About this Statement

This document is a QAA Subject Benchmark Statement for Earth Sciences, Environmental Sciences and Environmental Studies that defines what can be expected of a graduate in the subject, in terms of what they might know, do and understand at the end of their studies. It also describes the nature and characteristics of awards in a particular subject or area. Subject Benchmark Statements are produced by QAA on behalf of its members. A summary of the Statement is available on the QAA website for employers, prospective students and higher education providers who are not members of QAA.

This Subject Benchmark Statement covers the subjects as delivered at bachelor’s degree with honours level (including degrees with placement years and generally leading to the award of BSc or sometimes BA), integrated master’s degrees and taught postgraduate degrees (generally leading to the award of MSci, MSc or sometimes MA). Foundation degrees (FdSc) may provide a pathway towards an honours degree and hence the guidance on skills and knowledge base, including the emphasis on appropriate professional and practical skills, given here may be useful for those developing foundation degree curricula. Research degrees are not addressed in this Subject Benchmark Statement.

How can I use this document?

Subject Benchmark Statements are often used by higher education providers in the design and development of new courses in the relevant subject, as they provide a framework for specifying intended learning outcomes in an academic or vocational discipline. They are also used as a reference point when reviewing or revalidating degree programmes. They may be used by external examiners in considering whether the design of a course and the threshold standards of achievement are comparable with other higher education providers. They also provide professional, statutory and regulatory bodies (PSRBs) with the academic standards expected of students.

Subject Benchmark Statements provide general guidance for articulating the learning outcomes associated with a course but are not intended to represent a national curriculum in a subject or to prescribe set approaches to teaching, learning or assessment. Instead, they allow for flexibility and innovation in course design within a framework agreed by the subject community.

Relationship to legislation and regulation

The responsibility for academic standards lies with the higher education provider who awards the degree. Higher education providers are responsible for meeting the requirements of legislation and any other regulatory requirements placed upon them by their relevant funding and regulatory bodies. This Statement does not interpret legislation, nor does it incorporate statutory or regulatory requirements.

The regulatory function of the Statement will differ with regard to the educational jurisdictions of the UK. In England, Subject Benchmark Statements are not sector recognised standards as set out under the Office for Students’ regulatory framework. However, they are specified as a key reference point for academic standards in Wales under Quality Enhancement Review and in Scotland as part of the Quality Enhancement Framework. Because the Statement describes outcomes and attributes expected at the threshold standard of achievement in a UK-wide context, many higher education providers will use them as an enhancement tool for course design and approval. They will also use them for subsequent monitoring and review and to help demonstrate the security of academic standards.
Additional reference points

Higher education providers are likely to consider other reference points in addition to this Statement in designing, delivering and reviewing courses. These may include requirements set out by PSRBs and industry or employer expectations.

QAA has also published Advice and Guidance to support the Quality Code which will be helpful when using this Statement, for example in course design, learning and teaching, external expertise and monitoring and evaluation.

Explanations of unfamiliar terms used in this Subject Benchmark Statement can be found in QAA’s Glossary. Sources of information about other requirements and examples of guidance and good practice are signposted within the Statement where appropriate.
1 Context and characteristics of ES3 courses

Context

1.1 Throughout this Subject Benchmark Statement, Earth Sciences, Environmental Sciences and Environmental Studies are referred to collectively as ES3. The subject areas are also referred to individually and in combination where appropriate.

1.2 The review group recognises that the Subject Benchmark Statement covers a wide range of subjects. While each subject could be seen as a distinct area in its own right and each honours degree has its own characteristics, underpinned by a detailed rationale for its content, nature and organisation, it is clear that there is sufficient overlap between the subjects that a single Statement is appropriate. For the purpose of this Subject Benchmark Statement, it has been decided to combine the subject coverage and knowledge for both Environmental Sciences and Environmental Studies where possible. The previous versions of this Statement already show many common aspects to both subjects, especially in terms of subject knowledge content. With the integration of equality, diversity and inclusion (EDI) and sustainability in the Subject Benchmark Statement and the imperatives of considering the interactions between the social, economic and environmental components of sustainable development, even more overlaps are evident. However, the distinguishing features of each subject in terms of typical components and applications are also emphasised and listed. While it is recognised that courses vary considerably in the depth and specificity to which they treat subjects, it is anticipated that all graduates have appropriate knowledge of the main aspects of environmental sciences and studies, as listed. Note that the term ‘environment’ in this document should be interpreted as inclusive in its scope and should be taken to include all living things, both human and non-human.

Characteristics of ES3 courses

1.3 ES3 is characterised by the following common skills and knowledge:

- a focus on understanding physical, chemical and biological Earth systems in order to learn from the past, understand the present and influence the future
- an appreciation of societal contribution and context
- an emphasis on practical investigation
- multidisciplinary and interdisciplinary approaches
- the ability to work across a range of spatial and temporal scales
- the development of skills in observation and analysis to support decision-making in the light of uncertainty
- the development of professional skills and competencies that enhance employability.

1.4 There are a number of PSRBs that cover the range of subjects in ES3. Some of these offer accreditations for programmes, professional development courses and a variety of membership opportunities, including chartered status for individuals. The range of relevant PSRBs changes over time but notable organisations currently include The Chartered Institution of Water and Environmental Management, The Geological Society of London, the Institution of Environmental Sciences, the Chartered Institute of Ecology and Environmental Management, and the Institute of Environmental Management and Assessment. Many others cover more specialist aspects such as air quality, water quality or subjects allied to ES3 but linked to other subjects, such as engineering and agriculture.
Equality, diversity and inclusion

1.5 Equality, diversity and inclusivity (EDI) are integral to the ES3 disciplines, not only informing pedagogical practice but also as subject knowledge. Inclusion of diverse groups is critical to the development of subject learning communities, yet these groups may encounter multiple barriers to engagement. ES3 communities have a duty to confront and encourage the dismantling of all barriers to engagement and participation in our disciplines. In doing so, safe and supportive environments are created which encourage discussion, learning and co-production of ES3 curricula.

1.6 EDI can be explored in discipline contexts and by challenging discipline identities, including the impact of colonialism (see Decolonising the Curriculum), broadening interdisciplinary and cross-disciplinary perspectives and particularly valuing different cultural perspectives, ways of knowing and lived experience. The ES3 subjects are a route to justice through delivery of the UN Sustainable Development Goals and diverse perspectives are essential to confronting global grand challenges. To achieve this, academic programmes in ES3 disciplines cultivate graduates who are culturally aware, show ethical behaviour, consideration and respect. They will also be proficient in systems thinking, flexibility, interdisciplinarity and open to different ways of thinking and practising.

Sustainability

1.7 The terms sustainability and sustainable development are frequent inclusions in the ES3 disciplines as they are vital to managing Earth resources to promote the long-term well-being of the planet and all its inhabitants. It is important to note that sustainability is not solely about the environment. It is an ongoing process of addressing social, environmental and economic concerns to create a better world, and, as such, has particular relevance to the ES3 disciplines and positive graduate outcomes.

1.8 The application of sustainable development in the higher education sector takes place through education for sustainable development (ESD) which is the process of creating curriculum structures and subject-relevant content to support and enact sustainable development. As stated in the UNESCO 2019 definition, ‘ESD is holistic and transformational education which addresses learning content and outcomes, pedagogy and the learning environment. It achieves its purpose by transforming society’, a vision which is consistent with the aspirations of the ES3 disciplines. An understanding of the United Nations Sustainable Development Goals (SDGs) is essential to this vision.

1.9 To support the inclusion of sustainable development within the ES3 disciplines, users should refer to the QAA and Advance HE Education for Sustainable Development Guidance to address teaching and learning for sustainable development, key competencies, learning outcomes and assessment within the curricula.

Employability, entrepreneurship and enterprise

1.10 Employability is the set of competencies, demonstrated by a combination of knowledge, skills and behaviours that make individuals more likely to gain employment and be successful in their chosen occupations, benefiting themselves, the workforce, the community and the economy. It includes problem identification and solving, innovation, creativity, expression, communication and practical action. Entrepreneurship enhances employability by promoting personal development. It fosters those attributes that enable students to transition into successful graduates, actively participating in society and identifying opportunities to enable them to develop a meaningful career combined with the creation of cultural, social and economic value. These attributes apply equally across ES3, although the emphasis within the learning outcomes of the subjects will differ. Developing
close links with employers and involving them in curriculum and assessment design will contribute positively to graduate employability. With regard to employability and entrepreneurship, both subject areas will focus on competencies (knowledge, skills and behaviours) and cross-cutting themes such as business awareness and personal motivation.

1.11 In the context of the Earth sciences, employers will be looking for competence with the selection, application and interpretation of appropriate numerical, digital, qualitative and quantitative techniques and the ability to understand the Earth system in four dimensions.

1.12 In the context of environmental sciences and studies, employers will be looking for competence with best practice, survey and data analysis techniques, and knowledge of current legislation and policy.

1.13 To support the inclusion of employability, entrepreneurship and enterprise within the ES3 disciplines, users should refer to the QAA document Enterprise and Entrepreneurship Education: Guidance for UK Higher Education Providers.
2 Distinctive features of ES3 courses

Design

2.1 The ES3 subjects are interdisciplinary by nature, overlapping with science and humanity-based disciplines, including biology, chemistry, geography, informatics and physics. The subjects are inherently practical and practical skills are embedded in ES3 curricula. Research and scholarship also inform the curriculum design of all ES3 courses. Programmes are focused on the delivery of subject-specific intended learning outcomes and are innovative, flexible and inclusive in their design, paying due regard to decolonising the curriculum, including challenging Eurocentric conceptual frameworks and dismantling subject practices that perpetuate inequities. Programmes allow students to reflect upon their learning and the application of their knowledge for a sustainable society. Outcomes include knowledge and skills that provide graduates with a wide range of competencies, preparation for future employment and awareness of key challenges in sustaining a habitable planet.

Accessibility

2.2 Individuals and marginalised groups experience a variety of barriers to participation, many of which are intersectional. These barriers are purposefully addressed in the ES3 subjects so that all learners can equally access and thrive, with inclusive practices a pedagogical norm. The ES3 subjects are visual and graphic subjects traditionally underpinned by laboratory and field-based approaches, which can sometimes be exclusionary. Ensuring that all students can participate in such activities may require a mix of strategies, including careful design of field programmes and leveraging accessible technologies. Health, safety and well-being risk assessments should include protected characteristics and the additional risks that some student identities may face. Blending online learning with practical exercises can bring learners together and works across cultures, making for effective team and group work rather than reinforcing otherness.

Progression

2.3 Over the course of a bachelor’s degree with honours (FHEQ Level 6; FQHEIS SCQF Level 10), a student studying for a degree in the ES3 subject area will progress from one year of study to the next, in line with the regulations and processes for each institution. However, it is expected that in each year, the attainment of certain levels of knowledge, expertise and experience are achieved. These will build towards the final achievement of meeting all of the threshold-level subject-specific and generic skills listed in this Statement. Integrated master’s degrees (FHEQ Level 7; FQHEIS SCQF Level 11) require one further academic year of study and it is expected that at the end of this further year, students are able to demonstrate increased critical thinking, evaluation skills and independence. Students exiting early from a degree may be eligible for an Undergraduate Certificate of Higher Education, an Undergraduate Diploma of Higher Education or a General or Ordinary degree, depending upon the years of study completed to a satisfactory standard.

2.4 Where relevant, upon graduation from an undergraduate degree, it would normally be expected that a student who had achieved an upper second-class degree or higher would be capable of, and equipped for, undertaking postgraduate study in Earth Science, Environmental Science, Environmental Studies or an associated discipline and will also be equipped for entering programmes that cross and combine disciplines.

2.5 Joint honours undergraduates will achieve elements of the specific and generic skills for the subject but will add others according to the subjects covered in a joint programme.
Flexibility

2.6 Programmes offered may include full-time, part-time or distance learning. Programmes may offer a diversity of blended learning approaches combining classroom, laboratory, field and virtual opportunities. ES3 subjects are broad in scope so there may be instances where institutions specialise in particular areas of ES3. Programmes may provide international opportunities, virtual exchanges or professional experiences.

Partnership

2.7 Programmes may include work-based learning such as placements, vocational modules and work-related projects. Students can be considered as partners both in course design and with external bodies such as PSRBs. External experts support and enrich courses; contributions may include visiting lecturers, advisory boards (including industry and public bodies), PSRB professional guidance, accreditation and standards, and professional organisations. Apprenticeship degrees integrate taught elements of the course with workplace experience, which is further described in QAA’s Higher Education in Apprenticeships Characteristics Statement.

Monitoring and review

2.8 Degree-awarding bodies routinely collect and analyse information and undertake periodic course review according to their own needs. They will draw on a range of external reference points, including this Statement, to ensure that their provision aligns with sector norms. Monitoring and evaluation is a periodic, retrospective assessment of a course, conducted internally or by external independent evaluators. Evaluation uses information from monitoring, both current and historic, to develop an understanding of cohort demographics, student achievement and to inform future course planning. Such an evaluation also enables an understanding of the nature and extent of awarding gaps and is critical in being able to eradicate these.

2.9 Externality is an essential component of the quality assurance system in the UK, and its importance is reflected in the Quality Code Core practice: ‘The provider uses external expertise, assessment and classification processes that are reliable, fair and transparent’. Higher education providers will use external reviewers as part of periodic review to gain an external perspective on any proposed changes and ensure threshold standards are achieved and content is appropriate for the subject.

2.10 The external examination system currently in use across the UK higher education sector also helps to ensure consistency in the way academic standards are secured by degree-awarding bodies. Typically, external examiners will be asked to comment on the types, principles and purposes of assessments being offered to students. They will consider the types of modules on offer to students, the outcomes of a cohort and how these compare to similar provision offered within the UK. External examiners are asked to produce a report each year and make recommendations for changes to modules, assessments and even entire courses. Subject Benchmark Statements, such as this one for ES3, play an important role in supporting external examiners in advising on whether threshold standards are being met in a specific subject area.
3 Content, structure and delivery

Earth Sciences

3.1 Each honours degree has its own characteristics, underpinned by a detailed rationale for its content, nature and organisation. While it is recognised that courses vary considerably in the depth and specificity to which they treat subjects, it is anticipated that all graduates have appropriate knowledge and skills of the main aspects of the Earth Sciences, as listed below.

- The concepts and applications of sustainable development and systems thinking. This should be consistent with the QAA Education for Sustainable Development Guidance Document.
- The formation of the Earth and other planets and their place within the solar system.
- The central paradigms in the Earth Sciences: uniformitarianism (the present is the key to the past); the extent of geological time; evolution (the history of life on Earth); and plate tectonics.
- Geological time, including the principles of stratigraphy, the stratigraphic column, the fossil record, the methods of geochronology, the rates of Earth processes and major events in Earth history.
- The structure, composition and materials of the solid Earth, the hydrosphere, the atmosphere, the cryosphere and the biosphere; the processes operating and the cycling of matter and energy within and between them.
- The study of the biological, chemical and physical processes that underpin our understanding of Earth and planetary systems.
- The study of structures, materials and processes that includes an appreciation of temporal and spatial variations at appropriate scales.
- The formation of igneous, metamorphic and sedimentary rocks.
- The identification of rocks, minerals, fossils and geological structures and their relevant terminology, nomenclature and classification.
- The importance of Earth Sciences in resource management and the mitigation of, and adaptation to, environmental hazards, including climate change.
- An awareness that the understanding and knowledge gained from the subject and its application has to be considered within a wider socioeconomic and environmental context.
- An understanding of the ethical issues surrounding the legacy and uses of the discipline, engage in contemporary debates and appreciate the need for decolonisation.
- Collection and analysis of Earth Science data of the surface and subsurface, and the appropriate presentation, manipulation, modelling and extrapolation of these (sometimes incomplete) data in four dimensions.
- Observation and interpretation of field-based data (in situ and virtual) from first principles.
- Surveying and measurement, both in the field and laboratory, using quantitative and instrumental techniques.
- The use of qualitative and quantitative data, an understanding of using data sets and an appreciation of how to assess data quality and uncertainty.

3.2 Typical components may include:

- Earth materials
- economic geology
- energy geoscience
• engineering geology
• environmental hazards
• geochemistry
• geoconservation
• geoethics
• geographic information systems and remote sensing applications
• geological mapping
• geomorphology
• geophysics
• hydrogeology and hydrology
• igneous and metamorphic processes and petrology
• mineralogy
• natural resources
• oceanography and marine science
• palaeobiology
• palaeoclimatology and climate change
• palaeontology
• sedimentology
• stratigraphy
• structural geology
• sustainable geoscience
• tectonics: local and global
• volcanology
• urban geoscience.

3.3 Applications may include:

• the role of Earth Sciences in meeting the UN Sustainable Development Goals
• the sustainable exploration, management, development, remediation and storage of Earth resources (for example, minerals, water, aggregates, hydrocarbons, carbon dioxide and radioactive waste)
• the energy transition and alternative forms of energy that underpin the route to net zero carbon
• the use of past climates to understand climate change and the impact on the environment and society
• the use of civil geochemical and geotechnical engineering approaches (for example, land restoration, site investigations, infrastructural development and waste disposal)
• the mitigation and management of geohazards (for example, flooding, coastal erosion, earthquakes, volcanic eruptions and landslides)
• an awareness that the understanding and knowledge gained from the subject and its application has to be considered within a wider socioeconomic and environmental context.

Environmental Sciences and Studies

3.4 Each honours degree has its own characteristics, underpinned by a detailed rationale for its content, nature and organisation. While it is recognised that courses vary considerably in the depth and specificity to which they treat subjects, it is anticipated that all graduates have appropriate knowledge and skills of the main aspects of Environmental Sciences and Environmental Studies, as listed below.
• The concepts and applications of sustainable development and systems thinking. This should be consistent with the QAA and Advance HE Education for Sustainable Development Guidance.
• A holistic approach to study of the complexity and interconnections of the Earth’s systems and processes.
• The principles of sustainability and the use of sustainable approaches to manage natural and human-induced cycles of resource use.
• The importance of timescale (geological, present, short term, long term and future) on the impacts of natural and human-induced activities on ecosystems.
• The spatial scale, from global to local, of human impacts on the environment and responses to environmental change.
• The interconnections and inter-dependencies of all organisms within natural and managed ecosystems.
• The positive and negative impacts of development on the environment and management tools for addressing them.
• The impacts of environmental change on humans, non-humans and infrastructure.
• Monitoring, modelling and managing natural and human-induced environmental changes and behaviour.
• Understand how to predict, mitigate and manage risks presented by a changing environment and human pressures.
• Understanding uncertainty and how it applies to current and future decision-making.
• The role of institutions, organisations, governance structures and other stakeholders in managing and regulating human impacts on the environment.
• The importance of Environmental Sciences and Studies in resource management and the mitigation of, and adaptation to, environmental hazards, including climate change.
• Observation and interpretation of field-based data (in situ and virtual) from first principles.
• The use of qualitative and quantitative data, an understanding of using data sets and an appreciation of how to assess data quality and uncertainty.
• An awareness that the understanding and knowledge gained from the subject and its application should be considered within a wider socioeconomic and environmental context.
• Understand the ethical issues surrounding the legacy and uses of the discipline, engage in contemporary debates and appreciate the need for decolonisation.

3.5 Typical components may include:
• agriculture
• air quality
• aquaculture and fisheries management
• biodiversity and biodiversity loss
• circular economy
• climate change and its mitigation and adaptation
• conservation, including conservation of biota, and environmental stewardship
• ecology
• ecosystem services and natural capital
• energy sources production and use
• environmental ethics
• environmental policy, legislation and regulation (including global conventions and treaties)
• environmental and societal impact assessment
• environmental economics
• environmental management systems
• environmental modelling
• environmental monitoring
• environmental pollution
• forestry
• food security
• life cycle analysis
• nature-based solutions
• resource extraction, management and use
• sustainability and sustainable development
• waste management
• water resources.

3.6 Applications may include:

• the role of Environmental Sciences and Studies in meeting the UN Sustainable Development Goals
• the energy transition and alternative forms of energy that underpin the route to net zero carbon
• a holistic and multidisciplinary approach to resolve a broad spectrum of environmental issues and enhance environmental performance
• the ‘greening’ of industries and technologies (efficient resource utilisation, reduction in environmental impact)
• the modelling and prediction of environmental impacts at different scales
• the social, cultural, scientific and technological responses to climate change (including conservation of biodiversity, carbon sequestration and nature-based solutions)
• the informing of environmental policy, legislation and governance (including non-governmental organisations, public policy, local, national and international government)
• the pursuit of sustainable cities and communities through green design and innovation
• the understanding of ecosystem services and their benefit to society and biodiversity management.

Environmental Sciences only content

3.7 A degree programme in Environmental Sciences is normally expected to include the following subjects in addition to the combined content in sections 3.4 and 3.5, with graduates expected to demonstrate knowledge and understanding in these areas:

• the scientific study of physical, chemical, biological and anthropogenic processes operating on ecosystems
• major environmental processes on scales from global to organismal, and, where appropriate, to the molecular and atomic levels of organisation
• a scientific and interdisciplinary approach to identifying, understanding and managing the Earth's structure, processes and ecosystems
• the use of scientific and technological information and tools to inform decision-making processes and environmental management
• observation and interpretation of field-based data (in situ and virtual) from first principles
• surveying and measurement, both in the field and laboratory, using quantitative and instrumental techniques.
3.8 Typical components in addition to those addressed in the Environmental Sciences and Studies section may include:

- biogeochemical cycles
- environmental engineering
- principles of environmental science.

3.9 Applications in addition to those addressed in the Environmental Sciences and Studies section may also include:

- the monitoring, remediation and management of contamination and pollution (for example, contaminated land, air and water)
- the modelling of future impact on society from climate and environmental change
- the calculation of carbon footprints using a full range of data sources to underpin the route to net zero carbon
- the use of data to inform industrial and corporate environmental management practices
- the modelling of biodiversity loss to support ecosystem resilience.

Environmental Studies only content

3.10 A degree programme in Environmental Studies is normally expected to include the following subjects in addition to the combined content in sections 3.4 and 3.5, with graduates expected to demonstrate knowledge and understanding in these areas:

- the history and current evidence of natural and human-induced environmental change
- the sociological, political and economic implications of human interactions with the environment
- the relationship between the environment and human cultures and values.

3.11 Typical components in addition to those addressed in the Environmental Sciences and Studies section may include:

- conflict and cooperation in environmental decision-making
- environmental justice and social equity (at local, national and international and intergenerational scales)
- environmental philosophies
- indigenous environmental knowledge and practice
- values-based ethics.

3.12 Applications in addition to those addressed in the Environmental Sciences and Studies section may also include:

- the use of environmental philosophies and ethics in the resolution of environmental issues and concerns
- the inclusion of indigenous communities, their knowledge and their role in managing the environment.

Teaching and learning

3.13 Teaching is about engaging all learners to facilitate their knowledge and understanding and the subsequent application of concepts and processes. It includes curriculum design, the selection and delivery of content, the method and type of assessment,
and moderation and reflection. Learning is the process of gaining knowledge and skills through the processes of being taught, studying, experience and practice.

3.14 This Subject Benchmark Statement does not specify which methods of teaching or learning should be employed in relevant courses; however, learning outcomes should be achievable through the methods utilised and clearly articulated to the learners.

3.15 Teaching and learning are interlinked as part of the curriculum design process and methods chosen should be inclusive and appropriate to develop the knowledge and skills identified in sections 1 and 2. Research-led and enquiry-based courses may develop specific subject-based knowledge and skills.

3.16 The ES3 subjects are characterised by the integration of practical work, especially field-based activities, with theoretical studies. Programmes therefore offer all students opportunities for significant field-based learning and teaching to foster skills such as the ability to visualise and extrapolate data in three dimensions or understand the application of practical methodologies. Much advancement in knowledge and understanding in these subject areas is founded on accurate observation and recording in the field and the collection of empirical data for analysis. Developing field-related practical and research skills is therefore important for students wishing to pursue careers in ES3-related sectors. Field-based studies allow students to develop and enhance many graduate attributes, for example leadership, team working, problem-solving, self-management and interpersonal relationships, which are of value to their employability, entrepreneurship and active citizenship.

3.17 ES3 subjects have sustainability at their core. Teaching and learning should be clearly underpinned by education for sustainable development to achieve positive graduate outcomes, and teaching and learning methods should embody sustainability principles.

Assessment

3.18 Assessment strategy is an integral part of programme design. This Subject Benchmark Statement is not prescriptive about which assessment methods are used on courses. Authentic assessment approaches, based on tasks likely to be encountered in the workplace, can benefit employability outcomes for graduates and ease the transition from university to the workplace.

3.19 Assessment is inclusive for all students. It is designed in a way that facilitates learning and supports students to succeed, and it is clearly linked to the specified learning outcomes or desired competencies. Where appropriate, modified provision should be available.

3.20 Feedback is an important part of the assessment cycle and can be provided in a variety of formats. Formative feedback can benefit student performance and, when used appropriately, boost student confidence and outcomes. The opportunity for personal reflection, and peer and self-assessment is also a valuable component of assessment. Such feedback and reflection can enable transformative learning and is closer to workplace reality.

3.21 Examples of authentic assessment types include, but are not limited to:

- practical (especially field and lab-based) investigations
- research-led and enquiry-based, reflective evaluations of real-life case studies, working across a range of spatial and temporal scales
- case reports based on skills in observation and analysis to support decision-making in the light of uncertainty
• oral accounts and presentations of processes and issues, including an appreciation of societal contribution and context.

3.22 Where appropriate, assessments take multidisciplinary and interdisciplinary approaches and are clearly underpinned by education for sustainable development to achieve positive graduate outcomes.
4 Benchmark standards

Introduction

4.1 This Subject Benchmark Statement sets out the minimum threshold standards that a student will have demonstrated when they are awarded an honours degree in ES3. Demonstrating these standards over time will show that a student has achieved the range of knowledge, understanding and skills expected of graduates in ES3.

4.2 The vast majority of students will perform significantly better than the minimum threshold standards. Each higher education provider has its own method of determining what appropriate evidence of this achievement will be and should refer to Annex D: Outcome classification descriptions for FHEQ Level 6 and FQHEIS Level 10 degrees. This Annex sets out common descriptions of the four main degree outcome classifications for bachelor’s degrees with honours: 1st, 2.i, 2.ii and 3rd.

Threshold level

Intellectual skills (knowledge and understanding)

4.3 Graduates with an honours degree in ES3:

- have a knowledge and understanding of subject-specific theories, paradigms, concepts and principles
- integrate evidence from a range of sources to test findings and hypotheses
- consider and appraise issues from a range of interdisciplinary and multidisciplinary perspectives
- analyse, synthesise, summarise, appraise and critically evaluate information
- define complex problems and develop and evaluate possible solutions
- develop and test hypotheses to inform and design investigations (and experiments)
- plan, conduct and present an independent project with appropriate guidance
- take a critical approach to academic literature, data and other sources of information
- have confidence and competence in dealing with uncertainty in data and systems response.

Practical skills

4.4 Graduates of an honours degree in ES3:

- conduct fieldwork and laboratory investigations competently (as appropriate)
- describe and record observations in the field and laboratory
- interpret and evaluate practical results in a logical manner
- undertake laboratory and fieldwork ethically and safely with an appreciation of appropriate legal requirements
- gather, prepare, process and interpret data using appropriate techniques
- use appropriate numerical, statistical and qualitative techniques
- use appropriate technologies in addressing problems effectively.
Communication skills

4.5 Graduates of an honours degree in ES3:

- communicate effectively with a variety of audiences using a range of formats and media
- have good interpersonal communication skills to enable effective team working
- listen and acknowledge different perspectives
- effectively articulate and synthesise an argument
- present a case in an influential and persuasive manner.

Personal and professional skills

4.6 Graduates with an honours degree in ES3:

- reflect on the process of learning and evaluate personal strengths and weaknesses
- develop the skills for autonomous learning
- plan and organise workloads, including project management
- develop leadership qualities
- work effectively as a team member
- work online and remotely as well as in person
- demonstrate professional behaviours
- display an appreciation of developing graduate skills relevant to career pathways
- recognise the importance of planning for personal, career and professional development, including identifying and working towards targets
- recognise and respect the views of others
- demonstrate an understanding of the importance of risk assessment and associated legislation for health, safety and well-being
- recognise the importance of equality, diversity and inclusivity and develop behaviours that support EDI
- appreciate the need to act and work in an ethical and sustainable manner and in compliance with relevant legislation.

4.7 In addition to the competencies developed over the course of their programme, graduates of integrated master’s programmes will have gained significant specialism in a specific subject area through developing and leading an independent research project to a standard commensurate with that expected of a first-year postgraduate research student. Graduates of integrated master’s programmes will demonstrate the ability to independently interrogate the relevant literature, applying ideas, techniques and data to a range of questions, demonstrating key skills and working independently to design and carry out a project to address important practical questions.

4.8 At postgraduate (MSc or MA) level it is expected that students will build on the competencies listed above that are developed in their undergraduate studies but focus in greater depth on a specific aspect of the subject area, achieving knowledge and skills to enhance their employability.
5 List of references and further resources


6 Membership of the benchmarking and review groups for the Subject Benchmark Statement for Earth Sciences, Environmental Sciences and Environmental Studies

Membership of the advisory group for the Subject Benchmark Statement for Earth Sciences, Environmental Sciences and Environmental Studies (2021)

Dr Sian Davies-Vollum (Chair) University of Derby
Dr Tom Argles The Open University
Professor Debbie Bartlett University of Greenwich
Martin Baxter Institute of Environmental Management and Assessment
Dr Samira El Boudamoussi Imperial College of Science, Technology and Medicine
Georgia Clarke QAA Coordinator
Richard Howell Environment Agency (Retired)
Dr Rebekah Humphreys University of Wales Trinity Saint David
Professor Simon Kemp University of Southampton
Kevin Kendall QAA Officer
Professor Linda Kirstein University of Edinburgh
Dr Christina Manning Royal Holloway and Bedford New College
Dr Alicia Newton The Geological Society
Dr Rana Parween University Centre Askham Bryan
Bitsy Pout University of Southampton
Professor Diane Purchase Middlesex University
Dr Nicholas Ray Nottingham Trent University
Dr Alison Stokes University of Plymouth
Dr Rebecca Williams University of Hull
Dr Bethan Wood University of Glasgow

Membership of the review group for the Subject Benchmark Statement for Earth Sciences, Environmental Sciences and Environmental Studies (2019)

The fourth edition, published in 2019, was revised by QAA to align the content with the revised UK Quality Code for Higher Education published in 2018. Proposed revisions were checked and verified by the Chair of the Subject Benchmark Statement for Earth Sciences, Environmental Sciences and Environmental Studies review group from 2014.

Phil Wheater, Professor Emeritus Manchester Metropolitan University
Dr Alison Felce Committee of Heads of Environmental Sciences

Membership of the review group for the Subject Benchmark Statement for Earth Sciences, Environmental Sciences and Environmental Studies (2014)

Details provided below are as published in the third edition of the Subject Benchmark Statement.

Professor Phil Wheater (Chair) Manchester Metropolitan University
Pam Furniss Committee of Heads of Environmental Sciences
The Open University
The following employers and external stakeholders were invited to provide feedback on the Subject Benchmark Statement.

British Geological Survey
London Waste Ltd
Royal Geographical Society
Environment Agency
Thames Water Ltd

Membership of the review group for the Subject Benchmark Statement for Earth Sciences, Environmental Sciences and Environmental Studies (2007)

Details provided below are as published in the second edition of the Subject Benchmark Statement.

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