

The Royal Society of Biology's response to Qualifications Wales consultation: GCSE The Sciences (Double Award)

13 December 2022

<https://haveyoursay.qualifications.wales/gcse-the-sciences-db/>

The Royal Society of Biology responded to Qualifications Wales' consultation on the proposals for the new GCSE The Sciences double award qualification.

To inform this response, the Society has drawn on responses from members of the RSB's Curriculum Committee, Education Policy Advisory Group, Biology Education Research Group and the Education and Science Policy Committee. RSB have engaged with Wales previously on the development of their new curriculum and has taken part in informal discussions with Qualifications Wales surrounding the design of the new suite of GCSEs. Existing policy positions and our curriculum framework, *Evolving 5-19 Biology: recommendations and framework for 5-19 biology*, have also been used as points of reference throughout.

The proposals for the new GCSE qualification The Sciences include:

- a move away from the existing dual route available to English and Welsh students.
- a new qualification title - "The Sciences"
- a new approach to interdisciplinary topics
- Increased focused on practical and investigative skills as part of assessment.
- Two options for assessment: biology, chemistry and physics as separate exams at the end of Y11, or combined exams for the sciences with students able to enter in Y10 or 11.
- Assessment: 75% examination of three disciplines and "bringing the sciences together to solve problems", 10% practical exams, 15% investigation on one focus area from "bringing the sciences together to solve problems"

What will learners cover?

The qualification will allow learners to develop knowledge, understanding and skills in a broad range of science content, which allows them to appreciate the integrated and connected nature of the sciences. It will feature five areas of content:

- Scientific curiosity – Learners will develop the skills they need to investigate, explore, analyse, design and formulate creative solutions to scientific problems. These skills will be demonstrated across the qualification
- Bringing the sciences together to solve problems – Learners will make connections across the science disciplines by exploring problems and challenges related to three specified focus areas
- Biology
- Chemistry
- Physics

1. To what extent do you agree or disagree with our proposed qualification title of GCSE The Sciences (Double Award)?

Strongly Agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree
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2. Please explain your answer below. If you disagree, please suggest alternative titles.

The Royal Society of Biology feels the title “The Sciences” allows for distinctness of the three science disciplines within school timetables and regarding teacher expertise and deployment.

Throughout this response we will refer to the “features of triple science” i.e., taking the best features of previously available “triple science” individual biology, chemistry and physics GCSE qualifications and creating a more manageable double award, as a single route through the sciences.

The features of triple science that the Society supports are: separate reporting of grades, distinct identity in the school timetable.

The features of double award science that the Society supports are: allocation of two GCSEs worth of timetabled lessons for two GCSEs worth of content.

The Society feels combining the features of the two previously available routes at GCSE better supports: deployment of teachers in line with their expertise, recruitment of teachers as teachers of biology, chemistry or physics rather than as general science teachers, better recognition by students of disciplines, in turn supporting students to make more informed choices for their progression to post-16 qualifications.

Many of the aspects of the teaching and learning experience in schools are the indirect consequence of the qualifications that schools are entering their students for. The Royal Society of Biology recommends that Qualifications Wales and Welsh Government set out expectations alongside the implementation of new qualifications that support and promote the “features of triple science” approach. RSB would be happy to assist in developing and disseminating such messaging to awarding organisations and schools.

3. To what extent do you agree or disagree that the proposed design of GCSE The Sciences (Double Award) supports the Curriculum for Wales?

Strongly Agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree
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4. Please explain your answer below.

The Royal Society of Biology feels the proposal set out by Qualification Wales supports the Curriculum for Wales. However, the Society remains concerned about: the disconnect between 3 – 16 curriculum reform, GCSE qualification reform, and the existing suite of A levels which have not been included in this process so far; the lack of detail in the Curriculum for Wales and the burden on teachers to develop their own curriculum; the potential for inconsistency across Wales in Key Stage 1 – 3, and in turn preparedness of students for these new qualifications

5. To what extent do you agree or disagree with the proposed purposes and aims of GCSE The Sciences (Double Award)?

Strongly Agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree
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6. Please explain your answer below.

The Royal Society of Biology supports the purposes and aims of the proposed GCSE The Sciences (double award).

In November 2021, The Royal Society of Biology recently published *Evolving 5-19 Biology: recommendations and framework for 5-19 biology curricula*, setting out RSB's vision for biology curriculum as defined in 7 big questions of biology, and set out 8 recommendations for policy makers and curriculum designers. We intend for this document to be a starting point for discussions around curriculum reform and would be happy to meet with Welsh government officials to further discuss the framework. The full document as well as a summary for policy makers can be found at www.rsb.org.uk/curriculum

The proposed purposes and aims align well with the big questions, themes and exemplification set out for 14-16 in RSB's *Evolving 5-19 Biology* and have used this framework to inform the response that follows. The Society and its curriculum committee would welcome further discussion and input on the qualification as Qualification Wales move into the final phase of co-construction.

7. To what extent do you agree or disagree with the proposed content (knowledge, understanding, skills and experiences) for GCSE The Sciences (Double Award)?

Strongly Agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree
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8. Please explain your answer below.

The RSB has noted that Qualifications Wales has drawn on the Evolving 5-19 Framework recommendations, especially in respect to the scientific curiosity skills, and is pleased to see a high level of detail included for scientific methodology, data analysis and conclusions.

Whilst the RSB recognises that some of the content discussions will go to the exam boards and lie in their creation of the specification, there are some recommendations for content that we would like to see included alongside the topics that have already been mentioned. To further support our response, we have mapped the proposals and appendix against RSB's Evolving 5-19 Biology, and highlight some particular concerns below.

Mapping is available via this link:

https://www.rsb.org.uk/images/Mapping_proposed_GCSE_The_Sciences_against_RSBs_Evolving_5-19_Biology_-_December_2022.pdf

Our 14-16 exemplification as part of Evolving 5-19 Biology is available as an extract here: https://www.rsb.org.uk/images/Evolving_5-19_Biology_extract_-_11-16_exemplification.pdf

Within i) Variation, mutation and natural selection, including genomes, competition and natural selection, leading to diversity:

The purposes of mitosis and meiosis have been proposed as a topic, but the process of mitosis and meiosis has not been included.

The RSB would recommend that evolution and extinction are included, as they align well with the other topics, and would lead into teaching around fossils

The formation of fossils would be a welcome addition if it is the intention they are going to be used as a way to look at natural selection.

The addition of selective breeding would also work well with the topics that have been suggested.

Within ii) Dynamic ecosystems:

The name of the chapter itself suggests there is a focus on ecosystems that experience lots of change, frequently. Through consultation with the Curriculum Committee, a suggestion of Ecosystems as the title felt more appropriate.

Carbon and nutrient cycling have not been mentioned in the current proposed topics. When considering ecosystems as a whole, the exclusion of microorganisms and prokaryotes, especially when looking at the decay cycle play an arguably large role in balancing an ecosystem.

The RSB would recommend making some links to climate change within this topic, and whilst it is taught as one of the interdisciplinary subjects, it would be beneficial to add some additional detail in context with human population and the impacts on ecosystems.

Surrounding the energy transfers section, including pyramids of biomass and the calculations needed for the efficiency of energy transfers between trophic levels. Environmental problems should be framed in terms of positive contributions and solving global contributions

Within iii) Biological processes that maintain life by supporting the functions of cells, tissues, organs and organ systems:

There needs to be a clearer link between increasing the yield/biomass of plants grown and including teaching of limiting factors in photosynthesis.

The teaching of anaerobic respiration would also be an idea place to teach about anaerobic respiration in industry and other processes such as fermentation.

Within iv) Human health and wellbeing and factors that can positively and negatively affect it:

How pathogens cause symptoms of diseases in animals and plants is not specifically mentioned, and given the movements in the scientific landscape recently, it is vital that students are aware of this, alongside the teaching of vaccines and their mechanisms.

Drugs, alcohol, diet and other lifestyle choices are not mentioned. Whilst some of this could be covered in the interdisciplinary section, the depth of the coverage is a concern.

When infectious diseases and natural defense systems are mentioned, it does not specify if this will be in both plants and animals, which is a concern that plant based content will be missed from the curriculum.

Our Evolving 5-19 Framework takes care to recommend in the exemplification for 14-16 bioscience curricula, that humans are included in consideration of ecosystems, health and wellbeing, but are not the focus to the detriment of other organisms. The Society also notes that there is a surprising lack of ecology in the proposed curriculum. Where ecology is included, the Society feels it is poorly defined and would ill-prepare students for a world in which environmental issues are becoming increasingly important, and for tackling particular climate and biodiversity crises in the Welsh context.

The RSB feels there is a significant disadvantage if a focus on humans over other organisms is emphasized within a curriculum or specification. The Society is therefore concerned about the approach taken in sections ii) dynamic ecosystems and iv) human health and wellbeing and would prefer to see a more holistic specification in these areas. The Society would be happy to provide further support, informed by our curriculum framework, and can provide additional input from our member organisations such as the British Ecological Society.

9. We have proposed two options for how the external exams could be structured:

Option 1: Separate biology, chemistry and physics exams would be taken by learners at the end of year 11 (this could enable separate grades for each subject to be reported).

Option 2: Three exams, each one featuring a mix of biology, chemistry, and physics content, would be taken across years 10 and 11.

Which of these options do you prefer?

Option 1	Option 2	No preference	Not sure
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10. Please explain your answer below.

The Royal Society of Biology welcomes an emphasis on the importance of practical work in the sciences, through separate 10% practical exam assessment and would recommend that Qualifications Wales makes it clear to schools, teachers and learners that practical and investigative activities should be carried out throughout the qualification to support teaching and learning, not just the bare minimum required for assessment. This could be bolstered by including a more explicit reference to practical skills in the “focus of assessment”.

The Society supports the tiered assessment approach as a general requirement.

The Society also welcomes the novel assessment approach based on “Bringing the sciences together to solve problems” and would welcome further information on how Qualifications Wales and the awarding organisation plan to implement this as part of the new qualification, ensuring that it is truly interdisciplinary and does not default to biology, physics and chemistry.

The Society notes that both options include learners receiving two grades on a 15-point scale between A*A* and GG.

RSB supports a single route through the sciences, which has the features of individual science qualifications. We strongly support reporting of separate grades for the sciences and as such, the Royal Society of Biology’s recommendation is option 1 where this seems most achievable. Separate reporting of grades could either be in the overall award, or in the student transcript. Other features of separate science qualifications such as having separate teachers, deployed within their disciplinary expertise for each subject is also strongly advised. In order to keep the identity of the sciences separate under a joint qualification, having separate exams for the learners at the end of the qualification is vital to distinguish areas that might be of further interest to them in making their post-16 choices.

Research commissioned by RSB on behalf of Association for Science Education, Institute of Physics, Royal Society, and Royal Society of Chemistry, which looked at timetabling in England at GCSE suggested that students taking combined science GCSE were less able to identify biology, physics and chemistry lessons and content than their peers on the triple science route. If this lack of distinction in the school timetable is paired with reporting of a single grade for the sciences,

students will be less able to make informed choices for A level courses as high achievement in one science subject may be masked by poorer achievement in another science.

In conclusion, the Royal Society of Biology has a strong preference for option 1 presented in this proposal: Separate biology, chemistry and physics exams would be taken by learners at the end of year 11 which would enable separate grades for each subject to be reported. How to include the inter-disciplinary aspect in the overall award is a technical question for awarding organisations, and the Society would be happy to advise further on this matter.

The Society recognises the benefits of integrating the sciences through option 2, but could only support this route if the previously described features of triple science including reporting of separate grades for biology, chemistry and physics.

11. To what extent do you agree or disagree with the proposed assessment arrangements, including the role of digital technology, for GCSE The Sciences (Double Award)?

Strongly Agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree
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12. Please explain your answer below.

The Royal Society of Biology supports the use of digital technology in assessment as long as it is based on evidence of good assessment techniques, and is not used to completely replace practical lab and field-based tasks in the 10% practical assessment. It is vital that all students are provided the opportunity for hands on practical and investigative experience, including fieldwork.

Through informal discussions with Qualifications Wales, the RSB have understood that the introduction of technology is to be implemented over the lifetime of the qualification, with the intention that introducing technology is to help futureproof the new suite of qualifications so that they are suitable for a longer period of time. The Society supports the aspirational aims of Qualification Wales, and its attempt to future proof for assessments that make take place digitally over the next 5-10 years.

There are hardware considerations to be made when making decisions to this extent, and that no student should be disadvantaged, or have a different assessment experience to others.

The addition of digital assessment would also mean that the design of the proposed assessments may need to be reconsidered. A hybrid approach where schools can decide on digital or paper may not mean there is parity between the two types of assessment.

We would welcome any further discussion with Qualifications Wales throughout the creation process, as there are members of the Curriculum Committee who take a particular interest in the design of digital assessments and may be able to advise on the look of these assessments.

13. To what extent do you agree or disagree that the proposal for GCSE The Sciences (Double Award) meets the reasonable needs of learners in Wales? Please consider factors such as accessibility, manageability, wellbeing and progression onto post-16 pathways.

Strongly Agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree
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14. Please explain your answer below.

The Royal Society of Biology feels a double award GCSE The Sciences will adequately prepare students for progression to post-16 pathways. Both of the existing routes GCSE Science and GCSE Biology were designed with the intention that students could use either to progress to A level.

The Royal Society of Biology has reviewed data provided by Qualifications Wales on progression to AS and A level from the three separate science GCSEs and Double Award Science GCSE offered by WJEC and is satisfied that the findings quoted in the FAQs regarding impact on performance in Level 3 qualifications are sound. This data shows inequity between the routes – in 2014 to 2019, fewer students progressed to A level from GCSE Science Double Award than individual routes. However, the data also showed that in 2018/19 students who achieved an AA or A*A* at GCSE taking either route achieved a similar spread of outcomes at AS.

This suggests that the disparity in progression numbers between the two available routes is due to the existence of triple science, with the unintended consequence that students from GCSE Science route are less likely to progress but they are not less able to progress.

In England, a longitudinal research project ASPIRES has identified that the existence of a triple science route creates inequity in the system – social disadvantaged students are less likely to study Triple science, schools choose KS4 science options for students, students think that triple science is only for “clever” students.

These points are summarised in the following blog post:

MacLeod (2016), *Is GCSE Triple Science making the STEM skills gaps wider*

<https://blogs.ucl.ac.uk/aspires/2016/04/21/triplescience/>

And further discussed in *Stratifying science*

Louise Archer, Julie Moote, Becky Francis, Jen DeWitt, & Lucy Yeomans (2016), *A Bourdieusian analysis of student views and experiences of school selective practices in relation to Triple Science at Key Stage 4 in England*

<https://www.tandfonline.com/doi/full/10.1080/02671522.2016.1219382?scroll=top&needAccess=true>

The Society is also satisfied that the proposal for a single route, a double award GCSE The Sciences, will not impact students applying to higher education.

15. To what extent do you agree or disagree that the proposed GCSE in The Sciences (Double Award) is manageable for teachers to deliver? Please consider factors such as the size of the qualification, resources and the proposed approach to assessment.

Strongly Agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree
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16. Please explain your answer below.

The Royal Society of Biology supports a single route through the sciences at GCSE level and feels a double award will support a more manageable school timetable, workload for teachers (as it will reduce the number of different qualifications they prepare for) and accessibility for students.

The Society frequently hears from teachers that the existing individual science GCSEs are overburdened with too much in the specification for the allocated teaching time. We believe this increases perceived difficulty for students with many schools squeezing three GCSEs of content into two GCSEs of timetabled time.

Research commissioned by RSB on behalf of Association for Science Education, Institute of Physics, Royal Society, and Royal Society of Chemistry, which looked at timetabling in England at GCSE suggested that almost no schools were able to timetable three GCSEs worth of time for students on the triple science route – either expecting students to attend lunch time or after school classes, or to complete the course within 2 GCSEs worth of time. The experience of triple science by students is therefore dependent on the school they attend and the time available to them in the timetable. In this research, 78% of schools also reported beginning GCSE courses in Year 9 to enable teachers and students enough time to cover the overburdened science content.

While the research commissioned by our organisation focused on England, in the FAQs attached to this consultation Qualification Wales also refer to data showing that 20% of schools in Wales do not offer separate science GCSEs as an option, and suggest that as in England, where both routes are available sometimes students are given a choice on which route but sometimes the choice is made by the school.

17. Overall, to what extent do you agree or disagree with our proposal for GCSE The Sciences (Double Award)?

Strongly Agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree
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18. Please explain your answer below.

The Society has long supported a rethink of the existing KS4 science options in England and Wales, first setting out arguments in 2014 as part of SCORE in *The Science at key stage 4: time for a re-think?*

SCORE (2014) http://www.rsb.org.uk/images/score_sciences_at_ks4_final.pdf

In November 2021 The Royal Society of Biology recently published *Evolving 5-19 Biology: recommendations and framework for 5-19 biology curricula*, setting out RSB's vision for biology curriculum as defined in 7 big questions of biology, and set out 8 recommendations for policy makers and curriculum designers. We intend for this document to be a starting point for discussions around curriculum reform and would be happy to meet with Welsh government officials to further discuss the framework.

The full document as well as a summary for policy makers can be found at www.rsb.org.uk/curriculum

Recommendations in *Evolving 5-19 Biology* (page 16+17) include:

the biology curriculum content that is set out in policy and guidance documents should enable coherent learning progression from age 5-19.

the development of biology curriculum policy, guidance and content should draw upon previous curriculum development work and evidence from research where appropriate

the biology curriculum content set out in policy and guidance documents should be clear, teachable and assessable, while allowing scope for innovation in delivery

the biology curriculum should be contemporary yet durable

The Royal Society of Biology welcomes the proposals from Qualification Wales, and to further support our response we have conducted mapping of RSB's *Evolving 5-19 Biology* against the proposed content and appendix.

The Society and its curriculum committee would welcome further discussion and input on the qualification as Qualification Wales move into the final phase of co-construction.