
**This is the published version.**

©2015, Cambridge University Press

Reproduced by Deakin University with the kind permission of the copyright owner.


**Available from Deakin Research Online:**

http://hdl.handle.net/10536/DRO/DU:30074754
CHAPTER 5

Approaches to enhance science learning

Coral Campbell and Kate Chealuck

OBJECTIVES

At the end of this chapter you will be able to:

• recognise a range of formal and informal approaches that enhance children's science learning
• demonstrate the need to scaffold children's explorations and how this can be achieved
• use effective questioning for focusing and enhancing children's science learning
• describe ways that educators can enhance science learning through targeted exploration
• recognise the science skills, processes and knowledge that can be acquired by young children.

Overview

This chapter links theory with practice by discussing the range of approaches that can be used with young children to enhance their learning. It discusses the interactivity of approaches that educators use with children and settings. Whether it is through the processes of science, such as the development of observation, or through the skilful questioning of the educator, the approach used should enhance children’s learning.

Considering the range of learning theories presented in Chapter 4, how does an educator make sense of the multitude of theoretical perspectives available and
translate these into a practice that aids children's learning? One way is to consider the strong messages coming from all theories: children construct their own understanding, learning is enhanced through social interaction and the educator is pivotal to children’s learning.

The importance of prior knowledge

Working with the belief that children construct their own knowledge, we need to consider what else the constructivist theory is alerting us to with regard to children’s learning. One idea is that children build their learning on previous experiences. For an educator to enhance learning, knowledge of children’s previous experiences and understandings is required to make appropriate links. Thus, the most important factor influencing learning is what the learner already knows. Ascertain this and teach the child accordingly (Ausubel, 1968).

The acceptance of constructivist theory has led to a number of approaches that are used to enhance children’s learning or understanding in science. Because children construct meaning from experience, the educator needs to expand their experiential base, not only to introduce new experiences but also to build on children’s prior experiences. The educator should initially determine what children already know before attempting to provide new experiences. In that way the new experience will be linked with children’s previous schemas (mental representations), creating a new schema and a more complex or sophisticated understanding.

The debate: Child-instigated versus teacher-instigated activities

There is a general belief that children’s explorations should be child-instigated. However, a vast number of explorations would not be attempted if everything were left to children. In particular, some children (like some adults) work within their level of comfort and rarely challenge themselves. The natural breadth of young children’s experience is limited, and exposure to new things is always of interest to their enquiring minds. Thus, an effective early childhood educator should aim to expand children’s experiences by introducing activities that would normally be outside children’s scope of understanding and ability.

Approaches to enhancing children’s science learning

Intentional teaching

Current research supports the idea that educators should be purposeful and thoughtful in the way they provide experiences to children and interact with them (DEEWR, 2009; Epstein, 2007). The term ‘intentional teaching’ has been used to
describe the deliberate decisions and actions of an educator in the way they approach children’s learning. However, intentional teaching is not a ‘formal’ teaching approach and is not intended to mimic a school structured approach: rather, it is recognised as educators enhancing children’s learning through play in a purposeful way. Houghton (2013) identified that educators ‘need to be intentional in fostering children’s skills to discover and explore what they can do themselves’ (p. 10). In science, as in any other learning within the pre-school, intentional teaching is characterised by ‘educators taking the lead in deliberately and purposefully initiating and selecting a specific aspect of learning to focus on’ (Margetts & Raban, 2011, p. 55).

For an educator, it is important to recognise the science in regular activities such as making play dough, exploring small animals in the garden, floating and sinking play, gardening and many other child-instigated explorations. Intentional teaching may be demonstrated when the educator reads a story (for example, The Very Hungry Caterpillar) in response to a child’s investigation of caterpillars in the garden. It may be as simple as asking a child a question while they are observing the caterpillar’s movements in the garden.

Science for all ages

Educators frequently ask how they can ‘teach’ science to a baby. Rather than thinking of science in this restricted ‘curriculum’ way, educators should think about science as developing an understanding of the world. Babies need exposure to new experiences, new materials and the opportunities to explore new ideas. This exposure provides them with the basis for constructing meaning. Thus, an educator should be looking for ways to enrich the learning opportunities for babies to investigate new materials or phenomena using a range of their senses.

With toddlers, there are greater opportunities to expose children to new experiences and introduce them to phenomena that may not exist in their home environments. Children need to be able to follow their own investigations, while being scaffolded by educators to achieve success.

CASE STUDY 5.1

TO BOUNCE OR NOT!

Lincoln (18 months old) is obsessed with balls! At the moment his favourite game is to fill a plastic tub with a variety of balls – a basketball, netball, soccer ball, tennis ball, ‘bouncy’ balls and some soft, spongy balls. He drags the tub to the dining room table where he proceeds to throw each ball onto the table and watch what happens. ‘Uh oh!’, he exclaims as the big round, hard balls roll off the table and the small ‘bouncy’ balls bounce off the edge. He looks perplexed when the soft spongy balls don’t roll but stay on the tabletop where they land, and lifts his hands in an ‘I don’t know’ gesture. Lincoln is experiencing how the material from which the ball is made affects how the ball bounces: the hard balls bounce while the soft balls don’t.
REFLECTION

- How could Lincoln’s mother extend this science learning?
- What other everyday types of materials could children under 2 years of age explore?

CASE STUDY 5.2

LAUNDRY BASKET RIDES

Four-year-old Mason happily pushes his little brother around the house in a plastic laundry basket. On the tiles, the basket slides around the corners and moves easily, causing both boys to laugh and whoop. As soon as Mason tries to push the basket over the carpet, however, it slows to stopping. ‘It’s not working now,’ he complains. ‘It’s very hard! I need some help.’ Mum helps Mason pull the basket (still with his brother in it) back onto the tiles. ‘I don’t need you now!’ he shouts as he again picks up the pace and slides his little brother in the basket around easily. Mason is learning that the surface of the floor makes a large difference to the amount of effort he has to exert to move the basket and his brother.

REFLECTION

- How could the mother enhance this experience further while still keeping in the spirit of play and without interfering?
- Is there another play activity that could help reinforce the learning related to friction?

Formal and informal approaches to enhancing children’s learning

As discussed in Chapter 4, children’s understandings are often different or naïve in science. Thus, the educator should challenge those understandings by introducing discrepant experiences that encourage children to re-think their understanding. Further, educators should provide rich and varied experiences and promote, through discussion or questioning, more appropriate understanding of the scientific concepts.

Knowledge of the constructivist theory has led to the development of a number of ‘teaching’ approaches that foster learning in science (and other areas).
Despite variations, the salient points include probing children to determine prior understanding; using effective questions to highlight children’s thinking; and scaffolding children’s learning through dialogue, activities and focused discussion.

In helping children to construct their own knowledge, educators may facilitate children’s science experiences through a range of more formally recognised approaches. These include the process skills approach, guided discovery approach, interactive approach, inquiry learning approach, problem-based learning approach and project approach. Each of these is described below.

**Process skills approach**

In the process skills approach, the educator assists children to develop science skills. In essence, while building science knowledge, we also want children to develop the skills and processes to be able to confidently undertake their own investigations. In the process skills approach the educator focuses on a particular scientific skill, such as observing or communicating, or some combination of process skills. Process skills in the early years include observing, communicating, comparing, classifying, measuring and using tools, predicting and inferring. A summary of these process skills is presented in Table 5.1. Generic skills, such as collaborating, counting, estimating, generalising, recording and problem-solving, are also important to consider in the teaching and learning of science (Beaumont, 2010).

In assisting children to learn the skills of science, the educator is emphasising the nature of science and how scientists work. However, this is only one small part of learning in science and should always be complemented with other approaches.

**Table 5.1: Summary of the science process skills appropriate to the early years**

<table>
<thead>
<tr>
<th>Process Skills</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Observing</td>
<td>Using the senses to gain information. This is an extremely important skill that educators can enhance in young children. Close and accurate observation is crucial in following through with an investigation.</td>
</tr>
<tr>
<td>Communicating</td>
<td>Describing an object or event in simple terms, through oral, written, pictorial or graphic modes.</td>
</tr>
<tr>
<td>Comparing</td>
<td>Looking for similarities and differences between objects and events.</td>
</tr>
<tr>
<td>Classifying</td>
<td>Grouping objects into two or more meaningful categories based on one property. This also involves sorting, matching, grouping and naming colours and objects.</td>
</tr>
<tr>
<td>Measuring and using appropriate tools</td>
<td>Selecting appropriate tools for measuring a range of objects.</td>
</tr>
<tr>
<td>Predicting</td>
<td>Beginning to predict the possible outcomes of actions and events based on prior knowledge.</td>
</tr>
<tr>
<td>Inferring</td>
<td>Beginning to suggest reasonable explanations based on observations.</td>
</tr>
</tbody>
</table>
Guided discovery approach

Originally, the guided discovery approach was adopted by pre-school centres (and primary schools) as the most natural way for a child to investigate things of interest. Children attempt to make sense of their world through their own play explorations and, if a constructivist approach to learning is accepted, children build their own understandings from their own experiences. However, children are limited in how far the discovery can aid understanding. Interaction with peers and adults provides additional stimulus to extend understanding further. Eshach (2006) commented that ‘assuming children are able to understand complex concepts and are able, to some extent, to connect theory and evidence, educators should, in our view, expose children to situations in which those abilities may find fertile ground to grow’ (p. 17). Being a co-investigator with the child or asking effective questions that encourage further explorations provides children with the opportunity to extend their own investigations while they experience the science of their own world.

In undertaking their own investigation, or even through everyday play, children are often exposed to science experiences. This is termed 'incidental science' or part of an emergent curriculum; that is, curriculum arising from children’s own investigations (Dockett & Fleer, 2002, p. 199). Without further scaffolding at the point and time of interest, the opportunity to enhance children's learning may be missed. For this reason, it is crucial that early childhood educators have a basic understanding of science in the world. Educators who are attuned may recognise the science in spontaneous events and can make use of these to develop deeper understandings in children. In light of the literature on emergent curriculum suggesting that educators need to respond to the children's questions and learning needs 'on the spot', it is evident that some early childhood educators would not be prepared if their own background knowledge of science is insufficient (Campbell & Jobling, 2009). Dockett and Fleer (2002) described the role of adults as 'one of focussed observation and responding to the play that occurs in ways that extend and enhance learning' (p. 198).

Interactive approach and inquiry learning approach

The interactive approach to learning recognises that children have legitimate questions of their own to which they would like to find answers. In this approach, the children's questions lead the explorations and the educator's role is to provide resources and guide/scaffold the explorations. The educator supports the development of the children's ideas, asks focused questions, suggests alternative ways of thinking and helps develop children's responses. The extent of support offered by the educator is dependent upon the complexity of the investigation, the age of the children, and the available resources, which may include educator knowledge. The interactive approach relies strongly on the ability of the educator to be flexible, to be able to help children with knowledge or where to locate it, and to be able to take a 'helper' position with regard to children's learning.

The inquiry learning approach is the most current approach to science education and relates to children undertaking investigations to answer their own questions.
Chapter 5: Approaches to enhance science learning

It is said to follow a number of phases: engagement, exploration, explanation, elaboration and evaluation. With very young children, the engagement phase arises from the children’s own interest in a particular item or phenomenon. For scaffolded learning, the educator can use this engagement phase to determine the child’s prior understandings. The exploration phase is one that comes most naturally to children; however, as early childhood educators we can also introduce children to other explorations (or educator-instigated experiences) through providing additional materials and further scaffolding of the exploration. Through a guided exploration – encouraging children to ask their own questions, focusing their observations or asking specific questions – early childhood educators can help children develop their own scientifically enhanced explanations. By undertaking a range of activities, children can be extended to transfer their new knowledge to different contexts (elaboration). Finally, again through scaffolding, children can be encouraged to share their understandings with others and present their learning through discussion, role play, drawings or other communication mechanisms. While these may seem to be higher-order processes, we should never underestimate the capabilities of young children. With appropriate help, young children are highly capable of following through on an inquiry approach, particularly in the 5–8-years age group.

**Problem-based learning approach**

In problem-based learning, the educator provides a problem to children, usually in small groups, and gives them time to try to solve it. It is a child-centred approach. With young children, the educator works with the group to help find out facts, generate ideas and assist the learning. Children may challenge each other’s ideas and the educator helps to resolve issues. The process continues as new information is added to existing facts and more thinking occurs. Solving the problem is not the most important aspect; rather, it is the learning process through child-directed inquiry that is most important. Effective problems are those that engage children’s interest and motivate them to probe for deeper understanding of science concepts. Educators take a small role during problem-based learning – they stimulate learning by asking effective questions and offering support. With more practice, children become better able to direct their own learning and identify what they need to find out to solve their problem.

There are usually five steps in a problem-based approach:

1. The problem is presented to the group by the educator, who may use stimulus pictures to help children remember what to focus on.
2. Children talk about what they already know.
3. Children brainstorm their ideas and identify the broad problem.
4. Children identify what else they need to learn in order to prove or disprove their ideas.
5. Children share their findings with others.

Educators can generate ideas for problem-based learning from a wide range of resources: stories, television, children’s games, or news articles. Problem-based learning can enrich children’s normal learning experiences by providing them
with challenge and stimulation not normally available in their learning setting. The problem-based learning situation should align with the educator’s desired learning outcomes or with the existing theme in the early childhood setting.

**Project approach**

In the project approach, children are involved collaboratively in a particular project that requires problem-solving around a specific need. The project might be something as simple as children devising a means of reminding themselves to wash their hands after using the toilet. It could be that they are building a cubby house from materials they find outside. In attempting to solve a problem that is directly related to their own lives, children become active participants in their own learning and the generators of ideas to move the project forward. A typical science-related project involves children investigating some science ideas as part of the completion of the project. For example, children who are constructing temporary homes for small animals from the garden will need to investigate what the animal’s normal habitat looks like and what food is required. Project-based learning promotes critical and higher-order thinking, along with analytical and creative thinking. In the Australian Curriculum, project-based learning is linked with ‘Design and Creative Technology’, a preliminary process to later years engineering.

**Strategies for enhancing science learning**

Strategies for enhancing science learning are varied and in most instances can be applied across all of the informal and formal approaches to learning. Remembering that early childhood educators generally follow a play-based learning philosophy, some of the strategies accepted in early primary school are not necessarily applicable in an early childhood centre. Strategies that could be used include, but are not limited to, the following:

- direct instruction – instructing children in how to carry out a science exploration or experience
- demonstrations – showing children a science phenomenon that may be too difficult (or dangerous) for them to undertake
- questioning – see below for detail on questioning
- interactive – any strategy where children are actively contributing, such as brain-storming, co-learning, cooperative play, peer discussion, role plays, conferencing, or using children’s questions
- indirect instruction – scaffolding, inquiring, problem-solving
- autonomous or child-directed – project-based, play, exploration tables
- experiential – hands-on activities, exploration tables, construction or model building.

Information related to targeted exploration, children talking and children exploring is presented below as additional strategies for enhancing science learning.
Targeted exploration

Children explore the world around them at all times, trying to make sense of their own experiences. When we become aware of children's interest in a particular science area, it might be the time for a targeted exploration. Educators should know what children can achieve by themselves, and what might be realistic in terms of broadening their range of experiences and opportunities. A topic might be introduced in response to children's questions or through a related story or event. For example, when there is any major environmental disaster captured on the national news, children want to know more. The educator may be able to set up a tornado in a plastic bottle to show the movement of tornadoes, or show how clouds are formed in bottles. Simple activities or demonstrations in which children participate can provide additional experiences from which they build their understandings.

We have mentioned that children need scaffolding to be able to shift their initial naive beliefs to more scientifically appropriate ideas. Asking questions is one way to focus children's observations and open their eyes and minds to further possibilities. For example, a child may be watching a snail move and comment on how slow it is. A simple, focused observation would be to ask the child to see whether the snail moves faster over other surfaces. Another example occurs when a child comments on how soap bubbles move through the air; the teacher can ask whether the bubbles have different shapes.

Children talking

Recent research has indicated the power and value of children's talk with adults and peers (Eshach, 2006; Sfard, 2000). It is during these discussions or share-time that children may adjust their thinking or the talk process may help children clarify their own ideas. Such discussions may reveal to children that often there can be more than one idea or answer. It lets children know that it is alright to have a different response. In shared talking, children contribute to the discussion and extend their own thinking when challenged with alternative ideas. However, when engaging children in talk, an adult should allow time for children to 'gather' their thoughts and put these into words. Sometimes children have never had to order their thoughts in such a way as to make them understandable to others. Patience is required.

Group discussions add another dimension. Not all children will feel comfortable contributing in a group situation, but it can be an opportunity to introduce new vocabulary and draw out the more timid children by having them repeat the new words. This will provide them with a successful interchange and make the next discussion less fearful. The quantity and quality of adult-child shared talking supports children's learning and appears to be directly related to improved cognitive outcomes for children. As indicated by Koralek and Colker (2003), talking with children about what they were doing not only 'involved the children in a conversation, but also offered them the relevant vocabulary and modelled ways of thinking about and talking about their experiences' (p. 6).
Children exploring

From the first moment they enter the world, children start to explore. You can see it when a child learns to move a hand or arm deliberately. Each movement is practised over and over, and each time there is wonder in the child’s eyes at the discovery they have made. Dropping items onto the floor from a height is an investigation that produces several observations – the object often leaves the sight of the child, a sound follows the dropping, the object can re-appear. Slightly older children discover that they can ‘hide’ and re-appear, thereby establishing a constancy about the people and the objects in the immediate environment.

When children explore, they are usually following their own interests or those of their peer group. They use all five of their senses (sight, sound, touch, taste and smell) to work out what it is they have encountered. Their curiosity encourages investigation to solve problems or to make connections between what is known and what is unknown. Through their explorations, children play with objects, materials and ideas to extend or develop new understandings.

As children explore, they ask questions for further exploration or to seek ideas from others (peer group or adult). An educator can assist this through scaffolding and providing additional resources and experiences. As the educator observes children’s explorations, the use of shared conversations and focused questions can provide a direction or alternative direction for children’s inquiry.

Children require sustained periods of time for their explorations and their investigations. They require time to think about what they have seen or experienced. They also require time to try it all again and to solve any problems that may arise. Opportunities should be provided for children to involve others in their explorations or to work alone, with minimal interference. Scaffolding should never be deemed to be interference if undertaken professionally with consideration for children’s cognitive development.

Probing for understanding

There are several ways in which an educator can elicit children’s prior and current understandings, such as questioning, using children’s drawings and annotated drawings, using the ‘interview about instances’ strategy and using puppets.
Effective questioning as part of the scaffolding practice

There are many recognised ways to provide support for children undertaking their own investigation. Effective questioning – asking the right question at the right time – is a skill that is not all that well developed in many educators. It takes practice to ask an open-ended question that requires children to think along a particular path. Using questions effectively can draw children’s attention to a particular focus, or open up their mind to other possibilities. Simplistically, the question stems ‘Who?’, ‘Why?’, ‘How?’, ‘If?’, ‘Where?’, ‘What if?’ and ‘What do you think?’, linked to a science idea, can provide the stimulus for conversations, further investigations or deeper thinking. Questions that promote hypothetical, tentative and exploratory talk are productive, open-ended and usually centred on children in some way (Department of Education and Training, 2003).

There are many ways to use effective questions in early years settings. The following list is adapted from a publication issued by the Victorian Department of Education and Training (2003). It states that questions may be used to do the following:

- Prompt an exploration: this is particularly strong if the question was generated by the children.
- Stimulate a prediction before children undertake an activity or exploration: ‘What do you think will happen?’
- Find out what children know: ‘Why do you think the bubble floated?’
- Promote reasoning: ‘Why does the snail have those long stalks on its head?’
- Encourage children’s investigation and discussion; ask:
  - attention-focusing questions: ‘Have you noticed ... ?’
  - measuring and counting questions: ‘How many ... ?’; ‘How long ... ?’
  - comparison questions: ‘How are these different or the same?’
  - action questions: ‘What happens when ... ?’
  - problem-posing questions: ‘How can you make ... ?’; ‘Can you find a way to ... ?’
- Explore the children’s ideas and in doing so encourage them to reveal their alternative conceptions and why these are held. For example:
  - ‘What do you think ... ?’
  - ‘What can you see ... ?’
- Promote thinking and action. Your questions might focus on finding out the children’s ideas (prior knowledge) or on helping them to develop their ideas. A person-centred and specific question may help with the former: for example, ‘How do you think the sound of the siren travels from over there to your ear?’
- Develop processing skills. Such questions may be categorised as:
  - observing: ‘What do you see ... ?’
  - hypothesising: ‘Why do you think that happened?’
  - predicting: ‘What do you think will happen if ... ?’
  - investigating: ‘What would you want to do to find out?’
  - interpreting and drawing conclusions: ‘What did you find out?’
  - communicating: ‘How can you show this to others so they can understand?’ or ‘What else will you need to use (materials)’
CASE STUDY 5.3

THE GIRAFFE'S LONG NECK

A group of 4-year-old children was working with a collection of small plastic wild animals, not really involved with the other class activities that had been set up to investigate human and animal bodies. The educator moved across to the group as one child was pretending that her animal was eating. As an introduction into the play scenario, the educator asked the child what the animal was eating and the child responded. She then asked the other children one purpose of a giraffe’s long neck and they were quick to realise that it was connected with gaining access to food. She continued her focusing, asking them how many neck bones the giraffe had when compared with the dog. Again the children were gleeful as they indicated that a dog’s neck was much shorter than a giraffe’s and had fewer bones because it didn’t need to reach up to grab leaves in high places. At this point, the educator left the children to continue their play.

REFLECTION

• In terms of intentional teaching, what did the educator hope the children would learn from the questions she posed?
• Think of a range of other questions that could be asked to the children in this class.

Children’s drawings and annotated drawings

Ainsworth, Prain and Tytler (2011) suggested five reasons why drawing should be encouraged in science education: to enhance engagement, to learn to represent in science, to reason in science, as a learning strategy and to communicate. Drawings provide an accessible way for children to express their ideas about a science phenomenon. Annotated drawings include words, stated by the child but generally written by the educator, that explain what is happening in the drawing. Annotated drawings provide children with the opportunity to include more detail than is possible in a simple drawing, while also compensating...
for young children’s limited graphic skills in their drawing (Naylor, Keogh & Goldsworthy, 2004).

Children tend to draw what they understand. By asking children to describe their artwork, their prior understandings can become clearer. The educator can ask children to describe what is happening in the artwork, and may focus on one aspect of it.

**Interview about instances**

This is a simple technique that relies on an educator presenting a picture or artefact to a child and asking a number of focused questions to draw out the child’s understandings (White & Gunstone, 1992). It is a non-threatening way to determine quite specific information about a child’s conceptual understanding of a particular science theme or phenomenon. To encourage answers that relate to the concepts being probed, an educator should do the following:

- Begin with a focus question that requires application of the concept to be investigated, without forcing the child into an explicit definition. This indirect approach is usually quite productive because it allows the child to discuss their understanding. It can also help the instructor to gain an idea of how the child might apply the implicit concept.
- Not force the child into a specific response to each artefact. If the child does not have an understanding of the concept that allows them to talk about a specific instance, do not force the child to choose. This lack of understanding is an important piece of the child’s ‘conceptual framework’.
- Allow ‘wait time’ of at least three to five seconds to give the child time to interpret the question.

In addition, an educator can conduct one or more of the following:

- Prediction interview – children are asked to predict a possible outcome of a situation. This type of interview indicates whether a child can apply their own meaning to the situation.
- Sorting interviews – children are presented with pictures and asked to sort them according to a particular instruction. As the child sorts, they are asked to talk about what they are doing.
- Problem-solving interviews – similar to the sorting interview, the child is presented with a problem and with the physical means to solve the problem. They are asked to think aloud while attempting to solve the problem. Understanding the child’s conceptual framework remains the overarching goal in conducting the interview.

**Using puppets to determine children’s prior knowledge in science**

One way of determining children’s prior understandings in science is to use puppetry to question them about certain aspects. Children love playing with
CASE STUDY 5.4

EXPLORING FLOATING

The educator was working with a small group of 6-year-old children and had them sitting on the floor in a circle. In the centre of the floor was a large clear container filled with water and next to the container were about 10 items of various materials. The teacher wanted the children to explore what floated and what sank, but also wanted to engage them with the idea that the material that an object is made of, and possibly its shape, can affect its ability to float. Her prior experience with children made her aware that young children often believe that light things float while heavy things sink (two alternative concepts). She started off with a general discussion to tune them into the activity and to gain an understanding of their ideas of floating. One child answered ‘When things are on the top of the water’ and the others chorused their agreement. Another child added: ‘When they go to the bottom, they have sanked.’

Each child was then selected to trial an object by placing it in the water. Before this, children had to predict what they thought would happen to the item – float or sink? This raised many interesting comments from the children and provided the educator with some ideas of their prior learning. As they moved through the objects, the educator drew children’s attention to the material the object was made of. However, they still persisted with the belief that light things float and heavy things sink. Some also expressed the belief that small things float and big things sink. To challenge the children’s understandings, the educator introduced two pieces of wood – a match and a stick. The children thought the stick would sink because it was heavy, but that the match would float because it was light. When both floated, they were astounded. The educator discussed the material of the items, until one child commented that they were both wood. She repeated the activity with two pieces of metal – a paper clip and a metal toy. This time, the children were not as confident in predicting that the small item would float and the large one would sink. When both sank, the educator again asked the children what material the objects were made of. When they determined that they were metal, the children started to realise that what the object was made of could determine whether it floated. At that point the educator left the children to finish off their own further explorations.

REFLECTION

- What questions did the educator ask? List them.
- This is an educator-directed activity to determine children’s prior knowledge. What follow-up activity could be provided that would allow further development of children’s understandings of floating and sinking?
The ‘Puppets Project’ (<www.puppetsproject.com>) used puppets to assist 4–8-year-old children in learning science. Results from this research found that nearly all of the children were highly engaged and motivated when puppets were used. Children listened more, became more involved in the discussion and were more engaged in conversation with puppets. Many children who did not normally speak became more willing to share their ideas with the puppets. The children were found to give fuller explanations of their understandings so that the puppet would understand better. Children’s science talk was also found to involve more reasoning and children talked more readily about scientific problems with the puppets. Higher-order thinking skills (such as explanation and justification) were promoted and improved. This allowed educators to observe and document a range of science skills that may be difficult to see in other science explorations.

Like any resource, puppets should not be over-used. However, research has indicated that children react positively to puppets and, apart from their other uses at pre-school for imaginative play, they can be used to expand and enhance children’s understandings in many areas of science as well as provide an educator with many opportunities to document science learning.

### PRACTICAL TASK

#### USING PUPPETS FOR SCIENCE

Here are some tips for using a puppet in a science lesson:

- Think about a character when you are using the puppet. It should suit your personality and teaching style.
- Introduce your puppet to the children.
- Show a range of emotions and give the puppet a life outside the lesson (avoid stereotyping).
- Ensure the puppet has eye contact with individual children as it speaks to them.
- Avoid having the puppet make lengthy speeches.
• Discuss with children some ground rules (not too many) so that everyone has the opportunity to talk. Remember that most of us can, at times, have overlapping conversations. The idea is that all children feel that their ideas are equally valuable; all children who want to share ideas can do so.

When ready, your puppet can be used as a stimulus for talk. For example, have your puppet present a science problem to the children. Some examples of how to do this are:

• Being muddled and asking the children for ideas. Puppet says, ‘I don’t understand why the feather is floating. Can someone explain, please?’
• Presenting a range of ideas children have been overheard discussing. Puppet says, ‘Robbie said the car travels in a straight line if its wheels are straight’.
• Disagreeing with the educator’s ideas. Puppet says, ‘You’re wrong – the very hungry caterpillar turns into a moth, not a butterfly!’
• Using puppets to help children solve a problem. Puppet says, ‘Help me with this. What can I do?’

Inclusive science learning approaches

There are a number of practical approaches an educator can take to present an image of science that is inclusive within society. These include changing children’s materials (such as books or videos) to reflect wider social values of communication, divergent thinking, cooperation and concern. In terms of pedagogical practice, science activities and explorations provide opportunities for children of all backgrounds to participate at their own knowledge and comfort levels. To provide an inclusive teaching approach, educators should:

• recognise individual difference in all interactions with children
• balance interactions between all groups
• have similar expectations for all groups
• build confidence and self-esteem and value all children’s contributions
• change the image of science by helping children to see that science is all around them and is accessible to their explorations
• provide role-models that include all diverse groups
• challenge non-inclusive assumptions and behaviour
• vary teaching strategies
• improve access of equipment and equitable distribution of resources.

Of particular importance in Australia is the recognition of Indigenous knowledge systems, particularly in science. The Australian Curriculum provides guidance in developing Indigenous perspectives in the content and application of science knowledge (see Chapter 3).
CASE STUDY 5.5

SEEING THINGS FROM ROSS’ WORLD

Ross (4 years old) sat quietly with the other children, not really participating. His mother, a single parent, had been in to explain that Ross was an only child and spent most of his time playing by himself at home. Frequently he was left in the care of his mother’s grandmother, an elderly woman who just did not have the energy to do more than passive activities with him. Staff were trying different things to try to engage Ross in learning and exploring.

One day, one of the children had found a worm, so the educator asked children what they knew about worms. ‘Oh, it’s wriggly,’ said one child. Another said: ‘It’s cold and slippery.’ Ross spoke up: ‘It’s got rings around its body and hairs on its body.’ The educator encouraged Ross to speak further. ‘What else do you know about worms, Ross?’ He responded: ‘It’s got a thick bit near its centre and it’s got a mouth and a bottom and poo comes out its bottom.’ Staff were amazed at what Ross had observed about worms and decided to use this interest to engage him further. They found that he knew a great deal about all the small animals in the garden and was able to describe them and their habitats in detail. They used this as their way into Ross’ world and to enhance his learning by using the natural environment.

REFLECTION

- Provide an example of how the educators working with Ross could enhance his biological learning further.
- How could Ross’ natural interest in small animals in the garden be used as a vehicle for learning in other areas?

Conclusion

This chapter discussed various teaching approaches early childhood educators can use to advance children’s learning in science. It presented practical strategies for helping children to learn in science: intentional teaching, probing children’s prior understandings, scaffolding learning, effective questioning, and science explorations. Finally, it referred to the underlying beliefs that are at the heart of children’s learning: children construct knowledge from their own experiences, educators are able to scaffold that learning, and social situations enhance learning opportunities.
References


