Year 8

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

A model of matter is made up of particles and can be used to explain and predict the properties and behaviour of the states of matter.

What concepts do I want my students to understand?

- The properties and behaviour of the states of matter are explained through the motion and arrangement of particles.
- The particles in solids are: very close together, arranged in a regular pattern, unable to move from place to place, but can vibrate in a fixed position, held together by strong forces called bonds. Which explains why solids: have a fixed shape because the particles cannot move from place to place; cannot be compressed because the particles are very close together, and have no space to move into.
  The particles in liquids are: close together, arranged randomly , able to move around each other, Held together by bonds in a liquid strong enough to keep the particles together, but weak enough to let them move around. Which explains why liquids: can flow and change shape because the particles can move around each other; cannot be compressed because the particles are close together, and have no space to move into.
  The particles in gases are: far apart, arranged randomly, can move freely in all directions, held together by only very weak bonds. Which explains why gases:flow, and completely fill their container because the particles are free to move quickly in all directions; can be compressed because the particles are far apart, and have space to move into.

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

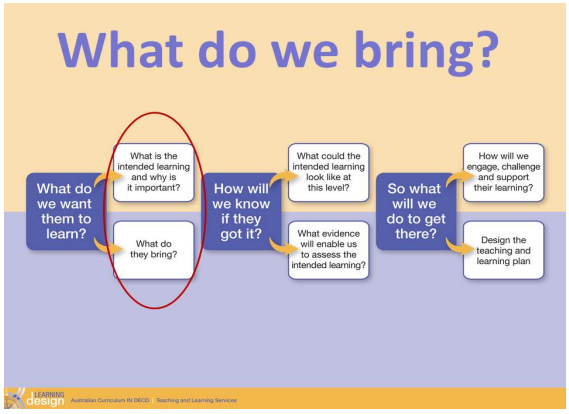
What might my students already know about this concept?

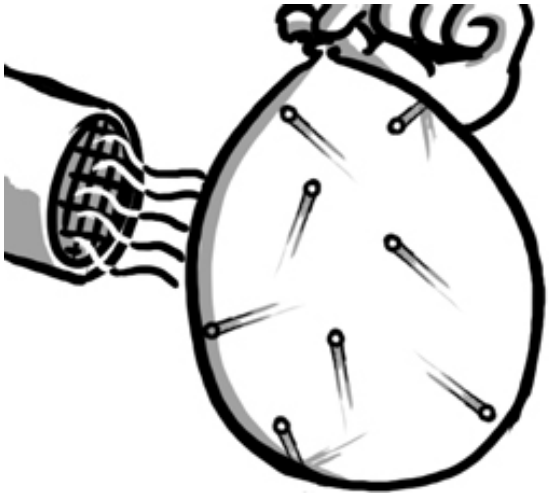
Substances can be changed physically and chemically. Reversible changes are when you can get back what you started with, whereas irreversible changes are when you cannot get back what you started and new materials are formed.

What content could I use to explore this concept?

We could learn this concept in many different ways, such as a role play, or modelling of the arrangement and motion of particles as they are heated, using digital simulations of particle behaviour or heating different liquids and comparing their expansion rates.

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).





The science understanding at Year 8 level is that the properties and behaviour of the states of matter are explained through the motion and arrangement of particles.

Year 8 example

For this example, I want my students to investigate the expansion and contraction of a sample of gas in a balloon which is a flexible container. I want the students to blow up two balloons until they are quite stretched but the same size, then heat the outside of one balloon with a hair dryer while placing the other balloon in the freezer.

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 8, I want my students to make observations of the balloons. Questions I could ask my students are:

- *What happened to each balloon?*
- *What changes happened to the balloon when it was heated? When it was cooled?*
- *Did they change shape? If so, what is making the balloon do this?*
- *How did the size change?*
- *How could you measure this?*

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 8, I want my students to ask scientifically investigable questions and identify patterns and relationships in what they observe.

I may prompt them by asking:

- *Did you see what you expected?*
- *What might be happening inside the balloon?*
- *How might particles be involved?*
- *At which point in this activity were air particles in each balloon farthest apart? Closest together?*
- *In which balloon do you think the particles had the most energy? Why?*

- *In what way might particle movement have particle movement have changed for this to have been observed?*
- *Would collisions between particles have increased, decreased or stayed the same? Why?*
- *What questions do you have?*

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 8, I want my students to make predictions based on scientific knowledge. In this example I want my students to predict what will happen if they filled a balloon with water, instead of air. I could ask my students:

- *How might the behaviour of the balloons be different from when they had air in them?*
- *What might be the difference in the particles?*
- *How might it be different if we filled a plastic bag instead of a balloon? Why?*

What investigations could you design?

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

Using the BitL questions, I could ask:

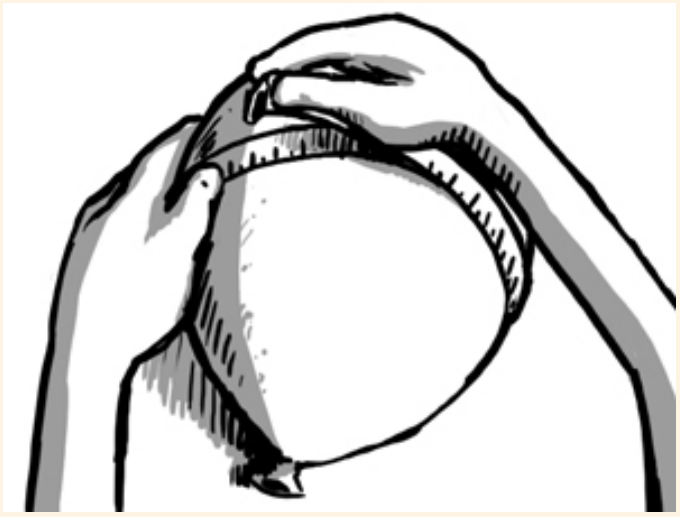
- *What investigations could you design?*

In Year 8, I want students to design a fair test based on their predictions. Questions I might ask my students are:

- *Which variable are you going to test?*
- *How will you control the other variables?*
- *What are you going to measure?*
- *How can you organise your data?*

I may suggest investigating whether the balloons can be compressed.

- *Does the water take up toe shape of the balloon?*



How can you review and communicate?

How can I help students share their observations and questions?

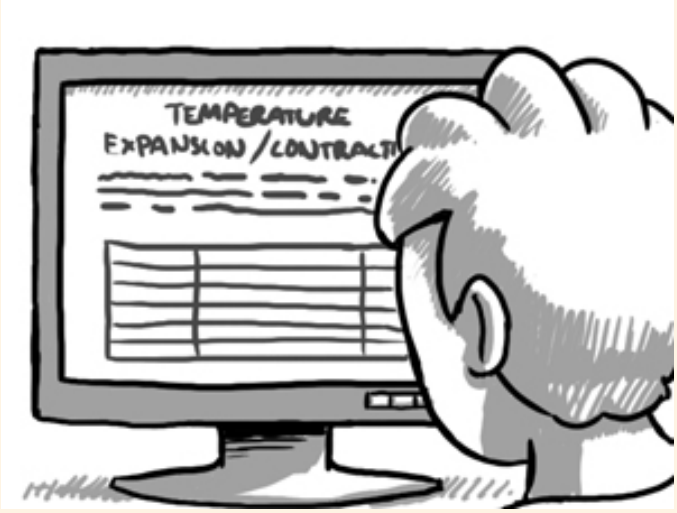
These questions stimulate student's reasoning and help them analyse, draw conclusions and make generalisations about the concepts.

Using the BitL questions, I could ask:

- *How can you review and communicate?*

I could ask them:

- *Where there any differences between your hypothesis and your conclusion?*
- *If so, what were they?*
- *How has your thinking changed?*



So what? What next?

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

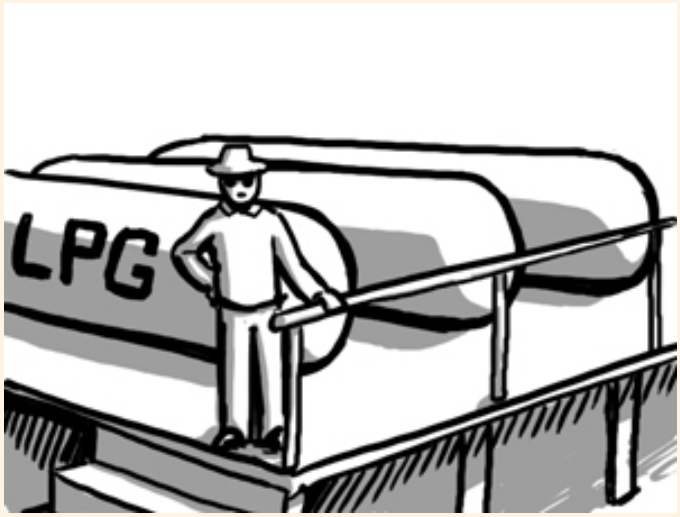
These questions support student's reasoning, to expand or change their ideas from their experience and evidence and generalise to new contexts.

Using the BitL questions, I could ask:

- *So what? What next?*

In Year 8, I want my students to start thinking about where this knowledge may be useful in society. I could ask my students:

- *Who might know this? Why?*
- *When are people concerned with how containers of liquids and gases behave?*



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 behaviour of solids, liquids and gases can be explained and predicted using a particle model.

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