



Pearson Level 3 Alternative Academic Qualification
BTEC National in

L3

Medical Science (Extended Certificate)

Specification

First teaching from September 2025

First certification from 2026

Issue 1

Qualification Number: 610/3958/5

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About Pearson

We are the world's leading learning company operating in countries all around the world. We provide content, assessment and digital services to students, educational institutions, employers, governments and other partners globally. We are committed to helping equip students with the skills they need to enhance their employability prospects and to succeed in the changing world of work. We believe that wherever learning flourishes so do people.

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Welcome

BTEC Nationals are widely recognised by higher education and industry as the vocational qualification of choice at Level 3. They provide students with meaningful and practical learning experiences across a range of career sectors to prepare them to progress to higher education as a route to graduate-level employment.

Recent data has shown that one in five adults of working age in the UK has a BTEC qualification. What's more, well over 90,000 BTEC students apply to UK universities every year and their BTEC Nationals are accepted by over 150 UK universities and other higher education institutions for relevant degree programmes either on their own or in combination with A Levels.

Why are BTECs so successful?

BTECs embody a fundamentally student-centred approach to the curriculum, with a flexible, unit-based structure and knowledge applied through a balanced combination of assignments and examinations. They enable the holistic development of the practical, interpersonal and thinking skills required to succeed in higher education and employment.

When creating these BTEC Nationals we focused on the skills and personal attributes needed to navigate the future, and have worked with many higher education providers, professional bodies, colleges and schools to ensure that their needs are met. Employers are looking for future employees with a thorough grounding in the latest industry requirements and work-ready skills such as critical thinking and problem solving. Higher education needs students who have experience of research, extended writing and meeting deadlines.

We have addressed these requirements by:

- Facilitating and guiding the development of transferable skills through the design and delivery of the qualifications, using a holistic and practical framework which is based on recent research into the most critical skills needed to navigate the future. This Transferable Skills framework has been used to embed transferable skills in the qualifications where they naturally occur and also to signpost opportunities for delivery and development as a part of the wider BTEC learning experience. See page 6 for further information.
- Supporting the delivery of Sustainability Education and Digital Skills development naturally through the content design of the qualifications. Mapping is provided for each qualification to identify where the opportunities for teaching and learning exist.
- Updating sector-specific content to ensure it is relevant and future-facing.
- Implementing a consistent approach to assessment with a balanced combination of internal and external assessments to better engage students, make the qualifications more accessible for them and more manageable for centres to deliver.

We are providing a wealth of support, both resources and people, to ensure that students and their teachers have the best possible experience during their course. See Section 5 for details of the support we offer.

This specification document should be used in conjunction *with Pearson BTEC Level 3 National Administrative Support Guide* which is available on our website.

A word to students

Today's BTEC Nationals will require commitment and hard work, as you would expect of the most respected applied learning qualification in the UK. You will have to complete a range of units, be organised, take some assessments that we will set and mark and undertake practical tasks and assignments. But you can feel proud to achieve a BTEC because, whatever your plans in life – whether you decide to study further, go on to work or an apprenticeship – your BTEC National will be your passport to success in the next stage of your life.

Good luck, and we hope you enjoy your course.

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1 Introduction

Why choose Pearson Level 3 Alternative Academic Qualification BTEC National in Medical Science (Extended Certificate)?

We've listened to feedback from all parts of the medical science subject community, including higher education. We've used this opportunity of curriculum change to redesign qualifications so that they reflect the demands of a truly modern and evolving medical science – qualifications that enable your students to apply themselves and give them the skills to succeed in their chosen pathway.

The Pearson Level 3 Alternative Academic Qualification BTEC National in Medical Science (Extended Certificate) enables students to study the principles and applications of medical science through three mandatory units, and further explore other areas in more detail via an optional unit. Students will also learn practical and investigation skills that build on this fundamental knowledge.

The mandatory units cover the following areas:

- Human anatomy, physiology and pathology
- Health issues and scientific reporting
- Practical microbiology and infectious diseases.

The optional units provide opportunity for students to choose one of the following specific specialist area in which they wish to develop their knowledge and skills:

- Diseases, disorders, treatments and therapies
- Biomedical science
- Human reproduction and fertility.

The qualification is designed to be taken alongside A Levels as part of a study programme and can link to learning in A Level subjects such as physical education and sport, sociology, chemistry and psychology. It is intended for students that wish to progress into higher education as a pathway to employment.

Total Qualification Time

For all regulated qualifications, Pearson specifies a total number of hours that it is estimated students will require to complete and show achievement for the qualification: this is the Total Qualification Time (TQT). Within TQT, Pearson identifies the number of Guided Learning Hours (GLH) that we estimate a centre delivering the qualification might provide. Guided learning means activities, such as lessons, tutorials, online instruction, supervised study and giving feedback on performance, that directly involve teachers and assessors in teaching, supervising and invigilating students. Guided learning includes the time required for students to complete external assessment under examination or supervised conditions.

In addition to guided learning, other required learning directed by teachers or assessors will include private study, preparation for assessment and undertaking assessment when not under supervision, such as preparatory reading, revision and independent research.

BTEC Nationals have been designed around the number of hours of guided learning expected. Each unit in the qualification has a GLH value of 60, 90 or 120. There is then a total GLH value for the qualification.

Each qualification has a TQT value. This may vary within sectors and across the suite depending on the nature of the units in each qualification and the expected time for other required learning.

The following table shows the qualifications in this sector and their GLH and TQT values.

Qualification title	Size and structure	Summary purpose
Pearson Level 3 Alternative Academic Qualification BTEC National in Medical Science (Extended Certificate)	360 GLH (500 TQT) Equivalent in size to one A Level. 4 units of which 3 are mandatory and 2 are external. Mandatory content (83%). External assessment (58%).	The Extended Certificate is for students who are interested in learning about the medical science sector alongside other fields of study, with a view to progressing to a wide range of higher education courses, not necessarily in medical science-related subjects. It is designed to be taken as part of a programme of study that includes A Levels.

Qualification and unit content

Pearson has developed the content of the new BTEC Nationals in collaboration with representatives from higher education and relevant professional bodies. In this way, we have ensured that content is up to date and that it includes the knowledge, understanding, skills and attributes required in the sector.

Centres should ensure that delivery of content is kept up to date. Some of the units within the specification may contain references to legislation, policies, regulations and organisations, which may not be applicable in the country you deliver this qualification in (if teaching outside of England), or which may have gone out-of-date during the lifespan of the specification. In these instances, it is possible to substitute such references with ones that are current and applicable in the country you deliver subject to confirmation by your Standards Verifier.

Assessment

Assessment is specifically designed to fit the purpose and objective of the qualification. It includes a range of assessment types and styles suited to vocational qualifications in the sector. There are three main forms of assessment that you need to be aware of: external, internal and synoptic.

Externally assessed units

Each external assessment for a BTEC National is linked to a specific unit. All of the units developed for external assessment are of 60, 90 or 120 GLH to allow students to demonstrate breadth and depth of achievement. Each assessment is taken under specified conditions, then marked by Pearson and a grade awarded. Students are permitted to resit the examination twice. This equates to three attempts in total: one inclusive of registration, the remaining two attempts as resits. If students resit an examined unit, the best grade achieved will count towards their overall qualification grade, not necessarily the most recent sitting. External assessments are available twice a year. For detailed information on the external assessments, please see the table in *Section 3*. For further information on preparing for external assessment, see *Pearson BTEC Level 3 National Administrative Support Guide*, which is available on our website.

Internally assessed units

Internally assessed units are assessed by a Pearson Set Assignment Brief (PSAB), which is set by Pearson, marked by you and subject to external standards verification. Before you assess you will need to become an approved centre, if you are not one already. You will need to prepare to assess using the guidance in *Pearson BTEC Level 3 National Administrative Support Guide*, which is available on our website. You will make grading decisions based on the requirements and supporting guidance given in the units. Where a student has not achieved their expected level of performance for an assignment,

they may be eligible for one resubmission of improved evidence for each assignment submitted if authorised by the Lead Internal Verifier. To ensure any resubmissions are fairly and consistently implemented for all students, the Lead Internal Verifier can only authorise a resubmission if certain conditions are met. If the Lead Internal Verifier does authorise a resubmission, it must be completed within 15 working days of the student receiving the results of the assessment.

Feedback to students can only be given to clarify areas where they have not achieved expected levels of performance. Students cannot receive any specific guidance or instruction about how to improve work to meet assessment criteria or be given solutions to questions or problems in the tasks.

If a student has still not achieved the targeted pass criteria following the resubmission of improved evidence for an assignment, the Lead Internal Verifier may authorise, under exceptional circumstances, one retake opportunity to meet the required pass criteria. The retake can be of a task or subset of the Pearson Set Assignment Brief that is of evidence in a new or revised form. The deadline for submission of the retake must fall within the same academic year.

Synoptic assessment

Synoptic assessment requires students to demonstrate that they can identify and use effectively, in an integrated way, an appropriate selection of skills, techniques, concepts, theories and knowledge from across the whole sector as relevant to a key task. Synoptic links between units are flagged within the unit. Please refer to *Unit 2: Practical Microbiology and Infectious Diseases* for further details.

Language of assessment

Assessment of the internal and external units for these qualifications will be available in English. All student work must be in English. A student taking the qualifications may be assessed in British or Irish Sign Language where it is permitted for the purpose of reasonable adjustment.

For information on reasonable adjustments see *Pearson BTEC Level 3 National Administrative Support Guide*, which is available on our website.

Grading for units and qualifications

Achievement in the qualification requires a demonstration of depth of study in each unit, assured acquisition of a range of practical skills required for progression to higher education, and successful development of transferable skills. Students achieving a qualification will have completed all units.

Units are assessed using a grading scale of Distinction (D), Merit (M), Pass (P), Near Pass (N) and Unclassified (U). The grade of Near Pass is used for Externally assessed units only. All mandatory and optional units contribute proportionately to the overall qualification grade, for example a unit of 120 GLH will contribute double that of a 60 GLH unit.

BTEC National qualifications are graded using a scale of P to D*, **or** PP to D*D*, **or** PPP to D*D*D* depending on the size of the qualification. Please see *Section 6* for more details. The relationship between qualification grading scales and unit grades will be subject to regular review as part of Pearson's standards monitoring processes on the basis of student performance and in consultation with key users of the qualification.

UCAS tariff points

The BTEC Nationals attract UCAS points. Please go to the UCAS website for full details of the points allocated.

Preparing students for the future

Transferable skills

Recent future skills reports have highlighted the growing importance of transferable skills for students to succeed in their careers and lives in this fast-changing world.

Following research and consultation with FE educators and higher education institutions, Pearson has developed a Transferable Skills Framework to facilitate and guide the development of transferable skills through this qualification. The Framework has four broad skill areas, each with a cluster of skills as shown below:

1. **Managing Yourself:** (1) Taking personal responsibility; (2) Personal strengths and resilience; (3) Career orientation planning; (4) Personal goal setting
2. **Effective Learning:** (1) Managing own learning; (2) Continuous learning; (3) Secondary research skills (4) Primary research skills
3. **Interpersonal Skills:** (1) Written communications; (2) Verbal and non-verbal communications; (3) Teamwork; (4) Cultural and social intelligence
4. **Solving Problems:** (1) Critical thinking (2) Problem solving; (3) Creativity and innovation

Each transferable skill has a set of descriptors that outline what achievement of the skill looks like in practice. Each unit in the qualification will show whether a transferable skill has been:

1. fully embedded through the design of the teaching and learning content and assessment of the unit. Skills that are embedded are 'naturally occurring' in that they are inherent to the unit content and don't require extension activities to deliver.
2. signposted as an opportunity for delivery and development and would require extension activities to deliver.

Units will show a summary of the transferable skills that have been embedded or signposted and *Appendix 2* shows the descriptors for each skill across all the skill clusters.

More information on the framework, its design and relevance for student progression is available in the *BTEC Transferable Skills Guide for Teachers*. Resources and guidance to support teachers in the delivery and development of these skills will be available in the Delivery Guide for this qualification and through our training offer.

Digital skills

Digital skills are required in every industry as well as in everyday life and with the acceleration of automation and AI in industry it is critical for students to understand how digital technologies are relevant and applied in the context of the sector they are studying.

With this in mind, we have used the Digital Skills Framework published by IFATE as a frame of reference to identify opportunities for the delivery and development of digital skills in this qualification.

This Digital Skills framework has five categories with specific digital characteristics that apply in varying extent across sectors:

1. **Problem Solving** – The use of digital tools to analyse and solve problems
2. **Digital Collaboration and Communication** – Using digital tools to communicate and share information with stakeholders
3. **Transacting Digitally** – Using digital tools to set up accounts and pay for goods/services
4. **Digital Security** – Identify threats and keep digital tools safe
5. **Handling Data Safely and Securely** – Follow correct procedures when handling personal and organisational data

Opportunities to develop these digital skills are identified where they are relevant and appropriate to a sector, meaning that:

- where they naturally occur
- where add no assessment burden
- where they will enhance a student's skills and knowledge in the sector.

Appendix 3 shows a mapping of the teaching and learning content to the five categories of the framework to show where digital skills have been embedded into this qualification.

Sustainability skills

To help students develop sustainability skills, practices and mindset, we have designed content in this qualification, aligned to the [UNESCO Sustainable Development Goals](#) (17 SDGs), that are relevant and appropriate to the sector. The SDGs are the most common point of reference for content that addresses sustainability education and provides a useful and pragmatic way of presenting this content.

Sustainability knowledge and understanding may be included in the teaching and learning content but not directly assessed. Alternatively, it could be assessed – the approach chosen for each unit is based on the relevance of the sustainability skills, knowledge and understanding to the purpose and scope of the unit.

Appendix 4 shows a mapping of the teaching and learning content to the relevant SDGs to show where sustainability concepts have been included in this qualification.

2 Qualification purpose

Pearson Level 3 Alternative Academic Qualification BTEC National in Medical Science (Extended Certificate)

In this section you will find information on the purpose of this qualification and how its design meets that purpose through the qualification objective and structure. We publish a full 'Statement of Purpose' for each qualification on our website. These statements are designed to guide you and potential students to make the most appropriate choice of qualification at recruitment.

The Pearson Level 3 Alternative Academic Qualification BTEC National in Medical Science (Extended Certificate) is an Alternative Academic Qualification (AAQ) designed for post-16 students with an interest in medical sciences and aiming to progress to higher education as a route to graduate level employment.

Equivalent to one A Level in size, it is suitable for students looking to develop their applied knowledge and skills in medical sciences as part of a study programme alongside two A Levels.

The qualification has been developed in consultation with higher education representatives and sector experts from associated professional bodies to ensure students have the knowledge, understanding and skills they need to progress to, and thrive, in higher education.

The qualification has three mandatory units covering the following topics:

- Human Physiology, Anatomy and Pathology – Human body systems, cell ultrastructure, and how substances are transported
- Health Issues and Scientific Reporting – The immune system, its dysfunction and genetic technologies. The validity and reliability of information used in health science reporting
- Practical Microbiology and Infectious Diseases – Methods of pathogenicity and infectious agents, growth of microorganisms and health and safety in a laboratory environment.

Students have a choice of three optional units covering the following topics:

- Diseases, Disorders, Treatments and Therapies – Principles of physiological diseases and disorders and their associated drug and medicine development
- Biomedical Science – Biomedical science techniques and their clinical application
- Human Reproduction and Fertility – Reproductive science including causes of infertility and associated impacts on health and well-being.

Students will develop the following knowledge and skills from the mandatory units:

- Knowledge and understanding of human physiology, anatomy and pathology
- Secondary research skills including collection and interpretation of data from valid sources and drawing reasoned conclusions
- Practical skills in microbiology and their application in the diagnosis of disease
- Critical thinking.

Students will develop the following knowledge from the optional units:

- Knowledge and understanding of specialist areas relating to infectious disease transmission, biomedical science and human reproduction and fertility.

Students can also develop other transferable skills such as personal responsibility and independent learning.

The core and specialist medical science knowledge, understanding and skills that students develop create a good foundation for transition to related degrees. Skills such as critical thinking and independent learning help students to be better prepared for the self-directed learning approach used in higher education and become more open-minded to learning. Research skills, in combination with the other transferable skills, create a strong foundation for academic success.

The following subjects would be suitable to combine with this qualification:

- Psychology
- Sociology
- Chemistry
- Physical Education and Sport.

This qualification can lead to progression to the following degrees:

- BSc (Hons) Nursing (Adult Health/Child Health/Mental Health)
- BSc (Hons) Psychology
- BSc (Hons) Physiotherapy.

3 Structure

Qualification structure

Pearson Level 3 Alternative Academic Qualification BTEC National in Medical Science (Extended Certificate)

Students must complete 3 mandatory units and 1 optional unit.

See *Section 6* for rules on qualification awarding.

Mandatory units – students complete and achieve all units

Unit number	Unit title	GLH	Type	How assessed
1	Principles of Human Physiology, Anatomy and Pathology	90	Mandatory	External
2	Health Issues and Scientific Reporting	120	Mandatory	External
3	Practical Microbiology and Infectious Diseases	90	Mandatory	Internal

Optional units – students complete and achieve 1 unit

Unit number	Unit title	GLH	Type	How assessed
4	Diseases, Disorders, Treatments and Therapies	60	Optional	Internal
5	Biomedical Science	60	Optional	Internal
6	Human Reproduction and Fertility	60	Optional	Internal

External assessment

58% of the total qualification GLH is made up of external assessment. A summary is given below. See the unit content and sample assessment materials for more information.

Unit	Type	Availability
Unit 1: Principles of Human Physiology, Anatomy and Pathology	<ul style="list-style-type: none">• An external examination set and marked by Pearson• 80 marks	January and May/June First assessment May/June 2026
Unit 2: Health Issues and Scientific Reporting	<ul style="list-style-type: none">• An external examination set and marked by Pearson• 80 marks	January and May/June First assessment May/June 2026

Synoptic assessment

The assessment of synoptic knowledge requires students to apply learning from one unit to the assessment in another unit. Within the assessment for *Unit 3: Practical Microbiology and Infectious Diseases*, students will be assessed on underpinning knowledge, ideas and concepts from *Unit 2: Health Issues and Scientific Reporting*. Synoptic links are flagged within the units.

There might be some further naturally occurring synoptic opportunities across the qualification where students can synthesise their learning. These will be outlined in the Delivery Guide to help with planning for your teaching.

4 Units

Understanding your units

The units in this specification set out our expectations of assessment in a way that helps you to prepare your students for assessment. The units help you to undertake assessment and quality assurance effectively.

Each unit in the specification is set out in a similar way. There are two types of unit format:

- Internally assessed units
- Externally assessed units.

This section explains how the units work. It is important that all teachers, assessors, internal verifiers and other staff responsible for the programme review this section.

Internally assessed units

Section	Explanation
Unit number	The number is in a sequence in the sector. Numbers may not be sequential for an individual qualification.
Unit title	This is the formal title that we always use and it appears on certificates.
Unit level	All units are Level 3 on the national framework.
Unit type	This confirms that the unit is internally assessed. See structure information in <i>Section 3</i> for full details.
GLH	Units may have a Guided Learning Hours (GLH) value of 120, 90 or 60. This indicates the numbers of hours of teaching, directed activity and assessment expected. It also shows the weighting of the unit in the final qualification grade.
Unit in brief	A brief formal statement on the content of the unit that is helpful in understanding its role in the qualification. You can use this in summary documents, brochures etc.
Unit introduction	This is designed with students in mind. It indicates why the unit is important, how learning is structured and how learning might be applied when progressing to employment or higher education.
Learning aims	These help to define the scope, style and depth of learning of the unit. You can see where students should be learning standard requirements ('understand') or where they should be actively researching ('investigate'). You can find out more about the verbs we use in learning aims in <i>Appendix 1</i> .

Section	Explanation
Summary of unit	This helps teachers to see the main content areas against the learning aims and the structure of the assessment at a glance.
Content	This sets out the required teaching content of the unit. Content is compulsory except where shown as 'e.g.'. Students should be asked to complete summative assessment only after the teaching content for the unit or learning aim(s) has been covered.
Assessment criteria	<p>Each learning aim has Pass and Merit criteria. Each assignment has at least one Distinction criterion. A full glossary of terms used is given in <i>Appendix 1</i>.</p> <p>Distinction criteria represent outstanding performance in the unit. Some criteria require students to draw together learning from across the learning aims.</p>
Transferable skills	This summarises the transferable skills present within this unit. The key helps to identify whether they are signposted but require additional assessment, embedded and achieved on completion or not present in this unit.
Essential information for Pearson Set Assignment Brief (PSAB)	This shows a brief summary of the activities required for the mandatory Pearson Set Assignment Brief. Centres must download and use the mandatory PSAB without alteration or contextualisation.
Further information for teachers and assessors	This gives you information to support the implementation of assessment. It is important that this is used carefully alongside the assessment criteria and PSAB.
Resource requirements	Any specific resource requirements that you need to be able to teach and assess are listed in this section. For more information on support resources, see the <i>Pearson BTEC Level 3 National Administrative Guide</i> .
Essential information for assessment decisions	This information gives guidance for each learning aim or assignment of the expectations for Pass, Merit and Distinction standard. This section contains examples and essential clarification.
Links to other units	This shows you the main relationship between units. This can help you to structure your programme and make best use of materials and resources.

Externally assessed units

Section	Explanation
Unit number	The number is in a sequence in the sector. Numbers may not be sequential for an individual qualification.
Unit title	This is the formal title that we always use and it appears on certificates.
Unit level	All units are Level 3 on the national framework.
Unit type	This confirms that the unit is externally assessed. See structure information in <i>Section 3</i> for full details.
GLH	Units may have a Guided Learning Hours (GLH) value of 120, 90 or 60. This indicates the numbers of hours of teaching, directed activity and assessment expected. It also shows the weighting of the unit in the final qualification grade.
Unit in brief	A brief formal statement on the content of the unit that is helpful in understanding its role in the qualification. You can use this in summary documents, brochures etc.
Unit introduction	This is designed with students in mind. It indicates why the unit is important, how learning is structured and how learning might be applied when progressing to employment or higher education.
Summary of assessment	This sets out the type of external assessment used and the way in which it is used to assess achievement.
Assessment outcomes	These show the hierarchy of knowledge, understanding, skills and behaviours that are assessed. Includes information on how this hierarchy relates to command terms in sample assessment materials (SAMs).
Content	For external units all content is obligatory. The depth of content is indicated in the assessment outcomes and sample assessment materials (SAMs). The content will be sampled through the external assessment over time, using the variety of questions shown.
Transferable skills	This summarises the transferable skills present within this unit. The key helps to identify whether they are signposted but require additional assessment, embedded and achieved on completion or not present in this unit.
Key terms typically used in assessment	These definitions will help you analyse requirements and prepare students for assessment.

Section	Explanation
Resources	Any specific resource requirements that you need to be able to teach and assess are listed in this section. For more information on support resources, see the <i>Pearson BTEC Level 3 National Administrative Guide</i> .
Links to other units	This shows you the main relationship between units. This can help you to structure your programme and make best use of materials and resources.

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Unit 1: Principles of Human Physiology, Anatomy and Pathology

Level: 3

Unit type: External

Guided learning hours: 90

Unit in brief

Students will explore the biological principles that underpin medical science.

Unit introduction

Knowing how the human body works, in good and poor health, is key to learning how you can make a difference to others in the field of medical sciences.

In this unit, you will study how the human body functions at a cellular and tissue level. You will go on to gain understanding of the various organ systems that comprise the human body – nervous, endocrine musculoskeletal, cardiovascular, respiratory, renal and digestive systems – and gain some insight into how these systems interrelate.

This unit will give you a foundation for biological study in medical science, as you will gain knowledge of how the human body functions. You will also gain some insight into the factors that affect health and how an understanding of such factors may help to make a positive impact upon our lives.

Summary of assessment

The unit will be assessed through one examination of 80 marks lasting 1 hour and 30 minutes.

Students will be assessed through a number of short- and long-answer questions.

The questions will assess knowledge and understanding of the underpinning principles of human physiology, anatomy and pathology, as well as the ability to apply your knowledge to new situations and will also test the skills of analysing and interpreting data and information from graphs, diagrams or text.

The assessment availability is twice a year in January and May/June. The first assessment availability is May/June 2026.

Sample assessment materials will be available to help centres prepare students for assessment.

Assessment outcomes

- AO1** Demonstrate knowledge and understanding of scientific concepts and theories, terminology, definitions and scientific formulae used in human physiology, anatomy and pathology.
- AO2** Apply knowledge and understanding of scientific concepts and theories, procedures, processes and techniques relating to human physiology, anatomy and pathology in given contexts.
- AO3** Analyse and interpret scientific information relating to human physiology, anatomy and pathology

[SP-CT]

Content

The essential content is set out under content areas. Students must cover all specified content before the assessment.

A: Biological molecules, cells and levels of organisation

Students will understand the structure and functions of biological molecules, bonding within and between molecules, and polymers and their monomers.

A1 Carbohydrates

A1.1 Monosaccharides:

A1.1.1 hexose sugars

A1.1.2 pentose sugars.

A1.2 Disaccharides:

A1.2.1 the formation of glycosidic bonds

A1.2.2 important disaccharides (sucrose, maltose, lactose)

A1.2.3 monosaccharide and disaccharides

A1.2.3a structural formulae

A1.2.3b dietary sources.

A1.3 Polysaccharides – polymers of alpha glucose:

A1.3.1 starch as a dietary energy source

A1.3.2 glycogen as energy store in liver and muscle cells.

A2 Proteins

A2.1 Proteins (polypeptides) as polymers of amino acids.

Students are not expected to know the names of all 20 amino acids involved in protein synthesis, nor are they expected to know the structural details of the side chains.

A2.2 Structure of amino acids (backbone).

A2.3 Formation of peptide bonds.

A2.4 Structure of proteins and polypeptides:

A2.4.1 primary structure – the sequence of amino acids

A2.4.2 secondary structure – coils (alpha helices) and folding (beta pleated sheets)

A2.4.3 tertiary structure – the roles of hydrogen bonds, van der Waals Forces, ionic bonds and disulphide bonds to maintain the 3D structure

A2.4.3 quaternary structure as illustrated by reference to insulin and haemoglobin

- A2.4.3** comparison of the structural and functional differences of fibrous and globular proteins as illustrated by reference to collagen and haemoglobin or enzymes.

A3 Lipids

A3.1 Saturated and unsaturated fatty acids.

A3.2 Triglycerides.

A3.3 Phospholipids.

A3.4 Cholesterol.

A4 Nucleic acids and their derivatives

A4.1 DNA:

- A4.1.1** a polymer of DNA nucleotides
structure of nucleotides as deoxyribose sugar, phosphate and a nitrogenous base

- A4.1.2** double helix and complementary base pairing

- A4.1.3** each chromosome is one molecule of DNA and each contains many genes (lengths of DNA that code for proteins).

A4.2 RNA:

- A4.2.1** single stranded polymer of RNA nucleotides

- A4.2.2** mRNA, rRNA and tRNA and an outline of their roles in protein synthesis.

A4.3 ATP (adenosine tri phosphate):

- A4.3.1** an activated nucleotide and its use as a universal energy currency

- A4.3.2** hydrolysis and resynthesis of ATP.

A4.3 Role of coenzymes in respiration:

- A4.4.1** NAD (nicotinamide adenine dinucleotide)

- A4.4.2** FAD (flavine adenine dinucleotide).

A4.4 Conditions associated with metabolism of biological molecules:

- A4.4.1** galactosaemia

- A4.4.2** PKU

- A4.4.3** coeliac disease

- A4.4.4** lactose intolerance.

A5 Cell ultrastructure

A5.1 Recognise cell structures from photomicrographs or electron micrographs.

A5.2 Calculate magnification and true size of organelles/cells from photo- and electron micrographs.

A5.3 Comparison of use of electron and light microscopes (limited to consideration of magnification, resolution, ease of use and ability to observe living specimens).

A5.4 The functions of organelles:

- A5.4.1** nucleus – houses cell's genome; site of DNA replication
- A5.4.2** nucleolus – consists of RNA and is the site of ribosome formation, tRNA formation and transcription
- A5.4.3** mitochondria – site of aerobic respiration (link reaction, the Krebs cycle and oxidative phosphorylation)
- A5.4.4** RER – transports newly made proteins to the Golgi apparatus; proteins may be folded here
- A5.4.5** Golgi apparatus – site of modification and packaging of proteins for export out of cell
- A5.4.6** SER – site of metabolism of drugs, detoxification, lipid synthesis including synthesis of steroid hormones
- A5.4.7** vesicles – membrane-bound structure in a cell that encloses enzymes or contains reserve protein channels; also involved in bulk transport and in transport of substances within cells
- A5.4.8** lysosomes – involved in cellular digestion, immune response and autophagy
- A5.4.9** ribosomes – site of protein synthesis
- A5.4.10** centrosome – containing centrioles – for formation of spindle threads before cell/nuclear division
- A5.4.11** cytoskeleton – provides shape and structure and a means of transportation of organelles within the cell
- A5.4.12** cytoplasm – gel like fluid in which organelles are suspended, and is the medium for some metabolic reactions
- A5.4.13** cell surface membrane (understand fluid mosaic model) and role in exchange of substances between cell and environment
 - A5.4.13a** role of cholesterol
 - A5.4.13b** role of proteins – channels, carriers, receptors and their role in cell signalling
 - A5.4.13b** role of glycolipids and glycoproteins.

A5.5 Surface area to volume (SA/V) ratio:

- A5.5.1** calculate SA/V of cells, structures and organisms
- A5.5.2** appreciate the relationship between size of objects and their SA/V ratio and its significance.

A6 Transport of substances into and out of cells

A6.1 Active transport (use of membrane proteins and ATP).

A6.2 Passive transport:

A6.2.1 simple diffusion

A6.2.2 facilitated diffusion

A6.2.3 osmosis.

A6.3 Bulk transport:

A6.3.1 transport of substances too large to pass through the membrane

A6.3.2 use of vesicles and ATP in exocytosis and endocytosis.

A7 The cell cycle

A7.1 The phases of the cell cycle:

A7.1.1 interphase

A7.1.1a G1 phase (cell growth, protein synthesis, increase in numbers of organelles and preparation for DNA replication)

A7.1.1b S phase (DNA replicates) and G2 phase (protein synthesis, rapid growth, checks for DNA damage and preparation for nuclear division, development of the spindle)

A7.1.2 M phase (nuclear division)

A7.1.2a mitosis – prophase, metaphase, anaphase, telophase (the products of mitosis are two diploid daughter cells genetically identical to each other and to the parent cell)

A7.1.2b meiosis – two divisions, each with four stages and a short interphase in between (the products are four haploid daughter cells – gametes – each genetically unique and that the diploid number of chromosome is restored at fertilisation). The significance of meiosis as a source of genetic variation.

A7.1.2c comparison of mitosis and meiosis (locations, processes, functions and products).

A7.2 Stem cells and differentiated cells:

A7.2.1 division (differentiated cells can no longer divide but there are adult stem cells, in all tissues, which can divide)

A7.2.2 the role of adult stem cells in tissue repair and growth.

A7.3 When the cell cycle is disrupted:

A7.3.1 cancer as a result of inappropriate cell proliferation due to the cell failing to recognise signals for when to stop dividing and undergo apoptosis

A7.3.2 the role of cytology screening in detecting cancer.

A7.4 Cellular processes:

A7.4.1 metabolism (as the total of all processes occurring at cellular level to promote and sustain life)

A7.4.1 overview of respiration

A7.4.1a outline of glycolysis (glycogen or glucose to pyruvate with a net gain of 2ATP per molecule of glucose and 2 reduced NAD)

A7.4.1b anaerobic respiration (uses pyruvate as hydrogen acceptor to reoxidise NAD producing lactic acid but with no more production of ATP)

A7.4.1a aerobic respiration – involving the link reaction, the Krebs cycle (names of the intermediate carboxylic acids are not required) and oxidative phosphorylation (chemiosmosis) in mitochondria to generate approximately 28 more molecules of ATP per molecule of glucose).

A7.5 Cell death:

A7.5.1 cells undergo a number of divisions (the Hayflick Limit), before undergoing apoptosis

A7.5.2 the difference between apoptosis (programmed cell death) and cell death due to damage, injury, loss of blood supply or infection (necrosis).

A8 Levels of organisation

A8.1 Tissue definition (as a group of cells that work together to perform a specific function or functions).

A8.2 Location and functions of tissues:

B4.3.1 epithelium

A8.3.2 endothelium

A8.3.3 connective tissue (blood, bone and cartilage)

A8.3.4 nerve tissue

A8.3.5 muscle tissue.

A8.3 Organ definition (a group of tissues performing similar functions).

A8.4 Awareness of the range of organ systems in the body.

A8.5 Definitions of branches of tissue studies:

A8.5.1 Histology (the microscopic study of tissues)

A8.5.2 Histopathology (the microscopic study of diseased tissues).

B: The Nervous and endocrine systems

Students will know, in outline, the structure and functions of the nervous system and the endocrine system.

B1 The nervous system

B1.1 The nervous system:

- B1.1.1** consists of the central nervous system (brain and spinal cord) and peripheral nerves
- B1.1.2** the structure and function of neurones (sensory, motor and relay neurones)
- B1.1.3** the conduction of nerve impulses
- B1.1.4** the reflex arc
- B1.1.5** the importance of myelin
- B1.1.6** the roles of synapses
- B1.1.7** the structure of synapses
- B1.1.8** neurotransmitters (the conduction of impulses across synapses).

B1.2 Outline of disorders of the nervous system (brief overview):

- B1.2.1** Parkinson's disease
- B1.2.2** multiple sclerosis (MS)
- B1.2.3** ALS amyotrophic lateral sclerosis (Lou Gehrig's disease).

B1.3 Hypothalamus:

- B1.3.1** role as the link between the nervous and endocrine systems and its role in homeostasis
- B1.3.2** supra chiasmatic nucleus (SCN)
 - B1.3.2a** overview of role in regulating circadian rhythms
 - B1.3.2b** effects of shift work on circadian rhythms and health.

B1.4 Calculate magnification and true size of structures from photo- and electron micrographs.

B2 The endocrine system

B2.1 The endocrine system:

- B2.1.1** names and locations of the main endocrine glands
 - B2.1.1a** the pituitary gland
 - B2.1.1b** adrenal glands
 - B2.1.1c** the thyroid gland
 - B2.2.1d** the islets of Langerhans in the pancreas

B2.1.2 definition of hormones (chemicals, secreted from ductless glands, that are carried in the blood to their target tissue and later broken down in the liver)

B2.1.3 functions of hormones

B2.1.3a growth hormone

B2.1.3b anti-diuretic hormone (ADH)

B2.1.3c thyroxine

B2.1.3d adrenaline

B2.1.3e insulin

B2.1.3f glucagon.

B2.2 Outline of disorders of the endocrine system:

B2.2.1 under secretion (as illustrated by hypothyroidism and growth hormone deficiency)

B2.2.2 over secretion (as illustrated by hyperthyroidism and acromegaly).

B2.3 Diabetes type 1 and type 2.

B3 Homeostasis

B3.1 Why homeostasis is necessary with reference to regulation of the body's temperature, salt and water balance, blood pH and blood pressure.

B3.2 How negative feedback loops are involved in homeostatic mechanisms.

B3.3 Thermoregulation – the role of hypothalamus and skin in sweating, vasodilation, vasoconstriction; the role of muscles in shivering.

B3.4 Osmoregulation (the role of the kidneys and ADH in osmoregulation).

B3.5 Control of blood glucose levels (the roles of insulin and glucagon).

B3.6 Control of blood pressure (the roles of the renin-angiotensin system, aldosterone, and baroreceptors).

C: The musculoskeletal system

Students will know, in outline, the structure and functions of the musculoskeletal system.

C1 The skeleton

C1.1 Names and locations of bones and structures:

C1.1.1 the axial skeleton

C1.6.1a cranium

C1.6.1b hyoid bone

C1.6.1c vertebral column (cervical, thoracic, lumbar, sacral and caudal regions)

C1.6.1d ribcage

C1.6.1e sternum

- C1.1.2** the appendicular skeleton – limbs and limb girdles
- C1.1.3** the functions of the skeleton (protection, support, movement, blood cell protection, storage of calcium and phosphate)
- C1.1.4** basic structure of a typical long bone.

C2 Joints, tissues and muscles

C2.1 Types of joints:

- C2.1.1** fixed (in the skull)
- C2.1.2** slightly moveable (in the vertebral column)
- C2.1.3** synovial (hinge and ball and socket).

C2.2 Synovial joint:

- C2.2.1** structure
- C2.2.2** synovial membrane and synovial fluid.

C2.3 Physical appearance of muscular tissue as seen in photo- or electron micrographs or diagrams:

- C2.2.1** skeletal
- C2.2.1** smooth
- C2.2.1** cardiac.

C2.4 Structure and functions of muscle:

- C2.4.1** skeletal
- C2.4.1** smooth
- C2.4.1** cardiac.

C2.5 Principles of sliding filament theory of contraction of skeletal muscle, with the roles of actin, myosin, troponin, tropomyosin, and ATP.

C2.6 The different properties of slow and fast twitch muscle fibres.

C2.7 Calculations involving proportions of slow and fast twitch fibres and in change of length of sarcomeres and muscles or of changes in muscle mass.

C2.8 Neuromuscular junctions and roles of neurotransmitters.

C2.9 Antagonistic muscles:

- C2.9.1** the role of tendons in attaching muscles to bones
- C2.9.2** origin and insertion
- C2.9.3** action of antagonistic muscles as illustrated by flexing and extending the forearm.

C3 Disorders of the musculoskeletal system

Students will know an outline of disorders.

C3.1 Osteoarthritis.

C3.3 Osteoporosis/ricke.

C3.3 Duchenne muscular dystrophy.

C3.4 Myasthenia gravis.

D: The cardiovascular and respiratory systems**D1 The cardiovascular system**

Students will understand the relationship between the structure and functions of the cardiovascular systems linked to health. Student should be able to describe risk factors for the conditions listed but an understanding of the development of the conditions is only required in outline.

D1.1 Double circulation:

D1.1.1 significance of double circulation – systemic and pulmonary

D1.1.2 overview of anatomy of double circulation.

D1.2 The heart:

D1.2.1 structure and function of the heart

D1.2.1 function of parts of the heart

D1.2.1a atria and ventricles

D1.2.1b myocardium

D1.2.1c myogenic muscle

D1.2.1d SAN (sino atrial node)

D1.2.1e AVN (atrioventricular node)

D1.2.1f atrioventricular valves and semi lunar valves

D1.2.1g septum and bundle of HIs

D1.2.1h Purkinje fibres

D1.2.1i coronary arteries and veins.

D1.3 The cardiac cycle:

D1.3.1 the stages of the cardiac cycle.

D1.3.2 interpretation of data (pressure and volume changes during the cardiac cycle, stroke volume, cardiac output, heart rate).

D1.3.3 calculation of heart rate, cardiac output and stroke volume at rest and during exercise.

D1.4 Structure and functions of blood vessels:

D1.4.1 the structural features and functions of blood vessels

D1.4.1a arteries,

D1.4.1b arterioles

D1.4.1b capillaries

D1.4.1b venules

D1.4.1b veins

D1.4.2 how the structures of the vessels adapt them for their functions.

D1.5 Blood:

D1.5.1 structure and functions of plasma (the fluid matrix, blood proteins; buffering; blood clotting)

D1.5.2 functions and structural adaptations of blood cells

D1.5.2a erythrocytes

D1.5.2b white blood cells (neutrophils, macrophages, NK cells, lymphocytes)

D1.5.2c B and T cells

D1.5.2c thrombocytes (platelets)

D1.5.3 calculation of blood clotting rates

D1.5.4 blood as an example of connective tissue.

D1.6 Outline of disorders associated with the cardiovascular system:

D1.6.1 bruising or contusion as damage to blood vessels under the skin resulting in bleeding

D1.6.2 pressure sores

D1.6.3 physiological shock – loss of blood volume and blood pressure

D1.6.4 cardiovascular disease (CVD) (diseases of the heart or blood vessels and includes atherosclerosis, arteriosclerosis, heart disease and stroke

D1.6.5 bradycardia, tachycardia and atrial fibrillation.

D2 The respiratory system

D2.1 Overview of anatomy of respiratory system.

D2.2 The structural adaptations of alveoli that allow gas exchange:

D2.1.1 squamous epithelium

D2.1.2 SA/V ratio

D2.1.3 surfactant.

D2.3 How the features of the airways protect the lungs from pathogens and pollutants:

D2.3.1 mucous membranes

D2.3.1 ciliated epithelium

D2.3.1 mucus (secreted by goblet cells)

D2.3.1 macrophages.

D2.4 The role in ventilation of:

D2.4.1 diaphragm

D2.4.2 rib cage

D2.4.3 intercostal muscles.

D2.5 Interpreting spirometer traces and identifying and defining lung volumes.

D2.6 Calculations from spirometer traces or other data:

D2.6.1 breathing rate

D2.6.2 respiratory minute volume

D2.6.3 oxygen consumption

D2.6.4 maximum flow rate.

D2.7 Dead space (in the airways where no gas exchange occurs).

D2.8 Outline of factors contributing to, the effect of, disorders associated with the respiratory system:

D2.8.1 asthma

D2.8.2 chronic bronchitis

D2.8.3 emphysema

D2.8.4 chronic obstructive pulmonary disease (COPD)

D2.8.5 pulmonary fibrosis.

E: The renal and digestive systems

Students will know, in outline, the structure and functions of the renal system.

E1 The renal system

E1.1 The functions of the kidneys:

E1.1.1 Excretion

E1.1.2 Osmoregulation.

E1.2 The relationship between the structure, function and processes of the renal system (which, along with the lungs, makes up the excretory system).

E1.3 Overview of anatomy of the renal system.

E1.4 Components of the nephron:

- E1.4.1** appearance and location (as seen on diagrams)
- E1.4.2** glomerulus function – site of ultrafiltration
- E1.4.3** Bowman's capsule function – collection of filtrate
- E1.4.4** PCT function – selective reabsorption
- E1.4.5** loop of Henle function – for water reabsorption
- E1.4.6** DCT function – to help regulate salt content and collecting ducts for reabsorption of water, during urine formation.

E1.5 ADH as a homeostatic mechanism in osmoregulation:

- E1.5.1** where it is made and secreted
- E1.5.2** its action on target cells (including the role of aquaporins and vesicles)
- E1.5.3** action as a homeostatic mechanism in osmoregulation.

E1.6 Outline of disorders of the renal system (overview of causes, symptoms and treatment):

- E1.5.1** kidney failure
- E1.5.2** kidney stones.

E2 The digestive system

E2.1 Appearance and location (as seen on diagrams) of components of the digestive tract:

- E2.1.1** mouth and salivary glands
- E2.1.2** oesophagus
- E2.1.3** stomach
- E2.1.4** duodenum
- E2.1.5** ileum
- E2.1.6** colon
- E2.1.7** rectum.

E2.2 Appearance and location (as seen on diagrams) of components of accessory organs:

- E2.2.1** liver
- E2.2.2** gall bladder
- E2.2.3** pancreas.

- E2.3** Digestion, absorption and assimilation of macronutrients:
 - E2.3.1** movement of the food bolus or chyme throughout the digestive tract by peristalsis
 - E2.3.2** the mouth
 - E2.3.2a** site of mechanical digestion by chewing
 - E2.3.2b** the role of saliva and salivary amylase in digesting starch maltose
 - E2.3.3** oesophagus (carries the food bolus to the stomach).
- E2.4** Stomach (site of more mechanical digestion and chemical digestion and action of pepsin).
- F2.5** Duodenum (action of bile, action of pancreatic enzymes – lipase, amylase and trypsin).
- E2.6** Ileum:
 - E2.6.1** site of completion of digestion and absorption of the products of digestion
 - E2.6.2** structure and function of villi and microvilli.
- E2.7** Assimilation of the products of digestion:
 - E2.7.1** role of the liver in deamination of excess amino acids
 - E2.7.2** storage of glucose as glycogen
 - E2.7.3** role of amino acids, glucose and fatty acids in metabolism.
- E2.8** The large intestine:
 - E2.8.1** the colon – its role in water reabsorption
 - E2.8.2** importance of the gut microbiota
 - E2.8.3** the rectum for storing faeces.
- E2.9** Outline of disorders of the digestive system:
 - E2.9.1** gastric ulcers
 - E2.9.1** irritable bowel syndrome (IBS)
 - E2.9.1** coeliac disease.
- E2.10** Calculations relating to the digestive system:
 - E2.10.1** calculate rates of absorption
 - E2.10.2** rates of enzyme action.

Transferable skills

Managing Yourself	Interpersonal Skills	Effective Learning	Solving Problems
MY – TPR	EL – MOL	IS – WC	SP – CT*
MY – PS&R	EL – CL	IS – V&NC	SP – PS
MY – COP	EL – SRS	IS – T	SP – C&I
MY – PGS	EL – PRS	IS – C&SI	

Table key

*	Signposted to indicate opportunities for development as part of wider teaching
√	Embedded in teaching, learning and assessment
Blank	TS not embedded or signposted in unit

Key terms typically used in assessment

The following table shows the key terms that will be used consistently by Pearson in our assessments to ensure students are rewarded for demonstrating the necessary skills.

Please note: the list below will not necessarily be used in every paper/session and is provided for guidance only.

Command or term	Definition
Add/Label	Students label or add to a stimulus material given in the question, for example labelling a diagram, adding units on a table, adding points or line to a graph.
Calculate	Obtain a numerical answer, showing relevant working and appropriate units where required.
Complete	Students complete a table/diagram.
Describe	Give an account of something or give an account of a process (in sequence where required). Statements in the response need to be developed as they are often linked but do not need to include a justification or reason.
Discuss	Consider the different aspects in detail of an issue, situation, problem or argument and how they interrelate. Does not require a conclusion.
Explain	Requires identification of a point and linked justification/exemplification of that point.
Give/Name/State	These generally all require recall of one or more pieces of information,
Identify	Requires some key information to be selected from a given stimulus/ resource.

Unit 2: Health Issues and Scientific Reporting

Level: 3

Unit type: External

Guided learning hours: 120

Unit in brief

Students will further develop their understanding of medical science through learning about contemporary health issues, alongside developing knowledge about scientific analysis, evaluation and reporting.

Unit introduction

In this unit, you will explore a number of key areas in the field of medical science, with a focus on health issues faced by the human population today to explore their impact on the world we live in. You will gain an understanding of diagnostic techniques, before focusing on health issues themselves alongside associated initiatives including, cancer and various aspects of immune dysfunction, to the increasingly important world of genetics.

You will learn how to research the impact of such health initiatives through developing knowledge in how to interpret and analyse different forms of scientific information, from newspaper articles to scientific journals. You will develop your critical thinking and analysis skills, including data analysis, learning how to assess the reliability of sources of published scientific information.

The content in this unit will deal with sensitive, potentially triggering themes. Please ensure students know how to access support.

Summary of assessment

The unit will be assessed through one examination of 80 marks lasting 2 hours.

Students will be assessed through a number of short- and long-answer questions. Students will need to explore and relate to contexts and data presented. The questions will assess understanding of health issues and associated initiatives and reporting.

The assessment availability is twice a year in January and May/June. The first assessment availability is May/June 2026.

Sample assessment materials will be available to help centres prepare students for assessment.

Assessment outcomes

- AO1** Demonstrate knowledge and understanding of scientific concepts and theories, terminology, definitions and scientific formulae used in health issues and scientific reporting
- AO2** Apply knowledge and understanding of scientific concepts and theories, procedures, processes and techniques relating to health issues and scientific reporting in given contexts
- AO3** Analyse and interpret scientific information relating to health issues and scientific reporting
- AO4** Make judgements or conclusions using scientific concepts, procedures, processes and techniques relating to health issues and scientific reporting

[EL-SRS]; [EL-PRS]

Content

The essential content is set out under content areas. Students must cover all specified content before the assessment. All topics require students to apply knowledge, analyse and evaluate.

A Diagnostic techniques

A1 Basic methods, normal range, unit of measurement and interpretation of the results as an indication of a patient's health

A1.1 Diagnostic technique for heart rate:

A1.1.1 method of diagnostic tests to observe heart rate

A1.1.1a electrocardiogram (ECG)

A1.1.1b pulse oximetry test

A1.1.2 normal range and unit of measurement

A1.1.3 interpretation of result from the diagnostic test

A1.1.4 abnormal result as an indication of patient's health

A1.1.4a arrhythmia

A1.1.4b atrial fibrillation

A1.1.4c tachycardia

A1.1.4d bradycardia.

A1.2 Diagnostic technique for blood pressure:

A1.2.1 method of diagnostic tests to observe blood pressure

A1.2.1a blood pressure cuff

A1.2.1b ambulatory blood pressure monitoring (AMPM)

A1.2.2 normal range and unit of measurement

A1.2.3 interpretation of result from the diagnostic test

A1.2.4 abnormal result as an indication of patient's health

A1.2.4a hypertension

A1.2.4b hypotension.

A1.3 Diagnostic technique for respiratory rate:

A1.3.1 methods of diagnostic tests to observe respiratory rate

A1.3.1a spirometry

A1.3.1b peak flow test

A1.3.2 normal range and unit of measurement

A1.3.3 interpretation of result from the diagnostic test

- A1.3.4** abnormal result as an indication of patient's health
 - A1.3.4a** chronic obstructive pulmonary disease (COPD)
 - A1.3.4b** asthma.

A1.4 Diagnostic technique for core body temperature:

- A1.4.1** methods of diagnostic test to observe temperature
 - A1.4.1a** rectal thermometer
 - A1.4.1b** forehead thermometer
 - A1.4.1c** ear thermometer
- A1.4.2** normal range and unit of measurement
- A1.4.3** interpretation of result from the diagnostic test
- A1.4.4** abnormal result as an indication of patient's health
 - A1.4.4a** infection
 - A1.4.4b** hyperthermia
 - A1.4.4c** hypothermia.

A1.5 Diagnostic technique for tissue perfusion:

- A1.5.1** methods of diagnostic tests to observe tissue perfusion and blood oxygen saturation
 - A1.5.1a** capillary refill test (CRT)
- A1.5.2** normal range and unit of measurement
- A1.5.3** interpretation of result from the diagnostic test
- A1.5.4** abnormal result as an indication of patient's health
 - A1.5.4a** dehydration
 - A1.5.4b** poor blood flow to tissue.

A1.6 Diagnostic technique for blood oxygen saturation:

- A1.6.1** methods of diagnostic tests to observe tissue perfusion and blood oxygen saturation
 - A1.6.1a** pulse oximetry
 - A1.6.1b** arterial blood gases
- A1.6.2** normal range and unit of measurement
- A1.6.3** interpretation of result from the diagnostic test
- A1.6.4** abnormal result as an indication of patient's health
 - A1.6.4a** hypoxemia
 - A1.6.4b** lung disease.

A1.7 Diagnostic technique for the assessment of nervous system function:**A1.7.1** methods of diagnostic tests to observe nerve conduction speed**A1.7.1a** electromyography (EMG)**A1.7.1b** nerve conduction velocity (NCS) test**A1.7.1b** reflex test**A1.7.2** normal range and unit of measurement**A1.7.3** interpretation of result from the diagnostic test**A1.7.4** abnormal result as an indication of patient's health**A1.7.1a** multiple sclerosis (MS)**A1.7.1b** peripheral neuropathy**A1.7.1c** spinal cord injury**A1.7.1d** neuromuscular conditions.**A2 Diagnostic tests for genetic and chromosomal conditions during pregnancy****A2.1** Amniocentesis:**A2.1.1** process of amniocentesis**A2.1.2** when amniocentesis would be carried out**A2.1.3** reasons for carrying out amniocentesis**A2.1.4** interpretation of the results in the context of health of the foetus.**A2.2** Chorionic villus sampling:**A2.2.1** process of chorionic villus sampling**A2.2.2** when chorionic villus sampling would be carried out**A2.2.3** reasons for carrying out chorionic villus sampling**A2.2.4** interpretation of the results in the context of health of the foetus.**A2.3** Ethical considerations of diagnostic tests.**B: Immune response and dysfunction****B1 Immune response**

Students will understand the processes involved in responding to pathogens.

B1.1 Types of Innate, non-specific physical defences:**B1.1.1** role of physical barriers**B1.1.1a** skin**B1.1.1b** mucous membranes**B1.2.1** blood clotting**B1.2.1** scabbing.

B1.2 Types of Innate, non-specific chemical defences:

B1.2.1 Mucous membranes

B1.2.2 Antimicrobial substances

B1.2.2a enzymes in tears and saliva

B1.2.2b stomach acid

B1.2.2c microbiota (gut flora)

B1.2.3 inflammation response

B1.2.3a causes of inflammation

B1.2.3b histamine

B1.2.3c effects of short term, acute inflammation

B1.2.3d effects of long term, chronic inflammation.

B1.3 Innate (non-specific) biological defences:

B1.3.1 mast cells

B1.3.2 phagocytes

B1.3.3 basophils

B1.3.4 eosinophils

B1.3.5 natural killer cells.

B1.4 Adaptive primary immunity:

B1.4.1 recognition of self and non-self

B1.4.2 definition of an antibody

B1.4.3 antibody structure

B1.4.4 definition of an antigen

B1.4.5 the formation of an antigen-antibody complex

B1.4.6 agglutination

B1.4.7 phagocytosis

B1.4.8 helper T cells

B1.4.2a role in the activation of B cells to secrete antibodies

B1.4.2b role in the activation of macrophages to destroy ingested microbes

B1.4.2c role in the activation of cytotoxic T cells to kill infected target cells.

B1.4.9 killer T cells (role in killing targeted cells bearing specific antigens)

B1.4.2.10 B cells (the response of B lymphocytes to a foreign antigen, clonal selection and the release of monoclonal antibodies).

B1.5 Adaptive secondary immunity:**B1.5.1** the role of T memory cells**B1.5.2** the role of B memory cells**B1.5.3** artificial adaptive immunity through vaccination.**B1.6** Passive immunity:**B1.6.1** natural passive immunity (newborn acquiring passive immunity from its mother through the placenta or breast milk)**B1.6.2** artificial passive immunity (monoclonal antibodies).**B2 Immune dysfunction**

Students will understand the theoretical causes, symptoms and treatment of diseases of the immune system. Description of treatment for immune diseases is limited to how methods of treatment help to restore immune function – in depth details of treatment plans are not required.

B2.1 Autoimmune diseases:**B2.1.1** Diagnosis of an autoimmune disease**B2.1.1a** C-reactive protein (CRP) blood test**B2.1.1b** antinuclear antibody (ANA) test**B2.1.1c** complete blood count (CBS) with white blood cell differential**B2.1.2** multiple sclerosis (MS)**B2.1.2a** theoretical causes**B2.1.2b** symptoms**B2.1.2c** impact on function**B2.1.2d** treatment of disease**B2.1.3** Crohn's**B2.1.3a** theoretical causes**B2.1.3b** symptoms**B2.1.3c** impact on function**B2.1.3d** treatment of disease**B2.1.4** rheumatoid arthritis**B2.1.4a** theoretical causes**B2.1.4b** symptoms**B2.1.4c** impact on function**B2.1.4d** treatment of disease.

- B2.2** Primary and secondary immunodeficiency diseases:
 - B2.2.1** severe combined immunodeficiency (SCID)
 - B2.2.1a** theoretical causes
 - B2.2.1b** symptoms
 - B2.2.1c** impact on function
 - B2.2.1d** treatment of disease
 - B2.2.2** HIV
 - B2.2.2a** theoretical causes
 - B2.2.2b** symptoms
 - B2.2.2c** impact on function
 - B2.2.2d** treatment of disease
 - B2.2.3** immune deficiency due to chemotherapy
 - B2.2.3a** theoretical causes
 - B2.2.3b** symptoms
 - B2.2.3c** impact on function
 - B2.2.3d** treatment of disease
 - B2.2.4** immunodeficiency due to organ transplants.
 - B2.2.4a** theoretical causes
 - B2.2.4b** symptoms
 - B2.2.4c** impact on function
 - B2.2.4d** treatment of disease
 - B2.2.5** ethical considerations of organ transplants and blood transfusions.
- B2.3** Allergies and allergens:
 - B2.3.1** allergy-induced asthma
 - B2.3.1a** theoretical causes
 - B2.3.1b** symptoms
 - B2.3.1c** impact on function
 - B2.3.1d** treatment of condition
 - B2.3.2** anaphylaxis
 - B2.3.2a** theoretical causes
 - B2.3.2b** symptoms
 - B2.3.2c** impact on function
 - B2.3.2d** treatment of condition

B2.3.3 dermatitis**B2.3.3a** theoretical causes**B2.3.3b** symptoms**B2.3.3c** impact on function**B2.3.3d** treatment of condition.**C: Genetics and Health****C1 Gene expression****C1.1** Structure and function of nucleic acids:**C1.1.1** deoxyribonucleic acid (DNA)**C1.1.2** ribonucleic acid (RNA):**C1.1.2a** messenger RNA (mRNA)**C1.1.2b** transfer RNA (tRNA).**C1.2** Transcription of DNA to RNA:**C1.2.1** process of transcription**C1.2.2** role of DNA helicase**C1.2.3** role of RNA polymerase.**C1.3** Splicing of RNA:**C1.3.1** introns**C1.3.2** exons.**C1.4** Translation of RNA to produce proteins:**C1.4.1** codons**C1.4.2** anticodons**C1.4.3** the role of tRNA.**C1.5** Types of gene mutation during DNA replication:**C1.5.1** deletion**C1.5.2** addition**C1.5.3** substitution.**C1.6** Effects on mutations on gene expression dependant on location.

C1.7 Hereditary mutations:

C1.7.1 characteristics of hereditary mutations

C1.7.1a in gametes

C1.7.1b genetic

C1.7.1c occur before conception

C1.7.1d can be passed onto offspring

C1.7.2 Causes of hereditary mutations

C1.7.3 Possible effects of hereditary mutations.

C1.8 Acquired mutations:

C1.8.1 characteristics of acquired mutations

C1.8.1a in somatic cells

C1.8.1b spontaneous

C1.8.1c occur after conception

C1.8.1d cannot be passed onto offspring

C1.8.2 Causes of acquired mutations

C1.8.2a exposure to radiation

C1.8.2b exposure to chemicals

C1.8.2c exposure to infectious agents

C1.8.3 Possible effects of acquired mutations.

C2 Genetic conditions and genetic screening

C2.1 Functions of:

C2.1.1 gene

C2.1.2 allele

C2.1.3 dominant

C2.1.4 recessive

C2.1.5 genotype

C2.1.6 phenotype

C2.1.7 heterozygous

C2.1.8 homozygous

C2.1.9 sex linkage

C2.1.10 carrier

C2.1.11 affected/sufferer

C2.1.12 non-affected/non-sufferer.

C2.2 Interpretation of genetic diagrams:**C2.2.1** familial pedigrees**C2.2.2** Punnet square diagrams.**C2.3** Inheritance of genetic and chromosomal conditions:**C2.3.1** conditions caused by recessive alleles**C2.3.2** conditions caused by dominant alleles**C2.3.3** sex-linked conditions**C2.3.4** conditions caused by aneuploidy.**C2.4** Effect of genetic and chromosomal conditions:**C2.4.1** cystic fibrosis (CF)**C2.4.2** Huntington's disease**C2.4.3** haemophilia**C2.4.4** Down's syndrome.**C2.5** Methods and limitations of obtaining DNA samples:**C2.5.1** oral/buccal swabs**C2.5.2** body fluids**C2.5.3** plucked hair.**C2.6** Use of DNA sequencing techniques to determine genetic conditions or predispositions:**C2.6.1** whole genome sequencing in newborns**C2.6.2** pre-employment genetic screening.**C2.7** Ethical considerations of genetic screening.**C2.8** Ethical considerations of acquisition, management and regulatory frameworks of genome sequencing and genetic screening data.**D: Cancer****D1 Development of cancer****D1.1** Causes of cancer:**D1.1.1** effects of chemical mutagens**D1.1.2** radiation exposure**D1.1.3** mutations in tumour suppressor**D1.1.4** oncogenes.**D1.2** Characteristics of benign tumour growth.**D1.3** Characteristics of malignant tumour growth.

D2 Cancer screening and diagnosis

D2.1 Types of cancer screening and diagnosis methods:

D2.1.1 biopsy

D2.1.3 laboratory tests (blood tests, cytogenic analysis tumour marker tests)

D2.1.4 imaging

D2.1.4a CT

D2.1.4b MRI

D2.1.4c nuclear imaging.

D2.2 Cancer screening programmes:

D2.2.1 bowel cancer screening

D2.2.1 breast cancer screening

D2.2.2 cervical screening.

D2.3 Benefits of cancer screening:

D2.3.1 early detection

D2.3.2 effect on treatment.

D2.4 Risks and limitations of cancer screening:

D2.4.1 false positives and false negatives

D2.4.2 different screening methods for different cancers

D2.4.3 barriers to screening.

D3 Cancer treatment

D3.1 Process of cancer treatment:

D3.1.1 surgery

D3.1.2 chemotherapy

D3.1.3 radiotherapy

D3.1.4 hormone therapy

D1.1.1 characteristics of cancer treatments

D3.2.1 short-term side effects following procedures

D3.2.2 long-term side effects following procedures

D3.2.3 different treatments required for different cancers

D3.2.4 success rate of different treatments.

E: Interpretation, analysis and evaluation of scientific information

Students will know how the type and source of data can affect the validity of the data and should be able to analyse data to draw conclusions.

E1 Quantitative and qualitative evidence

E1.1 Definitions of quantitative and qualitative evidence.

E1.2 Difference between quantitative and qualitative evidence.

E1.3 Appropriate use of quantitative and qualitative evidence.

E1.4 Methods of collection of data:

E1.4.1 clinical trials

E1.4.2 longitudinal studies

E1.4.3 retrospective cohort study

E1.4.4 case studies

E1.4.5 questionnaires

E1.4.6 observations

E1.4.7 laboratory experiments.

E1.5 Methods of processing quantitative and qualitative evidence:

E1.5.1 statistical significance

E1.5.2 types of average

E1.5.2 standard deviation

E1.5.2 uncertainty

E1.5.2 handling of anomalous data.

E1.6 Methods of presenting quantitative and qualitative evidence:

E1.6.1 infographics

E1.6.2 graphs

E1.6.3 uncertainty tables

E1.6.4 uncertainty written conclusions).

E2 How factors affect validity and reliability of quantitative and qualitative data sources and conclusions:

E2.1 Sample size.

E2.2 Peer review.

E2.3 Influence of organisations and individuals on health issues:

E2.3.1 World Health Organization (WHO)

E2.3.2 NHS

E2.3.3 Health Education England (HEE)

E2.3.4 patients

E2.3.5 universities and research groups/teams

E2.3.6 pharmaceutical companies

E2.3.7 charities and trusts.

E2.4 Funding source.

E2.5 Bias.

E2.6 Misuse of data – inappropriate extrapolation, extracting or misquoting of data).

E2.7 Sources of error in data:

E2.7.1 systematic

E2.7.2 random

E2.7.3 procedural

E2.7.4 sample selection.

E2.8 Use of secondary data/sources:

E2.8.1 date of publication

E2.8.2 author

E2.8.3 source of information (scientific journals, broadcasting media, print media, online sources, social media).

E3 Conducting data analysis

E3.1 Calculation of averages.

E3.2 Calculation of percentage changes.

E3.3 Drawing and interpretation of lines of best fit.

E3.4 Trends, patterns and relationships in data:

E3.4.1 interpreting graphical data to establish trends

E3.4.2 predicting extrapolations of data

E3.4.3 suggesting explanations for trends identified.

Transferable skills

Managing Yourself	Interpersonal Skills	Effective Learning	Solving Problems
MY – TPR	EL – MOL	IS – WC	SP – CT
MY – PS&R	EL – CL	IS – V&NC	SP – PS
MY – COP	EL – SRS *	IS – T	SP – C&I
MY – PGS	EL – PRS *	IS – C&SI	

Table key

*	Signposted to indicate opportunities for development as part of wider teaching and learning.
√	Embedded in teaching, learning and assessment
Blank	TS not signposted in unit

Key terms typically used in assessment

The following table shows the key terms that will be used consistently by Pearson in our assessments to ensure student are rewarded for demonstrating the necessary skills.

Please note: the list below will not necessarily be used in every paper/session and is provided for guidance only.

Command or term	Definition
Add/Label	Students label or add to a stimulus material given in the question, for example labelling a diagram, adding units on a table, adding points or line to a graph.
Calculate	Obtain a numerical answer, showing relevant working and appropriate units where required.
Complete	Students complete a table/diagram.
Describe	Give an account of something or give an account of a process (in sequence where required). Statements in the response need to be developed as they are often linked but do not need to include a justification or reason.
Discuss	Consider the different aspects in detail of an issue, situation, problem or argument and how they interrelate. Does not require a conclusion.
Explain	Requires identification of a point and linked justification/exemplification of that point.
Give/Name/State	These generally all require recall of one or more pieces of information,
Identify	Requires some key information to be selected from a given stimulus/ resource.
Show	Students must prove that a numerical figure is as stated in the question

Unit 3: Practical Microbiology and Infectious Diseases

Level: 3

Unit type: Internal

Guided learning hours: 90

Unit in brief

Students will investigate the effect of antimicrobial agents on the growth of microorganisms, by selecting and applying knowledge of microorganisms and infectious diseases. They will draw on their wider scientific understanding and skills to plan and carry out a range of practical techniques.

Unit introduction

Microbiology is an essential element within pathology, clinical and infection sciences and also in veterinary science. Over 15 million people die every year from infectious diseases, with emerging diseases and our inability to provide appropriate treatments a constant threat. An understanding of the nature of microorganisms will enable you to appreciate the various methods available to treat or cure diseases and to recognise the need to continue to develop new and innovative treatments.

In this unit, you will carry out your own investigation into the effect of antimicrobial agents on the growth of microorganisms. This will enable you to begin to understand the role of clinical microbiologists. To carry out your investigation you will explore a variety of tests using good laboratory practice. You will first develop an understanding of the significance of microorganisms as pathogens. You will link understanding of cell and tissue adaptation, function of biological molecules and the relationship between the structure, function and processes of key body systems with your knowledge of immune response to understand how diseases develop.

The investigation within this unit will benefit progression to higher education. It requires you to work independently to bring together understanding of scientific principles with practical skills to conduct an investigation to achieve a purpose, drawing on your understanding of cells, tissues and biological molecules gained in Unit 1, and your knowledge of qualitative and quantitative research methods gained in Unit 2.

Learning aims

In this unit you will:

- A** Understand the classification and nature of microorganisms
- B** Examine the transmission and treatments of infectious diseases
- C** Explore the application of techniques to culture and identify microorganisms
- D** Investigate the effects of antimicrobial agents on the growth of microorganisms.

Summary of unit

Learning aim	Key content areas	Assessment approach
A Understand the classification and nature of microorganisms	A1 Characteristics of different microorganisms A2 Methods of pathogenicity A3 Classification strategies	Undertake secondary research to support the production of materials analysing the structure of microorganisms, classification methods used to identify microorganisms, and the ways in which they cause disease.
B Examine the transmission and treatments of infectious diseases	B1 Classification overview of infectious diseases B2 Transmission of infectious agents B3 Infectious diseases, signs, symptoms and progression B4 Prevention and treatment of infectious diseases	Undertake secondary research to support the production of materials analysing the transmission and treatment of infectious disease.
C Explore the application of techniques to culture and identify microorganisms	C1 Health and safety C2 Microscopy and staining techniques C3 Culture of microorganisms C4 Quantitative analysis of microbes	Carry out a range of practical procedures and produce a concise practical report which evaluates the skills, methods, results and accuracy of the procedures and techniques used to cultivate microorganisms.
D Investigate the effects of antimicrobial agents on the growth of microorganisms	D1 Investigating the substances that inhibit the growth of microorganisms D2 Interpretation, analysis and evaluation	Undertake practical investigations which will enable you to write a report evaluating the effect of antimicrobial agents on the growth of microorganisms.

Content

The essential content is set out under content areas. Students must cover all specified content before the assessment.

Learning aim A: Understand the classification and nature of microorganisms

A1 Characteristics of different microorganisms

- Prokaryotes:
 - physical characteristics, to include – cellular structure, including the cell wall (Gram negative and positive), appendages for movement, genome and plasmids
 - growth characteristics, to include – binary fission, growth curves, reproductive strategies, the effect of temperature on the rate of enzyme activity and its impact on microorganism growth.
- Eukaryotes:
 - protists – eukaryotic nature of single-celled protists, classification based on mode of movement such as amoeboid (e.g. *Entamoeba histolytica*), flagellate (e.g. *Giardia duodenalis*), ciliate (e.g. *Balantidium coli*) and sporozoa (e.g. *Plasmodium falciparum*), structures and life cycles
 - fungi – structures, reproductive strategies.
- Acellular:
 - main characteristics of viruses, to include structure of the virion, types of genetic material in viruses, capsid, possibility of envelope, reproductive strategies of viruses (lysogenic and lytic cycles)
 - main characteristics of prions, to include that they are non-living, lacking in nucleic acids, made of mis-folded proteins based on normal brain proteins, cause damage to the brain leading to neurodegenerative diseases.

A2 Methods of pathogenicity

- Virulence mechanisms of bacteria:
 - access to the host
 - the role of adhesins, endotoxins and exotoxins, damage to host cells and tissues
 - outline how the immune system is evaded
 - incubation periods.
- Virulence mechanisms of eukaryotes:
 - access to the host
 - the production of proteases and endotoxins in fungi
 - use of adhesins, toxins
 - antigenic variation
 - the ability to survive inside phagocytic vesicles.

- Virulence mechanisms of viruses:
 - access to the host
 - direct cell damage
 - latency.
- Underlying mechanism for the evolution of pathogens:
 - mutations in relation to bacteria, tuberculosis and viruses, HIV.

A3 Classification strategies

- Phenotypic methods to classify bacteria:
 - shape and cell structure, to include cocci, bacilli, flagellate rods, spirilla, vibrios
 - comparison of the structure of the cell wall between Gram positive and Gram negative bacteria
 - oxygen requirements, to include aerobes, obligate aerobes, anaerobes,
 - facultative anaerobes.
- Classification of viruses:
 - Baltimore classification using type of nucleic acid and mode of replication
 - other methods, to include size, host organism, capsule structure.
- Classification of protists, to include cell structures, metabolisms, and methods of motility.

Learning aim B: Examine the transmission and treatments of infectious diseases

B1 Classification overview of infectious diseases

- Target organ: intestinal, respiratory tract, blood, urinary, systemic.
- Agent: bacterial, viral, protozoan, fungal, prionic.

B2 Transmission of infectious agents

- Direct:
 - physical contact, bodily fluids, across the placenta
 - animal contact, animal waste.
- Indirect:
 - transmission through intermediates (vectors), including mosquito, fleas, lice, ticks
 - airborne, including aerosols, droplets
 - vehicle borne, including surfaces (fomites), objects
 - food and waterborne.
 - zoonoses
- Chain of infection: spread through communities and the importance of herd immunity, agent, host, reservoir, portals of exit, mode of transmission, portals of entry.

B3 Infectious diseases, signs, symptoms and progression

The five types of pathogen:

- Bacterial, to include tuberculosis, meningitis, chlamydia, cholera.
- Viral, to include HIV-related disease, Ebola, norovirus, influenza, COVID-19.
- Fungal, to include ringworm, mycotoxicosis, candidiasis.
- Prionic: Creutzfeldt-Jakob disease (CJD), acquired and variant, kuru.
- Protistic, including malaria, giardiasis, and amoebic dysentery

B4 Prevention and treatment of infectious diseases

- Prevention:
 - mode of action of vaccines (active and passive)
 - vaccine types to include: live-attenuated, inactivated, mRNA vaccines, recombinant, toxoid
 - use of antiseptics and disinfectants
 - behaviours, including hygiene, hospital strategies, safe sex
 - environmental, including water sources, mosquito nets, handwashing and cleaning facilities.
- Treatments:
 - antibiotics – disruption of the cell wall formation and cellular processes
 - antifungal agents – disruption of cell wall, disruption of reproductive process
 - antivirals – entry to cell, disruption of replication process
 - antiprotozoal drugs, specifically those used to treat malaria linked to stage of infection.
- Current issues:
 - examples of the emergence of antibiotic resistance in bacterial populations, including multi-drug resistant *Neisseria gonorrhoeae*
 - causes and the importance of antibiotic resistance, to include horizontal and vertical gene transfer
 - causes, signs, and treatments of sepsis
 - modern practices that have led to the increase in infectious diseases, to include the overuse and inappropriate use of antibiotics and their use in agriculture
 - the benefits and importance of herd immunity in limiting transmission of disease and the role in vaccination programmes
 - antigenic variation in viruses, including SARS-CoV-2
 - social and cultural factors affecting the uptake of some vaccines/treatments, and the impact of these.

Learning aim C: Explore the application of techniques to culture and identify microorganisms [MY-TPR]

C1 Health and safety

- The importance of following standard operating procedures (SOPs), undertaking risk assessments, and compliance with relevant legislation such as Control of Substances Hazardous to Health 2002 (COSHH).
- Current legislation relating to the use of microorganisms in the workplace, including the categorisation of biological agents according to hazard and containment requirements.
- Biosafety cabinets, biosafety classification levels, use of personal protective equipment (PPE).
- Methods of sterilisation and disinfection.
- Aseptic technique: to include reducing activity in the immediate vicinity of the area, reducing exposure, use of sterile equipment, consideration of airflow in the vicinity, use of Bunsen burner flame to draw air currents upwards, flaming the neck of bottles, use of a sterile loop, pipette or spreader, sterilisation and safe disposal after exposure.
- Safe culturing of microorganisms, to include implications of temperature, contamination and sealing the Petri dishes, incubation time.

C2 Microscopy and staining techniques

- Microscopy and colony characterisation:
 - use of a microscope to observe microorganisms, to include hanging drop method
 - to view protists; preparation of a smear slide, to include air drying, fixing, use of oil immersion lens
 - staining techniques, to include Gram staining of bacteria, methylene blue stain and India ink staining for capsules around bacteria and yeast cells, use of mordants
 - growth characteristics in broths, to include turbid, pellicle, sediment, flocculent
 - colony morphology identification on plates, to include form, elevation, margin
 - limitations of staining techniques and morphological studies for identifying microorganisms.
- Measurement of object size using magnification formula ($\text{image size} = \text{actual size} \times \text{magnification}$) including conversion of units, rearrangement of the formula, and use of standard form.

C3 Culture of microorganisms

- Types of media:
 - preparation of nutrient media, nutrient broth, nutrient agar
 - selective media, to include MacConkey agar, mannitol salt agar, blood agar, potato dextrose agar.

UNIT 3: PRACTICAL MICROBIOLOGY AND INFECTIOUS DISEASES

- Methods of cell culture:
 - stab cultures, pour plates, streaking, lawn spreads, slant tubes
 - broth cultures
 - incubation temperatures.
- Isolation of pure cultures from mixed populations.

C4 Quantitative analysis of microbes

- Total population count:
 - haemocytometer, counting chamber
 - turbidimetric methods.
- Viable counts: serial dilutions, streak/spread plating.
- Principles of advanced quantitative techniques including flow cytometry, use of biosensors, quantitative real-time PCR (qPCR).

Learning aim D: Investigate the effect of antimicrobial agents on the growth of microorganisms [EL-PRS]

D1 Investigating the substances that inhibit the growth of microorganisms

- Suitability of pour plate or spread plate with confluent growth, incubation times, correct measurement of zones of inhibition.
- Antimicrobial susceptibility testing, for example:
 - disinfectants/antiseptics/natural compounds, including garlic, essential oils
 - concentration effects
 - bactericidal or bacteriostatic antibiotics.
- Measurement of antimicrobial susceptibility by zones of inhibition.

D2 Interpretation, analysis and evaluation

- Data collection and awareness of anomalous data, repeats and validity.
- Numerical data identified and presented, including graphs, tables and statistics as appropriate, including an understanding of the calculation and use of standard deviation and the use and interpretation of error bars on graphs.
- Sources of error in data.
- Using critical thinking skills to draw valid conclusions in relation to the purpose of the investigation:
 - questioning relevance of data and challenging own biases
 - breaking information/data into parts and identifying trends and patterns
 - identifying strengths and/or weaknesses and significance of information/data
 - drawing conclusions supported by structured reasoning and evidence.
- Common limitations, to include false susceptibility or resistance to antibiotic due to nonstandard confluent growth, use of old disks, disks not stored at 4°C, depth of agar inconsistent resulting in non-standard diffusion of the antibiotic, incorrect growth conditions for the bacteria.
- Potential areas for further research and development identified.

Assessment criteria

Learning aim A: Understand the classification and nature of microorganisms

Pass	Merit	Distinction
<p>A.P1 Describe the characteristics that are used to classify microorganisms.</p> <p>A.P2 Describe the roles of structures found in microorganisms and factors affecting growth.</p> <p>A.P3 Describe the virulence mechanisms of disease-causing microorganisms.</p>	<p>A.M1 Explain how characteristics are used to classify microorganisms.</p> <p>A.M2 Explain how virulence mechanisms of microorganisms cause infection.</p>	<p>A.D1 Compare the virulence mechanisms of different groups of disease-causing microorganisms.</p>

Learning aim B: Examine the transmission and treatments of infectious diseases

Pass	Merit	Distinction
<p>B.P4 Describe the development of different types of infectious disease.</p> <p>B.P5 Describe the prevention and treatment of the different types of infectious disease</p>	<p>B.M3 Discuss the development of infectious diseases and their associated prevention and treatment strategies.</p>	<p>B.D2 Evaluate the prevention and treatment of the different types of infectious disease and the impact of current issues in the use of these treatments.</p>

Learning aim C: Explore the application of techniques to culture and identify microorganisms

Pass	Merit	Distinction
C.P6 Carry out morphological studies, microscopy and staining techniques to identify microorganisms.	C.M4 Discuss the techniques used to identify and cultivate microorganisms in terms of the quality of results obtained.	C.D3 Evaluate the microscopy and microbiological practical techniques used and skills developed.
C.P7 Correctly select and use aseptic technique to cultivate microorganisms.	C.M5 Correctly select and use aseptic technique to grow and measure the growth of microorganisms, including the use of serial dilutions and counting techniques.	C.D4 Correctly use aseptic enumeration techniques and make judgements on the accuracy of the procedures used.

Learning aim D: Investigate the effect of antimicrobial agents on the growth of microorganisms

Pass	Merit	Distinction
D.P8 Cultivate microorganisms to accurately measure the effects of antimicrobials on their growth	D.M6 Interpret data collected in order to reach a conclusion, considering the impact on prevention and treatment of disease.	D.D5 Evaluate the methods, techniques and data collected to determine the effect of antimicrobials on the growth of microorganisms. [SP-CT]

Transferable skills

Managing Yourself	Interpersonal Skills	Effective Learning	Solving Problems
MY – TPR *	EL – MOL	IS – WC	SP – CT ✓
MY – PS&R	EL – CL	IS – V&NC	SP – PS
MY – COP	EL – SRS	IS – T	SP – C&I
MY – PGS	EL – PRS *	IS – C&SI	

Table key

*	Signposted to indicate opportunities for development as part of wider teaching and learning.
✓	Embedded in teaching, learning and assessment
Blank	TS not embedded or signposted in unit

Essential information for Pearson Set Assignment Brief (PSAB)

Pearson sets the assignment for the assessment of this unit.

The PSAB will take approximately 19 hours to complete.

The PSAB will be marked by centres and verified by Pearson.

The PSAB will be valid for the lifetime of this qualification.

Assessing the PSAB

You will make assessment decisions for the PSAB using the assessment criteria provided.

Section 1 gives information on PSABs and there is further information on our website.

Further information for teachers and assessors

Resource requirements

For this unit, students must have access to a well-equipped laboratory suitable for Key Stage 5 standard microbiology, including microbiological cultures such as *E.coli*, *S. aureus*, and *S. cerevisiae*.

In addition, it is recommended that whilst studying Learning Aims C and D students will keep a lab book to record the procedures they undertake as well as their observations, initial analysis, interpretations, personal reflections, and any other relevant information. Whilst this will not form part of the formal assessment of this unit it is recommended that students draw upon this information to inform their work during assessment activities. This may be electronic or paper-based, at the discretion of the centre.

Essential information for assessment decisions

Learning aim A

For distinction standard, students will compare virulence mechanisms of the main subgroups of disease-causing microorganism (bacteria, fungi, protists, and viruses). They will consider the relevance of these mechanisms and how they combine to influence the pathogenicity of the microorganism. The minimum expected would be one pathogen from each group (bacteria, fungi, protists, and viruses).

For merit standard, students will explain the classification methods for bacteria, fungi, protists, and viruses. Students must explain the Baltimore system of classification of viruses and explain how each subgroup is different in their mode of infectivity. Students will be able to explain the basis for the classification of bacteria based on features such as morphology, staining properties of the organism and oxygen requirements in bacteria. They will explain the virulence mechanisms used by bacteria, fungi, protists, and viruses using named examples of how these cause infection. Students are expected to use annotated diagrams to illustrate their explanations. The diagrams will be clearly labelled and accurate.

For pass standard, students will describe the characteristics used to classify microorganisms. They will describe the main features of the different types of microorganism using a named example from each of the subgroups (bacteria, fungi, protists, and viruses). The roles of the structures found in bacteria, fungi, protists, and viruses must be described. Named examples and annotated diagrams will be used to illustrate their descriptions. Students will describe the growth of microorganisms in terms of cell division, oxygen requirements, temperature factors and the features of growth curves. They will also describe the virulence factors identified in the unit content.

Learning aim B

For distinction standard, students will evaluate the treatments of at least three different types of disease caused by the types of pathogen identified in the section B3 of the unit content, and the impact of current issues in the use of these treatments. They will demonstrate a thorough understanding of the issues facing the treatment of infectious diseases. They will provide an evaluation of the causes of antibiotic resistance and problems with creating vaccinations owing to mutations and antigenic variation. They could evaluate some alternative/innovative treatments.

Students will demonstrate a thorough understanding of the issues facing the treatment of infectious diseases. They will provide a detailed explanation of some of the contributory events that have led to antibiotic resistance, the evasion of the immune system by some pathogens and problems with creating vaccinations owing to mutations and antigenic variation. They will then evaluate some alternative/innovative treatments.

For merit standard, students will use three examples to discuss the development of infectious diseases. They will compare how different invasive microorganisms disrupt the functions of host cells and organs and explain the chain of infection for each disease. They will discuss the modes of action of the available treatment and prevention strategies for each of the diseases. Students will discuss the potential impact of current issues facing disease treatment and prevention.

For pass standard, students will research infectious diseases caused by at least three of the five types of pathogen identified in the section B3 of the unit content. They will describe the mode of transmission of each pathogen, and the development and progression of the resultant infectious diseases. Students will describe methods to control the spread of, prevent, or treat the diseases. Students are expected to describe at least two current issues relating to the prevention and treatment of diseases. Students will be expected to use annotated diagrams to illustrate their descriptions. The diagrams will be detailed, clearly labelled and accurate.

Learning aim C

For distinction standard, students will evaluate their practical methods and provide judgements on the accuracy of the procedures. They will be expected to consider factors such as: subjectivity (including standard protocols in the use of the haemocytometer), quantitative versus qualitative data gained, difficulty of skill and cost implications.

Consideration will be given to modern clinical microbiology techniques. For example, why is the Gram stain commonly used in the first stage of the identification of microorganisms? Why might a microbiologist employ various methods of culturing bacteria and what are the purposes of selective and differential media in microorganism identification? Why would a microbiologist use streak plating to isolate individual colonies?

For merit standard, students will be expected to culture microorganisms, but are not expected to use selective media. Students will carry out total and viable cell counts of cultures using serial dilutions, spread plating and haemocytometer.

Students must compare the techniques used to cultivate microorganisms in terms of the quality of the results obtained. Comparisons will include the principles underlying the microbiological techniques used in terms of the staining procedures, colony characteristic identification methods, relevant aseptic technique and method of cultivation as well as the growth of the microorganisms in the different conditions. This should include an explanation of aseptic technique and a comparison of the methods of inoculation. Students are expected to explain the reasons for the health and safety procedures, aseptic technique and contamination issues, and to demonstrate skill and proficiency when carrying out these procedures.

For pass standard, students will carry out morphological studies, microscopy and staining techniques to identify microorganisms. This should include the use of the Gram stain to identify Gram-negative and Gram-positive bacteria; colony characterisation from a mixed culture (possibly air-exposed Petri dishes or swabs from around the laboratory). This will also include correct use of aseptic technique to prepare growth medium and pour agar plates, which will be used to inoculate with microorganisms. Students will undertake a risk assessment before carrying out their studies.

Students will develop skills in the following techniques: making a spread plate, making a smear slide, making a pour plate. They will then suitably and safely incubate these plates and make observations of the growth patterns.

Learning aim D

For distinction standard, students will evaluate the provided protocol (methods, techniques and data) that they have used to test the susceptibility of microorganisms to antimicrobial agents. Students will use information from secondary sources in their evaluations.

They will evaluate how effective their methods were in being able to analyse the effects and will suggest suitable alternatives or extensions to the methods or equipment that would enhance their results. Students will give a full account of the limitations of the procedures in terms of the health and safety procedures, aseptic technique and contamination opportunities, and will develop a rationale for improvement. They will also develop their evaluation to include the results of others, in order to provide a full and detailed report on the effect of antimicrobials on microbial growth.

For merit standard, students will measure microbial growth with precision, leading to a coherent analysis of the results from which valid conclusions will be drawn. Students will use their results to analyse the effectiveness of the different agents inhibiting microbial growth. Their conclusions will lead to a consideration of the wider impact of their findings on prevention and treatment of infectious diseases.

For pass standard, students will use given protocols to investigate the effects of antimicrobial agents on the growth of microorganisms. They will measure the effects of at least four antimicrobial agents on the microorganisms they have cultivated and will record their results, forming simple conclusions from their results comparing the effectiveness of these agents.

Links to other units

The synoptic assessment tasks for this unit allow students to select and apply knowledge on cells, tissues and, biological molecules from *Unit 1: Human Physiology, Anatomy and Pathology*.

Unit 4: Diseases, Disorders, Treatments and Therapies

Level: 3

Unit type: Internal

Guided learning hours: 60

Unit in brief

Students will explore biological molecules and pathways, and their relevance to diseases, disorders, treatments and therapies.

Unit introduction

This unit gives you theoretical knowledge of diseases and disorders, an insight into current and future treatments, and knowledge of how biology is applied to make a positive impact on our lives.

Biological molecules are at the forefront of treating many diseases and disorders. In this unit, you will have the opportunity to research how drugs and medicines are discovered, altered, designed, and synthesised to treat physiological diseases and disorders. This unit requires you to become familiar with current treatments and their potential benefits, while understanding their potential adverse effects. Potential treatments for the future are often covered in news stories and in television documentaries, and in this unit you will explore and research how new treatments are discovered. You will also explore the moral, ethical and legal implications of treating or not treating individuals.

Learning aims

In this unit you will:

- A** Understand biological molecules and pathways and their effect on the body
- B** Understand the effects of physiological diseases and disorders and associated treatments
- C** Examine the development of innovative and future types of treatment for physiological diseases and disorders.

Summary of unit

Learning aim	Key content areas	Assessment approach
A Examine biological molecules and pathways and their effect on the body	A1 Roles of proteins and lipids in maintaining health A2 The relationships between changes to molecules and the impacts these have on biological pathways and processes	Undertake research to support the production of an article which evaluates the importance of biological molecules and their impact on human health
B Understand the effects of physiological diseases and disorders and associated treatments	B1 Physiological diseases and disorders B2 Treatments for physiological diseases and disorders B3 Effects on the individual	Undertake research to support the production of materials evaluating the effects of the treatments of different physiological diseases or disorders
C Examine the development of innovative and future types of treatment for physiological diseases and disorders	C1 Drug and medicine discovery and development C2 Innovative treatments C3 Ethical, legal and moral issues	Undertake research to support the production of materials evaluating the development of new drugs

Content

The essential content is set out under content areas. Students must cover all specified content before the assessment.

Learning aim A: Examine biological molecules and pathways and their effect on the body

A1 Roles of proteins and lipids in maintaining physiological health

- Roles of proteins, including:
 - as antibodies
 - as hormones
 - as enzymes
 - in growth and repair, including clotting
 - in transport
- Roles of lipids, including:
 - in association with vitamins
 - in the production of hormones.
- Roles of nucleic acids, including:
 - transfer of genetic information during cell division and reproduction
 - coding for amino acid sequences during protein synthesis

A2 The relationships between changes to molecules and the impacts these have on biological pathways and processes.

Students will explore the causes and effects of disruption to biological processes, to include:

- lactose intolerance
- sickle cell disease
- cancer: prostate, lung, breast
- Atherosclerosis and coronary heart disease (CHD)
- diabetes (diabetes mellitus types 1 and 2) – regulation of glucose metabolism by hormones
- neurological conditions (e.g., dementia anxiety disorders and mood disorders, Parkinson's disease, Multiple Sclerosis)

Learning aim B: Understand the effects of physiological diseases and disorders, and associated treatments

B1 Physiological diseases and disorders

- The development and possible effects of the following:
 - lactose intolerance
 - sickle cell disease
 - cancer: prostate, lung, breast
 - atherosclerosis and coronary heart disease (CHD)
 - diabetes (diabetes mellitus types 1 and 2) – regulation of glucose metabolism by hormones
 - neurological conditions (e.g., dementia anxiety disorders and mood disorders, Parkinson's disease, multiple sclerosis).
- Mental health impact of diagnosis and prognosis, including positive and negative impacts.

B2 Treatments for physiological diseases and disorders

- Students will understand the types of treatment, therapies and the associated benefits of each when used in relation to specific physiological diseases and disorders, including:
 - radiotherapy, including brachytherapy
 - chemotherapy
 - hormone therapy
 - surgery
 - stem cell therapy.

B3 Effects on the individual

- Students will understand the possible effects on the body of the treatments listed above.
- Positive effects (advantages and benefits), including partial cure, cure, ability to lead an unaffected life.
- Negative effects (disadvantages, potential harm), including side effects of treatments.
- Risks associated with treatments, including exposure to increased levels of radioactivity during radiotherapy.
- Mental health impact of treatments and their side effects.

Learning aim C: Examine the development of innovative and future types of treatment for physiological diseases and disorders [SP-C&I]

C1 Drug and medicine discovery and development

- Students will explore drug discovery and development to include:
 - drugs derived from natural sources, including plants and animals
 - modification of natural products to develop drugs and medicines, including isolation, purification, optimisation of the active compound
 - an overview of the synthesis of new and novel compounds for therapeutic use
 - process of drug development from discovery to regulatory approval, including computer modelling, research integrity, and appropriate handling of data.
 - clinical trials, including:
 - placebos
 - randomised controlled trials (RCT), including double-blinding
- Problems during drug development, to include identifying suitable target, finding new candidate molecules, toxicity, lack of clinical efficacy, side effects, drug interactions

C2 Innovative treatments

Students will explore the development of innovative treatments for physiological diseases and disorders.

- Gene therapy:
 - identification, removal and modification of faulty genes
 - insertion of new or amended gene, vectors
 - including the treatment of metachromatic leukodystrophy (MLD).
- Surgical techniques, and current research and development into less invasive ways to remove cells and tissues including laser-based surgery.
- Targeted biological therapy and immunotherapy, including monoclonal antibody therapy, angiogenesis inhibitors, T-cell therapy.

C3 Ethical, legal and moral issues

Students will explore the ethical, legal and moral issues relating to treatments and drug development and testing.

- Ethical, social, and professional rules, including:
 - reliability of sources of information
 - confidentiality
 - informed consent
 - do no harm
 - 'can it be done?', 'should it be done?'
 - use of animal testing.

Assessment criteria

Learning aim A: Examine biological molecules and pathways and their effect on the body

Pass	Merit	Distinction
A.P1 Explain the roles of proteins, nucleic acids and lipids in maintaining physiological health.	A.M1 Discuss how disruption to biological molecules and processes can lead to one physiological disease or disorder.	A.D1 Evaluate the impact of one physiological disease or disorder on the person affected

Learning aim B: Understand the effects of physiological diseases and disorders and associated treatments

Pass	Merit	Distinction
B.P2 Describe the effects of physiological diseases and disorders B.P3 Describe the treatments of physiological diseases and disorders.	B.M2 Discuss the effects on the individual of physiological diseases and disorders, and their treatments.	B.D2 Evaluate the effects of treatments of physiological diseases and disorders.

Learning aim C: Examine the development of innovative and future types of treatment for physiological diseases and disorders

Pass	Merit	Distinction
C.P4 Describe the development and testing of a drug or medicine that has been synthesised for a specific purpose.	C.M3 Discuss the problems that may arise during development and testing of drugs, medicines, and treatments.	C.D3 Evaluate the ethical, legal and moral issues of drug/medicine development, testing and treatments for a physiological disease or disorder.

Transferable skills

Managing Yourself	Interpersonal Skills	Effective Learning	Solving Problems
MY – TPR	EL – MOL	IS – WC	SP – CT
MY – PS&R	EL – CL	IS – V&NC	SP – PS
MY – COP	EL – SRS	IS – T	SP – C&I *
MY – PGS	EL – PRS	IS – C&SI	

Table key

*	Signposted to indicate opportunities for development as part of wider teaching and learning.
√	Embedded in teaching, learning and assessment
blank	TS not embedded or signposted in unit

Essential information for Pearson Set Assignment Brief (PSAB)

Pearson sets the assignment for the assessment of this unit.

The PSAB will take approximately 11 hours to complete.

The PSAB will be marked by centres and verified by Pearson.

The PSAB will be valid for the lifetime of this qualification.

Assessing the PSAB

You will make assessment decisions for the PSAB using the assessment criteria provided.

Section 1 gives information on PSABs and there is further information on our website.

Further information for teachers and assessors

Resource requirements

No specialist resources are required for this unit.

Essential information for assessment decisions

Learning aim A

For distinction standard, students will draw on accurately referenced secondary source material to explain the relevance and/or significance of the normal and disrupted state of biological molecules for the physiological disease or disorder they have chosen. The impact of the disruption on the person suffering from the disease or disorder will be evaluated, with a conclusion given and justified.

For merit standard, students will give a detailed explanation of how the disruption of biological molecules is involved in a physiological disease or disorder. This will include how the disruption causes the disease or disorder and how the disorder causes disruption to molecules and metabolism (where this is known).

Students will need to give clear details of the changes to the structure of molecules and their implications.

For pass standard, students will give examples to explain the roles of proteins, nucleic acids and lipids in terms of their structure and functions in maintaining normal body functions. The explanations must relate to the importance of these biological molecules in maintaining physiological health.

Learning aim B

For distinction standard, students will give examples to help them evaluate the treatment of at least two different types of physiological diseases or disorders. Students should explore how the treatments ease the symptoms and how they address the underlying cause/s of the condition. They should also explore the side effects which may accompany these treatments, how these impact the person suffering from the disease or disorder and how these side effects might be mitigated.

For merit standard, students will discuss the effects of at least two physiological diseases or disorder. This will include the development of the disease/disorder and how it affects the individual. It will also include the physiological basis of treatments, and the positive and negative effects they have.

For pass standard, students will give clear descriptions of the effects and treatments of two physiological diseases and disorders on the individual. Students will include details of the treatments in terms of how they reduce symptoms as well as treating the underlying cause of these diseases and disorders.

Learning aim C

For distinction standard, students will evaluate the ethical, moral, and legal issues relating to drug/medicine development and testing and the treatment/s used for one physiological disease or disorder. An understanding of the differences between ethics and morals will be demonstrated, and the dilemmas scientists and medical professionals face will be considered in relation to these treatments.

For merit standard, students will discuss the difficulties that could be encountered during the development and testing of a drug, medicine or treatment for a specific physiological disease or disorder. The development and use of innovative treatments will be included, as will the importance of ethical and moral issues encountered when developing new drugs.

For pass standard, students will describe the development and testing regime for a synthetic drug or medicine which is used for a named disorder or disease. Students must give an objective account of the stages of drug and medicine testing. They will need to include information on the requirements for drugs and medicines to be rigorously tested prior to being approved for use.

Students must use technical language and demonstrate breadth of coverage of the unit.

Unit 5: Biomedical Science

Level: 3

Unit type: Internal

Guided learning hours: 60

Unit in brief

This unit will help students understand the role biomedical scientists play in identifying the causes of disease and in helping medical personnel to offer suitable treatments.

Unit introduction

This unit will help you understand three key areas of biomedical science: haematology, health screening, histology/cytology, and urinalysis. The analytical and diagnostic testing carried out in these three areas supports other health professionals in screening, diagnosing, monitoring disease progression and treatment. In this unit you will concentrate on biomedical science in relation to the human body, but many of the same techniques are used in veterinary science. Similar techniques are also valuable in the pharmaceutical industry, the blood and tissue transfusion and transplant service, forensic science, and food technology.

You will have opportunities to investigate urinalysis and how it can be used to diagnose and treat disease. Urinalysis provides important information to medical practitioners about the functions of the human body. You will consider the importance of maintaining 'norms' within the body and how deviations from these levels provide clues as to what is happening in the body to enable conditions to be diagnosed and treated.

Learning aims

In this unit you will:

- A** Understand the principles of haematology and its use in medical diagnosis
- B** Examine the use of health screening, histology and cytology in medicine
- C** Examine the use of urinalysis as an analytical and diagnostic tool.

Summary of unit

Learning aim	Key content areas	Assessment approach
A Understand the principles of haematology and its use in medical diagnosis	A1 The components of blood A2 Changes to blood components and composition A3 Diagnostic techniques used in haematology	Undertake secondary research to support the production of materials discussing the normal structure and function of each of the named blood component.
B Examine the use of, histology, cytology and disease screening	B1 Tissue and cellular investigations B2 Screening tests B3 Implications of the results of tissue and cellular investigations and screening	Undertake secondary research to support the production of materials to help explain the procedures and techniques used in health screening, histology, and cytology.
C Examine the use of urinalysis as an analytical and diagnostic tool	C1 Urine composition C2 Urinalysis	Undertake secondary research to support the production of materials discussing the use of urinalysis as an analytical and diagnostic tool, and carry out simple urinalysis.

Content

The essential content is set out under content areas. Students must cover all specified content before the assessment.

Learning aim A: Understand the principles of haematology and its use in medical diagnosis [EL-SRS]

A1 The components of blood

- Structure and function of the following blood components:
 - erythrocytes
 - leucocytes
 - thrombocytes (platelets)
 - plasma and serum.

A2 Changes to blood components and composition

The effects of diseases and disorders on the overall composition of blood, including the effects on the structure and function of key blood components:

- blood tests – normal values
- erythrocytic diseases associated with types of anaemia, thalassaemia, sickle cell anaemia, iron deficiency anaemia
- blood parasites (malaria)
- leukocytic (white blood cell) diseases associated with HIV, infectious mononucleosis, leukaemia, Hodgkin, and non-Hodgkin lymphoma
- antibody tests associated with syphilis, hepatitis B
- testing for myelodysplastic syndrome
- coagulation factors in bleeding/clotting disorders.

A3 Diagnostic techniques used in haematology

The procedures used in haematological diagnostic techniques:

- shape and appearance of blood cells
- counts of red blood cells and platelets
- white blood cell differential count
- haemoglobin tests/analysis for iron deficiency
- blood clotting – coagulation factors and prothrombin time
- antibody testing
- bone marrow aspiration.

Learning aim B: Examine the use of, histology, cytology and disease screening

B1 Tissue and cellular investigations

Types and methods of sample removal, preservation, and examination, including consideration of the appearance of normal and abnormal results:

- importance of informed consent
- aspiration of cerebrospinal fluid
- surgical removal of tissues for disease identification including cervical, breast, prostate tissue
- specimens taken in autopsies to establish cause of death.
- use of automated histology techniques.

B2 Screening tests

Types and methods of screening including consideration of normal and abnormal results:

- screening for cancers of the bowel and cervix
- screening for aortic aneurysm
- newborn blood spot tests.

B3 Implications of the results of tissue and cellular investigations and screening

Implications for individuals, their families, and health services:

- importance of correct and timely diagnosis and treatment
- prognosis and quality of life for individuals and their families
- implications of false positive and false negative results
- financial implications of screening costs for early diagnosis as opposed to cost of treatment when disease is diagnosed later.

Learning aim C: Examine the use of urinalysis as an analytical and diagnostic tool

C1 Urine composition

Main constituents of urine in health.

- Normal chemical composition including organic and inorganic solutes:
 - colour/clarity
 - odour
 - normal values
 - pH
 - specific gravity
 - water

- Abnormal urinary constituents:
 - glucose
 - proteins
 - ketone bodies
 - erythrocytes
 - leukocytes
 - bilirubin.
- The changes to normal values of the constituents of urine in the presence of diseases:
 - diabetes mellitus
 - renal failure
 - urinary tract infection (UTI)
 - liver disease/damage
 - prostate disease
 - urinary tract cancers.

C2 Urinalysis

- Urine sampling to prevent misleading results in urinalysis:
 - why cleanliness of genitalia and sterility of collection vessels before sample collection is important
 - the purpose of mid-stream sample collection
 - why specific times of day for sample collection are sometimes recommended
 - length of time between sample collection and testing, and preservation methods of samples that will not be tested immediately.
- Key indicators used in urinalysis:
 - visual – colour and clarity
 - chemical tests using test strips
 - pH, blood, protein, glucose, bilirubin, urobilinogen, ketones, nitrites, human chorionic gonadotropin (HCG)
 - specific gravity for determining concentration
 - under the microscope: crystalline structures, trichomonads, blood cells, micro-organisms, epithelial cells, casts.
- For each of the key indicators present in urine, the following must be considered:
 - normal ranges (as appropriate)
 - interpretation of results, factors that detrimentally impact accuracy of results e.g., contamination, drug/medicine use, diet
 - the mechanisms each analysis uses and when each kind of test (visual, chemical or microscope) is considered appropriate.

Assessment criteria

Learning aim A: Understand the principles of haematology and its use in medical diagnosis

Pass	Merit	Distinction
<p>A.P1 Describe the structure and function of the main components of blood.</p> <p>A.P2 Describe how diseases affect the composition of blood and how the changes are identified by blood testing.</p>	<p>A.M1 Explain the procedures used in diagnostic tests for different diseases.</p>	<p>A.D1 Evaluate the use of diagnostic testing of blood in relation to the detection of diseases.</p>

Learning aim B: Examine the use of, histology, cytology and disease screening

Pass	Merit	Distinction
<p>B.P3 Describe the use of analytical investigation in disease screening.</p> <p>B.P4 Describe the use of analytical investigations of cell and tissue samples.</p>	<p>B.M2 Explain the importance of accurate and timely diagnoses on treatment outcomes.</p>	<p>B.D2 Evaluate the implications of screening and early disease diagnosis for the individual and for the health service.</p>

Learning aim C: Examine the use of urinalysis as an analytical and diagnostic tool

Pass	Merit	Distinction
<p>C.P5 Describe how urine composition may vary in relation to health.</p> <p>C.P6 Correctly carry out simple urinalysis.</p>	<p>C.M3 Explain the causes of the results of urinalysis used in diagnoses of health status changes.</p>	<p>C.D3 Evaluate the use of urinalysis in domestic and clinical settings.</p>

Transferable skills

Managing Yourself	Interpersonal Skills	Effective Learning	Solving Problems
MY – TPR	EL – MOL	IS – WC	SP – CT
MY – PS&R	EL – CL	IS – V&NC	SP – PS
MY – COP	EL – SRS *	IS – T	SP – C&I
MY – PGS	EL – PRS	IS – C&SI	

Table key

*	Signposted to indicate opportunities for development as part of wider teaching and learning.
√	Embedded in teaching, learning and assessment
Blank	TS not embedded or signposted in unit

Essential information for Pearson Set Assignment Brief (PSAB)

Pearson sets the assignment for the assessment of this unit.

The PSAB will take approximately 18 hours to complete.

The PSAB will be marked by centres and verified by Pearson.

The PSAB will be valid for the lifetime of this qualification.

Assessing the PSAB

You will make assessment decisions for the PSAB using the assessment criteria provided.

Section 1 gives information on PSABs and there is further information on our website.

Further information for teachers and assessors

Resource requirements

For this unit, students must have access to laboratory access, samples of simulated urine and urine testing strips.

Essential information for assessment decisions

Learning aim A

For distinction standard, students must make judgements about the appropriate selection, implementation, and interpretation of diagnostic tests by medical workers and clearly link the disease and blood composition. They will give a detailed consideration of the implications of misdiagnosis of disease, with the accurate use of appropriate scientific terminology throughout.

For merit standard, students must explain how diagnostic tests are used when investigating two different diseases. They will refer to required equipment and techniques used in each diagnostic test. They must include detail of changes to the composition of blood with reference to normal ranges in humans.

For pass standard, students must link the structure and function of each of the main components of blood. For diseases associated with dysfunction or abnormality of blood components they must state the specific effects on blood composition, and how the changes/effects are identified through haematological examination.

Learning aim B

For distinction standard, students must evaluate the importance of early diagnosis leading to treatment and the implications of this, including a consideration of the associated emotional and financial costs to the individual and their families, and the financial cost to health services. Students must demonstrate an understanding of the importance of accurately sampling and reporting diagnostic results including the potential implications of false positive and false negative results.

For merit standard, students must provide an explanation of the importance of correct and timely diagnosis in the treatment of, and prognosis for, the individual. This will include an awareness of how tissue analysis can be enhanced using automated sampling.

For pass standard, students must describe different screening techniques and their role in early detection of disease. They must describe how cells and tissue samples are removed for examination and the appearance of normal and abnormal results. They must describe the implications of inaccurate test results.

Learning aim C

For distinction standard, students must evaluate the clinical techniques used in relation to urine sample collection, preservation, and analysis in domestic and clinical settings. They must consider the implications of inaccuracies in results and in their interpretation and how errors can be reduced.

For merit standard, students must explain how the results of urinalysis indicate the presence of disease. They must explain how the changes caused by disease lead to the results seen in specific diseases. They will explain how contamination when collecting or preserving urine samples can cause inaccurate results.

For pass standard, students will provide the normal values for the composition of urine in health and describe how these are affected by specific disease processes. Students must specify how samples of urine should be obtained to prevent misleading results.

Students will carry out simple urinalysis, accurately identifying any abnormality in samples of urine and suggesting what these abnormalities indicate in relation to health. Students will carry out a risk assessment before carrying out their urinalysis.

Unit 6: Human Reproduction and Fertility

Level: 3

Unit type: Internal

Guided learning hours: 60

Unit in brief

Students will gain an understanding of human reproduction and its control by hormones, and they will examine causes of infertility and possible treatments.

Unit introduction

The human body is a complex organisation of systems. Each system needs to be controlled in a well-defined range of parameters in order to contribute to the functions of the human body. In this unit, the focus is on human reproduction, its control mechanisms and associated fertility problems.

There have been many advances in the treatment of human infertility in recent years and, in this unit, you will have the opportunity to explore them and the hormonal control of the reproductive system. This unit will help with your understanding of the key homeostatic principles in relation to human fertility, which are essential if the reproductive system is to function correctly.

You will be investigating the hormonal control of human reproduction and the medical and social effects if the system malfunctions in humans. This unit will help you to progress to higher education in subjects allied to medicine.

Learning aims

In this unit you will:

- A** Understand the anatomy and physiology of the human reproductive system
- B** Understand the role of hormones in the regulation and control of the reproductive system
- C** Examine the causes, treatments and impact of infertility on people's health

Summary of unit

Learning aim	Key content areas	Assessment approach
A Understand the anatomy and physiology of the human reproductive system	A1 Structure and functions of the female and male reproductive organs A2 Female reproductive cycle A3 Puberty in males and females	Undertake research to support the production materials discussing the organisation and function of the human reproductive system.
B Understand the role of hormones in the regulation and control of the reproductive system	B1 Reproductive processes B2 Foetal development and birth B3 Contraceptive methods and their health implications	Undertake research to support the production of materials discussing the role of reproductive hormones.
C Examine the causes, treatments and impact of infertility on the people's health	C1 Causes of infertility C2 Potential treatments for infertility C3 The impact of infertility on the health and wellbeing of humans	Undertake research to support the production of materials evaluating the causes, treatments and impact of infertility on people's health.

Content

Learning aim A: Understand the anatomy and physiology of the human reproductive system [EL-SRS]

A1 Structure and functions of the female and male reproductive organs

- Female reproductive system: ovary, oviduct (fallopian tube), uterus, uterine horn, fimbriae, endometrium, cervix, vagina, labia.
- Male reproductive system: epididymis, seminal vesicle, Cowper's gland, prostate gland, testes, penis, scrotum, vas deferens, erectile tissue.

A2 Female reproductive cycle

- Menstrual cycle including histological changes in the uterus.
- Menopause, causes and effects on the female body.
- Processes leading to conception, to include: wafting of ova through fallopian tubes, semen delivery, fertilisation (including role of acrosome in penetration of the zona pellucida), implantation.
- Hormonal effects of fertilisation on the female reproductive cycle.

A3 Puberty in males and females

- Hormonal control and regulation of puberty.
- Development of secondary sexual characteristics.
- Comparison of changes in males and females during puberty.
- Effect of puberty on male and female behaviour.

Learning aim B: Understand the role of hormones in the regulation and control of the reproductive system

Students will understand the stages of the reproductive process with timescales for each referenced. They will also understand the role of hormones in these processes.

B1 Reproductive processes

Gamete development and release:

- oogenesis from oogonia; formation of primary, secondary and Graafian follicles; ovulation; formation and role of corpus luteum
- normal/abnormal morphology of oocytes; ovulation disorders
- spermatogenesis from spermatogonia, formation of primary and secondary spermatocytes and spermatids; spermination, role of Sertoli and Leydig cells
- normal/abnormal morphology and abundance of sperm.

B2 Foetal development and birth

- Stages of development, including embryonic and foetal, including gestation times.
- Role of the placenta and umbilical cord.
- Parturition in terms of dilation, expulsion and placental.

B3 Contraceptive methods and their health implications

- Oral, injection and implanted use of hormones to reduce likelihood of pregnancy, physical barriers, emergency contraception, male and female sterilisation.
- Health workers' involvement in birth control, including giving advice, awareness of contraindications, awareness of social, welfare, and other factors affecting a choice of contraception.

Learning aim C: Examine the causes, treatments and impact of infertility on people's health

C1 Causes of infertility

- Definition of infertility in couples.
- Erectile dysfunction.
- Low sperm production or low sperm motility.
- Physical problems, including blockage of sperm transport, damage caused by sexually transmitted infections (STIs).
- Hormone malfunctions.
- Antisperm antibodies.
- Effects of menopause.
- Hypo/hyperthyroidism.
- Problems with ovulation.
- Damage to fallopian tubes/cervix/uterus.

C2 Potential treatments for infertility

- Diagnosis of infertility, including semen/urine/blood tests, physical examination, cervical and tissue samples, use of laparoscopy/x-ray hysterosalpingogram (HSG), ultrasound.
- Sperm donation.
- Artificial insemination (AI).
- *In-vitro* fertilisation (IVF).
- Hormone replacement therapy.
- Induction of ovulation.
- Antibiotics if an infection is diagnosed, such as a sexually transmitted infection (STI).

- Ethical considerations on the use of reproductive technologies, including upper age limits, ownership of gametes and embryos (e.g., after the biological source of these has died), commercialisation, and public funding.

C3 The impact of infertility on health and wellbeing

- Trends in infertility rates in the UK over time.
- Psychological effect of infertility, including depression, non-fulfilment of the desire for a baby, anxiety, stress, pressure on relationships.
- Pressures of society to reproduce.

Assessment criteria

Learning aim A: Understand the anatomy and physiology of the human reproductive system

Pass	Merit	Distinction
<p>A.P1 Describe the anatomy and physiology of the human reproductive systems.</p> <p>A.P2 Describe the female reproductive cycle</p>	<p>A.M1 Analyse the functions of the structures of the male and female human reproductive systems.</p>	<p>A.D1 Discuss the role of the reproductive organs including the changes occurring at puberty.</p>

Learning aim B: Understand the role of hormones in the regulation and control of the reproductive system

Pass	Merit	Distinction
<p>B.P3 Describe the stages in gamete production, foetal development and parturition.</p> <p>B.P4 Describe the hormonal control of gamete production and the female reproductive cycle</p> <p>B.P5 Describe contraceptive methods and their health implications.</p>	<p>B.M2 Explain the role of hormones and the effects of different contraceptive methods in gametogenesis and conception.</p> <p>B.M3 Explain the role of hormones in pregnancy, foetal development, and parturition.</p>	<p>B.D2 Discuss the roles of reproductive hormones and the effects of different contraceptive methods</p>

Learning aim C: Examine the causes, treatments and impact of infertility on people's health

Pass	Merit	Distinction
<p>C.P6 Describe causes of infertility and the available treatments for them.</p> <p>C.P7 Describe how infertility can affect the health and wellbeing of people.</p>	<p>C.M4 Explain how infertility treatments can be tailored to specific fertility problems.</p>	<p>C.D3 Evaluate the causes of infertility and the use of associated fertility treatments</p>

Transferable skills

Managing Yourself	Interpersonal Skills	Effective Learning	Solving Problems
MY – TPR	EL – MOL	IS – WC	SP – CT
MY – PS&R	EL – CL	IS – V&NC	SP – PS
MY – COP	EL – SRS*	IS – T	SP – C&I
MY – PGS	EL – PRS	IS – C&SI	

Table key

*	Signposted to indicate opportunities for development as part of wider teaching and learning.
√	Embedded in teaching, learning and assessment.
blank	TS not embedded or signposted in unit

Essential information for Pearson Set Assignment Brief (PSAB)

Pearson sets the assignment for the assessment of this unit.

The PSAB will take approximately 11 hours to complete.

The PSAB will be marked by centres and verified by Pearson.

The PSAB will be valid for the lifetime of this qualification.

Assessing the PSAB

You will make assessment decisions for the PSAB using the assessment criteria provided.

Section 1 gives information on PSABs and there is further information on our website.

Further information for teachers and assessors

Resource requirements

No specialist resources are required for this unit.

Essential information for assessment decisions

Learning aim A

For distinction standard, students must show in their discussion that they understand the processes involved in male and female puberty. They should include internal changes to the reproductive organs as well as the external alterations to a person's physical appearance and changes to their behaviours. Students will have researched data to show differences, such as when puberty starts in males and females, along with factors such as health and environment. Students can use charts and graphs to help in their discussion. They will use the correct terminology and their discussion will be accurate in terms of the evidence they present. Their summary must reflect the evidence that they have presented.

For merit standard, students will analyse the specialisation shown by reproductive organs in relation to their function. Correct and accurate terminology will be used throughout. Students may use annotated diagrams to show the organs, along with diagrams of the cells/tissues and then analyse their roles, for example the ovary and its cell structure could be shown along with which cells are receptive to which hormones. Students will make clear the interrelationships between different parts of the reproductive systems.

For pass standard, students will produce accurate annotated diagrams and written descriptions of the structures and relevant functions of the male and female reproductive systems. The description of the female reproductive cycle must include details of menstruation, fertilisation and conception using correct and relevant biological terms.

Learning aim B

For distinction standard, students must show in their discussion that they understand the various contraceptive measures available and their success rates in preventing fertilisation. They will understand that contraceptive methods may have other effects besides preventing fertilisation of an ovum by a sperm, for example chemical methods such as different types of contraceptive pill having longer-term effects on fertility in some people. Lines of reasoning will be well developed, and skilful, and correct terminology will be used. Students will show their understanding of the ways in which some contraceptive methods interact with the natural reproductive hormones to reduce the chances of pregnancy.

For merit standard, students must show in their explanation that they understand the roles of hormones in terms of targeting specialised tissues, including in gametogenesis, pregnancy, foetal development, and parturition. The explanation needs to include the effects of hormones on their target tissues and how they affect the production of other hormones, including details of feedback mechanisms.

As part of this process, students must explain how the different methods of contraception can reduce the likelihood of fertilisation. Consideration must be given to both male and female systems. Again, correct terminology must be used throughout.

For pass standard, students will describe the reproductive process including how they are controlled by hormones. Students can use annotated diagrams or other suitable methods such as charts to show relevant detail.

A description of contraceptive methods should be given. Scientifically correct terminology must be used. Students must show knowledge of the health implications of the contraceptives they describe.

Learning aim C

For distinction standard, students must evaluate the causes of infertility in couples, the treatments available, and the ethical considerations of these. They must consider the impact of infertility and its treatment on people's wellbeing.

They will relate the treatments available to the causes of infertility, and then provide evidence of the effectiveness of the treatments. Students are expected to include data in their evaluation in order to support their conclusions.

For merit standard, students will explain the basis of different fertility problems and how treatments are tailored to address them. Students must explain how infertility in couples can be caused by a range of problems in both men and women. The investigations used to determine the causes must be outlined and the available approaches to treatment must be explained.

For pass standard, students could give a list of infertility causes and their associated treatments. Students are expected to show how infertility affects the people concerned in terms of the impact on mental health and pressure on relationships. Coherent descriptions must be provided using the correct terminology. The description of infertility and its impact needs to show the sources of information which students have used.

5 Planning your programme

Supporting you in planning and implementing your programme

There will be lots of free teaching and learning support to help you deliver the new qualifications, including:

- Our Delivery Guide will help you to plan how to deliver the content and assessments that make up the Pearson Level 3 Alternative Academic Qualification BTEC National in Medical Science (Extended Certificate) qualification. It also highlights opportunities to develop the transferable skills identified within the units in this specification.
- Sample Assessment materials are available for each external unit to help you to plan and prepare for assessments.
- Our mapping document highlights key differences between the new qualification and the Pearson BTEC Level 3 National Extended Certificate in Applied Human Biology (603/3040/5), which this qualification replaces.

Is there a student entry requirement?

As a centre it is your responsibility to ensure that students who are recruited have a reasonable expectation of success on the programme. There are no formal entry requirements but we expect students to have qualifications at or equivalent to Level 2.

Students are most likely to succeed if they have:

- five GCSEs at good grades, and/or
- BTEC qualification(s) at Level 2
- achievement in English and mathematics through GCSE or Functional Skills.

Students may demonstrate ability to succeed in various ways. For example, students may have relevant work experience or specific aptitude shown through diagnostic tests or non-educational experience.

6 Understanding the qualification grade

Awarding and reporting for the qualification

This section explains the rules that we apply in awarding a qualification and in providing an overall qualification grade for each student. It shows how all the qualifications in this sector are graded.

The awarding and certification of these qualifications will comply with regulatory requirements.

Eligibility for an award

In order to be awarded a qualification, a student must:

- achieve Near Pass (N) or above in all external units
- complete and **have an outcome** (D, M, P, N or U) for all units within a valid combination
- achieve the **minimum number of points** at a grade threshold.

Students who do not achieve the required minimum grade (N) for the external assessments will not achieve a qualification.

Award of the qualification grade

The final grade awarded for a qualification represents an aggregation of a student's performance across the qualification. As the qualification grade is an aggregate of the total performance, there is some element of compensation in that a higher performance in some units may be balanced by a lower outcome in others.

BTEC Nationals are Level 3 qualifications and are awarded at the grade ranges shown in the table below.

Qualification	Available grade range
Extended Certificate	P to D*

The *Award of qualification grade* table, shown further on in this section, shows the minimum thresholds for calculating these grades. The table will be kept under review over the lifetime of the qualification. The most up-to-date table will be issued on our website.

Pearson will monitor the qualification standard and reserves the right to make appropriate adjustments.

Students who do not meet the minimum requirements for a qualification grade to be awarded will be recorded as Unclassified (U) and will not be certificated. They may receive a Notification of Performance for individual units. The *Information Manual* gives full information.

Points available for internal units

The table below shows the number of **points** available for internal units. For each internal unit, points are allocated depending on the grade awarded.

Grade	Unit size (60 GLH)
U	0
Pass	6
Merit	10
Distinction	16

Grade	Unit size (90 GLH)
U	0
Pass	9
Merit	15
Distinction	24

Points available for external units

Raw marks from the external units will be awarded **points** based on performance in the assessment. The table below shows the **minimum number of points** available for each grade in the external units.

Grade	Unit size (90 GLH)
U	0
Near Pass	6
Pass	9
Merit	15
Distinction	24

Grade	Unit size (120 GLH)
U	0
Near Pass	8
Pass	12
Merit	20
Distinction	32

Pearson will automatically calculate the points for each external unit once the external assessment has been marked and grade boundaries have been set. For more details about how we set grade boundaries in the external assessment please go to our website.

Claiming the qualification grade

Subject to eligibility, Pearson will automatically calculate the qualification grade for your students when the internal unit grades are submitted and the qualification claim is made. Students will be awarded qualification grades for achieving the sufficient number of points (with valid combinations) within the ranges shown in the relevant *Award of qualification grade* table for the cohort.

Award of qualification grade

Applicable for registration from 1 August 2025.

Extended Certificate (360 GLH)

Grade	Points threshold
U	0
Pass	36
Merit	52
Distinction	74
Distinction *	90

The table is subject to review over the lifetime of the qualification. The most up-to-date version will be issued on our website.

Example of a grading table for Pearson Level 3 Alternative Academic Qualification BTEC National in Medical Science (Extended Certificate)

Unit number	GLH	Type (Int/Ext)	Grade	Unit points
1	90	Ext	Near Pass	6
2	120	Ext	Merit	20
3	90	Int	Pass	9
4	60	Int	Distinction	16
TOTAL	360		Pass	51

Appendix 1 Glossary of terms used for internally assessed units

Term	Definition
Adequate	Student work is satisfactory or acceptable in quality and quantity.
Analyse	Students break the issue/situation down into the key elements and show their understanding of the issues/situation applied to the scenario/context. Responses would be significantly beyond generic.
Apply/use/employ	Students implement a method, technique, process or approach in an activity.
Assess	Students give careful consideration to all the factors or events that apply, identify which are the most important or relevant and make a judgement on the importance of the factors.
Carry out	Students demonstrate skills through practical activities, in line with certain requirements.
Clear/ly	The qualities required are well demonstrated, unambiguous and beyond a basic level.
Coherent	Student intentions are clear, logically structured and can be interpreted by others.
Compare	Students show knowledge and understanding by identifying the main factors relating to two or more items/situations or aspects of a subject that is extended with the required explanations, e.g. similarities/ differences, advantages/disadvantages, impacts.
Comprehensive	Used to describe either scope or depth, e.g. <ul style="list-style-type: none"> Student work is well developed and thorough covering all aspects/information in terms of both depth and breadth Or: <ul style="list-style-type: none"> Students demonstrate in-depth and accurate understanding of the aspects being assessed.
Confident	Student work demonstrates well-developed and secure application of skills or processes that are significantly beyond a basic level.
Consistent	Students demonstrate reliable and constant practice that maintains a set standard.
Create/produce	Students generate an idea/outcome to specific criteria.
Demonstrate	Students carry out and apply knowledge, understanding and/or skills in a practical situation.
Describe	Students provide an account of something, or highlight a number of key features of a given topic or process that shows a level of understanding.
Detailed	Students cover most if not all of the expected requirements and demonstrate a high level of understanding.

Term	Definition
Develop	Students apply a process of improving/progressing skills, concepts or work in order to produce outcomes.
Discuss	An issue, situation, process will be presented and the student will need to break the issue/situation/process down into the key elements, show their understanding of the issues/situation/process applied to the scenario/context (so generic answers are not acceptable), and show interrelationship in their answers.
Effective	Students demonstrate skills or provide outcomes that are well developed with a range of proficient qualities and that achieve objectives
Evaluate	Students consider various aspects of a subject's qualities in relation to its context such as: strengths or weaknesses, advantages or disadvantages, pros or cons. They will come to a judgement supported by evidence which will often be in the form of a conclusion.
Examine	Students demonstrate an ability to thoroughly inspect something in order to determine its qualities beyond a basic exploration.
Explain	Students can give an insight into the topic showing some level of understanding by providing reasons or examples.
Explore	Students undertake practical research or investigation to develop their skills or understanding of the topic/activity.
Implement	Students take actions or measures to put something into effect.
Investigate	Students perform a systematic inquiry into a topic using research skills, usually to demonstrate their understanding of a topic.
Justify	Students give relevant and logical reasons or evidence to support their actions or opinions.
Partial/some	To an extent, but not completely. Students do not include all of the requirements.
Perform	Students demonstrate a range of skills required to complete a given activity.
Prepare	Students organise a task/equipment/individuals/activities in advance of carrying it out.
Realistic/feasible	Students demonstrate insight into the logistics and manageability of proposals/plans/objectives/ideas and show consideration of the potential to achieve the outcomes.
Refine/optimize	Students make considered improvements to outcomes.
Review	Students consider evidence in order to make judgements about the qualities.
Understand	Students demonstrate insight or ability to interpret a subject.
Undertake	Students demonstrate skills through practical activities, often referring to given processes or techniques.

Appendix 2 Transferable Skills framework

Code = transferable skill initials-skill cluster initials

Managing yourself

Code	Skill cluster	Performance Descriptor
MY-TPR	Taking personal responsibility	<ul style="list-style-type: none">• Demonstrates understanding of their role and responsibilities and the expected standards of behaviour.• Demonstrates compliance with codes of conduct and ways of working.• Makes use of available resources to complete tasks.• Manages their time to meet deadlines and the required standards.• Demonstrates accountability for their decisions or actions.
MY-PS&R	Personal strengths and resilience	<ul style="list-style-type: none">• Identifies own personal strengths and demonstrates the ability to use these in relevant areas.• Demonstrates the ability to adapt own mindset and actions to changing situations or factors.• Uses challenges as learning opportunities.

Code	Skill cluster	Performance Descriptor
MY-COP	Career orientation planning	<ul style="list-style-type: none"> • Undertakes research to understand the types of roles in the sector in which they could work. • Reviews own career plans against personal strengths and identifies areas for development to support progression into selected careers. • Takes part in sector-related experiences to support career planning.
MY-PGS	Personal goal setting	<ul style="list-style-type: none"> • Sets SMART goals using relevant evidence and information. • Reviews progress against goals and identifies realistic areas for improvement. • Seeks feedback from others to improve own performance.

Effective learning

Code	Skill cluster	Performance Descriptor
EL-MOL	Managing own learning	<ul style="list-style-type: none"> • Maintains a focus on own learning objectives when completing a task. • Demonstrates the ability to work independently to complete tasks. • Reviews and applies learning from successful and unsuccessful outcomes to be effective in subsequent tasks.
EL-CL	Continuous learning	<ul style="list-style-type: none"> • Engages with others to obtain feedback about own learning progress. • Responds positively to feedback on learning progress from others. • Monitors own learning and performance over the short and medium term.
EL-SRS	Secondary research skills	<ul style="list-style-type: none"> • Define the research topic or question. • Uses valid and reliable sources to collate secondary data. • Interprets secondary data and draws valid conclusions. • Produces a reference list and cites sources appropriately.
EL-PRS	Primary research skills	<ul style="list-style-type: none"> • Define the research topic or question. • Carries out primary data collection using appropriate and ethical research methodology. • Interprets primary data to draw valid conclusions.

Interpersonal skills

Code	Skill cluster	Performance Descriptor
IS-WC	Written communication	<ul style="list-style-type: none"> • Produces clear formal written communication using appropriate language and tone to suit purpose.
IS-V&NC	Verbal and non-verbal communications	<ul style="list-style-type: none"> • Uses verbal communication skills effectively to suit audience and purpose. • Uses body language and non-verbal cues effectively. • Uses active listening skills and checks understanding when interacting with others.
IS-T	Teamwork	<ul style="list-style-type: none"> • Engages positively with team members to understand shared goals and own roles and responsibilities. • Respectfully considers the views of team members and shows courtesy and fairness. • Completes activities in line with agreed role and responsibilities. • Provide support to team members to achieve shared goals.
IS-C&SI	Cultural and social intelligence	<ul style="list-style-type: none"> • Demonstrates awareness of own cultural and social biases • Demonstrates diversity, tolerance and inclusivity values in their approach to working with others.

Solving problems

Code	Skill cluster	Performance Descriptor
SP-CT	Critical thinking	<ul style="list-style-type: none"> • Demonstrates understanding of the problem or issue to be addressed. • Make use of relevant information to build ideas and arguments. • Assesses the importance, relevance and/or credibility of information. • Analyses, interprets and evaluates information to present reasoned conclusions.
SP-PS	Problem solving	<ul style="list-style-type: none"> • Presents a clear definition of the problem. • Gathers relevant information to formulate proposed solutions. • Selects relevant and significant information to formulate proposed solutions. • Identifies negative and positive implications of proposed solutions. • Presents and justifies selected solutions to problems.
SP-C&I	Creativity and innovation	<ul style="list-style-type: none"> • Identifies new and relevant ideas to help solve a problem. • Refines ideas into workable solutions based on test results and/or feedback.

Appendix 3 Digital Skills framework

Problem solving

Using digital tools to analyse and solve problems:

Performance descriptor	Unit mapping
Use digital tools and techniques for research, collaboration and resolution of problems.	<p><i>Unit 2: Health Issues and Scientific Reporting,</i> Content area E (when learning about data analysis)</p> <p><i>Unit 3: Practical Microbiology and Infectious Diseases</i> Learning aim A (when researching microorganisms, transmission and treatment of infectious diseases)</p> <p><i>Unit 4: Diseases, Disorders, Treatments and Therapies</i> Learning aim A Learning aim B Learning aim C (when researching biological modules, interventions to treat or manage biological modules, and the development of new drugs)</p> <p><i>Unit 5: Biomedical Science</i> Learning aim A Learning aim B Learning aim C (when researching structure and function of blood, procedures and techniques used in health screening, cytology, urinalysis).</p> <p><i>Unit 6: Human Reproduction and Fertility</i> Learning aim A Learning aim B Learning aim C (when researching the human reproductive system, use of hormones, causes of fertility and fertility treatments).</p>
Have up-to-date knowledge of ways that technology is used within a sector.	N/A

Performance descriptor	Unit mapping
Present ideas and finding using digital tools.	<p><i>Unit 3: Practical Microbiology and Infectious Diseases</i> Learning aim A (presenting information on microorganisms, transmission and treatment of infectious diseases)</p> <p><i>Unit 4: Diseases, Disorders, Treatments and Therapies</i> Learning aim A Learning aim B Learning aim C (when presenting information on biological modules, interventions to treat or manage biological modules, and the development of new drugs)</p> <p><i>Unit 5: Biomedical Science</i> Learning aim A Learning aim B Learning aim C (when presenting information on structure and function of blood, procedures and techniques used in health screening, cytology, urinalysis).</p> <p><i>Unit 6: Human Reproduction and Fertility</i> Learning aim A Learning aim B Learning aim C (when presenting information on the human reproductive system, use of hormones, causes of fertility and fertility treatments).</p>
Use digital tools to manipulate data.	<p><i>Unit 2: Health Issues and Scientific Reporting,</i> Content area E (when learning about data analysis)</p>

Digital collaboration and communication

Using digital tools to communicate and share information with stakeholders:

Performance descriptor	Unit mapping
Understand and use digital collaboration and communication platforms.	N/A
Use collaboration tools to meet with, share and collaborate with customers and colleagues.	N/A

Transacting digitally

Using digital tools to set up accounts and pay for goods/services:

Performance descriptor	Unit mapping
Use online systems to access and update digital records.	N/A
Set-up accounts to complete transactions.	N/A

Digital security

Identify threats and keep digital tools safe:

Performance descriptor	Unit mapping
Understand the types of malware.	N/A
Understand the threats involved in carrying out online activities.	N/A
Protect personal and organisation information and data.	N/A
Keeping systems secure.	N/A

Handling data safely and securely

Follow correct procedures when handling personal and organisational data:

Performance descriptor	Unit mapping
Manage passwords and keep them secure.	N/A
Identify website and services that are secure and insecure.	N/A
Understand the digital policy for a sector.	N/A
Understand the impact of online data.	N/A
Understand copyright and intellectual property.	N/A

Appendix 4 Sustainability framework

Sustainable development goal	Unit mapping
SDG 1: No poverty	N/A
SDG 2: Zero hunger	N/A
SDG 3: Good health and wellbeing	<p><i>Unit 1: Principles of Human Physiology, Anatomy and Pathology</i> Content area B2.2: Disorders of the endocrine system Content area C3: Disorders of the Musculo-skeletal System Content area D2.8: Disorders associated with the respiratory system Content area E2.9: Disorders of the digestive system</p> <p><i>Unit 2: Health Issues and Scientific Reporting</i> Content area A: Diagnostic techniques Content area B: Immune response and dysfunction Content area C: Genetics and health Content area D: Cancer Content area E: Interpretation, analysis and evaluation of scientific information</p> <p><i>Unit 3: Practical Microbiology and Infectious Diseases</i> Content area B: Transmission and treatment of diseases</p> <p><i>Unit 4: Diseases, Disorders, Treatments and Therapies</i> Content area B: Effects of physiological diseases and disorders and associated treatments Content area C: Development of innovative and future types of treatment for physiological diseases.</p> <p><i>Unit 5: Biomedical Science</i> Content area A: Principles of haematology in medical diagnosis Content area B: Use of health screening, histology and cytology in medicine Content area C: Use of urinalysis as an analytical and diagnostic tool.</p> <p><i>Unit 6: Human Reproduction and Fertility</i> Content area C: Causes, treatment and impact of fertility on people's health.</p>

Sustainable development goal	Unit mapping
SDG 4: Quality education	N/A
SDG 5: Gender equality	N/A
SDG 6: Clean water and sanitation	N/A
SDG 7: Affordable and clean energy	N/A
SDG 8: Decent work and economic growth	N/A
SDG 9: Industry, innovation and infrastructure	N/A
SDG 10: Reduced inequalities	N/A
SDG 11: Sustainable cities and communities	N/A
SDG 12: Responsible consumption and production	N/A
SDG 13: Climate action	N/A
SDG 14: Life below water	N/A
SDG15: Life on land	N/A
SDG 16: Peace, justice and strong institutions	N/A
SDG 17: Partnerships for the goals	N/A

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