

Teaching Science in Christian Schools / Talk 2

## Changes in Science Curriculum Development, and Science-Faith Challenges



ISCAST-CASE LECTURE  
HELD AT NEW COLLEGE, UNSW  
on Monday 23rd Oct 2017

ISCAST – <http://www.iscast.org>  
CASE – <http://case.edu.au>

DR DAVID RUYS  
HEAD OF SCIENCE  
ST CATHERINE'S SCHOOL, WAVERLEY

## Challenge: Day-to-day Demands

- Assessment & marking
- Reporting
- Programming
- Differentiation
- Registration
- Accreditation
- Variation to routine forms
- Equipment and risk forms



<http://i1.wp.com/www.teachergratitude.co.uk/wp-content/uploads/2016/11/Overwhelmed-teacher.jpg?resize=598%2C400>

# Challenge: Day-to-day Demands

- Lesson plans
- Classroom management
- Engagement
- Keeping up with best practice



<https://i.pinimg.com/originals/61/8a/44/618a44aea23e6c95d444acc6600e326.jpg>

# Science Syllabus

- NSW Syllabus is stage based
  - Each stage covers 2 years
  - Content can be covered anywhere within the two years
- Education requirements administered by NESA
- Syllabus state-based (pre-2014) -> national Curriculum
  - Stage 4 – 5 in 2014 - 2015
  - Stage 6 in 2018 – 2019
- Stage 4 - 5 syllabus consists of outcomes specifying
  - Skills - Working Scientifically
  - Knowledge & Understanding (KU)
  - Values and attitudes (VA)

Stage	Year group
1	1 - 2
2	3 - 4
3	5 - 6
4	7 - 8
5	9 - 10
6	11 (Preliminary) – 12 (HSC)

# Outcomes - Skills

STAGE 5

## SKILLS – WORKING SCIENTIFICALLY

### PLANNING INVESTIGATIONS

---

#### OUTCOME

##### A student:

- › produces a plan to investigate identified questions, hypotheses or problems, individually and collaboratively SC5-5WS

**Related Life Skills outcome:** SCLS-5WS

#### CONTENT

WS5.1 Students identify data to be collected for an investigation by:

- describing the purpose of an investigation
- explaining why certain types of information need to be collected in a range of investigation types  
- selecting possible sources of data, including secondary sources, relevant to the investigation
- justifying why variables need to be kept constant if reliable first-hand data is to be collected in controlled experiments

# Outcomes – Knowledge & Understanding

STAGE 5

## KNOWLEDGE AND UNDERSTANDING

### PHYSICAL WORLD

---

#### OUTCOMES

##### A student:

- › applies models, theories and laws to explain situations involving energy, force and motion SC5-10PW
- › explains how scientific understanding about energy conservation, transfers and transformations is applied in systems SC5-11PW

**Related Life Skills outcomes:** SCLS-10PW, SCLS-11PW, SCLS-12PW

#### CONTENT

PW1 Energy transfer through different mediums can be explained using wave and particle models. (ACSSU182)

##### Students:

- explain, in terms of the particle model, the processes underlying convection and conduction of heat energy
- identify situations where waves transfer energy
- describe qualitatively, using the wave model, the features of waves including wavelength, frequency and speed

# Outcomes – Values and Attitudes

## Objectives

### Students:

- develop an appreciation of the contribution of science to finding solutions to personal, social and global issues relevant to their lives now and in the future
- develop a willingness to use evidence and reason to engage with and respond to scientific and technological ideas as informed, reflective citizens

SC5-1VA

## Challenge: Teaching Science or Teaching Syllabus?

- Content is quite heavily prescribed
- Class time can be dominated by Skills and KU
  - Preparing for assessment
  - Preparing for HSC from earlier stages or for NAPLAN
    - Market or political pressure ("my schools")
- Teaching Values and Attitudes at risk of being tokenistic
  - Challenging for teacher – needs to be intentional
  - Challenging for students - open-ended and higher order thinking



The self-titled "Sons of the Syllabus"  
Physics class of 2016

# Teaching Focus

KNOWLEDGE

SKILLS

VALUES

IMPORTANCE



or



?

# Teaching Focus

KNOWLEDGE

SKILLS

VALUES

IMPORTANCE



# Challenge: Compartmentalisation

- “Non-overlapping magisteria” ..... false and unhelpful?
  - Creating “Well-educated monsters”?
  - In keeping with secularist framework of syllabus
  - Can separate science (skills and knowledge) from faith
- Complementary Magisteria
  - True Christian education sees all activity as worship
    - Knowledge
    - Skills
    - Values

# Opportunities: Touch-points in the syllabus

- Origins (KU)
  - Evolutionary theory
    - Syllabus allows for discussing alternatives (e.g. indigenous stories)
  - Big Bang theory
- Technology and society (VA)
  - Outcomes re: impact of science on society
  - Science careers
- Bioethics (KU/VA)
  - Cloning, stem cells, vaccination

# Sample classroom activity

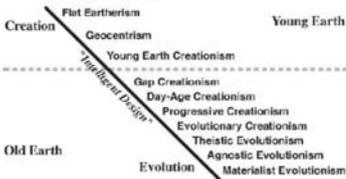
**Creation-Evolution Continuum**

There is no denying it, the question of the origin of life and the theory of Evolution causes controversy and clashes of opinion. The quest for answers about our very existence will always raise strong emotions, but we need to think clearly and be able to debate with others respectfully.

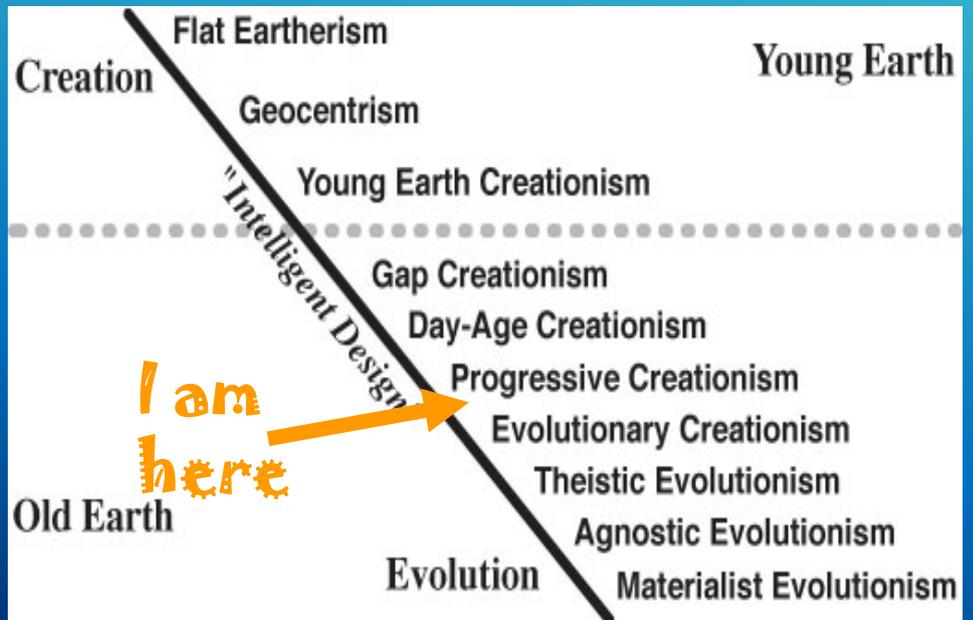
Many people think that the world is divided into only two groups: evolutionists who believe in evolution and the Big Bang versus Christians who believe that God created everything in 6 days. This overly simplistic picture is completely wrong! There are many different perspectives about the origin of life and the universe, for people of all degrees of religious faith. Eugene Scott, who promotes a public understanding of Science in the USA, has put together a helpful chart (the evolution-creation continuum) to show the different positions that people take.

Look at the continuum below, then:

- 1) Define what the following terms mean:  
Theism  
Agnostic  
Materialist
- 2) Research the different positions on the continuum (especially those you have never heard of) and summarize them on the next page. Bullet points may be helpful. Try to find one well-known proponent of each (e.g. Richard Dawkins for Materialist Evolutionism).
- 3) Place an arrow and the words "I am here" on the continuum to mark which position lines up most closely with your own World View.



**Class debate:**  
You will debate the topic "is random chance enough to account for the origin and diversity of life on Earth?". You will be assigned by lottery to the "for" or "against" argument on the day of the debate.



# Compartmentalisation

KNOWLEDGE

SKILLS

(insert God here) →

VALUES



# Syllabus Changes: New Stage 6

- NSW Syllabus: 2001 – 2017
- National Curriculum: 2018 - ?
  - Same length, level and assessment requirements
  - Responsive to feedback from universities
  - Introduced new courses
    - Investigating Science
    - Extension Science (Year 12)



## Changes in Curriculum

- Skills, skills and more skills
- Experiment-based
- Inquiry driven, not context driven
- Removal of history and philosophy of Science outcomes
- Addition of “Depth Study”
  - 15 hours (of the total 120)
  - Personal interest project



<https://s-i.huffpost.com/gen/1543098/images/o-CHEMISTRY-EXPERIMENT-facebook.jpg>

# Comparison - old

## 2. An analysis of the external forces on vehicles helps to understand the effects of acceleration and deceleration

### Students learn to:

- describe the motion of one body relative to another
- identify the usefulness of using vector diagrams to assist solving problems
- explain the need for a net external force to act in order to change the velocity of an object
- describe the actions that must be taken for a vehicle to change direction, speed up and slow down
- describe the typical effects of external forces on bodies including:
  - friction between surfaces
  - air resistance
- define average acceleration as:

$$a_{av} = \frac{\Delta v}{\Delta t}$$

### Students:

- analyse the effects of external forces operating on a vehicle
- gather first-hand information about different situations where acceleration is positive or negative
- plan, choose equipment or resources for and perform a first-hand investigation to demonstrate vector addition and subtraction
- solve problems using vector diagrams to determine resultant velocity, acceleration and force
- plan, choose equipment or resources and perform first-hand investigations to gather data and use available evidence to show the relationship between force, mass and acceleration using suitable apparatus

# Comparison - new

## Content

### Forces

**Inquiry question:** How are forces produced between objects and what effects do forces produce?

### Students:

- using Newton's Laws of Motion, describe static and dynamic interactions between two or more objects and the changes that result from:
  - a contact force
  - a force mediated by fields
- explore the concept of net force and equilibrium in one-dimensional and simple two-dimensional contexts using: (ACSPH050)  
  - algebraic addition

# Challenge: Removal of context and values

- New syllabus is mechanistic
  - Reductionist
  - Rationalist
- Discussion of philosophy and/or faith could be easily sidelined
- Develops know-how, but not know-why

~~▪ process information to discuss Einstein and Planck's differing views about whether science research is removed from social and political forces~~

~~▪ discuss the ways in which developments in scientific knowledge may conflict with the ideas about the origins of life developed by different cultures~~

# Opportunities

- More open-ended / less prescribed
- Depth studies give free rein for students and teachers
- May facilitate a better understanding of practise-as-worship



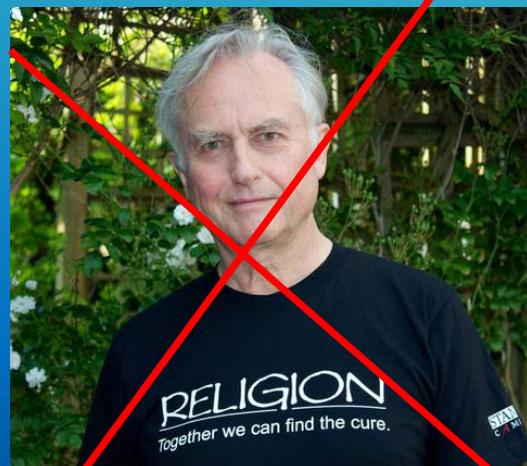
<https://i.pinimg.com/736x/1e/2a/a2/1e2aa21c9241c702db548c9b078c9f53--rube-goldberg-machine-project-based-learning.jpg>

## Challenge and Opportunity: Releasing students into the wild

- Rapidly changing job market
  - Many current jobs will be redundant due to automation and global connectivity
  - Many jobs that students will take don't exist yet
- Significant global challenges
  - Climate change
  - Resource scarcity
- Marketplace of ideas
  - Academia is often hostile to Christian faith, especially in Science
  - Increasing mistrust of religious viewpoint within secular society
    - Terrorism, child abuse scandals, same-sex marriage debate....

## Challenge and Opportunity: Equipping students

- The world is full of bad science and even worse philosophy (e.g. Richard Dawkins)
- Students of faith need to be:
  - Scientifically literate
  - Critical thinkers
  - Problem solvers
  - Good communicators
  - Discerning
  - Equipped to defend their beliefs
- Holistic approach needed
- Significant overlap with Stage 1 – 5 syllabus rationale
- Scope exists within Stage 6 to create opportunities



[http://www.age-of-the-sage.org/quotations/quotes/richard\\_dawkins\\_god\\_religion-a.jpg](http://www.age-of-the-sage.org/quotations/quotes/richard_dawkins_god_religion-a.jpg)

# Questions?



<https://coelsblog.files.wordpress.com/2013/01/why.png?w=625>