Year 10

Conceptual narrative Science: Diversity and evolution

In the Biological Sciences strand, there are three main conceptual threads being developed from Foundation through to Year 10. They are the concepts of diversity and evolution, form and function and interdependence and ecosystems.

Big ideas

The theory of evolution by natural selection explains the diversity of living things.

What concepts do I want my students to understand?

- Heritable characteristics are passed on from one generation to the next, through the transmission of genes and DNA.
- Theory of evolution.
- Natural selection.
- Evidence from the past and present diversity of life on earth, can predict possible futures.

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 the concepts (diversity and evolution, form and function, interdependence and ecosystems) together, because they complement each other.

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

Introduction

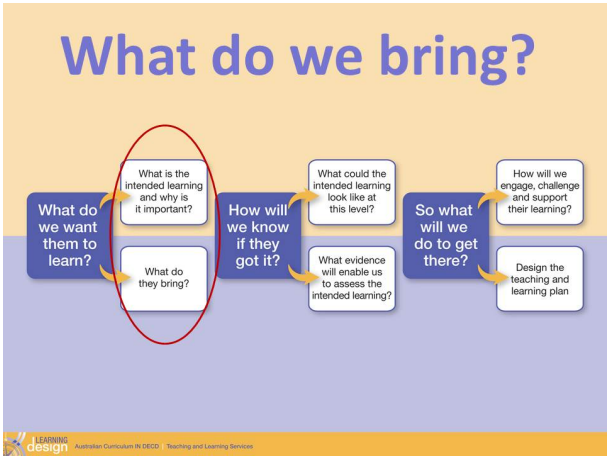
What might my students already know about this concept?

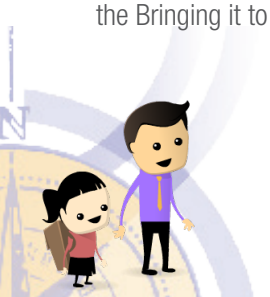
Classification enables us to organise the diversity of life on Earth. The form and function of living things, adapt to the environment where they live. Organisms are made up of cells, and the products of cells.

What content could I use to explore this concept?

Students can learn about the role of DNA and genes through using models, diagrams and videos. We can investigate the changes caused by natural selection, in a particular population, as a result of artificial selection in breeding for desired characteristics, or interpreting fossils records and other evidence for evolution.

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 the diversity of living things can be explained by the theory of evolution through natural selection. We want them to understand the role of genes and DNA in passing on heritable characteristics from one generation to the next.

Year 10 example

In this example, I want my students to use a pedigree chart for dog breeding and analyse the heritable characteristics. In using this chart, I want my students to explore the role of DNA and genes, and their transmission of heritable characteristics, such as coat colour from one generation to another.

What do you observe?

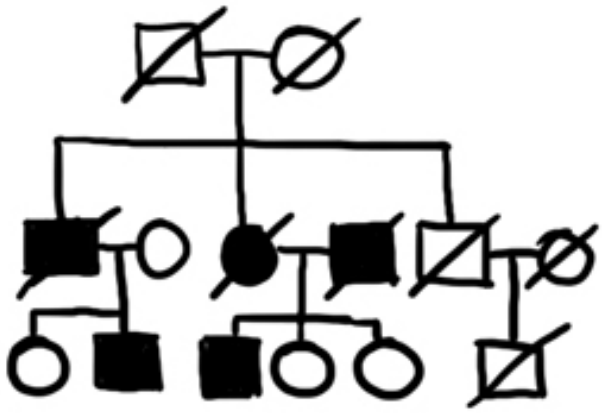
How can I help my students make observations?

Using the BitL questions, I could ask:

- *What do you observe?*

In Year 10, I want my students to make observations that change over time and geographically. I want them to select data that is reliable to make observations from. Questions I could ask my students are:

- *What do you observe about pedigree charts?*
- *What features or character traits do you observe in each generation?*
- *What symbols help to make the chart easier to read?*



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 10, I want my students to reveal patterns from their observations, and describe and explain exceptions. I could ask my students:

- *What is the same about each generation? What is different?*
- *What features appear generation after generation?*
- *Are there any anomalies?*
- *Are there any features not present in the last generation, that were there at the beginning?*
- *When did the change occur?*
- *What are your questions?*

What do you predict will happen?

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

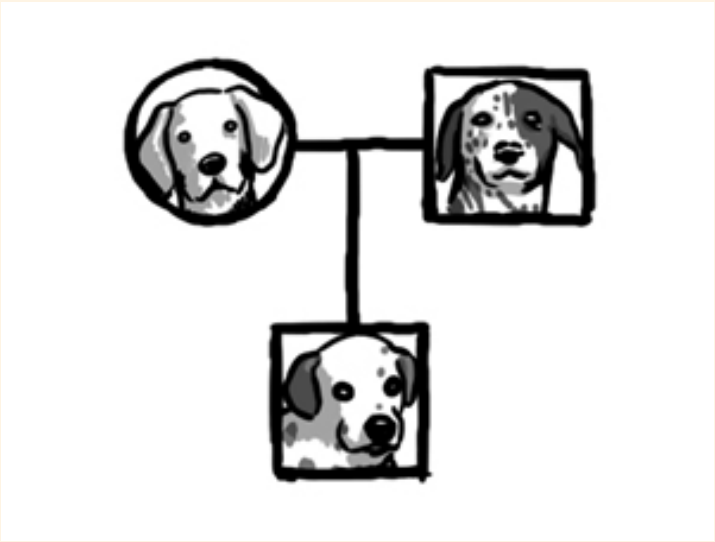
Students ask testable questions that help them to narrow the focus of the inquiry. These questions provide opportunities for students to make predictions.

Using the BitL questions, I could ask:

- *What do you predict will happen?*

In Year 10, I want my students to predict what will happen over time. I could ask the students:

- *What do you think will happen in the next generation?*
- *What other predictions might be plausible?*
- *What determines what the next generation will look like?*
- *What determines what genes a particular puppy gets?*
- *What changes can we predict with accuracy?*
- *How can you use the pedigree chart to investigate if a white coat is autosomal, sex linked, recessive or dominant?*
- *What do you predict the phenotypic ratio for coat colour will be in the F5 generation?*



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 design their own investigations. Questions I might ask:

- *How might you test your hypothesis?*
- *What could you try?*
- *Would computer modelling be useful?*
- *How will you measure and record data?*
- *How could measure your results?*
- *How will you be sure that the data is reliable and representative?*

How can you review and communicate?

How can I help students share their observations and questions?

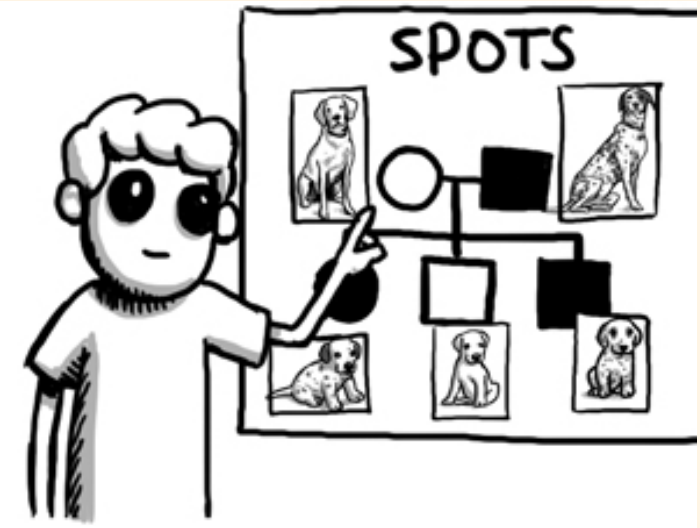
These questions stimulate student's reasoning and help them analyse, draw conclusions and make generalisations about the concepts.

Using the BitL questions, I could ask:

- *How can you review and communicate?*

In Year 10, I want my students to analyse patterns in the data to generalise and justify their conclusion based on evidence and scientific theories. I might ask my students:

- *How can you best represent your data and evidence?*
- *How could you improve your test/investigation?*
- *How could you explain what you have found?*
- *Has your hypothesis changed? How?*
- *What can you infer from the data?*
- *How can you justify your conclusion?*



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?*
- *How would understanding the genotype of the parents, influence your decision to purchase or breed a dog?*
- *What other information would be useful in making your decision?*
- *How does this type of research translate to reproductive science in humans?*
- *Who might benefit?*
- *What is the 'cost'?*
- *What would our lives be like if we didn't know this?*

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 why they need to learn that heritable characteristics are transmitted from one generation to the next via genes and DNA.

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 the concepts (diversity and evolution, form and function, and interdependence and ecosystems) together, because they complement each other.

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

Biological sciences

In the biological sciences sub-strand, there are three main conceptual threads being developed from Foundation to Year 10.

They are the concepts of diversity and evolution, form and function and interdependence and ecosystems.

Let's look at the diversity and evolution concept

Year 2

This concept starts in Year 2 with familiar examples of how living things grow, change and reproduce. Students might look at changes from birth to maturity of different animals and plants, such as chicken eggs or sunflower seeds, comparing the adult with the offspring.

Year 3

In Year 3, the focus is on what distinguishes living things from nonliving things so students might explain why they would classify a range of items from the school environment (e.g. stones, sticks, feathers, insects, and parts of plants) as living or nonliving. Students notice that living things have a variety of external features which can help to group them.

Year 4

In Year 4, the idea that living things grow and reproduce is continued by looking at life cycles, such as when the plant grows, flowers and produces seeds, or the tadpoles change as they mature and become adult frogs.

Year 5

In Year 5, students learn that adaptations help an organism survive in its environment. For example, students might consider how arctic animals have adapted to survive in extreme cold.

Year 7

In Year 7, students discover that there are differences within and between groups of organisms, and use classification further, to enable them to organise and communicate about this diversity. For example. sorting and classifying different species of birds from the local environment.

Year 10

In Year 10, the theory of evolution combines these ideas with the role of genes and DNA, in passing on features or heritable characteristics from one generation to the next. This explains the past and present diversity of life on earth and offers a means to predict possible futures. Students at Year 10 level, are increasingly taking on a global perspective and so consider the relationship of biodiversity, natural selection and evolution.

So, from Year 2 to Year 10, students develop their understanding of evolution and diversity, by building on from their thinking about life cycles, to consider adaptation and survival of familiar objects, and then understand how this supports the theory of evolution by natural selection.