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## **Changes to Science GCSEs in Wales**

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**Institute of Physics response to the Welsh Government's consultation on new  
science GCSEs in Wales**

**A full list of the Institute's submissions to consultations and inquiries can be  
viewed at [www.iop.org](http://www.iop.org)**

**24 November 2014**

1. If you supply contact details, we may contact you for clarification of your answers. We will not provide these details, or details of your answers, to any third party.

2. Are you responding as an individual or on behalf of your organisation?

Organisation

3. Please select type of organisation or choose 'not applicable' if responding as an individual.

Other – Learned Society

4. Please indicate whether or not your organisation operates in Wales or select 'Not applicable' if responding as an individual.

Yes

5. [Individual] Are You? (please select as appropriate)

*It is proposed that a new GCSE science suite should be introduced for first teaching from September 2016. Three pathways\* are proposed:*

- **Science (Double Award)** – containing elements of Biology, Chemistry and Physics – worth 2 GCSEs.
- **Individual Sciences** (Biology, Chemistry, Physics) – as individual GCSEs.
- **An 'Applied' Science (Double Award)** - worth 2 GCSEs. This qualification would have a more context and thematic led approach which might appeal to some learners.

*\*Other, non-GCSE qualifications will remain available in Wales but will not count in the science element of the revised capped points score based on nine qualifications from 2018.*

**6. The Welsh Government expects most learners to take at least two GCSEs in science from September 2016. In light of this, do you think that a single GCSE Science qualification should be developed?**

The stance of the Institute of Physics, and SCORE, remains that the sciences should be taught as individual subjects. Given the breadth and depth of understanding and knowledge that is represented by physics, biology and chemistry it is a reasonable expectation that each learner attain at least two GCSEs in science. As an enabling subject science plays an important role in ensuring that each learner is equipped for whatever future study they choose, and a single science GCSE closes many doors to STEM careers.

There are two important questions relating to a single certificate that need to be addressed: what is its purpose and how will it fit in the whole curriculum – i.e. what will students study if they are not studying the sciences? It is our position that all students should study the same amount of science which occupies of the order of 20% of curriculum time. This time can be gainfully used to provide all students with a useful contribution to a balanced curriculum.

There is, however, a risk in this approach which is that there will be a bias to teaching biology and chemistry over physics. Given the profile of teachers at secondary school level, with physics seriously under-represented, many students will be taught physics by a non-specialist who, however competent, will not enthuse them in the subject. Furthermore, a lack of physics teachers may lead schools to push more students towards biology and chemistry, as they feel more capable of catering to demand in these subjects. There is also a generally held prejudice that physics is a “hard” subject, in which students are less likely to achieve the best results. Students may, consequently, be discouraged from choosing further study in physics. .

It is therefore important to ensure that studying two sciences is seen as the minimum, and not the expectation.

**7. Do you agree that there should be an ‘Applied’ Science (Double Award) GCSE with a contextualised approach as an alternative to the Science Double Award?**

Again, there are questions that need to be addressed: what is the distinct purpose of the Applied Science route (what will it provide that the science GCS route does not provide)? There is merit in the idea that contextualisation aids learning, but if the emphasis is on the context rather than the principle itself, then the utility of what is being gained may be doubtful. There are also questions over where the Applied Science GCSE leads. We have concerns that a student could achieve two A\* grades in double award 'Applied' science and not be able to progress to A-Levels in any of the traditional sciences. This would represent a misleading and unfair system. As with all the routes through science at GCSE level, it should be made abundantly clear where, and how, particular choices will restrict students' options at A-level.

Like the current system, the 'Applied' science route is open to decisions being made by schools in their own interest rather than that of the student. If there is any perception that the 'Applied' science GCSE is an easier option, or if indeed this is the underlying intention, then students who could attain C grades in GCSE double science will be moved onto the 'Applied' option instead to ensure performance measures are maintained. This would severely disadvantage those learners in their progression as it would effectively close the door to A-Levels in the vast majority of STEM subjects, an area which the Welsh Government sees as a priority.

***A number of possible titles have been suggested for the 'Applied' Science (Double Award) GCSE (if it is to be offered) to reflect its alternative approach.***

**8. Please indicate which of the options below you prefer and/or suggest alternatives.**

- *Double Applied Science*
- *Practical Science*
- *Science in Practise*

*Recommendation 24 of the Review of Qualifications states that unitised GCSEs will be allowed with a limit of one resit per unit and the higher mark counting. It is proposed that each Science qualification will be unitised with assessments available in the summer of Year 10 and Year 11. There would be one resit opportunity per unit.*

**9. Do you agree with the proposal outlined above?**

*Recommendation 24 of the Review of Qualifications states that tiering should be allowed in GCSEs 'only where there is a clear case for doing so due to the nature of the subject.' It is proposed to offer Higher (A\*-D) and Foundation tiers (C-G), as is currently the case, for all proposed qualifications in the new GCSE Science suite.*

<b>Higher</b>	A*	A	B	C	D			
<b>Foundation</b>				C	D	E	F	G

**10. Should tiering be retained based on this model?**

*Recommendation 24 of the Review of Qualifications states that the use of ‘controlled assessment’ should be allowed ‘only where there is a clear case for doing so due to the nature of the learning which is to be assessed.’ It is proposed to include an untiered, practical assessment that will be carried out in centres, but will be externally marked by WJEC. Tasks will change annually and the assessment would contribute 10% to the final award in each Science qualification.*

**11. Do you agree that a practical assessment should be part of the qualification and contribute 10% to the overall grade in each of the proposed GCSE Science qualifications?**

Practical assessment should certainly contribute at least 10% of the overall grade. There is a strong case that it could contribute more than 10% to the overall grade, with many existing courses having 25% assessment by practical, but ultimately the weighting should be at a level to reflect the importance of practical science. Whatever the weighting practical assessment is set at, assurances would need to be given that moderation would be appropriate and well-supported to meet needs.

Practical work is an intrinsic part of the specifications. It is vitally important in developing a conceptual understanding of many topics and it enhances the experience and enjoyment of science. It is proposed that there will be a strong emphasis on the completion of practical activities during the courses. Specified practical work that could be naturally integrated into everyday teaching would be identified. This would need to be undertaken by learners so that they are suitably prepared for the written examinations.

**12. Do you agree with the proposal outlined above?**

Yes and the Institute of Physics is willing to provide material help in ensuring that teachers are equipped to deliver this practical work.

**13. Do you think this approach would improve the development of enquiry based practical skills?**

Yes

**Table 1: Proposed assessment structure and the relative weightings for the new Science GCSEs**

<b>GCSE qualification</b>	<b>Summer Year 10</b>		<b>Spring Year 11</b>		<b>Summer Year 11</b>	
<b>Science (Double Award)</b>	<b>DA* Biol 1</b>	<b>15% - 1 hr</b>	<b>Practical</b>	<b>10%</b>	<b>DA Biol 2</b>	<b>15% - 1 hr</b>
	<b>DA Chem 1</b>	<b>15% - 1 hr</b>			<b>DA Chem 2</b>	<b>15% - 1 hr</b>
	<b>DA Phys 1</b>	<b>15% - 1 hr</b>			<b>DA Phys 2</b>	<b>15% - 1 hr</b>
<b>Biology</b>	<b>IS* Biol 1</b>	<b>45% - 1.5 hr</b>	<b>Practical</b>	<b>10%</b>	<b>IS Biol 2</b>	<b>45% - 1.5 hr</b>
<b>Chemistry</b>	<b>IS Chem 1</b>	<b>45% - 1.5 hr</b>	<b>Practical</b>	<b>10%</b>	<b>IS Chem 2</b>	<b>45% - 1.5 hr</b>
<b>Physics</b>	<b>IS Phys 1</b>	<b>45% - 1.5 hr</b>	<b>Practical</b>	<b>10%</b>	<b>IS Phys 2</b>	<b>45% - 1.5 hr</b>

'Applied' Science (Double Award)	Unit 1	22.5% - 1.5 hr	Practical	10%	Unit 3	25% - 1.5 hr
	Unit 2	22.5% - 1.5 hr			Unit 4 (Internal Assessment)	20%

*\*DA = Double Award*

*\*IS = Individual Sciences*

14. For Science (Double Award), do you agree with the assessment structure outlined above?

Yes

15. For Science (Double Award), do you agree with the number of units and frequency of assessment?

16. For Science (Double Award), do you agree with the allocated timing of each unit?

**Table 1: Proposed assessment structure and the relative weightings for the new Science GCSEs**

GCSE qualification	Summer Year 10		Spring Year 11		Summer Year 11	
Science (Double Award)	DA* Biol 1 DA Chem 1	15% - 1 hr	Practical	10%	DA Biol 2 DA Chem 2	15% - 1 hr

	DA Phys 1	15% - 1 hr			DA Phys 2	15% - 1 hr
		15% - 1 hr				15% - 1 hr
Biology	IS* Biol 1	45% - 1.5 hr	Practical	10%	IS Biol 2	45% - 1.5 hr
Chemistry	IS Chem 1	45% - 1.5 hr	Practical	10%	IS Chem 2	45% - 1.5 hr
Physics	IS Phys 1	45% - 1.5 hr	Practical	10%	IS Phys 2	45% - 1.5 hr
'Applied' Science (Double Award)	Unit 1  Unit 2	22.5 % - 1.5 hr  22.5 % - 1.5 hr	Practical	10%	Unit 3  Unit 4  (Internal Assessment)	25% - 1.5 hr  20%

***\*DA = Double Award***

***\*IS = Individual Sciences***

**17. For Individual Sciences (Biology, Chemistry and Physics), do you agree with the assessment structure outlined above?**



Yes

**18. For Individual Sciences (Biology, Chemistry and Physics), do you agree with the number of units and frequency of assessment?**

**19. For Individual Sciences (Biology, Chemistry and Physics), do you agree with the allocated timing of each unit?**

**Table 1: Proposed assessment structure and the relative weightings for the new Science GCSEs**

GCSE qualification	Summer Year 10		Spring Year 11		Summer Year 11	
Science (Double Award)	DA* Biol 1 DA Chem 1 DA Phys 1	15% - 1 hr 15% - 1 hr 15% - 1 hr	Practical	10%	DA Biol 2 DA Chem 2 DA Phys 2	15% - 1 hr 15% - 1 hr 15% - 1 hr
Biology	IS* Biol 1	45% - 1.5 hr	Practical	10%	IS Biol 2	45% - 1.5 hr
Chemistry	IS Chem 1	45% - 1.5 hr	Practical	10%	IS Chem 2	45% - 1.5 hr

Physics	IS Phys 1	45% - 1.5 hr	Practical	10%	IS Phys 2	45% - 1.5 hr
'Applied' Science (Double Award)	Unit 1  Unit 2	22.5 % - 1.5 hr  22.5 % - 1.5 hr	Practical	10%	Unit 3  Unit 4  (Internal Assessment)	25% - 1.5 hr  20%

***\*DA = Double Award***

***\*IS = Individual Sciences***

**20. For 'Applied' Science (Double Award), do you agree with the assessment structure outlined above?**

**21. For 'Applied' Science (Double Award), do you agree with the number of units and frequency of assessment?**

**22. For 'Applied' Science (Double Award), do you agree with the allocated timing of each unit?**

*Recommendation 24 of the Review of Qualifications states that the use of 'controlled assessment' should be allowed 'only where there is a clear case for doing so due to the nature of the learning which is to be assessed.' It is proposed to include an additional non-exam based assessment for the 'Applied' Science (Double Award) GCSE which would contribute 20% towards the final qualification. This would be based upon task(s) that change annually, and be designed to help learners to think critically and in a scientific manner about information and claims that are made, and would involve evaluating different sources of information. To ensure comparability with other Science GCSEs, the assessment will be rigorous, and externally moderated by WJEC.*

**23. Should 'Applied' Science (Double Award) GCSE include non-exam assessment in addition to the 10% practical?**

It is entirely reasonable that a GCSE based around application should have a larger component of assessment outside formal examination. However, as outlined above, it is important that this qualification is not viewed as an easy option. It is therefore important that, if the decision to offer this qualification is made, that this element is very carefully moderated and monitored to ensure that the work presented is entirely that of the student.

**24. If you answered Yes above, should the additional non-exam assessment carry a 20% weighting?**

*The Welsh Government wishes to see a Welsh perspective incorporated as a compulsory element of all GCSE specifications developed for teaching in Wales if the opportunity arises naturally from the subject matter and if its inclusion would enrich learners' understanding of the world around them as citizens of Wales as well as the UK, Europe and the world.*

*It is proposed that a Welsh perspective should be incorporated in each of the GCSE science qualifications taught from September 2016 by use of examples and case studies in order to place learners' understanding of the subject content in the context of the world around them.*

**25. Do you agree with the proposal outlined above?**

It is possible to include a 'Welsh' element within the physics content, although this should flow naturally from the application of understanding (for instance, using the concept of potential energy being lost to do work at the Dinorwig Power Station) and may be better left to the individual teacher to decide which elements of local knowledge they wish to apply.

*All GCSEs developed for teaching in Wales will, where appropriate, include an assessment of learners' writing skills. The Welsh Government has indicated that writing will be assessed through two separate strands:*

*I. Writing Accurately (incorporating language, grammar, punctuation and spelling); and*

II. *Communicating and Organising (incorporating meaning, purposes, readers and structure).*

*These strands will be assessed via the use of a set of embedded performance descriptors for use within the context of an extended answer question, for each GCSE subject. This is in addition to any subject specific marking criteria for each performance band.*

*For example, where three bands are present:*

<b>Performance bands</b>		
<b>Threshold Performance</b>	<b>Intermediate Performance</b>	<b>High Performance</b>
<b>Errors in grammar, punctuation and spelling are likely to impede communication on occasions. Structure and organisation is limited and meaning is often unclear.</b>	<b>Grammar, punctuation and spelling is generally good but with occasional errors. Structure and organisation is usually good and meaning is generally clear.</b>	<b>Grammar, punctuation and spelling is consistently accurate. Structure and organisation is accomplished and meaning is clear.</b>

**26. Do you agree with the proposal outlined above?**

*If the proposals outlined in this paper were adopted, what additional teaching resources would help you deliver the new GCSEs in Science? Please provide details in the box below.*

**27. Additional teaching resources**

**28. Any additional comments**

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