Year 5

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

All matter takes up space and has mass. Classification of matter includes solids, liquids and gases and these have different observable properties and behave in predictable ways.

What concepts do I want my students to understand?

- There are three states of matter, solids, liquids and gases.
- Solids have definite shape and volume.
- Liquids have a defined volume but take the shape of their container.
- Gases take both the volume and shape of their container.
- Liquids and gases (fluids) flow.

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.

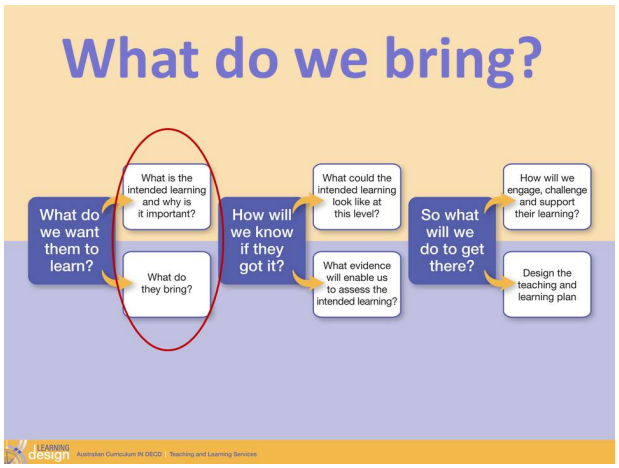
Introduction

What might my students already know about this concept?

There are 3 states of matter: solids, liquids and gases.
Solids have a definite shape and volume
Liquids have a defined volume but take the shape of their container
Gases take both the volume and shape of their container
Liquids and gases (fluids) flow.

What content could I use to explore this concept?

We could learn these concepts through observing the effect of temperature on the different states of a substance or using an online interactive simulation.



The science understanding for students at Year 5 level is that solids, liquids and gases have different observable properties and behave in different ways.

Year 5 example

In this example, my students will observe three glass jars, one containing water as vapour, another as a liquid and another as ice.

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 5, I want my students to observe similarities that change over time. Questions I would ask my students are:

- *What are the properties of these materials?*
- *What are their shapes? Volumes?*
- *How might these materials behave?*
- *What happens if you tilt each container?*
- *What equipment might help you to make observations of the properties of these materials?*
- *How are these properties changing?*

What patterns and relationships can you see?

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

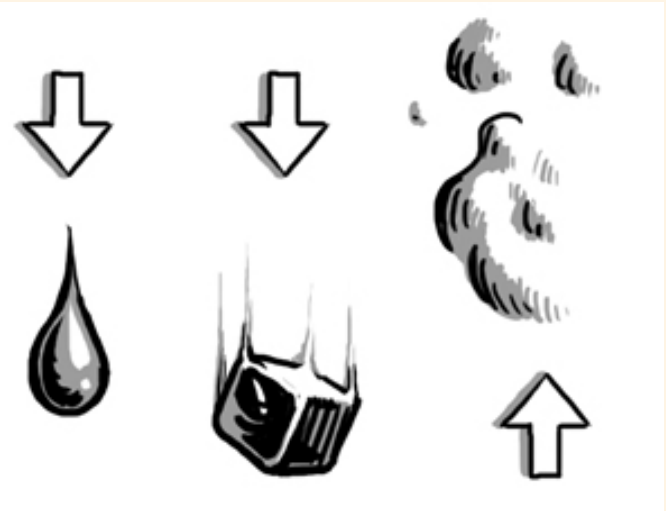
Student's curiosity leads them to ask questions. These questions help students to order their findings into a pattern to be able to make comparisons or find relationships. These questions support students to be more precise and foster analysis and classification of the observations.

Using the BitL questions, I could ask:

- *What patterns and relationships can you see?*

I could ask:

- *What are the similarities and differences in the properties of ice, water and water vapour?*
- *How can you change water from one state to another?*
- *Does water always behave like this? When doesn't it?*
- *What else behaves like this?*
- *Is there anything unusual?*
- *What questions do you have about solids, liquids and gases?*



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 5, I want my students to predict findings of an investigation.

- *What might happen if water is heated on a stove?*
- *What causes this?*
- *How might an ice cube put in water, behave differently to one left in an empty dish? Why do you think this?*
- *Scientists think that temperature causes a change of state. How does this relate to what you know about 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?*

In Year 5, I want the students to develop a fair test, so they can investigate the cause and effect between variables. To help students understand a fair text, I could prompt them by asking:

- *What happens to the change of state when we dissolve other materials in water?*
- *How might you investigate this?*
- *What will you change / measure / keep the same?*
- *What are the safety risks?*
- *What technology will help you with your investigation? How?*

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 5, I want my students to identify how scientific discoveries are used to solve problems that directly affect peoples' lives. To do this, I could ask students:

- *How do you use lists, tables or graphs to record and communicate your data and thinking about ice, water and water vapour?*
- *What are the advantages and disadvantages of each method?*
- *How could science ideas about change of state, help you explain the data?*
- *How does the data support, or not support science ideas?*
- *How fair was your investigation?*
- *How could you improve it?*

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?*
- *Who might be interested in water changing state? Why?*
- *How might this inform thinking about climate change or keeping your drink bottle colder, or keeping food safe?*
- *What else about the different states of matter could you investigate?*

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 solids, liquids and gases have different 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.