Teaching Science in Christian Schools / Talk 2

Changes in Science Curriculum Development, and Science-Faith Challenges

ICAST-CASE LECTURE
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ICAST – http://www.iscast.org
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Challenge: Day-to-day Demands

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

Challenge: Day-to-day Demands

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

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)
Outcomes - Skills

**SKILLS – WORKING SCIENTIFICALLY**

**PLANNING INVESTIGATIONS**

**OUTCOME**

A student:

- produces a plan to investigate identified questions, hypotheses or problems, individually and collaboratively SCS-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

**KNOWLEDGE AND UNDERSTANDING**

**PHYSICAL WORLD**

**OUTCOMES**

A student:

- applies models, theories and laws to explain situations involving energy, force and motion SCS-10PW
- explains how scientific understanding about energy conservation, transfer and transformations is applied in systems SCS-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 ▶ IMPORTANCE or ?

SKILLS ▼

VALUES ▲
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 doubt that the majority of the public and the scientific community support the concept of evolution over creationism. Many people today believe that the world is the result of a divine or supernatural process, while others believe in a naturalistic explanation of life. However, the question of whether creationism or evolutionism is the correct explanation of life remains a contentious issue.

KNOWLEDGE
SKILLS
VALUES

I am here

Compartmentalisation

KNOWLEDGE
SKILLS
VALUES

(insert God here)
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
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) [1, 2]
  - 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

Opportunities

- More open-ended / less prescribed

- Depth studies give free rein for students and teachers

- May facilitate a better understanding of practise-as-worship
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
Questions?

[Image of a Calvin and Hobbes comic strip with the following conversation:

WHY DO YOU SUPPOSE WE'RE HERE?
BECAUSE WE WALKED HERE.
NO, NO... I MEAN HERE ON EARTH.
BECAUSE EARTH CAN SUPPORT LIFE.
NO, I MEAN WHY ARE WE ANYWHERE? WHY DO WE EXIST?
BECAUSE WE WERE BORN.
FORGET IT.
I WILL, THANK YOU.]

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