Foundation

Conceptual narrative Science: Forces and motion

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

Objects move in different ways.

What concepts do I want my students to understand?

- Objects move when forces act on them.
- How an object moves depends on its size and shape.

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

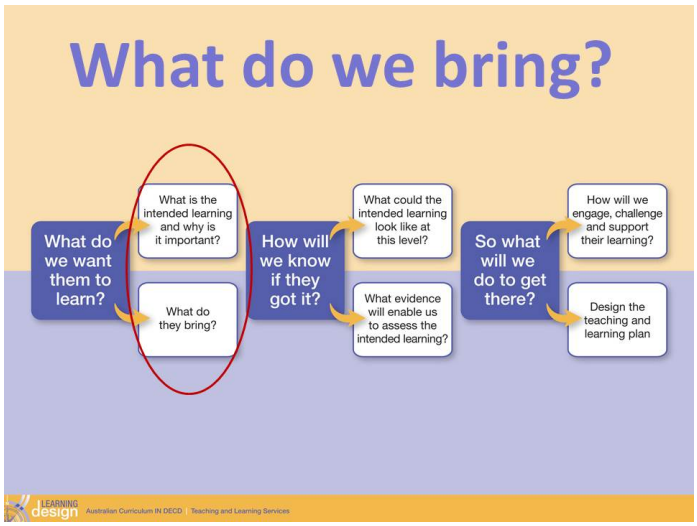
What might my students already know about this concept?

Students are likely to have experience of how toys and other objects move.

What content could I use to explore this concept?

There are many ways to investigate this concept. We could compare how balls such as marbles, tennis balls, and basketballs move and how that relates to their size and shape.

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).



At Foundation, we want our students to understand that the size and shape of an object affects how it moves.

Foundation

In this example, I want my students to participate in a rolling competition. My students will compare balls and see which ones roll the furthest before they have a "roll off".

What do you notice?

How can I help my students make observations?

Using the BitL questions, I could ask:

- *What do you notice?*

In Foundation, I want my students to make observations using their senses. Questions I could ask are:

- *What do you see, hear and feel when you roll the ball?*
- *What does the ball do?*
- *Does it roll in a straight line?*
- *What is interesting about what you have experienced?*
- *Which ball rolled the furthest? How far did it go?*
- *Which balls rolled the fastest?*
- *Which ones made the most noise?*

What do you think?

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 do you think?*

I want my students to ask questions about what they notice. I could prompt them by asking:

- *What is the same about the balls that roll a long way? What is different?*
- *Does the size matter?*

What do you think if?

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 think if...?*

Some students in Foundation may be able to use patterns to make predictions. Questions I might ask my students are:

- *What do you think if we used a smaller ball?*
- *What do you think if we used a lighter ball?*
- *What do you think if we kicked or pushed the ball along the ground?*
- *What do you think might happen if we rolled the balls down a slope?*

How can you explore?

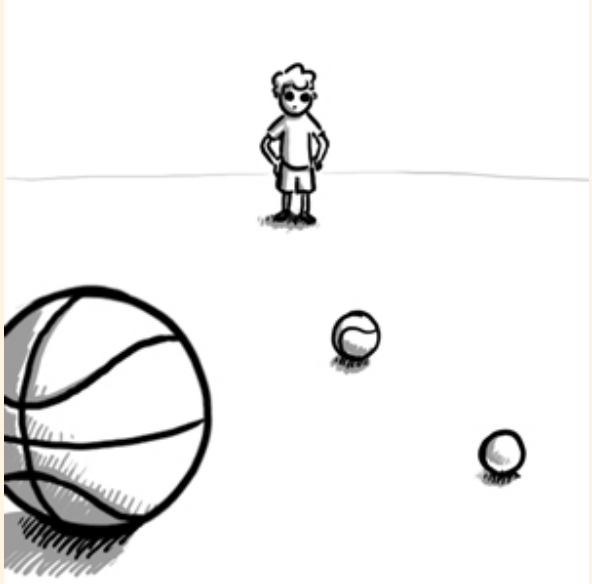
These questions support students to develop science inquiry skills and problem solve.

Using the BitL questions, I could ask:

- *How can we explore?*

In Foundation, I want my students to start exploring their questions and predictions.

- *How are you going to find out which size and shape of ball moves the furthest?*
- *What are your ideas? Which is your best idea?*
- *How could you test your idea?*



How can you share?

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 share?*

In Foundation, students represent their observations and findings through discussion, role plays and drawing. Questions I could ask my students are:

- *How could you record how far each ball rolled?*
- *Can you draw a diagram to show what happened?*
- *Did anyone else find different balls that rolled a long way? What did they find?*

So what?

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

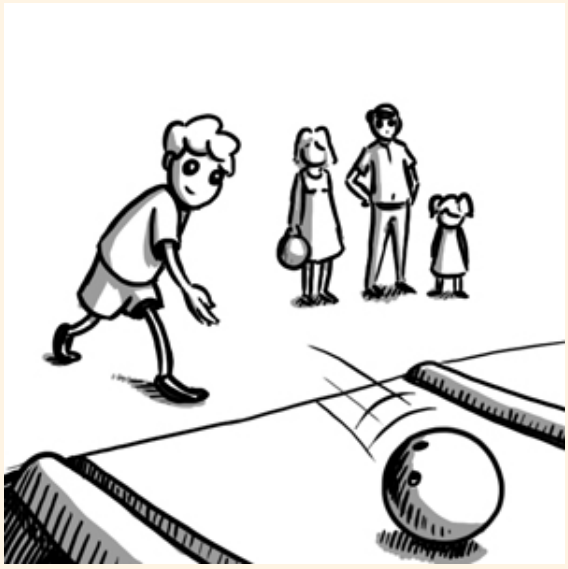
These questions support student's reasoning, to expand or change their ideas from their experience and evidence and generalise to new contexts.

Using the BitL questions, I could ask:

- *So what?*

It is important to connect the concept to their everyday lives so they can see why it is important to know this.

- *Why do you need to know about how different ball roll?*
- *Where do you see balls around you?*



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 think, work and process scientifically. Students can connect science to their world and consider how heat energy is produced and is able to move from one object to another. Students can connect science to their world and consider why they need to learn that size and shape affect how things move.

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 forces and motion.

Foundation

In the Foundation year, students look at the way objects move, and how they move depends on their size and shape. For example, different balls like footballs, tennis balls and table tennis balls roll differently depending on their size and shape.

Year 2

In Year 2, students learn that movement is caused by either a push or a pull, and that it takes a bigger push to move a brick than a lunch box. They also learn that you can change the shape of some objects when a push or pull force is applied.

Year 4

In Year 4, students group forces as contact forces and non-contact forces. Examples of forces acting on contact are, a bat striking a ball or friction, where one object rubs against another object, like when you get a carpet burn. An example of a non-contact force is the pull of a magnet on paperclips.

Year 7

Year 7 is when students look at common situations where a balanced or unbalanced force cause changes to an object's motion. An example of a balanced force is a tug-of-war where the force exerted by the two teams is equal and it is clear that neither team will win. We say the forces on the rope are balanced, when the rope stays still. However, if the forces on the rope are unbalanced we can see a different effect. If in the tug-o-war and one side exerts greater force than the other, then the forces on the rope are unbalanced and the rope starts to move in the direction of the greatest force.

Year 10

At Year 10, students use Newton's laws to describe and predict motion and use mathematics to quantify this. Force is equal to, the mass times the acceleration, and speed is equal to distance divided by time. These are equations that students use to describe the effects of interactions between objects. They extend the application of force to other scales, including forces between atoms and between stars and planets.

So from Foundation to Year 10, students broaden and deepen their understanding by building on from their learning about forces and the motion of familiar objects, to consider a wider range of forces and then use laws and mathematical models to describe, predict and generalise.