An Chomhairle Náisiúnta Curaclaim agus Measúnachta
National Council for Curriculum and Assessment

Draft Consultation Report on the Background Paper for Junior Cycle Science

February 2014

Table of Contents

Science

1. Introduction

1.1 Consultation process

The background paper and brief for junior cycle science was approved for consultation by Council in September 2013. The NCCA's consultation process began in October 2013 and concluded on the 17th January 2014. The consultation process consisted of a number of different elements:

- an online questionnaire (both quick response and extended response questionnaires)
- an invitation for written submissions
- focus-group meetings.

The aim of this process was to hear the open and honest views of the public on the background paper and brief for junior cycle science.

1.2 Online questionnaire and invitation to make written submissions

In total, 315 respondents completed the online surveys: 9 respondents to the short response survey and 306 respondents to the extended survey.

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. The Irish Science Teachers' Association (ISTA) made a number of direct requests via their email network of science teachers.

Almost 80% of the respondents to the extended response survey were teachers, 3% were parents, and 4.6% were third-level lecturers/researchers.

In addition to the online questionnaire, there was an invitation to make written submissions. In total, 8 written submissions were received (Appendix 1). They ranged in length from 1000 to 6500 words.

1.3 Consultation meetings

Two consultation meetings were held, as follows:

1. 21st November 2013: a focus group of 16 science teachers. Each teacher represented a school from within the NCCA school network.
2. 8th January 2014: a focus-group meeting with a group of 12 students from two schools. Due to unforeseen circumstances, students from a third school were unable to attend, resulting in a smaller sample than anticipated.

Other organisations held consultation meetings to inform their responses to the consultation.

1.4 Focus of the consultation

The main areas of focus of the consultation meetings and online survey were

- the purposes of junior cycle science
- concerns regarding science education
- course structure and implications for progression
- features of 21st century science specifications
- assessment in junior cycle science
- the brief for the review of junior cycle science.

While some of the submissions focused on broader issues such as suggestions for models of professional development, almost all of the submissions provided feedback on the issued outlines above. Many of the submissions contained detailed comments and suggestions for the development of the new curriculum and assessment specification for junior cycle science.

2. Feedback from the consultation

In general, the background paper was welcomed by participants in the consultation. While there were a number of concerns raised and challenges highlighted, there was a shared sense of a need to reform junior cycle science. Some respondents criticised or referenced a lack of detail on aspects such as course content and assessment despite the fact that such details can really only emerge from the development process. The following areas of feedback emerged from the consultation process.

2.1 The purposes of junior cycle science

There is a clear consensus emerging that junior cycle science can help prepare students to become scientifically informed citizens, will improve their preparation for employment and further studies; junior cycle science has a role to play in increasing awareness of environmental issues , and has the potential to improve our future economy.

> *Junior cycle science should help to stimulate an interest in science and support better informed citizens as well as supporting the continued flow of future potential scientists. This needs to reflect the reality that within the junior cycle (JC) student population there will be students whose formal science education will cease following JC as well as those who will continue with science to senior cycle and further.* (Royal Irish Academy (RIA))

> *The sciences are an important part of students' cultural inheritance, whether or not they go on to work in the sciences.* (Institute of Physics in Ireland (IOP))

There were 104 responses to the open comments associated with this question on the online survey. A large portion of this commentary related to the importance of developing analytical thinking skills and promoting creativity and curiosity. This was also the overarching consensus of the teachers who attended the focus-group meeting. It was acknowledged by many respondents that an inquiry-based learning (IBL) approach would be necessary to realise these purposes.

Based on our experience in the Discover Sensors project, SFI is convinced that a new JC science programme, focused on inquiry based approaches, has the potential to equip young people with a deep understanding of science allowing then to progress to third level, and/or gain employment in important business/industry sectors in the Irish economy. (Science Foundation Ireland)

The linkages between science and the key skills are rooted in inquiry, process knowledge, experimental design, and scientific reasoning - all elements of the scientific method. It is this method that must be at the heart of any new curriculum – not rote learning. (Professional Development Service for Teachers (PDST))

There is a strong consensus that supports the purposes proposed for junior cycle science in the background paper and that this can be achieved through IBL. However, it is acknowledged that such an approach will require reduction of content and there are some concerns associated with this: these are explored in section 2.2 below.

2.2 Concerns regarding science education

Question 5 of the online survey set out to get an overview of the role of science in junior cycle and to explore respondents' views on the current curriculum and how it supports inquiry-based learning.

As can be seen from Table 1, almost 92% do believe that an important role of science is to prepare students with sufficient core knowledge so that they can acquire, interpret and understand additional information on their own. However, respondents expressed mixed views as to whether students learn science in an investigative way. A small majority of 57% indicated that students do not learn science in an investigative way throughout the three years of junior cycle, while 30% believe that they do learn in an investigative way. The results of the responses to the final statement presents another interesting result, with 43% expressing the view that the list of practical activities in the current syllabus does not enrich our students' experience of science, while 43% of respondents have an opposing view.

Table 1: Concerns regarding science education

Answer options	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
An important role of science is to prepare students with sufficient core knowledge so that they can acquire, interpret and understand additional information on their own.	3.1%	2.7%	2.7%	43%	48.8%
Our current junior cycle students do not learn science in an investigative way throughout the three years of junior cycle.	9.3%	20.9%	12.8%	43.4%	13.6%
The list of practical activities in the current syllabus does not enrich our students' experience of science.	10.1%	33.3%	14%	29.8%	12.8%

These figures can be greater understood by analysing the open-ended question. 68 respondents made additional comments when answering this question. These were thematically analysed with the feedback from the written submission and focus-group meetings. The themes that emerged were focused on

a) current practical work arrangements
b) curriculum content and how it is assessed
c) our understanding of inquiry-based learning (IBL).

a) Concerns regarding current practical work arrangements

Many respondents indicated that the list of mandatory experiments in Coursework A was too long, too prescriptive and fails to capture students’ interest.

> *We would like less write ups because filling up in a write-up for so long is a waste.* (Student, focus-group meeting)

It was acknowledged by many respondents that the intentions of Coursework B was an important step forward in science education in Ireland. However, there was a strong consensus that it has not been utilised in the way it was envisioned. The consensus was that Coursework B, in its current form, was not promoting a truly investigative approach. The most commonly cited reasons for this related to the layout of the pro-forma booklet, the phraseology used and how the coursework is assessed.

> *..the Coursework B pro-forma booklet has caused great difficulty for students in Junior Certificate (age 15,) particularly the difficult wording of the booklet. This has led to the teachers providing considerable help to students when completing their projects.* (National Centre for Excellence in Mathematics and Science Teaching and Learning (NCE-MSTL))
>
> *The coursework B section is assessed in a way which does not reward scientific thinking, rather it rewards pupils who follow a formulaic approach to writing up. There is no benefit in students coming up with original experiments and often that works against them.* (Teacher, online survey)
>
> *The two Coursework B investigations currently required to be carried out in 3rd year was viewed as too demanding and it was felt that if one such investigation was carried out in 2nd year and the other in 3rd year, this would be more appropriate.* (ISTA)

b) Curriculum content and assessment

The view was expressed that the current curriculum was content heavy, leaving teachers 'time poor', resulting in many teachers resorting to a didactic style of teaching where rote learning is favoured. Many respondents were of the belief that the terminal assessment rewards memory above understanding. The wide breadth of content and the final assessment paper were also listed as disincentives to promoting inquiry-based learning.

> *Little genuine investigation occurs. Facts are memorised. Understanding is not tested effectively.* (Online survey)
>
> *Teachers are over influenced by the terminal assessment and the need to cover facts. They often state that they start with inquiry methods but eventually have to move on to ordinary teaching, There is a disconnect between teaching and learning. Teachers have to justify "covering material" and there is little appreciation of the fact that just because*

something is "taught" is no indicator of what is learned or understood. Just moving on is not justifiable. (Online survey)

Junior ISTA members expressed concern that the current course is too long and that fewer topics should be included in the new subject specification but that these should be developed in more detail. This would provide teachers with more time to develop student interest and to adopt an enquiry-based approach to learning. (ISTA)

Generally it is felt that the 2003 syllabus is overloaded with content. This prevents students and teachers engaging fully with the practical nature of the syllabus from a position of inquiry. (PDST)

There is a broad consensus for the reduction of content knowledge in order to facilitate deeper understanding. Associated with this consensus, there is also a fear that reducing content knowledge could make the progression to senior cycle more difficult for students. It is accepted by many that the learning outcomes will need to be broad enough to allow for flexibility and should not be prescriptive. This raised concerns relating to depth of treatment.

There is concern that there may not be sufficient guidance to inform teachers regarding the depth of coverage required. This may result in varying levels of outcomes and competence leaving some students at a disadvantage entering senior cycle. (Ibec)

The issue of learning outcomes being specific as to depth of treatment needs to be addressed. (PDST)

c) Inquiry-based learning

All of the written submissions welcomed the emphasis on IBL. However, many expressed some concerns regarding the extent to which IBL approaches are being used, the time demands required of teachers using IBL, and the difficulties some teachers have with this approach.

> *While the intention of the current Junior Cert science syllabus is to encourage inquiry based teaching and learning, our experience from Discover Sensors indicates that this is not happening in classrooms. Science teachers often tend to be dependent on the text book. While the practical activities in the current syllabus have the potential to enrich the science experience, they are in the main followed in a prescriptive fashion by teachers and students.* (SFI)

An analysis of the comments of the online survey revealed that there are opposing views of how best to approach inquiry-based learning. This divergence may be rooted in different understandings of how students learn. Some respondents believe that content knowledge can be built through inquiry while others believe that a strong foundation of science content knowledge must be established before effective inquiry can occur. The following comments from the online survey illustrate this dichotomy.

> *If we want our students to think like scientists then we must help them to develop an inquiry based disposition. Further, in order to facilitate informed inquiry in the classroom we need a science syllabus that still respects the importance of content knowledge. Just because skills/competencies development is the current 'fashion' in educational change in Ireland and internationally doesn't mean we have to abandon content knowledge entirely.* (Science teacher, online survey)

> *I feel that there is a distorted view on the nature of inquiry in JC science education. It has become linked purely to practical work and things such as coursework B, which is not the case. Developing an inquiry based disposition amongst teachers and students can happen through enriching activities without the need for experimentation.* (Science teacher, online survey)

There is also a sense from some of the commentary that a reduction in content knowledge to provide the time and opportunities for deeper learning is associated with *dumbing down* science.

> *When I look at old texts that were used for the Inter Certificate, I see at first hand how we have dumbed down the science course that we offer in*

schools. Investigative learning can only be achieved when students have a base knowledge that can be added to. The coursework B section of the current course is an absolute proof of this. Without total teacher input many students don't have any real scientific understanding of concepts that are being put forward. (Science teacher, online survey)

Earlier it was stated that almost 92% of respondents believed that an important role of science is to prepare students with sufficient core knowledge so that they can acquire, interpret and understand additional information on their own. The findings in this section suggest that there may not be a shared understanding of the term 'core knowledge' in science, or a shared sense of what core scientific knowledge should be. For those who confine their understanding of core scientific knowledge to science content, it is understandable that they will view content reduction as 'dumbing down' science.

The consultation process reveals that there are concerns as to the extent to which students engage in genuine scientific investigations.

2.3 Course structure and implications for progression

An analysis of the quantitative data from the online survey reveals there is no over-arching consensus on which is the preferred approach to structuring the new junior cycle science specification. A small number of respondents (n=43) made additional comments to this question. In general they expressed a willingness to change in this respect. A similar sentiment was expressed at the teacher focus-group meeting. Some respondents elaborated on why they favoured one approach above the other.

“Measurement is physics" yet human body ratios fascinate and lead to data analysis and consideration of major themes in biology. "States of matter is chemistry” yet measurement of temperature around changes of state impact hugely throughout science. "Photosynthesis is biology" yet concerns the construction of new molecules of matter using the energy of the sun. Outdated considerations of subject specialisms do no service to our students or teachers. An interdisciplinary approach is required. Emphasis should be on key skills and how they support scientific exploration and development. (Science teacher, online survey)

A response from the teacher focus group offered another interesting perspective:

> *The division of the content into Physics, Chemistry and Biology can bias teachers' presentation of some of the content that they teach as they can have a positive or negative bias towards a particular area of learning. Teachers' anxiety towards particular areas of learning can be passed onto children.* (Teacher focus group)

The respondents who favoured the course structure of the 2003 syllabus put forward the argument that this was necessary as senior sciences are divided into physics, chemistry, and biology.

> *In Leaving Cert the three main science domains are separate subjects; if the new junior cert develops a more generalisation of these main domains it may hinder student's progression to Leaving Cert science courses.* (Undergraduate science education student, NUI Maynooth)

The majority of the written submissions expressed their preference for how the course should be structured. However, there was no consensus on how best to structure the course. One submission advocated for the timetabling of specialist teachers to teach each of the separate strands.

> *We strongly believe that each of the sciences should have separate identities, be taught by subject specialists and that they should be balanced up to the age of 16.* (Institute of Physics in Ireland)

> *The Academy would normally expect chemistry, biology and physics to be taught as separate disciplines.* (Royal Irish Academy)

> *The PDST feel that these aims can best be achieved through a thematic approach to the specification rather than the current divisions of Biology, Physics and Chemistry.* (PDST)

> *The NCE-MSTL advocates the intention to teach the subject in themes and think this would be a new, fresh approach. However this is assuming*

it means integration of the three strands of physics, chemistry and biology. (NCE-MSTL)

There is no over-arching consensus on which is the preferred approach to structuring the new junior cycle science specification. In general there is a willingness to change in this respect. There is a strongly held belief by some that a thematic approach would negatively impact on the physical sciences in senior cycle.

2.4 Features of 21st century science specifications

Respondents to the online survey were asked to articulate what they felt the core of science education should be. The results are shown on Table 2 below. 84% agreed that the nature of science should be at the core of science education, and 71% agreed that the acquisition of scientific facts, concepts and theories should be at the core. This is reflective of the views expressed in the focus-group meeting with teachers and the written submissions.

Table 2: Respondents' views as to what they felt the core of science education should be

The core of science education should be the…	Strongly disagree/Disagree	Neutral	Agree/ Strongly agree
...'nature of science' and its processes of inquiry.	4.9%	10.8%	84.3%
...acquisition of scientific facts, concepts and theories.	12.8%	16.2%	71%

The majority of the comments were generally positive and highlight the importance of the two and recognise the linkages between them.

It is not an either/or choice, indeed an understanding of the NoS [nature of science] *necessitates the "acquisition" of concepts and theories. The trick is to ensure that this acquisition itself is inquiry-based i.e. develop skills and content simultaneously.* (Teacher educator, online survey)

> *I think it must be an amalgamation of both. When people undertake a PhD they are carrying out an investigation in an inquiry based approach. However, for example, when they do their viva they must be able to answer on a body of knowledge. So learning facts, in my opinion, has an equal place to learning 'the nature of science*. (Science teacher, online survey)

Once again, as in section 8.2, there were a number of comments reflecting different perspectives on how we acquire knowledge.

> *The process of inquiry is redundant and would be quite fruitless without a good foundation in scientific fact and theory. Students need scientific language and knowledge to verbalise and describe phenomena they are investigating or observing.* (Science teacher, online survey)

> *Why is there so much negativity about rote learning? Without the facts and meanings they will not be able to develop an understanding of the 'nature of science'.* (Science teacher, online survey)

Question 10 of the online survey set out to explore respondents' level of agreement with the features of 21st century science specifications as outlined in section 7 of the background paper. The results, expressed as percentages in Table 3 below, show there is a strong agreement with many of the features outlined in the background paper.

Table 3: Level of agreement with the features outlined in section 7

Answer options	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
It is important that students develop an understanding of how to analyse and interpret data.	1.3%	0.4%	0.8%	39.2%	58.2%
Learning how to hypothesise and make predictions is an important outcome for students.	1.7%	2.1%	7.6%	46.4%	42.2%

Understanding of the scientific method is an important learning outcome at JC level.	2.1%	5.5%	11.9%	45.8%	34.7%
An understanding of how scientific knowledge is itself open to revision in the light of new evidence is not important at JC science level.	13.2%	34.6%	17.1%	19.2%	15.8%
At JC level an understanding of how scientists rely on human qualities such as reasoning, logic, creativity, persistence and precision, is not an important learning outcome.	19%	40.5%	15.2%	15.2%	10.1%

The consensus from the consultation process is that there is a need to place the nature of science at the core of the curriculum and there is general agreement with many of the features outlined in the background paper.

2.5 Assessment

The focus of question eight of the online survey was to gauge what the respondents felt junior cycle science should focus on assessing. Respondents were asked to rate a number of features. The results are presented in descending order on Table 4 below.

Table 4: Results of respondents' level of agreement on which features junior cycle science should focus on assessing (where 5 is of most importance and 1 is of least importance.)

Answer options	**1**	**2**	**3**	**4**	**5**	**Rating average**
application of knowledge and understanding to familiar and unfamiliar situations	1.6%	3.3%	4.9%	35.7%	54.5%	4.38
ability to form reasonable and logical argument based on evidence	1.6%	3.7%	9.9%	31.7%	53.1%	4.31
scientific inquiry	2.9%	4.5%	9.9%	37%	45.7%	4.18
understanding of the ethical aspects of science	5.8%	13.6%	14.8%	36.2%	29.6%	3.7
knowledge and recall of facts	10.2%	15.6%	27%	32.4%	14.8%	3.26

The feature rated the highest, with a mean score of 4.38, was application of knowledge and understanding to familiar and unfamiliar situations, followed by the ability to form reasonable and logical arguments based on evidence. This is an interesting result when compared with a finding in question 10 that revealed a significant number of respondents did not agree that an understanding of how scientists rely on human qualities such as reasoning and logic, is an important outcome of the study of science in junior cycle.

The lowest level of importance was given to a focus on assessing 'knowledge and recall of facts'. Notably, this feature was given the highest 'least important' rating. However, it does support the general consensus that there is too strong a focus in current assessment on recall of facts.

Sixty one respondents skipped this question and only 41 comments were submitted to the open response. The majority of the comments could be classified as generally positive about the potential for reform with many suggestions for different modes of assessment.

> *The new junior cycle outlines that assessment will be ongoing which I believe is a great idea as it allows students to be active learners and see how they can improve.* (Under-graduate science education student, NUIM)
>
> *I would welcome the introduction of an e-portfolio for JC Science but it would have to be developed in a way that all students in each school were treated equally.* (Science teacher, online survey)
>
> *It should also focus on scientific communication (in whatever medium that works best).* (Science teacher, online survey)
>
> *Flexibility to allow them to show their skills in a variety of ways, article published, video clip, talk they gave, demonstration they completed etc.* (Science teacher, online survey)

Only four comments expressed concerns relating to the move towards school-based assessment. However, teachers at the focus-group meeting raised their concerns regarding school-based assessment. They expressed fear that the system may be open to abuse and that teachers would be vulnerable to pressure from parents. One of the participants expressed the view that

> *The current culture in schools may not allow for colleagues to challenge other colleagues' marking of students work.* (Teacher, focus-group meeting)

Many of the other comments at the focus-group meeting and on the online survey offered suggestions for how science could be assessed. There was support expressed for:

a) e-portfolios
b) a focus on accessing understanding of science in the final assessment
c) a practical examination.

a) e-portfolio

The concept of an e-portfolio was welcomed by many of the contributors to the consultation process because it brings assessment closer to the point of learning. E-portfolios were viewed positively as they enable students to present their work using a wide range of media such as digital recordings of presentations, models and experiments. It was also suggested that student participation in science fairs should be credited and that this material could be incorporated into students' e-portfolios.

> *Ibec welcomes the concept of the e-portfolio as an assessment tool. It offers huge potential in terms of demonstrating the achievement of learning outcomes and in a fashion that reflects the breadth of media available to 21st century learners.* (Ibec)

> *We welcome the move to alternative modes of assessment and the use of an e-portfolio to gather evidence of learning throughout the junior cycle.* (SFI)

> *Assessment could be based on a portfolio of student work. Where students justify why their work is in the portfolio presented for assessment.* (Science teacher, focus-group meeting)

However, there were concerns raised that this would require considerable resources and supports for teachers and schools.

> *The Discover Sensors programme has already experimented with an e-portfolio approach to Junior Science through our SciFolio initiative. While this approach has worked well we believe teachers need further assistance on designing meaningful and authentic tasks.* (SFI)

> *While I agree that an e-portfolio is a good idea, not all schools have the appropriate equipment available.* (Science teacher, online survey)

> *Although the suggested use of e-portfolio is welcomed, the application of such a tool needs to be further outlined in order to make an informed decision on its use and application in the assessment of science.* (NCE-MSTL)

b) Practical assessment

A number of respondents suggested the introduction of a practical examination as part of the assessment of junior cycle science. Many respondents stressed the need for direct observation of students performing a practical assessment task in order to assess manipulative and technical skills.

> *Assessment we would like are practical exams- perform experiments live in front of examiner, make live models in relation to the science chapter/topic.* (Student, focus-group meeting)
>
> *Technical and manipulative skills can best be assessed through direct observation by the assessor.* (IOP)
>
> *The ISTA favours the inclusion of a practical assessment which would evaluate a student's ability to handle equipment and follow instructions. This practical assessment should be based on the practical activities included in the subject specification… To ensure the validity of marks awarded to students, this practical exam needs to be marked by an external examiner.* (ISTA)
>
> *The ideal should be an assessment system that tests whether the student has learned and understands an idea or only a definition. To achieve this goal, assessment could potentially consist of a combination of: (i) and (ii). A practical test through direct observation that would assess a student's technical and manipulative skill.* (RIA)

Understandably, there was little detail on the exact nature of the assessment tasks and how they would be assessed. However, it was suggested by some respondents that the practical assessment would be incorporated into the final assessment task or at least issued by the State Examinations Commission (SEC).

> *The PDST would like to see a compulsory practical assessment included and that this practical assessment would take place during the students' third year. We would like to see this practical assessment be issued centrally to schools by the SEC.* (PDST)

c) Final assessment

As highlighted earlier, the two most highly rated features of assessment were: assessing application of knowledge and understanding to familiar and unfamiliar situations, and the ability to form reasonable and logical arguments based on evidence. There was a strong consensus for making these the focus of the terminal examination.

> *The PDST feel that it is important that all students should have a basic knowledge of facts in science, but that the emphasis in the exam should not be on the simple recall of these facts but on applying this knowledge to solve problems and draw conclusions. We would like to see the students tested on their ability to form a logical argument based on the evidence presented and their knowledge of science.* (PDST)
>
> *Examinations in the sciences should assess the subject-specific capabilities of candidates, their understanding and their knowledge, and should also assess the nature, processes and methods of science. Assessment items should be subtle and probing to engender high quality teaching and measure high quality learning.* (IOP)
>
> *With regard to the final examination paper, the ISTA advises that assessment of scientific literacy in Ireland needs to be more in keeping with PISA style assessment. This final examination paper also should be marked externally to ensure legitimacy of the results.* (ISTA)

Despite the fears and reservations expressed it is heartening to see high levels of support for the proposed assessment focus of the new specification.

There is a broad welcome for the potential to include a variety of modes of assessment and a cautious welcome for the use of e-portfolios due to resource and support issues. The consultation process suggests that consideration should be given to practical assessment and that greater prominence be given to assessing application of knowledge and understanding of science in the final assessment.

2.6 The brief for the review of junior cycle science

It was evident from the online survey that there is strong support for many of the features of the brief. The commentary from the online survey was broadly supportive of the brief, however there were a number of respondents who expressed concerns regarding the provision of adequate resources, professional development and school-based assessment. A small number of respondents were not in favour of a focus on inquiry skills development.

The consultation process highlighted a number of concerns in relation to the brief:

- That science was not a core subject and would not be taken by all junior cycle students. This raised two other issues: there would be a reduction in the numbers of hours available for science, and the specification will be at a common level.
- The speed of change proposed.
- Bridging units were viewed as difficult to incorporate into the system and could pose significant logistical issues for schools.
- The online survey reveals that there are a significant minority who have reservations as to how effective it would be to improve science at junior cycle by aligning it to primary science. Similar concerns were expressed at the focus-group meeting, based on their experiences, that 'there is a lack of consistency of science/inquiry experience of incoming first years'. (Teacher, focus-group meeting)

In the consultation process a number of concerns were raised that did not feature as part of the brief as they related to resources and support. The following concerns were noted, related to provision of

- laboratory technicians
- adequate laboratory and ICT equipment
- sufficient and appropriate continuous professional development (CPD) to support IBL approaches, design of assessment tasks, and use of e-portfolios.

The consensus from the consultation process suggests general agreement with the main points of the brief for the review of junior cycle science. Concerns were expressed with some aspects set out in the framework for the review of junior cycle, especially related to assessment.

3. Progressing the findings of the consultation

It was evident from the consultation findings that the deliberations of the development group considered many of the issues identified by the respondents to the process. This section of the report will address some ways in which progress can be made on the issues raised.

3.1 The purposes of junior cycle science

The development group has begun the work of drafting the rationale and aims for junior cycle science which reflect and elaborate on the purposes for which there was a strong consensus in the consultation process.

3.2 Concerns regarding science education

The development group has discussed how best to promote the development of the processes of inquiry. The following areas form part of its immediate deliberations:

1. The breadth/depth balance of content.
2. Level of prescription for practical activities.
3. How the specification can exemplify the type of learning envisioned.

3.3 Course structure and implications for progression

The consultation responses present a variety of positions on the preferred approach to structuring the new junior cycle science specification. The development group has discussed how a thematic approach could negatively impact on the physical sciences in senior cycle. Consideration is being given to an over-arching strand, the Nature of science, and contextual strands. The physical sciences are identifiable within the contextual strands under consideration. The development group is also exploring how the elements can promote horizontal connectedness across the strands to support a thematic approach.

3.4 Features of 21st century science specifications

There appears to be general agreement from the consultation that the nature of science ought to be at the basis of the science curriculum. To this end the development group is considering using 'the nature of science' as the overarching strand. In light of the consultation findings the group will need to carefully consider how the specification can:

1. exemplify that the acquisition of scientific facts, concepts and theories is complementary to learning about the nature of science
2. promote the development of scientific analytical thinking skills.

3.5 Assessment in junior cycle science

There is a broad welcome for the potential to include a variety of modes of assessment. This will form part of the immediate deliberations of the development group. Attention will be given to practical assessment in science. The key questions to be addressed are:

1. What is the most appropriate performance task for junior cycle students?
2. Will this task be part of the school-component assessment or final assessment task?
3. What assessment and moderation arrangement will be required? Particularly if there is an element of direct observation.

The consultation process also suggests that greater prominence be given to assessing application of knowledge and understanding of science in the final assessment. Consideration can be given to this in parallel to the drafting of learning outcomes.

4. Conclusion

The consultation process was very fruitful and beneficial to the ongoing development of the new specification. The level of engagement of the respondents must be acknowledged and the NCCA are very grateful for the open and honest feedback received.

The consultation responses indicate a strong consensus that supports the purposes proposed for junior cycle science in the background paper, and signal a broad welcome for the focus of the review of junior cycle science. The consultation suggests that to encourage a deeper understanding of science concepts and a focus on the nature of science, the breadth of content will have to be reduced. Changes to the assessment of junior cycle science were viewed as fundamental to the reform. Many alternative approaches were suggested and welcomed.

The greatest challenge to realising the purposes of junior cycle science may be in the pedagogical considerations of the specification. The majority of the teachers who engaged in the consultation process favoured the reform of many aspects of junior cycle science. For many teachers, they see themselves as facilitators of learning who appreciate the value of IBL and the importance of developing scientific analytical thinking and investigative skill. Some feel constrained by the current syllabus and assessment model. There was another significant minority of teachers who expressed concern regarding the move towards a specification that has a greater focus on the development of skills and understanding about science. This may be rooted in their understanding of how students learn and what they value as core scientific knowledge. In this instance, enacting the new specification in the classroom may pose significant pedagogical challenges for these teachers. Appropriate supports will need to be incorporated into the specification and CPD to support a move away from teacher-led and didactic approaches to more student-centred and IBL approaches.

Appendix

Appendix 1

List of submissions from agencies and organisations

- Irish Business and Employers Federation (Ibec)
- Institute of Physics in Ireland (IPI)
- National Centre for Excellence in Mathematics and Science Teaching and Learning (NCE-MSTL)
- Royal Irish Academy (RIA)
- Professional Development Service for Teachers (PDST)
- Science Foundation Ireland (SFI)
- Undergraduate science education students, NUI Maynooth (NUIM)
- Irish Science Teachers' Association (ISTA)