Year 9

Conceptual narrative Science: Properties of matter

In the chemical sciences sub-strand, there are two main conceptual threads being developed from Foundation through to Year 10, changes of matter and properties of matter.

Big ideas

Matter is made up of atoms, which are made up of subatomic particles. Changes in the particles of the nucleus of unstable atoms produce radiation.

What concepts do I want my students to understand?

- Matter is made up of atoms.
- Atoms are made up of protons and neutrons in the nucleus, and electrons which orbit the nucleus.
- Change in the nucleus of unstable atoms can release alpha and beta particles and gamma radiation.

Appendix 1 shows how the three interwoven strands, Science Understanding, Science as a Human Endeavour and Science Inquiry Skills, work together to build the sophistication and complexity of the science concepts from Foundation to Year 10.

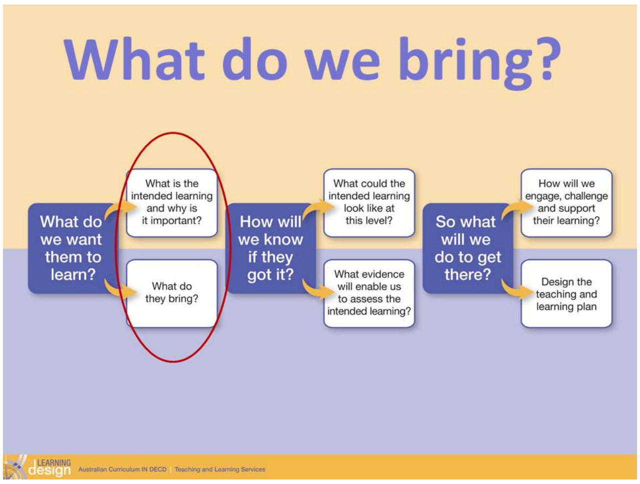
This conceptual narrative illustrates one of the nine science concepts from the Australian Curriculum: Science Content structure*.* It tells the story of the concept in isolation of the eight others. However, there are situations when it is advisable to teach both concepts, (properties of matter and changes of matter) together, because they complement each other.

Note: Not all concepts are specifically addressed in each year level.

Introduction

What might my students already know about this concept?

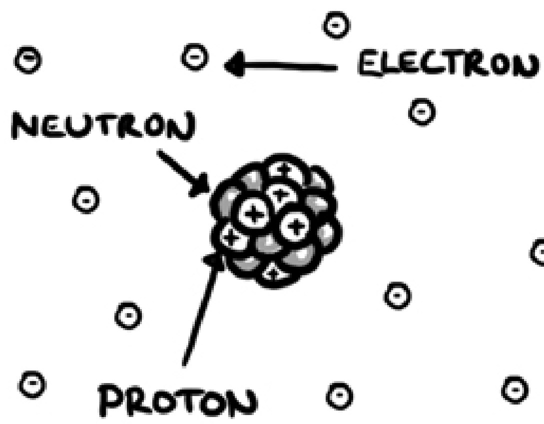
Students are likely to understand that matter is made up of particles and that the arrangement and interaction between these particles, determines the properties of substances.



What content could I use to explore this concept?

We could investigate this concept through investigating issues around nuclear energy and weapons, investigating the history of the development of our understanding of the atoms or looking at different models of the atom.

Now to bring the essence of scientific understanding to life, let's think about this concept through the six questions from the Bringing it to Life tool (BitL).



In Year 9, we want our students to understand that all matter is made of atoms which are composed of protons, neutrons and electrons and that natural radioactivity arises from the decay of nuclei in atoms.

Year 9 example

For this example, I my students will investigate a number of different models of atoms or metaphors of atoms.

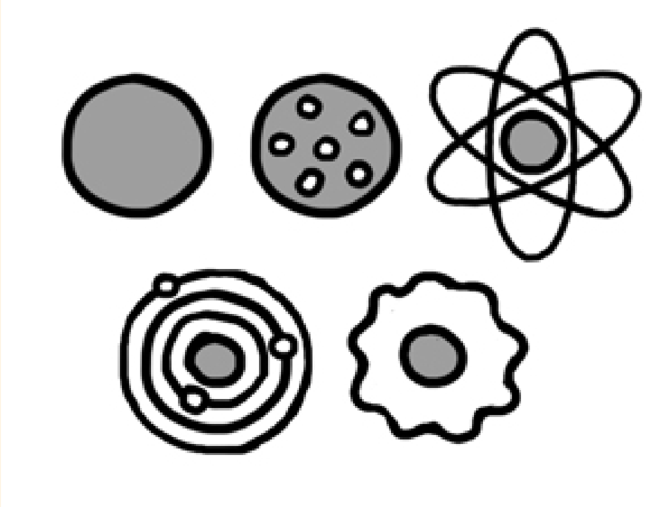
What do you observe?

How can I help my students make observations?

Using the BitL questions, I could ask:

- *What do you observe?*

- *What are the observable similarities and differences between the different models of the atom provided?*
- *What do you notice about the particles in the atom?*
- *What problems are there in making observations of atoms?*
- *What equipment could help scientists get around these?*



What patterns and relationships can you see?

How can I help students to see patterns and relationships? What questions might my students ask?

Student's curiosity leads them to ask questions. These questions help students to order their findings into a pattern to be able to make comparisons or find relationships. These questions support students to be more precise and foster analysis and classification of the observations.

Using the BitL questions, I could ask:

- *What patterns and relationships can you see?*

- *What are the models like?*
- *How are they different from that?*
- *What is a challenging question that you would ask one of those historic scientists?*
- *How might today's technology have changed those scientists' thinking?*

What do you predict might happen?

How can I help students to identify and formulate investigable questions?

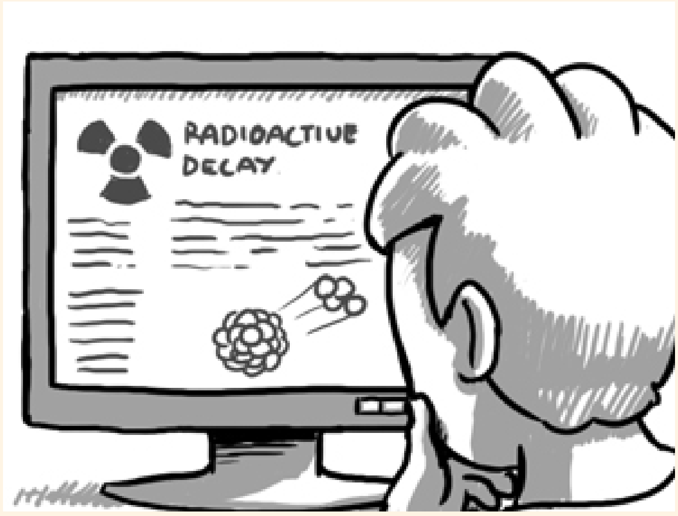
Students ask testable questions that help them to narrow the focus of the inquiry. These questions provide opportunities for students to make predictions.

Using the BitL questions, I could ask:

- *What do you predict might happen?*

At Year 9, I want my students to predict what they think might happen by formulating a scientific testable hypothesis. I might prompt them with:

- *What might happen if the number of particles in an atom were changed?*
- *When might this happen?*



What investigations could you design?

These questions support students to develop science inquiry skills and problem solve.

Using the BitL questions, I could ask:

- *What investigations could you design?*

At Year 9, I want my students to not only know how to use an inquiry approach to answer scientific questions, but to design their own investigations. I would ask the students:

- *How might you test your predictions?*
- *Which variables will you keep constant?*
- *How will you consider fairness?*
- *Which safety and ethical issues should you consider in your investigation?*
- *How could you design a text to challenge the plum pudding (Thomson's) model of the atom or (Rutherford's) solar system model?*

How can you review and communicate?

How can I help students share their observations and questions?

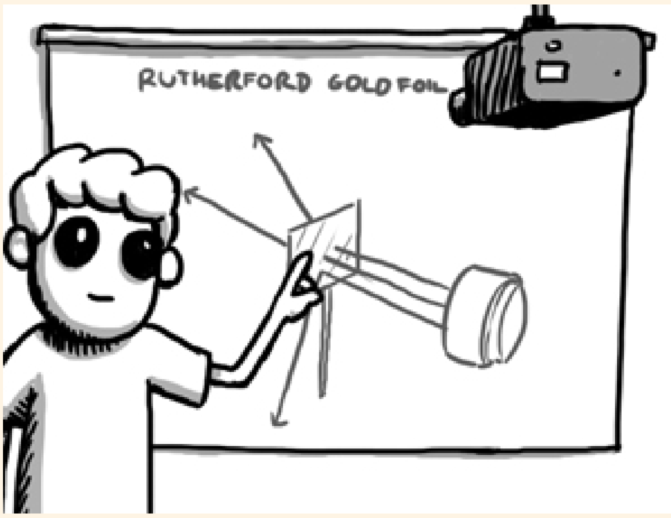
These questions stimulate student's reasoning and help them analyse, draw conclusions and make generalisations about the concepts.

Using the BitL questions, I could ask:

- *How can you review and communicate?*

At Year 9, I want my students to analyse and communicate any patterns they discover, and evaluate their results. I also want them to consider the source of uncertainty in their results and ways to improve the quality of the data. I would ask my students:

- *What new questions might you ask to find out about the model?*
- *What technology could you use to communicate the models?*
- *What are the advantages and disadvantages of the different technologies?*
- *For which audience would the various representations be useful?*



So what? What next?

How can I help students apply the concepts in a rnage of authentic contexts?

These questions support student's reasoning, to expand or change their ideas from their experience and evidence and generalise to new contexts.

Using the BitL questions, I could ask:

- *So what? What next?*
- *Who might be interested in the modelling of atoms? Why?*
- *What else could you investigate about the composition of matter?*
- *Whose theory on the model of the atom is most widely accepted today?*
- *How has technology changed the way we think about the structure of atoms today?*
- *Whose point of view should also be considered? Why?*
- *What new technology might help us to understand this even better?*

Concluding comments

What concepts might students develop through working with the BitL questions in this way?

By exploring this science understanding through these questions, we can help our students to be able to think, work and process scientifically. Students can connect science to their world and consider why they need to learn that matter is made of atoms.

Appendix 1

Appendix 1 shows how the three interwoven strands, Science Understanding, Science as a Human Endeavour and Science Inquiry Skills, work together to build the sophistication and complexity of the science concepts from Foundation to Year 10.

This conceptual narrative illustrates one of the nine science concepts from the Australian Curriculum: Science Content structure. These concepts develop in depth and breadth of understanding from Foundation to Year 10. This conceptual narrative tells the story of the concept in isolation of the eight others. However, there are situations when it is advisable to teach both concepts, (properties of matter and changes of matter) together, because they complement each other.

Note: Not all concepts are specifically addressed in each year level.

Chemical sciences

In the chemical sciences sub-strand, there are two main conceptual threads being developed from Foundation through to Year 10. They are the concepts, properties of matter and change of matter.

Let's look at the properties of matter concept

Foundation

If you think of the composition of matter through Foundation, the focus is that objects in the world are made up of materials, which have properties, for example, a plastic plate is strong compared to a paper plate which can tear easily.

Year 4

At Year 4, the focus is on grouping materials into either natural or processed materials, and explaining how the properties of these materials determine their use. For example, when choosing building materials, wood is a natural material which is strong and can be cut, whereas concrete is a processed material which is also strong but can be moulded.

Year 5

In Year 5, we want students to understand the characteristic properties of solids, liquids, and gases. For example, ice, water, and water vapour are the same substance but differ in whether they have a fixed shape and volume.

Year 7

Year 7 students work with mixtures, to reach the understanding that some substances are pure while others are made up of a number of substances. They mix substances together and then separate them using a range of techniques to get back the substances they started with. For example, salt dissolved in water can be recovered by evaporating the water.

Year 8

At Year 8 level, the properties and behaviour of the states of matter are explained through the motion and arrangement of particles. For example, there is no regular arrangement of particles in a gas, so the particles are well separated, creating free space between the particles, which means that gases can be compressed.

Year 9

During Year 9 we introduce abstract thinking about the concept of matter. We want students to know that all matter is made up of particles, which we call atoms, and understand that atoms are made up of smaller particles called protons, neutrons and electrons. Since we are unable to see these atoms physically with our eyes, it is more complex for students to understand the particle model of matter.

Year 10

Even deeper thinking is required at Year 10. We want the students to be able to understand that the Periodic Table is a way of organising elements based on their atomic structure and properties.

So, from Foundation to Year 10, students broaden and deepen their understanding. They start with the properties of matter in their immediate surroundings and build on those to consider properties of matter in the wider world, and then use abstract models and theories to describe, explain, predict and generalise