Year 7

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

Mixtures, including solutions, are made up of substances mixed together, which can be separated by a range of techniques.

What concepts do I want my students to understand?

- The separation technique used, is based on the physical properties of the substances that make up the mixture, for example filtration separates on particle size, decanting, panning and centrifuging on density, evaporation on volatility.
- The mixture is separated back into the original substances unchanged.
- Other separation techniques include crystallisation, chromatography and distillation.

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

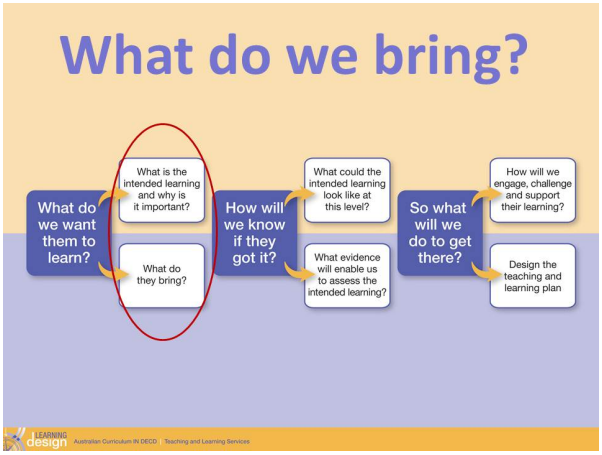
What might my students already know about this concept?

Students are likely to know that materials have different properties and materials can be combined by mixing.

What content could I use to explore this concept?

There are many ways to explore and understand this concept. For example, students could evaporate the water from solutions of salt and water to get back the salt. They could filter suspensions of sand and water, or use a magnet to remove iron filings from sand.

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 7, we want students to understand that mixtures, including solutions, contain a combination of pure substances that can be separated using a range of techniques based on their properties.

Year 7 example

In this example, students will be provided with a mystery white powder (sugar, calcium carbonate and rice) left behind at a crime scene.

What do you observe?

How can I help my students make observations?

Using the BitL questions, I could ask:

- *What do you observe?*

In Year 7, I want my students to make observations using their senses and extend their senses using appropriate equipment. I would ask my students to look closely at the mixture and ask:

- *What do you notice?*
- *What equipment might help your observations?*
- *What different materials do you notice?*
- *What happens when the powder is mixed with water?*
- *How does this change the materials?*

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?*
- *Could there be any substances that you don't notice?*
- *What similarities and differences might there be in the substances?*
- *How are the properties different?*

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?*

In Year 7, I want my students to predict how we might separate the mixture into the original substances. I could ask my students:

- *How could you separate the substances in the mixture?*
- *How could you separate the larger particles from the rest?*
- *What other properties could you use to separate the mixture?*
- *What do you already know or what have you observed that led to your prediction?*

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?*

In Year 7, I want my students to test their predictions by gathering data and use evidence to develop their explanation. I can ask students to make suggestions about how they could investigate their separation of the mixture, for example:

- *Can you separate a mixture without equipment?*
- *What are the safety risks?*
- *Using what you already know, how could you separate the mixture?*
- *Which way will be best?*
- *How do you separate a mixture where the two substances look alike?*

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?*

In Year 7, I want my students to record and communicate their data and thinking about separating mixtures changes, in lists, tables or graphs. I also want them to reflect on their methods. I might ask the students:

- *What are the advantages and disadvantages of the method you used?*
- *How does the data support, or not support science ideas?*
- *Did you experience any difficulties, separating the mixtures?*
- *How could you improve your investigation?*
- *How did you separate the mixture?*
- *What did you learn from this investigation about the properties of substances?*
- *How can the properties of substances be used to separate them from a mixture?*
- *After substances are separated, do they maintain the same properties as before?*
- *Why did you choose to separate the mixture the way you did? Draw a flowchart to show how you separated the mixture.*

So what? What next?

How can I help students apply the concepts in a range 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?*

This concept is important to know in our everyday lives. I could ask my students:

- *What people do you think would know about the separation of mixtures or the properties of substances?*
- *Why would a chemist need to know about the properties of substances?*
- *How could you use the different separation methods to separate other types of mixtures?*

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 mixtures, including solutions, contain a combination of substances that can be separated using a range of techniques based on their properties.

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