The Community’s Contribution to Science Learning: Making It Count

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“Boosting Science Learning: What Will It Take?”
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Overview

Two underpinning assumptions:
• the community should contribute to science learning
  – what do we know about the current outcomes of learning science at school?
• the community has potential to contribute but needs some assistance to “make it count”
  – outline community-based opportunities for learning science,
  – meld this with what we know about learning outside of school, and
  – use case studies to illustrate how we can make it count
Background

• Agreed goal of science education is scientific literacy

A definition based on *The Status and Quality of Teaching and Learning in Australian Schools* (Goodrum, Hackling, & Rennie, 2001)
Scientific Literacy – a definition

Scientifically literate people

- Are interested in and understand the world around them
- Make informed decisions about the environment and their own health and well-being
- Engage in communication of and about science
- Are able to identify questions, investigate and draw evidence-based conclusions
- Are sceptical and questioning of claims made by others about scientific matters
- Are interested in and understand the world around them
Background

- Agreed goal of science education is scientific literacy

- Key issues
  - declining enrolments when science is not compulsory
  - little evidence that scientific literacy is an outcome of school science
## Some data from high school students

<table>
<thead>
<tr>
<th>Science at school:</th>
<th>Very often/nearly always (%)</th>
<th>Almost never (%)</th>
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</thead>
<tbody>
<tr>
<td>Relevant to my future</td>
<td>22</td>
<td>19</td>
</tr>
<tr>
<td>Useful in everyday life</td>
<td>18</td>
<td>18</td>
</tr>
<tr>
<td>Deals with things I am concerned about</td>
<td>14</td>
<td>31</td>
</tr>
<tr>
<td>Helps me to make decisions about my health</td>
<td>13</td>
<td>35</td>
</tr>
</tbody>
</table>

(From Goodrum, et al., 2001)
Background

• Agreed goal of science education is scientific literacy

• Key issues
  – declining enrolments when science is not compulsory
  – little evidence that scientific literacy is an outcome of school science

• Apparent main reason – school science does not engage the majority of students, therefore they do not learn science in a meaningful way
Synthesis

• “A recurring evidence-based criticism of traditional school science has been its lack of relevance for the everyday world”. (Aikenhead, 2006, p. 31)

• “most students tend not to learn science content meaningfully (i.e., do not integrate it into their everyday thinking)”. (Aikenhead, 2006, p. 27)

• Our challenge is to make it worthwhile for students to learn science in a meaningful way, i.e., to change the science curriculum so that it has demonstrable relevance and value to students.

• Achieving this involves bringing science at school and science in the community much closer together.
Community-based opportunities for learning about science

• Students’ families and friends
  (students spend barely 20% of their waking hours in school)
Community-based opportunities for learning about science

• Students’ families and friends,
• Institutions, such as museums, zoos, aquaria, etc.,
Community-based opportunities for learning about science

• Students’ families and friends,
• Institutions, such as museums, zoos, aquaria, etc.,
• Community and government organisations,
Help us fight an alien invasion.

Protecting WA from cane toads.

In the movie, the aliens are always from another planet. But WA is facing an invasion from a creature that's alien to Australia.

Cane toads were introduced to Queensland decades ago to try and stop the banana leaf cane and crops. Instead, they've become a major pest in farms and gardens. With every farmer predicting as many as 100,000 eggs a year, and with no natural predators, they quickly started to spread throughout Australia, moving towards WA. And now they're almost here.

The aliens are deadly.

How to spot an alien.

Australia has many native frogs that are an important part of the natural environment. It's very important to correctly identify cane toads. In addition to the big yellow glands behind their eyes, here are some other signs that you've found a cane toad:

- The distinctive ridges on the back of the toad's head.
- Cane toads have very distinctive bony ridges over their eyes. These ridges aren't found in native frogs.
- Their big yellow glands behind their eyes also aren't found in native frogs.
- Cane toad feet don't have claws on the ends of the toes.
- They often hop or jump away when they're threatened. Native frogs usually sit still.

How we're fighting the invasion.

Scientists are working on a biological control to stop these aliens, but they can't do it alone. One of the best ways to stop the invasion is to work together to remove these cane toads.

The best way to get involved is to join the fight against cane toads. Contact your local council to find out how you can help. You can also leave your email address to receive updates on the latest developments.

The distinctive ridges on the back of the toad's head.

If you see a cane toad in WA, report it immediately to 1800 084 881 (free call).

If you find a kangaroo giant frog?

In the Northern Territory, the kangaroo giant frogs often visit the local zoos. Check these points to see if you've found an alien:

- Cane toads are found all over the region, while kangaroo giant frogs are found only in the Northern Territory.
- Cane toads have distinctive bony ridges over their eyes. Kangaroo giant frogs do not.
- Cane toads are found all over the region, while kangaroo giant frogs are found only in the Northern Territory.

Is an alien hiding in your car?

Cane toads are known to hitchhike on vehicles, including caravans. They can cause significant damage, and it's important to remove them before they enter your vehicle.

When you see a cane toad on your way, look it up and check your vehicle for damage.

Knowledge is our best weapon. This is a battle for the future of WA, and we need to win it. For more information, visit conservation.wa.gov.au
Community-based opportunities for learning about science

- Students’ families and friends,
- Institutions, such as museums, zoos, aquaria, etc.,
- Community and government organisations,
- Media, including TV, radio, newspapers, internet
Kimberley canal backers angry as report says bringing water from the NW is an expensive and risky venture

**Tap aquifer rather than a new desal: water chief**

**COMPARING THE COST**

<table>
<thead>
<tr>
<th></th>
<th>PIPELINE</th>
<th>CANAL</th>
<th>OCEAN TANKER</th>
<th>WATER BAG</th>
<th>DESALINATION</th>
<th>YARRAGADEE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cost of delivery ($/kL)*</td>
<td>5.1</td>
<td>6.5</td>
<td>5.0</td>
<td>5.0</td>
<td>1.5</td>
<td>0.93</td>
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<tr>
<td>Capital cost ($)</td>
<td>11.9b</td>
<td>14.5b</td>
<td>6.2b</td>
<td>5.3b</td>
<td>3b</td>
<td>398m</td>
</tr>
<tr>
<td>Energy consumption (kW an hour per kL delivered)</td>
<td>5.8</td>
<td>3.7</td>
<td>10.5</td>
<td>8.6</td>
<td>4.3</td>
<td>1.0</td>
</tr>
<tr>
<td>Greenhouse gas produced (equivalent CO2 tonnes)</td>
<td>0.6m</td>
<td>0.5m</td>
<td>Moderate</td>
<td>1.6m</td>
<td>(unavailable)</td>
<td>(unavailable)</td>
</tr>
<tr>
<td>Relative environmental impact</td>
<td>Moderate</td>
<td>High</td>
<td>Moderate</td>
<td>Moderate</td>
<td>Moderate</td>
<td>Low</td>
</tr>
</tbody>
</table>

*Based on a 200GL/year scenario for all options except Yarragadee aquifer which is based on 45GL/yr tapping capacity. Y 0.5GL bag.

**Yarragadee is sustainable and good for the South-West and WA in general,** Dr Gill said.

Dr Gill said if the EPA backed the Yarragadee option then the State's water needs to 2017 would be met.

"There will not be a need for a costly second desalination plant before that time," he said.

The Kimberley study commissioned by former premier Geoff Gallop in 2004 found the cost of bringing Kimberley water to Perth would be between five times higher than South-West solutions and would at least double the average annual household water bill from $304 to $610.

The study, headed by Professor Graham Mason, expensive and riskiest option with the worst environmental effects.

The cost of building the canal was estimated to be at least $14.5 billion, which would make the cost of water, based on production of 200 gigalitres a year, $6.5b a kilolitre compared to the current cost of about 90c/kL.

Alan Carpenter said the report ended hopes of bringing water from the Kimberley and showed there was no silver bullet for Perth's needs, only a variety of practical measures.

"It's something that people have had as a dream for a long time but we have to be realistic," the Premier said. "The numbers don't stack up."

But former Opposition leader the canal proposal put forward by engineering company Tenix.

Mr Barnett said he had not put an absolute cost on the canal. "I did say that I based my commitment on the figures produced by Tenix," he said.

"The last time I spoke to Tenix, only two or three weeks ago, they stood by their design and they stood by their $2 billion costing."

But WA spokesman for Tenix, Ron Edwards, said $2 billion had been a rough figure and the company had no firm cost because a full feasibility study had not been done.

"It's very clear to us that the panel at (committee consultant) GHĐ have never looked at the Tenix proposal.

**Hands off our supply: South-West**

GRAHAM MASON

South-West shires including Augusta-Margaret River, Nannup, Capel and Busselton have urged the Environmental Protection Authority to oppose the plan to tap the Yarragadee aquifer and pipe water to Perth.

"The preferred position for local governments in the South-West is that the aquifer be retained for regional use and the (Water) Corporation find alternative, albeit more expensive options, for water supply to the city," the councils said in a submission to the EPA.

Opposition Leader Paul Omodei said yesterday he would not support tapping Yarragadee unless regional water needs and protection of the environment could be guaranteed.

The Government is hedging its bets on water resources as the Water Corporation throws its support behind the Yarragadee aquifer.

Water Resources Minister John Kehelke said yesterday the second desalination plant, proposed for Rockingham, was being planned in case the Yarragadee plan proved to be unacceptable.

He would not say whether he preferred tapping Yarragadee or building a second desalination plant.

Environment Minister Mark McGowan also would not indicate which water solution he preferred.

He said both proposals would be formally assessed by the EPA and he would make a decision once the investigative and consultative process was complete.

Mr McGowan faces a backlash from his constituents in Rockingham who do not want the second desalination plant built in the area.

The Rockingham Council spent
Kimberley canal backers angry as report says bringing water from the NW is an expensive and risky venture

Tap aquifer rather than a new desal: water chief

From The West Australian, page 6, May 3, 2006

Hands off our supply: South-West

ROBERT TAYLOR, JESSICA STRUITT and GRAHAM MASON

The Water Corporation has stepped up pressure on the State Government to opt for the Yarragadee aquifer to solve Perth's short-term water needs instead of a second desalination plant as a government report yesterday killed off the notion of bringing water from the Kimberley.

Water Corporation chief executive Jim Gill said his highest support yet for Yarragadee, saying that the Government would not need to build a second desalination plant if it decided to take 45 gigalitres a year from the aquifer. The $387 million Yarragadee is sustainable and good for the South-West and WA in general," Dr. Gill said.

Dr. Gill said if the EPA backed the Yarragadee option then the State's water needs to 2017 would be met. "There will not be a need for a costly second desalination plant before that time," he said.

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The Rockingham Council spent...
Community-based opportunities for learning about science

- Students’ families and friends,
- Institutions, such as museums, zoos, aquaria, etc.,
- Community and government organisations,
- Media, including TV, radio, newspapers, internet,
- etc.

Students come to school informed (or misinformed) about science by their experiences in the community. Teachers need to be aware of, and respond to, students’ preconceptions.

How can we harness the potential of these community resources to engage students’ interests and promote meaningful learning?
Learning science from community resources

• Learning is a personal process that is contextualised according to where, when, how and with whom it occurs.
• Learning requires the assimilation of new experiences with previous ones to revise and reconstruct understanding.
• Therefore, using community resources
  – Increases the variety of stimuli and sources of information,
  – extends the range of physical environments, and of the social and cultural circumstances that can stimulate learning,
  – enables science knowledge to be demonstrated in the everyday world,
  – allows learning to occur in places students continue to visit after school,
  – familiar places can jog old memories to help assimilate new experiences.
If the ultimate goal of science education is scientific literacy, then school science should aim to give students a repertoire of knowledge and experiences that can be retrieved from memory to aid interpretation of new situations and provide direction for making decisions about them.
Using scientific knowledge in real-world situations: a caveat

• In the context of real world issues, individuals need to transform the information they obtain into a form that is usable to them in their own personal circumstances, that is, they must construct “knowledge for practical action”  
  (Layton, Jenkins, Macgill, & Davey, 1993)

• Students must make this same transformation. However, science issues in the real world can be complicated.
Example: the solar-powered boat project

• Academically talented Year 9 students in a Western Australian school
• Construction of a solar-powered boat in a 3-month course in science, technology and mathematics.

(From Venville, Rennie, & Wallace, 2004)
Example: the solar-powered boat project

• Academically talented Year 9 students in a Western Australian school
• Construction of a solar-powered boat in a 3-month course in science, technology and mathematics
• In science, students learned about series and parallel circuits, Ohm’s Law, \( V=RI \), \( P=VI \), \( P=W/t \) and \( W=Fs \).
• Given: electric motor 10,000rpm, 1.5 - 3V, maximum current 2,000mA
• How did students use their science knowledge in this “real-world” project?

(From Venville, Rennie, & Wallace, 2004)
<table>
<thead>
<tr>
<th>Kevin and Jin-ming</th>
<th>Sharon and Cynthia</th>
<th>Reece and Sam</th>
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<tr>
<td>Dt T Tr S O</td>
<td>Dt T Tr S O</td>
<td>Dt T Tr S O</td>
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</table>

Dt – discipline theory  
T – teacher  
Tr – trials and testing  
S – other students in same class  
O – outside students/parents
The problems

• Students appeared to understand the science concepts on paper, but found them hard to apply. “Ohm’s Law didn’t help,” said one.

• Other contextual (often unmeasurable) variables came into play making the science too complex.

• School science knowledge is decontextualised and built on abstract, perfect models.

• Students had to “repackage” their knowledge to fit an imperfect, but real, context. They had limited skills to do this.
Significant outcomes

• There was considerable learning:
  – Making, testing and constantly refining the circuit (and hull) design consumed time.
  – Students practised hands-on skills.
Significant outcomes

• There was considerable learning:
  – Making, testing and constantly refining the circuit (and hull) design consumed time.
  – Students practised hands-on skills.
  – They obtained enhanced understanding of the solar-powered boat as a system, rather than disconnected “bits”.
  – They learned something about costs and benefits in terms of the trade-offs as each decision was made.

• And the realisation that science knowledge is a starting point but decisions for practical action must be made in context.
The central issue

• “when the science curriculum does not include the difficult process of transforming abstract canonical content into content for taking action, canonical science remains unusable outside of school for most students.”

(Aikenhead, 2006, p. 30)
The central issue

• “when the science curriculum does not include the difficult process of transforming abstract canonical content into content for taking action, canonical science remains unusable outside of school for most students.” (Aikenhead, 2006, p. 30)

• Solution: Move beyond the textbook, use community resources to explore community issues, acknowledge and learn to deal with
  – the many uncontrolled variables that make science knowledge just a starting point,
  – “the science knowledge featuring in everyday contexts is characterised by uncertainty and dispute amongst scientists” (Ryder, 2001, p. 37),
  – often competing social and cultural values that provide conflicting interpretations of how to use science knowledge.
Other issues to consider

• Using community resources requires time and effort to ensure worthwhile outcomes.
• For example, organising a successful field trip involves overcoming administrative and financial hurdles at school, as well as careful pedagogical planning.
• Developing school-community partnerships brings additional challenges.
  – How can these be developed?
  – What are their successful characteristics?
Case studies based on science-related issues

1. Argentine ants, DDT, and willie wagtails
2. The *Onitis caffer*, *Sisyphus spinipes*, *Hister nomas*, *Leotongus militaris*, and *Onthophagus gazella* story
3. Air pollution problems in a mill town
4. Ecological sustainability for indigenous, venomous snakes
Case study 1: Birdwatch WA

Birds Australia Western Australia (Inc) Perth Birdwatch

Rainbow Lorikeet  Australian Ringneck  Willie Wagtail

Copyright photos courtesy of Dave Watts
Results mapped in the Perth metropolitan area after the two weeks of public observation and reporting.
Case studies based on science-related issues

1. Argentine ants, DDT, and willie wagtails
2. The *Onitis caffer*, *Sisyphus spinipes*, *Hister nomas*, *Leotongus militaris*, and *Onthophagus gazella* story
   what do they have in common?
3. Air pollution problems in a mill town
4. Ecological sustainability for indigenous, venomous snakes
Case study 2: The Dung Beetle Crusade

What is the Dung Beetle Crusade?
It's another CSIRO Double Helix Science Club national experiment. In November 1994, over 1500 people around Australia headed for cow and horse paddocks to collect dung beetles. The beetles were then identified and the information fed into a climate-matched computer program, Climex, to find areas where each dung beetle species could live but is low in numbers. Double Helix helpers then sent dung beetles from populated areas and spread them in regions with low beetle numbers.

Why do we need to spread dung beetles? By burying dung, the beetles allow pastures to grow better, remove the breeding site of flies and other pests and fertilise the soil by recycling nutrients. The Dung Beetle Crusade is supported by the CSIRO Division of Entomology and the WA Department of Agriculture.

CSIRO's Double Helix Science Club
If you'd like to do other experiments, go on excursions, get The Helix magazine and be involved in lots of science activities, write to CSIRO's Double Helix Club, PO Box 225, DICKSON ACT 2602

(Thanks to Ross Kingsland)
Case studies based on science-related issues

1. Argentine ants, DDT, and willie wagtails
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3. Air pollution problems in a mill town
4. Ecological sustainability for indigenous, venomous snakes
Case study 3: Air watch project

• The Australian Department of Education, Science and Training (DEST) funded the Australian Science Teachers Association (ASTA) for a national pilot project whereby schools worked with their local community on a science awareness-raising project.

• One project was based in a mill town (5,000-6,000 people) situated on a river. A recurring problem is poor air quality with smoke haze, particularly in winter.

• Year 9 academic extension class implemented a project to
  – raise community awareness and understanding of the problem
  – erect some air monitoring equipment in the town as a tangible outcome of the project
  – set up a website for on-line meteorological information.
Hello and welcome to the New Norfolk High School air quality awareness web page. This page was set up by the hard working students of the grade 9/10 science extended class.

The completed mural on the Banjos wall in Burnett street

One of two signs made by L3 science extended. This one is situated on the Lyell Highway heading to Hobart.
Wood Smoke

In winter the air is being more polluted than any other time of year due to the fact it is colder and people are using their wood fires more.

The local councils are trying to spread information around the community about their effects on the wood smoke in the community.

During winter wood smoke is said to make up to three times as much pollution as cars.

There are many ways to improve wood smoke, here are some ways to show you how it can be improved.

Changing your heater for something else such as electric heating like a heat pump that is also environmentally friendly.

This like all pollution as we know is bad for us because this pollution has bad gasses in it such as carbon monoxide. There are also a few different organic compounds that are also toxic. Not only that but there also fine particles that are bad for us because they travel and go deep into our lungs. These particles are tiny some are even smaller than 2.5 microns.

Heritage wood heaters are said to be one of the most powerful sorts of wood heaters in Australia. People like them because they come in fan forced, radiant, and convection heaters. The prices of these heaters range from around 300 dollars up to about 1500 dollars.
Survey

The students at New Norfolk High School prepared a survey which was circulated in the local community newspaper, "The Gazette".

You can find the survey questions here.

The following is a summary of the survey results. You can find the raw data here.

- 56.8% of New Norfolk citizens have a wood heater.
- 90% of those people think they pay a fair price for their wood.
- 36.6% of those people have thought about changing their heating sources.

Of those who do not use a wood heater, 54.4% use a gas heater, 73.8% use electric heating, and 10.0% use other sources of heating. These figures add to over 100% due to people ticking ‘yes’ to more than one heating option.

- At least 22.3% of people burn rubbish in their backyard.
- About 4.3% of people in New Norfolk burn things they are not supposed to.
- About 88% of people in New Norfolk have at some stage have thought about the air quality around New Norfolk.

When asked to rate the air quality in New Norfolk the following results were obtained (with 1 being the dirtiest and 10 being the cleanest).
Data collected from New Norfolk Air Watch Station.
The (foreign-owned) mill was not easy to blame: it was the town’s major employer of their parents, the sponsor for the local football team, and donated the expensive air-monitoring equipment!

Culprit was not the mill but domestic wood-burners.

Community participation very high, At a town meeting, they petitioned for a buy-back scheme.

Lessons dealt with some science issues (combustion, smoke haze settling in valleys, etc) but the relevance of this content was given by the context of the project.

Students had first-hand experience with risks, benefits, trade-offs, social interactions between various community members and groups.
Case studies based on science-related issues

1. Argentine ants, DDT, and willie wagtails
2. The *Onitis caffer*, *Sisyphus spinipes*, *Hister nomas*, *Leotongus militaris*, and *Onthophagus gazella* story
3. Air pollution problems in a mill town
4. Ecological sustainability for indigenous, venomous snakes
Case study 4: Living with tiger snakes

- During 2004-2005, ASTA, with funding from DEST, established 24 School Community Industry partnership in science (SClps) projects throughout Australia.
- The underlying purpose was to raise science awareness in the school and community.
- One project in Western Australia was “Living with Tiger Snakes” based at an urban Wildlife Centre, with Years 4-7 children from a nearby school.
- The aim was to educate students and the community about the ecological importance of tiger snakes around the lake environs, and reduce the unnecessary slaughter of them.
LIVING WITH TIGER SNAKES

MAY 2005
MASA JAMIE BODI NICK
Introduction

For the last couple of months we have been learning about tiger snakes.
We learned about their habitat and snake safety, and what to do when bitten by a snake.
Snake Survey

We went for an early morning walk looking for tiger snakes.

Unfortunately nobody saw a tiger snake except a few people, like Bodi and Masa in our group.
We investigated what creatures live in the lake water. We found a frog. Tiger snakes eat frogs.
We have also learnt that if snakes are attacked they are defensive. They are only trying to protect themselves.

We need to act in a safe way.
We did a survey of attitudes toward snakes and made lots of different kinds of information packs to inform the public about tiger snakes:

- Role plays
- Safety posters
- Food pyramid
- Diorama
- Cartoons
- Outdoor signs
- Model of snake habitat
- PPT presentations
METHOD

1. First we talked about what KIND of questions we would put in the survey. We finished up with 8 questions in total.
2. Then the survey was typed up on computer and 200 copies printed for us to use.
3. Each student had to ask 5 people the 8 questions; then add up the results from their 5 surveys.
4. Students then got into groups of 5 and made Group totals of their results. Group totals were added to make Class totals and finally Class totals were added to make the Upper Primary totals for all the survey questions.
5. Our team then calculated percentages, made graphs of the results and worked out the findings from the survey.

How to make a frog smoothie!

mmmm…
Q. 1. a) How would you react if you saw a snake?

Most people (56%) said they would be scared if they saw a snake. About a third of the people (31%) would react positively. The ‘other’ attitude category was confusing.
Different groups of students created and performed role plays about what to do if you were bitten by a snake.
We made safety posters about snake safety to inform the community how to keep safe and what to do if they are bitten.
We learnt a lot about tiger snakes. The community survey found that there was a need for public education about tiger snakes. Our project will contribute to this education.
Now we know that *tiger snakes* are not aggressive, they are only defensive. We also now know how to keep a snake friendly garden.
Living with tiger snakes – outcomes

• Increased understanding of significance of tiger snakes and their life habits
  – science learning outcomes (especially Life and Living strand)
  – cross curricular engagement (everything except LOTE)
  – values integration
  – community involvement

• Lessons learnt for teachers and wildlife centre staff
  – work inequality
  – sharing activities between two venues
  – primary versus secondary pedagogy
  – money for effort – need for a balance

• The value of learning by experience
Characteristics of successful projects:

- are based on some **issue/stimulus which comes from the community** and is not imposed.
- require **local knowledge** to ensure input of community members.
- are **educative**, because they
  - focus on science as a way of knowing, thinking and acting, and
  - model science inquiry (working scientifically).
- are **integrated into science at school** and so legitimise participation by students and teachers.
- **involve negotiation and decision-making with the community** in regard to
  - social, political and economic factors,
  - differing perspectives from different groups, and
  - information collected (both local and science-related).
- have a **tangible outcome** to indicate when the project is complete and has achieved something worthwhile.
Characteristics of successful projects:

- are based on some **issue/stimulus which comes from the community and is not imposed.**
- require **local knowledge** to ensure input of community members.
- are **educative**, because they
  - focus on science as a way of knowing, thinking and acting, and
  - model science inquiry (working scientifically).
- are **integrated into science at school** and so legitimise participation by students and teachers.
- **involve negotiation and decision-making with the community** in regard to
  - social, political and economic factors,
  - differing perspectives from different groups, and
  - information collected (both local and science-related).
- have a **tangible outcome** to indicate when the project is complete and has achieved something worthwhile.
- **And in addition** – some funding which can go a looooonnnnggg way
Pedagogical characteristics

Successful projects are built into, not added on to, the school science curriculum.

Three simple rules about using community resources successfully might be:

- **Integration.** Experiences with community resources are integral, not peripheral, to science at school.
- **Preparation.** Teachers and students understand what the tasks and expected outcomes are and what needs to be done to achieve them.
- **Accountability.** Teachers and students are jointly responsible for ensuring task completion.
How do these projects contribute to scientific literacy?

<table>
<thead>
<tr>
<th>Scientifically Literate People</th>
<th>Underlying Skills and Abilities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Are interested in and understand the world around them</td>
<td>Apply science knowledge and skills in daily life Seek information to explain new phenomena or solve problems</td>
</tr>
<tr>
<td>Engage in the discourses of and about science</td>
<td>Feel comfortable to listen to, and to read, write and talk about science in everyday situations</td>
</tr>
<tr>
<td>Scientifically Literate People</td>
<td>Underlying Skills and Abilities</td>
</tr>
<tr>
<td>-------------------------------</td>
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</tr>
</tbody>
</table>
| Are able to identify questions, investigate, and draw evidence-based conclusions | Think through issues and identify, obtain and use needed information  
Understand the meaning of “fair test”  
Make and defend an argument |
| Are skeptical and questioning of claims made by others about scientific matters | Distinguish between fact and opinion  
Assess quality of evidence |
| Make informed decisions about the environment and their own health and well-being | Recognise and cope with risk and uncertainty in decision making  
Choose to act responsibly and ethically |
Making the community’s contribution count

- We aim for “learning that is self-motivated, voluntary, guided by the learner’s needs and interests, learning that is engaged in throughout [the learner’s] life”.
  (Dierking, Falk, Rennie, Anderson, & Ellenbogen, 2003, p. 109)

- Involving community resources promotes opportunities for learning science that students perceive as relevant and worthwhile, so that learning is meaningful and lasting.

- By using experiences in the community to help students develop and practise the skills and abilities that contribute to scientific literacy, we will make the community’s contribution count.
<table>
<thead>
<tr>
<th>Dimension</th>
<th>Scientifically Literate Persons</th>
<th>Technologically Literate Persons</th>
</tr>
</thead>
<tbody>
<tr>
<td>Knowledge</td>
<td>Interested in and understand the world around them</td>
<td>Understand the designed world, artefacts, systems, infrastructure</td>
</tr>
<tr>
<td>Capability</td>
<td>Engage in communication of and about science</td>
<td>Have practical hands-on skills and fix simple technical problems</td>
</tr>
<tr>
<td></td>
<td>Identify questions, investigate and draw evidence-based conclusions</td>
<td>Identify practical problems, design and test solutions</td>
</tr>
<tr>
<td>Ways of thinking and acting</td>
<td>Are sceptical and questioning of claims made by others</td>
<td>Recognise risks, weighs costs and benefits</td>
</tr>
<tr>
<td></td>
<td>Make informed decisions about the environment and their own health and well-being</td>
<td>Evaluate, select and safely use products, and contribute to decision-making about the development and use of technology (From Rennie, 2003)</td>
</tr>
</tbody>
</table>