Comparison document

(Version 3.1 April 2016 compared to previous version)

Higher Human Biology Course Assessment Specification (C740 76)

The purpose of this document is to give a quick, visual guide to any amendments or clarifications made during the revision process.

Valid from August 2014

This edition: April 2016~~5~~, version 3.1~~0~~

Please refer to the note of changes at the end of this Course Assessment Specification for details of changes from previous version (where applicable).

Course outline

Course title: Higher Human Biology

SCQF level: 6 (24 SCQF credit points)

Course code: C740 76

Course assessment code: X740 76

The purpose of the Course Assessment Specification is to ensure consistent and transparent assessment year on year. It describes the structure of the Course assessment and the mandatory skills, knowledge and understanding that will be assessed.

Course assessment structure

Component 1 — question paper	100 marks
Component 2 — assignment	20 marks
Total marks	**120 marks**

This Course includes six SCQF credit points to allow additional time for preparation for Course assessment. The Course assessment covers the added value of the Course.

Equality and inclusion

This Course Assessment Specification has been designed to ensure that there are no unnecessary barriers to assessment. Assessments have been designed to promote equal opportunities while maintaining the integrity of the qualification.

For guidance on assessment arrangements for disabled learners and/or those with additional support needs, please follow the link to the Assessment Arrangements web page: www.sqa.org.uk/sqa/14977.html.

Guidance on inclusive approaches to delivery and assessment of this Course is provided in the *Course Support Notes*.

Assessment

To gain the award of the Course, the learner must pass all of the Units as well as the Course assessment. Course assessment will provide the basis for grading attainment in the Course award.

Course assessment

SQA will produce and give instructions for the production and conduct of Course assessments based on the information provided in this document.

Added value

The purpose of the Course assessment is to assess added value of the Course as well as confirming attainment in the Course and providing a grade. The added value for the Course will address the key purposes and aims of the Course as defined in the Course Rationale. It will do this by addressing one or more of breadth, challenge, or application.

In this Course assessment, added value will focus on the following:

- breadth — drawing on knowledge and skills from across the Course
- challenge — requiring greater depth or extension of knowledge and/or skills
- application — requiring application of knowledge and/or skills in practical or theoretical contexts as appropriate

This added value consists of:

- a question paper, which requires learners to demonstrate aspects of breadth, challenge and application; learners will apply breadth and depth of skills, knowledge and understanding from across the Course to answer questions in human biology
- an assignment, which requires learners to demonstrate aspects of challenge and application; learners will apply skills of scientific inquiry, using related knowledge, to carry out a meaningful and appropriately challenging task in human biology and communicate findings.

Grading

Course assessment will provide the basis for grading attainment in the Course award.

The Course assessment is graded A–D. The grade is determined on the basis of the total mark for all Course assessments together.

A learner's overall grade will be determined by their performance across the Course assessment.

Grade description for C
For the award of Grade C, learners will have demonstrated successful performance in all of the Units of the Course. In the Course assessment, learners will typically have

demonstrated successful performance in relation to the mandatory skills, knowledge and understanding for the Course.

Grade description for A
For the award of Grade A, learners will have demonstrated successful performance in all of the Units of the Course. In the Course assessment, learners will typically have demonstrated a consistently high level of performance in relation to the mandatory skills, knowledge and understanding for the Course.

In addition, learners achieving a Grade A will have demonstrated a high overall level of performance by:

- retaining knowledge and understanding over a long period of time
- showing a deeper level of knowledge and understanding
- integrating and applying skills, knowledge and understanding across the three component Units of the Course
- displaying problem solving skills in less familiar and more complex contexts
- applying skills of scientific inquiry and analytical thinking in complex contexts that involve more complex data

Credit
To take account of the extended range of learning and teaching approaches, remediation, consolidation of learning and integration needed for preparation for external assessment, six SCQF credit points are available in Courses at National 5 and Higher, and eight SCQF credit points in Courses at Advanced Higher. These points will be awarded when a grade D or better is achieved.

Structure and coverage of the Course assessment

The Course assessment will consist of two Components: a question paper and an assignment. The question paper will have two Sections. The assignment will have one Section.

Component 1 — question paper

The purpose of the question paper is to assess breadth and depth of knowledge and understanding from across the Units.

The paper will assess scientific inquiry skills, analytical thinking skills and the impact of applications on society and the environment.

The question paper will give learners an opportunity to demonstrate the following skills, knowledge and understanding by:

- demonstrating knowledge and understanding of human biology by making statements, describing information, providing explanations and integrating knowledge
- applying knowledge of human biology to new situations, analysing information and solving problems
- planning or designing experiments/practical investigations to test given hypotheses or to illustrate particular effects, applying safety measures
- selecting and presenting information appropriately in a variety of forms
- processing information (using calculations and units, where appropriate)
- making predictions and generalisations based on evidence/information
- drawing valid conclusions and giving explanations supported by evidence/justification
- identifying a source of error and suggesting improvements to experiments/practical investigations

The mandatory skills and knowledge are specified in the 'Further mandatory information on Course coverage' section at the end of this Course Assessment Specification.

The question paper will have 100 marks.

The question paper will have two Sections.

Section 1, titled 'Objective Test', will have 20 marks.

Section 2, titled 'Paper 2', will contain restricted and extended response questions and will have 80 marks.

Marks will be distributed approximately proportionately across the Units. The majority of the marks will be awarded for applying knowledge and understanding. The other marks will be awarded for applying scientific inquiry, scientific analytical thinking and problem solving skills.

For more information about the structure and coverage of the Question Paper, refer to the Question Paper Brief.

Component 2 — assignment
The purpose of the assignment is to assess the application of skills of scientific inquiry and related human biology knowledge and understanding.

The assignment requires learners to apply skills, knowledge and understanding to investigate a relevant topic in human biology. The topic should draw on one or more of the key areas of the Course, and should be chosen with guidance from the assessor.

The assignment will give learners an opportunity to demonstrate the following skills, knowledge and understanding by:

- applying knowledge of human biology to new situations and analysing information
- selecting information from a variety of sources
- presenting information appropriately in a variety of forms
- processing the information (using calculations and units, where appropriate)
- drawing valid conclusions and giving explanations supported by evidence/justification
- communicating findings/information

The assignment will have 20 marks out of a total of 120 marks.

The majority of the marks will be awarded for applying scientific inquiry and analytical thinking skills. The other marks will be awarded for applying knowledge and understanding related to the topic chosen.

The assignment offers challenge by requiring skills, knowledge and understanding to be applied in a context that is one or more of the following:

- unfamiliar
- familiar but investigated in greater depth
- integrates a number of familiar contexts

This assignment has two stages:

- a research stage
- a communication stage

In the course of their assignment, learners are required to:

- choose a relevant topic in human biology (the assessor must review the appropriateness of the topic chosen)
- state appropriate aim(s)
- research the topic by selecting relevant data/information
- process and present relevant data/information
- analyse data/information
- state conclusion(s)
- evaluate their investigation
- explain the underlying biology of the topic researched
- present the findings of the research in a report

Setting, conducting and marking of assessment

Question paper

This question paper will be set and marked by SQA, and conducted in centres under conditions specified for external examinations by SQA. Learners will complete this in 2 hours and 30 minutes.

Controlled assessment — assignment

This assignment is:

- set by centres within SQA guidelines
- conducted under a high degree of supervision and control

Evidence will be submitted to SQA for external marking.

All marking will be quality assured by SQA.

Setting the assessment

Set by centres within SQA guidelines.

Conducting the assessment

The **research** stage will be conducted under some supervision and control.

The **communication** stage will be conducted under a high degree of supervision. SQA will provide Assignment General assessment information and Assignment Assessment task documents. SQA will specify the material to be taken into the communication stage of the assignment.

The production of the report will be carried out:

- in time to meet a submission date set by SQA
- independently by the learner

Further mandatory information on Course coverage

The following gives details of mandatory skills, knowledge and understanding for the Higher Human Biology Course. Course assessment will involve sampling the skills, knowledge and understanding. This list of skills, knowledge and understanding also provides the basis for the assessment of Units of the Course.

The following gives details of the skills:

- demonstrating knowledge and understanding of human biology by making statements, describing information, providing explanations and integrating knowledge
- applying human biology knowledge to new situations, analysing information and solving problems
- planning and designing experiments/practical investigations to test given hypotheses or to illustrate particular effects
- carrying out experiments/practical investigations safely, recording detailed observations and collecting data
- selecting information from a variety of sources
- presenting information appropriately in a variety of forms
- processing information (using calculations and units, where appropriate)
- making predictions and generalisations from evidence/information
- drawing valid conclusions and giving explanations supported by evidence/justification
- evaluating experiments/practical investigations and suggesting improvements
- communicating findings/information effectively

These skills will be assessed, across the Course, in the context of the mandatory knowledge.

The following table specifies the mandatory knowledge for the Higher Human Biology Course.

Human Cells

1 Division and differentiation in human cells

(a) Somatic cells divide by mitosis to form more somatic cells.

(b) Cellular differentiation is the process by which a cell develops more specialised functions by expressing the genes characteristic for that type of cell.

(c) Stem cells — embryonic and tissue (adult) stem cells.

Stem cells are unspecialised somatic cells that can divide to make copies of themselves (self-renew) and/or differentiate into specialised cells. Tissue (adult) stem cells are involved in the growth, repair and renewal of the cells found in that tissue. They are multipotent.

The main body tissue types are epithelial, connective, muscle and nerve tissue. The body organs are formed from a variety of these tissues.

The cells of the early embryo can make all of the differentiated cell types of the body. They are pluripotent. When grown in the lab scientists call these embryonic stem cells.

(d) Germline cells divide by mitosis to produce more germline cells or by meiosis to produce haploid gametes. Mutations in germline cells are passed to offspring. Mutations in somatic cells are not passed to offspring.

(e) Research and therapeutic uses of stem cells by reference to the repair of damaged or diseased organs or tissues. Stem cells can also be used as model cells to study how diseases develop or for drug testing. The ethical issues of stem cell use and the

regulation of their use.
(f) Cancer cells divide excessively to produce a mass of abnormal cells (a tumour) that do not respond to regulatory signals and may fail to attach to each other.
If the cancer cells fail to attach to each other, they can spread through the body to form secondary tumours.

2 Structure and replication of DNA
(a) Structure of DNA – nucleotides contain deoxyribose sugar, phosphate and base. DNA has a sugar–phosphate backbone, complementary base pairing — adenine with thymine and guanine with cytosine. The two DNA strands are held together by hydrogen bonds and have an antiparallel structure, with deoxyribose and phosphate at 3' and 5' ends of each strand.
(b) Chromosomes consist of tightly coiled DNA and are packaged with associated proteins.
(c) Replication of DNA by DNA polymerase and primer. DNA is unwound and unzipped to form two template strands. DNA polymerase needs a primer to start replication and can only add complementary DNA nucleotides to the deoxyribose (3') end of a DNA strand. This results in one strand being replicated continuously and the other strand replicated in fragments which are joined together by ligase.

3 Gene expression
(a) Phenotype is determined by the proteins produced as the result of gene expression. Only a fraction of the genes in a cell are expressed.
Gene expression is influenced by intra- and extra-cellular environmental factors. Gene expression is controlled by the regulation of both transcription and translation.
(b) Structure and functions of RNA.
RNA is single stranded, contains uracil instead of thymine and ribose instead of deoxyribose sugar. Messenger RNA (mRNA) carries a copy of the DNA code from the nucleus to the ribosome. Ribosomal RNA (rRNA) and proteins form the ribosome. Each transfer RNA (tRNA) carries a specific amino acid.
(c) Transcription of DNA into primary and mature RNA transcripts in the nucleus. This should include the role of RNA polymerase and complementary base pairing.
The introns of the primary transcript of mRNA are non-coding and are removed in RNA splicing. The exons are coding regions and are joined together to form mature transcript. This process is called RNA splicing.
(d) Translation of mRNA into a polypeptide by tRNA at the ribosome.
tRNA folds due to base pairing to form a triplet anticodon site and an attachment site for a specific amino acid. Triplet codons on mRNA and anticodons translate the genetic code into a sequence of amino acids. Start and stop codons exist. Codon recognition of incoming tRNA, peptide bond formation and exit of tRNA from the ribosome as polypeptide is formed.
(e) Different proteins can be expressed from one gene as a result of alternative RNA splicing and post translational modification. Different mRNA molecules are produced from the same primary transcript depending on which RNA segments are treated as exons and introns. Post translation protein structure modification by cutting and combining polypeptide chains or by adding phosphate or carbohydrate groups to the protein.

4 Genes and proteins in health and disease
(a) Proteins are held in a three dimensional shape by peptide bonds, hydrogen bonds, interactions between individual amino acids.
Polypeptide chains fold to form the three dimensional shape of the protein.
(b) Mutations result in no protein or a faulty protein being expressed.
Single gene mutations involve the alteration of a DNA nucleotide sequence as a result

of the substitution, insertion or deletion of nucleotides. Nature of single-nucleotide substitutions including: missense, nonsense and splice-site mutations. Nucleotide insertions or deletions result in frame-shift mutations or an expansion of a nucleotide sequence repeat. The effect of these mutations on the structure and function of the protein synthesised and the resulting effects on health.
Chromosome structure mutations – deletion; duplication; translocation.
The substantial changes in chromosome mutations often make them lethal.

5 Human genomics
(a) Sequencing DNA. Bioinformatics is the use of computer technology to identify DNA sequences. Systematics compares human genome sequence data and genomes of other species to provide information on evolutionary relationships and origins.
Personalised medicine is based on an individual's genome. Analysis of an individual's genome may lead to personalised medicine through understanding the genetic component of risk of disease.
(b) Amplification and detection of DNA sequences.
Polymerase Chain Reaction (PCR) amplification of DNA using complementary primers for specific target sequences. DNA heated to separate strands then cooled for primer binding. Heat tolerant DNA polymerase then replicates the region of DNA. Repeated cycles of heating and cooling amplify this region of DNA. Arrays of DNA probes are used to detect the presence of specific sequences in samples of DNA. The probes are short single stranded fragments of DNA that are complementary to a specific sequence. Fluorescent labelling allows detection. Applications of DNA profiling allow the identification of individuals through comparison of regions of the genome with highly variable numbers of repetitive sequences of DNA.

6 Metabolic pathways
(a) Anabolic pathways require energy and involve biosynthetic processes. Catabolic pathways release energy and involve the breakdown of molecules. These pathways can have reversible and irreversible steps and alternative routes.
(b) Control of metabolic pathways - presence or absence of particular enzymes and the regulation of the rate of reaction of key enzymes within the pathway. Regulation can be controlled by intra and extracellular signal molecules.
Induced fit and the role of the active site of enzymes including shape and substrate affinity. Activation energy. The effects of substrate and end product concentration on the direction and rate of enzyme reactions. Enzymes often act in groups or as multi-enzyme complexes. Control of metabolic pathways through competitive (binds to active site), non-competitive (changes shape of active site) and feedback inhibition (end product binds to an enzyme that catalyses a reaction early in the pathway).

7 Cellular respiration
(a) Glucose broken down, removal of hydrogen ions and electrons by dehydrogenase enzymes releasing ATP.
(b) The role of ATP in the transfer of energy and the phosphorylation of molecules by ATP.
(c) Metabolic pathways of cellular respiration. The breakdown of glucose to pyruvate in the cytoplasm in glycolysis, and the progression pathways in the presence or absence of oxygen (fermentation). The phosphorylation of intermediates in glycolysis in an energy investment phase and the generation of ATP in the energy pay-off phase. The role of the enzyme phosphofructokinase in this pathway. The formation of citrate. Pyruvate is broken down to an acetyl group that combines with coenzyme A to be transferred to the citric acid cycle as acetyl coenzyme A. Acetyl (coenzyme A) combines with oxaloacetate to form citrate followed by the enzyme mediated steps of the cycle. This cycle results in the generation of ATP, the release of carbon dioxide and

the regeneration of oxaloacetate in the matrix of the mitochondria. Dehydrogenase enzymes remove hydrogen ions and electrons which are passed to the coenzymes NAD or FAD to form NADH or $FADH_2$ in glycolysis and citric acid pathways. NADH and $FADH_2$ release the high-energy electrons to the electron transport chain on the mitochondrial membrane and this results in the synthesis of the bulk of the ATP.
(d) ATP synthesis — high-energy electrons are used to pump hydrogen ions across a membrane and flow of these ions back through the membrane synthesises ATP using the membrane protein ATP synthase. The final electron acceptor is oxygen, which combines with hydrogen ions and electrons to form water.
Substrates for respiration. The role of starch, glycogen, other sugar molecules, amino acids and fats in the respiratory pathway.
Regulation of the pathways of cellular respiration by feedback inhibition — regulation of ATP production, by inhibition of phosphofructokinase by ATP and citrate, synchronisation of rates of glycolysis and citric acid cycle.

8 Energy systems in muscle cells
(a) Creatine phosphate breaks down to release energy and phosphate that is used to convert ADP to ATP at a fast rate. This system can only support strenuous muscle activity for around 10 seconds, when the creatine phosphate supply runs out. It is restored when energy demands are low.
(b) Lactic acid metabolism. Oxygen deficiency, conversion of pyruvate to lactic acid, muscle fatigue, oxygen debt.
(c) Types of skeletal muscle fibres
Differences between slow twitch and fast twitch muscle fibres.
Slow twitch (Type 1) muscle fibres contract more slowly, but can sustain contractions for longer and so are good for endurance activities. Fast twitch (Type 2) muscle fibres contract more quickly, over short periods, so are good for bursts of activity.

Physiology and Health

1 The structure and function of reproductive organs and gametes and their role in fertilisation
(a) Gamete production in the testes. The roles of seminiferous tubules, interstitial cells, testosterone, prostate gland and seminal vesicles.
(b) Gamete production in the ovaries to include maturation of ova and the development of a follicle.
(c) Site of fertilisation in the oviduct and zygote formation.

2 Hormonal control of reproduction
(a) Hormonal onset of puberty. Pituitary gland is stimulated to release follicle stimulating hormone (FSH),luteinising hormone (LH) or interstitial cell stimulating hormone (ICSH) by a releaser hormone produced in the hypothalamus
(b) Hormonal control of sperm production. FSH promotes sperm production and ICSH stimulates the production of testosterone. Testosterone also stimulates sperm production and activates the prostate gland and seminal vesicles. Negative feedback control of testosterone by FSH and ICSH.
(c) Hormonal control of the menstrual cycle. Development of a follicle and the endometrium in the uterus. Roles of FSH, LH, oestrogen and progesterone in the menstrual cycle. Development of a follicle, the corpus luteum and the endometrium. Follicular and luteal phases. Blastocyst implantation. Negative feedback control through pituitary gland, FSH and progesterone, leading to menstruation.

3 The biology of controlling fertility
(a) Infertility treatments and contraception are based on the biology of fertility. Risks

and ethics associated with fertility treatments.
(b) Fertile periods. Cyclical fertility in females leading to a fertile period. Continuous fertility in males. Calculation of fertile periods and their use.
(c) Treatments for infertility. Stimulating ovulation. Ovulation stimulated by drugs that prevent the negative feedback effect of oestrogen on FSH secretion. Other ovulatory drugs mimic the action of FSH and LH. These drugs can cause super ovulation that can result in multiple births or be used to collect ova for in vitro fertilisation (IVF) programmes.
Artificial insemination. Several samples of semen are collected over a period of time. Artificial insemination is particularly useful if the male has a low sperm count. If a partner is sterile a donor may be used.
Intra-cytoplasmic sperm injection (ICSI). If mature sperm are defective or very low in number ICSI can be used — the head of the sperm is drawn into a needle and injected directly into the egg to achieve fertilisation.
In vitro fertilisation (IVF). Surgical removal of eggs from ovaries after hormone stimulation. Incubation of zygotes and uterine implantation. Pre-implantation genetic diagnosis (PGD). The use of IVF in conjunction with PGD to identify single gene disorders and chromosomal abnormalities.
(d) Contraception — physical and chemical methods of contraception
Biological basis of physical methods. Chemical contraceptives are based on combinations of synthetic hormones that mimic negative feedback preventing the release of FSH/LH.

4 Ante- and postnatal screening
(a) Antenatal screening identifies the risk of a disorder so that further tests and a prenatal diagnosis can be offered.
Ultrasound imaging. Anomaly scans may detect serious physical problems. Dating scans, for pregnancy stage and due date, are used with tests for marker chemicals which vary normally during pregnancy.
Biochemical tests to detect the normal physiological changes of pregnancy.
Diagnostic testing. Amniocentesis and chorionic villus sampling (CVS) and the advantages and disadvantages of their use. Cells from samples can be cultured to obtain sufficient cells to produce a karyotype to diagnose a range of conditions.
Rhesus antibody testing. Anti-Rhesus antibodies are given to Rhesus negative mothers after a sensitising event or after birth.
(b) Postnatal screening. Diagnostic testing for metabolic disorders, including phenylketonuria (PKU), an inborn error of metabolism. Individuals with high levels of phenylalanine are placed on a restricted diet.
The use of pedigree charts to analyse patterns of inheritance in genetic screening and counselling. Patterns of inheritance in autosomal recessive, autosomal dominant, incomplete dominance and sex-linked recessive single gene disorders.

5 The structure and function of arteries, capillaries and veins
(a) The structure and function of arteries, capillaries and veins to include endothelium, central lumen, connective tissue, elastic fibres, smooth muscle and valves. The role of vasoconstriction and vasodilation in controlling blood flow.
(b) The exchange of materials between tissue fluid and cells through pressure filtration and the role of lymph vessels. Similarity of tissue fluid and blood plasma with the exception of plasma proteins.

6 The structure and function of the heart
(a) Cardiac function and cardiac output. Definition of cardiac output and its calculation.
(b) The cardiac cycle to include the functions atrial systole, ventricular systole, diastole. Effect of pressure changes on atrio-ventricular (AV) and semi lunar (SL) valves. Blood

flow through the heart and its associated blood vessels.
(c) The structure and function of cardiac conducting system including nervous control. Control of contraction and timing by cells of the sino-atrial node (SAN) and transmission to the atrio-ventricular node (AVN). Location of the SAN and AVN in the heart. Interpretation of electrocardiograms (ECG). The medulla regulates the rate of the SAN through the antagonistic action of the autonomic nervous system (ANS). Sympathetic accelerator nerves release nor-adrenaline (nor-epinephrine) and slowing parasympathetic nerves release acetylcholine.
(d) Blood pressure changes, in response to cardiac cycle, and its measurement. Blood pressure changes in the aorta during the cardiac cycle. Measurement of blood pressure using a sphygmomanometer. A typical reading for a young adult is 120/70 mmHg. Hypertension is a major risk factor for many diseases including coronary heart disease.

7 Pathology of cardio vascular disease (CVD)
(a) Process of atherosclerosis, its effect on arteries and blood pressure and its link to cardiovascular diseases (CVD).
(b) Thrombosis — events leading to a myocardial infarction (MI) or stroke. Endothelium damage, clotting factors and the role of prothrombin, thrombin, fibrinogen and fibrin. Thrombus formation and formation and effects of an embolus.
(c) Causes of peripheral vascular disorders including narrowing of arteries due to atherosclerosis, deep vein thrombosis (DVT) and pulmonary embolism due to blood clots.
(d) Control of cholesterol levels and familial hypercholesterolaemia.
Cholesterol synthesis and its function in the cell membrane and in steroid synthesis. Roles of high density lipoproteins (HDL) and low density lipoproteins (LDL). LDL receptors, negative feedback control and atheroma formation. Ratios of HDL to LDL in maintaining health, the benefits of physical activity and a low fat diet. Reducing blood cholesterol through prescribed medications.
Genetic screening of familial hypercholesterolaemia (FH) and its treatments.

8 Blood glucose levels and obesity
(a) Chronic elevated blood glucose levels leads to atherosclerosis and blood vessel damage.
Pancreatic receptors and the role of hormones in negative feedback control of blood glucose through insulin, glucagon and adrenaline (epinephrine).
Diagnosis, treatments and role of insulin in type 1 and type 2 diabetes.
(b) Obesity linked to cardiovascular disease and diabetes.
Definition and characterisation of obesity. Body fat, body density measurements and BMI calculations. Role of exercise and diet in reducing obesity and CVD.

Neurobiology and Communication

1 Divisions of the nervous system and parts of the brain
(a) Structures and functions of the central nervous system (CNS).
(b) Structures and functions of the peripheral nervous system (PNS) to include the autonomic nervous system (ANS) and the somatic nervous system (SNS).
The antagonistic action of the sympathetic and parasympathetic systems on heart rate, breathing rate and digestive processes.
(c) The functions of the medulla and cerebellum in the central core of the brain.
(d) The functions of the limbic system.
(e) The functions of the cerebral cortex in receiving sensory information, coordinating voluntary movement and making decisions in the light of experience.
(f) Localisation of brain functions to include sensory areas, motor areas and the

association areas concerning language, personality, imagination and intelligence. Information from one side of the body is processed in the opposite side of the cerebrum, transfer of information occurs through the corpus callosum.

2 Perception and memory

(a) Perception is the process by which the brain analyses and makes sense out of incoming sensory information. The three areas of perception involve segregation of objects, perception of distance and recognition.

(i) Segregation of objects. Perceptual organisation into figure and ground. Perceptual organisation of stimuli into coherent patterns. Visual cues such as relative size, superimposition and relative height in field.

(ii) Perception of distance. Binocular disparity in judging distance. Perceptual constancy as objects become nearer and the viewing angle changes.

(iii) Recognition. The importance of shape rather than detail in the recognition of objects. Matching perceived shapes to shape descriptions stored in memory and the role of inference in recognition. The influence of perceptual set where past experience, context or expectation influences the way a stimulus is perceived.

(b) Memory involves storage, retention and retrieval of information.

Memories include past experiences, knowledge and thoughts.

All information entering the brain passes through sensory memory and enters short term memory. Information is then transferred to long term memory (LTM) or discarded.

(i) Sensory memory. This lasts a few seconds and retains all of the visual or auditory input.

(ii) Short-term memory (STM). This includes memory span, the serial position effect, maintaining items by rehearsal and loss of items by displacement and decay. Improvement of STM by 'chunking'.

(iii) Long-term memory (LTM). The transfer of information from STM to LTM due to rehearsal, organisation and elaboration. Information is encoded using shallow encoding or elaborative encoding. Retrieval is aided by the use of contextual cues.

(iv) Location of memory in the brain. Episodic and semantic memories are stored in the cortex. Procedural memories (skills) are linked to the motor cortex. Emotional memories involve links between the cortex and the limbic system. Spatial memory is located in the limbic system.

3 The cells of the nervous system and neurotransmitters at synapses

(a) Structure and function of neurons to include dendrites, cell body and axons. Sensory, motor and inter neurons. Structure and function of myelin sheath in increasing the speed of impulse conduction. Myelination continues from birth to adolescence.

Glial cells. Physically support neurons and produce the myelin sheath. They also maintain a homeostatic environment around the neurones and remove debris by phagocytosis.

(b) Neurotransmitters at synapses. Chemical transmission at the synapse by neurotransmitters to include vesicles, synaptic cleft and receptors. The need for removal of neurotransmitters by enzymes or reuptake to prevent continuous stimulation of post-synaptic neurones. Receptors determine whether the signal is excitatory or inhibitory. Synapses can filter out weak stimuli arising from insufficient secretion of neurotransmitters. Summation of a series of weak stimuli can trigger enough neurotransmitter to fire an impulse.

(c) Function of converging, diverging and reverberating neural pathways.

Plasticity of response is created when new neural pathways are developed to create new responses, bypass areas of brain damage, to suppress reflexes or responses to sensory impulses.

(d) Neurotransmitters, mood and behaviour. The functions of endorphins and

dopamine. Endorphins are neurotransmitters that stimulate neurones involved in reducing the intensity of pain. Increased levels are also connected with euphoric feelings, appetite modulation and release of sex hormones. Endorphin production increases in response to severe injury, prolonged and continuous exercise, stress and certain foods. Dopamine induces the feeling of pleasure and reinforces particular behaviour in the reward pathway. Neurotransmitter related disorders and their treatment. Agonists bind to and stimulate receptors mimicking the neurotransmitter. Antagonists bind to specific receptors blocking the action of the neurotransmitter. Other drugs inhibit the enzymes which degrade neurotransmitters or inhibit re-uptake.
(e) Mode of action of recreational drugs. Can mimic neurotransmitters. Changes in neurochemistry alter mood, cognition, perception and behaviour. Many recreational drugs affect neurotransmission in the reward circuit of the brain.
Drug addiction/tolerance. Sensitisation is an increase in the number and sensitivity of neurotransmitter receptors as a result of exposure to drugs that are antagonists and leads to addiction. Desensitisation is a decrease in the number and sensitivity of receptors as a result of exposure to drugs that are agonists and leads to drug tolerance.

4 Communication and social behaviour

(a) The effect of infant attachment.
Infant attachment studies. Early infant attachment is important in laying the foundation for the future formation of stable relationships. Secure attachment and insecure attachment, responses of detachment, anger or inconsistent responses.
Socialisation and learning. Humans have a long period of dependency on adults providing time for socialisation and learning to occur. Authoritative control generally results in greater social competence than permissive control.
(b) The effect of communication.
The importance of non-verbal communication in the formation of relationships between individuals and how it can signal attitudes and emotions as well as acting as an aid to verbal communication.
Verbal communication is used in the transmission of knowledge, development of culture and social evolution.
(c) The effect of experience. Learning is a change in behaviour as a result of experience.
The repeated use of a motor skill results in a motor pathway being established.
Human behaviour may be learned by observation and imitation.
Reinforcement, shaping and extinction of behaviour as seen in trial and error learning.
Generalisation and discrimination.
(d) The effect of group behaviour and social influence.
Social facilitation. Increased performance in competitive/audience situations.
De-individuation. Loss of personal identity in a group leading to diminished restraints on behaviour.
Internalisation is the changing of beliefs as a result of persuasion. Identification is the changing of beliefs to be like an admired influencing source.

Immunology and Public Health

1 Non-specific defences

(a) Physical and chemical defences. Epithelial cells form a physical barrier and produce secretions against infection.
(b) Inflammatory response to include release of histamine by mast cells causing vasodilation and increased capillary permeability. The increased blood flow and secretion of cytokines leads to an accumulation of phagocytes and the delivery of antimicrobial proteins and clotting elements to the site of infection.
(c) Phagocytes and apoptosis by natural killer (NK) cells. Phagocytes and NK cells release cytokines which stimulate the specific immune response. Phagocytes recognise

surface antigen molecules on pathogens and destroy them by phagocytosis. NK cells induce the viral infected cells to produce self-destructive enzymes in apoptosis.

2 Specific cellular defences
(a) Immune surveillance. A range of white blood cells constantly circulate monitoring the tissues. If tissues become damaged or invaded, cells release cytokines which increase blood flow resulting in specific white blood cells accumulating at the site of infection or tissue damage.
(b) Clonal selection theory. Lymphocytes have a single type of membrane receptor specific for one antigen. Antigen binding leads to repeated lymphocyte division resulting in a clonal population of lymphocytes.
(c) T and B lymphocytes. Lymphocytes respond specifically to antigens on foreign cells, cells infected by pathogens and toxins released by pathogens.
T lymphocytes have specific surface proteins that allow them to distinguish between the surface molecules of the body's own cells and cells with foreign molecules on their surface. Immune system regulation failure leads to T lymphocyte immune response to self antigens (auto immune disease). Allergy is a hypersensitive B lymphocyte response to an antigen that is normally harmless.
T lymphocytes. One group of T lymphocytes destroy infected cells by inducing apoptosis. Another group of T lymphocytes secrete cytokines that activate B lymphocytes and phagocytes. When pathogens infect tissue, some phagocytes capture the pathogen and display fragments of its antigens on their surface. These antigen presenting cells activate the production of a clone of T lymphocytes that move to the site of infection under the direction of cytokines.
B lymphocytes. Each B lymphocyte clone produces a specific antibody molecule that will recognise a specific antigen surface molecule on a pathogen or a toxin. Antigen-antibody complexes may inactivate a pathogen or toxin or render it more susceptible to phagocytosis. In other cases the antigen-antibody complex stimulates a response which results in cell lysis. B lymphocytes activated by antigen presenting cells and T lymphocytes produce a clone of B lymphocytes that secrete antibodies into the lymph and blood where they make their way to the infected area.
(d) Immunological memory. Some T and B lymphocytes produced in response to antigens by clonal selection survive long term as memory cells. A secondary exposure to the same antigen rapidly gives rise to a new clone of lymphocytes producing a rapid and greater immunological response.

3 The transmission and control of infectious diseases
(a) Infectious diseases caused by pathogens, transmitted by direct physical contact, water, food, body fluids, inhaled air or vector organisms and controlled by quarantine, antisepsis, individual responsibility (good hygiene, care in sexual health and appropriate storage/handling of food), community responsibility (quality water supply, safe food webs, and appropriate waste disposal systems) and vector control.
(b) Epidemiological studies of infectious diseases. Description of spread to include sporadic (occasional occurrence), endemic (regular cases occurring in an area), epidemic (unusually high number of cases in an area) and pandemic (a global epidemic). Control measures to include preventing transmission, drug therapy, immunisation or a combination of these.

4 Active immunisation and vaccination and the evasion of specific immune responses by pathogens
(a) Active immunity can be developed by vaccination with antigens from infectious pathogens, so creating an immunological memory. Antigens from infectious pathogens, usually mixed with an adjuvant to enhance the immune response, include inactivated pathogen toxins, dead pathogens, parts of pathogens and weakened pathogens.

The design of vaccine clinical trials including randomised, double-blind and placebo-controlled protocols. Importance of group size to reduce experimental error and statistical significance.
The importance of herd immunity in infectious disease control. Herd immunity occurs when a large percentage of a population are immunised. Non-immune individuals are protected as there is a lower probability they will come into contact with infected individuals. The herd immunity threshold depends on the disease, the efficacy of the vaccine and the contact parameters for the population. Public health immunisation programmes. Establishing herd immunity to a number of diseases. Difficulties when widespread vaccination is not possible due to malnutrition, poverty or vaccine rejected by a percentage of the population.
(b) Many pathogens have evolved mechanisms that evade the specific immune system which has consequences for vaccination strategies. Antigenic variation. Some pathogens can change their antigens avoiding the effect of immunological memory. Role and impact in diseases like malaria, trypanosomiasis and influenza. Direct attack on the immune system. HIV attacks lymphocytes which is the major cause of AIDS. Tuberculosis (TB) survives within phagocytes and avoids immune detection.

Administrative information

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History of changes to Course Assessment Specification

Course details	Version	Description of change	Authorised by	Date
	2.0	Page 2 – the number of marks awarded for the assignment has changed. Pages 5 and 6 – the descriptions of the skills to be assessed have been rewritten to better explain what is required. Page 7 – Conducting the assessment: this has been rewritten to clarify how stages will be assessed. Suggested timings for each stage have been removed. Page 8 –the details of the skills to be assessed have been rewritten for clarity Page 8 onwards – Further mandatory knowledge: these tables have been substantially revised to aid understanding	Qualifications Development Manager	April 2014
	3.0	Updates to 'Division & Differentiation in human cells' section due to scientific developments.	Qualifications Manager	April 2015
	3.1	Reference to Question Paper Brief inserted.	Qualifications Manager	April 2016