Even More Brain-Powered Science

Inquiry Learning With Unexpected Results

Thomas O'Brien

Hawker Brownlow EDUCATION

NSTApress
National Science Teachers Association
Arlington, VA

Contents

NST0843 • 9781760010843 • © 2015 Hawker Brownlow Education

Even More Brain-Powered Science and the Australian Curriculum

In recent years, the Australian Federal Government has been working closely with state and territory educational offices in an effort to implement a national curriculum for all Australian schools. This Australian Curriculum sets consistent national standards, in an effort to improve learning outcomes for all students, as well as laying the foundations for future learning, growth and active participation in the community.

Effective science instruction is crucial to all students, as the skills they learn and cultivate in the science classroom are not only important tools for use in other subject areas, but also in everyday life. The Australian Curriculum: Science emphasises the need for students to apply their scientific thinking in all aspects of their studies, encouraging exploration, investigation, observation and problem solving. The curriculum also prompts students to look back at the influence science has had on their own lives, as well as on society as a whole. Ultimately, the Australian Curriculum: Science is designed to provide students with the knowledge, skills and reasoning abilities to make informed decisions not only about their own lives, but about global issues and concerns.

This revised Australian edition of *Even More Brain-Powered Science* features correlations with the three strands – Science Understanding, Science as a Human Endeavour and Science Inquiry Skills – of the Australian Curriculum: Science, including various content descriptions for seven of the science activities. These content descriptions describe the knowledge, concepts, skills and processes that teachers are expected to teach and students are expected to learn. The remaining six activities each feature links to other elements in the Australian Curriculum: Science, including the rationale, aims, cross-curriculum priorities and links to other learning areas. These links showcase how each activity contributes to the overarching ideas of the science curriculum, as well as those of the other subject areas within the Australian Curriculum.

The Australian Curriculum content descriptions found in *Even More Brain-Powered Science* are taken from Foundation (Prep, Reception, Kindergarten etc) to Year 12, but it should always be assumed that these are only a guide. While this book is designed for use with Year 6–12 students, F–5 Australian Curriculum: Science content descriptions are also included to illustrate the appropriate prerequisite work that students should engage in prior to the meaningful review and extensions they will participate in

subsequent to those year levels. These content descriptions mainly focus on the physical and chemical sciences, but many of the lessons also draw strong analogies to biological science concepts.

While it is recommended that teachers use the science activities in this book with their Australian Curriculum: Science instruction, the activities featured in *Even More Brain-Powered Science* can just as easily be used with other educational frameworks at the state or institutional level. For a full overview of the Australian Curriculum please visit *http://www.australian-curriculum.edu.au/*.

NST0843 • 9781760010843 • © 2015 Hawker Brownlow Education

Science Education Topics

As with the two previous books, this book has two foci – *discrepant-event science inquiry activities* and linked *visual participatory analogies for science teacher education*. The following topics are organised to show the sequence of sections by the larger frame science education themes. Appendix C lists the science concepts in alphabetical order. In either case, the book does not need to be used in any kind of strict linear sequence, but rather can be explored on a "need to know and use" basis.

Acronyms Used in Science Education Topics

BBS: (Black Box System) A hidden mechanism is explored via observation and testable inferences.

BIO: Biological analogies and applications are specifically highlighted.

HOE: (Hands-On Exploration) Learners working alone or in groups directly manipulate materials.

HOS: (History Of Science) A story, case study or resource from the history of science is featured.

MIX: (Mixer) Learners assemble themselves into small groups based on a specific task.

NOS: (Nature Of Science) These activities focus on empirical evidence, logical argument and sceptical review.

PAD: (Participant-Assisted Demonstration) One or more learners physically assist the teacher.

POE: (Predict-Observe-Explain) These activities use this inquiry-based instructional sequence.

PPP: (Paper-and-Pencil Puzzle) These activities use a puzzle, which is typically focused on the NOS; often a BBS.

STS: (Science-Technology-Society) The focus is on practical, real-world applications and societal issues.

TD: (Teacher Demonstration) The teacher manipulates a system and asks and invites inquiry questions.

TOYS: (Terrific Observations and Yearnings for Science) The activity uses a toy to teach science.

(continued)

(continued)

Section 1. Welcome Back to Interactive Teaching and Experiential Participatory Learning

Activity	Activity Type	Science Concepts
1. Science and Art: Duelling Disciplines or Dynamic Duo?	PPP/MIX TD optional p. 3	NOS as compared to art diffraction of white light to form a rainbow of colours Extensions: Draw-a-Scientist-Test + Science for All + HOS
2. Acronyms and Acrostics Articulate Attributes of Science (and Science Teaching)	PPP TD optional p. 17	NOS, teaching and mnemonics acid-base indicators and pH Extensions: Analysing Assumptions About Learning-Teaching

Section 2. Reading, Student Construction of Meaning and Inquiry-Oriented Science Instruction

Activity	Activity Type	Science Concepts and Learning Principle Modelled
3. Tackling the Terrible Tyranny of Terminology: Divide and Conquer	PPP TD options p. 31	reading, cognition and NOS acid-based indicators and/or pressure-volume lung model
4. Inquiring Into Reading as Meaning-Making: Do Spelling and Punctuation Really Matter?	PPP p. 43	reading, cognition, NOS and POE Extension: Cloze test and inference-making
5. Ambiguous Text: Meaning-Making in Reading and Science	PPP p. 53	prior knowledge, reading and cognition: empirical evidence, logical argument and sceptical review in science and reading Extension: Fossil Footprints

NST0843 • 9781760010843 • © 2015 Hawker Brownlow Education

Section 3. Integrated Instructional Mini-Units: 5E Teaching Cycles

Activity	Activity Type	Science Concepts and Big Ideas
6. Resurrection Plant: Making Science Come Alive!	TD/HOE/BIO/HOS p. 69	characteristics of and requirements for life, plant adaptations and evolution. Extension: Perplexing Plants and Triops
7. Glue Mini-Monster: Wanted Dead or Alive?	TD/BIO/HOS p. 83	characteristics of, requirements for and scale of life (microscopy)
8. Water "Stick-to-It-Ness": Stuck on Money Matters	HOE p. 97	POE, cohesion, adhesion and surface tension of water Extensions: DHMO pseudoscience Oobleck and non-Newtonian fluids
9. Burdock and Velcro: Mother Nature Knows Best	HOE/BIO/HOS p. 113	form/function fitness, engineering design/Velcro and microscopy
10. Osmosis and "Naked" Eggs: The Environment Matters	TD/HOE/BIO p. 127	osmosis; the cell membrane as the structure that both separates and connects the cell to its environment and measurement skills
11. 5 Easy Yet pHenomenal Steps to Demystifying Magic Colour-Changing Textas	HOE p. 145	physical and chemical changes, chromatography and molecular movement, and acid-base chemistry and pH indicators
12. 5 Easy Steps Back Into "Deep" Time: Visualising the Geobiological Timescale	HOE/BIO/MIX/HOS p. 159	NOS, mathematics of powers of 10 scale, models, geological time, evolution and STS
13. 5 Easy Steps to Earth–Moon Scaling: Measurements and Magnitudes Matter	HOE/PAD/HOS p. 189	estimation, mathematics, scale, measurement, astronomical distance (within solar system), models, analytical and aesthetic perspectives