Year 10

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

The law of conservation of energy explains that total energy is maintained in energy transfer and transformation.

What concepts do I want my students to understand?

- Law of conversation of energy - energy cannot be created or destroyed.
- Energy transfer and transformations in systems is not 100% efficient.

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.

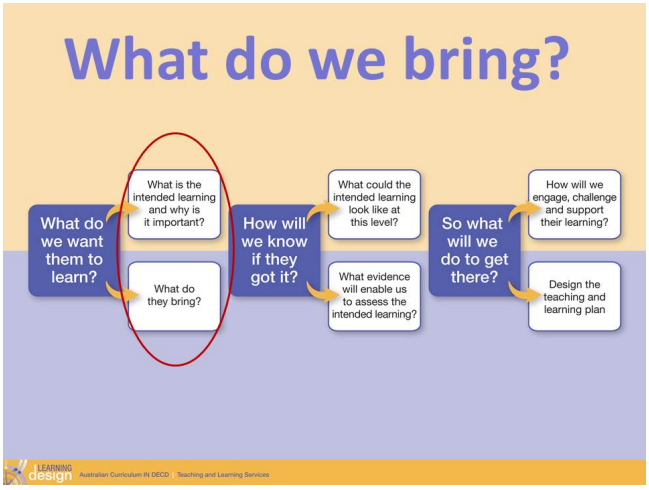
This conceptual narrative illustrates one of the nine science concepts from the Australian Curriculum: Science Content structure. It tells the story of the concept in isolation of the eight others. However, there are situations when it is advisable to teach both concepts (energy and forces and motion) 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?

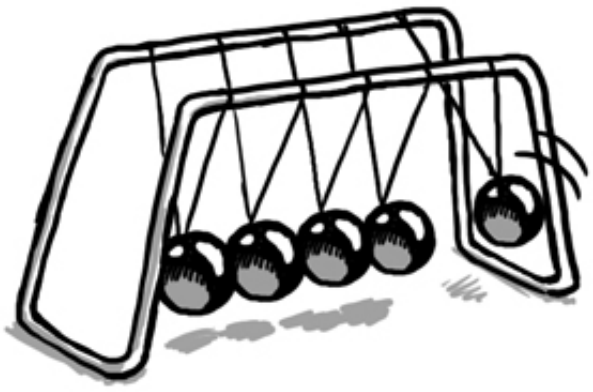
Students are likely to be aware that heat and light energy are produced by sources and their transfer is inhibited by some materials and promoted by others. Electricity like other energy is produced by a range of sources and can be transferred from place to another. There are different forms of energy including movement (kinetic energy), heat and potential energy, and they can cause change within systems. Energy is transferred through different mediums like air, water and metal and can be explained using wave and particle models.



What content could I use to explore this concept?

We could investigate energy transfer and transformation in car crashes, desk lamps or refrigerators.

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 energy transfer and transformation explains that energy is conserved in a system.

Year 10 example

In this example, I am going to use refrigerators. Students will observe a refrigerator in operation at home or at school.

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 10, 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 fridges transform electrical energy into a range of other forms. Questions I could ask my students are:

- *What do you notice when the fridge is switched on?*
- *When the door is opened?*
- *What happens if you use an energy meter to record how much electricity is being used?*

What patterns and relationships can you see?

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

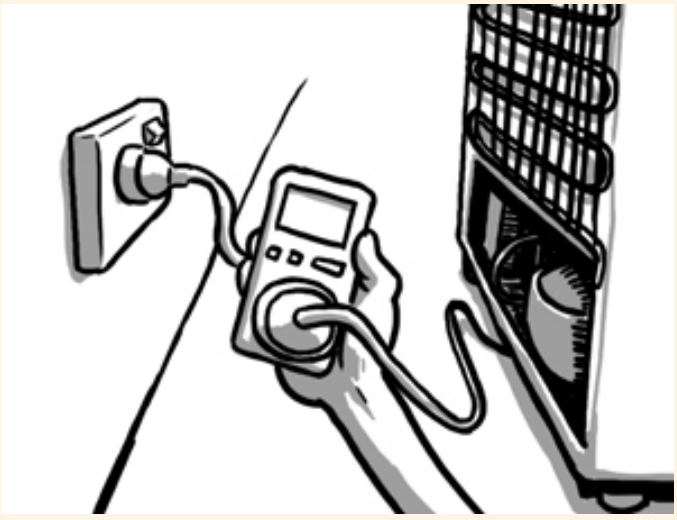
Student's curiosity leads them to ask questions. These questions help students to order their findings into a pattern to be able to make comparisons or find relationships. These questions support students to be more precise and foster analysis and classification of the observations.

Using the BitL questions, I could ask:

- *What patterns and relationships can you see?*

In Year 10, I want my students to notice the relationship between the different energy transformations and the amount of electrical energy used. I could ask the students:

- *What do you see and hear when the fridge is switched on? After it has been on for a while? When you open the door?*
- *What changes are there in the electricity use?*



What do you predict will 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 10, I want my students to hypothesise, predict what might happen with the question they formulated and think about whether their hypothesis be scientifically tested. I could prompt them with questions like:

- *What might happen if you put something hot into the fridge? If the room temperature changed? If the fridge was full or empty?*

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:

- *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 can you review and communicate

How can I help students share their observations and questions?

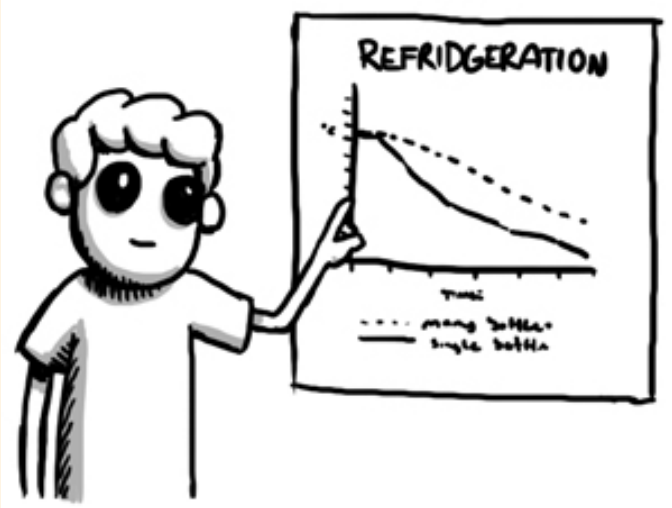
These questions stimulate student's reasoning and help them analyse, draw conclusions and make generalisations about the concepts.

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. I would ask my students:

- *Do you think differently about your prediction? If so how?*
- *How might someone else explain this same phenomenon?*
- *What new questions might you ask to find out more about energy transfer in systems?*



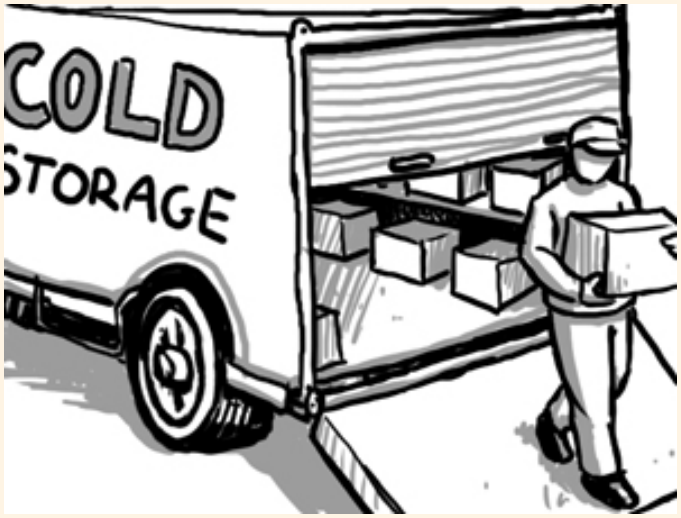
So what? What next?

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 what careers would this be useful?*
- *What general statement could you write to describe how usable energy can be reduced, when a system is not 100% efficient?*
- *Who might need to know this and why?*
- *How can scientific models be used to predict the energy transformations?*



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 energy transfer and transformation explains that energy is conserved in a system.

Appendix 1

Appendix 1 shows how the Science as a Human Endeavour strand develops in sophistication and complexity across 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.

Let's look at the concept energy

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.