Year 6

Conceptual narrative Science: Changes of matter

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

Big ideas

Reversible changes are when you can get back what you started with because it can be undone or reversed. A reversible change might change how a material looks or feels, but it doesn't make new materials. For example: Dissolving is an example of a reversible change. When sugar is mixed in water it looks like it disappears, however, when you evaporate the water you can get back the sugar you started with.

Irreversible changes are when you cannot get back what you started with because it cannot be undone and is a permanent change. In an irreversible change, new materials are always formed. Sometimes these new materials are useful to us. For example: Heating can cause an irreversible change. When you cook a raw egg by heating it, the cooked egg cannot be changed back to a raw egg again.

What concepts do I want my students to understand?

We now want students to understand that changes to materials can be reversible or irreversible.

- Reversible changes are when you can get back what you started with because it can be undone or reversed.
- A reversible change might change how a material looks or feels, but it doesn't make new materials.
- Irreversible changes are when you cannot get back what you started with because it cannot be undone and is a permanent change
- In an irreversible change, new materials are always formed.

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?

Materials can be changed physically in lots of different ways and different materials can be mixed with other materials for a particular purpose. A change of state between solid and liquid can be caused by adding or removing heat.

What content could I use to explore this concept?

There are a number of examples teachers could use to show reversible changes. We could melt chocolate and change it back into solid chocolate, or freeze water to make ice and change it back into liquid water. Other examples:

1) Boiling water in a kettle to make steam. The steam can be collected on a cold glass where it turns back into water as it cools. 2) Add heat to copper sulphate and observe the colour change. Add cold water and you will get back the copper sulphate and colour you started with.

Examples teachers could use to show irreversible changes 1) Burning wood you get ash and smoke but you cannot change the ash and smoke back to wood again. 2) Mixing vinegar and bicarbonate of soda makes lots of bubbles of carbon dioxide. These bubbles and the liquid mixture left behind cannot be turned back into vinegar and bicarbonate of soda again.

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 6, we want our students to build on their understanding that materials can be changed physically in lots of different ways and that by adding or removing heat materials, can change their state of matter. We now want students to understand that changes to materials can be reversable or irreversible.

Year 6 example

In this example, students will mix different substances (flour, salt, sand and Alka-Seltzer) with water.

What do you notice?

How can I help my students make observations?

Using the BitL questions, I could ask:

- *What do you notice?*

In Year 6, we want our students to make observations using senses and equipment to observe the properties of these materials. When students mix different substances with water, I could prompt them to notice by asking:

- *Do these materials look like each other? Or, are they different? How are they different?*
- *What happens when you mix these materials with water? What do you see?*
- *Do you hear anything when they are added to water?*
- *How are their properties changing?*
- *How are they similar to/different from the original 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?*

We want our students to notice the patterns of change of the materials, when they are mixed. To help the students notice the patterns, I could prompt the students by asking:

- *What are the similarities and differences in the properties of the substances when they are added to water?*
- *Is there anything unusual?*
- *If you evaporate off the water, can you get back the materials you started with?*

What do you predict?

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 6, we want our students to test their predictions by gathering data and using the evidence to develop their explanation. I could ask:

- *What do you think will happen if we mix the substances and then heat them?*
- *Could we get back the original substance?*
- *How will we know it's the same substance?*
- *Do you think you could get coffee or sugar back after mixing them with water?*

How can you test it?

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

Using the BitL questions, I could ask:

- *How can you test it?*

We want students to investigate their questions. In Year 6, we want students to use digital technologies in their investinvestigations. I could ask students to make suggestions on how they could investigate their questions. For example:

- *What other substances could you mix with water and check if you can get back the substances we started with?*
- *What will you change/measure/keep the same?*
- *What are the safety risks?*
- *Are there digital or other technologies which may aid your investigation?*

How can you review and communicate?

How can I help students share their observations and questions?

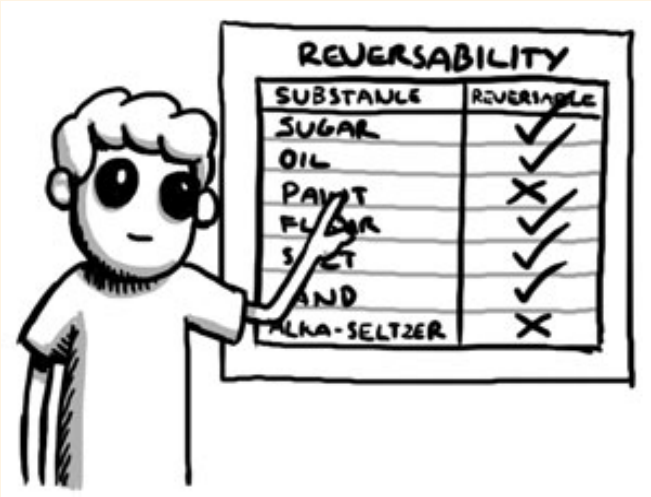
These questions stimulate student's reasoning and help them analyse, draw conclusions and make generalisations about the concepts.

Using the BitL questions, I could ask:

- *How can you review and communicate?*

In Year 6, we want our students to record and communicate their data and thinking about reversible and irreversible changes in lists, tables or graphs. We also want them to reflect on their methods. I might ask my students:

- *What are the advantages and disadvantages of the method you used?*
- *How does the data support (or not) science ideas?*
- *How fair was your investigation?*
- *How could you improve your investigation?*



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?*

We want students to see how scientific knowledge and understandings are used to solve problems that inform personal and community decisions. We want students to see that people from a range of cultures have made important contributions to the advancement of science. I would ask my students:

- *Who might be interested in what happens when substances are mixed with water? Why?*
- *How might this inform decisions about how you store materials?*

This concept important to know for our everyday lives. We could ask students, "Where do you see science in your everyday life?" For example:

- *Where does the salt come from that we put on hot chips?*

When salt is mixed with water, it disappears because it dissolves in the water to make salty water. But we can get the salt back again by boiling or evaporating off the water which leaves the salt behind. The salt company in northern Adelaide, has big salt lakes that bring in seawater. The sun evaporates the water, leaving a big pile of salt which we can then use for our hot chips.

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 the world is made up of different materials.

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 concept, change of matter.

Let's look at the change of matter concept

Year 1

If you think of the change of matter in Year 1, the focus is that everyday materials can be physically changed in many ways, such as, by bending, stretching or heating. For example, plasticine can be stretched, and an ice cream melts when it is left in the sun.

Year 2

In Year 2, this concept is expanded to understand that materials can be changed when they are mixed with other materials for a new purpose. For example, jelly crystals are changed when they are mixed in water to make jelly.

Year 3

In Year 3, the focus is on changes of state associated with heating and cooling. For example, the change of state from solid chocolate to liquid chocolate when heat is added, or liquid water to solid ice, when heat is removed.

Year 6

When students are in Year 6, they investigate and classify a range of changes as physical or chemical. The first type of change is reversible, where you can get back what you started with. For example, when ice melts to become water, the change can be reversed, by freezing. The second type of change is irreversible. With this type of change, you cannot get back the materials you started with. An example of this is burning paper, where you cannot get paper back from the ash formed.

Year 8

At Year 8 level, we want students to successfully use the terms, elements and compounds. Students make compounds, which can have a number of pure substances or elements joined together through chemical reactions. They learn that new substances are formed, when a chemical reaction occurs. As when iron (an element) reacts with oxygen (another element) in the air, the new compound, iron oxide forms, known as rust and is a new substance, from which the original iron can't be easily recovered.

Year 9

In Year 9, we want students to understand changes in the nucleus of the atom, and how unstable atoms can release alpha and beta particles and gamma radiation. We also want students to understand that chemical reactions involve the rearrangement of atoms to form new substances, and that during a chemical reaction, matter is not created or destroyed. This is known as the Law of Conservation of Mass. For example, the role of oxygen in respiration compared to combustion of butane.

Year 10

Even deeper thinking is required at Year 10. We want the students to be able to understand that there are many different types of chemical reactions which can produce a range of products, and can happen at different rates, depending on the conditions. For example, iron and steel are both produced from iron ore.

So, from Foundation to Year 10, students broaden and deepen their understanding of changes of matter. They start with familiar materials and build on those to consider a wide range of changes and then classify them as physical or chemical. By Year 10, they are able to use particle and atomic theories to explain and classify these changes.