the specific assessment objective requiring candidates to:

draw on existing knowledge to show understanding of the ethical, social, economic, environmental and technological applications of human physiology and health.

Tasks need, therefore, to be selected appropriately. Candidates should be encouraged to use ICT wherever possible in carrying out the assessment task.

**Skill I** assesses the ability to select and use appropriate information. The number of sources referred to in the criteria for the performance levels will depend on the suggested task and the resources available but stress should be placed on the range of resources used rather than the absolute number. There is no merit in confining a search for information to standard class textbooks.

**Skill J** is concerned with the assessment of the ability to present an argument logically and coherently and expressing ideas with appropriate scientific terminology. Spelling, punctuation and grammar should be taken into account only insofar as they affect the clarity of the argument.

Communicating

Within this section candidates should:

select, organise and present relevant information clearly and logically, using appropriate vocabulary.

| SKILL | PERFORMANCE LEVEL | | | |
|---|---|---|---|---|
| Commun-icating | 0 marks | 1 mark | 2 marks | 3 marks |
| **I Selection and retrieval of appro-priate informa-tion** | Unable to find relevant information or found from limited number of sources but failed to use this selectively. | Found relevant information from a good range of sources but failed to use this selectively in support of an argument. | Found relevant information from a good range of sources but only used some of this selectively in support of an argument. | Found relevant information from a good range of sources and used all of this selectively in support of an argument. |
| **J Communi-cation of scientific informa-tion** | Many arguments lack clarity and logical presentation. Poor use of scientific terminology. | Most of the arguments clearly and logically presented and some use made of appropriate scientific terminology. | Arguments clearly and logically presented throughout, although not always making use of appropriate scientific terminology. | Arguments clearly and logically presented throughout. Makes use of appropriate scientific terminology throughout. |

### 17.6 Evidence to Support the Award of Marks

Teachers are encouraged to annotate candidates' reports to help guide the moderator on their choice of the marks for each ability.

Teachers should keep records of their assessments during the course, in a form which facilitates the complete and accurate submission of the final assessments at the end of the course.

When the assessments are complete, the final marks awarded under each of the assessment criteria must be entered on the Candidate Record Form, with supporting information given in the spaces provided.

Candidate Record Forms are available on the AQA website in the Administration area. They can be accessed via the following link http://www.aqa.org.uk/admin/p_course.php.

The Candidate Record Form must be attached to the candidate's work.

# 18 Supervision and Authentication

### 18.1 Supervision of Candidates' Work

Candidates' work for assessment must be undertaken under conditions which allow the teacher to supervise the work and enable the work to be authenticated. If it is necessary for some assessed work to be done outside the centre, sufficient work must take place under direct supervision to allow the teacher to authenticate each candidate's whole work with confidence.

### 18.2 Guidance by the Teacher

The work assessed must be solely that of the candidate concerned. Any assistance given to an individual candidate which is beyond that given to the group as a whole must be recorded on the Candidate Record Form.

### 18.3 Unfair Practice

At the start of the course, the supervising teacher is responsible for informing candidates of the AQA Regulations concerning malpractice. Candidates must not take part in any unfair practice in the preparation of coursework to be submitted for assessment, and must understand that to present material copied directly from books or other sources without acknowledgement will be regarded as deliberate deception. Centres must report suspected malpractice to AQA. The penalties for malpractice are set out in the AQA Regulations.

### 18.4 Authentication of Candidates' Work

Both the candidate and the teacher are required to sign declarations confirming that the work submitted for assessment is the candidate's own. The teacher declares that the work was conducted under the specified conditions, and records details of any additional assistance.

### 18.5 Use of ICT

Centres offering courses based on this specification are encouraged to make candidates aware of the use of appropriate information technology in conducting research and handling data. Centres must be fully aware from the onset of coursework if candidates are to use such techniques so that the work can be verified as the candidate's own. Centres must declare on the *Coursework Cover Sheet* when they have used data generated by software. A candidate who uses a word processor or computer software will not for this reason gain more marks than a candidate who does not. Use of a word processor or computer software will be regarded only as an additional tool or technique and credit will be awarded only for how the data are used and analysed. The data used by the candidate in any software program must be available for scrutiny by the Moderator.

# 19 Standardisation

### 19.1 Standardising Meetings

Annual standardising meetings will usually be held in the autumn term. Centres entering candidates for the first time must send a representative to the meetings. Attendance is also mandatory in the following cases:

- where there has been a serious misinterpretation of the specification requirements;
- where the nature of coursework tasks set by a centre has been inappropriate;
- where a significant adjustment has been made to a centre's marks in the previous year's examination.

After the first year, attendance is at the discretion of centres. At these meetings support will be provided for centres in the development of appropriate coursework tasks and assessment procedures.

### 19.2 Internal Standardisation of Marking

The centre is required to standardise the assessments across different teachers and teaching groups to ensure that all candidates at the centre have been judged against the same standards. If two or more teachers are involved in marking a component, one teacher must be designated as responsible for internal standardisation. Common pieces of work must be marked on a trial basis and differences between assessments discussed at a training session in which all teachers involved must participate. The teacher responsible for standardising the marking must ensure that the training includes the use of reference and archive materials such as work from a previous year or examples provided by AQA. The centre is required to send to the moderator the Centre Declaration Sheet, duly signed, to confirm that the marking of centre-assessed work at the centre has been standardised. If only one teacher has undertaken the marking, that person must sign this form.

A specimen Centre Declaration Sheet appears in Appendix B.

# 20 Administrative Procedures

## 20.1 Recording Assessments

The candidates' work must be marked according to the assessment criteria set out in Section 17. The marks and supporting information must be recorded in accordance with the instructions in Section 17. The completed Candidate Record Form for each candidate must be attached to the work and made available to AQA on request.

## 20.2 Submitting Marks and Sample Work for Moderation

The total component mark for each candidate must be submitted to AQA on the mark sheets 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.

## 20.3 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.

Special consideration should be requested for candidates whose work has been affected by illness or other exceptional circumstances. Information about the procedure is issued separately.

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. AQA will advise on the procedures to be followed in such cases.
Where special help which goes beyond normal learning support is given, AQA must be informed so that such help can be taken into account when assessment and moderation take place.

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 accept the assessments made at the previous centre. Centres should contact AQA at the earliest possible stage for advice about appropriate arrangements in individual cases.

## 20.4 Retaining Evidence and Re-Using Marks

The centre must retain the work of all candidates, with Candidate Record Form attached, under secure conditions, from the time it is assessed, to allow for the possibility of an enquiry upon results. The work may be returned to candidates after the issue of results provided that no enquiry upon result is to be made which will include re-moderation of the coursework component. If an enquiry upon result is to be made, the work must remain under secure conditions until requested by AQA.

Candidates re-taking the examination may carry forward their moderated coursework marks. These marks have a shelf-life which is limited only by the shelf-life of the specification, and they may be carried forward an unlimited number of times within this shelf-life.

# 21 Moderation

## 21.1 Moderation Procedures

Moderation of the coursework 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 the sample of work must reach the moderator by the specified date in the year in which the qualification is awarded.

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 order to meet this possible request, centres must have available the coursework and Candidate Record Form 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, AQA reserves the right to alter the order or merit.

## 21.2 Post-Moderation Procedures

On publication of the GCSE results, the centre is supplied with details of the final marks for the coursework component.

The candidates' work is returned to the centre after the examination with a report form from the moderator giving feedback to the centre on the appropriateness of the tasks set, the accuracy of the assessments made, and the reasons for any adjustments to the marks.

Some candidates' work may be retained by AQA for archive purposes.

# Awarding and Reporting

## 22 Grading, Shelf-Life and Re-Sits

| | | |
|---|---|---|
| 22.1 | Qualification Titles | The qualification based on this specification has the following title: AQA GCSE in Human Physiology and Health. |
| 22.2 | Grading System | The qualification will be graded on an 8 point grade Scale A*, A, B, C, D, E, F, G. Candidates who fail to reach the minimum standard for grade G will be recorded as U (unclassified) and will not receive a qualification certificate.<br><br>Candidates must be entered for either the Foundation Tier or Higher Tier. For candidates entered for the Foundation Tier, grades C–G are available. For candidates entered for the Higher Tier A*-D are available. There is a safety net for candidates entered for the Higher Tier, where an allowed Grade E will be awarded where candidates just fail to achieve Grade D. Candidates who fail to achieve a Grade E on the Higher Tier or Grade G on the Foundation Tier will be reported as unclassified. |
| 22.3 | Re-Sits | Individual components may not be retaken, but candidates may retake the whole qualification more than once. |
| 22.4 | Minimum Requirements | Candidates will be graded on the basis of work submitted for assessment. |
| 22.5 | Carrying Forward of Centre-Assessed Marks | Candidates re-taking the examination may carry forward their moderated coursework marks. These marks have a shelf-life which is limited only by the shelf-life of the specification and they may be carried forward an unlimited number of times within this shelf-life. |
| 22.6 | Awarding and Reporting | This specification complies with the grading, awarding and certification requirements of the current GCSE, GCE, VCE, GNVQ and AEA Code of Practice 2007 and will be revised in the light of any subsequent changes for future years. |

# Appendices

## A Grade Descriptions

The following grade descriptors indicate the level of attainment characteristic of the given grade at GCSE. They give a general indication of the required learning outcomes at each specific grade. The descriptors 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 (as in section 6) overall. Shortcomings in some aspects of the examination may be balanced by better performances in others.

**Grade A** Candidates recall a wide range of knowledge from all areas of the specification.

Candidates use detailed scientific knowledge and understanding in a range of applications relating to scientific systems or phenomena.

Candidates draw together and communicate knowledge from more than one area, use routinely scientific or mathematical conventions in support of arguments, use a wide range of scientific and technical vocabulary throughout their work.

Candidates explain how scientific theories can be changed by new evidence and identify some areas of uncertainty in science.

Candidates use scientific knowledge and understanding to select an appropriate strategy for a task, identifying the key factors to be considered. They make systematic observations in qualitative work and decide which observations are relevant to the task in hand. When making measurements they decide the level of precision needed and use a range of apparatus with precision and skill to make appropriately precise measurements. They select a method of presenting data appropriate to the task; they use information from a range of sources where it is appropriate to do so. They identify and explain anomalous observations and measurements and the salient features of graphs.

Candidates use scientific knowledge and understanding to identify and explain patterns and draw conclusions from the evidence by combining data of more than one kind or from more than one source. They identify shortcomings in the evidence, use scientific knowledge and understanding to draw conclusions from their evidence and suggest improvements to the methods used that would enable them to collect more reliable evidence.

**Grade C** Candidates recall a range of scientific information from all areas of the specification.

Candidates use and apply scientific knowledge and understanding in some general contexts. Candidates describe links between related phenomena in different contexts, use diagrams, charts and graphs to support arguments, use appropriate scientific and technical vocabulary in a range of contexts.

Candidates describe how evidence is used to test predictions made from scientific theories, and how different people may have different views on some aspects of science.

Candidates use scientific knowledge and understanding to identify an approach to a question, for example, identifying key factors to vary and control. Candidates use a range of apparatus to make careful and precise measurements and systematic observations and recognise when it is necessary to repeat measurements and observations. They present data systematically, in graphs where appropriate, and use lines of best fit. Candidates identify and explain patterns within data and draw conclusions consistent with the evidence. They explain these conclusions using scientific knowledge and understanding and evaluate how strongly their evidence supports the conclusions.

**Grade F** Candidates recall a limited range of information.

Candidates use and apply knowledge and understanding in some specific everyday contexts.

Candidates make some use of scientific and technical vocabulary and make simple generalisations from information.

Candidates relate scientific explanations to some experimental evidence and describe simple examples of benefits and drawbacks of scientific development.

Candidates devise fair tests in contexts, which involve only a few factors. They use simple apparatus to make measurements appropriate to the task and record observations and measurements in tables and graphs. Candidates obtain information from simple tables, charts and graphs and identify simple patterns in information and observations. They offer explanations consistent with the evidence obtained.

# B Record Forms

Candidate Record Forms and Centre Declaration Sheets for Human Physiology and Health (3417) are available on the AQA website in the Administration area. They can be accessed via the following link
http://www.aqa.org.uk/admin/p_course.php

C

# Overlaps with Other Qualifications

| | |
|---|---|
| GCSE Sciences:<br>(GCSE Science A,<br>GCSE Science B,<br>GCSE Additional Science,<br>GCSE Biology,<br>GCSE Chemistry,<br>GCSE Physics) | Some topics within the Human Physiology and Health specification can be found in part in the GCSE Sciences.<br><br>However the approach, breadth and depth of coverage of these topics may vary considerably. |
| GCSE Environmental Science | There is a degree of overlap in the following topics:<br><br>• healthy water - effects of fertilisers<br>• water treatment<br>• sewage treatment<br>• respiration<br>• food chains and webs<br>• genetic engineering<br>• recycling of materials<br>• refuse disposal.<br><br>The approach, breadth and depth of coverage of these topics varies between the specifications. |
| GCSE Applied Science<br>(Double Award) | There is some overlap in the biological content. |