Exploring the Australian Curriculum: Science

21 September 2011

Melanie Isaacs
Senior Project Officer Science
The tricky business of teaching science...

What is heat?

Rugs get wicked hot!

Jumpers are hot

Heat comes from the sun

If you put a thermometer inside a beanie, it would get hot.
Let’s test the idea that materials contain heat.

...So the students wrapped beanies/sweater/rugs around thermometers and left them for 15 mins...

15 mins later, the temperature had not changed!

them in there long enough.
If cold air is seeping in, are there ways we can stop that happening?

...So the students found ways of stopping the cold air getting in – some sealed their experiments in plastic bags, the ends of rolled rugs were plugged with beanies, experiments were tucked into cupboards... and left overnight.

But when the students checked the next day... the temperature had not changed!
Choose statement A or B, or if you’re not sure, stand in the middle.

Heat can come from clothes. But cold air gets in so it’s hard to measure.

Undecided

Heat comes from our bodies and gets trapped inside winter clothes.
### Session Overview

1. Background to the Australian Curriculum: Science
2. Structure and organisation
3. Key messages
The shape of the science curriculum

- Shape paper published May 2009
- Consultation over 2009-10
- Publication December 2010
- Validation of achievement standards 2011
What’s changing?

• the nature of public engagement with science – personal and public science-based issues and conflicting views
• the challenges to science; critiques of the ways science knowledge is developed and articulated
• the knowledge explosion – amount and availability of science information
• the nature of schooling
• the student population
• the nature of youth (inequity and materialism)

Tytler, 2007
What are the challenges?

• engaging today’s students
• preparing students to engage with their world – as citizens and as scientists
• balancing knowledge and other science capabilities in the curriculum
### Purposes of science

<table>
<thead>
<tr>
<th>Purpose</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cultural purpose</td>
<td>To ensure that all members of society develop an understanding of the scope of science and its application in contemporary culture</td>
</tr>
<tr>
<td>Democratic purpose</td>
<td>To ensure that students develop a confidence about science which would enable them to be involved in scientific and technological issues as they impact on society</td>
</tr>
<tr>
<td>Economic purpose</td>
<td>To ensure that Australia has the number and quality of people with strong backgrounds in science and technology is business and public life, as well as in science and technology, that are needed to secure the country’s future prosperity</td>
</tr>
<tr>
<td>Personal development purpose</td>
<td>To ensure that all members of society benefit from the contribution that the values and skills of science can make to their ability to learn and operate successfully throughout life</td>
</tr>
<tr>
<td>Utilitarian purpose</td>
<td>To ensure that all members of society have sufficient knowledge of science to enable them to operate effectively and critically in activities where science can make a contribution to their personal wellbeing</td>
</tr>
</tbody>
</table>

Symington & Tytler (2004)
## Roberts’ 7 knowledge emphases

<table>
<thead>
<tr>
<th>Emphasis</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>An <strong>everyday coping</strong> emphasis</td>
<td>what you need to know to understand and control your immediate environment</td>
</tr>
<tr>
<td>A <strong>structure of science</strong> emphasis</td>
<td>how science operates as a discipline</td>
</tr>
<tr>
<td>A <strong>Science, Technology and Society</strong> emphasis</td>
<td>situating science knowledge within a social and technological perspective</td>
</tr>
<tr>
<td>A <strong>scientific skill development</strong> emphasis</td>
<td>focusing on investigative skills and procedures</td>
</tr>
<tr>
<td>A <strong>correct explanations</strong> emphasis</td>
<td>focussing on science theories and concepts, the products of science</td>
</tr>
<tr>
<td>A <strong>self as explainer</strong> emphasis</td>
<td>science as a cultural institution, and a human endeavour, with the history of science being emphasised</td>
</tr>
<tr>
<td>A <strong>solid foundations</strong> emphasis</td>
<td>as preparation for further studies</td>
</tr>
</tbody>
</table>

Based on Roberts (1988)
### Osborne et al’s science themes

<table>
<thead>
<tr>
<th>Scientific methods and critical testing</th>
<th>Diversity of scientific thinking</th>
<th>Specific methods of science</th>
</tr>
</thead>
<tbody>
<tr>
<td>Creativity</td>
<td>Science and certainty</td>
<td>Cause and correlation</td>
</tr>
<tr>
<td>Historical development of scientific knowledge</td>
<td>Moral and ethical dimensions</td>
<td>Characteristics of scientific knowledge</td>
</tr>
<tr>
<td>Science and questioning</td>
<td>Hypothesis and prediction</td>
<td>Cumulative and revisionary nature of scientific knowledge</td>
</tr>
<tr>
<td>Cooperation and collaboration</td>
<td>Observation and measurement</td>
<td>Empirical base of scientific knowledge</td>
</tr>
<tr>
<td>Analysis and interpretation of data</td>
<td>Science and technology</td>
<td>Status of scientific knowledge</td>
</tr>
</tbody>
</table>

The Australian Curriculum

• sets what all students are to be taught (content) and the quality of learning expected by years or bands of schooling (achievement standards)

• affirms the central importance of discipline-based knowledge and skills as well as general capabilities and cross-curriculum priorities
Key Principles for Development

• The Australian Curriculum will make clear what we want all young Australians to learn

• Classroom teachers are best placed to organise learning for students; they will make decisions about the pedagogical approach intended to achieve the best learning outcomes

• The Shape of the Australian Curriculum (V2) guides the development of the Australian Curriculum and is available at http://www.acara.edu.au/verve/_resources/Shape_of_the_Australian_Curriculum.pdf

• The Shape of the Australian Curriculum: Science is available at http://www.acara.edu.au/verve/_resources/Australian_Curriculum_-_Science.pdf
Learning Area Structure Foundation to Year 10

Rationale and aims
- outline the purpose and structure of the learning area

Content descriptions
- core knowledge, understandings and skills – what students will be taught
- accompanied by content elaborations that illustrate and exemplify content

Achievement standards
- describe the learning typically expected of students
- accompanied by work samples that illustrate and exemplify
Science - Organisation

Overarching ideas

Science Understanding
- Biological sciences
- Chemical sciences
- Earth and space sciences
- Physical sciences

Science as a Human Endeavour
- Nature and development of science
- Use and influence of science

Science Inquiry Skills
- Questioning and predicting
- Planning and conducting
- Processing and analysing data and information
- Evaluating
- Communicating
• core content
• conceptual development across and over sub-strands
• year by year bands
Science as a Human Endeavour

- the unique nature of science and scientific knowledge
- development of scientific knowledge
- how science knowledge and applications affect peoples’ lives
- how science is influenced by society
- how science informs decision making
- two-yearly bands
Science Inquiry Skills

- Questioning and predicting
- Planning and conducting
- Processing and analysing data and information
- Evaluating
- Communicating

- evaluating claims
- investigating ideas
- solving problems
- drawing valid conclusions
- developing evidence-based arguments
- broad notion of ‘investigation’
- role of representation and discourses of science
- two-yearly bands
Connecting the three strands

Science Understanding

Science as a Human Endeavour

Science Inquiry Skills
## Relationships Between the Strands

<table>
<thead>
<tr>
<th>🎉</th>
<th>🙁</th>
</tr>
</thead>
<tbody>
<tr>
<td>Science as a Human Endeavour can provide a context for learning</td>
<td>Science as a Human Endeavour becomes extra content</td>
</tr>
<tr>
<td>Science as a Human Endeavour can be used to engage students at a range of levels</td>
<td>Science as a Human Endeavour is just done ‘once the other stuff is finished’</td>
</tr>
<tr>
<td>Content of the Science Understanding strand is learnt through inquiry methods</td>
<td>Science Inquiry Skills become separate content that ‘has to be covered’</td>
</tr>
<tr>
<td>All strands are assessed and recorded</td>
<td>Only the Science Understanding strand is assessed formally</td>
</tr>
</tbody>
</table>
### Relationships Between the Strands: Example 1

<table>
<thead>
<tr>
<th>Science Understanding content description (Year 4)</th>
<th>Science Understanding content elaborations (Year 4)</th>
<th>Science as Human Endeavour elaborations (Year 4)</th>
<th>Science as Human Endeavour content description (Year 3/4)</th>
</tr>
</thead>
</table>
| **Chemical sciences**  
Natural and processed materials have a range of physical properties; these properties can influence their use | considering how the properties of materials affect the management of waste or can lead to pollution | considering methods of waste management and how they can affect the environment | Use and influence of science  
Science knowledge helps people to understand the effect of their actions |
Overarching Ideas

• represent key aspects of a scientific view of the world

• bridge knowledge and understanding across the disciplines of science

• support the coherence and developmental sequence of science knowledge within and across year levels
Overarching Ideas

• Patterns, order and organisation
• Form and function
• Stability and change
• Scale and measurement
• Matter and energy
• Systems
Year Level Descriptions in Science

• Emphasise theinterrelated natureof the three strands, and the expectation that planning a science program will involve integration of content from across the strands.
• Re-emphasise the overarching ideas for that particular stage of schooling
• Provide an overview of the content for the year level
Year Level Description: Example

In the Year 6 curriculum students begin to develop models for relationships and systems, ranging from feeding relationships in biological systems to representations of energy transfer and transformation.

They begin to develop notions of sustainability of systems and explore the effects of change on a system as a whole. Students continue to develop their understanding of different types of change and that rates of change vary, including for geological processes.

They look at the reversibility of changes to materials as a precursor to the consideration of chemical change in later years. Students increasingly use scientific language to describe their ideas and employ a range of representations to communicate their understanding.
Activity
Key messages

The science curriculum…

– emphasises an inquiry approach
– has been written to encourage integration of the three strands
– utilises six overarching ideas to provide a conceptual frame for learning across F-10
– integrates the cross-curriculum priorities and the general capabilities