LEVEL 1 2 3 4 **5**

It's Elementary

THE LEARNING CONTEXT

The teacher's intended outcomes were for the students to:

- demonstrate an understanding of the particle nature of matter when making explanations to changes observed when investigating familiar substances
- communicate their scientific ideas using appropriate scientific symbols, models, and vocabulary.

The intended outcomes were aligned to the following "big ideas":

- All materials are made up of elements joined together in a wide range of combinations.
- The periodic table identifies such elements and represents them in increasing atomic number grouping similar elements into "families".
- Atoms can be joined together in different ways, namely by ionic or covalent bonding.
- The kind of bonding can influence the properties of a material.
- Chemical reactions result in the formation of new substances, which can be very different from the original chemical reactants.
- Physical changes, including change of state, do not result in the formation of new substances.
- Materials can exist in different states, that is, as a solid, liquid, or gas.
- For a particular material to change state, energy is required.

Initially the teacher asked the students to draw and explain their present ideas about atoms, elements, compounds, and mixtures. He used this information to plan his teaching.

During the study the students:

- studied atomic structure: protons, neutrons, and electrons, and atomic number
- chose an element and presented a report on the symbols, name, properties, and atomic structure of that element for the other students to evaluate
- studied the first 20 elements of the Periodic Table
- learnt to distinguish metals and non-metals
- looked at the nature of compounds by burning magnesium
- studied chemical bonding
- examined formulae and equations
- classified substances and separated mixtures such as sand, salt, and water using separation methods that included decanting, filtering, and evaporating
- made concrete and looked for the evidence of chemical change.

Following these activities, the teacher asked the students to draw further diagrams of atoms, elements compounds, and mixtures, and describe the "separating" steps. They revisited their initial ideas about elements and atoms and evaluated their understanding.

Teacher-student conversation

The teacher discusses Deborah's final diagram:

Teacher: In what ways do your diagrams show how your ideas have changed?
Deborah: My first diagram didn't really show that it is pure water and it didn't show that the molecules in the water are all the same.
Teacher: What else did you find out?
Deborah: I found out the size of a molecule is very little; it's so small that you can't see it. And I found out about what the symbols mean, and that scientists use symbols as a way of communicating specific ideas about things.

WHERE TO NEXT?

To move Deborah to the next learning step, the teacher could help her focus on investigating and explaining the changes to materials that occur in other familiar settings, such as in cooking or baking (developing and communicating scientific understanding).

The teacher could ask the class to investigate the history of the development of the theories scientists use to explain the nature of matter (developing and communicating scientific understanding).

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CURRICULUM LINKS

Science in the New Zealand Curriculum
Achievement Objectives

Level 5: Making Sense of the Material World
Students can distinguish between elements, compounds, and mixtures, using simple chemical and physical properties, and describe a simple model of the atom.
Science in the New Zealand Curriculum, page 98
http://www.tki.org.nz/r/science/curriculum/p98_99_e.php

Levels 5 and 6: Developing Scientific Skills and Attitudes
Reporting: Students can present well reasoned, complete reports supported by relevant data in ways, and forms, appropriate to nominated audiences.
Science in the New Zealand Curriculum, page 47
http://www.tki.org.nz/r/science/curriculum/p44_51_e.php

Level 5: Making Sense of the Nature of Science and its Relationship to Technology
Students can use their knowledge of a scientific idea to identify and describe examples of technology in which that idea is applied.
Science in the New Zealand Curriculum, page 34
http://www.tki.org.nz/r/science/curriculum/p34_35_e.php

NCEA (National Certificate of Educational Achievement)

Achievement standards

AS90189: Science 1.4 Describe aspects of chemistry
http://www.nzqa.govt.nz/ncea/ach/science/index.shtml

REFERENCES

Ministry of Education (1993). Science in the New Zealand Curriculum. Wellington: Learning Media.

New Zealand Qualifications Authority (2003). Science 1.4 Describe aspects of chemistry. Accessed from http://www.nzqa.govt.nz/ncea/ach/science/index.shtml

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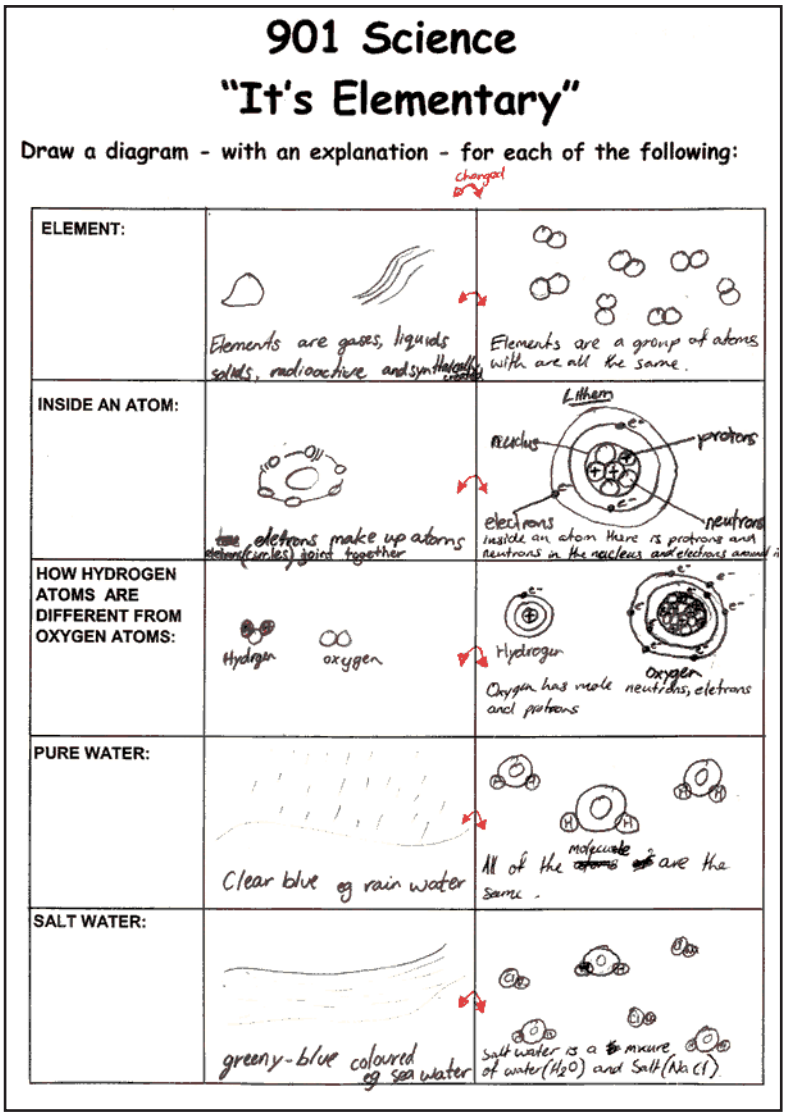
WHAT THE WORK SHOWS

Deborah's diagram of the nature of matter, and her accompanying explanations show how her understanding has developed over the course of the study. She records her initial understanding and in the final diagrams she show changes in her thinking, and how she evaluates her understanding.



Deborah's diagram of the initial and final stages of her work

Progress Indicator

Developing and Communicating Scientific Understanding

Using scientific ideas in constructing explanations
Her drawing to explain the difference between hydrogen and oxygen atoms indicates that she *constructs an explanation for an experience, using appropriate scientific ideas* (L4).

Using scientific vocabulary
Deborah consistently *uses scientific terms and symbols,* and diagrams *appropriately* to communicate her explanation of the particle nature of matter.

Reflecting on their scientific understanding
She *evaluates her own explanations and scientific understanding and the connections she has made*. She has made links to the manner in which scientists work.