Science for Children

Science for Children introduces readers to the pedagogy of primary and early childhood science education. It presents a wealth of science content across the birth-to-12-years continuum, demonstrating how science can come alive in the classroom.

The book pays special attention to the three strands of science, in accordance with the Australian Curriculum. It also uses the practice principles and learning outcomes of the national Early Years Learning Framework to present content for babies through to the transition into the Foundation year at school.

Science for Children explores various approaches to teaching and learning in science. It covers inquiry approaches in detail; makes explicit links to the 5Es; critiques longstanding approaches, such as discovery approaches and a transmission approach; and explores Indigenous perspectives and a Vygotskian framework. This allows the reader to make informed choices about when to use a particular approach in primary classrooms and early childhood settings.

Designed to prepare future educators for practice, Science for Children challenges students and offers practical classroom-based strategies for their science teaching careers.

Science for Children includes a single-use six-month subscription to Cambridge Dynamic Science, providing access to interactive content to support complex science topics. Additional resources for instructors are available online at www.cambridge.edu.au/academic/science.

Marilyn Fleer is the Foundation Chair of Early Childhood Education at Monash University.
Science for Children

Marilyn Fleer
Contents

Science for Children and Cambridge Dynamic Science     page xi
Acknowledgements     xii

Part 1 Research Foundation for Developing a Personal
Approach to Teaching Science     1

Chapter 1 Science as a human endeavour     3
Introduction     3
Leading change in science     8
Looking inside the classroom     9
Looking inside an early childhood setting     18
How we feel about science matters     24
Summary     26
References     27
Acknowledgement     28

Chapter 2 Researching children’s understanding and ways of learning     29
Introduction     29
Children’s understanding     29
Finding out children’s understandings     32
Moving through learning rather than to learning – new lenses     42
Border-crossing in science education     50
Ways of learning     53
Summary     53
References     53
Appendix     55
Acknowledgement     57

Part 2 Transmission and Discovery Approaches to Teaching
and Learning in Science     59

Chapter 3 A transmission approach to teaching science     61
Introduction     61
Contents

Looking inside a classroom and early childhood setting: a transmission approach 62
Transmission in everyday life 65
What assumptions underpin a transmission approach to teaching science? 67
Strategies for developing effective teaching and learning 69
The place of transmission in the teaching of science 71
Transmission approach in early childhood 72
Classroom management in a transmission approach 75
Planning for learning 76
Summary 79
References 79
Acknowledgement 80

Chapter 4 A discovery-based approach to learning science 81
Introduction 81
Looking inside the classroom 82
Approaches to discovery learning 87
What assumptions underpin a discovery-based approach? 88
Preparation and planning 89
A critique of a discovery-based approach to learning 91
Classroom and early childhood setting management in a discovery-based approach to learning science 96
Assessment in a discovery-learning approach 97
Summary 100
References 100
Appendix 101
Acknowledgement 103

Part 3 Inquiry-based Approaches 105

Chapter 5 Inquiry-based approach to teaching science 107
Introduction 107
Science involves making and testing predictions, gathering data and using evidence 109
What are microbes or micro-organisms? 111
Looking inside the classroom 112
Engage 113
Explore 117
Explain 124
Elaborate 125
Evaluate 127
What assumptions underpin an inquiry-based approach to teaching science? 130
Classroom/centre management in an inquiry-based approach 133
### Chapter 6 Inquiry-based approach to learning science

**Introduction**  
148

**Looking inside a classroom**  
149

**An experience of an inquiry-based approach to learning**  
153

6.1 Planning two lessons: an overview of an inquiry-based approach to learning with a small group of children  
160

6.2 Planning a sequence of lessons – an inquiry-based approach to learning with the whole class  
161

**Working with multi-age groups: drawing on the Australian Curriculum – Science**  
169

**Digital technologies supporting learning**  
171

**Year 3 children explain their inquiry: an inquiry-based approach to learning about the zoo in my garden**  
171

**Year 1 children explain their inquiry: an inquiry-based approach to learning about worms**  
174

**What assumptions underpin an inquiry-based approach to learning science?**  
176

**Classroom/early childhood setting management in an inquiry-based approach to learning science**  
177

**Assessment in an inquiry-based approach to learning science**  
180

**Summary**  
183

**References**  
184

---

**Chapter 7 Teaching for conceptual change: constructivism**

**Introduction**  
185

**How you feel about your learning matters**  
186

**Constructivism**  
186

**Defining the nature of conceptual change**  
187

**Children’s thinking books**  
187

**Children’s thinking about electricity**  
188

**Researching understandings about electricity**  
190

**Anamika’s understanding about electricity**  
193

**Concepts about electricity**  
195

**Respecting children’s ideas**  
198
Contents

Creating a need to change your thinking 199
Looking inside the classroom 200
Finding out what the children in our class know 202
Creating cognitive conflict – what might children not be so sure about and want to investigate? 203
Children setting up the investigations 205
Children answering their questions 205
Teacher reflections on the approach 206
What assumptions underpin teaching for conceptual change? 207
Classroom/centre management in teaching for conceptual change 208
Linking science to other curriculum areas 210
Assessment approaches for teaching for conceptual change 211
Concerns about teaching for conceptual change 211
Summary 213
References 214

Part 4: Inclusive Constructions of Knowledge Across and Within Communities and Cultures 217

Chapter 8 Conceptual play and contextual and conceptual intersubjectivity: cultural–historical approaches to learning in science 219
Introduction 219
Looking inside the classroom – teacher diary 221
What understandings do children have about Earth and Space sciences? 226
Looking inside the classroom – the child’s perspective 234
Looking inside the classroom: infants–toddler’s perspective 239
A cultural–historical perspective on learning in science 241
Looking into the context, rather than just considering the concept 242
Knowledge construction through building contextual intersubjectivity 243
Knowledge construction through building conceptual intersubjectivity 245
Digital technologies supporting learning 249
Leading change in science education 250
Cultural–historical curriculum 251
Summary 253
References 253
Acknowledgement 255

Chapter 9 Culturally sensitive teaching: sustainability and relatedness in our ecosystems 256
Introduction 256
Teacher thinking about sustainability 261
Science content knowledge – ecosystems 263
Contents

Looking inside an early childhood setting: infants, toddlers and preschoolers working and playing scientifically – a systems view of the human body 265
Pedagogical practices for supporting sustainability in early childhood education 266
Looking inside the classroom: Year 4 children investigating the birds in their playground 268
Citizen Science 271
Place-based education 273
Culturally sensitive teaching 274
Planning for inclusive pedagogy 276
Leading change – Priscilla Reid-Loynes 277
Summary 278
References 278
Appendix 279

Part 5: Leadership in Science 283

Chapter 10 Becoming a leader of science: situating yourself 285
  Introduction 285
  Selecting and constructing a personal framework 288
  The place of each approach in teaching science 290
  Key principles for effective teaching 293
  Guidelines for implementing a teaching approach 299
  A synthesising activity 303
  Leading change in science education 304
Summary 307
References 308

Index 309
Science for Children and Cambridge Dynamic Science

Cambridge Dynamic Science harnesses the power of interactive digital technology to deliver a comprehensive online resource for teaching and learning in the science classroom.

Purchasers of Science for Children are provided with a single-use, 6-month subscription to Cambridge Dynamic Science, which contains interactive content to support complex science topics. Your unique access code is printed on the inside front cover (ebook purchasers should follow the instructions provided on page ii).

Relevant interactive activities are identified throughout the book with this icon. The relevant Year, Module and Units are listed with the icons.

Login/access instructions

1. Go to www.cambridge.edu.au/dynamicscience and click on Join Now.
2. Enter your name and email address and create a username and password. Enter the unique access code provided. Click submit.
Acknowledgements

I wish to acknowledge the foundational co-author of the first edition of Science for Children, Dr Tim Hardy, and the subsequent co-author Rev Dr Beverley Jane for editions two and three. Their contributions to the ideas and directions of the previous editions have provided a strong foundation from which to prepare this book. In addition, I would like to thank Nina Sharpe for her untiring belief in the value of this publication and in her unwavering support in bringing this book to press. Special acknowledgement is made to all the individuals who have contributed to specific chapters. Details are provided in the relevant chapters.

Cambridge University Press is grateful to the following individuals and organisations for permission to use their material in Science for Children.

Web icon: © shutterstock.com/veronchick84; Figure 2.3 (clockwise from top): © shutterstock.com/SoRad; © shutterstock.com/Piyato; © shutterstock.com/RATOCA; © shutterstock.com/Ramona Kaulitzki; © shutterstock.com/Panaiotidi; © shutterstock.com/MaKars; © shutterstock.com/ufuk sezen; Newgen Publishing and Data Services; © shutterstock.com/Miroslava Hlavacova; © shutterstock.com/S.V.Art; © shutterstock.com/Tribalium; © shutterstock.com/Alemon cz; © shutterstock.com/T-Kot; © shutterstock.com/Ramona Kaulitzki; 2.5–7 (magnifying glass): © shutterstock.com/Mega Pixel, (image) © shutterstock.com/Olesya Feketa. All Shutterstock.com images 2015 are used under licence from Shutterstock.com.

All material identified by (ACARA <year>) is material subject to copyright under the Copyright Act 1968 (Cth) and is owned by the Australia Curriculum, Assessment and Reporting Authority 2015.

For all Australian Curriculum material except elaborations: This is an extract from the Australian Curriculum.

Elaborations: This may be a modified extract from the Australian Curriculum and may include the work of other authors.

Disclaimer: ACARA neither endorses nor verifies the accuracy of the information provided and accepts no responsibility for incomplete or inaccurate information. In particular, ACARA does not endorse or verify that:
Acknowledgements

The content descriptions are solely for a particular year and subject;
All the content descriptions for that year and subject have been used; and
The author's material aligns with the Australian Curriculum content descriptions for the relevant year and subject.

You can find the unaltered and most up to date version of this material at http://www.australiancurriculum.edu.au. This material is reproduced with the permission of ACARA.

Every effort has been made to track and acknowledge copyright. The publisher apologises for any accidental infringement and welcomes information that would redress this situation.