

# INTRODUCTION



This book is about primary science education. It presents the latest evidence-informed ideas, strategies, resources and information for your consideration as you build your knowledge and expertise as a teacher in this foundational learning area. Underpinned by the premise of building your own and your students' science identity, there is a focus on learning through using local outdoor areas, socio-scientific issues and current events as stimuli for questions and investigations to better understand how science is practised in the real world, and to realise that it is a 'messy' human endeavour – particularly when it comes to solving real-world issues.

Each chapter responds to questions about why we teach science in primary school, how students can demonstrate their learning, how to plan effective lessons and learning sequences, the teacher's role in a primary science classroom, how the integration of other learning areas and Cross-Curriculum Priorities can be used to support the learning of science concepts when there are compelling synergistic links, and much more.

You will be challenged to consider how different people's worldviews, including your own and those of your students, influence sense-making, understanding and interactions with living and non-living things, and how this may lead to the development of alternative science conceptions. You will learn how to design, implement and assess targeted learning experiences that uncover these alternative science conceptions with a view to working *with* students to develop their abilities to express their ideas more scientifically over time. There are ideas for how to include practical, relevant, hands-on science activities that promote positive emotional responses in students as they work collaboratively and share findings with their peers.

At the heart of this book is the notion of how to optimise students' interest, engagement and learning in, of and about science. This is supported by a wealth of contemporary classroom science teaching examples. It is hoped that you will use this book and the online resources as part of your teaching toolkit. This text is designed for Australian primary schools using the latest versions of the Australian Curriculum and the Australian Professional Standards for Teachers. Wherever possible, Australian examples have been used to support explanations. The same terms as the Australian Curriculum represent each of the years of primary schooling: Foundation (F) for the first year of schooling followed by Year 1 (1), Year 2 (2), Year 3 (3), Year 4 (4), Year 5 (5) and Year 6 (6).

Since this is the first edition of this text, we are keen to receive feedback and encourage you to send us your thoughts, questions and ideas about how it can be improved for the next iteration.





PART 1

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PLANNING  
FOR SCIENCE

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# WHY DO WE TEACH SCIENCE IN PRIMARY SCHOOL?

## LEARNING OUTCOMES

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On completion of this chapter, you should be able to:

- describe features of worldview values and how these influence people's interactions with the world and others (Section 1)
- outline how science and the work of scientists have developed in societies over time and their role in the world today (Section 2)
- reflect on your own schooling experiences of science and compare these with current views about the purposes of primary science education (Section 3)
- detail the role of the Australian Curriculum in primary science education (Section 4).

## Introduction

This chapter presents foundational ideas and discussion around the notion of worldviews, including how they develop, how they are influenced by education and how they impact learning. There is a focus on identifying the features of worldviews that incorporate science perspectives with an emphasis on strategies for nurturing and developing students' scientific dispositions, such as their 'science identity' and 'science capital'. The contributing role of primary science education through the Australian Curriculum will be examined. As we work through these ideas, you will examine your own worldviews about science and use evidence from the science education research literature to explore current views about the purposes of science education in primary schools. The following chapter sections provide details of these ideas:

Section 1: What is my worldview and why is that important?

Section 2: What is science and what is its role in the world today?

Section 3: What is primary science education and why is it important?

Section 4: What is the role of the Australian Curriculum in primary science education?

**Belief:** an idea that you have that something is true or exists (even though there is no evidence)

**Value:** a measure of the importance or worth of something to you

**Attitude:** how you express your values and beliefs when interacting with the world

**Behaviour:** what you do or how you act with other living and non-living things

## Section 1: What is my worldview and why is that important?

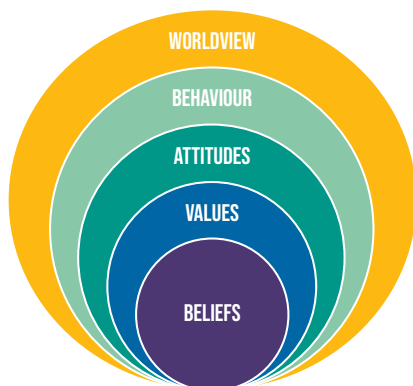
### What is a worldview?

A worldview is the fundamental way in which a person makes sense of, understands and interacts with living and non-living things in their life. It is determined by the **beliefs** (I believe in ghosts and life after death), **values** (I value honesty and respectfulness in others), **attitudes** (I feel confident when trying new things) and **behaviours** (when working with others I try to be pleasant and polite) that have developed and will continue to develop through their lifetime. Worldviews are not fixed. Opinions and ideas can change as you interact with and learn from others. What is needed is an openness not only to listening to, but *hearing*, other people's interpretations of the world. Figure 1.1 represents the relationship between beliefs, values, attitudes and behaviours that combine to form a worldview. Refer to Link 1.1 and Multimedia link 1.1 to gain insights into how beliefs and biases influence our perceptions.



**Link 1.1** *The Conversation:* Coronavirus responses highlight how humans are hardwired to dismiss facts that don't fit their worldview

**Multimedia link 1.1** TED Talk: Three kinds of bias that shape your worldview with J. Marshall Shepherd



**Figure 1.1** The relationship between beliefs, values, attitudes and behaviours that combine to form a worldview

Worldviews are often strongly linked to cultural backgrounds and religious beliefs, to the ways we have been raised by our parents and relatives. In a multicultural society such as Australia, it is important to be receptive and open to the different ways people interpret and interact with each other and the environment so you, as a teacher, may identify the best way to present alternative



ways of perceiving the world. For example, modelling how resources can be used sustainably at school through involving students in water-saving, recycling and gardening projects can change their own and their family's views and behaviours related to sustainability. See Chapter 9 for ideas about how to nurture students' worldviews related to this Cross-Curriculum Priority area as well as the areas of Aboriginal and Torres Strait Islander Histories and Cultures, and Asia and Australia's Engagement with Asia.

It is particularly important that, as a teacher, you have a clear understanding of your own science worldview because this will profoundly influence how you design and implement science learning activities in the classroom. Some learned attitudes, beliefs, values and behaviours are strongly held and difficult to change, yet when alternative ways of viewing the world are presented in age-appropriate and culturally sensitive ways, you and your students may begin the journey of conceptually changing the ways in which you think about science and what it means. We will discuss this in more detail in relation to science education in Chapter 2, where primary students' typical alternative science conceptions are presented.

As an educator, insights into your own worldviews are needed before you can effectively consider those of others. There are several ways in which people's views have been researched. In the following section, we will discuss three approaches: (1) the World Values Survey; (2) Indigenous views compared with Western views; and (3) the Schwartz theory of basic values (Schwartz, 2012). In Section 3 we explore how this knowledge is useful when thinking about values that are inherent in primary science education practices and how the 'Science Capital Teaching Approach' (Godec, King & Archer, 2017) can be used to tap into and enhance students' worldviews about science.

## Ways of framing different people's worldviews: The World Values Survey

The World Values Survey, which began in 1981, captures overall data related to people's beliefs, values and motivations in 100 countries. The Inglehart-Welzel World Cultural Map (2022) compares people's values related to two main dimensions (see Figure 1.2):

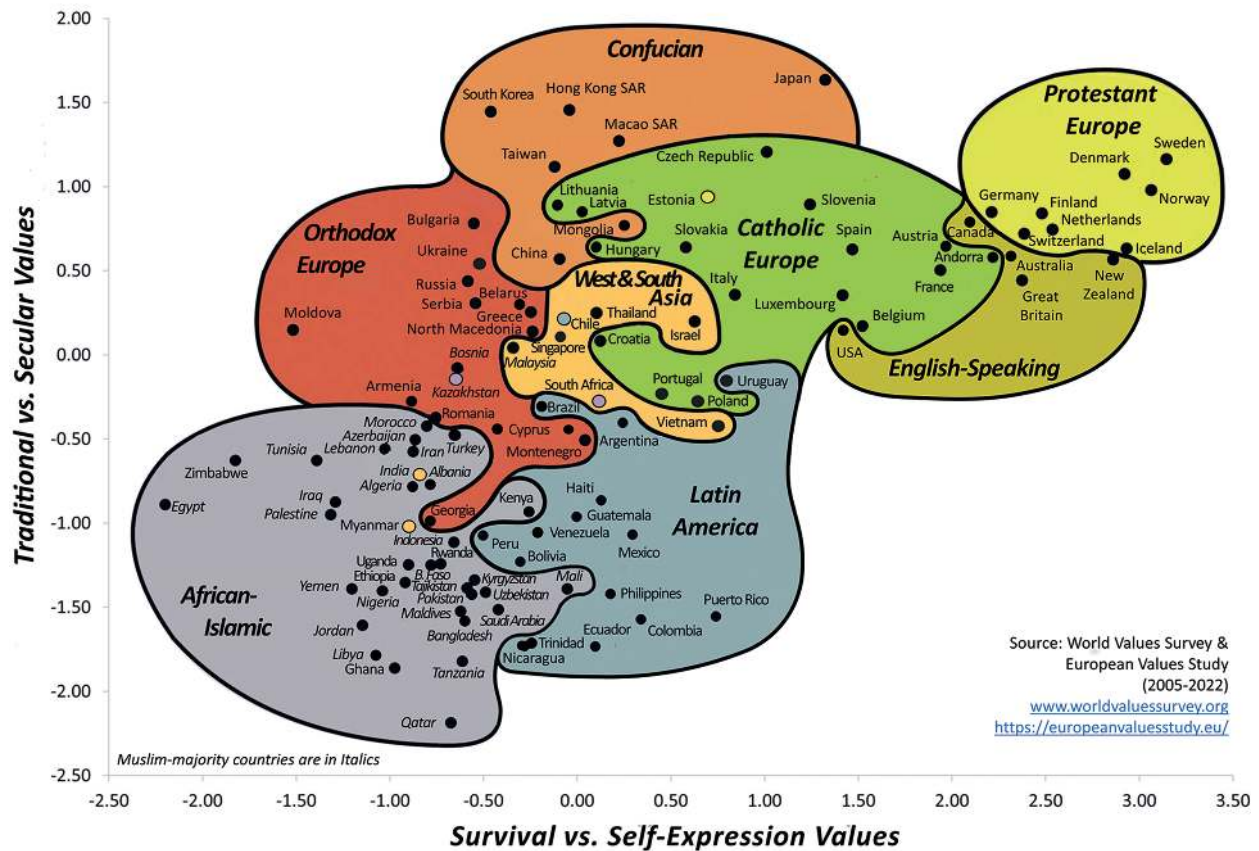
1. Traditional values versus secular values
2. Survival values versus self-expression values.

The value categories (traditional, secular, survival, self-expression) that differentiate societies are defined as follows:

*Traditional values* emphasize the importance of religion, parent-child ties, deference to authority and traditional family values. People who embrace these values also reject divorce, abortion, euthanasia and suicide. These societies have high levels of national pride and a nationalistic outlook and include those countries who are in the lower half of Figure 1.2.

*Secular-rational values* have the opposite preferences to the traditional values. These societies place less emphasis on religion, traditional family values and authority. Divorce, abortion, euthanasia and suicide are seen as relatively acceptable but suicide is not necessarily more common. Countries with these values are in the upper half of Figure 1.2.

## The Inglehart-Welzel World Cultural Map 2022



**Figure 1.2** The Inglehart-Welzel World Cultural Map 2022

Source: The Inglehart-Welzel World Cultural Map 2022 – World Values Survey 7 (2022). Retrieved from: <http://www.worldvaluessurvey.org>.

*Survival values* place emphasis on economic and physical security. It is linked with a relatively ethnocentric outlook and low levels of trust and tolerance. These countries are in the left half of Figure 1.2.

*Self-expression values* give high priority to environmental protection, acceptance of those from other countries, diverse sexualities and gender equality, and rising demands for participation in decision-making in economic and political life. These countries are in the right half of Figure 1.2. (World Values Survey, 2022)



**Link 1.2:** World Values Survey data (2017–20)

**Multimedia link 1.2:** World Values Survey – time lapse video

**Link 1.3:** Calendar of cultural and religious dates

Imagine the cultural (and climate) differences that someone from Qatar or Ghana would experience if they were to visit or move to Sweden, Denmark or Norway. While these are extreme examples, the point is that everyone views the world through their own lens. Societies with a wide range of cultures have more opportunities to interact with and learn about each other's similarities and differences. Many primary schools hold annual events where different cultures are invited to share their celebrations, festivals, foods, dances, music and costumes. Refer to Link 1.2 and Multimedia link 1.2 for data and an animation about the World Views Survey, and to Link 1.3 for opportunities to participate in cultural events with your students.



## Ways of framing different people's worldviews: Indigenous views compared with Western views

While Figure 1.2 presents a broad overview of the views of each represented country, this does not mean everyone in each of those countries thinks and behaves in the same way. The first Aboriginal and Torres Strait Islander peoples who lived sustainably and successfully for more than 60 000 years in Australia had particular ways of knowing, being and doing in the world that were quite different from other groups of humans who later travelled to and colonised Australia. These differences in worldviews persist today, so it is important to be aware of what they may be.

For many Aboriginal and Torres Strait Islander people in Australia, their culture is based on deep connections to land, family, law, ceremony and language (AIATSIS, n.d.). The kinship system (see Link 1.4) is used to work out a person's relationship with others and to the universe, which in turn determines the ways in which they should behave towards other people, the land and the resources provided by the land.

We will discuss the importance of Australian Indigenous people's perspectives related to primary science education in more detail in Chapter 9, but in preparation, consider the work of Anne Mead (n.d.), an Australian psychologist who has worked in Western Australia with Aboriginal communities. Her work provided the basis for Table 1.1, which presents eight differences between Indigenous (Canadian) and Western values. This comparison has been corroborated as reflecting those of Indigenous Australians by Dr Michael Donovan, a Gumbaynggir man from the north coast of New South Wales and an expert in Aboriginal



Link 1.4: Indigenous kinship

**Table 1.1** Eight differences between Indigenous [Canadian] and Western worldviews

Area	Indigenous [Canadian] value	Western value
Belief system	Spiritually orientated society. System based on belief and spiritual world.	Scientific, requiring proof as a basis of belief.
Reality/truth	There can be many truths; truths are dependent upon individual experiences.	There is only one truth, based on science or Western style law.
Connections	Society operates in a state of relatedness – people, objects and the environment are all connected. Law, kinship and spirituality reinforce this connectedness. Identity comes from connections.	Compartmentalised society, becoming more so.
Land	The land is sacred and usually given by a creator or supreme being.	The land and its resources should be available for development and extraction for the benefit of humans.
Time	Time is non-linear, cyclical in nature. Time is measured in cyclical events. The seasons are central to this cyclical concept.	Time is usually linearly structured and future orientated. The framework of months, years and days reinforces this structure.
Societal expectations	Feeling comfortable is measured by the quality of your relationships with people.	Feeling comfortable is related to your success in achieving your goals.
Human role	Human beings are not the most important in the world.	Human beings are most important in the world.
Wealth	Amassing wealth is important for the good of the community.	Amassing wealth is for personal gain.

Source: ICTI (2016).



**Figure 1.3** Schwartz’s model for the relationship between 10 core values (inside circle) and four themes (outside circle)  
 Source: Schwartz (2012).

educational research: ‘if there was an Australian version it would be very similar’ (personal communication, 12 July 2021).

Hopefully, as you have been reading this chapter, you have begun to see some of your own worldviews reflected in the examples provided.

### Ways of framing different people’s worldviews: The Schwartz theory of basic values

Shalom Schwartz (2012) is an expert in values research. The Schwartz theory of basic values is a set of 10 related values that may be identified across all cultures, and as such provide a way for you to identify your own values system. The 10 core values may be grouped into themes, as shown in Figure 1.3, while value definitions and related values are presented in Table 1.2.

**Table 1.2** Schwartz’s value definitions and related values

Schwartz theme	Schwartz value	Definition	Related values
Openness to change	Self-direction	Independent thought and action	Creativity Freedom Curiosity Independence
	Stimulation	Novelty, challenge in life	Daring
	Hedonism	Pleasure for oneself	Pleasure Self-indulgence
Self-enhancement	Achievement	Personal success according to social standards	Ambitious Successful Capable
	Power	Social status and prestige	Authority Wealth Recognition
Conservation	Security	Safety, harmony and stability	Healthy Belonging Clean
	Conformity	Following social norms	Obedience Politeness Honouring elders
	Tradition	Respect, commitment to and acceptance of customs	Humble Devout