

Earth Science Education in Australian Schools:

Where have we come from, where are we now and where are we going?

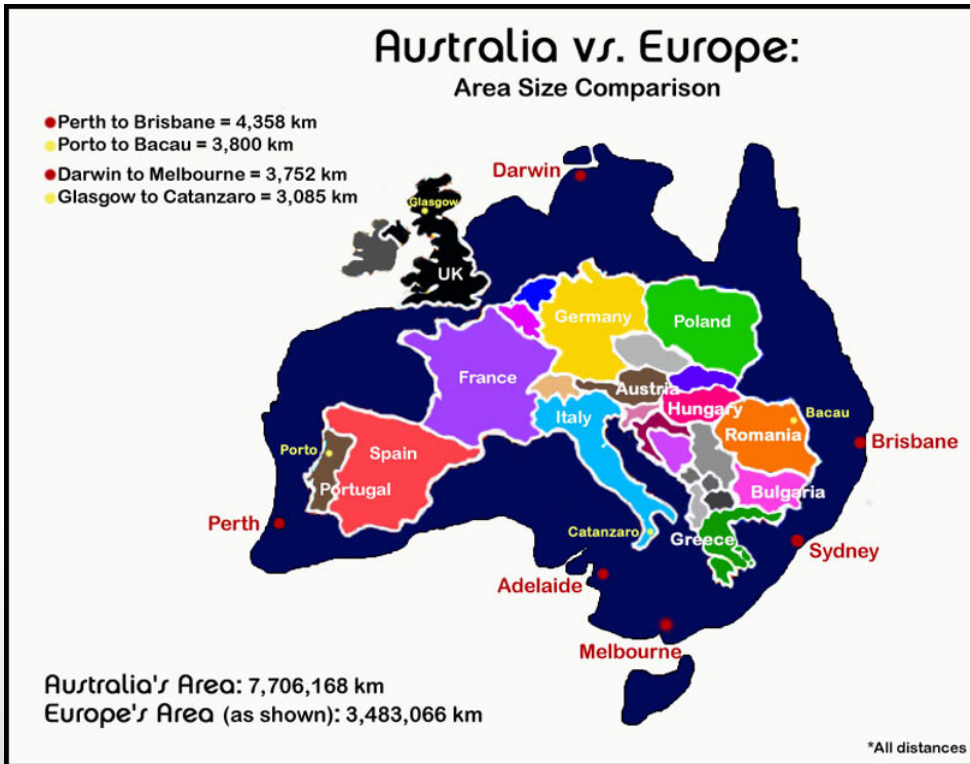
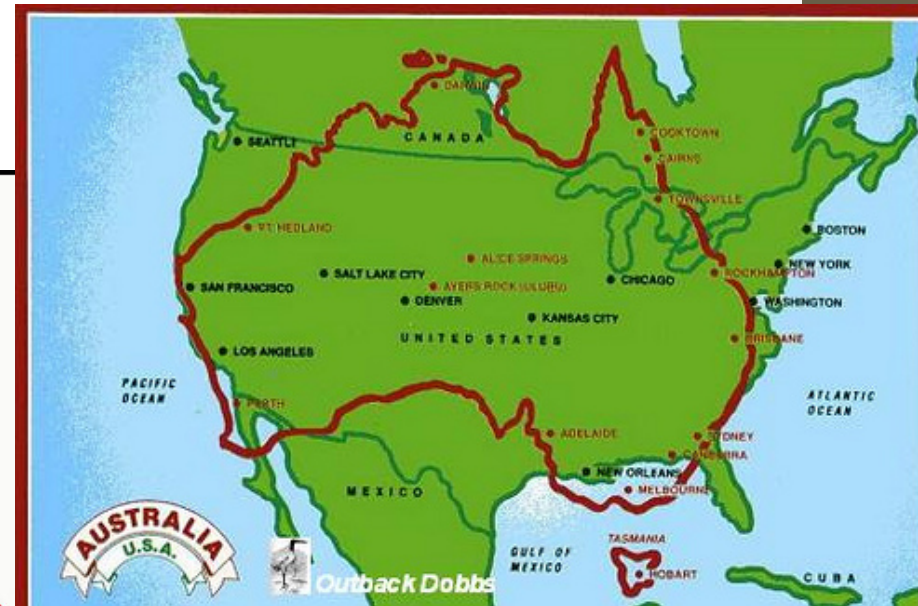
Greg McNamara

Geoscience Education and Outreach Services

Where have we come from? ...

Australia

- A big place with a small population
 - Mining always a big thing
 - Resource based economy
 - Lots of geology in schools?

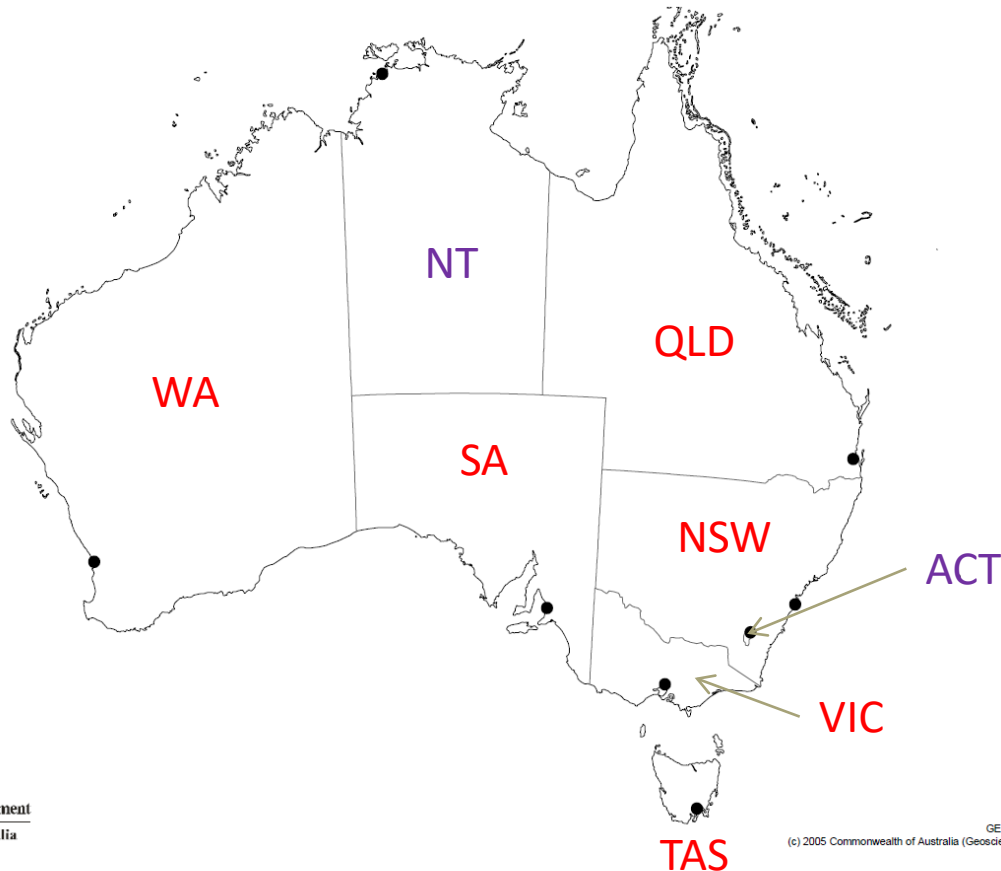


<http://on-walkabout.com/2011/02/26/how-big-is-australia-compared-to-the-united-states>

Where have we come from? ...

State by state

- 6 **States** and 2 **Territories** ... Federation 1901

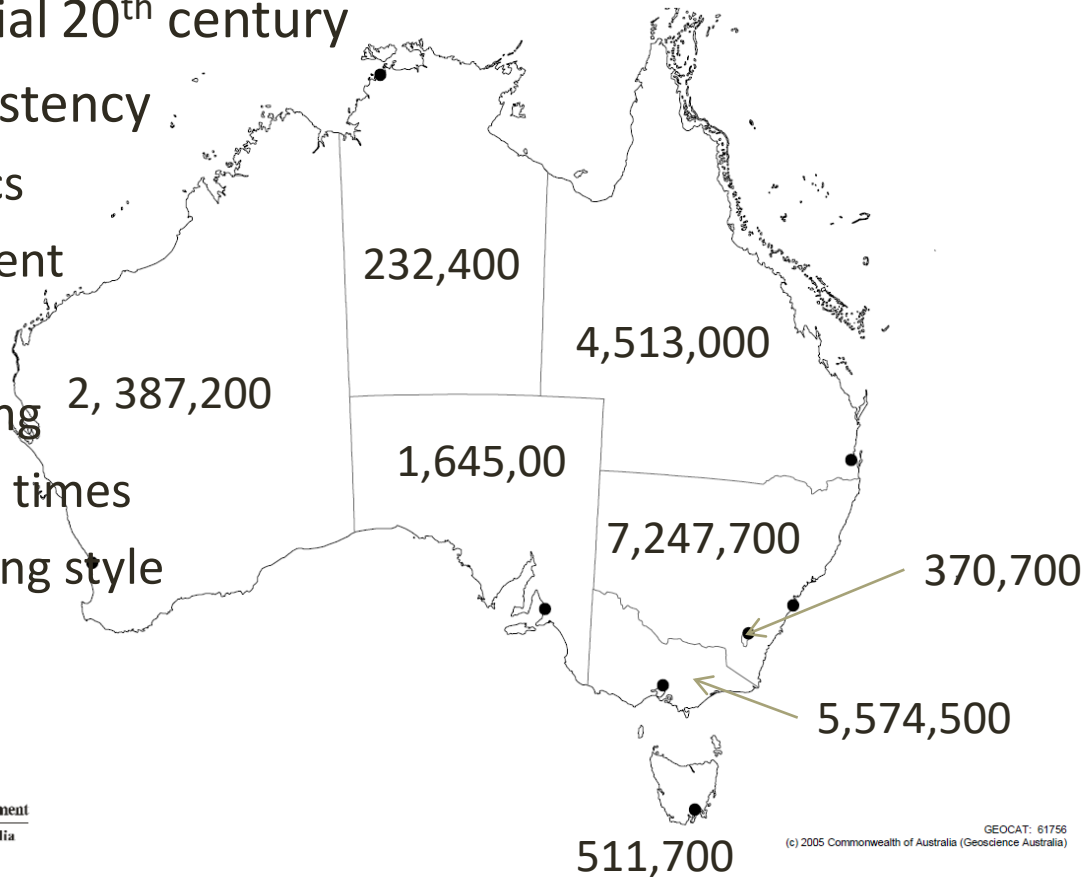


Where have we come from? ...

State by state

Today ~22,485,300 persons in total
3,773,801 at Federation

- States manage their own education systems (8)
- Parochial 20th century
- Inconsistency
 - Topics
 - Content
 - Level
 - Testing
 - Term times
 - Writing style
 - ...+

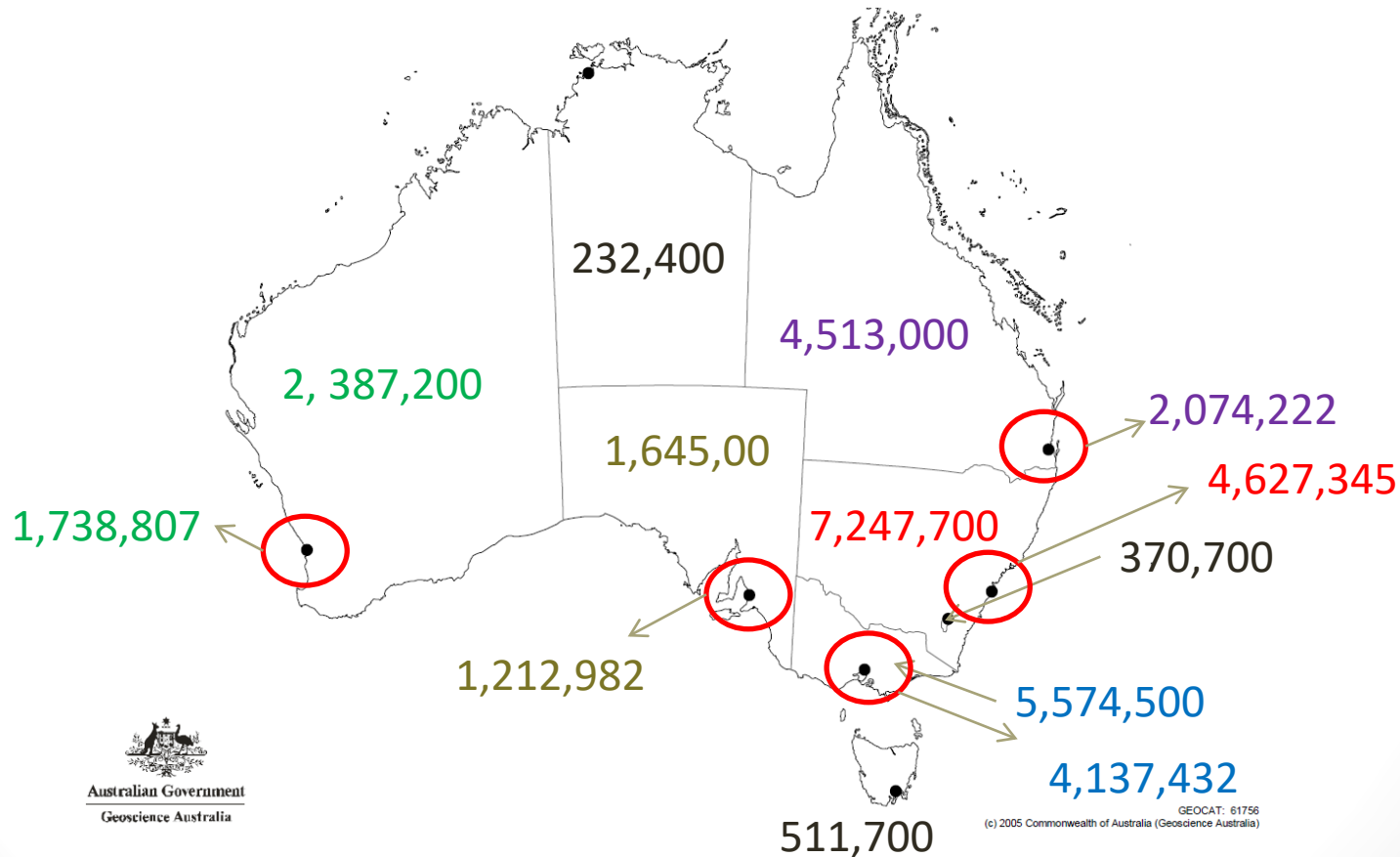


Where have we come from? ...

State by state

At 30 June 2011, more than 14.5 million people, close to two-thirds of Australia's population, resided in a capital city

- States manage their own education systems

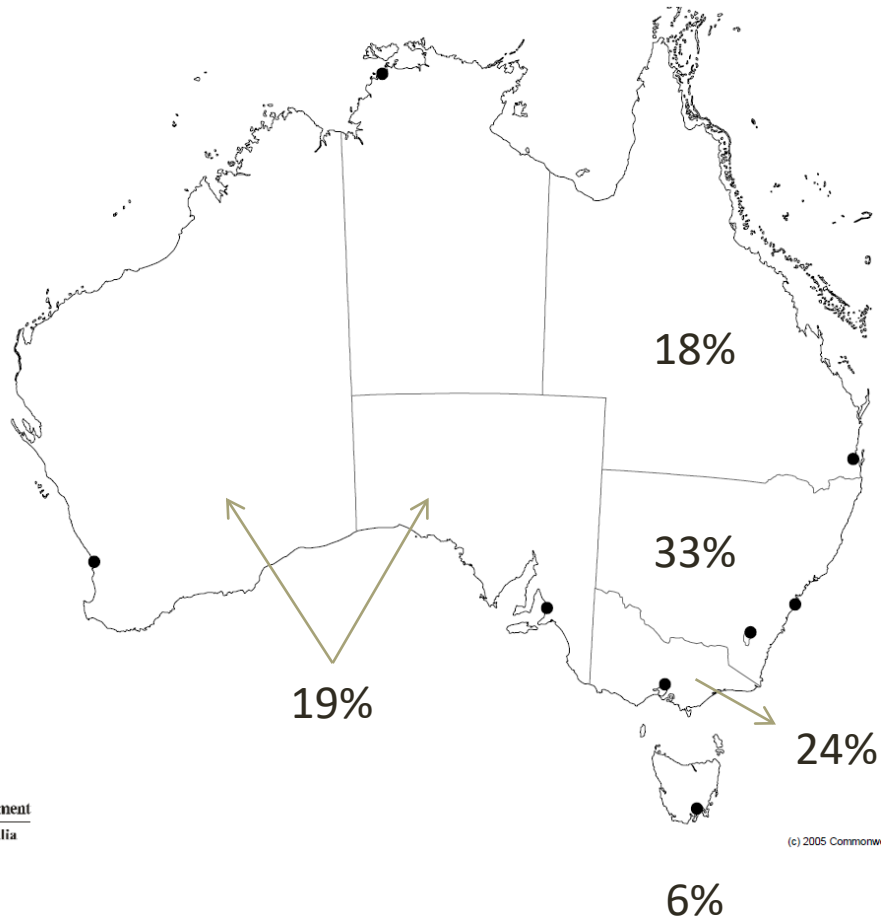


Where have we come from? ...

State by state

- More schools in eastern States

- 71% government schools
- 29% non-government
 - 18% Catholic schools
 - 11% Independents



Where have we come from?

State by state

- 8 curriculum authorities – same same but different!
 - Same general curriculum structure
 - Different splits between Primary and Secondary
 - Different term or semester split
 - State centric
- K/P/F – 10:
 - SCIENCE a subject area
 - EARTH & BEYOND a topic at most year levels
 - ALL similar but different
 - Same general content
 - Same range of subtopics
 - Different content in same years
 - Different emphasis in content
- Senior – Yr 11-12: All offered Physics/Chemistry/Biology
 - Some offered Geology ... but few schools took the option
 - Over time more options came in, Geology lost out, enrolments declined
 - Some states dropped it all together

Where have we come from? ...

Content content content

- 20th century science curricula were content heavy
 - Prescriptive and inflexible
 - Light on student engagement
 - Poor at supporting diverse learning styles
 - Skewed towards learning for university entrance
- GEOLOGY K-10 & in senior was a victim of this approach!
 - Rocks don't bite, fight, defecate or reproduce
 - Rocks are dusty, dirty, smelly and heavy
 - Chalk and talk
 - Classification
 - BORING!
 - For students
 - For teachers

Where have we come from? ...

Teacher disengagement

- Low numbers of geology trained teachers
 - Preference for teaching comfort zone subjects
- Geology side-lined in non-accountable world
 - Assign to last week of term/year
 - Loose last week of term due to during the term
 - On the books but never really done
 - Done and never really assessed
 - Less and less done as years pass ...
 - Many admit to not teaching it anymore
 - Others admit to cherry picking the content
 - Others admit to a lip service lesson or two

Insert your
own
excuse!

Sports
carnival

School play

Flu

Where have we come from? ...

Matriculation!

- Senior science subjects skewed to university entrance
- University entrance conditional on total score + subjects
 - English
 - Mathematics
 - Science subjects
 - Physics
 - Chemistry
 - Biology

Universities usually used Chemistry as a prerequisite for Geology

- University Geology teaching assumed no prior knowledge
- => No incentive for top students to do senior Geology

Where have we come from? ...

Slow death of senior geology

- Victoria
 - Geology taught at senior until 1995
 - 1992 ... 138 enrolments in Yr 12
 - 1995 ... 75 enrolments in Yr 12 ... discontinued
 - Environmental studies => Environmental science
 - 1996 ... commenced
 - 2011 ... 533 completed Yr 12 ... growing numbers
- Tasmania
 - ditto

Where have we come from? ...

Slow death of senior geology

- South Australia
 - Geology still taught at senior
 - 2009 ... 144 sat final exam
 - 2011 ... 31 sat final exam
 - 2012 ... only 4 schools teaching a total of 50 students at senior
 - 2013 ... ?
- Northern Territory
 - Was taught
 - Discontinued in 2010

Where have we come from? ...

Slow death of senior geology

- Queensland
 - Geology taught at senior still
 - Dropped as low as 13 schools, from a high of 40 schools
 - 2012 ... 20 schools ~450 students
 - Going against the trend
- ACT
 - Geology only taught in senior at one school today
- Western Australia & NSW
 - Now teach Earth & Environmental Science
 - Prior to that numbers in Geology were dismal ...

Where have we come from? ...

Hobart declaration

- 1989
- A framework of cooperation
- 10 common national goals for schooling plus
 - National reporting
 - National collaboration on curriculum development
 - Australian handwriting style
 - Aim for a common school entry age

Where have we come from? ...

Adelaide declaration

- 1999
- National goals for schooling plus
 - Adoption of 8 Key Learning areas
 - Arts
 - English
 - Health and physical Education
 - Languages other than English
 - Mathematics
 - Science
 - Studies of Society and Environment
 - Technology

Where have we come from? ...

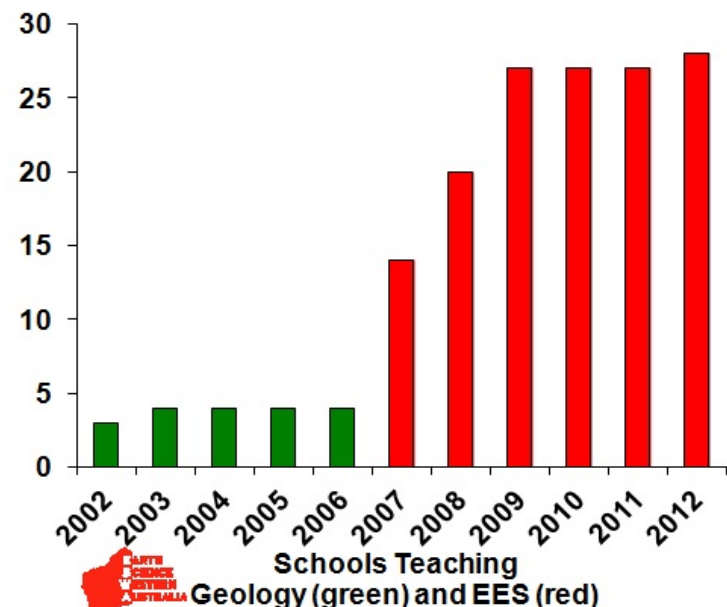
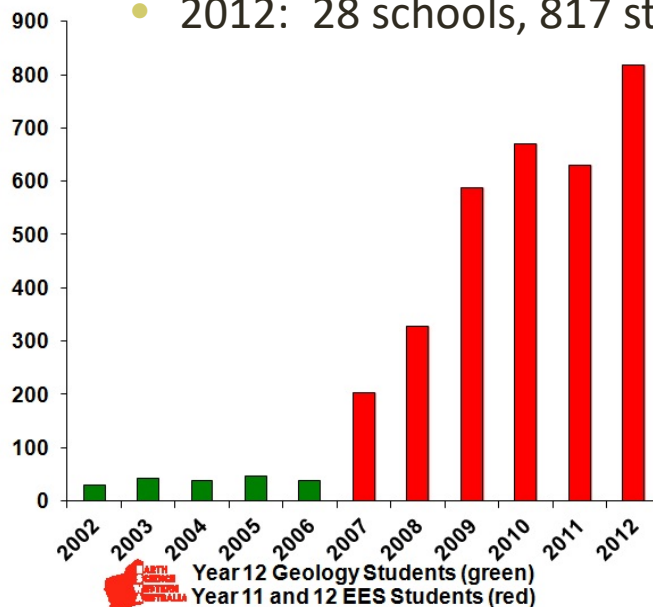
2004+

- Lurching towards a national curriculum ...
- State curriculum authorities still doing their own thing ...
 - Tasmania introduced changes in 2004-5
 - 5 essential learning outcomes
 - No prescriptive content
 - Context developed at school level
 - Victoria – Essential Learning Standards
 - 8 KLAs
 - 3 strands with multiple domains
 - NSW
 - 4 prescribed focus areas
 - 3 domains
 - Context chosen by teacher

Where have we come from? ...

... and the rise of E&ES

- Earth and Environmental Science
 - NSW
 - 2000: 203 candidates ... Geology discontinued [1099 in 1979]
 - 2012: 1504 candidates ... still a small course
 - Western Australia
 - 2006: 4 schools, 38 students ... Geology discontinued
 - 2012: 28 schools, 817 students



Where are we now? ...

Still by State

- State's systems still incompatible in 21st century

State/Territory	Preparatory year (first year of school)	Month of and age at commencement for Year 1	Primary schooling	Secondary schooling	Minimum school leaving age
New South Wales	Kindergarten	January, 5 turning 6 by 31 July	Kindergarten Years 1–6	Years 7–12	17 years ^(a)
Victoria	Preparatory	January, 5 turning 6 by 30 April	Preparatory Years 1–6	Years 7–12	17 years ^(b)
Queensland	Preparatory	January, 5 turning 6 by 30 June	Preparatory Years 1–7	Years 8–12	17 years ^(c)
South Australia	Reception	January, 5 years 6 months by 1 January	Reception Years 1–7	Years 8–12	17 years ^(d)
Western Australia	Pre-primary	January, 5 turning 6 by 30 June	Pre-primary Years 1–7	Years 8–12	17 years ^(e)
Tasmania	Preparatory	January, turning 6 by 1 January	Preparatory Years 1–6	Years 7–12	17 years ^(f)
Northern Territory	Transition	January, 5 turning 6 by 30 June	Transition Years 1–6	Years 7–12 ^(g)	17 years ^(h)
Australian Capital Territory	Kindergarten	January, 5 turning 6 by 30 April	Kindergarten Years 1–6	Years 7–12	17 years ⁽ⁱ⁾

Where are we now? ...

National Curriculum F-10

- Same same but different
 - SCIENCE KLA appears to be similar to many old state documents
 - Earth Science part of a major sub-strand
 - States writing their own versions?

Once the Australian curriculum for a learning area is endorsed by state and territory Education Ministers the Board of Studies will commence its syllabus development process. The new syllabuses will include the Australian curriculum and retain many of the features familiar to NSW teachers. NSW schools would not be required to begin the planning phase for the Australian curriculum until 2013, with the curriculum moving to the classroom teaching phase from 2014

- Accountability
 - Much greater imperative to teach the entire curriculum
 - Resurgent interest in PD
 - Teachers 'in panic' about 'new' content
 - TESEP Round and Round with Rocks PD in demand

Where are we now? ...

National Curriculum F-10

- Science Structure: 3 interrelated strands taught in an integrated way
 - Science Understanding
 - 4 sub-strands
 - Biological sciences
 - Chemical sciences
 - Physical sciences
 - Earth and space sciences
 - Science as a Human Endeavour
 - 2 sub-strands
 - Nature and development of science
 - Use and influence of science
 - Science Inquiry Skills
 - 5 sub-strands
 - Questioning and predicting
 - Planning and conducting
 - Processing and analysing data and information
 - Evaluating
 - Communicating

Where are we now? ...

National Curriculum F-10

- Science: 6 overarching ideas
 - Patterns, order and organisation
 - Form and function
 - Stability and change
 - Scale and measurement
 - Matter and energy
 - Systems

Where are we now? ...

National Curriculum F-10

- Year levels focus for science
 - Foundation – Year 2
 - awareness of self and the local world
 - Years 3 – 6
 - recognising questions that can be investigated scientifically and investigating them
 - Years 7–10
 - explaining phenomena involving science and its applications

=> Earth & Space content should lead into senior Earth and Environmental Science appropriately

Where are we now? ...

National Curriculum F-10

- Year level specifics in Earth & Space
 - Foundation – Year 2
 - General science
 - Years 3 – 6
 - Specific Earth & Space science topic areas
 - Years 7–10
 - Rocks, Minerals, Plate Tectonics & Earth Systems

Where are we now? ...

National Curriculum E&ES

- Senior secondary years 11 & 12
 - Started out as Environmental Science
 - Lobbying by the geoscience community saw it change to Earth and Environmental Science
 - First drafts were very much 'us' & 'them' in structure
 - Feedback did produce further change
 - Earth Systems Science approach
 - Integrated as much as possible
 - *In Earth and Environmental Science, students develop their understanding of the Earth system model, and the ways in which interactions between the Earth spheres and interactions between Earth processes, environments and resources are related within the Earth system.*
 - *In this subject, the term 'environment' encompasses terrestrial, marine and atmospheric settings and includes Earth's interior. Environments are described and characterised with an Earth and Environmental Science focus rather than with a particular ecological, biological, physical or chemical focus*

Where are we now? ...

National Curriculum E&ES

DRAFT situation

- Very much subject to further change
- Not transparent
- Year 11
 - Unit 1: Introduction to Earth systems
 - Unit 2: Earth Processes - Energy Transfers and Transformations
- Year 12
 - Unit 3: Living on Earth - Extracting, Using & Managing Earth Resources
 - Unit 4: The Changing Earth - the Cause and Impact of Earth Hazards

Where are we now? ...

National Curriculum E&ES

- NOT a 'soft' science option at senior level
- Structure: 3 interrelated strands taught in an integrated way
 - Science Understanding
 - Science as a Human Endeavour
 - Science Inquiry Skills
- *In the Senior Secondary Science subjects, the three strands of Science Understanding, Science as a Human Endeavour and Science Inquiry Skills build on students' learning in F - 10*

Where are we going?

- Where are we going? ... 2013+
 - Unified national standards and curricula?
 - Some states slow to begin the process
 - Many issues around each subject
 - Senior Earth and Environmental Science?
 - Most states working towards it slowly
 - Some resistance from states where Environmental Science taught
- National adoption of science F-10 a work in progress
 - Slow beginning
 - All now seem to be on board

Where are we going? ...

... back to the future?

- State politics
 - Changes to more conservative governments may see less enthusiasm for a national approach
 - National curriculum may 'drift' state by state
 - Education used as a tool in wedge politics
- Federal politics
 - Prospect of electoral backlash may see federal support for a national approach decline
 - This may manifest at the E&ES senior level first
 - Wedge politics
- University entry requirements
 - E&ES enrolments at senior may be influenced by prerequisites
 - Earth Science departments reluctant to impose prerequisites
 - Top students may still do key entry requirement subjects

In summary ...

- Where have we come from? ... 1901 - 1990
 - Australia as a nation of autonomous states
 - Inconsistent schooling structures, standards and curricula
 - Inflexible and prescriptive curricula
 - Keyword is Geology
 - Declining enrolment, closure of courses
- Where are we now? ... 2012
 - A national curriculum for F-10 Science + rolling out
 - Student centred and inquiry based curricula
 - Key words are Earth Science / Earth Systems Science
 - Senior Earth and Environmental Science a work in progress
- Where are we going? ... 2013+
 - Unified national standards and curricula?
 - Senior Earth and Environmental Science?

Thank you