Chapter 2
Developing Scientific Literacy:
Introducing Primary-Aged Children to Atomic-Molecular Theory

Jennifer Donovan
University of Southern Queensland, Australia

Carole Haeusler
University of Southern Queensland, Australia

EXECUTIVE SUMMARY

This chapter challenges existing school science curricula modes for teaching atomic-molecular structure and describes a current research project designed to provide supporting evidence for reviewing school science curricula. Using evidence from this project and other research studies, the chapter argues for the introduction of atomic-molecular structure in the curriculum at Year 3 or 4 and proposes that consideration be given to devising a spiral curriculum in which the macroscopic and microscopic properties of matter are taught concurrently rather than sequentially.

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ORGANIZATION BACKGROUND

Three years ago, a former high school teacher responded to questions about matter and atoms from his young son. His son's interest and apparent capacity to grasp the concepts led to the teacher offering to teach the rest of his son's primary class. The apparent success of this early venture led to further development of the teaching and learning program and the backyard development of innovative hands-on models to better facilitate the learning. We are two science teachers, now University educators of preservice primary teachers, who became interested in this program. Our study seeks to verify whether the teacher's claims of success can be supported by research. Consequently, the research participants in this case are a diverse class of Year 4 children in a school new to the specialist science teacher. Our research examines the development in these children's understanding of atomic-molecular theory from their learning experiences with the specialist science teacher following 10 hours of instruction on atoms, molecules, and elements (1 hour per week over a 10-week period).

SETTING THE STAGE

Commonly, the teaching of atomic-molecular structure begins in high school. For example, in the new Australian Curriculum: Science (Australian Curriculum, Assessment and Reporting Authority [ACARA], 2013) the first mention of 'atoms' is in Year 9, when most students are 14 years old. The new K-12 Next Generation Science Standards from USA (National Research Council [NRC], 2013) are based on disciplinary core ideas from their earlier framework (NRC, 2012). This K-12 Framework introduces particles at Grade 5, and then elaborates these as atoms at middle school level, Grade 6. By the end of Grade 8 students should know there are approximately 100 different types of atoms, but even in this bold new curriculum which aims to introduce core ideas in science, technology and engineering from students' earliest schooldays, the details of atomic-molecular structure and the Periodic Table are still not tackled until Grade 9. However, at least this progression attempts a spiral curriculum (pioneered by Bruner, 1960) by introducing the scientific language of atoms earlier and building upon this baseline. The new national science curriculum to be introduced in the United Kingdom from September 2014 appears at first glance to be conservative, but introduces the particle model and atoms from Key Stage 3, i.e. Year 7 and onwards (Department of Education, 2013). However, this is classed as high school and part of the secondary science curriculum; there is no mention of atoms in the primary science curriculum.

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