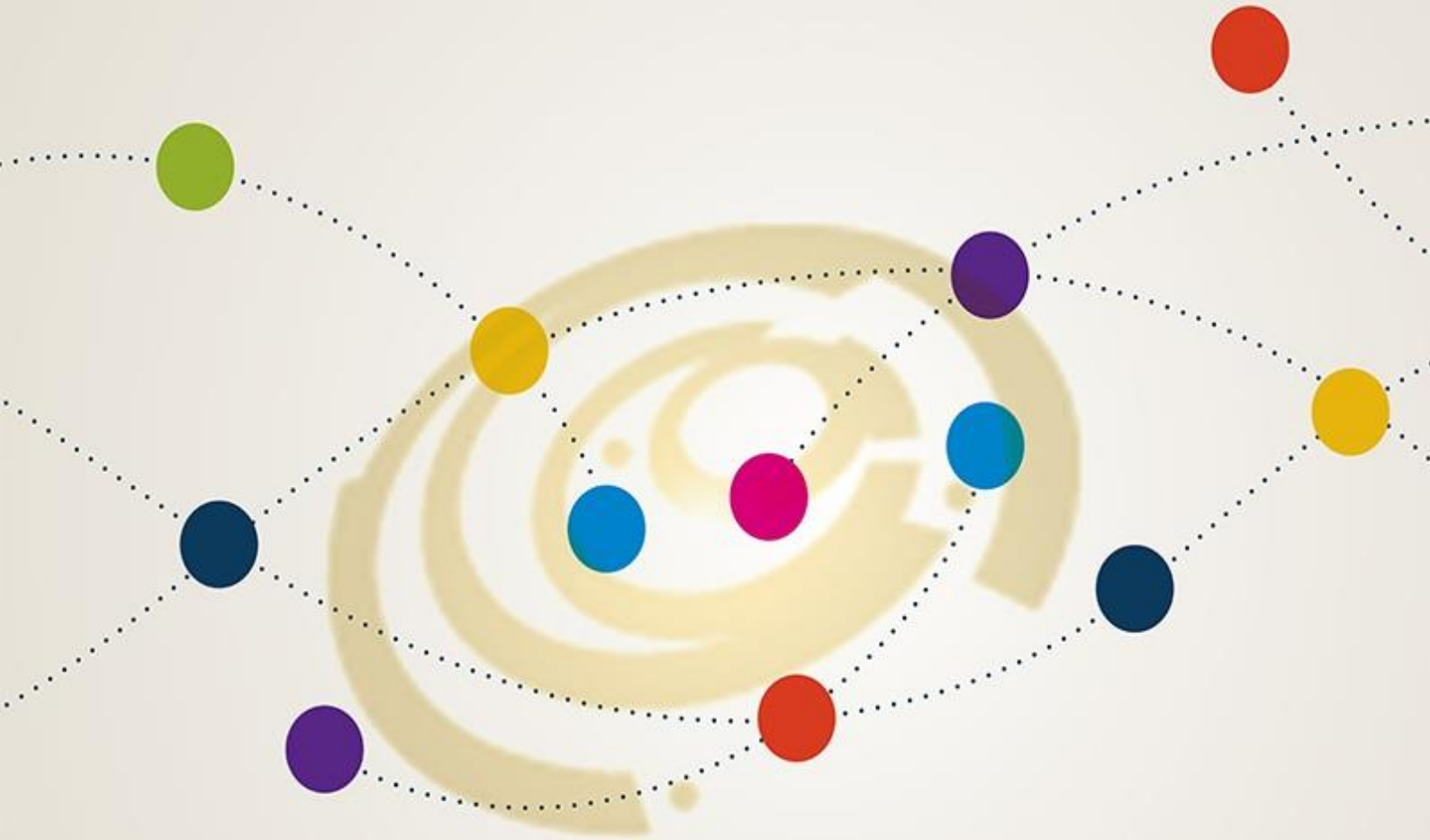

Consultation Report on the draft specification for Junior Cycle Science

NCCA

December 2014

Contents

1. Introduction

The draft specification for Junior Cycle Science was approved for consultation by Council in September 2014. The consultation process consisted of a number of different elements:

- an online questionnaire
- a consultation conference
- focus group meetings with students
- independent evaluation

The aim of this process was to hear the views of a wide range of interests. However, because of industrial relations issues, teachers were unable to participate at this time. The consultation focused, for the most part, on the curriculum specification. Specifically, it sought feedback on the draft introduction, rationale, aim, course overview, strands and learning outcomes for Junior Cycle Science. Consultation on the assessment for certification arrangements was deferred until discussions have taken place between the Minister and the teaching unions.

Online questionnaire

In total, 117 respondents completed the online survey (Appendix 1) with 53% of respondents identifying themselves as post-primary science teachers.

Requests to complete the survey were circulated in several ways: a direct request was sent via an email network of science education partners. A general announcement was posted on the front page of the *juniorcycle.ie* website.

Consultation conference

On the 14th October 2014, a consultation conference was held in Dublin Castle. A wide variety of stakeholders in science education attended (Appendix 2). There were 70 participants representing the second-level students' union, support services for teachers, DES, SEC, management bodies, third-level institutions, business and industry, and the organisations involved in informal science learning initiatives. The participants were divided in five randomly selected focus groups, each group were asked the same questions (Appendix 3) by a facilitator, and feedback was collected by a scribe on a flip chart at each session.

Student focus groups

The perspectives of students on the draft specification was also sought. Two schools were involved in this aspect of consultation. In both, the groups were composed of students from second, fourth and fifth year. The purpose of this engagement was to consult students as experts on their own experience of learning science.

Independent evaluation

An independent evaluation of the draft specification was conducted by Prof Cecília Galvão and Paula Serra, from the Institute of Education at the University of Lisbon. The evaluators were chosen due to their considerable experience in science education, with previous experience in developing, monitoring and evaluating national policies on curriculum development.

They identified the main challenges facing science education in the 21st century, with particular emphasis on those directly related to curriculum development. They undertook an analysis of the extent to which the draft specification addresses those challenges and how solutions presented in the specification compare with the recommendations of experts from recent science education research. The executive summary of this evaluation is included as Appendix 4 of this report, the full report can be accessed from www.juniorcycle.ie.

This report

This report outlines the areas of feedback that emerged from the consultation process and the implications for the further development and implementation of the specification. The main areas of feedback related to:

- Specific sections of the specification
- Pedagogy
- Continuing professional development

2. Feedback from the consultation

In general, the initial impressions of the draft specification are positive. The opportunities for development of skills and deeper learning was welcomed by participants. It was acknowledged that it was different to what was there before but it could build on good practice that exists in schools and is aligned with the recommendations for curriculum development from international science education research. There were a number of concerns raised and challenges identified. It was highlighted that this specification will require a culture change in many schools as it focuses on a different type of learning. There were some fears expressed about assessment, and the nature and quality of continuing professional development (CPD) that will be provided to teachers. The respondents to the online survey expressed very high levels of neutrality, conflicting views were expressed but for each question the balance was to the positive. Considering the industrial relations climate that prevailed during the consultation, this is affirming. The students involved in the focus group meetings expressed great enthusiasm for the specification and the reform of junior cycle science.

The following areas of feedback emerged from the consultation process. A summary of the findings is outlined in Appendix 5.

2.1 Sections of the specification

Rationale and Aim

In general terms, the initial response to the rationale and aim was positive. Participants welcome the focus on encouraging enjoyment, developing scientific literacy and nurturing creativity. At the same time recognising that this is only part of the learning process, it needs to be enacted into the classroom. It was acknowledged that for this to happen it will require, in many schools, a culture change.

The majority of respondents to the online survey expressed the view that engaging students with the new science course would either be effective or very effective in encouraging students:

- to develop a sense of enjoyment in learning science (66%)
- to acquire a body of scientific knowledge (54%)
- to develop key skills, including literacy and numeracy skills (70%)

- to develop a scientific habit of mind through activities that foster investigation, imagination, curiosity and creativity(67%).

Course structure

There is strong consensus that the new course structure represents a welcome development. It is recognised that there is a focus on the *Nature of science*, for which there is strong support. This was viewed as being fundamental to the realisation of the aims of the specification. It was acknowledged that the course structure facilitates a more holistic approach to teaching and learning science which reflects the multi-disciplined approach to solving real-world problems and reality of the world of work. Many participants emphasised the need for adequate supports and professional development for teachers to maximise the possibilities offered by the course structure and to unpack the learning outcomes of the *Earth and space* strand, in particular.

There was general consensus that the traditional disciplines of science are identifiable within the course structure as it is presented. However, some participants expressed a concern regarding the naming of the *Materials* strand. This concern is rooted in the lack of visibility of chemistry and the possible negative impact this may have on future uptake of chemistry at senior cycle.

The inclusion of the *Earth and space* strand elicited a diverse range of views. These views were in the main positive; they supported the inclusion of this strand. It was acknowledged that the strand provided opportunities to nurture students' curiosity, and that it could act as the hook to capture students' interests, from which point students' understanding of important concepts in science can be further developed. This view was unanimously shared by students in the consultation process; they expressed great enthusiasm about the inclusion of this strand. It was also suggested by a small number of participants at the consultation conference that there could be a greater focus on Earth in this strand, or that this strand might be better placed in a specification for junior cycle geography. Finally, it was widely accepted that CPD will be needed to support the teaching of this strand.

Learning outcomes

There was a guarded welcome for the learning outcomes, but genuine fears and constructive concerns about them too. The general consensus regarding the flexibility inherent in the learning outcomes is that it provides freedom that did not previously exist. This presents opportunities for enhancing student motivation in learning science by tailoring activities to local interests and needs, and to topical issues.

On the other hand, there is also a fear that their openness may present challenges for teachers in unpacking them and in planning for teaching, learning, and assessment. There are also concerns surrounding equality of learning opportunities within and between schools because of the perceived potential for teachers and schools to interpret learning outcomes in different ways.

An analysis of the responses to questions relating to learning outcomes in the online survey reveals a high level of neutrality (almost 22% on average) in the responses, and almost 65% of respondents skipped these questions. Both figures are surprisingly high but worth noting; there are no indications as to the reasons for this. The majority of respondents expressed the view that the learning outcomes are appropriate for students in junior cycle, are not content heavy, and encourage students' natural curiosity and wonder about the world. Less than 25% of respondents indicated that they believe the learning outcomes are unclear, and 13% of respondents indicated that the learning outcomes are content heavy.

Respondents to the online survey were asked to indicate how appropriate the learning outcomes for the *Nature of Science* strand are in supporting the development of the students' understanding of scientific skills, attitudes and values, so that they learn what science is and how it works. Analysis of this question reveals an average rating of 3.7 (1= very inappropriate, 5= very appropriate). Respondents were also asked; how appropriate are the learning outcomes for the contextual strands in developing students' content knowledge of science? The learning outcomes for the *Earth and space* strand received the highest average rating of 3.6. The learning outcomes for the *Biological world* and *Physical world* strands received an average rating of 3.42 and 3.36 respectively. The learning outcomes for the *Materials* strand received the lowest average rating, 3.3. However, very few respondents chose to say more in the open response option to this question. Once again, the naming of the *Materials* strand was highlighted as an issue of concern.

The majority of participants in the online survey skipped the open response questions relating to learning outcomes; the responses gathered were mixed but the balance overall was positive. The majority of concerns related to specific areas of content knowledge that were viewed as having been removed from the curriculum or expressed in a different way or placed in a different context.

An analysis of the discussions at the consultation event and the results from the online survey reveals a flexibility-specificity dichotomy with the majority favouring flexibility. However, the freedom this presents appears to generate a sense of apprehension and concern about moving to something new, causing some participants to seek the familiar, namely greater levels of specificity. When explored further, the emerging consensus is that this would remove the flexibility of the learning outcomes, one of the key features of the specification. The earlier consultation on the background paper revealed

similar concerns; in that case, respondents were worried that flexible learning outcomes might give rise to something being examined that had not been covered in class.

The independent evaluation of the draft specification reports that learning outcomes as defined in the specification are aligned with international recommendations. It also reports that the selection and management of content in the draft specification is consistent with international recommendations in science education. Nonetheless, there are a number of suggested amendments to learning outcomes suggested in the report.

Appendices 1-3

The annotated examples included in Appendix 1 were seen as a positive development and welcome support for teachers. However, some examples received a more guarded welcome than others. The commentary on the examples revealed that

- a shared understanding of the purpose of the annotated examples needs to be communicated and developed
- there are unrealistic expectations of what the examples can achieve, such as exemplifying the process that generated the work of students
- there is a strong focus on the content knowledge in the samples regardless of the learning intentions of the task.

There was a wish to see more tasks and a greater variety of tasks. Some participants cautioned against providing too many examples and some concern was expressed about the accessibility of the language in the samples for use in DEIS schools and with EAL students.

The vast majority of respondents to the online survey (70%) expressed the view that the glossary of action verbs in Appendix 2 contribute in a significant way to developing a shared understanding of the learning outcomes. A similar view emerged during the consultation event. However, some respondents were concerned that they may cause confusion while some simply question how they will be used in practice.

There was also a strong welcome for the sample assessment items in Appendix 3. There was consensus that they support and reinforce inquiry-based learning and have the potential to be instrumental in influencing pedagogy in a positive way. Similar to feedback on Appendix 1, some concern was expressed about the literacy levels required to read and understand the items.

2.2 Pedagogy, and its key influencers

One of the main themes emerging from the consultation surrounded the approach to learning and teaching that will be required to realise the potential presented by the specification in the classroom. The factors that affect and influence pedagogy were also the subject of much discussion and comment. The theme of pedagogy, learning and teaching can be divided into the following sub-themes:

- practical work
- inquiry-based learning
- collaboration
- assessment
- textbooks

Practical work

In this report, practical work refers to tasks in which students observe or manipulate real objects or materials. It is not a pedagogical approach, it is a learning activity. In fact different pedagogical approaches can be used to undertake the same practical tasks.

Students were very positive about practical work in science and it is something they would like to do more of. They responded favourably to the absence of a list of prescribed experiments in the draft specification, as many expressed frustration at transcribing a write-up from their textbook or ebook to a laboratory copy. Some students questioned the value of following a given method for which the results and conclusions are already available in their textbook. Students identified the investigations in Coursework B of the current syllabus as one of the most enjoyable experiences of learning science. Given this response, it was not surprising that the same students also responded very favourably to the scientific research tasks outlined in the draft specification.

Those attending the consultation conference emphasised that the specification has the potential to be more engaging and to capture the imagination of students. The flexibility of the learning outcomes and the absence of prescribed practical activities contribute to this. The view was expressed that the prescription of mandatory experiments should not be viewed negatively, but that a cookbook approach to practical work and experimentation represents a potential problem. It was cautioned that

this could happen with the new course if textbooks adopted the same approach as they had for Coursework A of the current syllabus. An alternative view on prescription of experiments and the potential for a 'cookbook approach' was offered by some participants who highlighted the usefulness of such an approach to developing students' laboratory and manipulative skills.

The online survey reveals high levels of neutrality (25%) on the question related to practical work. The majority (54%) indicated that the draft specification provides the flexibility to engage students in practical work that captures students' interests. However, the majority (48%) also indicated that they would prefer a list of mandatory activities. This echoes the flexibility-specificity dichotomy discussed above and the concern about changing the existing course and moving away from the familiar

Inquiry-based learning

There is a broad welcome for the emphasis on inquiry in the specification and for how the specification has been designed to facilitate varying degrees of inquiry depending on the local context, teacher confidence, and the learning intentions of the activity. A small number of participants cautioned against too strong an emphasis on inquiry and highlighted the role and value of inspirational teachers. The prospect of greater opportunity to experience inquiry-based learning was welcomed by students.

Concerns were expressed regarding difficulties some teachers have with this approach and whether adequate supports will be provided to ensure that opportunities for student-led inquiry arise within each year. The greatest fear that emerged about inquiry-based learning is that practice in some classrooms will not change and students' first experience of inquiry might be conducting a scientific research task for assessment for certification in second or third year.

The independent evaluation of the draft specification reported that the course structure *recognises* the centrality of inquiry in learning science (p9). The reports praises the draft specification for not prescribing or favouring

> *any "method" of scientific research; but instead giving relevance to the conditions that "make science, science" (reliability, accuracy, precision, fairness, safety, ethics…) and stressing common practices of investigations (e.g. distinguish questions that are possible to investigate scientifically, design investigations, produce data, identify patterns or anomalies in data, draw and justify conclusions, review). (p10)*

The report also notes the importance given to issues investigations.

Collaboration

The value of collaboration emerged as an important sub-theme of the consultation. This encompasses both teacher collaboration during CPD and in-school planning for teaching, learning, and assessment, as well as student collaboration in the classroom. Some concerns were expressed about readiness of students to collaborate but these were countered by other comments that students coming from primary school are often already familiar with collaborative learning. Group work is another feature of learning in science that students said they would enjoy and value. In general, the views expressed on collaboration were positive and highlight the importance and need for collaboration in planning for teaching, learning, and assessment.

Assessment

Consultation on the assessment for certification arrangements was deferred, and no questions were posed about the proposed assessment arrangements that were set out in Appendix 4 of the draft specification. However, assessment nevertheless emerged as a theme throughout the discussions.

A general view was that, due to contextual and cultural factors, the assessment for certification provisions and arrangements could have a disproportionate influence on the pedagogical approaches adopted in science classrooms. Therefore, the nature of the school work component and final assessment will need to achieve a fair balance in reflecting and aligning with the aims of the specification.

The independent evaluation of the draft specification reported that the assessment arrangements were

> *consistent with the objectives of the curriculum and with international recommendations, and … contains solutions that promote the alignment of the curriculum implemented by teachers to the prescribed curriculum.(p16)*

Textbooks

The view from the consultation was that it will be important that textbooks are aligned with, and underpin, the spirit of the specification. A range of views were expressed on the role of the textbook in junior cycle science. Some predicted they will have a diminishing role as the specification is implemented due to the flexibility of the learning outcomes. However, others suggest that they may

become more influential as some teachers would seek to interpret the specification through a textbook.

2.3 Continuing professional development

The main theme of the consultation conference was the central importance of continuing professional development (CPD) for the introduction of the specification in schools. The draft specification is a welcome but radically innovative change which may require different teaching methodologies and classroom practice for some teachers, and they will need to be fully supported in making this transition. This can be a cause of concern with many questioning the ability of the system to be able to achieve change on this scale. On the other hand, a view repeatedly expressed was that we should take confidence from, and build on, good practice that already exists in classrooms and science initiatives. But overall, the view that adequate and appropriate CPD will be of fundamental importance to the reform of Junior Cycle Science predominated. It was also noted that higher education institutions, business and industry, and teacher professional networks have a role to play in supporting the introduction of the new course.

3. Implications of the consultation

It was evident from the consultation that the draft specification is welcome. The consultation process was very affirming of the work of the NCCA Development Group for Junior Cycle Science. This section of the report looks at ways in which progress can be made on some of the issues raised.

3.1 Areas for further consideration

The consultation process revealed some constructive and considered concerns about particular sections of the specification. Addressing these concerns will be the immediate focus of the development group. The following are areas to be considered:

- The nomenclature of the strands: Particularly, the naming of the *Materials* strand and how to ensure visibility and parity of esteem for the traditional discipline of chemistry
- Learning outcomes: Some suggestions for amendments to the learning outcomes were collected during the consultation process. The majority of the feedback relates to the learning outcomes for the Nature of *Science*, suggestions for the review of the *Materials* strand, and an additional learning outcome was proposed for the *Biological world* strand.
- Annotated examples of student work: Further consideration will be given to ensuring that the purpose of these samples is communicated accurately.
- Features of quality: Due to the diversity of tasks and presentation formats that students can employ in the school-based components of assessment, the features of quality will need to be monitored in the first years of their introduction and use. It may be advisable to work with practicing teachers from a range of school contexts to trial and revise the features of quality used for assessment for certification.
- Presentation: The role of infographics in facilitating the faithful interpretation and lively presentation of the specification will be considered.

3.2 Continuing professional development

As noted above, CPD emerged as the dominant theme of the consultation. The key challenge for CPD is to effectively support translating of the aims of the specification into real practice. It was acknowledged that the change process may initially be difficult and will require time and supports. The following areas should provide a focus for CPD:

- Unpacking and interrogating learning outcomes to plan for teaching, learning, and assessment
- Building assessment capacity
- The *Nature of science* and its integration into classroom practice
- Introducing new methodologies to support varying degrees of inquiry-based learning
- Supporting an integrated approach to teaching and learning science

The form and nature of CPD was also the subject of discussion throughout the consultation. It was felt that CPD should be:

- Discursive
- Collaborative
- Ongoing

A communities of practice model was viewed as having the greatest potential for supporting the introduction of the specification. This model can be applied within schools, in local education centres, and in online forums.

Consideration should also be given to the role that higher education institutions, business and industry, and teacher professional networks can play in the provision and support of CPD; and how this could be coordinated to maximise the uptake and success of related initiatives.

4. Conclusion

The consultation process was very informative and beneficial. While many teachers were unable to participate at this time, the level of engagement of those who did and of participants from such a wide variety of stakeholders must be acknowledged and NCCA is grateful for the open, honest, committed, experience-based and expert feedback received.

The consultation findings indicate strong support for the direction that science education is taking at junior cycle through the draft specification. It is acknowledged that the achievement of progress and momentum in travelling in this direction has implications for the culture of classroom and schools, for learning and teaching, and for teachers and schools. The outcomes of the consultation suggest that provision of adequate and sufficient CPD, and changing assessment practices are fundamental to the successful introduction of the draft specification of Junior Cycle Science.

Echoing the initial consultation on the background paper, this consultation also established that the single greatest challenge to realising this specification in the classroom will be supporting teachers in dealing with any pedagogical challenges they may face as they implement the specification in their classroom.

Appendix 1

Online survey used during the consultation on the draft specification

Introduction

The aim of this process is to hear the open and honest views of teachers/parents/students and interested parties on the draft curriculum and assessment specification for junior cycle science. This consultation will involve gathering feedback through this survey, a consultation conference and targeted meetings.

The NCCA would greatly appreciate your feedback. This feedback will inform the further work on the development of the junior cycle science specification. Please read the draft specification which can be accessed here. Then complete this questionnaire as fully as possible but feel free to skip any item that is not relevant to you.

Participant's details

***1. I am responding as a ...**

- ◯ Science Teacher
- ◯ Non-science Teacher (Post-primary)
- ◯ Primary teacher
- ◯ Principal/ Deputy Principal (Post-primary)
- ◯ Principal/ Deputy Principal (Primary)
- ◯ Second level student
- ◯ Third level student
- ◯ Parent/ Guardian
- ◯ Teacher educator
- ◯ Pre-service Teacher
- ◯ Third level lecturer/researcher
- ◯ Other

Other (please specify)

2. Responding on behalf of ... (if applicable)

3. School type (if applicable)

- ◯ Voluntary secondary school
- ◯ Community school
- ◯ Comprehensive school
- ◯ Vocational school
- ◯ Community college
- ◯ Other

Other (please specify)

4. Did you participate in the consultation on the background paper for Junior Cycle Science?

- ◯ Yes
- ◯ No

5. You can provide your name and email address to enable us to follow-up on particular issues that you may identify. However, the survey data will be anonymised and we will ensure that no views that you articulate will be attributed to you or your school/organisation or be reported in any way that would allow you or your school/organisation to be identified.

Name

Email address

General Information

In this section of the survey we invite you to comment on your overall response to the draft specification

6. Please indicate your level of agreement with each of the following statements:

	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
The Rationale and Aim sections give me a clear account of what the specification sets out to achieve	◯	◯	◯	◯	◯
The layout of the specification is unclear	◯	◯	◯	◯	◯
The Links section of the specification explains how science is linked to central features of learning and teaching at junior cycle.	◯	◯	◯	◯	◯
The Overview section of the specification provides a useful summary of what will be studied	◯	◯	◯	◯	◯
There is a clear structure to the strands and elements	◯	◯	◯	◯	◯
The learning outcomes are clear	◯	◯	◯	◯	◯
The language is difficult to understand	◯	◯	◯	◯	◯

Rationale and Aim

The Rationale and Aim for junior cycle science were drafted to reflect and elaborate on the purposes for junior cycle science outlined in the background paper, for which there was a strong consensus in the consultation process.

7. Engaging students with this draft specification would be...

- ◯ ...very effective in encouraging them to develop a sense of enjoyment in learning science
- ◯ ...effective in encouraging them to develop a sense of enjoyment in learning science
- ◯ ...ineffective in encouraging them to develop a sense of enjoyment in learning science
- ◯ ...very ineffective in encouraging them to develop a sense of enjoyment in learning science

8. Engaging students with this draft specification would be...

- ◯ ...very effective in encouraging them to acquire a body of scientific knowledge
- ◯ ...effective in encouraging them to acquire a body of scientific knowledge
- ◯ ...ineffective in encouraging them to acquire a body of scientific knowledge
- ◯ ...very ineffective in encouraging them to acquire a body of scientific knowledge

9. Engaging students with this draft specification would be...

- ◯ ...very effective in encouraging them to develop key skills, including literacy and numeracy skills
- ◯ ...effective in encouraging them to develop key skills, including literacy and numeracy skills
- ◯ ...ineffective in encouraging them to develop key skills, including literacy and numeracy skills
- ◯ ...very ineffective in encouraging them to develop key skills, including literacy and numeracy skills

10. Engaging students with this draft specification would be...

- ◯ ...very effective in encouraging them to develop a scientific habit of mind through activities that foster investigation, imagination, curiosity and creativity
- ◯ ...effective in encouraging them to develop a scientific habit of mind through activities that foster investigation, imagination, curiosity and creativity
- ◯ ...ineffective in encouraging them to develop a scientific habit of mind through activities that foster investigation, imagination, curiosity and creativity
- ◯ ...very ineffective in encouraging them to develop a scientific habit of mind through activities that foster investigation, imagination, curiosity and creativity

If you wish, please outline any additional comments you have regarding the Rationale and Aim as set out in the draft specification.

Scientific inquiry and Practical activities

The following concerns were identified in the consultation on the Background paper:
• The extent to which students engage in genuine scientific investigations
• The list of mandatory experiments in Coursework A was too long, too prescriptive and fails to capture students' interests.

11. Please indicate your level of agreement with each of the following statements.

	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
The draft specification provides the flexibility to engage students in practical work that captures students' interests	◯	◯	◯	◯	◯
I'd prefer a prescribed list of mandatory practical activities	◯	◯	◯	◯	◯
The draft specification increases the possibilities for students to engage in genuine scientific inquiry	◯	◯	◯	◯	◯

If you wish, please outline any additional comments regarding scientific inquiry and practical activities in the junior cycle science.

Course structure.

The consultation on the background paper revealed that there:
• was a consensus that the nature of science should be moved to the core of the curriculum
• was no over-arching consensus on which is the preferred approach to structuring the new junior cycle science specification. Some respondents favoured a thematic approach whilst others supported the retention of the traditional division of science into the discrete disciplines of physics, chemistry and biology. The course structure of the draft specification attempts to reconcile both views.

12. Regarding the course structure junior cycle science, please respond to the following statements showing your level of agreement.

	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
The Overview section provides a clear description of the Stands of the specification	◯	◯	◯	◯	◯
The Overview section provides a clear description of the Elements of the specification	◯	◯	◯	◯	◯
The traditional divisions of science are not easy to identify	◯	◯	◯	◯	◯
A thematic approach to planning teaching and learning is facilitated in this proposed structure	◯	◯	◯	◯	◯
The unifying strand moves the nature of science to the core of the curriculum	◯	◯	◯	◯	◯

You may wish to add further comments in relation to how the draft junior cycle science specification could be structured. If so, please use the space below.

Learning outcomes

13. Please indicate your level of agreement with the following statements.

The learning outcomes in the draft specification...

	Strongly disagree	Disagree	Neutral	Agree	Strongly Agree
...are appropriate for students of science in junior cycle	◯	◯	◯	◯	◯
Please tell us why					
...are not content heavy	◯	◯	◯	◯	◯
Please tell us why					
...are unclear in describing the understanding, skills and values students should be able to demonstrate	◯	◯	◯	◯	◯
Please tell us why					
...encourage students' natural curiosity and wonder about the world to be nurtured	◯	◯	◯	◯	◯
Please tell us why					
...enable students to develop an understanding of the world around us and the wider universe	◯	◯	◯	◯	◯
Please tell us why					
...support students in making informed decisions about science related issues they will face	◯	◯	◯	◯	◯
Please tell us why					

14. Strand 1, The Nature of Science

How appropriate are the learning outcomes for the Nature of Science in supporting the development of the students'.....

	Very inappropriate	Inappropriate	Neutral	Appropriate	Very appropriate
....understanding of scientific skills, attitudes and values so they learn what science is and how scientists work	◯	◯	◯	◯	◯
Please tell us why					

15. Strand 2-5, Contextual strands

How appropriate are the learning outcomes for the contextual strands (Earth and space, Materials, Biological world, Physical world) in developing students' content knowledge of science?

	Very inappropriate	Inappropriate	Neutral	Appropriate	Very appropriate
Learning outcomes for Earth and space	◯	◯	◯	◯	◯
Please tell us why					
Learning outcomes for Materials	◯	◯	◯	◯	◯
Please tell us why					
Learning outcomes for Biological world	◯	◯	◯	◯	◯
Please tell us why					
Learning outcomes for Physical world	◯	◯	◯	◯	◯
Please tell us why					

16. Appendix 1 of the draft specification includes annotated examples of student work in support of teacher judgement.

Please comment on the concept of using annotated examples of student work by responding to these statements.

	Strongly disagree	Disagree	Neutral	Agree	Strongly Agree
They examples show how learning outcomes link to classroom work	◯	◯	◯	◯	◯
The examples did not help to indicate the standard of work one might expect	◯	◯	◯	◯	◯
The examples show how the Nature of Science permeates other strands	◯	◯	◯	◯	◯

Additional comments

17. The glossary of action verbs included in Appendix 2 ...

◯ ...are not very useful.

◯ ...contribute to developing a shared understanding of the learning outcomes.

Other (please specify)

18. Appendix 3 includes some suggested sample assessment items. Please indicate you level of agreement with the following statements.

The questions included in appendix 3 focus on assessing....

	Strongly disagree	Disagree	Neutral	Agree	Strongly Agree
...knowledge and recall of facts	◯	◯	◯	◯	◯
...application of knowledge and understanding to familiar and unfamiliar situations	◯	◯	◯	◯	◯
...ability to form reasonable and logical argument based on evidence	◯	◯	◯	◯	◯

If you wish, please outline observations you would like to make regarding the sample items provided in appendix 3.

Suggestions for improvement

19. In your opinion, are there areas of the specification that should be revised?

◯ Yes

◯ No

If yes, please specify which area(s), explain why these changes should be made, and suggested improvements to this area of the specification.

20. In this final section we invite you to comment on the scope of the specification and its implications for students and teachers. In particular, we would welcom4 any observations you might have on the assessment arrangements detailed in Appendix 4, Work to date on potential assessment arrangements. Please include any other general comments that you might wish to make here also.

Thank you

Thank you for taking the time to complete this questionnaire. Please do not forget to press 'Submit' when you are finished.

A summary of the findings will be published on the NCCA website at the end of the consultation.

Appendix 2

List of organisations/institutions represented at the consultation conference

3M Ireland Limited

Association of Community & Comprehensive Schools (ACCS)

Airfield Education Outreach Centre

Amgen

Analog Devices

AoL

Ballina Beverages

Blackrock Education Centre

CASTEL - Dublin City University

Curriculum Development Unit/Education &Training Board Ireland (CDETB)

Department of Education and Skills

Dublin Institute of Technology

Dublin City University

Dublin Institute for Advanced Studies

Educate Together

Educational Research Centre

Engineers Ireland

Ericsson

Education and Training Board Ireland

Galway Education Centre

Google

Higher Education Authority

Hibernia College

IBM

Irish Congress of Trade Unions

Intel Ireland

Irish Primary Principals Network

Irish Second-level Students' Union (ISSU)

Irish Science Teachers Association

Junior Cycle for Teachers (JCT)

Joint Management Body (JMB)

National Centre for Excellence in Mathematics and Science Teaching and Learning

National University of Ireland Maynooth (NUIM)

Professional Development Service for Teachers (PDST)

Pharma-Chem lreland

Royal Dublin Society

National University of Ireland Galway (NUI), School of Education.

Science Foundation Ireland (SFI)

Science Gallery Dublin

Sustainable Energy Authority Of Ireland (SEAI)

SFI Discover

State Examinations Commission

Trinity College Dublin

University College Cork

University College Dublin

University of Limerick

Appendix 3

Consultation conference: Focus group questions

- What were your initial impressions when you read the draft specification?
- What do you think of the Rationale and Aim as set out in the draft specification?
- What do you think of the Course structure as set out in the draft specification?
- In your opinion, does the draft specification address the following concern identified in the consultation on the background paper?

  The extent to which students engage in genuine scientific investigations

  The list of mandatory experiments in Coursework A was too long, too prescriptive and fails to capture students' interests.
- What is your opinion of the learning outcomes as set out in the draft specification?
- In your opinion, do you think these additional materials are useful in supporting the implementation of the draft specification in the classroom?

Appendix 4

Executive summary from *Draft specification for junior cycle science: review and critique* (Galvão and Serra, 2014)

EXECUTIVE SUMMARY

The position presented here focuses on the *Draft Specification for Junior Cycle Science* report (September, 2014), which was produced by the National Council for Curriculum and Assessment (NCCA). To clarify the goals and objectives, and the level to which these have been met, we also analysed the *Background Paper and Brief for the Review of Junior Cycle Science* (September, 2013).

In order to support our position, we reviewed a selection of reports and recommendations for science education (Table 1) from various internationally renowned publications. From this review, we identified the main challenges related to curriculum development facing science education in the 21st century. Other challenges, such as teacher training, schools' management and non-formal science education can determine the direction and effectiveness of science education for young people. However, as these challenges are not directly related to the curriculum, they were not considered in the present report.

Table 1- Reports and recommendations selected for review

Biological Sciences Curriculum Study (BSCS). (2007). *A decade of action: Sustaining global competitiveness. A synthesis of recommendations from business, industry, and government for a 21st-century workforce*. Colorado Springs, CO: BSCS.

Fensham, P. (2008). Science education policy-making: Eleven emerging issues. UNESCO.

European Commission (2004). *Europe needs more scientists: Report by the high level group on increasing human resources for science and technology in Europe*. Brussels: European Commission.

National Research Council (2007). *Taking science to schools. Learning and teaching science in Grades K-8.* R. A., Duschl, H. A., Schweingruber, A. W., Shouse (Eds.). Committee on Science Learning, Kindergarten through Eighth Grade. Washington, DC: The National Academies Press.

National Research Council (2012). *A framework for K-12 science education: Practices, crosscutting concepts, and core ideas*. Washington, DC: The National Academies Press.

OECD (2013). *PISA 2012 assessment and analytical framework*. OECD Publishing.

European Commission (2007). *Science education now: A renewed pedagogy for the future of Europe*. Brussels: European Commission.

European Commission/Eurydice (2011). *Science education in Europe: National policies, practices and research*. Brussels: EACEA.

Osborne, J & Dillon. J. (2008). *Science education in Europe: critical reflections.* London: The Nuffield Foundation.

Royal Society (2014). *Vision for science and mathematics education.* London: The Royal Society Policy Centre.

In this report, we present challenges for curriculum development that were identified in the literature, we analyse the extent to which the *Draft Specification for Junior Cycle Science* (***JC Science Specification***) meets these challenges, and examine how the solutions presented in the specification converge with the recommendations of the experts.

Main conclusions

Challenge 1: Motivation for students to pursue science-related professions

The *JC Science Specification* recognises the importance of this purpose of science education and presents some solutions. Furthermore, it consistently addresses this challenge throughout all components of the document: aim, strands of knowledge, learning outcomes and assessment. The specification explicitly ensures that this aspect of the curriculum will be at the forefront for those responsible for its implementation and with transforming the school science in an attractive and motivating subject, in particular teachers, authors of textbooks, school leaders and teachers' educators.

Challenge 2: Scientific literacy/science for all

In line with the international research, the *JC Science Specification* recognises the need for students to be involved in the analysis and discussion of real socio-scientific issues, during which they can weigh up different interests and come to recognise the relevance of knowledge and scientific reasoning for solving problems, and for empowering citizens to analyse those problems. The specification document includes strategies for achieving those goals which are apparent at various levels: in the selection of content in each of the strands of knowledge; in the learning outcomes; in the assessment; and in the teachers' guidelines.

Challenge 3: Nature of Science/how science works: the construction of authentic inquiry tasks

The *JC Science Specification* states that Nature of science is the unifying strand that permeates all the four contextual strands: Physical world, Materials, Biological world, and Earth and space. In doing so it recognises the centrality of inquiry in science learning. Establishing transversal components in the curricula without a clear specification of what should be taught and why, may cause the components to be forgotten by teachers and textbooks. Thus, we

consider it important that the *JC Science Specification* has explained the components of the learning outcomes in the Nature of science strand. We highlight as a strong point of this component of the curriculum, which is in line with international recommendations, that it does not prescribe or favour any 'method' of scientific research; but instead gives relevance to the conditions that 'make science, science' (reliability, accuracy, precision, fairness, safety, ethics etc.). We also note the importance given to research focused on controversial issues, which require the intersection of information and diverse perspectives and the application of criteria of scientific validity, with the goal to facilitate rational and unbiased appraisal. Looking at the learning outcomes as a very important component of the curriculum, we propose some changes, showing the corresponding reasons.

Challenge 4: Selection and exploration of topics

The *JC Science Specification* is in line with international recommendations in this area. It establishes four large areas of scientific knowledge as contextual strands: Earth and space, Physical world, Materials and Biological world. For each of these areas of knowledge, it establishes a set of learning outcomes concerning a restricted set of concepts and theories, which reflect the main explanatory ideas of each area. We suggest the addition of one more item in the Energy element of the Biological world strand: 'Explain how matter and energy flow through ecosystems'.

Challenge 5: Learning outcomes

The definition of learning outcomes in the *JC Science Specification* is in line with international recommendations, as is the linking of learning situations for enacting competencies to scientific inquiry. However, to fully meet the curriculum objectives, we consider that some areas could be improved. We suggest the addition of a figure representing the integration of inquiry skills, attitudes and knowledge (the essence of learning outcomes). Similarly, in each table concerning the learning outcomes for the contextual strands (Earth and space, Materials, Physical world and Biological world) it should be possible to cross between the four elements that are associated to the Nature of science strand.

Challenge 6: Curriculum, teaching and assessment aligned with each other

The *JC Science Specification* is aligned with the international research in this area: the specification places a significant proportion of the summative assessment within the classroom, and places formative assessment in a prominent role for promoting scientific learning. In addition to this evaluation component, the *JC Science Specification* establishes a final assessment of an examination paper at a common level, with a weight of 60%. The *JC Science Specification* offers sensible and balanced solutions that take advantage of the benefits of each type of assessment (school work assessment and final assessment) and that compensate for the limitations of each one. In summary, the assessment model proposed by the *JC Science Specification* is consistent with the objectives of the curriculum and with international recommendations, and it contains solutions that promote the alignment of the curriculum implemented by teachers to the intentional curriculum.

Appendix 5

Summary of findings emerging from the consultation

1. In general terms, the initial response to the draft specification is positive.
2. The response to the rationale and aims is also positive. Participants welcome the focus on encouraging enjoyment, developing scientific literacy and nurturing creativity.
3. There is strong consensus that the new course structure represents a welcome development.
4. There is a guarded welcome for the learning outcomes, there are genuine fears and constructive concerns about them too.
5. The annotated examples included in Appendix 1 are a positive development and welcome support for teachers. However, some examples were better received than others.
6. The vast majority of respondents to the online survey expressed the view that the glossary of action verbs in Appendix 2 contributes in a significant way to developing a shared understanding of the learning outcomes.
7. There is a strong welcome for the sample assessment items in Appendix 3. There is consensus that they support and reinforce inquiry-based learning and have the potential to be instrumental in influencing pedagogy in a positive way.
8. Those attending the consultation conference emphasised that the specification has the potential to be more engaging and to capture the imagination of students. The flexibility of the learning outcomes and the absence of prescribed practical activities contribute to this.
9. There is a broad welcome for the emphasis on inquiry in the specification and for how the specification has been designed to facilitate varying degrees of inquiry.
10. The value of collaboration emerged as an important theme of the consultation.
11. Assessment for certification will have a very significant influence on the pedagogical approaches adopted in science classrooms.
12. It will be important that textbooks are aligned with, and underpin, the spirit of the specification.
13. The main theme of the consultation conference was the central importance of continuing professional development (CPD) for the introduction of the specification in schools. The draft specification is a welcome but radically innovative change which may require different teaching methodologies and classroom practice for some teachers, and they will need to be fully supported in making this transition.