Evolution is widely accepted to mean ‘change through time’. We speak of our evolving language, evolving teaching methods and evolving technologies. Biological evolution refers to the origin of new species, which evolve from existing life forms over time.

Evolution is the foundation of palaeontology and biology. Scientists have gathered a huge amount of evidence which has greatly contributed to our understanding of how evolution works, and which supports the theory of evolutionary change.

**Examples of evolution:**
Within the fossil record, there are many examples of how one species evolves into another. Two such examples from the fossil park are the whale and horse.

*Ambulocetus natans* in action
*A reconstruction of an early cousin of whales.*

Whale evolution begins about 60 million years ago. Whales’ ancestors had toes and could walk on land. Fossil records indicate that whales and dolphins have evolved from a four-legged aquatic mammal. The fossils indicate that over time hind limbs have become reduced, while the front legs have modified into flippers.

We still find hip bones in modern whales, a remnant of their terrestrial past. Recent DNA analyses indicates that whales and hippos share a common ancestor!
Did you know that most palaeontologists consider birds to be the direct descendants of dinosaurs? Most palaeontologists and zoologists believe that birds and reptiles are related. The two groups share many common features including skeletal elements, both lay shelled eggs and both have scales. Have you ever noticed the scales on a bird’s legs?

**Models for early Cetacean evolution**

<table>
<thead>
<tr>
<th>Present</th>
<th>Modern toothed whales</th>
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<tbody>
<tr>
<td>10 million years ago</td>
<td>Rodclus homalalo, one of the earliest cetaceans</td>
</tr>
<tr>
<td>20 million years ago</td>
<td>Fossil of an early cetacean with reduced hind limbs</td>
</tr>
<tr>
<td>30 million years ago</td>
<td>Hypothetical meonychid skeleton</td>
</tr>
<tr>
<td>40 million years ago</td>
<td>Reduced hind limbs could not have aided it in making or swimming. Rodclus swam with an up-and-down motion as do modern whales</td>
</tr>
<tr>
<td>50 million years ago</td>
<td>Rodclus probably walked on land, as do modern sea lions, and swam by having its backbone and paddling with its hind limbs (as modern )</td>
</tr>
<tr>
<td>60 million years ago</td>
<td>Hypothetical meonychid skeleton</td>
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**Fossil of Archaeopteryx, the link between birds and dinosaurs**
Activity

1. What did you find out about the whale bones fossilized at the Fossil Park’s dig site?

2. What did you find out about the short-necked giraffe? Is it the predecessor of the giraffe we know today? Explain your answer.

3. Choose one of the mammals represented at the Fossil Park and prepare an information sheet on its evolutionary journey through the geological time scale, to the modern day.

4. Name any of the Fossil Park mammals that do not have a modern relative. Suggest reasons why they went extinct.
Teacher notes

1. The whale vertebrae in the dig are from a baleen whale which was probably between 7 and 9 metres long.

2. No, it is not the predecessor of the modern long-necked giraffe. There were long-necked species of giraffe co-existing with the sivathere at Langebaanweg, and these are likely predecessors of modern giraffids. The sivathere and long-necked giraffe share a common ancestor with deer and bovids (A bovid is any of almost 140 species of cloven-hoofed mammals belonging to the Family Bovidae).

3. Choose one of the mammals represented at the Fossil Park and prepare an information sheet on its evolutionary journey through the geological time scale to what we see today.

Use the example of the horse to assist learners.
4. **Sabre tooth cat, sivathere, bear, wolverine.**

General reasons for extinction.
Climate change, environmental change, loss of ecological niche.
Competition – May be immigration of new competitors for resources, or existing competitors may begin to exploit resources more successfully.
Disease.

It is uncertain exactly why the sivatheres went extinct, however, below is a suggested explanation.

Giraffes and sivatheres would have competed for some of the same food sources. The longer-necked giraffes were able to get their food from higher branches, whereas the sivathere with its short neck, ate from lower branches, and also ate grasses. Many other animals also competed with the sivathere for the same food resources. As the vegetation and environment changed over time, the sivatheres and other competitive species competed for food. Those populations who failed to compete successfully may have ultimately become extinct. At various times, long-necked giraffe species were likely to have experienced a competitive advantage over short-necked giraffes as they could eat from the top of trees. Long-necked giraffes have survived whereas their short-necked relatives have become extinct.

Other factors that could have played a role in extinction:

**Changes in predation patterns:** The behaviour of predators may change, new predators may become active in an area, or predator numbers may increase - any of these variables may detrimentally affect prey species numbers.

**Survival of the fittest:** The individuals who are best adapted to the environment they are living in are the ones who will most likely survive as they have a competitive advantage over less well-adapted species. The organisms which can cope with environmental change and adapt to changes in their habitat and living conditions will survive. Those that cannot adapt will become extinct.