EDUCATION REVIEW April 13 – 19, 2006

Biotechnology's wheel of knowledge

CATHY BUNTTING and ALISTER JONES describe the development of a biotechnology learning hub for New Zealand's schools

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Alister Jones and Cathy Buntting.

NEW ZEALAND'S economy is built on our exceptional ability to add value to agricultural products by applying biological knowledge, and biotechnology is seen as a key to increasing the productivity and 'value-added' nature of our primary export industries. According to New Zealand's Biotechnology Strategy, launched in 2003, biotechnology also has the potential to contribute to and influence other areas of the economy, from health care and biosecurity, to issues of criminal justice.

A key action area identified within the government's Biotechnology Strategy is to enhance biotechnology education in New Zealand, including at the school level. However, evidence from the Curriculum Stocktake Sampling Study, which collected teachers' responses to the curriculum and was undertaken by the University of Waikato and funded by the Ministry of Education, suggests that in both the science and technology curriculum areas, biotechnology is an area where teachers need additional resources for both their own knowledge and for their students.

One of the significant areas to consider is how to translate biotechnology knowledge and practice into educationally relevant and useable forms for teachers and their students. Resources that are developed must also be pertinent to the New Zealand situation, provide scope for both technological and science teaching and learning, and model effective classroom programmes which enhance student learning.

Although a number of individual initiatives occurring in the area of biotechnology education do exist, there was no clear strategy on how to develop a more efficient and effective national approach. A research and development project to address these concerns is being undertaken by the Wilf Malcolm Institute for Educational Research and the Centre for Science and Technology Education Research at the University of Waikato, in conjunction with CWA New Media. The project is funded by the Ministry of Research, Science and Technology.

The project goals include: raising awareness of the role of biotechnology in the New Zealand curriculum, both with the education and the biotechnology sectors; demonstrating how biotechnology knowledge can be transformed into classroom experiences; and developing an online digital framework to make the biotechnology industry more visible to schools.

The purpose is to develop a research-informed model for developing and supporting biotechnology education in New Zealand schools. Components which have contributed to the development of this model include: a literature review on effective practice in biotechnology education, as well as successful school-industry links; classroom-based research to identify 'what works'; and national meetings with the biotechnology sector. The classroom studies, meetings with industry, and features of the hub itself are highlighted here.

Classroom-based case studies

CLASSROOM-BASED case studies were carried out in six classrooms (Years 5-9) at four schools. The key purpose was to identify ways in which biotechnological knowledge can be transformed into appropriate classroom teaching and learning experiences, and consisted of three phases: a teacher workshop, collaborative development of classroom materials, and the development of case studies of classroom practice.

The findings highlighted that biotechnology learning needs to be situated in real-life contexts that are relevant to the learners, but that units need to have realisable end-points that take into account the constraints of working with living systems. Knowledge about the nature of biotechnology, as well as the underpinning science and technology, is important. The students also need to be able to identify and engage with the various scientific and technological concepts, and a biotechnology focus needs to be maintained across the full range of achievement objectives, learning activities, learning outcomes, and assessment tasks. In complex, long-term units, students need to be guided in the synthesis of ideas from different activities, and benefit from teachers working alongside them to provide immediate, ongoing and appropriate feedback.

Classroom studies are ongoing to explore ways to enhance the teaching and learning of biotechnology in schools from Years 1-13.

Comments from the biotechnology industry

THE BIOTECHNOLOGY SECTOR was invited to contribute their views about school access to modern biotechnological knowledge and ways in which this could be facilitated. Three focus group meetings were held, involving representatives from six crown research institutes, five universities and 11 private biotechnology companies.

Participants held a range of views of biotechnology, framed by their own endeavours, and felt that any definition of biotechnology needs to reflect the diversity of ways in which a biological system can be applied to produce a process or product. They also stressed the interplay between scientific and technological processes, and that the success of a project is dependent on the underpinning science as well as the creativity of the team and the marketing of the product/process. Skills in mathematics, computing, communication, business and entrepreneurship are also valuable, and because one person is unlikely to be highly skilled in all these areas, teamwork is essential.

Participants also felt that there was a common perception among the public that biotechnology outcomes pose a threat to New Zealand, rather than being a factor that underpins our long-term wellbeing. They suggested that this requires more of an effort from the biotechnology industry to interact with teachers and students so that future citizens will be able to make informed decisions about biotechnologies that are likely to be part of their everyday life. They indicated, however, that it was difficult for an organisation to build relationships with more than a few schools at a time.

The development of an online portal for biotechnology in schools

THE NEW ZEALAND Biotechnology Learning Hub (www.biotechlearn.org.nz) is an online portal that was developed as a result of the research findings. Its principal aim is to bring the biotechnology and education sectors together in a more sustainable and educationally meaningful way to enhance teaching and learning in New Zealand schools. The content is developed as a result of a research process both in terms of the biotechnology that is featured, and best practice of teaching, learning and assessment.

A key feature of the hub is the 'focus stories' – in-depth case studies of modern biotechnology in action. These have been developed in conjunction with the biotechnology industry and educators and provide authentic contexts in which classroom learning can be situated.

Information about the science and technology components is provided in the form of text, video clips, animations, and interactive activities, and can be used as teacher background and/or for student investigations.

In addition, unit plans include a range of suggested learning activities and have been designed to show how teachers can transform the biotechnology presented in the focus stories into relevant teaching and learning experiences.

An 'in-the-lab' section includes video and animated explanations of common molecular biology tools, as well as examples of the diverse range of contexts in which these tools are used.

In addition to being an online portal, the Biotechnology Learning Hub has personnel and physical resources to respond to the needs of teachers, students and the biotechnology sector. The hub is still developing and content for the website is expected to continue to grow in response to the needs of teachers, students, and the biotechnology sector.

A governance board with representatives from the science, innovation, and education sectors provides overall direction.

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What is the Biotechnology Learning Hub?

The Biotechnology Learning Hub brings together the worlds of biotechnology and education, and is rich in multimedia content that highlights current New Zealand research and makes it accessible to New Zealand school teachers and students, as well as the wider community. The hub is at www.biotechlearn.org.nz