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Summary

The Primary Science Specialist (PrimSS) Professional Learning Program 2013, is a component of the Primary Mathematics and Science Specialist Professional Learning Program.

The Primary Mathematics and Science Specialist initiative recruited 100 Specialists to boost primary students’ engagement and achievement levels in mathematics and science. Sixty mathematics and 40 science Specialists have worked in school clusters in 55 schools across the state. Specialists were provided with 20 days’ intensive training, delivered by experts including internationally recognised maths and science education academics. The specialists continue to teach, provide high quality professional learning to colleagues and neighbouring schools.

(Edwards, G. DEECD Annual Report)

Within this initiative, the Deakin Science Education team delivered the Primary Science Specialist Professional Learning Program in 2011, 2012 and the final five days in 2013. In the final component, the Deakin team provided approximately 4.5 days of pedagogy, science content and strategies related to developing teachers’ capacities. Ongoing contact with the teachers in the last 12 months has enhanced the relationships and contributed significantly to the success of the subsequent program.

The final five day PrimSS Professional Learning Program 2013 supported primary science specialists with further professional learning through engagement with university science specialists, new information and heightened pedagogical practice. In particular, considerable time was devoted to the sharing of developed practices amongst the specialists themselves. The five day program built teacher capacity to boost primary students’ engagement and achievement in science.

Approach to the program

From our delivery and follow up of the first 15 days, the Deakin Science Education team is very familiar with this cohort of specialist teachers – their experience and their needs. Contact with the cohort through email and also attendance at workshops organized by the group, have enabled us to develop a strong sense of the variety of situations in their schools and the challenges many have faced. We have a significant amount of data from the first 15 day program which we used to inform the development of the final 5 day program. In addition, a survey was sent to all participants in November 2012, which provided insights into the ongoing progress that the science specialists had been making in their schools.

In this 5 day program, we have drawn on this knowledge and in particular have made the specialist teachers’ voice – their successes and their concerns – a central part of the approach to each phase of the program. It was very clear in the initial program, in the surveys, and in subsequent discussion with the group, that the sharing of their ideas and experience was especially valued. They had been in a new situation in their schools and the comparison of strategies they had used, ideas for interacting with teachers and the school leaderships,
clarification of their role, was critically important to tease out through these five days. The group has developed a strong sense of community over time, and the particular pedagogies used in these sessions drew on these strengths.

An initial survey, sent out prior to the commencement of the program, requested commentary on participants’ experience but more importantly canvassed experiences that we can drew on in framing the sessions, such as stories of successful learning, variations in role that can be expressed in a framework, and successful professional support strategies. During key sessions the participants’ experiences were used to explore and establish key features of supporting/managing change, of quality student learning, of the use of resources such as primary connections, and of supporting effective pedagogy. Our knowledge of these specialist teachers’ experience, and the survey returns, allowed us to structure these sessions around key principles.

The comments extracted from the initial survey related to 9 sections which we considered valuable in designing the program:

- Section 1: Celebrating success
- Section 2: Enabling factors
- Section 3: Inhibiting factors
- Section 4: Planning for change
- Section 5: Quality learning
- Section 6: Assessment
- Section 7: Resource use
- Section 8: Professional Learning
- Section 9: Focus of the program

The responses from about half of the participants allowed us to embed the participants’ needs into the program and to confirm that these elements of the program were appropriately targeted to the needs of the group.

Delivered in two phases, it was possible to provide teachers with a few days to trial and/or collect examples of a quality teaching unit they had been involved in. Time was allowed for the teachers, working in small groups, to report back to others and share their experiences. Three groups (P-2, 3&4, 5&6) were filmed throughout the discussion. This video material will be edited and provided back to teachers as exemplars of quality learning from within the schools.

The 5 days of the Deakin program were focussed mainly on revising inquiry and the representation construction approach and extending some of the big ideas of science previously introduced. Concept areas around matter, light, biological concepts around plant growth, elements of force, were highlighted. Early childhood science principles were discussed. In response to participants’ comments and needs, we introduced: content related to physical sciences such as light and its links within AusVELS; differentiated learning; higher end learning in science (micro-organisms); reasoning skills; assessment; improving science content learning.

During the program, involvement of participants was crucial. Each session drew on the expertise of the group through sharing, keynote presentations, and feedback sessions. In particular, it became clear that the participants had developed an enormous amount of untapped expertise in areas relating to the use of software programs to enhance their teaching and children’s learning as well as an ability to adapt technological/digital resources to increase students’ engagement. Bearing in mind the diversity of science education and
Teaching experiences of the group, it proved valuable to listen to comments being raised and make small but important adjustments to the content of the delivery on a daily basis. This strategy worked well, enabling us to be responsive, in real time, to participants' requirements.

The ongoing discussion with participants, in addition to the pre-program survey provided us with guidance on what aspects participants were hoping for in the final 5 day program. We analysed their needs alongside the DEECD framework to develop the material for the last five days.

The final 5 days delivery was extremely well received. Informal comments received indicated that participants were very pleased with the focus of the five days. One teacher, Keren Barro, Assistant Principal at Apollo Parkways Primary School, provided a congratulatory speech on the last day, commenting on how valuable the professional learning had been for all participants and thanking all Deakin Science Education Staff involved in the development and presentation of the 5 days.

The findings that emerge from the various forms of participant feedback, and our own field notes on the workshops, are:

1. In describing the participating teacher cohort:
   a. The science teaching experience within the cohort was considerable and varied. During the five day program, the Deakin Science Education team observed strong and significant science knowledge being displayed by the participants.
   b. The level of expertise in using digital technologies varied, but most had engaged with it at a high level. In the workshops there were some impressive displays of competence with digital technologies.
   c. In supporting teacher change, participants commented on the variability of acceptance within their schools. One commented that if the DEECD and Government felt science was so important, she thought that there should be a mandated reporting obligation for science from f-6.
   d. Science specialists clearly had a strong sense of their role and were comfortable in developing and directing change in their schools.

2. In terms of timing and participation of the program:
   a. Some participants felt the 5 day program could have been undertaken earlier in the year.
   b. Participation rates varied between 35-40. Undertaking the program during Education Week caused some issues for attendance of the participants.
   c. Evaluation of the 5 day program by Deakin Science Education staff did not occur, as ACER were running a full program evaluation on the last day. It did not seem reasonable to apply yet another evaluation regime on the participants.

3. The participants’ perceived benefits from participating in the program included:
   a. Ideas for teaching science topics
   b. Enhanced science understandings
c. Enhanced understanding of inquiry pedagogies

d. Enhanced understanding of supporting change

e. Ideas and inspiration from others’ practice and innovation.

4. Feedback from the pre-program survey indicated that the science specialist were often isolated in their efforts to bring about change. Whilst they had support from the leadership teams in most cases, it was still left up to the specialist to do the work of changing teachers’ perceptions at the level of classroom practice.

5. The participants delivered their own ‘quality learning’ unit to others within the group. This presentation help define their principles of quality learning

   a. there was a recognised development in their role from science teacher to science specialist and this was evident the way they spoke about supporting change in their schools and other teachers’ classrooms.

   b. participants achieved increasing insight into their role as science specialist through sharing with others during discussion

**Recommendations**

1. The additional 5 day Deakin PrimSS professional learning program played a critically important role in supporting these specialist teachers. The pre-program survey highlighted the isolation felt by many and the bringing together of the cohort for further professional learning and the opportunity to share experiences was a recognition of their role within their schools. We recommend that there are opportunities to bring the group together more frequently as evidenced by the cohort planning their own ‘celebration’ days. Perhaps two days from the final 5 day program could be used in the first year to bring the cohort together for discussion of their roles and sharing of expertise,

2. Any future primary science specialist program needs to keep the interactive nature of the program and maximize opportunities for "hands-on" learning in small collaborative groups. In particular, the length and intensity of the program required breaks from sitting, listening and discussion. Allowing participants to interact with materials and ideas effectively allowed them to construct their own understanding in a socially collaborative manner.

3. Future programs should include sessions on ‘principles of supporting change’ and clarification of the specialists’ role, nearer the beginning of the program. This was reinforced in the final 5 days, when questions relating to their role were few. The issue of recalcitrant teachers was the most important issue at this time and the expertise of the group developed ways of dealing with this.

4. There was an identified need for increased science knowledge to be delivered in the 5 day program. This was incorporated into the program but could have been even further enhanced by broadening the number of science content topics over the five days.
5. The previous program was very successful at supporting improvement of the individual participants. It was also successful in providing strategies for participants to support and manage change in their schools. However, for this program to run more effectively, participants need to be given additional support. Ongoing contact with the DEECD curriculum team would assist with this.

6. That science PD programs focus effectively to incorporate networking within and across schools.

7. That consideration be given to how to effectively support these science specialists across the first two years of the change process in schools.

2013 Primary Science Specialist Learning Program – Report of Delivery

Introduction
The purpose of this report is to describe the 5 day DEECD/Deakin Primary Science Specialist (PrimSS) professional learning program and to examine the outcomes of the program based on feedback from participants, using a variety of data sources within the program. This evaluation of the Deakin professional learning program for primary science specialists is conducted for formative purposes, using mainly teachers' perceptions of the focus on science content, pedagogy and the supporting change/moving forward. Feedback was acted on over the period of the professional development program.

An Overview of the Primary Science Specialist (PrimSS) Learning Program
The five-day Primary Science Specialist Professional Learning Program was proposed by the Department of Education and Early Childhood Development to provide teachers with additional specialist training in science teaching and learning, in the developing use of Primary Connections materials, and in supporting change in schools.

The objective of the initial program was for schools to have science specialists working with both students and with teachers. With improved science teaching, children will become more engaged in science and their science learning outcomes will be enhanced. The role of the science specialists was, and still is, to build the capacity of other teachers to plan and implement science inquiry explorations in their own classrooms.

Within the five day program, Deakin developed and delivered approximately 4.5 days of high-quality, interactive, evidence-based professional learning. An awareness of the previous program meant that these five days could raise the level of teachers’ discipline-based science understanding and pedagogical content knowledge in science. Within the program there was a focus on enhancing participants’ capabilities to effectively manage change in schools, as a core aspect of the science specialist role. This program was developed and delivered with an awareness of the heightened abilities of the participants in all of these areas since the original program. It was envisaged that these capabilities could be harnessed to provide greater knowledge through providing opportunities to participants to describe and share their successes and their challenges. See Appendix One for the full five day program.
The schedule for the program is shown in Table One.

### Table One  Breakdown of 5 day Primary Science Specialist Professional Learning Program

<table>
<thead>
<tr>
<th>Day</th>
<th>Date</th>
<th>Organisation</th>
</tr>
</thead>
</table>
| 1   | 20th May | **Towards Victoria as a Learning Community**  
Mr. Wayne Craig  DEECD session  
Whole school curriculum planning – AusVELS Mathematics and Science  
Dr. David Howes  DEECD session  
*Reflections – leading change*  
  - Considering specialists’ role and management  
  - Using teacher documents for whole school planning.  
  - Sharing and reflecting on the issues arising  
  Ass Prof Coral Campbell & Dr Sandra Herbert |
| 2   | 21st May | **AusVELS Science- Reporting achievement QA**  
Ms Rosemary Roberts  
Assessment – Sustainability to interrogate assessment.  
Dr. Laura Barraza & Prof. Russell Tytler  
*Children learning in Science*  
Dr. Linda Hobbs & Ass Prof. Coral Campbell  
*How students learn science – supporting deeper learning*  
Using the developmental maps and continua to plan for effective instruction.  
Dr. Linda Hobbs & Dr. John Cripps Clark |
| 3   | 22nd May | **What is effective science teaching?**  
  - Instructional frameworks: Structuring your science lesson  
  - Differentiation to support diverse learning needs and learning styles.  
  Ass. Prof. Peter Hubber & Prof. Russell Tytler  
*Representational approach*  
  - Differentiation: Challenging tasks and Questioning  
  - Key challenge for teachers  
  Prof. Russell Tytler & Ass. Prof. Peter Hubber |
| 4   | 30th May | **Supporting effective science teaching in our school**  
Supporting Early Years teachers to teach science  
Ass Prof. Coral Campbell & Dr. Wendy Jobling  
*Primary Connections – revisited*  
Dr. Wendy Jobling & Dr. Laura Barraza |
Supporting primary teachers to teach physical science  
Creative ways of supporting high achieving students  
Ass. Prof. Peter Hubber & Dr. Wendy Jobling

5 31st May

Leading professional learning: where to?  
Prof John Munro  DEECD session  
Productively using AusVELS support material  
Ass. Prof. Peter Hubber & Dr John Cripps Clark  
Influencing Others? How to make it possible.  
Prof. Russell Tytler & Ass. Prof. Peter Hubber

Evaluators overview of achievements and milestones  
Ms Marion Meiers & Ms Kate Reid (ACER)  DEECD session

Background Information on the Design of the Deakin - led components of the Program

The strategic importance of science and the need for high quality science teaching is being highlighted at national and state levels. The Primary Science Specialist (PrimSS) Learning Program (20 days in total) is modeled on the successful National Partnerships Primary Mathematics initiative. The PrimSS Learning Program is aimed at building teacher capacity and boosting primary students’ engagement and achievement in science. This initiative is designed to promote sustained improvement in schools beyond the life of the initiative.

The additional 5 day program was informed by contemporary state, national and international evidence-based research, in particular the research into representation construction pedagogy undertaken by the Deakin science education team. As required by the tender, the program was designed to further develop the capacity of Science Specialists in the following areas of practice:

- teacher discipline knowledge and pedagogical content knowledge in science
- underpinning current research and evidence-based practices in science teaching
- knowledge of how students learn in science
- effective science teaching and building shared understandings
- identifying and understanding the big ideas in science, effective pedagogy and appropriate outcomes at the different ‘stages of learning’.
- curriculum design and planning in science
- assessment approaches
- using data to inform planning and teaching including assessment tools: VELS teacher judgements, rich common assessment tasks
- differentiating learning for all students
- mentoring principles and practices
- Instructional Model
- identifying useful and effective science resources, including science eBookboxes
- an understanding of science processes and scientific literacy.

Workshops used a number of delivery modes and resources to explore these areas. In particular, teachers’ voices and experiences were called upon to support the workshop
deliveries. Student work samples, examples of teacher practice and shared ideas were used to ground exploration in practice. Prior to the program, teachers were requested to bring to the program, samples of whole school planning documents for discussion. In addition, the teachers were provided with a set task which required them to collect an example of a unit of science exploration in which they had interacted with the teacher or students. This was the focus of one of the sessions that interrogated quality learning in science.

The Deakin program incorporated resources promoted on the DEECD Science Domain page (http://www.education.vic.gov.au/studentlearning/teachingresources/science/default.htm) with particular attention to the Science Developmental Continuum P – 10, ACARA Science Samples, Primary Connections and AusVELS. Leading change material from the DEECD Science in Schools Research Program (Tytler and others from Deakin), was also used. Current video resources from an ARC Research program (Tytler, Hubber, Chittleborough and others) were used to support discussions on questioning, for instance, response to student input, the nature of inquiry teaching, and planning activity sequences. Recent research on representation construction and early childhood science education was used to frame discussions on effective teaching and provide examples of inquiry challenge activities, and to explore challenging science ideas in areas not covered in the previous workshops.

An external contractor (ACER) has been appointed by DEECD to evaluate the five day program and this includes an evaluation on the Deakin Science Education delivery component. However, the Deakin science team have also conducted informal evaluations of the program for formative purposes, using mainly teachers’ perceptions of the 5 day program.

Teaching Science in Primary Schools

Primary teachers, while they express some of the alternative conceptions displayed by school students, are nevertheless well placed to teach science effectively. They are much more sophisticated in the way they generate new ideas, in the way they link ideas across phenomena, and in the principled nature of their explanations (Tytler, 1993; 1994). Harlen (1997) also refers to ‘the relative ease with which understanding of some big ideas was developed by the teachers’ (p. 335) and goes on to ‘suggest that what holds back teachers’ understanding is not ability to grasp ideas but the opportunity to discuss and develop them’ (p. 336). Contact with the science specialists across the previous 14 months, since the delivery of the initial program, proved that this was the case. On the celebration days, held by the teachers themselves, discussion revolved around ways of operating to support change and in the sharing of ideas. Specialists seemed comfortable with the science content knowledge they had to undertake the tasks assigned to their roles. However, in the pre-program survey, it was clear that many of them now wanted to extend that knowledge, particularly in physical science. Higher level discussion of the big ideas in science, e.g. light, environmental sustainability, micro-organisms and the particle nature of matter therefore, were a key approach in science specialists’ professional learning.

Content knowledge is important for a number of reasons. Research in mathematics, and in science (e.g. Harlen 1997; Tytler et al. 1999) show that content knowledge is critical for designing lessons for underlying concepts, engaging students in the exploration of ideas, recognizing students’ conceptual difficulties, asking productive questions, responding spontaneously and productively to students’ ideas, taking advantage of ‘teachable moments’, and monitoring progress in understanding. The fact that the teachers were asking for more
knowledge implies that they are prepared to extend, not just their own understandings, but that of the teachers and children at their respective schools. Many had sought professional learning in science from a number of external providers.

It has been found that even teachers with a strong reputation for teaching science can run interesting activities without engaging in an ensuing conceptual discussion. Associated with this was a tendency to assess at a low, descriptive level rather than focus on children’s capacity to construct conceptual explanations. A key feature of the five day professional learning program for science specialists was to raise the level of conceptual understandings in designing activities, the need to design sequences of activities that build ideas over time, and the need for assessment strategies to support this.

**A representational focus in teaching and learning science**

Recent research indicates the value of a representational focus for science learning that builds on earlier conceptual change research, and it is this perspective that informs the *Primary Science Specialists Professional Learning (PSSPL) Program 2011-2012 and 2013*, which is to build teacher capacity to improve student learning outcomes in primary science. This representational focus draws on current understandings of science learning as the increasing capacity to participate in scientific discourse, viewed as the capacity to use a mix of verbal, graphic and mathematical modes to represent science concepts and processes.

The systematic integration of representational negotiation of ideas with induction into the practices of science discourse can provide a powerful practical support for enhancing student conceptual growth and this approach was embedded within the 5 day program. Students need to learn how to interpret and construct texts that represent science activities, reasoning processes, concepts, findings, and knowledge claims. These particular literacies of science are discursive tools, or building blocks for thinking and working scientifically, as well as the necessary components for representing scientific understandings. Developing understanding of science topics involves learning to represent, refine, and re-represent ideas in different modes as part of learning science literacy, rather than viewing learning as a purely cognitive process of shedding naïve conceptions in favour of scientific ones. A representational focus based on students’ active generation and evaluation of representations places reasoning and scientific literacy at the centre of the learning agenda. The five day program whilst highlighting current specialists’ knowledge and experience, also introduced new learning with a strong representational approach.

**Working with teachers to support teacher change**

It is widely accepted in the education community that significant teacher professional learning, such as that required to establish a strong science program in primary schools is not adequately served by short term workshops but must involve longer term processes grounded in the cultural practices of schools. The primary science specialist initiative has the capacity to provide ongoing support for teachers in schools and to put in place quality science and teaching and learning practices. However, this must involve careful preparation of the specialist teachers to understand the nature of change required, and effective strategies by which they can support teachers in this change. It also requires support from school leaders. In the 5 day program, teachers were introduced to the Clark & Hollingsworth’s model for professional learning which enabled them to relate to the four domains through which they had been working already and which will support their understandings across the final year of their role.

Figure One. Clarke-Hollingsworth Model of Professional Growth
Scientific literacy, the Primary Connections materials, and AusVELS
Scientific literacy is important to prepare future citizens for “interacting in a global environment needing to know how to learn, adapt, create, communicate, and how to interpret and use information critically”, and be able “to make personal decisions on the basis of a scientific view of the world” (National Curriculum Board, 2009, p. 4). As a result of scientific literacy skills being recognised as essential to understand the world around us and engage in discourses of and about science, a literacy approach to learning and knowing in science has become popular (Prain & Waldrip, 2006). In Australia, the Primary Connections resources provide professional development programs and resources on how literacies of science such as linguistic, numerical, graphic and tabular representations can be used as communication and learning tools. The philosophy whereby “Primary Connections units engage students in activities that reflect the mutually supportive relationship between science and literacy” (Primary Connections, 2006, Workshop Literacies of Science, slide 13) is strongly consistent with the representational approach proposed for this primary science specialist program. Likewise, The Science Continuum P-10 has a strong emphasis on scientific literacy skills. It uses the Atlas of Science Literacy which “is designed to help educators navigate the science curriculum” (Rigsby, 2002) to help identify learning pathways consistent with the Science Victorian Essential Learning Standards (VELS) curriculum. The science concept development maps based on the atlas are used to show the progression of understanding and possible developmental pathways for selected scientific topics. The resulting online resource The Science Continuum P-10 – is a unique and valuable resource for teachers, with a constructivist approach.

AusVELS, PoLT, and the e5 Instructional Model
The AusVELS is a framework for whole school curriculum planning. AusVELS is underpinned by clear educational purposes, principles and values. An integral part of these is assessment which should be considered to serve three key purposes: assessment for learning where data are used to inform teaching; assessment as learning when students reflect on and monitor their progress to inform their future learning goals and; assessment of learning where evidence of student learning is used to make judgements on student learning against goals and standards (such as VELS).
Figure Two – Assessment DEECD

Assessment FOR learning occurs when teachers use inferences about student progress to inform their teaching.

Assessment OF learning occurs when teachers use evidence of student learning to make judgements on student achievement against goals and standards.

Assessment AS learning occurs when students reflect on and monitor their progress to inform their future learning goals.


Linking closely to PoLT is the E5 or e5 instructional model which is described as a tool to assist school leaders and teachers in adopting an inquiry approach to learning. Engage, Explore, Explain, Elaborate and Evaluate are processes central to an inquiry learning approach and are the domains for the e5 instructional model. While the e5 instructional model uses the same domains as the 5E inquiry model used in the Primary Connections materials, the e5 instructional model describes the changing role of the teacher as the inquiry process in the classroom, changes from teacher-initiated inquiry, to teacher-guided inquiry and then to student-initiated inquiry. The e5 Instructional model has been abstracted and generalized to remove the sequential nature of the 5Es, characterizing them as moments in an effective teaching process, with different levels of exemplification.

The 5 day program was shaped around the following principles:

- Each day there were several sessions which required input from the specialist teachers, acknowledging the degree of expertise built up within the group and offering opportunities for that expertise to be shared.
- There are two or three sessions daily which are based around extending the key ‘big ideas’ in teaching and learning science, exemplified in each case through ‘big ideas’ in science content.
- Each session consists of opportunities for teacher reflection and/or input of material supported by hands-on activities and.
- Throughout the program, participants’ prior and ongoing perspectives and knowledge were monitored so that presenters were constantly alerted to learning opportunities and needs.
Workshops used a variety of delivery modes and resources to explore the pedagogical, content and leadership areas. Student work samples and examples of teacher practice were used to ground exploration in practice.

During the gaps in the program, between days 3 and 4, participants sought out examples of school based tasks, exemplars of quality learning which fed back into the program.

The program was supported by digital resources, supplementing key content areas. These were developed at the point of need or taken from the team’s existing resource materials. It incorporated student resource material promoted on the Science Domain page, with particular attention to the Science Developmental Continuum P – 10, the professional learning model and specific readings to enhance learning.

Figure Three: Overview of the components of the PrimSS Professional Learning Program 2011-2013

These components were originally developed as an organisational tool for the PrimSS 2011-2012 Professional Learning Program but were revisited in the development of the 2013 Primary Science Specialist Professional Learning Program.
Evaluation methodology and evaluation tools

The evaluation of the 2013 PrimSS Professional Learning program used a mixed mode methodology with a qualitative surveys and incidental data collected through discussion and teacher artefacts. Evaluation tools included:

- Pre-program email survey - December 2012
- Pre-program email survey - May 2013
- Celebrations discussion – post-it notes of enablers of success
- Presentations of planning documents – electronic and hard copy
- Incidental material – Deakin Science Education team journal notes and material collected through workshops

The data were collected throughout the program.

In addition, ACER undertook an independent evaluation at the conclusion of the 5 day program, which will be provided to us in aggregated form.

The Pre-program email survey - December 2012
This survey, delivered in November 2012, was initially intended to be an opportunity for the specialists to provide feedback on how they were progressing at their schools. The survey asked for appraisal of the original program, given that the specialists had been in the role for nearly 12 months.

Table Two Primary Science Specialist Learning Program Survey December 2012

<table>
<thead>
<tr>
<th></th>
<th>Strongly disagree</th>
<th>Disagree</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Do you feel that the professional learning was valuable in providing you with sufficient knowledge to complete your role satisfactorily?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Do you feel that the professional learning relating to science pedagogy was valuable in providing you with sufficient knowledge to complete your role satisfactorily?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Do you feel that the total professional learning relating to “leadership” was valuable in providing you with sufficient knowledge to complete your role satisfactorily?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>In my role, I tend to use mainly Primary Connections material.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>In my role, I tend to use a range of teaching resources</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>The teachers in my school are starting to teach science with less support</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>The teachers in my school tend to use Primary Connections</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>The teachers in my school tend to rely on my knowledge</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>I feel my role has developed significantly over the year</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>I feel that I have not been able to extend my role fully</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>I have been able to successfully network with other science specialists from the program</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Open ended responses

- Please comment on your role as leader or support person for developing other teachers’ science teaching.
- Open discussion – please feel free to comment on any aspect of the above, to add depth or clarity to any responses above, or to comment on anything not included.

**The Pre-program email survey - May 2013**

The specific purpose of this email survey was to gain information from the participants in advance of the program so their needs could be addressed within the delivery of the program. It asked for teacher comment around the following components.

- Section 1: Celebrating success
- Section 2: Enabling factors
- Section 3: Inhibiting factors
- Section 4: Planning for change
- Section 5: Quality learning
- Section 6: Assessment
- Section 7: Resource use
- Section 8: Professional Learning
- Section 9: Focus of the program

**Celebrations Discussion**

During the initial Celebration discussions, held on the first day of the program, teachers were asked to generate the key factors which have enabled success to occur within their schools. This data was compiled into a number of categories and highlighted the success factors which have influenced quality learning in science education within their schools.

**Presentations of planning documents**

Across the entire five days of the program, participants shared many of their documents from whole school planning through to individual lessons. These provided strong evidence of the ongoing successes that were occurring in schools.

**Incidental material collected through workshops**

Across the period of the program, teachers discussed freely, elements of their roles that were working, those which weren’t and how they were managing. We consider ourselves privileged to be recipients of frank and open discussions.

**Presentation of the Data**

**Pre-program email survey - December 2012**

**Table Three - Percentage responses to survey –after 12 months in the role of Science specialist (n=11)**

<table>
<thead>
<tr>
<th>12 months on – please comment in respect to your role now</th>
<th>Strongly disagree</th>
<th>Disagree</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>My role has tended to be positive</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I would like my role to be extended past the end of 2013</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I would like to try other leadership roles in the future</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Question</td>
<td>Yes</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
<td>-----</td>
<td>----</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Do you feel that the professional learning was valuable in providing you with sufficient knowledge to complete your role satisfactorily?</td>
<td>36</td>
<td>64</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Do you feel that the professional learning relating to science pedagogy was valuable in providing you with sufficient knowledge to complete your role satisfactorily?</td>
<td>45</td>
<td>55</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Do you feel that the professional learning relating to “leadership” was valuable in providing you with sufficient knowledge to complete your role satisfactorily?</td>
<td>36</td>
<td>45</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>In my role, I tend to use a range of teaching resources</td>
<td>9</td>
<td>55</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>The teachers in my school are starting to teach science with less support</td>
<td>18</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>The teachers in my school tend to rely on my knowledge</td>
<td>9</td>
<td>91</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>I feel my role has developed significantly over the year</td>
<td>9</td>
<td>36</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>I feel that I have not been able to extend my role fully</td>
<td>9</td>
<td>56</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>I have been able to successfully network with other science specialists from the program</td>
<td>9</td>
<td>27</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>My role has tended to be positive</td>
<td>36</td>
<td>63</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>I would like my role to be extended past the end of 2013</td>
<td>36</td>
<td>36</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>I would like to try other leadership roles in the future</td>
<td>63</td>
<td>36</td>
<td></td>
</tr>
</tbody>
</table>

From the survey responses, we can see that the area of 'leadership' in the original program was considered by about a third of the participants as not being satisfactory enough for their needs. In terms of their role within the school, most felt that whilst their role had developed that they had not been able to extend their role fully. For many of them, there seemed to be a stumbling block with supporting other teachers to embrace science teaching. One thing which is clear from the above is that whilst about a third would not like to extend their role as a science specialist, most did. In fact, having taken on this type of role, all specialists were now seeing themselves as leaders of change and wanted future opportunities to take on a leadership positions within their school.

**Pre-program email survey - May 2013**

**Section 1: Celebrating success - written comments from teachers**

- developing science units at each level of the school with year level teams
- resourcing these science units with resources with a particular focus on the development of digital resources.
- developing our own and then our teachers content knowledge
- the school has a better scope and sequence for science
- it is now a school priority
- the students are undertaking more inquiry in science which is having a significant impact in all other curriculum areas.
- we have worked across the school with every classroom teacher.
- Motivating the students and generating enthusiasm and natural curiosity.
- Sharing and celebrating our success at our whole school weekly assembly.
• Feeling like a Science Specialist.
• Planning engaging and stimulating, hands on lessons each week.
• Implementing change in our school, such as conservation and sustainability.
• Eclipse Breakfast-viewing of the 2012 Solar Eclipse before school including a bacon and egg breakfast. Very well attended. We were able to use our solar telescope that we won in an astronomy competition in 2011.
• Students’ ability to design experiments and understand the scientific process have escalated.
• Being able to work collaboratively with other teachers in their classrooms.
• School science night where each class ran a science experiment.
• Science Specialist Cluster Meetings – sharing ideas, resources and events
• Increase in Science profile in the school
• School participation in the Solar Boat Challenge
• Science Day last year and scheduled again this year - An expectation of students and parents that it will happen every year.
• Links built with the local secondary school
• Working with a volunteer undergraduate from Deakin to assist with Solar Boat Challenge
• Year 2 science unit lead by secondary science teachers conducted at the local secondary school with Yr 10 mentors.
• Better organisation of resources and readily available resources to teach science
• Teachers engaging in professional conversations relating to student outcomes in science and also about their teaching focus in science.
• Improvement in the teaching of science in the school or just ensuring it is covered in the program
• Student outcomes have improved although still working out assessment processes to support this statement

"I have realised how much I love science both as a learner and as a teacher and would like to continue to work in this area. I have gained immense satisfaction from the positive and enthusiastic way in which this area of the curriculum is embraced and loved by the students."

Section 2: Enabling factors
• A supportive team at my school, including School Council and the parent community.
• Having access to a healthy budget.
• Having a space to call “The Science Lab.”
• Time allocated to me to gather resources, build my own capacity, share with other teachers and meet with networking groups.
• Having my allocated 2 ½ days to coach in this year.
• Having had a chance to test out many of the Primary Connections units myself.
• Having money to buy supplies that students find highly engaging and help their understandings.
• Leadership support – trusting us (the Science Specialists) to lead and engage in our roles in the way that we see fits the school or area of the school the best.
• Regular meetings with leadership to share how we are going and support of them with the direction that we are taking
• Support for resources from the Science department at the local secondary school.
• Funding from the initiative
• The provision of Primary Connections as a core for teachers establishing their science teaching
• On a personal level developing flexible ways to work with my colleagues to ensure that science is considered and planned for before it is taught throughout the school – not just a last minute what do I need before the lesson.
• Each year level that I am working with has a Science Coordinator to work with me to ensure the resources and program is continuing.
• Some teachers are team teaching the science lessons which works well for them
• Time. Money

"I have found that my personal expertise and passion for this area of the curriculum invaluable in ensuring that I succeed in my role of highlighting science at my school in a new and vibrant way. Being full time [4 days] in the role and not having the responsibility of a grade has made meant that I am able to dedicate myself to the role."

Section 3: Inhibiting factors
• The role is funded at 0.5, however the reality has been that my role takes more time than this – it cuts into my other 0.5 role and I find this frustrating and stressful and that my other role suffers
• Resistance of staff to change
• My own lack of experience
• Restrictions from Principal about using the budget
• Some members of Leadership wanting to push their own agenda
• Lack of time to plan, discuss, etc. with the other science specialist
• Jumping straight in to teaching week 1 term 1 2012 with no opportunity to have 1 on 1 discussions with classroom teachers
• Lack of direction from the Department – the different ways each group of science specialists have implemented the initiative may impact on the long term benefits obtained from the initiative eg those that have not worked on building classroom teacher capacity
• Lack of support from the Department – not answering emails, etc.
• Stress and frustration
"One of the factors that initially inhibited me when introducing an inquiry based learning model to be used in delivering our science program was resistance to change by some teachers. People naturally prefer to operate within their comfort zones and so will resist change. …Other teachers lacked knowledge or interest in the science area and therefore lacked the skills and confidence to teach these topics. This was particularly obvious in the physics and chemistry strands of the program."

Section 4: Planning for change

- Having someone in leadership as a Science specialists
- We had structure that facilitates change through the school, curriculum leaders, team leaders and effective team planning.
- AusVELS has been a timely introduction enabling curriculum to be the focus of discussions
- Science has been included in our AIP. We are in our 4th cycle of our strategic plan and we want to make Science an even bigger part of our Student Learning.
- Detailed AusVels documents available online.
- The goals need to be realistic and reachable. This means that along with the long term goal you needs short term attainable goals. Milestones that are reached and passed, giving all participants a sense of success along the way.
- The participants need to work as a team together to achieve the goals and support must come from all levels including leadership. Without a positive attitude from all participants the road will be much harder. People must believe in the need for change and want to be part of it. If they can see that the benefits are worthwhile they are less likely to resist the changes.
- It is important to have the required support available for change to occur. Flexibility is required as each individual teacher will already be at a different stage along the path, this means that they may have differing needs. Mentoring, modeling, team teaching, support both physical and emotionally needs to be tailored to each individual while at the same time structure for the change is clear and times lines are in place and are adhered to. A mixture of firmness and give and take is essential.
- Mutual trust and respect must exist within an environment that is non-judgmental if progress is to occur. Recognizing our weaknesses allows us to work on strengthening them. Recognizing our strengths allows our confidence to flourish and means that we can share and support our peers. This must occur between all members within each team and as a leader I need to encourage and model it.
- A caring and compassionate team that is realistic in the goals set and workload imposed and who share the responsibilities has the greatest chance of success when trying to instigate change.
- Good communication.
- Modeling effective teaching practice.
- Supporting staff so that they feel confident to have a go on their own.
Section 5: Quality learning
"The quality of student learning in the science is extremely high. We feel that that the students’ knowledge and skill has far surpassed what we originally expected our students to be able to show and achieve. The inquiry and investigative approach we have utilised, the questioning techniques we have developed and employ and the collaborative/cooperative group tool that primary connections promote, have assisted this. Teachers can now more clearly see the potential of their students and our planners provides a higher level of challenge."

See Appendix Two – Term Planner, from which the following example of a science investigation was drawn.

Figure Four – example of one component of a unit planner

Scientific Investigations: Term 2 Weeks 2-4, 2012

Focus: Senses

<table>
<thead>
<tr>
<th>Stations</th>
<th>Investigations</th>
<th>Resources</th>
</tr>
</thead>
</table>
| 1        | Senses - Hearing Mystery Noise | Students listen to each sound on an ipads and then draw what they hear. | •Ipods with sound bites  
• A4 paper  
• Pencils  
• *Science Journals |
| 2        | Senses - Smell Smelling Jars | Students lift lids on smelling jars and record what they smell. | •Smelling jars (coffee, rose, chocolate, basil, orange spray, lavender)  
• A4 table to record findings |
| 3        | Senses Match | Match the sense to the body part ie. Rose to the nose, drum to the ear. | •Matching cards |
| 4        | Senses - Seeing Where’s Happy Healthy | Students use magnifying glass to find what is healthy & unhealthy. | •Happy Healthy posters  
• Magnifying glass  
• Checklist |
| 5        | Senses - Taste Taste testing | Classify food into salty, sour, sweet and bitter. Students are blindfolded and need to describe the taste and guess the food item. Students complete the response sheet | •Honey (sweet)  
• Coffee salad green(bitter)  
• Lemon, Green apple (sour)  
• Potato chips (salty)  
• Response sheet |
| 6        | Senses - Touch Touch Tables | Students explore touch tables and record their finding using scientific language. Eg, Hard, rough, smooth etc. | •Fur, silk, scowrer, plastic, wool, metal, sandpaper, ceramic |
| 7        | Construction Making something to help people see | Students are challenged to make something that will help someone see. | •Knex  
• Daisy construction |
| 8        | Reading corner | Students spend time in the reading corner developing their understanding of the five senses. | • A range of senses books  
• Senses  
• Visual literacy |
• Quality learning has taken place across my school in many different ways.
  o A struggling and unfocussed student was able to describe exactly what he
    was building when he made a seismograph and explained how it measures
    earthquakes on the Richter Scale.
  o In the grade 5/6 the RAT [rich assessment tasks] that were produced by the
    students alongside their primary connection unit “Our place in space” using
    the Inquiry based Learning model were an excellent example of quality
    learning. Students researched their topic in order to find answers to their 3
    fat questions and then presented their findings in a wide variety of ways.
• When the Marvellous Micro organism PC unit was studied once again amazing things
  were produced and the students’ interest in this very different way of looking at
  everyday things [bread making and the role of yeast in it] was very high.
• The preps weekly science afternoon involving 80 students with parent helpers and
  rotating activities enabled all students to participate at their individual learning pace.
• Science investigators, an extension program for a small group of students from
  across the school [prep to grade 6] enables these students to investigate topics and
  do activities that would not normally be available to them.
• In general the Primary Connection units when followed as they are planned have
  enabled the teachers to provide high quality learning activities to their students.

"We have worked with the VCAA to provide samples of our student work in Science for use
on the VCAA website and ACARA samples we can provide copies of some of these on the
days. We have also implemented all of the SISAT (Science inquiry skills assessment tasks)
across the school so we have these as well – these show significant student development in
the 18months we have implemented them.
The "Science Culture" is impacting on our whole school. We are more water conscious, energy use conscious and care more about our grounds and gardens. The children come to me to talk about a news story they saw or a documentary they watched. They have questions about the world they live in!

**Section 6: Assessment**

What assessment tools do you or the teachers at your school use for assessing student learning?

<table>
<thead>
<tr>
<th>Assessment approach</th>
<th>Yes/no</th>
</tr>
</thead>
<tbody>
<tr>
<td>Departmental assessment items</td>
<td></td>
</tr>
<tr>
<td>Other test materials</td>
<td></td>
</tr>
<tr>
<td>Collaborative teacher judgment</td>
<td></td>
</tr>
<tr>
<td>Rubrics</td>
<td></td>
</tr>
<tr>
<td>Checklists</td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td></td>
</tr>
</tbody>
</table>

Most teachers used the first three items as assessment approaches, but only a few used rubrics or checklists. In addition to these, teachers commented on their use of:

- Primary connection assessment tools (directly linked to VELS or AUSVELS).
- Teacher generated assessment, especially in the lower grades.
- We include ICT as part of our assessment. Photographing the student's work or using apps and saving them.
- Children's examples of work in their science books.
- A cross check on children's performance during the science session.
- The science skills test given to us by ACER is also useful.

One school created Portfolio Tasks which include an activity, rubric and reflection, each term for each grade level.  

**Figure Two – Portfolio Task.**
Figure Three – Student assessment rubric
Section 7: Resource use

In response to the table about resource use, most teachers indicated that they did not use developmental maps but did use the science continuum, Primary Connections, digital tools and resources and network connections.

<table>
<thead>
<tr>
<th>Resource</th>
<th>Yes/no</th>
</tr>
</thead>
<tbody>
<tr>
<td>Science continuum</td>
<td></td>
</tr>
<tr>
<td>Primary connections</td>
<td></td>
</tr>
<tr>
<td>Developmental maps</td>
<td></td>
</tr>
<tr>
<td>Digital tools and resources</td>
<td></td>
</tr>
<tr>
<td>Network connections</td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td></td>
</tr>
</tbody>
</table>

"We use primary connections as a basis for our units we have however found that many of them are not challenging enough for our students so often we combine units to provide more challenge. The background reading material and the fact they are based on the 5Es model enables us to utilise much of the content. As primary science specialists we use the background information provided by Deakin too to increase our capacity."
"I use primary connections as a starting point to guide the sequence and content of the unit I am teaching. I then modify the lessons and add videos and content to support what I am teaching. I also try and incorporate an activity which supports one of the e5 capabilities."

Section 8: Professional Learning
Many teachers have accessed external professional learning sessions to augment their existing knowledge and to extend their understandings around particular science content and science pedagogies.

- STAV conferences 3 days [technology and general sciences]
- Round and round with rocks  Melbourne museum
- 5 days at a sister school that has been teaching and trialling PC units from their inception.
- Merit and equity training
- Apollo PS Big day out with other science teachers.
- Robotics
- ACMA cyber smart
- Online courses to improve my science knowledge in physics and biology.
- Professional reading, subscribe to websites, Science related apps, networking and run PLTs at my school.
- Attendance at science specific PD e.g. Transit of Venus, National Curriculum
- Reading of science magazines
- Internet research and subscription to newsletters and news feeds
- Professional discussions with other science specialists, science teachers, scientists

Section 9: Focus of the program
- physical science in AusVELS
- planning to teach sound and light
- a unit on Energy/electricity unit - how can you establish when students achieve above expected level and can the two areas be achieve together?
- resources that other schools have purchased with their funds.
- Assessment
- Planning for high achievers
- Forming partnerships
- Applying for grants.
- How to differentiate learning.
- Look at the higher end of learning for science. ie microorganisms etc. Also looking at the flow of learning from foundation through to grade 6.

"I think that we need to look at assessment of science within the classroom in a realistic manner. Teachers need to be able to carry out these assessments as part of their everyday teaching program. Assessing the early years is especially problematic as these often require one to one testing which is not feasible for the classroom teacher."
Celebrations discussion

The 'Celebration discussions' provided much stimulus for sharing of material and ideas. In particular, teachers identified the key components of success within their schools - those things which enabled success. These aligned strongly with those identified in the earlier survey and were grouped according to:

- access to funding
- teacher attitude
- whole school support
- leadership support
- time
- resourcing
- organisation
- physical space and
- personal expertise.

Figure Five – Responses to Celebration discussion –Support Leadership and Whole school
Leadership and whole school support was deemed to be very important to the success of the program. Parents, teachers, leadership teams all indicated that the program was important, which was a strong factor in assisting the specialists in sustaining the energy to keep going.

The support of the Leadership team was crucial to providing time in meetings for discussion about the program, for accessing funding and for general management of a myriad of minor elements of the role.
There were a number of comments made about the forms of ‘enablers’. For example, one teacher commented on how the very positive feedback from their local secondary school on the improvement of children’s science capacity was a motivational factor for the whole school. They felt that there was external recognition for the efforts put into the science program.
Presentations of planning documents

Figure Seven – Alfredton Primary School – selection of planning documents

Alfredton Primary School

Whole School Science Improvement Action Plan
2013

![Whole School Science Improvement Action Plan](image)

A Whole School Science plan should support effective Science instruction & planning.

<table>
<thead>
<tr>
<th>What do we do now?</th>
<th>What do we want to do?</th>
<th>How will we do it?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Professional Leadership:&lt;br&gt;The principal and wider school leadership provide Science leadership. School leadership is actively involved in ensuring that science learning is a central part of the school’s improvement efforts. (Institutional Leadership). The school has two primary Science Specialists and there is a whole school science plan which is regularly reviewed and updated by the teachers who contribute to its implementation.</td>
<td>Two (8.5) Primary Science specialists in place 2012-2013 in place. One P-2, the other 3-6.</td>
<td>Build teacher capacity in all teaching staff, P-6 and improve student learning outcomes in Science.</td>
</tr>
<tr>
<td></td>
<td>Whole school Science Implementation Plan developed 2013</td>
<td>Mentoring, modelling and professional conversations by Science Specialists in the classroom, staffroom and school wide.</td>
</tr>
<tr>
<td></td>
<td>ESP and AIP focus on Science Improvement.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Full 2013 APS Science Improvement Action Plan in Term 2 2013</td>
<td></td>
</tr>
<tr>
<td></td>
<td>School Leaders support the mentoring and modelling framework in Science.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>All staff provided with relevant Primary Connections units.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Science Specialists to unpack major skills and concepts with Classroom teachers.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Science Specialists supply resources.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Continue to provide Primary Connections units.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Class Teachers begin to be more independent in teaching Science in their classrooms.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Teachers continue to implement the Primary Connections units which have been updated to include the National Curriculum.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Science Specialists at Grade level team meetings.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Each individual staff member to read and try to comprehend Primary Connections units. Use the Science Specialists to assist in developing the big ideas.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Teachers ready to independently implement a Science program based on the Primary Connections model from the start of 2014.</td>
<td></td>
</tr>
<tr>
<td>Focus on Teaching &amp; Learning</td>
<td>Science specialists drive the planning and learning based on the Primary Connections model. They continue to raise awareness and the profile of Science within our school community.</td>
<td></td>
</tr>
<tr>
<td>----------------------------</td>
<td>--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
<td></td>
</tr>
<tr>
<td>Purposeful Teaching</td>
<td>National Curriculum Science Dimensions Progression Points and Assessment maps are to be used for the first time in 2013. National Curriculum familiarity enhanced to build teacher expertise in Science learning and teaching.</td>
<td></td>
</tr>
</tbody>
</table>

- **Science** Specialists model Primary Connections Units: Best practice Science learning to be reflected in all classrooms. All schools to be well resourced with Primary Connections teachers, guides and associated resources.

- **SIT** Team reports regularly to whole staff to ensure that Science is maintained as a whole school focus for teaching and learning improvement.

- **Science** Specialists and implemented by all classroom teachers with support from the Primary Science Specialists.

- **SIT** continues to maintain Science focus.

- **SIT** reports at scheduled leadership and whole staff meetings.

- **National Curriculum** as a priority and plan appropriate professional learning for whole staff.

- **Year level planning and PLTs** to audit science lessons and budget for resourcing requirements into 2014.
This document from Alfredton Primary school had a further two pages related to: High Expectations of all Learners, Accountability, and Learning Communities. Overall, planning documents supplied by most schools, were highly detailed and very specific about all elements of the school’s science plan.

Incidental Material

Journal notes

- One teacher commented that they felt the material on leadership came too late in the program. They felt they needed strategies as ‘agents of change’ from the start.
- The teachers loved the Deakin input (Marion Meiers).
- The venue worked well, although there were quite a few teachers missing on the final day.
- Significant competence display by specialists. Deakin Science Education team was impressed by teachers who spoke authoritatively to the group on principles of leading change. They had accessed websites with models of leadership and were able to talk convincingly of how they were using these to gain a perspective on different blockers they came across, what might be causing these, and how to deal with them.
- Many specialists are really adept at iPad usage and were very innovative in generating digital representations. Sharing their expertise was a productive part of the sessions.
- Primary Connections lower grade units too boring - needed additional engaging material
During discussions around teachers’ experiences with the quality of children’s learning, teachers were provided with the opportunity to articulate their experiences as a series of principles of quality learning. Above is one example. Appendix three contains further examples. Overall, the general development of principles evolved around:

- Using a 5Es approach (Primary Connections material)
- Modelling science language in context
- Using a hands on approach through science activities
- Explicit instructions
- Student involvement in their own learning
- Children demonstrating capacity to ‘talk’ the science

Figure Nine – Using a representational approach to cater for diverse learners – plant life cycle
This is a generalised representation of a flowering plant reproductive cycle that one group of teachers constructed showing the pathway through flower, fruit and seed. Teachers had to classify a range of plant parts and then to generalise to their role in the reproductive cycle.

In addition, there were some excellent representations of seed germination and seedling growth that some teachers constructed on their own iPads.

Figure Ten – Primary Connection materials revisited
This image represents one group of specialists’ thoughts on the Primary Connections materials. The factors considered were: How have the units been used? How do they represent examples of good practice? Were there any issues arising from their use? There was general agreement on one particular element—the lack of the CD which was included in the old resource. Many of the teachers would like to see not only the CD available but also the other resources included on a CD as sometimes the on-line system is inconvenient (or too slow in some rural areas). If the cost was reasonable payment for this would be an option.

Analysis of the Data

The data from the pre-program survey in December 2012, 11 calendar months after the commencement of their role, indicated that all responding specialists were positive about their role and felt that they were making significant inroads into supporting change in their schools. Many indicated that they would like to continue into their role in future (or some other leadership role) as they felt that they hadn’t been able to fully extend their role. Data at that time indicated that most felt that the other teachers in their school were still relying on them in a significant manner. Overall, the responses on the survey tended to be positive, indicating that the program was working in bringing change to science in the participating schools.

The pre-program survey, taken just prior to the last 5 day program, had a different purpose to the prior survey. The intention of this May 2013 survey was to find out what additional components teachers wanted to cover and where they felt they needed more assistance. Responses to this survey, highlighted the successes occurring at each school, the perceived ‘gaps’ in their professional learning and the need for concentration on particular topics and areas during the professional learning program. The data showed that specialists felt that they were having considerable success in many facets of their roles including the improvement of
science within the school and the enabling of a more prominent science curriculum. They were able to note quality learning in the teaching of science, examples of community engagement in science, and specific indicators of change in other teachers’ perceptions of science. Suggestions for the program included: enhanced understanding of the physical, microbiological and other ‘high end’ knowledge of science, assessment, differentiated learning and resourcing learning. At the teachers’ requests, these were included in the 5 day program.

In the data arising from the “Celebrations discussion”, held on the first morning of the program, teachers were asked to highlight the enablers of success. Many of these factors were related specifically to the support they gained from the leadership team, other teachers, students and the broader school community. With this support, they felt able to undertake their role, even when it required many more hours of time and commitment than they had originally thought required. Having funding to enable planning time and to purchase resources was another key item to the specialists’ success. Several specialists indicated that having a dedicated space for science education minimised the requirement to move resources around, enabling them to use their time more productively.

The incidental discussions also provided much information which could be used to inform future programs. Teachers spoke plainly and openly at times revealing small aspects of their role which they wanted to change. They revealed that they believed that they could make further changes, but really needed some support in working out how to do this. Aspects such as the fact that the lower end Primary Connections materials were ‘too boring’ or did not contain enough student interactivity not only provides some advice for the development of future Primary Connections units, but highlights the fact that the specialists were thinking about the quality of the learning experiences for students as they administered the units and supported teachers to do the same. Observations by Deakin Science education staff indicated that teachers displayed a high level of competence in both their understanding of themselves as change agents and also their use of ICT and digital objects to support student learning.

**Development of the Primary Science Specialists and their role, over time.**

From the point of view of the Deakin Science education team, we believe that we have seen significant growth of the science specialists as they have managed their role from the start of the professional learning program until close to the end. Initially, as they were new to their role, the Science Specialists trialled science activities to build their own confidence in teaching science. They developed their knowledge of the science curriculum and the resources they would need. Most adopted the Primary Connections materials to use with the other classroom teachers. The teachers initially expressed uncertainty about their new role, but as the professional development program progressed and teachers began to plan for the implementation of a science program in the school(s), their roles at their individual schools became clearer. At the end of the first year, they reported having faced many challenges such as stimulating other teachers to teach science. Some teachers reported that the workload was excessive with insufficient time for planning and assistance. For example one teacher described her difficulty of “dealing with 11 different classroom teachers all at different stages of development and acceptance”. Others complained that the half time load created management issues, as the twin role is not easy to manage. The scope and variability of the role of the science specialist led to some misunderstandings of the role at the school level. While the Science Specialists duties varied according to the needs of the school, their shared goal was the same: to promote science. The expected duties were not prescriptive, and varied depending on the size, location and needs of the school, but commonly included:
• Working with teachers to provide guidance on how and what science was taught
• Whole school curriculum planning for science
• Managing the purchase and storage of resources needed to teach science
• Promoting science in the school and linking science to the community
• Providing guidance in assessing students

The breadth and significance of the role became evident from the Science specialist recollections. Here is a description by one Science Specialist as to how she perceived her role, after 12 months experience as a Science Specialist:

My role is to facilitate the successful delivery of the science curriculum at my school through an enquiry based learning model. To do this I need to empower my classroom teachers to initially successfully delivery the concepts and aims embedded in the Primary Connections units they are teaching. I need to ensure that my teachers have the materials, conceptual knowledge, organizational skills and confidence to engage their students in an enquiry based learning model while delivering the units.

I see my role as being a model, mentor, and provider of support through team teaching and to assist in the organization of resources and materials required to teach the units of work. I also need to organize and provide PD training for the classroom teachers on the integration of the units of work across the curriculum using the inquiry based learning model. To do this I have structured a program where my teachers work both with me in a team teaching situation and independently to deliver different units of work.

Towards the end of the first year, Specialists were seeing changes in their teachers and attitudes to science teaching. Although they reported that there were some teachers who were slow to pick up the challenge, they also reported on some extraordinary progress. See from one teacher’s comment following:

In Term 1, they (teachers) commented on how fun Science was and how much the students enjoyed it. They seemed quite surprised. By Term 3 they were much more involved in the planning of lessons and were happy to tailor their lessons to the needs of their students. They were much more confident and willing to share ideas with their team, teach without as much guidance and to try new things. As they taught different concepts they were learning off each other which I think will really help for 2013. By Term 4 the teachers were running Science lessons outside of the usual once per week where I was involved.
Other indicators and enablers of successful progress include: the use of Family Science Nights, the involvement of external incursions, the positive response from children “What are we doing today in science?” , networking with other specialists and with Deakin Science Education team, parent interest and support, enhanced specialist capacity (development of understanding of science through ‘doing’). Science specialists tended to work with a ‘gradual release model’ moving slowly through the processes of incorporating science into the classroom of every teacher. As mentioned above, this required the science specialist to be skilled in science content and its pedagogy, but also in developing rapport with other teachers to build capacity and confidence in their teaching of science.

Conclusion

The additional 5 day Deakin PrimSS professional learning program played a critically important role in supporting these specialist teachers. As evidenced by their own ‘Celebrations Days’ held in June and Oct 2012, the cohort required the support of like-minded teachers. They voluntarily came together to share ideas and continue their networks and this strong and close alliance helped support all teachers, but particularly those who were more isolated. The pre-program survey (Dec 2012) highlighted the isolation felt by many and the bringing together of the cohort for further professional learning and the opportunity to share experiences was both a recognition and a validation by the DEECD of their role within their schools.

The five day program used a similar format to the previous fifteen day program, although with significant input from the participants themselves. The interactive nature of the program allowed for sharing at the point of need and maximised opportunities for ‘hands-on’ learning in small collaborative groups.

Sessions which dealt with ‘principles of supporting change’ and clarification of the specialists’ role, were based to a large extend on participants’ experiences and formatting the sharing of these experiences. There were some issues raised around how to move the last of the recalcitrant teachers into teaching science on a regular basis. This seemed to be the main issue within schools, even with strong support from Principals and the leadership teams.

There seemed to be a need for more contact with DEECD, mainly in terms of validation of the role in the earlier days. However, with the role finishing in 2013, questions were being asked about future support for the role or whether there were any plans for ongoing support. These questions were raised the first session, but may well have been answered during the DEECD led sessions.

Overall, these data provided evidence of positive changes in schools and of the substantial influence the specialist’s role, and hence the Primary Science Specialist Professional Learning Program, was having at supporting changed teachers’ practice in science and improving the science learning outcomes for children in the schools.
Recognising that the teachers have been progressively working through their own school science program, often building their own science experience and capabilities, this five day program will use the teachers’ own experiences to interrogate the pedagogical science content knowledge and the leadership qualities still needed by the specialists. Overall, this will reinforce the capabilities so far developed and will enhance the primary science specialists’ abilities to lead others based on a) their own enhanced knowledge and understanding of science and b) developing further their leadership skills.

The five day program is based on the following overarching themes:

- **Day One** – Drawing on the experiences of the primary science specialists to establish leadership principles
- **Day Two** – The student as learner
- **Day Three** – What is meant by effective teaching?
- **Day Four** – Supporting effective teaching
- **Day Five** – Moving forward, leading change

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<tr>
<th>Session</th>
<th>Session Title</th>
<th>Description</th>
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<tr>
<td>Day 1</td>
<td>Leading change</td>
<td>DEECD with all mathematics and science specialists</td>
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| Mon 20 May  | Reflections – leading change | The key ideas underpinning this session are:  
- how far the science specialist have come - CELEBRATIONS  
- Where have we come from? |
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<tr>
<th>Time</th>
<th>Activity</th>
<th>Details</th>
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<tr>
<td>12.45pm-2.00pm</td>
<td>Considering specialists’ role and management Coral and Sandra</td>
<td>• Where are we now? This session will bring together the specialists with an opportunity to share their very positive successes in their schools over the last 16 months. In response to a survey question “What have been some of your successes in your role as science specialist?” we will summarise some of the outstanding successes that have been achieved and present them back to the group. Teachers will be placed in table groups and a discussion time allowed so that they can share further with each other. Following from this, participants will engage in a ‘post it’ activity where they will be asked to identify the enablers to success which will also link with the second survey question, “What do you consider are key factors which have enabled you to undertake your role satisfactorily?” They will write each enabler onto a ‘post it’ note and pin it onto a display board, under the headings which will be generated from the survey responses to the same question. Formed into groups, teachers will discuss these enablers through their experiences over the last 12 months. A feedback time will be allowed, to which other comments might be offered up from within the broader group. Moving onto identifying the nature of specialist’s role, participants will undertake a quick SWAT (strengths, weaknesses, opportunities, threats) analysis of their role. This will be used to assist in the generation of, and revisiting of the principles of leading change. Principles include: • Developing a science vision, • Strategic planning to implement change –using planning tools, • Effective leadership. • Teamwork and collegiality. • Professional Development. • Networking. • Monitoring the implementation.</td>
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<td>Day 1</td>
<td>Using teacher documents for whole school planning. Sharing and reflecting on the issues arising</td>
<td>The key ideas underpinning this session are: • What school planning models are being used? How are they similar, how do they differ? • What are the benefits of each of the models? • What are the enablers or the inhibiting factors?</td>
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Deakin University, June 2013
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<th><strong>Identify the science teaching and learning objectives</strong></th>
<th>This session will build on the discussion of the previous session where participating teachers are given an opportunity to report on their experiences as science specialists in 2012. The teachers will have identified the key components and characteristics of effective change leadership. The presentations will raise issues and promote discussion related to the key issues related to the evaluation of their whole school planning document. These issues will be identified and placed under specific themes for further discussion. Time is provided for cooperation between teachers to discuss issues. How can they learn from each other and what can facilitators do to support them?</th>
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<tr>
<td><strong>Revise the document Science in my school in 2013</strong></td>
<td>- With the survey, teachers are asked to provide their latest whole school planning document and this will provide examples for discussion around whole school planning. Their whole school planning document will be examined for the key components and characteristics of effective change leadership. The DEECD modules on whole school planning and planning for cohorts of students will be introduced and working examples provided. <a href="http://www.education.vic.gov.au/school/teachers/support/Pages/curriculum.aspx">http://www.education.vic.gov.au/school/teachers/support/Pages/curriculum.aspx</a></td>
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<td><strong>Assessment – teacher reflection on how we know when quality learning is occurring.</strong></td>
<td>- One of the questions in the survey focuses on inhibiting factors: What have been some of the factors which have inhibited you in carrying out your role? How have you worked to overcome these? Responses from the survey will be distributed to groups to be discussed. How the teachers moved past the inhibiting factors will be a focus of the discussion. Each group will report back to the whole group.</td>
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<tr>
<td><strong>Coral and Sandra</strong></td>
<td>- The teachers will be grouped with others with expertise and experience in particular Year Levels, F-6, and will focus on a content area and explore the use of the scope and sequence charts from the Australian curriculum found at <a href="http://www.australiancurriculum.edu.au/Science/Content-structure">http://www.australiancurriculum.edu.au/Science/Content-structure</a> to guide practice to identify of key knowledge and skills for each stage/year level and determine a set of goals – science teaching and learning objectives for their schools.</td>
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<td>- Teachers will bring together the solutions to their issues, plus their understanding of their school’s science education goals to review and revise their whole school planning document. Using data from the survey, teachers will identify their current assessment strategies for whole school assessment and cohort assessment and align these with principles of assessment for learning. This will lead into further discussion around what works best at each school, what provides most comprehensive analysis of student learning and ways forward in their particular contexts.</td>
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### Session 1

**Day 2**  
**Tuesday 21 May**  
**Session 1**  
**9.00am-9.20am**

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<tr>
<th>AusVELS</th>
<th>DEECD AusVELS Q &amp; A</th>
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| Laura & Russell | The key ideas underpinning this session are:  
  • How do we know when quality learning is occurring?  
  • The assessment tools used by the teachers in their schools  
  • Discussion on the assessment items provided by the DEECD as part of the program |

Teachers will be introduced to current thinking about sustainability, and its place in AusVELS. Examples of sustainability in the curriculum will be presented and discussed.

The researchers have been involved in a cross- national project on ‘Socially Acute Questions’ (SAQs) where Australian and French tertiary students generated a response to environmental issues. A framework of socio-scientific sustainability reasoning was developed. This work has been recently published in Teaching Science journal.

Teachers will be introduced to an SAQ and work in groups to develop a considered response, before joining groups to refine their ideas taking into account different viewpoints. Reporting back and the consideration of what constitutes quality learning and thinking will be informed by presentation of the reasoning framework. Its value as a formative and summative assessment tool will be discussed, as well as its relation to assessment for learning principles and other forms of assessment that could support learning about sustainability.

A discussion of assessment and learning will be informed by the presentation of assessment principles and the different resources that can support this, with examples.

### Session 2

**Day 2**  
**Tuesday 21 May**  
**Session 2**  
**11.00am-12.15pm**

| Children learning in Science | The key ideas underpinning this session are:  
  • Developing understanding of children’s learning in science using teacher samples |
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<tr>
<td>Linda and Coral</td>
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**Deakin University, June 2013**
What do we know about students when they are learning science? Teachers provide examples of quality learning – activities or sequences that were successful. Using photographs or lists of ‘learning highlights’, teachers will develop further understanding of how students learn in science. What are recurring themes in the teachers’ examples?

Presentation of a series of keynote addresses: teachers from Bannockburn, Warrnambool East, Blackburn cluster, Shepparton group to present instances of quality learning.

Begin discussion with an initial set of principles of quality learning. To what extent is this list indicative of the quality learning experiences in the keynotes? What could be added?

In Year level groups, participants share their own experiences of quality learning. What is similar? What is different? What role does context (school location, availability of resources, community), teacher learning and commitment, and nature of the initiatives influence the quality learning? Discuss also how quality learning in science might be different in other subject areas.

In Year level group, add to or rewrite the quality learning principles as informed by their own experiences of quality learning, and as appropriate for their year level. For each principle created, and using their own experiences, teachers prepare a list of exemplary comments of “What quality learning looks like” and “What quality learning does not look like”.

Use IMYMS components (esp. Deeper learning component) as an example of what it might look like. Discussion, comparing the different quality learning at different levels – are they the same, or there fundamental differences?

| Day 2 | Tues 21 May Session 3 1.00pm-2.15pm | How students learn science – supporting deeper learning Linda and John | The key ideas underpinning this session are:

- Illustrations of children’s learning in science
- Developing understanding of how children learn – factors which contribute
- How students learn science, supporting deeper learning (meaning

Through challenge activities on the topic of light teachers will explore aspects of supporting quality learning about light. Groups will map out ideas for building light activities into a unit sequence and identify the learning principles underpinning these including meaningful contexts, challenging activities, opportunity to explore, differentiated tasks.
The experience of the activity will stimulate discussion about how children learn- ways in which contextual social, cultural, and psychological factors influence different learners’ engagement with science.

**Light concepts: refraction and reflection**

Light concepts: refraction and reflection: light travels in straight lines, light can be bent by changing the density of the medium it is travelling in; light can be reflected from a reflective material. Diagnostic assessment “Use the Light” Postbox activity (Hubber) to identify the various conceptions of light, and to introduce the different ways of representing light. Each person completes questions. Each question responses are posted into separate boxes, and each table group analyses all of the responses for one question. They represent the different ideas in an appropriate way, and share with the class. A discussion of the range of ideas that people can have about light. Compare with the children’s concepts literature.

In order to demonstrate how activities can be used to promote deeper learning, a Representational Challenge will be posed where each table group will receive a scenario that requires them to change the direction of light in order to solve a problem. They will then be asked to represent how refraction or reflection occur in multiple ways, such as role play, graph, diagram, verbal, gestures. They share their representation with the whole group.

A discussion follows, focusing on:

- **Meaningful contexts and value for learning,** including a discussion on the different aims associated with relevance (Newton 1986):
  - Moral aims are concerned with empowering people in their choices;
  - Contextual aims are those concerned with placing science in broader contexts so that students see the significance of science to people’s lives;
  - Philosophical and epistemological aims are concerned with presenting science as it is practiced in order to present an appropriate image of the nature of science; and
  - Psychological aims are concerned with teaching that is considered relevant to students themselves, and which possesses some motivational value.

The Categories of Meaning Making (Darby-Hobbs) can provide a structure for thinking about how different “stories.”

- **Differentiation through rich tasks:** the tasks allows for different levels of engagement: problem solving (investigation of effect of medium on laser, selecting of materials, engagement with scenario); hands on kinesthetic engagement with materials; representation; theoretical and empirical understandings and how they relate to the phenomenon.

- **Role of different factors affecting learning:** how the nature of the task and various contexts might react: social, cultural elements, links to relevance aims and purposes associated with challenging tasks.
| Day 2           | Using the developmental maps and continua to plan for effective instruction. John and Linda | The key ideas underpinning this session are:  
• The development of sequences and units using resources such as the science continuum and developmental maps  
Using the continued focus on the content of ‘light’, discussion on how they can be sequenced developmentally – groups use the developmental maps and continua to develop quality learning sequences.  
This session models the need for building on prior experiences by using the experiences relating to light from the previous session to explore the use of developmental maps to develop quality learning sequences.  
The ideas from the postbox activity from Session 2 are placed onto the AAS developmental map for Light. This gets teachers familiar with the maps and how ideas progress/are built up (use some words from AAS document). Discussion of the construction of the developmental maps and their aims, potential for planning.  
Follow up with a discussion about how activities can be modified to meet the learning needs of different year levels – couch this in terms of developmental levels, recognizing that in a single year level students will have different levels of understanding of the concepts. Ask teachers to modify the representational challenge from Session 2 so that it can be used to develop quality learning at each level of the continuum. Teachers are asked, “How might they develop a sequence that includes differentiation through rich tasks.”  
Literature: AAS developmental maps |
### Day 3
Wed 22<sup>nd</sup> May
Sessions 1
9am-11am

<table>
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<tr>
<th>What is effective science teaching?</th>
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<tr>
<td>The key ideas underpinning this session are:</td>
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<td>- Unpacking the defining characteristics of effective science teaching and its relationship to inquiry-based teaching and learning</td>
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<td>- What elements are consistent, what are different?</td>
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<td>- The role of the teacher is significant in adopting inquiry-based science classroom.</td>
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<td>- Discourse is a key element of inquiry teaching and learning.</td>
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ACARA (2010) states that “The science curriculum emphasises inquiry-based teaching and learning. A balanced and engaging approach to teaching will typically involve context, exploration, explanation and application. This requires a context or point of relevance through which students can make sense of the ideas they are learning. Opportunities for student-led open inquiry should also be provided within each phase of schooling.”

This session explores the various elements of inquiry-based teaching and learning and their relationship to effective science teaching. A broader perspective about inquiry teaching and learning will be envisioned than a perspective that inquiry is just about student-centred practical work and/or project work.

Deakin researchers have a current ARC funded EqualPrime project which involves the exploration of quality science teaching at Year 4 level. Video capture of lessons undertaken by teachers in this research project will be used in this session. Participants interrogate aspects of the video (teacher called Bob) to define what effective teaching is about. They will focus on key aspects: how to set up an inquiry, questioning, productively responding to student input, establishing key understandings, linking representational modes, types of teacher talk. The discussion will be supported by analyses the researchers have carried out on the video segments, to highlight these multiple aspects of effective inquiry teaching.

Participants will undertake workshop activities that model inquiry-based teaching and learning. The science context will be forces and flight. Participants will discuss and workshop classroom discourse as a key element of inquiry teaching and learning drawing on current literature in education research focusing on the shift from ‘dialogic’ or open student centred talk associated with exploration of phenomena, to ‘authoritative’ or focusing talk through which the teacher moves the class towards the scientific perspective. Using the e<sup>5</sup> instructional framework, teachers can attempt to locate the teaching practice within the framework of inquiry teaching and learning.

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### Day 3
Wed 22<sup>nd</sup> May
Session 2

<table>
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<tr>
<th>Differentiation to support diverse learning</th>
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<tr>
<td>The key ideas underpinning this session are:</td>
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<td>- Focus on student difference and needs in teaching</td>
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Instructional frameworks: Structuring your science lesson

Peter & Russell
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<tr>
<th>Time</th>
<th>Session Title</th>
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<tr>
<td>11.15am-12.30pm</td>
<td>needs and learning styles.</td>
<td>This session will draw on the collective experiences of the participants and Deakin facilitators to explore differentiation to support diverse learning needs and learning styles.</td>
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<td>Peter &amp; Russell</td>
<td>Following discussions that highlight the main issues in creating classroom environments to support diverse learning needs and learning styles participants will explore video footage taken from Deakin’s ARC funded EqualPrime project of an ‘ideas about matter’ year 4 sequence (teacher called Nicky). This footage shows how effective teaching can highlight aspects of how teachers set up a learning challenge, organise sequences. Within this section, the video can be viewed to consider how the teacher(s) deal with differentiation within the classroom, Teacher understanding of ideas about matter will also be developed. Participants will then model an inquiry-based approach within the science content area of ‘ideas about matter’. Specifically, the participants will investigate a question they pose concerning dissolving rates of sugar. In undertaking this task the teachers will be expected to think about developmental aspects of both conceptual understandings about matter, and about investigative skills, and ways in which the inquiry might be differentiated to support diverse learning needs and learning styles.</td>
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<td>Day 3</td>
<td>Representational approach</td>
<td>Key ideas underpinning this session are:</td>
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<td>Wed 22 May</td>
<td>Differentiation: Challenging tasks and Questioning</td>
<td>- Inquiry through representational challenge, negotiation</td>
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<td>Session 3</td>
<td>Russell &amp; Peter</td>
<td>- Using representation to increase or reduce the complexity of a task to suit students’ needs.</td>
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<td>1.15pm-2.30pm</td>
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<td>- Formative assessment as a differentiation strategy</td>
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<td>A representational approach will be revisited through plants as the science content area. Such an approach can highlight how tasks can be ramped up or down to suit individual students’ needs through the choice of representation. The key foci will be differentiation, and the representation construction principles. The key concepts will be children’s ideas about plants, plant structure and function, plant reproduction. Following presentation of the literature on children’s ideas about living things, plants, and the purposes of plant structures, participants will perform the following activities:</td>
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<td>1. identify a variety of plant parts,</td>
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<td>2. dissect a variety of flowers</td>
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<td>In each case being challenged to represent the variety using Venn diagrams, tables, or classification keys. They will represent flowering plant reproductive cycles, and the adaptive nature of the flower structures.</td>
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<td>Day 3</td>
<td>Wed 22 May</td>
<td>Session 4</td>
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<td>Representational approach &amp; key challenge for teachers</td>
<td>Key ideas underpinning this session are:</td>
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<td>Russell &amp; Peter</td>
<td>- Continuing with representational approach using plant concepts.</td>
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<td>- Homework task</td>
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<td>In the first part of this session the plant topic will be continued. Teachers will work with fast growing plants, planted in small containers at 4 intervals prior to the session to provide a model of staged growth. Teachers will be challenged to represent the process of growth through annotated drawings or other means, including a quantitative representation of the growth rate.</td>
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<td>Discussion will focus on the representational difficulties in investigating growth. Data will be generated to illustrate variation in measurement and challenge teachers to represent this.</td>
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<td>The concept of cycling of material in plants, involving photosynthesis, will be discussed through observations of a terrarium and presentation of children’s ideas about this.</td>
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<td>This will be followed by an exploration of the development of ideas about plants across the F to 6 AusVELS curriculum.</td>
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<td><strong>Part 2: Homework task</strong></td>
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<td>Collecting evidence of quality learning sequences and teacher learning within their school – bring back examples for discussion p-2, 3-4, 5-6. Focus on what was their role, how did they support the teacher, what was the teacher’s view about the experience, how can they capitalise on this to support further development of effective practice leading to quality learning in the school.</td>
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<td>Teachers will discuss the nature of the homework task - clarification and modifications will be made and emailed to teachers.</td>
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### Supporting effective science teaching in our school

**Coral and Wendy**

The key ideas underpinning this session are:
- Feedback from teachers around homework task
- What did they find out that could assist them in their role
- Using a researched model of teacher learning to make sense of the support role

In this session, teachers will report back on their examples of quality learning sequences and working with teachers in their schools. Working in teams (P-2, 3-4, 5-6), they will report in three separate groups. The discussions will be videoed to become a resource for teachers which can be uploaded onto the Ultranet site (with permission) or which can be shared electronically via other formats.

They will be given a teacher professional growth model (Clarke-Hollingsworth) which they will annotate in groups to map and make sense of their own experiences. The discussion will focus on fleshing out the model and using it to identify key features of teacher change that can be productively targeted.
- Teachers will identify in this model, approaches that can assist teachers with whom they are working, to change their current practice.
- Are there challenges for particular levels that may relate to organisational issues, such as literacy and numeracy blocks?
- Identify creative ways to work with these teachers to support change?
- Reporting back to the whole group on possible solutions.

### Supporting Early Years teachers to teach science

**Coral and Wendy**

The key ideas underpinning this session are:
- Understanding the Early Years Learning Framework (birth-8) (also the Early Years Learning and Development Framework birth-5)
- Play pedagogy in the early years for effective science teaching
- Intentional science teaching in the early years

Teachers in the P-2 area will be asked to discuss specific examples of science learning in their schools. Using these examples and video capture of science instruction through intentional teaching in early years settings, teachers will develop their own understandings of the requirements of the Early Years Learning Framework and the theories relating to play pedagogy.
### Day 4
**Thurs 30th May**

<table>
<thead>
<tr>
<th>Time</th>
<th>Session</th>
<th>Presenter(s)</th>
<th>Topic</th>
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</table>
| 11.15am-12.30pm | Session 3 | Primary Connections – revisited Wendy and Laura | The key ideas underpinning this session are:  
- Discussion around how schools are using these materials  
- The effective use of Primary Connections  
- Branching out – incorporating other resources  
- Aligning units to the AusVELS  

Teachers will work through key activities in a renewed primary connections unit that links to the Australian Curriculum, Marvellous Micro-organisms or, Earthquake Explorers (Note: subject can change depending on receipt of new materials from Primary Connections. Discussion will focus on key features and learning principles of each unit and how the units have been adjusted to accommodate AusVELS.  

Recognising that many schools are using the Primary Connections material, this session will investigate how teachers and schools are using the materials. The core elements and teaching strategies of an enquiry base of the Primary Connections material will be re-visited and teachers will have the opportunity to share their experiences with these materials. Teacher will be asked to revise a lesson sequence from Primary Connections, linking it to AusVELS. |
| 1.15pm-2.30pm | Session 4 | Supporting primary teachers to teach physical science Peter & Wendy | The key ideas underpinning this session are:  
- The importance of a knowledge of physical sciences in today’s world within the context of the overarching concept of energy.  
- Extending teachers’ knowledge of energy – aiming for higher level understandings in physical sciences.  
- Linking the Science as a human endeavour strand with knowledge and skills in the Socio Scientific Issue of climate, and cutting edge science related to renewable energies.  
- The concept of energy is embedded across all strands and levels of the curriculum.  

An area of concern for many primary teachers in teaching topics related to the physical sciences has been their lack of confidence in knowing the science sufficiently to adopt student-centred teaching and learning approaches. This |
The key ideas underpinning this session are:

- Using a Science Technology Engineering Mathematics (STEM) approach based on a design technology energy project to engage and support higher achieving students
- Representational approach to teaching and learning energy related topics

High achieving students may be supported with the provision of tasks that are sufficiently students-centred and open ended to, not only engage such students, but to challenge and extend their knowledge. Authentic tasks that integrate science, mathematics and technology can assist higher order thinking and support high achieving students. A representational approach can also be used to extend high achieving students.

In this session, teachers will be introduced to the idea of how integration of science with technology can assist higher order thinking and support high achieving students. They will workshop energy related activities that utilise the STELR materials as well as electric circuit materials that model a STEM and representational approach.
<table>
<thead>
<tr>
<th>Day 5 Fri 31 May</th>
<th>Maths and Science in the whole school context</th>
<th>All mathematics and science specialists, with John Munro</th>
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<tbody>
<tr>
<td>Session 1</td>
<td>9.00am-10.30am</td>
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<tr>
<td>Day 5 Fri 31st May</td>
<td>Productively using AusVELS support material</td>
<td>The key ideas underpinning this session are:</td>
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<tr>
<td>Session 2</td>
<td>11 am–12.30pm</td>
<td>- Familiarisation with AusVELS that extends beyond the standards;</td>
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<td>Peter &amp; John</td>
<td>- Exploring and critiquing digital tools and resources, including ‘ebook boxes’</td>
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<td>- The concept of digital pedagogy from a representational as well as a TPACK perspective.</td>
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<td>There is a significant amount of resources that has been produced nationally and locally (DEECD) that support an understanding of AusVELS (Science) and its implementation in the primary classroom. This session seeks to explore the various aspects of the AusVELS (Science) curriculum that include not only the standards but other areas such as overarching ideas and cross-curriculum priorities. The context of digital tools and resources, and digital pedagogies, will be used in exploring and critiquing AusVELS support materials.</td>
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<td>This session will workshop various digital tools and resources that are readily available to the teachers such as ‘ebook boxes’ and ‘scootle’, which includes the ICT in everyday learning: A toolkit for teachers resources. The session will also explore digital hardware such as digital microscopes or data loggers such as motion capture, and software such as inspiration for concept mapping, or animation software, to explore what a ‘digital pedagogy’ might mean and its potential for supporting quality learning in science.</td>
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<tr>
<td>Day 5 Fri 31st May</td>
<td>Influencing Others? How to make it possible.</td>
<td>The key ideas underpinning this session are</td>
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<tr>
<td>Session 3</td>
<td>1.15–2.44 pm</td>
<td>- Leading change</td>
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<td></td>
<td>Russell &amp; Peter</td>
<td>- Leading others</td>
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<td>- Developing your own style as a change agent/leader</td>
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<td>The session will involve a set of scenarios identifying common problems in leading change in schools. Groups will develop role plays that highlight the problem and also point to solutions. Each group will present their perspective on the scenario and approaches to solutions using role play or other means. Discussion will generate ideas from the wider group.</td>
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<td>The set of scenarios will be generated from the specialists survey returns, but examples of scenarios might be:</td>
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Deakin University, June 2013
• The early years coordinator resists introducing science topics on the grounds that the literacy program takes precedence
• One of three teachers in the middle years offers passive resistance to inquiry approaches despite the enthusiasm of the others
• The principal refuses to allow extra planning time for groups to develop new science units

Out of the presentations and discussion, the set of principles concerning leading change will be revisited and deepened.

Part 2: Planning
Teachers work in groups to develop plans, based on the input from the five days:
• For themselves, and for the school
• For the short term, and for the long term.

The subsequent group reports and discussion will be used to revisit principles of working with teachers and leading change.

The final discussion will open up the question of what further support is needed by these specialist science leaders.

Day 5
Fri 31st May
Session 4
2.45pm-3.30pm
Evaluators overview of achievements and milestones
ACER
### INQUIRY UNIT: Staying Alive

#### LEVEL 1: Term 2 2012

<table>
<thead>
<tr>
<th>Year Level: Prep</th>
<th>Host Content Domain: Biological Sciences</th>
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<tbody>
<tr>
<td>Duration: Term Two - 11 weeks</td>
<td>Teaching Staff: Tara Binger, Janine Hough, Tegan Smith and Alex Katsogiannis</td>
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</table>

**Science Outcomes** (What do you want the students to know at the end of the unit.)
- Identify the basic needs for a human to survive such as air, food, water and shelter.
- Identify the senses and describe how each sense helps us.
- Follow directions to conduct simple investigations of the amount of water consumed by an animal and by humans.
- Make and share observations

**Focus Questions** (The major questions you are going to ask the students.)
- What do humans need to stay alive?
- What are our senses?
- What does a scientist do?

### RESOURCES

**Picture Books:**
- The Very Hungry Caterpillar
- "Bartholomew and the Oobleck"

**Non-Fiction Texts:**
- Senses
- Body parts
- Audio non fiction books

**Non-Fiction Texts- Big Books:**
- You are what you eat
- Fantastic Food

**Artefacts-concrete aids:**
- Plastic Food
- Human torso
- Stethoscopes
- Food Pyramid - Felt Board
- Human Body Felt x3
- Magnifying glasses
- Smelling jars (coffee, rose, chocolate, basil, orange spray, lavender)
- Funnels, watering cans with different spouts.

**Single Use Items**
- Taste Testing
  - Honey (sweet)
  - Coffee salad green (bitter)
  - Lemon, Green apple (sour)
  - Potato chips (salty)
- Textures
  - Veggies & fruit - mystery bag
  - Fur, silk, wool
  - Scourer, plastic, metal,
  - Sandpaper, ceramic

**Videos & Tapes**
- The Lunch Bunch (Video)

**Maps:**
- Human Body
- Anatomy Charts x3

**Board Games:**
- Body Bingo
## ASSESSMENT ROUTINES AND RECORDS

1. **Teacher Observations** - identifying and monitoring interest level.
2. **Anecdotal notes** made by the classroom teacher
3. **Oral questioning**
4. **Science Journal Excerpt** from Science Journal to be placed in portfolio
<table>
<thead>
<tr>
<th>Week/Stage</th>
<th>Activities</th>
<th>Scientific Investigations</th>
<th>Assessment</th>
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<tbody>
<tr>
<td></td>
<td><strong>Engage</strong></td>
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<td>Activities designed to engage and immerse the students in a topic.</td>
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<td><strong>What is Means to Stay Healthy Weeks 1 &amp; 2</strong></td>
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<td>1. Introduce Focus Questions: Display in classroom</td>
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<td>2. Introduce Ideas Map - Discuss what humans need to stay healthy.</td>
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<td>• Students develop an ideas map of what they think they need to stay healthy. Draw themselves in a square and draw things that they need to stay healthy.</td>
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<td>3. DVD on Health (Lunch Bunch)</td>
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<td>4. Photo &amp; Word Wall - Collect photos of what is means to be healthy i.e. running, sleeping, eating veggies, drinking water, laughing. Create a photo wall &quot;We are Staying Healthy&quot;</td>
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<td><strong>No Scientific Investigations Weeks 1 &amp; 2</strong></td>
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<td><strong>Explore</strong></td>
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<td></td>
<td>These activities give insight to what children already know and prepare them for further investigation.</td>
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<td><strong>Our Senses - Weeks 3-5</strong></td>
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<td>2. Pre-Assessment- What I know about our Senses</td>
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<td>3. Sorting Senses (refer Staying Alive-Life &amp; Living Unit - Stretch your senses.)</td>
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<td>• Use their senses to describe a mystery object</td>
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<td>• Identify the body parts associated with the different senses</td>
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<td>• Use a question chart to record descriptions of sensory experiences.</td>
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<td>4. Senses Detectives (refer Staying Alive-Life &amp; Living Unit - Stretch your senses.)</td>
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<td>• Comparison Chart - Use senses to make decisions about different situations they may encounter in their everyday life - a comparison chart of quiet/noisy things, warm/hot and cool things, smelly/fragrant things, hard/soft things using magazine cut-outs, illustrations or words.</td>
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<td>• Record observations in a class table.</td>
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<td><strong>Weeks 3 - 5: Senses</strong></td>
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<td></td>
<td>1. Healthy Reading Corner</td>
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<td>Portfolio Assessment: Five Senses. Show what I know about our Senses.</td>
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<td>2. Hearing: Mystery Noises *Science Journals</td>
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<td>3. Where's Happy Healthy?</td>
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<td>4. Senses - Smell: Smelling jars</td>
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<td>5. Construction something to help someone see.</td>
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<td>6. Senses Match</td>
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<td>7. Five senses interactive Website - <a href="http://pbskids.org/sid/isense.html">http://pbskids.org/sid/isense.html</a></td>
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<td>8. Touch Table</td>
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<td>9. Senses - Touch: Water play</td>
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<td>10. Science Experiment: (Support) *Science Journals</td>
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<td>11. Taste Testing (Support) *Science Journals</td>
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<td>12. Sight: Eye Testing *Science Journals</td>
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<td><strong>Move it! Weeks 6-8</strong></td>
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<td>1: Chomp, chomp! (refer Staying Alive-Life &amp; Living Unit)</td>
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<td>• Discuss food and what makes them hungry and record in class science</td>
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<td><strong>Science Journal</strong></td>
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</table>
These activities give insight to what children already know and prepare them for further investigation.

1. Record what food they eat during a day use sticky notes to create and display on a class chart.
2. Why do we need to eat? Record student ideas in class chart.

2: Huff and Puff (refer Staying Alive-Life & Living Unit)

2.1 Introduce POE (predict, observe, explain recording chart)
   a. Predict & record on chart
   b. Observe & participate in the physical activities
   c. Explain findings
   d. Complete individual Puff Pieces Chart

2.2 Explore how their breathing changes after high-level physical activity.
   (Running, jumping, skipping, stars jumps, etc.)
   - Explore other changes to their body after high-level physical activity.
   - Students stand still, close eyes and listen to breathing.
   - Place hands on ribcage to observe breathing (slow or fast?)

3: Slurp and See (refer Staying Alive-Life & Living Unit)

a. Class Discussion: Discuss why we need to drink water - Discuss what happens to our bodies when we drink water.
   b. Y Charts: Develop two Y-Charts Firstly, How do they LOOK, FEEL & SOUND when sitting in class. Secondly, AFTER Phys. Educ Lesson: How do you LOOK, FEEL & SOUND after working with Mr Daley?
   c. Discuss changes which occurred after the physical activities…inc SWEATING Lead discussion on PERSPIRATION

Space and Shelter - Week 8

Space & Shelter (refer Staying Alive-Life & Living Unit)

- Observe the difference between a confined and an open space. Play games to experience competing with others for space. (Tin of Sardines----- A sheet of newspaper)
- Explore an area with a lot of space go out and explore what students can do on the oval that they can’t do in their classroom.
- Discuss the protection and shelter by their home space.
- Compare their home space to their classroom
- Describe what SAFE PLAY AREAS look like, sound like & feel like…

Weeks 6 - 8: Food and Exercise

1. ICT Fresh Food Kids
2. Making Fruits and Vegetables
   a. Science Journals
3. ??? Non Fiction Text (Listening Post)
4. Healthy Reading Corner
5. Who wants to be a chef? (Support)
6. Stethoscopes (active & passive heartbeats) *Science Journals
7. My Body (body parts)
8. Exercise on the IWB (Wii Fit) (Support)
9. Favourite Fruits (Maths Data) *Science Journals
10. Cross sections of Fruit and veggies (Drawing or Writing)
11. Mystery Bag of Fruits and Veggies
12. Food Classification – Vein Diagram *Science Journals
13. The Lunch Box Challenge (Construction)
- Create a model of a safe place using straw, plasticine, cardboard. PHOTOGRAPH Models.

**Take it or Leave it! - Week 9**
- (Refer Staying Alive-Life & Living Unit)
- Graphic Organisers:
  - Record ideas about the basic needs of humans
  - (Refer Staying Alive-Life & Living Unit) Represent basic human needs using a sorting diagram.

**How much water do I need? - Week 10**
- Introduce a plastic cup of water & ask students if they would drink more or less than the cup of water in a day? (Refer Staying Alive-Life & Living Unit)
  - Discuss ideas about how to measure water consumptions
  - Class Data Collection: Investigate and compare how much water the teacher, and four students drink in a day. Provide plastic named cups to ensure accurate measurements. **Class Science Journal**
  - Analyse a graph of the water consumption.
  - Pictograph: Analyse the outcome of class data and create a pictograph in their own science journal. To show their findings.

**Week 9-11 - Making Connections**
1. Food Making Machine
2. Healthy Reading Corner
3. ????Non Fiction Text (Listening Post)
4. Dramatic Play Safety- Lollypop crossing
5. ICT: Healthy Meal
6. Exploring food packets with a magnifying glass. **Science Journals**
7. Bingo with body parts (Support)
8. Play dough Shelter for Plastic Animal or person
9. Can you make sound with water?
10. Things that make sounds exploration table - how do they make sound? **Science Journals**
11. Magnifying Board **Science Journals**
12. Sleeping - What do you need to sleep well?

**Portfolio Assessment:**
Making Connections. Show what I know about being a scientist. Reflection on acquired knowledge
- What is a basic need?
- What are our senses?
- What does a scientist do?

**Evaluate (Week Eleven)**
End of topic
Students reflect on their learning journey.

**Sensational Reviews - Week 11**
- Review the unit using a class science journal, word wall and other resources developed during the unit
- Ideas Map: Students complete a new Ideas map that reflects their acquired knowledge.
- Senses Mix Up (refer Staying Alive-Life & Living Unit) * science journal.
- Reflect on their learning during the unit. Review the staying advice unit and record student responses in **Class Science Journal**
Appendix Three - Examples of teachers’ principles of quality learning
Teacher focus  Student focus  Grade 4  what quality learning does look like

Principle 1: Student engagement

Encourage use of complex language
Essential Question
No discipline problems, quality discussions
Student-driven learning, students understand
What is expected of them, hands-on,
'light bulb' moments, using scientific language

Principle 2: Teachers on board

teacher modelling
Quality Learning Year 2

- Understanding of 
  Explicit instructions - task orientated
- Engaged + motivated
- Quality of students questions and 
  discussion
  - Acceptance of student's ideas/misconception

In revisiting, students demonstrate 
  a growth in their understanding of 
  concepts
- Demonstrate enthusiasm, excitement 
  through an action, i.e., drawing, role-play,
- "Bringing Science" connections to the 
  Classroom & Things from home.

Not learning if unable to do 
  all of above.
Appendix Four – Further examples of Teachers’ comments on Primary Connections materials

How has it been used?
- Initially followed very strictly (1 year).
- Now reflecting on units and what can add.
(Plan & Reflect, easier after it's been used.)
- Keep structure but bring in new resources.

Examples of Good Practice.
- True teacher attitude
- Discussing & meetings
- Long term planning (recorded)
- Build on knowledge (e.g.) Sequential.
- Using classroom Science Journals

Any Issues?
- Multi-age grades - be creative
- Need PD on Primary Connections.
- Massachusetts - be good on-line
- Too much writing - adapt own worksheet
- Time for each session - take over 2 sessions
- Teacher complete in literacy session
Appendix Five – Interpretation of positives and negative on one school’s programs