Introduction

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Science in early childhood

As we present the fourth edition of *Science in Early Childhood*, we are continually aware of how much science education in early childhood has moved forward since the first edition. While retaining the essential elements of science learning and teaching that inform and guide pre-service and in-service educators/teachers of preschool and early years settings at school, this new edition provides a more expansive collection of topics. More detailed coverage and new chapters include scientific inquiry in the early years, teaching science inclusively, Indigenous Ways of Knowing science, encouraging playful young scientists and science learning through informal experiences. All other chapters have been updated.

Research in early childhood science is developing internationally as well as in Australia, and we have drawn on work done by the authors and reviews of the broader research literature, so *Science in Early Childhood* provides information that is relevant and responsive to its intended audience. Each chapter helps to develop content knowledge of areas of science and instructs on how to guide children's learning in that area. Many different approaches to science learning are taken, with an understanding that science is interrelated with most other curriculum areas and with an understanding that young children tend to learn through play in a holistic way.

There is a growing recognition of the importance of science explorations in children's lives as they try to make sense of the world around them. Cognitively, it is important for

educators/teachers to have input into children's developing science understandings and to be able to guide their concept development. *Science in Early Childhood* is designed to complement Australia's Early Years Learning Framework (EYLF) and the Australian Curriculum: Science, with references in each chapter to the alignment of content with the philosophy and anticipated outcomes of the national guidelines. Internationally, the 'early years' comprise a period recognised as that time between birth and 8 years of age, and this book provides resources for practitioners working with this age range. In recognition of the general acceptance in the early years community of 'learning through play', *Science in Early Childhood* highlights varied types of learning and learning environments: naturalistic, informal and formal. Information in chapters is illustrated through the use of detailed case studies and practical examples that relate to both preschool and the early years of school.

This edition maintains its four parts, constructed around the required elements of effective science teaching and learning. Our approach has been to label these sections based on questions that students and practitioners of early childhood science would ask:

Part 1 'What initial information should I know to teach science?' includes information on policy documents and learning theories. Chapters 1–4 fall within Part 1.

Part 2 'How can I enhance children's learning of science?' presents different approaches to science learning and the importance of play as a pedagogy. Part 2 covers Chapters 5–11.

Part 3 'How can I use the learning environment to enhance children's science understandings?' describes learning through informal experiences and learning through the environments. Chapters 12 and 13 are presented in Part 3.

Part 4 'How do I plan and assess in science?' covers essentials of planning, intentional teaching, assessment and reflective practice. Part 4 covers Chapters 14–17.

Chapter summaries

Chapter 1 starts with examples of typical child-instigated explorations in science, highlighting the importance of early childhood education as a whole and of developmental and cognitive psychology. This chapter describes children's wonder and curiosity towards the world as it outlines what science looks like in the early years. As part of the definition of science, the chapter introduces conceptual, procedural and attitudinal science knowledge, and looks at how these relate to young children's learning of science.

Chapter 2 provides the reader with an overview of the policy landscape and the documents that are influential in early childhood science provision. Attention is focused on Australia's first national curriculum framework for early childhood educators/teachers – *Belonging, Being and Becoming: The Early Years Learning Framework for Australia* (EYLF) (DEEWR, 2009). The relevance of the EYLF in relation to teaching science in the early years is explained, concluding with the identification of science outcomes for children within the framework. The voices of early childhood educators/teachers are highlighted to illustrate how those working in the field are engaging with the framework.

Chapter 3 introduces the reader to the Australian Curriculum: Science, starting with a brief outline of the history of the Australian Curriculum. The three curriculum strands of Science Understanding, Science as Human Endeavour and Science Inquiry Skills are described, along with how these could be woven together to provide a framework for developing experiential, connected and sequential science learning experiences for children in the early years. The seven general capabilities and three cross-curriculum priorities are presented, along with examples that relate to science in the early years. Case studies provide an insight into how the Australian Curriculum: Science can be implemented.

Chapter 4 discusses various theories of learning that have an impact on how educators/teachers can work with young children. Theories about how children (and, indeed, adults) learn science and the factors that affect learning in young children are described. The relationship between everyday concepts and scientific concepts is distinguished. Various case studies are presented to highlight aspects of children's learning.

Chapter 5 links practice to theory with a discussion of the range of formal and informal teaching approaches used with young children to enhance their science learning. It outlines the importance of such strategies as scaffolding and targeted explorations. Using illustrative case studies, attention is paid to process skills, guided discovery, the interactive approach and project-based learning, and intentional teaching. Whether through the processes of science, such as the development of observation, or through the skilful questioning of the educator/teacher, the approach used should enhance children's science learning. The chapter includes a discussion on the importance of children's prior knowledge in terms of the teaching and learning of science.

Chapter 6 introduces scientific inquiry in the early years. This chapter describes the inquiry-based approach to learning science, where children are actively involved in finding the answers to questions. The scientific inquiry process of identifying and posing questions; planning, conducting and reflecting on activities and investigations; processing, analysing and interpreting evidence; and communicating findings is presented. Science inquiry activities that can be used with young children are described: observation, observation and measurement over time, classification, skills activities, research activities, conducting a survey, exploration activities and fair test investigation. Various case studies demonstrate these activities.

Chapter 7 presents an introduction and overview of inclusive teaching within the context of science in the early years. Inclusive teaching is about proactive, intentional and purposeful decisions being made by the educator/teacher to allow all students to reach their full potential. Inclusive practices, such as differentiation and the Universal Design for Learning framework, are described. Case studies are presented that provide opportunities to identify inclusive practices.

Chapter 8 provides insight into science learning that incorporates Indigenous science knowledge and the roles of both culture and Indigenous Ways of Doing. Social protocols, which underpin Indigenous Knowledge, particularly in science, are discussed to provide background to a non-Indigenous educator/teacher. This chapter describes principles and strategies for educators/teachers to embed Indigenous science into their settings. Cases of how practitioners have done this in various settings are presented.

Chapter 9 highlights the importance of play in young children's science learning. During playful events, children can explore, discover, investigate and experiment, thus promoting critical thinking and scientific inquiry. Play pedagogies that promote children's learning through playful activities are discussed. Four case studies are presented to highlight how educators/teachers can encourage children's scientific exploration and thinking through play.

Chapter 10 explores how young children's science identity can be enhanced when thoughtful pedagogy is provided by the educator/teacher. The first part of this chapter presents the definitions of science identity and pedagogy, followed by an exploration of the relationship between educator/teacher beliefs and what they teach. The second half of the chapter presents two case studies to illustrate pedagogical practices associated with the learning and teaching of science with young children, using play as a medium, in order to enhance their science identity.

Chapter 11 focuses on STEM education in early childhood. It describes what STEM looks like in early childhood settings and identifies ways in which STEM elements can be incorporated into children's learning. The chapter describes how STEM-related play can enhance young children's appreciation of the world and provides a range of examples that have potential for STEM learning.

Chapter 12 provides insight into the large amount of science learning that can occur through informal experiences. Informal experiences relate to those that occur outside formal educational settings, such as family settings, museums, zoos and natural locations. As learning in these environments is free choice, children tend to be more motivated and interested in learning than in formal educational settings. This chapter describes the importance of informal experiences in the learning of science, the funds of knowledge that families share with their children, the rich and diverse cultural and linguistic science experiences that children bring to their educational settings, and the importance of educators/teachers acknowledging and using children's and families' funds of knowledge in developing science learning experiences.

Chapter 13 focuses on a growing interest in the value of children learning science in the outside environment. Considering a range of outdoor settings, this chapter highlights the benefits of the outside environment for children's development and science learning. It presents ways in which young children can be provided with meaningful outdoor experiences that enhance their science and environmental understandings. Affordances for science learning through play that embrace 'bush' or 'beach' kindergarten time are described. This chapter also discusses how early years educators/teachers can enhance children's affinity with the environment through varied pedagogical approaches.

Chapter 14 explores the planning required for effective science teaching and learning. Whole-school or whole-centre planning and term planning are presented. The 5Es teaching and learning model (Engage, Explore, Explain, Elaborate and Evaluate) is introduced and demonstrated to illustrate the constructivist approach to developing science programs. Early learning centre planning is described, emphasising the importance of an emergent curriculum. The importance of planning a science-rich learning environment to support young children's scientific learning is also noted.

Chapter 15 highlights the role of an intentional, purposeful educator/teacher. It provides ideas and examples of how they can plan for and teach children with regard for their individual and collective learning experiences. The chapter highlights the important place of verbal scaffolding and lesson planning. The components of a lesson plan are described and illustrated.

Chapter 16 presents information on how educators/teachers observe, assess and document science learning. Early childhood educators/teachers use evidence to determine what children know and understand, and base this on a process of observation (how children explore and interact within their environment), anecdotal note-taking, journal entries, checklists and folios of children's work. The chapter outlines steps associated with the assessment of learning in science as outlined in the EYLF and in the Australian Curriculum: Science, with an indication of some appropriate strategies. The information in this chapter is supported by reference to examples of educator/teacher practice.

Finally, Chapter 17 refers to an important aspect of the role of any professional educator/teacher – that of ongoing professional learning. This chapter discusses reflective practice and critical reflection as a means of ensuring that educators review and monitor their own practice and to understand how this practice affects children's learning outcomes. Tools such as reflective journals and professional portfolios are discussed. The theoretical aspects of educators'/teachers' pedagogical content knowledge, content knowledge and pedagogical knowledge are explored.

REFERENCE

Department of Education, Employment and Workplace Relations (DEEWR). (2009). *Belonging, Being and Becoming: The Early Years Learning Framework for Australia*, Canberra: Commonwealth of Australia.