Year 9

Conceptual narrative Science: Energy

In the physical sciences sub-strand, there are two main conceptual threads being developed from Foundation through to Year 10, energy and forces and motion.

Big ideas

Models can be used to explain transfer of energy through different media.

What concepts do I want my students to understand?

- Use wave and particle models to explain energy transfer through different media.
- Use the particle model to explain conduction and convection of heat.
- Heat transfer by radiation.
- Use wave model to explain the transfer of sound through different mediums.

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 (energy and forces and motion) together, because they complement each other.

Note: Not all concepts are specifically addressed in each year level.

Introduction

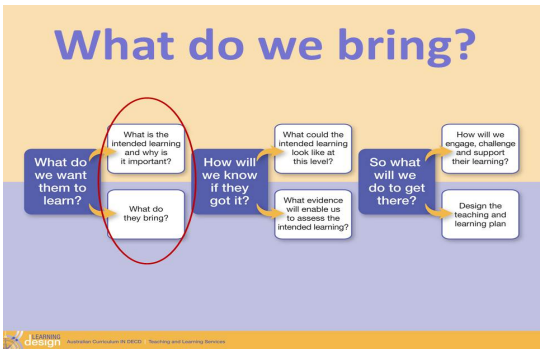
What might my students already know about this concept?

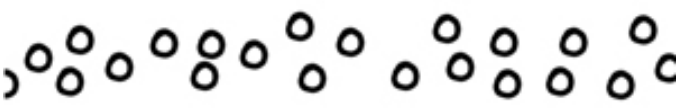
Students are likely to be aware that heat and light energy are produced by sources, and their transfer is inhibited by some materials and is promoted by others. We now want students to understand that electricity, like other energy, is produced by a range of sources and can be transferred from one place to another. There are different forms of energy, including movement (kinetic energy), heat and potential energy, and they can cause change within systems.

What content could I use to explore this concept?

We could investigate the transfer of heat through the processes of convection, conduction and radiation, or we could investigate the transfer of energy through an electric circuit or explore the properties of light waves.

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 9, we want our students to understand that energy is transferred through different mediums like air, water and metal and can be explained using particle models.

Year 9 example

In this example I am going to use sound energy. My students can make different sounds, by using plastic bottles with different amount of water. They can then relate their findings to the length waves.

What do you observe?

How can I help my students make observations?

Using the BitL questions, I could ask:

- *What do you observe?*

At Year 9, I want my students to critically review what they observe, and use equipment to aid their observations. In this example, I want my students to observe that sound energy is transferred through different mediums and makes waves. Questions I could ask my students are:

- *What do you notice about the sound when you blow into the bottle?*
- *What do you notice when you hit the bottle? Is it loud or soft, high pitched or low pitched? Does it vibrate?*
- *Does the sound change if you hold the bottle?*
- *What happens to the water?*
- *What do you observe if you use Audacity audio recording software to look at the sound pattern of blowing over the bottles?*
- *How is it different with different bottles?*

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 want my students to notice the relationship between the different amounts of water and the sound produced. I could ask the students:

- *How does the sound change with different amounts of water?*

I want my students to ask their own questions from what they notice, and formulate an investigable question.

- *Can you see any patterns when you compare different pitches using Audacity?*
- *How do the ideas of wavelength, frequency and amplitude simplify your search for patterns?*

What do you predict might happen?

How can I help students to identify and formulate investigable questions?

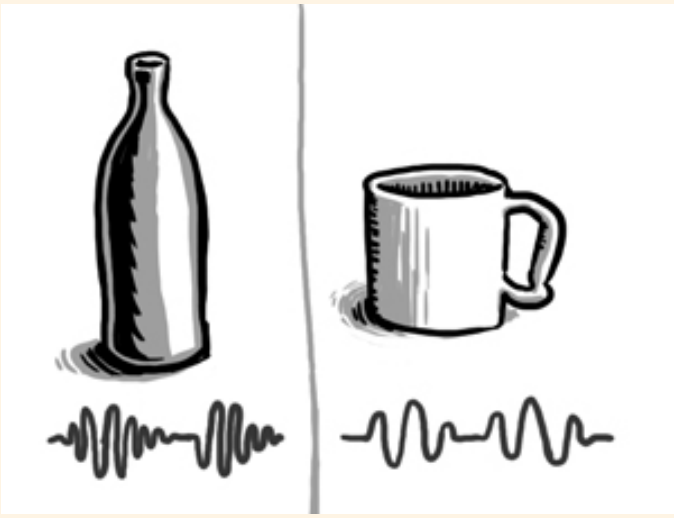
Students ask testable questions that help them to narrow the focus of the inquiry. These questions provide opportunities for students to make predictions.

Using the BitL questions, I could ask:

- *What do you predict will happen?*

In Year 9, I want my students to formulate a hypothesis which can be scientifically tested. I could prompt them with questions like:

- *What might happen if the bottles were glass?*
- *How might that change the sound?*
- *How does the wavelength change?*



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 9, 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:

- *Which prediction will you test?*
- *How might you test your prediction?*
- *What will you change? Which variables will you keep constant?*
- *How will you consider fairness?*
- *How could measure your results?*
- *What equipment could you choose that will improve the accuracy of your data?*
- *How might you use Audacity audio recording software to measure the sound amplitude or frequency?*

How can you review and communicate?

How can I help students share their observations and questions?

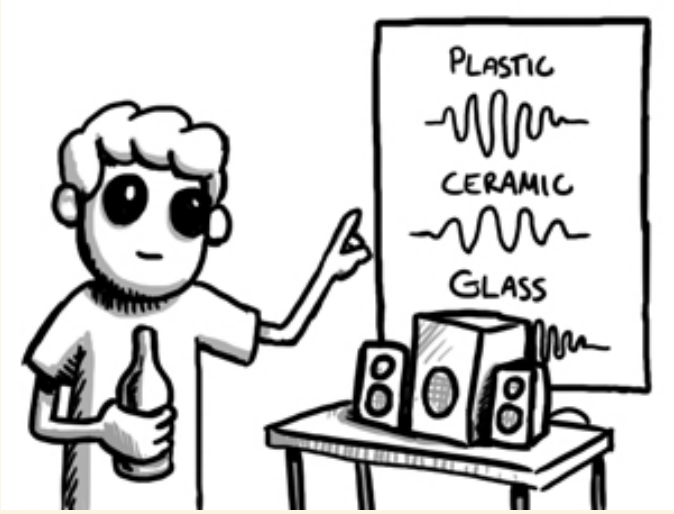
These questions stimulate student's reasoning and help them analyse, draw conclusions and make generalisations about the concepts.

Using the BitL questions, I could ask:

- *How can you review and communicate?*

At Year 9, I want my students to analyse and evaluate the data they collected, and communicate any patterns they identified. I also want them to consider the source of uncertainty in their results and ways to improve the quality of the data. I would ask my students:

- *Do you think differently about your prediction? If so, how?*
- *How might someone else explain the same phenomenon?*
- *What new questions might you ask to find out more about sound waves?*



So what? What next?

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

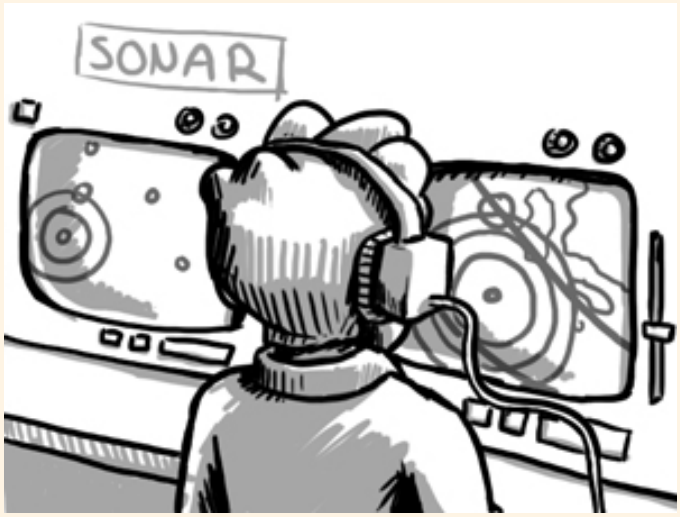
These questions stimulate student's reasoning and help them analyse, draw conclusions and make generalisations about the concepts.

Using the BitL questions, I could ask:

- *So what? What next?*

In Year 9, I want my students to discuss possibilities for the future and how technological advances have changed the way we think about this scientific ideas.

- *Who might be interested in sound waves and how they travel and change in water?*
- *In what careers would this be useful?*



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 how sound energy transfer, through different mediums, can be explained using wave and particle models.

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 (energy and forces and motion) together, because they complement each other.

Note: Not all concepts are specifically addressed in each year level.

Physical sciences

In the physical sciences sub-strand, there are two main conceptual threads being developed from Foundation through to Year 10. They are the concepts, energy and forces and motion. Let's look at the concept, energy.

Year 1

This begins in Year 1, where students investigate familiar forms of energy, such as light and sound. Students learn that objects can only be seen when they are illuminated by light. Students sense light coming from the sun, and sound coming from a phone. Students explore how they can make sounds, such as clapping their hands.

Year 3

In Year 3, students learn about heat, another form of energy. They learn that things produce heat, and heat moves from one object to another. For example, if you are feeling cold, you can stand in front of a fire to warm up. The heat from the fire moves to your body.

Year 5

At Year 5, there is a deeper understanding of how light energy is transferred. The focus is on how light can be reflected, such as when a light beam reflects off a mirror, or refracted, such as when a light beam is bent as it moves from the air into water so a ruler looks bent in a glass of water, and absorbed, such as when the curtains get warmed up as the light shines on them. Students also learn how light from a source forms shadows.

Year 6

In Year 6, the energy focus is on electricity and students learn that it can come from many different sources such as wind, solar cells or from burning fossil fuels. They also learn electrical circuits provide a means of transferring electrical energy through wires, and electrical energy can be transformed into light energy to light up a globe.

Year 8

In Year 8, students learn to classify the different forms of energy, such as kinetic, potential and heat energy which cause change to systems. Students learn that heat energy is often produced as a by-product of energy transfer, which can be illustrated in flow diagrams showing energy transformations that occur in every day appliances. For example, an iron transforms electrical energy into heat energy to iron your clothes.

Year 10

In Year 10, students generalise their thinking to use the law of conservation of energy, where they learn that energy cannot be created or destroyed. They account for energy transfer and transformation within systems and explain how no system is 100% efficient.

So from Year 1 to Year 10, students broaden and deepen their understanding of energy as they move from concrete to abstract thought. They use laws and models to describe predict and generalise.