Year 7

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

Change to an object's motion is caused by unbalanced forces acting on the object. Students model and explain concepts of balanced and unbalanced forces.

What concepts do I want my students to understand?

- Constant motion is when an object is not changing its speed or direction. That is, it's moving at the same rate, in the same direction and includes objects which are stationary.
- Constant motion occurs when forces are balanced. If forces are unbalanced, there will be a change in speed and/or direction of movement.

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

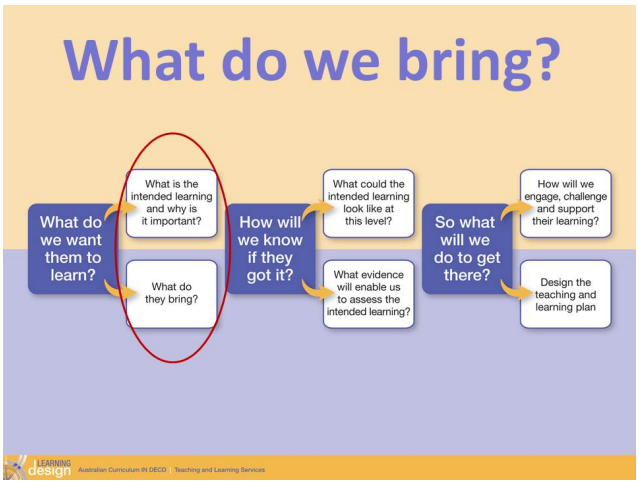
What might my students already know about this concept?

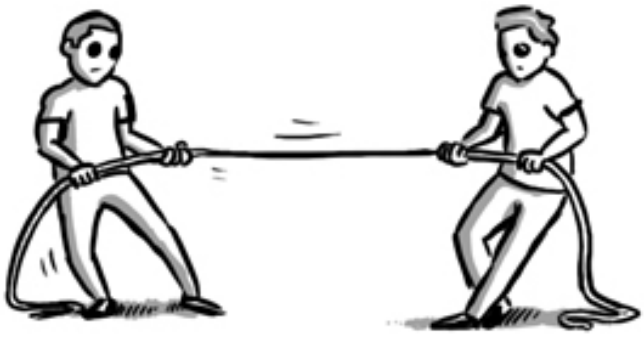
Students may know that forces are pushes or pulls, and that some forces act on contact, whereas others act at a distance.

What content could I use to explore this concept?

There are many ways to investigate this concept. We could explore the force of gravity and how it affects the motion of objects when they are dropped, pushed, thrown or lifted. We could look at simple machines, such as pulleys and levers, and investigate the unbalanced force required to move the pulley or lever.

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 7, we want our students to understand how balanced and unbalanced forces are different.

Year 7 example

In this example, I want my students to experiment with falling, by designing and constructing a maze for a rolling marble.

What do you observe?

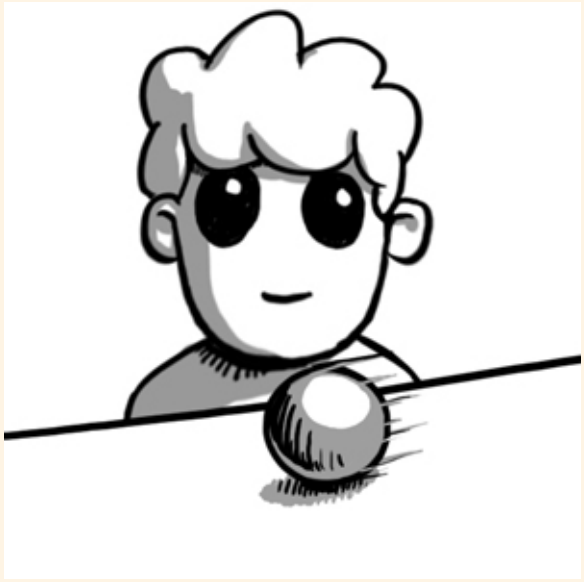
How can I help my students make observations?

Using the BitL questions, I could ask:

- *What do you observe?*

At Year 7, I want my students to observe that an object will change its motion when an unbalanced force acts on it. I will ask students to roll a marble down their table, using books to change the slope of the table. Questions I could ask:

- *What do you notice about the rolling marble? What do you see? What do you hear?*
- *What could you measure?*
- *What starts and stops it rolling?*



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?*

At Year 7, I want my students to describe the trends they see. Some questions I could ask are:

- *What happened when you changed the slope of the table?*
- *When were the forces balanced? How did you know?*
- *When were the forces unbalanced? How did you know?*
- *How do forces change an object's motion?*
- *Can you design a maze on a sloping table that takes exactly 10 seconds for the marble to complete?*

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?*

At Year 7, students start to make predictions based on scientific knowledge. I want my students to make predictions about constant and changing motion, which they can relate to balanced and unbalanced forces. I could ask:

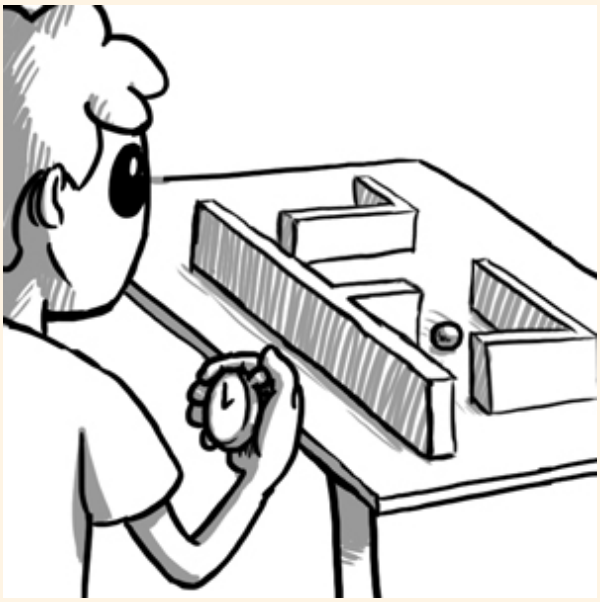
- *What makes the marble roll?*
- *How long does it take the marble to move the first third? Second third? Last third of the maze? Why are they different?*
- *How would it be different if we had the table level and pushed the marble at the start?*
- *Where are forces balanced here? Unbalanced?*

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?*
- *What can you investigate about the marble race?*
- *What would you measure?*
- *What could you change?*
- *What would you keep the same?*
- *How will you record your data?*
- *What safety and ethical considerations are there?*
- *Who might be interested in what you find?*



How can you review and communicate?

How can I help students share their observations and questions?

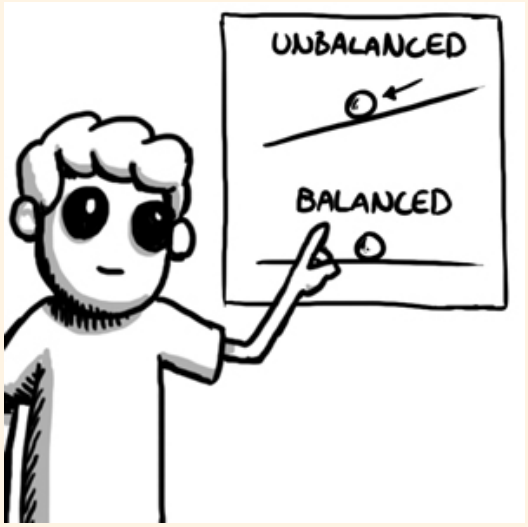
These questions stimulate student's reasoning and help them analyse, draw conclusions and make generalisations about the concepts.

Using the BitL questions, I could ask:

- *How can you review and communicate?*

At Year 7, I want my students to use scientific language when communicating their ideas and suggesting improvements in their methods. Some questions I could ask are:

- *What did you find out?*
- *How can you represent the data you have collected?*
- *How can you share your findings with others?*
- *Can you communicate the patterns in your findings with others, using the terms balanced and unbalanced forces?*
- *What could you do to improve your investigation?*
- *Were your results different to what you predicted? How?*



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?*

Questions I can ask my students:

- *What questions about movement and balanced and unbalanced forces do you have now? How might you go about answering some of these questions?*
- *Who might be interested in your findings?*
- *When would it be important to know about the effect of balanced and unbalanced forces on motion, especially falling?*
- *How might understanding these phenomena help to improve safety?*

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 about the action of balanced and unbalanced forces on a moving or stationary object.

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.