Year 10

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

Different types of chemical reactions are used to produce a range of products and can occur at different rates.

What concepts do I want my students to understand?

- Chemical reactions are used to produce particular products.
- Different factors such as temperature, light, size of particles, adding a catalyst influence the rate of reactions.
- Rate of reaction is how fast the reaction proceeds.

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

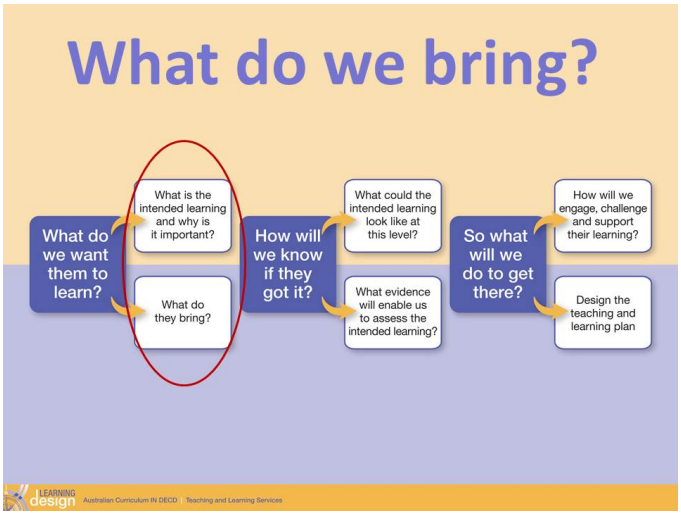
What might my students already know about this concept?

Element, mixture and compound. Compounds can have a number of pure substances or elements joined together through chemical reactions. New substances are formed when a chemical reaction occurs. Law of Conservation of Mass.

What content could I use to explore this concept?

We could learn this concept by observing the effects on the rate of a chemical reaction by adding a catalyst, or increasing the temperature, or increasing the light.

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 10, we want our students to understand that different types of chemical reactions are used to produce a range of products and can occur at different rates.

Year 10 example

In this example I want my students to investigate how an iodine clock involves a chemical reaction that suddenly turns blue due to the formation of an iodine-starch complex. The colour change occurs abruptly, like an alarm clock ringing! Students would repeat this investigation using two different amounts of potassium iodate.

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 10, I want my students to make observations that change over time and geographically, using equipment to extend their senses. I would ask my students to watch their clock solution, and describe what they see happening. Questions I may ask:

- *What equipment is required to make accurate measurements?*
- *What happens when we increase the amount of potassium iodate by 10mL?*
- *What changes do you notice?*

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?*

In Year 10, I want my students to identify patterns and start to form generalisations from their observations and data. Questions I might ask:

- *What do you think is happening and why?*
- *How does the amount of potassium iodate added, influence the rate of the reaction?*

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?*

In Year 10, I want my students to formulate a scientifically testable hypothesis. I may suggest:

- *Can you predict the volume of potassium iodate needed to make the clock change colour in 25 seconds? Or, does the temperature of the solution affect the rate of the reaction?*

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 10, 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?*
- *How could you measure your results?*
- *What equipment could you use that will improve the accuracy of your data?*
- *How will you keep yourself and others safe in this investigation?*

How can you review and communicate?

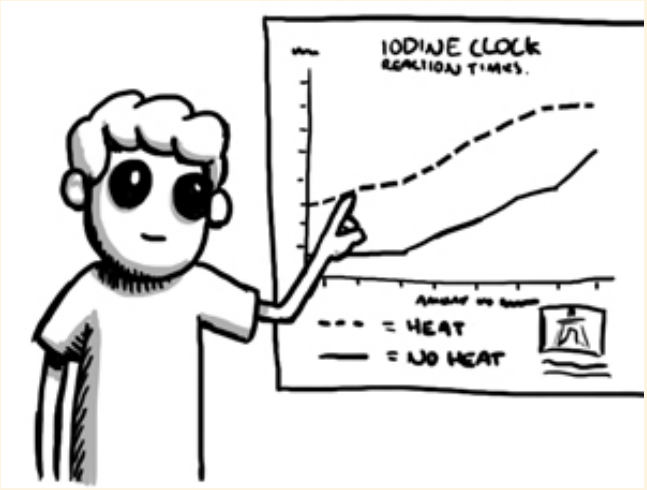
How can I help students share their observations and questions?

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?*

At Year 10, I want my students to analyse patterns in the data to generalise and justify their conclusion, based on evidence and scientific theories. Questions I could ask my students are:



- *How can you best represent and identify trends in the data you collected?*
- *Which graph would probably give a more accurate prediction of the amount of potassium iodate solution needed to make the iodine clock 'ring' in 25 seconds? Explain.*
- *Were your results consistent with your hypothesis?*
- *How close did the actual reaction time come to the predicted time of 25 seconds?*
- *How do your findings align with the findings of others?*
- *What possible sources of error in this investigation may have led to longer or shorter reaction times?*
- *What can you infer from the data? What generalisation can you make?*
- *How can you justify your conclusion?*

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?*
- *Can you write a general statement describing the effect of the reactant concentration on the rate of a reaction?*
- *Who might need to know this and why?*
- *How can scientific models be used to predict the effects of reaction rates in chemical reactions?*
- *Why might an industry employ a chemist who understands about the factors that affect the rates of reactions?*

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 different types of chemical reactions are used to produce a range of products and can occur at different rates.

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.