

# Making a difference

PrimaryConnections

Stage 3 Project Brief: 2006–2008



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# Making a difference

Primary**Connections**

Stage 3 Project Brief: 2006–2008



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# Project rationale

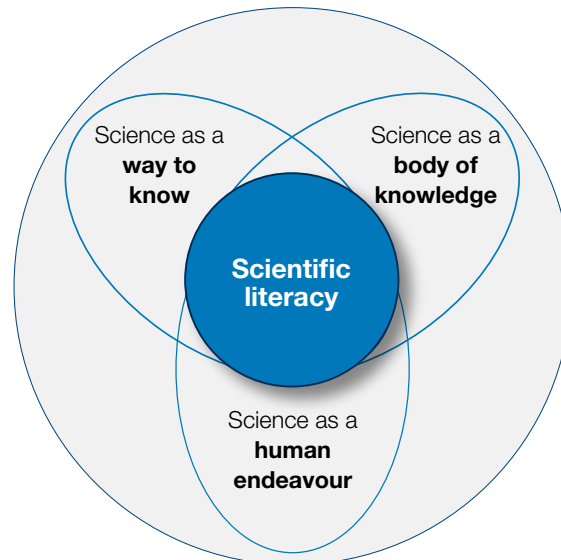
High quality teaching of both science and literacy in Australian primary schools is a national priority in order to develop scientifically literate citizens who can contribute to the social and economic well-being of Australia and achieve their own potential. A community with an understanding of the nature of science and scientific inquiry will be better equipped to participate in and contribute to an increasingly scientific and technological world.

However, the teaching of science in primary schools has been a cause for concern for some time. Despite the recognition by parents, teachers, principals and education leaders that science should be a priority area of learning, science teaching has a low status in the primary curriculum (Peers, 2001). The 2001 national review (Goodrum, Hackling & Rennie, 2001) found that in some primary schools science is not taught at all. When science is taught on a regular basis in primary schools it is student-centred and activity-based and there is a high level of student satisfaction. The review concludes that if primary teachers of science are to be effective in improving student learning outcomes, they need access to quality professional learning opportunities, supported by quality curriculum resources. It also argues that to develop quality science education resources, collaboration between jurisdictions is essential. This could reduce wasteful duplication in the preparation of curriculum resources and resources for teacher professional learning. The **PrimaryConnections** project has been developed in response to these concerns and recommendations.

It is acknowledged internationally that the major purpose of science education is to develop the scientific literacy of students. This purpose underpins the activities of the Education and public awareness section of the Australian Academy of Science, including the **PrimaryConnections** project. Scientific literacy was described in the national review of science teaching in Australia (Goodrum, Hackling & Rennie, 2001) as a person's capacity to:

- be interested in, and understand the world around them
- engage in the discourses of and about science
- be sceptical and questioning of claims made by others about scientific matters
- be able to identify questions and draw evidence-based conclusions
- make informed decisions about the environment and their own health and well-being.

The opportunity to develop scientific literacy in the Primary**Connections** programme occurs when students engage with the ‘science domain’. The draft *Statements of Learning for Science* (MCEETYA, 2006) describe the ‘science domain’ as: ‘science as a human endeavour, science as a way to know, and science as a body of knowledge’. For the Primary**Connections** project this interrelationship is represented graphically in Figure 1.



**Figure 1: The development of scientific literacy through organisers of the science domain.**

Most students and citizens will be users rather than generators of scientific knowledge. Hence an understanding of the nature of science and scientific knowledge will prepare them to be critical consumers of scientific information, to distinguish fact from fiction, and to judge the evidence of scientific claims. Primary**Connections** will build on students’ natural curiosity, nurture their sense of wonder, and develop their passion for exploring how the world works.

## Project aim

The aim of the Primary**Connections** programme is to improve the quality and quantity of science teaching and learning in primary schools, through enhancing teachers’ confidence and competence. This is achieved by developing teachers’ pedagogical content knowledge in teaching science and literacy through an innovative programme of professional learning supported with rich curriculum resources.

## Project outcomes

Quality science education needs a central place in the primary years as it lays the foundation for a scientifically literate society where people can make informed decisions about a multitude of things that affect them. Our vision is that through the Primary**Connections** approach, teachers and students will develop an enhanced appreciation and enjoyment of teaching and learning in science and literacy in the primary years.

The success indicators for the Primary**Connections** project are:

- improved student learning outcomes in science
- improved student learning outcomes in the literacies of science
- enhanced teacher self-efficacy and confidence in teaching science and literacy
- increased teaching time for science
- an enhanced profile for the teaching of science in Australian primary schools.

## The benefits

Primary**Connections** focuses on teacher change and will therefore support initiatives aimed at enhancing the quality of teaching and learning in schools, a key education focus in all states and territories. It will also contribute to developing the capacity of primary teachers as curriculum leaders which will support broader curriculum initiatives in jurisdictions.

Primary**Connections** is designed to help students question, investigate, gather and analyse information, and make evidence-based decisions about themselves and their world: that is, to enhance their scientific literacy. This includes developing the essential learning necessary to equip students to meet the demands of living in a global, knowledge-based world. This is more than simply acquiring a body of knowledge: it means being a critical thinker and an informed consumer.

Improved scientific literacy enhances the capacity for improved personal decision-making, and impacts on aspects of community sustainability such as energy and water use, personal fitness and health, and lifestyle choices. Improved well-being, increased employment and reduced workplace absenteeism results in reduced social security and medical costs, and hence improved economic conditions for all.

As we move increasingly to a knowledge-based economy we need a workforce capable of informed and creative decisions capitalising on scientific understanding. This results in improved productivity, more viable businesses and the creation of new jobs.

Benefits from an increase in the scientific literacy of students will be seen in the development of a workforce that is equipped to engage with more sophisticated technologies and who understand the impact of the applications of science to their businesses, community and personal life.

# History of the PrimaryConnections project

## Stage 1

In 2003 a proposal initiated by the Australian Academy of Science and titled the *Primary Science and Literacy Project* argued for the development of an innovative programme for Australian primary schools to improve learning outcomes in both literacy and science. A sophisticated professional learning programme supported by rich curriculum resources was proposed, to improve both the quality and quantity of primary science teaching. Through its Australian Foundation for Science, the Academy funded the 'proof of concept' stage (Stage 1). This phase sought to identify the scope of the initiative, develop a conceptual model for the program and gain support from jurisdictions and the Australian Government Department of Education, Science and Training (DEST). The programme subsequently became known as **PrimaryConnections**: linking science with literacy.

## Stage 2

Stage 2 of **PrimaryConnections** was launched in August 2004, funded by DEST through its Quality Teacher Programme. This stage covered the development, trial and evaluation of a professional learning model and an approach to curriculum resource development. Products included draft professional learning modules, an educational DVD, sample curriculum units, sample support curriculum materials, and a draft unit template to enable teachers to construct their own units of work.

## Research evidence – Stage 2

**PrimaryConnections** Stage 2 was monitored by a comprehensive research programme designed and carried out by researchers from Edith Cowan and LaTrobe universities. The research evaluated the trial and informed full-scale development and implementation of the project.

The Stage 2 Research Report (Hackling & Prain, 2005) indicated that the programme had a strong and positive impact on students, teachers and schools. Based on the data gathered, the following assertions can be made about the impact of the programme during the trial.

### **PrimaryConnections:**

- made large and statistically significant increases to teachers' confidence and self-efficacy with teaching science
- made large changes to teachers' practice including increased frequency of teaching literacy skills needed for learning science; use of diagnostic assessment; frequency of hands-on activity work; and use of digital cameras
- supported a large increase in science teaching time and status of science in the school curriculum
- received a very positive response from students
- increased the quality and amount of learning of science and literacy
- resulted in large and statistically significant increases in learning achievement in sample classes studying the *Plants in action* unit.

Primary**Connections** Stage 3 will be informed by the findings and recommendations of the Stage 2 Research Report. A copy of the report can be found at [www.science.org.au/reports/pcreport1.pdf](http://www.science.org.au/reports/pcreport1.pdf)

## Project structure

Primary**Connections** is a collaborative project, drawing on expertise as required to meet the needs of a national initiative. This approach provides the highest quality programme and builds ownership and commitment necessary for implementation in all states and territories.

The project's Managing Director is Ms Shelley Peers from the Australian Academy of Science. The project is overseen by a Steering Committee, comprising representatives of the Australian Academy of Science and DEST.

The project is informed by advice from a national Reference Group. The initial Reference Group (first established in December 2003) comprised representatives from all state and territory government, catholic and independent sectors, and professional associations in both science and literacy. Their input has been a valued part of the project to date. In Stage 3, the Reference Group will be expanded to include the Australian Council of Deans of Education and the Australian Primary Principals Association. This will assist in developing a programme that appropriately represents the needs of all stakeholders.

The ongoing research component will be conducted by science and literacy education specialists from Edith Cowan and LaTrobe universities. Professional learning workshops for trial teachers and professional learning facilitators will be developed and conducted by expert consultants, to ensure the highest quality input to the development and delivery of the programme.

We are indebted to the trial schools and teachers Australia wide for their contribution to the project to date. During Stage 2, 106 trial teachers from 56 trial schools experienced a total of eight days of professional learning. This has had significant benefits for teachers, schools and the project, resulting in high-quality feedback to refine the processes and products. To ensure the fidelity of implementation and ongoing quality feedback during the trial process, we will continue to work with trial schools selected at the end of 2004: no further trial schools will be called for in Stage 3.

## Timeliness

The development of the Primary**Connections** programme is timely in that it builds on much of the work done to date such as the *Getting it Right* project in Western Australia (Western Australian Department of Education and Training), the *Spotlight on Science* initiative in Queensland (Education Queensland) and the in Victoria (Victorian Department of Education and Training). The collaborative approach adopted for the project takes account of the priorities of all stakeholders, and positions Primary**Connections** for successful uptake.

The Primary**Connections** program has been developed collaboratively, is well conceptualised, has undergone substantial trialling, and has been thoroughly researched. The evidence indicates that it is making a significant difference to teachers and students. Hence, it is with considerable confidence that we move to Stage 3.



# PrimaryConnections Stage 3

## Stage 3 PrimaryConnections project

Stage 3 of the PrimaryConnections project will extend from 2006 to the end of 2008. It is funded by DEST through its Quality Teacher Programme. Stage 3 involves the development of the PrimaryConnections professional learning programme and curriculum resources. It also includes support for initial uptake by Australian schools. Stage 3 consists of distinct but overlapping phases of activity including:

- transition from PrimaryConnections Stage 2
- movement to whole-school implementation in trial schools
- implementation of the programme in schools Australia wide
- development of consolidation and sustainability strategies to promote ongoing engagement with the PrimaryConnections programme.

## Underpinning frameworks

The frameworks developed in Stages 1 and 2 of the project will continue to be refined and will guide the project in Stage 3. This section outlines the frameworks for the programme.

## Professional learning approach

Teacher professional learning lies at the heart of the PrimaryConnections programme. Report after report has concluded that teacher change is the key to raising the quality of science education. The 2001 national review of science education in Australia (Goodrum, Hackling, & Rennie, 2001) found that teachers are the most important single factor in improving student learning in science.

The PrimaryConnections professional learning model from Stage 2 (Hackling & Prain, 2005), describes teacher professional growth which is supported through a staged programme of learning. This includes opportunities for reflection, practise in new pedagogical skills and support through aligned curriculum resources (Figure 2).



**Figure 2:** PrimaryConnections professional learning model (Stage 2) (Hackling & Prain, 2005).

The PrimaryConnections professional learning programme is designed to improve teachers’ confidence and competence in teaching science and literacy by developing their pedagogical content knowledge.

Primary science pedagogical content knowledge includes:

- Knowledge of curriculum, outcomes and standards
- Knowledge of science concepts, processes and the nature of science
- Knowledge of science teaching and assessment pedagogies
- Knowledge of literacy practices and forms of representation relating to science
- Knowledge of students and their learning

Five pedagogical principles underpin the PrimaryConnections programme (Australian Academy of Science, 2005a) (see Table 1). These draw on the Victorian Department of Education, *Principles of learning and teaching* (2004).

**Table 1:** PrimaryConnections pedagogical principles (Australian Academy of Science, 2005a).

1.	Students are supported and challenged to develop deep levels of thinking
2.	Science is linked with students’ lives, perspectives and interests
3.	Learning connects with communities and practice beyond the classroom
4.	The learning environment promotes independence, and collaboration
5.	Assessment practices are an integral part of teaching and learning

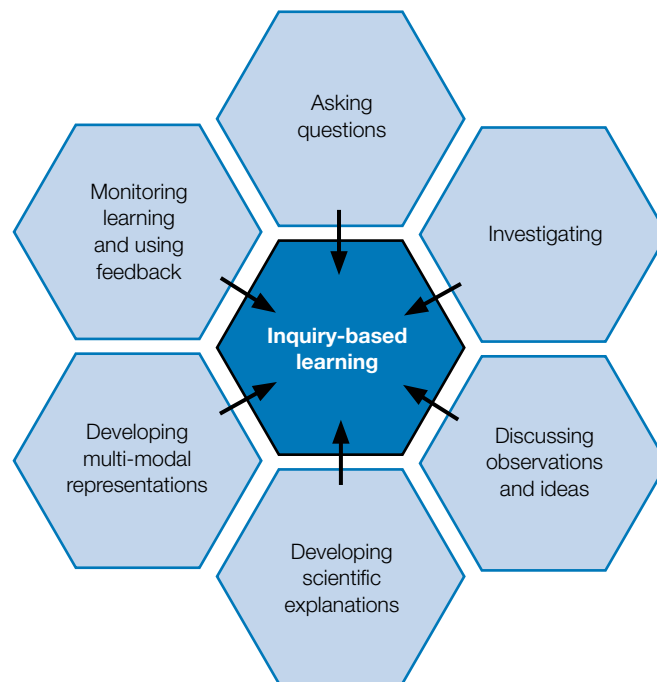
## Inquiry and investigative approach

PrimaryConnections employs an inquiry approach to teaching and learning so that students’ questions become the focus for investigation and the basis for developing scientific explanations. Student-planned investigations are undertaken using planning templates which teachers use to scaffold scientific inquiry.

Inquiry is facilitated through small group cooperative learning (Australian Academy of Science, 2005b). Working in teams enables students to share their experiences and consider different points of view and solutions to a problem. Teams develop the social skills of sharing, leading, communicating, building trust and managing conflict. These skills are relevant to students' lives, not only in school and work, but also in family and personal relationships.

Students are supported to produce multimodal representations of their understandings (see Literacy section). These representations are monitored by teachers so they can give students feedback to enhance their learning.

The elements of the Primary**Connections** inquiry approach to teaching and learning (Australian Academy of Science, 2005b) are represented graphically in Figure 3.



**Figure 3: Elements of the PrimaryConnections inquiry approach (Australian Academy of Science, 2005b).**

### Linking science with literacy

The approach of linking science with literacy is based on the assumption that students need to use their everyday literacies to learn the new literacies of science, and that they need explicit instruction to do so. As the concepts and processes of science cannot be learnt separately from their representation (Gee, 2004; Lemke, 1998; Norris & Phillips, 2003), literacy practices are needed to engage with science phenomena and ideas. The Primary**Connections** programme therefore incorporates a range of literacy practices and forms of representation to engage students in learning both science and literacy, and to provide ways for students to show what they know. Using these strategies students learn to connect science with their everyday world and values. Linking science with literacy also provides meaningful purposes and relevant contexts in which students demonstrate learning outcomes in science and literacy simultaneously.

Primary**Connections** develops the literacies of science that students need to learn and represent their understanding of science concepts and skills. Representations in science are multimodal, including text, tables, graphs, models, drawings and embodied forms such as gesture and role play (Australian Academy of Science, 2005b).

As an example, each Primary**Connections** unit includes a number of literacy focuses (Australian Academy of Science, 2005b). These are the literacy processes and products that are developed in the unit; for example science journals, storyboards, labeled diagrams, cross-sections, tables, timelines, graphs, role-plays, procedural texts and biographies. Literacy focuses:

- use a wide range of everyday language practices and texts that can support the learning of science concepts and content
- involve learning the subject-specific vocabulary and design features of genres of science
- use the particular literacies of science
- connect the learning of science to students' local communities.

### Primary**Connections** 5Es teaching and learning model

Primary**Connections** is based on an inquiry-oriented teaching and learning model. Students use their prior knowledge and literacies to develop explanations for their hands-on experiences of scientific phenomena. Students have opportunities to represent and re-represent their developing understandings. They are actively engaged in the learning process. Students develop investigation skills and an understanding of the nature of science. Teaching and learning progresses through five phases: *Engage*, *Explore*, *Explain*, *Elaborate* and *Evaluate*. The phases are based on the 5Es model developed by Bybee (1997).

### Embedded assessment

Assessment is ongoing and embedded to enhance learning in Primary**Connections**. This aspect of the model has been refined from Stage 2. Assessment is linked to the development of literacy products in each of the phases of the teaching and learning model. In the *Engage* phase, **diagnostic assessment** is used to elicit students' prior knowledge so that the teacher can take account of this in planning how the *Explore* and *Explain* lessons will be implemented. In the *Explore* and *Explain* phases, literacy products enable the teacher to monitor students' developing understanding and provide feedback that can extend and deepen students' learning through **formative assessment**. The investigation report produced in the *Elaborate* phase and the literacy product developed in the *Evaluate* phase provide opportunities for **summative assessment** of students' learning of the investigation skills and concepts developed through the unit. The relationships between the 5Es, investigations, representation of understandings and assessment are illustrated in Table 2.

**Table 2: PrimaryConnections 5Es teaching and learning model.**

<b>Phase</b>	<b>Focus</b>
<b>ENGAGE</b>	Engage students and elicit prior knowledge <b>Diagnostic assessment</b>
<b>EXPLORE</b>	Provide hands-on experience of the phenomenon <b>Formative assessment</b>
<b>EXPLAIN</b>	Develop scientific explanations for observations and represent developing conceptual understanding Consider current scientific explanations <b>Formative assessment</b>
<b>ELABORATE</b>	Extend understanding to a new context or make connections to additional concepts through a student-planned investigation <b>Summative assessment of the investigating outcomes</b>
<b>EVALUATE</b>	Students re-represent their understanding and reflect on their learning journey and teachers collect evidence about the achievement of outcomes <b>Summative assessment of the conceptual outcomes</b>

## PrimaryConnections Stage 3 project components

Stage 3 of the project has eight major components. The activities and products of these components are listed in Table 3.

**Table 3: Major components of PrimaryConnections Stage 3 project and associated activities and products.**

Component	Stage 3 activities and products
1 Professional learning	<ul style="list-style-type: none"> <li>• train Professional Learning Facilitators</li> <li>• develop a suite of professional learning modules for facilitators to use as a resource to conduct workshops</li> </ul>
2 Curriculum resources	<ul style="list-style-type: none"> <li>• develop further curriculum units (total of 19 units) which include science background information on CD-ROM</li> <li>• develop further unit-linked resources (for example assessment rubrics, equipment lists and electronic resource sheets)</li> <li>• further develop a web presence to support uptake by teachers in trial schools and other interested teachers and schools</li> <li>• provide professional learning workshops to support trial teachers to provide feedback on trial units</li> </ul>
3 First year of schooling	<ul style="list-style-type: none"> <li>• collaboratively develop resources for Early Stage 1 (the first year of compulsory schooling)</li> </ul>
4 Indigenous perspectives	<ul style="list-style-type: none"> <li>• further develop the Indigenous focus for the programme</li> <li>• incorporate Indigenous contexts in curriculum units as appropriate</li> </ul>
5 Pre-service teacher education	<ul style="list-style-type: none"> <li>• develop a Pre-Service Teacher Education Resource Pack</li> <li>• conduct workshops for pre-service teacher educators</li> </ul>
6 Developing a web presence	<ul style="list-style-type: none"> <li>• develop a web presence to provide up-to-date information and extra curriculum resources and to support networks for trial teachers and facilitators</li> </ul>
7 Research and evaluation	<ul style="list-style-type: none"> <li>• undertake further research to monitor and evaluate trialling processes and inform ongoing refinement of deliverables</li> </ul>
8 Promotion	<ul style="list-style-type: none"> <li>• develop a promotion and public relations strategy to build ownership by jurisdictions, schools and others and provide information about the programme</li> </ul>

This following section provides an overview of the eight main components of the Primary**Connections** project for Stage 3. Primary**Connections** Stage 3 will be monitored by the Steering Committee through six-monthly reports in March and September each year of the project.

## 1. Professional learning component

Continuous professional learning lies at the heart of the Primary**Connections** programme. It is central to enhancing teachers' pedagogical practice and to providing improved opportunities for student enjoyment and learning in science and literacy.

The professional learning programme will be conducted by professional learning facilitators who have undertaken three days of training. Their role is to mentor and support teachers and schools in changing practice and beliefs.

The professional learning component will comprise two main activities and products:

- training professional learning facilitators
- developing professional learning modules for facilitators to use as a resource to conduct workshops.

### *Professional Learning Facilitators*

A cohort of Professional Learning Facilitators (PLFs) will be trained at three-day workshops in Canberra before March in 2006, 2007 and 2008. This training will prepare facilitators from all states and territories to mentor and support teachers and schools in changing practice and beliefs about teaching science. Once trained, these facilitators will conduct workshops and information sessions, mentor school co-ordinators and provide briefings to principals, resource teachers, teacher librarians and curriculum support teachers. They will be supported by state-based workshops held twice yearly.

Nominations will be sought from independent, catholic and government school systems and others such as teacher professional associations, for appropriate personnel to train as Professional Learning Facilitators. Schools and systems will need to consider the ongoing work of these facilitators in 2006 and beyond regarding the allocation and cost of time for them to work with schools interested in implementing Primary**Connections**. Other ways to support schools interested in uptake may also be considered, for example through access to state-based funds from the Australian Government Quality Teacher Programme.

During Stage 3 the effectiveness of the Professional Learning Facilitator training will be monitored by ongoing research. This is addressed in the Research Component (see Component 7). The conduct, delivery and development of the professional learning programme will be refined and the professional learning modules will be evaluated and refined, based on feedback.

The professional learning modules will be linked to the curriculum resources and exemplify particular teaching strategies. They will:

- address general principles of teaching and learning, adult learning styles, pedagogical tools and strategies, and presentation skills
- be negotiated with particular schools or teachers and customised to address particular student or teacher needs

- be available in electronic form so that they can be tailored to suit local needs and various modes of delivery
- Video clips exemplifying various pedagogies will be incorporated from the *Questioning Minds* DVD (Australian Academy of Science, 2005c) produced in Stage 2.

The recommended model for school implementation will be for all teachers to undertake professional learning in the Primary**Connections** programme. It will be recommended that schools identify a Primary**Connections** school leadership team to ensure capacity building and sustainability consistent with the schools' particular circumstances. Membership of that team could include staff such as the science co-ordinator, the literacy co-ordinator, the resource teacher or teacher-librarian, the curriculum support teacher and the principal or deputy/assistant principal.

The following strategies to support successful implementation of the Primary**Connections** programme are recommended as an optimal approach for consideration by school leadership teams:

- the school Primary**Connections** coordinator attend a one-day school coordinator workshop presented by a trained Primary**Connections** Professional Learning Facilitator where this workshop is available
- half-day audit of school curriculum and practices be conducted involving all teachers, facilitated by the leader of the project at that school (the school coordinator) using the survey tools developed for the 'Auditing' module
- a one-day initial professional development workshop for all school staff, presented and facilitated by a trained Professional Learning Facilitator – this may also be presented as two shorter workshops
- one or two follow-up half day or after school workshops conducted by a trained Professional Learning Facilitator extending teachers' understanding of key pedagogical principles and practices in areas of need identified by that school
- two or three whole school collegial discussions facilitated by the school coordinator to allow teachers to reflect on and support each other in implementing the new approaches to teaching and learning.

## 2. Curriculum resources and unit development

In Stage 3, a suite of units and supporting curriculum resources will be developed, trialled and published to support teachers to implement the Primary**Connections** teaching and learning approach. This will allow a diversity of units to exemplify various pedagogical emphases, address a range of conceptual contexts and provide increased coverage of state and territory curriculum frameworks

The units will be organised into four stages of learning, linked to years of schooling and outcome levels on the National Scientific Literacy Progress Map (Table 4). This map was developed for the Year 6 national assessments of scientific literacy (MCEETYA, 2005) (see Attachment 2).

**Table 4: Stages, years and outcome levels.**

PrimaryConnections stage	Years of schooling	Outcome levels*
Early Stage 1	1	<1–1
Stage 1	2–3	1–2
Stage 2	4–5	2–3
Stage 3	6–7	3–4

\* From the *National Scientific Literacy Progress Map*

The resources will exemplify the underpinning PrimaryConnections 5Es teaching and learning approach. PrimaryConnections units are designed to develop students' skills in working scientifically as they undertake investigations and communicate their understanding about science ideas. Units incorporate:

- PrimaryConnections 5Es teaching and learning model
- cooperative learning strategies
- literacy practices and forms of representation
- assessment integrated with teaching and learning processes
- background science information for the teacher
- an inquiry and investigative approach
- ICTs and learning objects

Unit topics will be drawn from a scope and sequence developed from a summary of the curriculum documents of all states and territories, and will be aligned to and consistent with the final *Statements of Learning for Science* agreed to by the Ministerial Council on Education, Employment, Training and Youth Affairs (MCEETYA) to be released later in 2006. Units will incorporate Indigenous perspectives and links to students' communities outside of school. They will be based on the four conceptual strands of the *National Statement and Profile for Science*: Earth and Beyond; Energy and Change; Life and Living; and Natural and Processed Materials.

In selecting topics for unit development, consideration will also be given to a whole school approach in their implementation. A minimum 'core' of two units per grade level with an additional unit for the first year of school will be developed. At least one further unit for each stage will also be developed, bringing the total to 19 units in the suite (Table 5).

**Table 5: Number of Stage 3 units in PrimaryConnections stages.**

PrimaryConnections stage	Number of units to be published in Stage 3
Early Stage 1	4
Stage 1	5
Stage 2	5
Stage 3	5
<b>TOTAL</b>	<b>19</b>

Feedback from trial teachers, project consultants, the Steering Committee and the Reference Group will also guide the selection of topics. Where appropriate, integration with technology and mathematics curriculum areas, and integration across science strands will also be considered.

The curriculum resources will also make explicit links with:

- relevant online materials (learning objects) developed by the Le@rning Federation ([www.thelearningfederation.edu.au](http://www.thelearningfederation.edu.au))
- science literacy assessment materials developed as part of the Science Education Assessment Resources (SEAR) Project (<http://cms.curriculum.edu.au/sear/>)
- the National Scientific Literacy Progress map that underpins both SEAR and the Primary Science Assessment Project (PSAP) that measures the performance of Year 6 students in science (Attachment 2) ([http://cms.curriculum.edu.au/sear/newcms/view\\_page.asp?page\\_id=3539#map](http://cms.curriculum.edu.au/sear/newcms/view_page.asp?page_id=3539#map)).

The scope and sequence of the curriculum units will be monitored and revised as needed, and will be available from the Primary**Connections** website. The current scope and sequence is Attachment 1 (June 2006).

Additional unit-linked resources for teachers (including assessment rubrics, equipment lists, lists of literacy resources and electronic resource sheets) will also be developed and available from the Primary**Connections** website.

### **3. First year of schooling**

An 'introductory unit' for Early Stage 1 of primary schooling will be developed and trialled to focus on the needs of learners in the first year of compulsory schooling. This will be based on a consultation process including feedback from focus groups of Early Stage 1 trial teachers. Four curriculum units will be developed for Early Stage 1 (see Table 5).

While the project will not include unit development for the years prior to compulsory schooling, specific mention of the benefits of teaching science to preschool children (aged 3-5 years) will be included in the Primary**Connections** Pre-Service Teacher Education Resource Pack (See below).

### **4. Indigenous perspectives**

Indigenous perspectives will be incorporated into the Primary**Connections** programme. Further consultation will be undertaken to explore effective strategies to address science and literacy performance for indigenous students, in line with Australian Government policy to address indigenous education within mainstream school programmes.

[www.dest.gov.au/sectors/indigenous\\_education/policy\\_issues\\_reviews/national\\_goals\\_for\\_indigenous\\_education.htm](http://www.dest.gov.au/sectors/indigenous_education/policy_issues_reviews/national_goals_for_indigenous_education.htm)

[www.dest.gov.au/sectors/indigenous\\_education/policy\\_issues\\_reviews/indigenous\\_education\\_and\\_training\\_2005\\_2008.htm](http://www.dest.gov.au/sectors/indigenous_education/policy_issues_reviews/indigenous_education_and_training_2005_2008.htm)

## 5. Pre-service teacher education

A Pre-Service Teacher Education Resource Pack will be developed for the Primary**Connections** programme to provide universities with a set of coherent resources to introduce pre-service teachers to the Primary**Connections** teaching and learning model and develop their familiarity with the resources. The need for such a resource emerged from Stage 1 and Stage 2 activities. Many requests for such a resource were received and considerable interest in its use has been shown by tertiary educators.

The Pre-Service Teacher Education Resource Pack will be revised and adapted as required during the project based on feedback, research and evaluation provided by pre-service teacher educators, the facilitators, Project Steering Committee, Reference Group and project consultants.

A workshop or information session for pre-service teacher educators will be conducted in July of 2006, 2007 and 2008 (in conjunction with the Annual Conference of the Australasian Science Education Research Association) to introduce the resource pack and the Primary**Connections** programme to pre-service teacher educators. This will include specific mention of the benefits of teaching science to preschool children (aged 3–5 years).

## 6. Developing a web presence

The Primary**Connections** website ([www.science.org.au/primaryconnections](http://www.science.org.au/primaryconnections)) will be further developed to enable ongoing updating of project information and project materials, and provide a communication link with and between all participants of the project. In particular, the website will provide up-to-date information, additional resources and supportive networks for trial teachers and facilitators. It will also have a marketing and promotion function.

## 7. Research and evaluation

The research component will provide ongoing monitoring and evaluation, to inform the refinement of resources prior to publication, and to constantly review student outcomes, teacher and facilitator professional development, the effectiveness of the Professional Learning Facilitators and the impact of the whole-school implementation on students, teachers and schools. It will also review project processes.

The findings of this research will be reported in regular research reports. These reports will form an important component of a wider programme of longitudinal research to monitor the effectiveness of the Primary**Connections** project.

Research reports will document the findings from research on the various components of the project, including:

- longitudinal change in student learning outcomes in science and the literacies of science, and change in attitudes to science
- longitudinal change from base levels in trial teachers' confidence and self-efficacy (beliefs about their own ability to teach science) and classroom practice

- 'case-study' experiences of teachers involved in whole-school trials
- the impact of various models for school implementation on student outcomes
- the growth of trained professional learning facilitators and the effectiveness of the professional learning modules and facilitator activities
- the impact of various models for training and accreditation of the professional learning facilitators
- pre-service educators workshops and resource pack
- curriculum resources and support materials.

Following consultation, a final Research Plan will be developed by 30 September 2006 and monitored by the Steering Committee. An independent mid-term review of the project to assess the progress and impact of the programme will also be conducted.

## **8. Promotion**

To promote national uptake of the Primary**Connections** programme a promotion and public relations strategy for the project will be developed. The strategy will provide information about the project for schools and other interested parties. The strategy will be a staged approach and will be reviewed and refined as further curriculum resources and professional learning materials are developed, and the training of Professional Learning Facilitators progresses.

## Uptake

A staged uptake is anticipated, with 2006 being a transition year in which the approach is refined, further resources are developed and the first group of accredited facilitators is trained. Whole school implementation will occur in trial schools and other self-nominating schools depending on the capacity of trained facilitators in jurisdictions and their availability to support schools. It is anticipated that 2007 will see greater uptake and hence an increased demand for professional learning support continuing into 2008 and beyond.

## Principles for uptake

The needs and priorities of jurisdictions and the funding available will influence the models for uptake of Primary**Connections** in schools. The following principles are proposed for implementation to ensure quality and sustainability. These were negotiated with the Primary**Connections** Reference Group (24 June 2005):

- whole-school roll-out
- a combination of professional learning and curriculum resources
- professional learning facilitated by trained facilitators
- professional learning presented by a facilitator plus a trial teacher where facilitators are not trial teachers
- team-based school co-ordination to ensure succession planning
- ongoing support and co-ordination for accredited facilitators.

## Support for implementation

A complex interaction of factors will impact on the development and uptake of the Primary**Connections** programme. However, one of the most important factors will be the support for primary teachers of science from principals, district and regional managers and jurisdiction leaders. Any initiative to improve science education in primary schools involves the need to engage with change. Without adequate and ongoing support for teachers, change in classrooms will be limited or will not occur. Appropriate support includes the supply of adequate resources, and planned opportunities for teacher professional learning over significant periods of time.

## Conclusion

This project offers an opportunity to make a difference – for teachers and students Australia wide – in the teaching and learning of science and literacy. However, a collective will, and commitment to work together, is required if long-term and sustained improvement in primary school classrooms is to be a reality.

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## References

- Australian Academy of Science, (2005a). *Making connections – a guide for facilitators*, 1st edition. Canberra: Australian Academy of Science.
- Australian Academy of Science, (2005b). **PrimaryConnections: Plants in action**. Canberra: Australian Academy of Science.
- Australian Academy of Science, (2005c). *Questioning Minds DVD*. Canberra: Australian Academy of Science.
- Bybee, R.W. (1997). *Achieving scientific literacy: from purposes to practical action*. Portsmouth, NH: Heinemann.
- Goodrum, D., Hackling, M. & Rennie, L. (2001). *The status and quality of teaching and learning of science in Australian schools: a research report*. Canberra: Department of Education, Science, Training and Youth Affairs.
- Gee, J. P. (2004). Language in the science classroom: Academic social languages as the heart of school-based literacy. In E.W. Saul (Ed.), *Crossing borders in literacy and science instruction: Perspectives in theory and practice* (pp.13 – 32).
- Lemke, J. (1998). Multiplying meaning: Visual and verbal semiotics in scientific text. In J. Martin & R. Veel (Eds.) *Reading science: Critical and functional perspectives on discourses in science*. London: Routledge.
- Hackling, M. W. & Prain, V. (2005). **PrimaryConnections: Stage 2 Trial: Research Report**. Canberra: Australian Academy of Science.
- Ministerial Council on Education, Employment, Training and Youth Affairs (MCEETYA), (2005). *National Year 6 science assessment report: 2003*. Melbourne: Curriculum Corporation.
- Ministerial Council on Education, Employment, Training and Youth Affairs (MCEETYA), (2006). *Draft statements of learning for science*. Melbourne: Curriculum Corporation.
- Norris, S. P, & Phillips, L. M. (2003). How literacy in its fundamental sense is central to scientific literacy. *Science Education*, 86,122-138.
- Peers, C. (S.) E. (2001). *Teacher professional growth during implementation of a science curriculum innovation*. Unpublished Masters (Research) thesis, Queensland University of Technology, Brisbane.
- Victorian Department of Education, (2004). *Principles of learning and teaching*. Retrieved from [www.sofweb.vic.edu.au/pedagogy/plt/index.htm](http://www.sofweb.vic.edu.au/pedagogy/plt/index.htm).

## Attachment 1: PrimaryConnections Stage 3 Curriculum Unit map

Stage	Scientific Literacy level	Year of schooling	Earth and Beyond	Energy and Change	Life and Living	Natural and Processed Materials
Early Stage1	< 1	1	Weather effects me and my surroundings	Movement of children, animals and toys	Caring for living things, their needs and living spaces	Types of materials in my surroundings and their properties.
			<i>Weather in my world (A)</i>	<i>On the move (B)</i>		
1	1-2	2 and 3	Features of the day and night sky	Types of energy and how we use them	Living and non-living things, life processes	Materials, their properties and uses.
			Water as a natural resource: its sources and uses; using water responsibly <i>Water works (C)</i>	How pushes and pulls act in everyday situations <i>Push-pull power (A)</i>	Structural features of plants and animals, grouping organisms	<b>Material matters (B)</b> Rubbish and recycling. Re-use of materials
2	2-3	4 and 5	Changes brought about by the rotation of the Earth, day and night, shadows <i>Spinning in space (B)</i>	Energy transfer, light and sound	Plant life cycle, conditions needed for growth <i>Plants in action (A)</i>	Cooking and chemistry of food. Mixing, dissolving, melting. Heating and cooling changes substances. Reversible and irreversible changes
			Changes at the surface of the Earth. Solls.	Energy sources, energy audit, patterns of use, transport, reducing waste	Structure and function of body systems, breathing, circulation, energy and exercise	Investigating properties and uses of materials eg plastic. Testing strength, transparency, absorbency, biodegradability. <i>All sorts of stuff (C)</i>
3	3-4	6 and 7	Recording and analysing weather data. Seasonal changes	Transfer and storage of energy, electrical circuits and current. <i>Electric circuits (C)</i>	Biotechnology and yeast <i>Marvellous micro-organisms (A)</i>	Materials, structure, properties, design <i>Build it better (B)</i>
			Our solar system, relationships between Earth, Sun, Moon and the lunar cycle, gravity keeps things in orbit	Forces and motion, balanced and unbalanced forces, distance, time and speed	Human impact on natural systems, pollution, interdependence, food chains, water	Physical and chemical changes to matter. Formation of new substances and conservation of matter e.g. combustion.

**Key: A** – units that have been trialled, revised and published; **B** – units that have been trialled; **C** – units that are being written (\* with working titles only)  
The Curriculum Unit Map will be regularly updated and made available on the PrimaryConnections website [www.science.org.au/primaryconnections](http://www.science.org.au/primaryconnections)

JUNE 2006

## Attachment 2: Scientific Literacy Progress Map

Domains of scientific literacy			
Level	Domain A Formulating or identifying investigable questions and hypotheses, planning investigations and collecting evidence	Domain B Interpreting evidence and drawing conclusions, critiquing the trustworthiness of evidence and claims made by others, and communicating findings	Domain C Using understandings for describing and explaining natural phenomena, and for interpreting reports
1	Responds to the teacher's questions, observes and describes.	Describes what happened.	Describes an aspect or property of an individual object or event that has been experienced or reported.
2	Given a question in a familiar context, identifies a variable to be considered, observes and describes or makes non-standard measurements and limited records of data.	Makes comparisons between objects or events observed.	Describes changes to, differences between or properties of objects or events that have been experienced or reported.
3	Formulates scientific questions for testing and makes predictions. Demonstrates awareness of the need for fair testing. Makes simple standard measurements. Records data as tables, diagrams or descriptions.	Displays data as tables or bar graphs, identifies and summarises patterns in science data. Applies the rule by extrapolating or predicting.	Explains the relationships between individual events that have been experienced or reported and can generalise and apply the rule by predicting future events.
4	Identifies the variable to be changed, the variable to be measured and several variables to be controlled. Uses repeated trials or replicates.	Calculates averages from repeat trials or replicates, plots line graphs where appropriate. Conclusions summarise and explain the patterns in the data. Able to make general suggestions for improving an investigation (eg, make more measurements).	Explains interactions, processes or effects, that have been experienced or reported, in terms of a non-observable property or abstract science concept.
5	Formulates scientific questions or hypotheses for testing and plans experiments in which most variables are controlled. Selects equipment that is appropriate and trials measurement procedure to improve techniques and ensure safety.	Conclusions explain the patterns in the data using science concepts, and are consistent with the data. Critiques reports of investigations noting any major flaw in design or inconsistencies in data.	Explains phenomena, or interprets reports about phenomena, using several abstract scientific concepts.
6	Uses scientific knowledge to formulate questions, hypotheses and predictions and to identify the variables to be changed, measured and controlled. Trials and modifies techniques to enhance reliability of data collection.	Selects graph type and scales that display the data effectively. Conclusions are consistent with the data, explain the patterns and relationships in terms of scientific concepts and principles, and relate to the question, hypothesis or prediction. Critiques the trustworthiness of reported data (eg, adequate control of variables, sample or consistency of measurements), and consistency between data and claims.	Explains complex interactions, systems or relationships using several abstract scientific concepts or principles and the relationships between them.

**Note 1:** The national standard for scientific literacy for Year 6 students has been set at Level 3.2.

**Note 2:** This map was developed for the Primary Science Assessment Project and the Science Education Assessment Resources Project funded by the Australian Government Department of Education Science and Training.





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