## Criteria, attributes and supporting notes

The Criteria and their Attributes are the requirements for accreditation – the notes aim to give you help in identifying how you could satisfy those criteria and attributes – they are not definitive, but aim to support your curricular development.

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| **1. A graduating level capstone experience which includes analysis, synthesis and critical evaluation, resulting in a defined output** | |
| **Attributes** | **Notes** |
| **i. The capstone experience will integrate and develop the skills and knowledge gained in earlier years; bring reflection and focus to the whole of the degree experience; and provide students with the opportunity to demonstrate and apply the understanding and skills that they have developed** | The capstone experience tackles a central scientific question or issue in depth, which the students take ownership of. All sections of the capstone experience should relate to the same issue rather than being a collection of unrelated essays. The capstone experience must be the pinnacle of the course, drawing on and extending the students’ learning at previous levels. It should be a first-hand experience of applying science. The Society accepts that research is a collaborative process (e.g. between student and supervisor, and/or between students) but the contribution of individual students must be identifiable and assessable. |
| **ii. The capstone experience will be:** | *Further help can be found in* [*Annex 1*](#Annex_1)*.* |
| **a. An extended piece of enquiry-based work, relevant to the degree, with a justified approach that effectively communicates its outcomes** | There are a variety of approaches to research, but central to these is a desire to find out something, and this enquiry may be either hypothesis driven or lead to the formation of a hypothesis. The research can be qualitative, quantitative, laboratory/field or design-based, or utilise other scholarly approaches such as outreach and communications. Many types of experiences can be devised that can fulfil the criterion for a capstone experience *(e.g. laboratory or field-based, pedagogic, computer-based, socio-biological and biogeographical research, science communication and outreach*). There may also be different approaches (see examples in Annex 1), and group approaches. **The important factor in deciding whether these represent a capstone experience is the presence of independently sourced information that is critically analysed.**  Capstone experiences should be based on systematic and rigorous methods, with a clear explanation of how these methods are applied, to achieve the purpose and goals of the capstone experience. The capstone experience is expected to be an “extensive” piece of work, and the Society interprets this to mean that it should be equivalent to **at least 25% of the credit allocated to a student's final year of full-time study**. The capstone experience need not be limited to one module, as long as the links between modules are clear. |
| **b. Underpinned by a range of relevant sources, and will show recognition of health and safety, environmental and ethical considerations** | Sources that inform capstone experiences include textbooks, journal articles, surveys, interviews, experiments, original data, secondary data, websites, blogs, tweets, wikis, reflecting on ethical issues in preparation for or arising from the experience, practice reports and direct personal experience. What is appropriate depends on the type of capstone experience and the purpose that the source is being used for. It should be recognised that all sources have strengths and limitations, and reflection on the limitations and validity of the sources used is part of the process.  The Society recognises that responsibility for health and safety, risk analysis and ethical approval lies with the institution. However, the student should have been involved in these processes as they apply to their capstone experience (*e.g. by preparing a draft risk assessment or ethics application that can be submitted as assessed coursework or included in the capstone experience report*). |
| **c. Contextualised, and show recognition of the provisional nature of knowledge, building to an appropriate conclusion**  **d. Based on the processes of critical thinking, synthesis, reflection and evaluation** | Students must (1) frame their research within the context of existing knowledge, (2) develop and test ideas, (3) devise, execute and manage objectives, (4) critically analyse data and (5) communicate the results of their study with reference to information sources. |

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| **2. Demonstration of the acquisition of technical skills and familiarity with the practical environment** | |
| **Attributes** | **Notes** |
| **i. Students learn in a hands-on, practical environment, and are trained in the technical skills appropriate to their main subject interest** | The biosciences are a collection of subjects which require significant technical and practical training to demonstrate the key principles and develop students’ problem solving strategies which use an experimental approach. Different subjects have their own requirements: while recognising this diversity, the RSB seeks to ensure that all students learn in a hands-on, practical environment, and are trained in the technical skills appropriate to their main subject interest. Competency requires repeated learning and assessment of individual students’ skills, whether working in a group or alone. |
| **ii. Skill acquisition is demonstrably a progressive process** | Students are expected to evidence increasing competency and familiarity with the skills they are acquiring over the period of their programme. The Society is specifically seeking evidence for the development of the **appropriate technical skills in relation to the subject**, whether in the field, the laboratory or the workplace.  A system for recording the development of skills and experience of the practical environment should be present within the programme, to demonstrate the progressive nature of the learning. |
| **iii. There is a list of the core, assessed, technical skills used in the laboratory, field or other setting which form the foundation for the degree(s)** | There is no core list of competencies which must be achieved by all students: any such list would be rapidly out-of-date. However, the very basic operations (*sample and specimen handling, pipetting, manipulation of solutions, measurement, use of essential equipment)* and knowledge of the different forms of error would be expected.  Different subject areas will have different requirements – please check the requirements under [criterion five](#Acc_Criterion_5_Guidance), which gives links to subject-specific material. The Society will need to feel confident that the HEI is **explicit** about which technical skills are being acquired by its students and where they are assessed. The HEI should have, and provide, **a list of the core technical skills used in the laboratory and/or field, which form the foundation for the degree subject,** and what would be deemed appropriate as a level of competency.  A bespoke list may not be necessary if it is already present, for example in validation documentation or student handbooks. If a bespoke summary for the submission is required then please follow the format of the table given in [Annex 2](#_Annex_2_–). The table should evidence a progressive approach ([see 2ii](#Acc_Criterion_2ii_Guidance)), where basic techniques and skills are built on during the course of the programme. |
| **iv. There is evidence of competency in the core technical skills for all students on the programme** | There should be description of how the technical skills are assessed. This can be briefly summarised in the submitted matrix ([Annex 2](#_Annex_2_–)). For example, “*technical skills of individuals are assessed on a pass/fail basis by laboratory demonstrators during the series of practical classes in modules BIO40001, BIO40002*”, or any other appropriate approach. Assessments that test knowledge and understanding (e.g. written reports or theory examinations) cannot, on their own, be used to assess technical skill. HEIs may wish to discuss their approach with the Society who provide training courses for Society members on teaching, learning and assessment in the biosciences, and generate and share examples of good practice.  If technical skill is being acquired and assessed in a module we would expect it to be reflected in the module learning outcomes.  Evidence should be provided of a basic competency in the core technical skills for all students on the programme. For example, through a record of the individual achievement of skills. There must be evidence that students are trained and tested in the basic competencies, and achieve a threshold standard set by the HEI, and which would be deemed appropriate, for example, by employers. However, there is no requirement for all students to achieve a high level of competency in every technical skill. The Society is accrediting life science programmes, not professional training programmes. |
| **v. Training in research study design and the principles of data management, such as Good Laboratory Practice** | Obtaining and managing data is critical for successful evidence-based approaches, be they in the laboratory or in wider employment. Data management in particular is critical for ensuring that evidence gathered is verifiable, and for Quality Management, embodied in the principles of Good Laboratory Practice (GLP) and other similar approaches. GLP is internationally recognised for the development and manufacture of drugs. While using a full GLP approach in a learning and teaching environment is not usually feasible, students should be introduced to the concepts embodied by GLP and Quality Management, and should be able to discuss and defend the approaches implicit in this approach. |
| **vi. Students will appreciate the concept of ‘Big Data’ and its importance in understanding the living world** | "Big Data" is the name given to extremely large data sets that are now generated both in biological research and in the wider business and industrial world. In particular for the biosciences, the development of large data sets to address questions from a molecular level to a population level, be it genomics or environmental level analyses, poses challenges in understanding the scale, advantages and drawbacks of such datasets. Students should understand the nature and difficulties of working with large data sets, including their strengths and limitations. |

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| **3. The development and use of transferable graduate skills** | |
| **Attributes** | **Notes** |
| **i. Graduates will have the basic skills of word processing, use of spreadsheets, and presentation software** | There should be clear evidence that students have acquired these essential basic skills.  As a general point, we would normally expect to see transferable skills in the learning outcomes of a module if the skill (as opposed to knowledge and understanding) is both acquired and assessed. But given the widespread use of IT in assignments we do not expect it to appear in the learning outcomes of all modules, only those where it represents a significant feature (e.g. where students are first introduced to spreadsheets etc.). |
| **ii. Graduates will be able to find, cite and use appropriate information** | There should be evidence that students:   * are able to collect, sort and protect/backup personal online resources, including issues of intellectual property * demonstrate competence in the use of reference management systems * understand and avoid plagiarism and the importance of personal integrity * make the most of social media opportunities for networking ethically and responsibly. |
| **iii. There will be evidence that students will consider and approach a wide range of problems and problem types critically, confidently and independently** | The criterion includes two broad categories of problem: mathematical and logistical (e.g. in research, manufacture, health care or environmental management). Students should be exposed to both during the programme.  The curriculum should show evidence of integration and reinforcement of problem solving skills throughout a degree programme. Institutions should provide evidence that there are opportunities for the development of these skills at all levels of degree programmes so that students graduate as creative and effective problem solvers.  *Students should be encouraged (wherever appropriate) to:*   * *rephrase problems in their own words and be clear about what is being asked; divide a complex problem into smaller, more manageable steps* * *reformulate a problem, allowing for the identification of more than one solution* * *ensure the answers/solutions to problems make sense/are feasible.*   Students should also be given the opportunity to solve open-ended problems where more than one solution is apparent from the outset (see [criterion six](#Acc_Criterion_6_Guidance) for further consideration of creative approaches to problem solving).  Problem solving frameworks that can help define and clarify the nature of a problem, and identify a solution, may also be considered. These could include the 5Ws and 1H (Who, What, Where, When, Why, How) tool and the Osborn-Parnes Creative Problem Solving Process. Institutions may wish to make use of these frameworks when developing students’ problem solving skills. |
| **iv. Students will communicate through both oral and written approaches, and to a range of audiences** | Institutions should provide evidence that they develop students to communicate effectively through oral and written presentations. This should be formally included in the programme (and as appropriate, supported less formally through outreach or presentations to, for instance, student-led societies). |
| **v. Graduates will be experienced in teamwork approaches, including the concepts of leadership; the recognition of individual contributions; and the significance of group dynamics to effective teamworking** | Teamwork can be particularly valuable with diverse teams, where each member may have a different background and therefore a distinct perspective on problems to be solved.  Providing a curriculum framework in which teamwork and leadership skills are developed is a vital recognition of their importance. **HEIs must show where they teach the principles of teamwork, and how they implement those principles**: it is not enough to say that 'students work in pairs/groups', if those students have no understanding of the benefits and challenges of working as part of a team. Students’ understanding of teamwork should include the question of interdisciplinarity, where teams with different skills and knowledge come together to solve a problem (*see* [*criterion six*](#Acc_Criterion_6_Guidance)). |
| **vi. There will be evidence of acquisition of general management skills including project management** | There should be reference to these skills in learning outcomes of specified modules where it is a significant feature (e.g. where students plan and/or cost a piece of work). This framework should include the development of time management, organisation and interpersonal skills, including the use of milestones. *This may be cross-referred to the learning points in* [*criterion six*](#Acc_Criterion_6_Guidance). |
| **vii. Regulatory and ethical issues, including environmental and social aspects, are considered and addressed by students at appropriate times throughout their programme of study** | Student exposure to and understanding of ethical issues regarding experimentation and its regulation, and more broadly in their discipline, provides the necessary appreciation needed for certain types of research, particularly those dealing with animals, humans and environmental issues. The study of ethics, including reflection and discussion, helps students to develop widely applicable skills in communication, reasoning and reflection, as well as an understanding of why codes of conduct exist, and how that should affect their work as a professional in science.  As stated in [criterion one](#Acc_Criterion_1_Guidance), HEIs need to be clear about the difference between the institution’s responsibilities in securing ethical approval and meeting legal requirements around health and safety and the learning, teaching and assessment of students’ knowledge of these aspects within a programme. |

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| **4. A foundation in mathematics, statistics, chemistry and physics within a biological context appropriate to the discipline**  At a basic level, all bioscience degrees should integrate mathematics, statistics, chemistry and physics to the extent that knowledge and understanding of science principles governing current techniques and concepts should be embedded within the curriculum. | |
| **Attributes** | **Notes** |
| **i. The coverage of chemistry and physics should be of sufficient depth and breadth to provide the necessary knowledge and understanding for students to appreciate and apply these subjects within a biological context** | The biological sciences sit on a foundation of physical and mathematical sciences. It is appropriate that the integration of mathematics, chemistry and physics be taught within a biological context. In this way, these subjects can be embedded within the curriculum as part of the learning developmental cycle that is relevant to specific bioscience disciplines. The use of molecular techniques in all areas of biology necessitates the need for chemistry to be included in the curriculum of all bioscience degrees.  Contextual understanding should be demonstrated through the integration of these physical sciences with the biological curriculum, as appropriate. The curriculum should highlight, via learning outcomes, where interdisciplinary science knowledge and understanding is fundamental to future developments within specific fields. The extent to which this is covered will depend upon the discipline. However, a bioscience graduate should be able to prepare solutions at known concentrations, understand the concepts of molar, molarity and molality, and manipulate solutions, as well as understand the nature and application of buffers. |
| **ii. The knowledge and appreciation of mathematical principles must be sufficient to support the understanding and application of key biological concepts, and underpin problem solving at the theoretical and practical levels** | Different specialisms may vary in the underpinning of mathematics, statistics, chemistry and physics at the technical and analytic skills levels. For instance, the treatment of descriptive and analytical statistics may vary between the molecular, the whole organism and the ecological and environmental sciences streams.  A greater underpinning of physics might be deemed necessary for disciplines within the molecular stream where the biological applications of synchrotron radiation, x-ray crystallography or other physical science techniques are covered.  We would expect all students to have an understanding of the science principles behind the technical equipment they use. |
| **iii. Graduates will be equipped with the appropriate knowledge and skills needed to handle variation in data at different levels of complexity** | Students should be equipped with the knowledge of mathematics and statistical approaches needed to handle variation at different levels, including qualitative approaches, especially with regard to the greatly increased amount of data being generated by modern laboratory and computing techniques. Students should understand the statistical aspects of experimental procedures, encompassing the analysis of collected data, the design and analysis of studies, the development of calibration and analysis techniques, multivariate statistics, and the robustness of data. |

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| **5. Specific skills and knowledge appropriate to the degree title** | |
| **Attributes** | **Notes** |
| **i. Bioscience graduates will have knowledge of the fundamentals of biology, including: an overview of biodiversity and the biological environment; molecular, cell and whole organism biology; biochemistry, genetics, and the concept of evolution** | It is essential that graduates from an accredited degree not only have an overview that helps them understand their chosen field of study but that they can “hold their own” in terms of basic biological knowledge in the context of overall public awareness.  The topics forming the fundamentals of biology provide the underpinning context to the specialisation. The Society accepts that they may be explored to a greater or lesser extent according to specialisation of the degree and it may be appropriate that some of the core topics be mainly taught at FHEQ Level 4 (or SHEQ Levels 7 or 8 in Scotland). |
| **ii. Degrees will adhere to the relevant recommendations within the QAA Subject Benchmark Statements for Biosciences and/or Biomedical Sciences, with reference to other Benchmark Statements as appropriate** | The Society recognises general areas (e.g. Molecular Aspects of Biology, Whole Organism Biology, Ecological and Environmental Sciences). The key topics within these degrees are outlined in the Quality Assurance Agency Biosciences Benchmark Statement and/or the Biomedical Sciences Benchmark Statement and are not repeated here. Accredited programmes will be expected to adhere to the guidance for the typical standard of the most current Benchmark Statements (available at **www.qaa.ac.uk/quality-code/subject-benchmark-statements#**). |
| **iii. Specialist degrees will meet the subject-specific requirements of the relevant Learned Societies as listed in Annex 3** | Many honours degrees are awarded in subjects that have relevant Learned Societies. HEIs should consult with the appropriate Learned Societies for the specific skills and knowledge that may be required for a specific programme name. Some subject areas have defined additional Learning Outcomes (see [Annex 3](#_Annex_3_–)) which should be considered as conditions for accreditation of degrees with relevant titles or foci. |

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| **6. Developing creativity and enterprise**  The RSB recognises the importance of creating environments that support and promote the development of creativity, enterprise and entrepreneurship with our primary focus being on the experiential creative and innovative side, as being of key value to all graduates in their future employment.  Enterprise education will develop students’ capabilities as “enquiring, critical thinking, future orientated thinkers”4, as evidenced through contextualised specific learning experiences embedded within the curriculum; and assessment strategies and approaches that promote a creative and entrepreneurial environment. | |
| **Attributes** | **Notes** |
| **i. Students are taught to apply and evaluate original or unconventional ideas, and to tackle problem solving using techniques designed to develop individual and group creativity, evidenced through assessment approaches which recognise and reward such thinking** | Institutions should make it clear how they promote creativity and creative problem solving, in the students’ programme of study, using techniques designed to develop individual and group creativity.  For group sessions there should be evidence that **students experience structured, constructive and inclusive approaches to creative problem solving**. When these activities are assessed, emphasis should be placed on students demonstrating how they have engaged with techniques designed to promote creativity in individuals, and the extent of their participation in group sessions. As an example for the former, students could be asked how they have utilised a specific technique during creative problem solving. Students should not be awarded marks solely on the basis of coming up with novel ideas, as this is frequently an unrealistic expectation. |
| **ii. Graduates are expected to have an understanding, embedded in the teaching of their subject(s), of:** | As well as an environment which promotes enterprise and entrepreneurship, there are some key learning points which students should be exposed to in order to aid their understanding of the post-degree work environment.  This learning **should not solely be in addition to current curricula**, which would lead to student overload, but should look at current curricula and approaches to see how they can be adapted to address the skills and knowledge cited. |
| **a. A contextualised learning experience using real-world scenarios to gain better alignment with expected key employability skills** | Students learn through application and practice as well as real-life case studies: there are many areas of the life sciences where principles can be taught by reference to "real-world" examples. This can often be done by inviting external specialists and employers to show how the basic science relates to their industry, for instance using Enterprise Masterclasses. Employers seek an awareness of the wider context and how to develop graduates' skills for that wider context, and HEIs are charged with preparing their students for that world. |
| **b. The notion and value of intellectual property** | Intellectual property drives the economic engines of innovation - students should understand how IP rights work locally and more widely outside the UK, why IP is important for development, and how to protect it. |
| **c. The importance of evaluating feasibility and impact through a reflective approach**  **d. The interdisciplinary nature of enterprise**  **e. Financial literacy in the context of developing commercial awareness** | HEIs will recognise that these three areas are intrinsic to scientific research and the use of that research. |

4 Enterprise and Entrepreneurship Education: Guidance for UK Higher Education Providers, January 2018, QAA

# Annex 1 – Further guidance for the capstone experience

**The type of capstone experience**

Many types of level 6 capstone experiences can be devised that can fulfil the criterion for a capstone experience (e.g. laboratory or field-based, critical review, pedagogic, computer-based, socio-biological and biogeographical research). The important factor in deciding whether these represent a capstone experience is the presence of independently sourced information that is critically analysed. Some examples of non-traditional capstone experiences might include the following:

1. Informatics capstone experiences. These may use computer-held, information databases that are ecological, molecular, physiological, epidemiological or taxonomical in nature, which can be investigated using software to identify trends or relationships or processes. In this type of capstone experience, the primary data already exists in one form but it has to be found, manipulated and analysed so that conclusions may be reached.
2. Science education capstone experiences. These may create new ways of imparting knowledge and will include analysis of the reaction to, or success of, a particular pedagogic approach or method.
3. Public engagement capstone experiences. These may involve the creation, delivery and critical evaluation of new ways of engaging (i.e. two-way communication) the public with science.
4. Questionnaire-based capstone experiences. These may find out what is known or not known, acted on, or understood about a process or treatment. They may test an idea by asking and analysing the answer to questions. A hypothesis is required, with ethical or other matters considered and response data generated and analysed.

This guidance note is cautious about use of the word “dissertation” as it is used differently across HEIs. It may for example be a term used to describe the submitted written report following a period of laboratory/field research or it could be used to describe a literature review. Panel members will need to be confident about how an applicant uses the term and may need to seek clarification when considering an application.

Whilst straight literature-based reviews of a topic do not qualify as a capstone experience because they typically lack a reinterpretation of the primary data, hypothesis driven critical reviews of the literature are permitted as, to address the hypothesis, students are required to critically evaluate and interpret literature and information. Similarly, systematic reviews (e.g. of clinical trials, healthcare intervention or scientific information), with or without meta-analysis of data from the discovered papers, are permitted.

If students are required to undertake studies or use methodologies with which they are unfamiliar (e.g. qualitative research methods, systematic reviews, meta-analyses, surveys, science communication) they should be provided with appropriate prior education and support, including in data/statistical analysis and interpretation.

In deciding whether a particular format of capstone experience meets the Society’s criteria for accreditation, panel members will look beyond the title and determine whether individual formats meet all the criteria for a capstone experience (graduating level, analysis, synthesis and critical evaluation, resulting in a defined output etc.). The assessment should be valid, appropriate for the particular capstone experience, and capable of assessing the intended learning outcomes. This may include assessments other than extended reports e.g. scientific papers, reflective e-portfolios.

**Individual or team capstone experiences**

Independent work is an important aspect of the capstone experience. Independence is demonstrated easily when a capstone experience is performed individually, but this does not necessarily mean that capstone experiences undertaken in a team setting fail to meet this criterion.

It is important to understand that team working does not necessarily mean that every member of a team does exactly the same tasks. On the contrary, team working (as emphasised by employers) often involves individuals with their own areas of expertise combining on a team-based task, sometimes working independently and sometimes collectively on the same task-so that the output is the sum of individual and team contributions.

The Society does not wish to be prescriptive in determining how teams are organised and function, and multiple formats are permissible. They could be following the same line of enquiry, with individual students contributing different elements, or they could all be doing exactly the same tasks, working collaboratively to create a greater data-set than could be achieved individually. The critical elements are that they should all contribute to the research design, individual roles/responsibilities should be allocated by the team based on their individual knowledge, skills and expertise (i.e. how they can best serve the team), and that any data/information created is team data, owned collectively by the team, irrespective of individual contributions. This would require students to be formally taught about teamwork and how to work in and/or build a successful team.

Whilst the data/information is team data, normally the assessment should be individual (i.e. each writes their own scientific paper using this team data/information), so unique reports are created, and each student is assessed independently. This does not preclude moderation of marks based on contribution to the “team”; indeed, the latter is encouraged. A collective single assessed output from the team is also permissible provided there is a fair and transparent mechanism for moderation of marks to reward an individual’s contribution to the team output(s); such that all members of the team do not necessarily receive the same mark. If the primary mode of assessment is a single team output then students should be informed of this prior to choosing their capstone experience, and no student should be allocated to a capstone experience with a single team-based assessment against their wishes.

**Range and choice**

It is likely that an institution will provide a range of capstone experience types for their students. By offering a range of capstone experiences, it enables individual students to decide for themselves what they want to achieve, personally and professionally, from the experience, and therefore to choose accordingly. It should be a “safe space” for them to experience different career options, to gain work experience, and develop specific skills that would be useful in their future graduate employment.

It is a requirement for accreditation that all capstone experiences offered to students meet the accreditation criteria. This ensures that all students can demonstrate the threshold levels for the learning outcomes associated with the capstone experience. The process for the allocation of capstone experiences should be fair and transparent, and where a choice of capstone experience type is available, this process should ideally ensure that all students who wish to undertake a specific capstone experience should be able to do so. Further, institutions should ensure that, when offering a range of capstone experiences, each has equal status (to students and staff), with the understanding that specific formats of capstone experiences might be more appropriate for different students depending on their career aspirations.