ASTA RESPONSE TO THE AUSTRALIAN CURRICULUM ASSESSMENT AND REPORTING AUTHORITY

AUSTRALIAN CURRICULUM – SCIENCE: K-10 CONSULTATION

May 2010

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Area of interest:

ASTA is a federation of the eight Australian state and territory Science Teacher Associations, and is the peak professional body representing the science education community of Australia.

This submission is submitted by ASTA following comprehensive consultation with all eight of our member Science Teacher Associations. These member STAs have also held extensive local consultation forums and processes within their own memberships that have contributed to this response. Many of them will also respond independently.

Therefore we note that this response should be considered as a comprehensive collective view of a very large sample of Science educators across Australia.

ASTA strongly endorses the development and implementation of an Australian Curriculum: Science. Australia has a relatively small population of 21 million people and cannot justify spending large amounts of money to duplicate the development of curriculum in 8 state and territories. ASTA strongly supports the centralisation of curriculum development and the collaborative nature of the curriculum development process. ASTA has been pleased with the level of engagement afforded to it throughout this process as the peak body representing science educators across Australia.

ASTA strongly endorses the structure of the curriculum with the development of three strands – Science Inquiry Skills, Science as a Human Endeavour and Science Understandings. The integration of these strands will enable teachers to develop science programs that are relevant and engaging for their students. The curriculum also allows teachers to choose contexts that are relevant to their students' interests and situations.

Science Inquiry Skills:

The strong focus on Science Inquiry Skills is a strength of this curriculum as it emphasises the importance of students' learning through "doing" science and the importance of the way that scientists think, and plan and perform investigations to test hypotheses. The content descriptions in this strand are generally clear and unambiguous. The developmental continuum is generally appropriate. The use of verbs at the beginning of each content description gives appropriate detail of the depth and breadth of treatment required.

There are ten general capabilities that are part of the Australian Curriculum of which it is indicated that eight are explicitly taught through the Australian Curriculum: Science. If this is the case, then they should be clearly articulated in the content descriptions. Many of these should be clearly articulated through the Science Inquiry Skills strand. Literacy is clearly articulated through the Communication content descriptions. Numeracy is also reasonably well covered through the Observing and Measuring and Analysing Results content descriptions. However, "uncertainty and reliability in measurement", "issues relating to accuracy of data" and "linear mathematical relationships" should be explicitly included in the content descriptions. There are very general statements about the inclusion of ICT in Observing and Measuring and Analysing Results. However, the skills involved in secondary data research have not been clearly articulated as content descriptions in the Science Inquiry Skills strand. In the general capabilities section of the document (page 8), it clearly indicates that the following ICT skills will be included in the science curriculum:

- The use of the internet to research science concepts and applications
- The use of digital learning objects such as animations and simulations to enhance students' understanding and engagement in science
- The use of the internet and local networks will facilitate a collaborative approach among students that models the methods of modern science

- Data collection and analysis through probeware, data logging and the use of spreadsheets
- Provide a range of media for the communication and sharing of students' ideas and understandings both within and beyond the classroom

However, they are not explicitly articulated in the content descriptions. The content descriptions are the mandatory part of the curriculum, hence any skills and knowledge that are considered mandatory must be clearly articulated in this part of the curriculum document. This may mean that some of the Science Inquiry Skills will need to be broadened to include these specific skills. For example, in the Observing and Measuring content descriptions – "including using ICT" could be replaced with more specific information from the above dot points.

Thinking skills as outlined in the General Capabilities section on page 8 have been reasonably well articulated in the Science Inquiry Skills strand. Creativity needs to be more explicitly included in the Science Inquiry Skills strand, especially:

- Developing creative questions and speculation
- Thinking new ways about the world around them
- Suggesting novel solutions to science-based problems.

Self-management and teamwork are implicit in the Science Inquiry Skills but could be more explicitly articulated, e.g. Investigation Methods in Years 9 and 10 could be modified to commence with the words "collaboratively and individually". It should also be explicit in the Science Inquiry Skills that "the degree of guidance is reduced in later years and students are required to work more independently". The general capability, ethical behaviour, fits in both the Science Inquiry Skills and Science as a Human Endeavour strands. In terms of Science Inquiry Skills, gathering "evidence honestly and ethically" must be more explicit in the content descriptions. The Evaluating Evidence content descriptions could more clearly articulate the need to make "valid judgements about social, environmental and personal issues that involve science".

Science as a Human Endeavour:

The inclusion of the Science as a Human Endeavour strand is to be commended. This strand will assist teachers in making the science relevant and engaging by analysing applications of science, looking at the historical development of ideas, areas of current

research and utilising examples of careers related to various parts of science. However, the statements need to be clarified and modified to ensure that some of them place an appropriate emphasis on developing a curriculum that is relevant to the 21st century. There has been strong representation that the curriculum presented is not a 21st century curriculum with contemporary contexts. It has been suggested that the curriculum can only identify the core concepts and it is up to the teachers to make it engaging and relevant to their students with an emphasis on contemporary contexts. However, there must be clear statements in the curriculum to ensure that contemporary contexts are explicitly included in learning sequences for all year levels. A strong link showing how an understanding of science can lead to the development of new technologies and how the utilisation of new technologies have, in turn, led to a greater understanding of science are areas where further development is required. There is also the need to ensure that the general capability, ethical behaviour, is explicitly covered in this strand, especially in terms of applications of science in the areas of biotechnology and nanotechnology. Students must be able to distinguish between economic and environmental / scientific arguments when analysing issues. This should also be explicitly covered in this strand.

The content descriptions for Science as a Human Endeavour must be clear and unambiguous so that teachers can clearly see how they will link with the Science Inquiry Skills and Science Understanding strands. The Science Inquiry Skills, Science as a Human Endeavour and Science Understanding strands are supposed to be integrated to develop a coherent learning program. Therefore, it is important that these content descriptions are able to be integrated rather than “forced to fit”. For example, the Contribution of Scientists content description in Years 9 and 10 is a true statement but it does not enable meaningful teaching and learning experiences to be developed, whereas the Contribution of Scientists content descriptions for Years 7 and 8 clearly enable teachers to choose appropriate examples to develop meaningful experiences for their students.

Science Understandings:

Generally, it is considered that there is too much in the Science Understanding strand to be covered in the suggested time frame, especially if there is to be an appropriate emphasis on the development of the Science Inquiry Skills and Science as a Human Endeavour strands as well. However, there has not been agreement on what should be removed. We need to look at what concepts students need to understand to engage with

the issues that they will need to understand as they become active and engaged citizens of the future. It should not be about what teachers like teaching, it should be about what is considered essential for the students to learn. Some of the content descriptions are unclear. For example, the intent of the Matter and Energy content description in Year 10 is unclear. Even after reading the content elaboration statements, the intent is unclear since many of the examples in the content elaborations would not be considered “essential” knowledge for students. The content descriptions must be clarified since these are the mandatory parts of the curriculum. The elaborations are not mandatory, they are examples of how the curriculum could be interpreted, not must be interpreted.

Some of the content descriptions are beyond the cognitive levels of the students at that Year level, e.g.

- Year 3 – “Life cycles and reproductive processes of plants and animals” should be modified to “Life cycles of plants and animals”.
- Year 10 – “The role of genes in determining patterns of inheritance and the chemical processes in cells” should be modified to “The role of genes in determining patterns of inheritance”.

There is some repetition in the content descriptions, e.g.

- Year 5 – “Some materials are composed of observable structure or parts (such as fibres, crystals, layers or grains) and structure or smaller parts can influence the overall properties of materials” AND
- Year 7 – “Substances can be compared using observable and measurable properties and the uses of these substances are dependent on these properties”.

Removing these apparent repetitions will assist with the need to streamline the Science Understanding strand.

The content descriptions in the Science Understanding strand should be analysed to see where they can be better linked to enable the development of deeper and richer learning sequences, rather than concepts being covered in an earlier year, then repeated where it is required for understanding a content description in a later year, e.g.

- Year 8 – “The role of geological evidence, including the fossil record, in investigating ancient events, past environmental conditions and changes over time” should be linked with

- Year 10 – “Plate tectonics explains global patterns of geologic activity, continental movement, and the characteristics of the Australian continent”

since fossil evidence is one of the pieces of evidence which supports the Theory of Plate Tectonics. This would also allow for the streamlining of the Science Understanding strand.

There is no mention of heat as a form of energy until Year 7 where it is included in Transferring and Transforming Energy. It should be included earlier as a type of energy since it is very familiar to students.

Another way to streamline the Science Understanding strand would be to see where some of the content descriptions could be more appropriately placed in the Geography or Health curriculums, rather than in the Science curriculum. This does not preclude the inclusion of a deeper treatment of some of these into a Science curriculum for Senior Secondary, however, it will enable the concepts to be covered without tokenistic treatment due to lack of time to cover the curriculum.

Year 7:

There has been considerable discussion about the Year 7 curriculum because in some states / territories it is taught by specialist teachers of science with access to specialist science equipment in specialist facilities while in others, it is taught by generalist teachers with limited equipment in general teaching spaces. This is a difficult issue to satisfactorily resolve. ASTA would strongly suggest that the content descriptions for Year 7 be reviewed to ensure that they are appropriate for the cognitive level of the students. Further, ASTA would recommend that ACARA liaise with MCEEDEYA to ensure that appropriate resources and professional learning experiences for teachers be provided to ensure that this curriculum can be covered appropriately regardless of whether it is taught by specialist or generalist teachers.

Cross-curriculum Dimensions:

ACARA has also indicated that there are 3 cross-curriculum dimensions. It is indicated on page 9 that only sustainability must be explicitly addressed in the Australian Curriculum: Science. It further indicates that it will be “explicitly addressed in the content descriptions of each of the strands of the Australian Curriculum: Science”. This is not evident in the content descriptions as they are currently written.

Achievement Standards:

The achievement standards have been the focus for considerable discussion and it is generally agreed that considerable work is required if these are to be useful for teachers. Some of the concerns include: that they have not been pitched at a "C" grade as indicated by ACARA; and that statements related to some of the content elaborations have been included, when these are not a mandatory part of the curriculum.

Other issues:

ASTA is concerned by the short timeline for the development, consultation, revision and implementation of the Australian Curriculum: Science. Teacher engagement with all facets of this process is necessary for its development and successful implementation. ASTA believes that the timelines are unrealistic, especially for the analysis of information from the consultation process to ensure that all issues are considered and appropriate actions are taken to modify the curriculum before the publication of the curriculum in August 2010. ASTA is also concerned by the short overlap of the consultation processes for the K-10 and Senior Secondary curricula. This meant that teachers were not able to make detailed comments or note implications regarding the continuum from Year 10 to Year 11.

At present, most States and Territories do not mandate hours for science. It is left at the discretion of sectors and schools. However, this curriculum has been written with specific timeframes in mind, namely:

- 1 hour per week for Years K-2
- 2 hours per week for Years 3-6
- 3 hours per week for Year 7
- 4 hours per week for Years 8-10

These times are considerably more than is "custom and practice" in the vast majority of schools across Australia. How will ACARA ensure that schools provide the time that will be necessary for all strands of this curriculum to be appropriately covered? Some of the comments about "too much content" may be due to teachers looking at the content descriptions and the time that is currently available for science curriculum in their school, rather than the time indicated in the ACARA curriculum documents. Now that ACARA is responsible for the development of curriculum for a variety of subjects, not just the Phase 1 courses, will the times be adjusted for the phase 1 courses? If so, how will ACARA adjust the content descriptions to ensure that there is not too much to be covered in the time available?

There is a need for some clear statements to be explicit in the Australian Curriculum: Science regarding:

- The three strands must be integrated to develop teaching / learning sequences.
- The content descriptions are not a list of topics that are taught in isolation.
- Is it an expectation that a Science Research Project be undertaken in each Year / Stage of learning?
- The content descriptions for Science Inquiry Skills and Science as a Human Endeavour are written in “stages”. Is it expected that all content descriptions for these two strands will be taught to each year group or are they to be spread across the stage? If it is the latter, how will this be reflected in the achievement standard?
- Addressing the needs of individual students, e.g. students with special needs.
- Degree of flexibility in the curriculum to cater for composite classes.

Teachers need to be provided with information regarding implementation timelines. At present, MCEEDEYA has agreed that there will be “substantial implementation” of the K-10 Curriculum by 2013. What does “substantial implementation” mean? It will not matter how good the Australian Curriculum: Science documents are if teachers do not engage with the documents and translate them into meaningful learning sequences for their students. Teachers need to know the timelines that they will need to work within. These timelines must be cognisant of the degree of change required and the time required for this to occur effectively when teachers are expected to fulfil their responsibility to their current students while trying to develop learning sequences for the new curriculum for their future students.

There have been conflicting statements made by ACARA and various education jurisdictions regarding the nature of these documents. ACARA has indicated that these are the curriculum documents that teachers will use to develop their programs. Some education jurisdictions, however, have indicated that they will map the documents to their existing frameworks, which will be used to develop a syllabus that will be published so that teachers can develop their programs. Teachers are confused and need to be given clear guidance as to the purpose of the document for Australian Curriculum: Science.

It is imperative that teachers are given appropriate professional learning opportunities so that they can fully engage with the Australian Curriculum: Science, especially the

integration of the content descriptions from the three strands. Teachers will also need support to ensure that the pedagogy underpinning the curriculum becomes a reality. There is a particular need for professional learning around the Science as a Human Endeavour strand to ensure that there is an appropriate emphasis on it rather than it being treated as a “tokenistic add-on”. There is also the need to ensure that there are resources available that support the Science as a Human Endeavour strand, rather than all resources being focussed on the content descriptions for the Science Understanding strand.

Finally, it is imperative that ACARA work with MCEEDEYA to ensure that appropriate resources are made available to schools to allow for the successful implementation of the Australian Curriculum: Science. This includes both time for the development of programs and money to ensure that appropriate equipment and facilities are available for all parts of the curriculum to be covered. This is particularly appropriate where there is a significant difference between current practice and facilities and that which is required for the successful implementation of the new Australian Curriculum: Science.