

Worksheet: Understanding the past

Phase FET
Grade 10 – 12

Learning area: Life Sciences

Strand: Biodiversity, change and continuity

Theme: Biodiversity, change and continuity

Specific Aim 1: Acquiring knowledge of natural sciences

Specific Aim 3: Appreciating and understanding the importance



Activity Sheet



Activity 1: Reading and comprehension

Read the article on the past life at Langebaan and then answer the questions that follow.

Past life at Langebaan on the West Coast

The West Coast Fossil Park is situated on the West Coast of South Africa and contains fossils which are 5 to 5.2 million years old. The kind of vegetation found on the West Coast today is a scrubby fynbos, which has adapted to the relatively dry conditions in which it grows. Even though the West Coast has a rich bird, amphibian, reptile and small mammal population, there is a lack of large animals such as hippo, rhino, giraffe and elephant which inhabited the area till a few hundred years ago. In recent times humans have altered the landscape by grazing domestic animals on it, burning the veld, and by extensively hunting and trapping wildlife. Climatic and environmental change over the last 5 million years has also played a role in the evolution of some plant and animal species, and the extinction of others.

Very few indigenous trees are found on the West Coast today, unlike 5 million years ago, when the climate was warmer and wetter than today, and the area was a lush subtropical paradise which contained areas of open grassland, woodland and riverine forest. The West Coast Fossil Park is situated within the area where the ancient (palaeo) Berg River once flowed into the ocean. Today, the Berg River enters the sea far to the north of the Park.



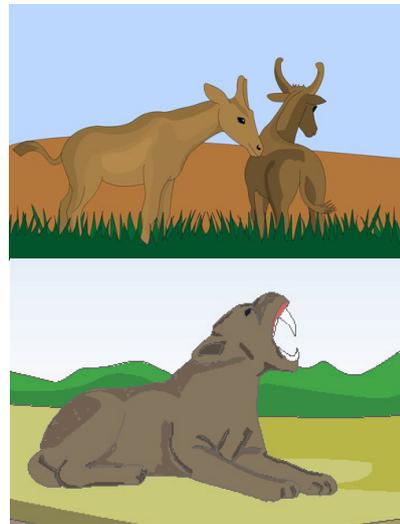
Many animals, now extinct, lived in the riverine forests, on the wooded savannah plains, and in the sea and on offshore islands. Some 5 million years ago sea level was much higher than its present level and it covered the area between Saldanha Bay and St Helena Bay. The mainland coast followed a line of granite hills north and south from Langebaanweg, where what is believed to be the mouth of the palaeo-Berg River formed an estuary. A few kilometres offshore were several islands formed by the high ground around Vredenburg and south towards to Yzterfontein.

Living along the sea shores and on these islands were true seals (*Homiphoca capensis*) and various penguin species. The true seal, a relative of the living crab-eating seal of Antarctica, also lived on and around the islands. Many of the seabirds and seals probably crossed the narrow channel from their island homes to feed near the Berg River estuary on the mainland.

Apart from the marine species already mentioned, many mammals like the hippopotamus and giant pig inhabited the river and riverside forests, while the sivathere, a member of the giraffe family, which had a short neck and large "horns" lived in both grasslands and open woodland and was a mixed feeder (ie. grazer and browser). A long-necked giraffe, very similar to the living species, and an okapi-like giraffid (*Palaeotragus*) also lived in the dense forests and woodland along the palaeo-Berg River.

The giraffes and other large herbivores were preyed upon by one of the most unusual mammals recorded at Langebaanweg. This was the bear (*Agriotherium africanum*) which was of gigantic proportions. This animal was one of the largest terrestrial carnivores to inhabit Sub-Saharan Africa. Animals such as the extinct elephant-like gomphothere (*Anancus capensis*) also made this lush area their home.

Other unusual animals that lived in the Langebaanweg area were the giant wolverine (*Plesiogulo monspessulanus*), sabre-toothed cats, three-toed horses (*Hipparion*), and an extinct buffalo. The nearest living relatives of the wolverine are found in Arctic regions, while giant pigs are now limited to parts of North and South America. The sabre-toothed cats, three-toed horse and other mammals such as the sivathere have no living descendants in the area, but relatives of many of the Langebaanweg species still occur commonly in Africa today. They include aardvark, foxes, mongooses, elephant, dassie, rhinoceros, and a variety of antelopes, rodents, birds, reptiles and amphibians. A small number of shark species and invertebrate fauna are extinct.



Invertebrates such as snails and mussels, and vertebrates, including mammals, birds, reptiles and amphibians that lived in and around the estuary were buried and preserved in a variety of different environments around Langebaanweg, such as river channels, inter-tidal mudflats, salt marsh and floodplain sediments. The river channel deposits include the remains of animals washed down from inland habitats as well as from the estuary. The result is a very rich and diverse bone bed dominated by skeletons of the extinct giraffid, *Sivatherium hendeyi*. At the same time, phosphate rich deposits formed in the ancient estuary as a result of an abundance of organic matter from the nutrient rich sea water.

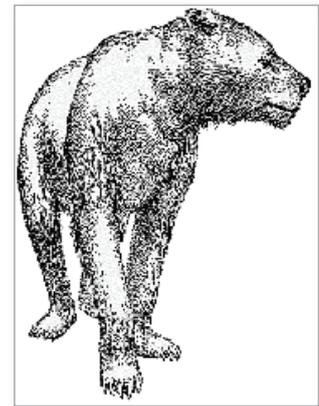


This organic and phosphate rich matter settled on the estuarine and sea floors, forming the phosphate minerals which were to be mined some 5 million years later. Gradually, over a period of 4 million years, sea levels changed to present levels, consequently, the coastline migrated seaward leaving the site of the ancient estuary about 16 km inland, in an area now known as 'Langebaanweg'. Subsequent climatic changes, coupled with the recent catastrophic impact of human activity, have converted the area from a wildlife paradise to one of relative desolation.

The fossil rich deposits first came to light when Dr Ronald Singer (from the anatomy department at the University of Cape Town) visited Beard's Quarry (Beard's Quarry is near to Langebaanweg airforce base) in 1958. He was accompanied by Dr Hooijer (from Leiden University) and Dr Crompton (Director of the South African Museum). The mine superintendent showed them a small collection of unusual phosphate samples and bones collected by one of the mine employees. In amongst this sample was an ankle bone of an extinct short-necked giraffe belonging to the sivathere group and a tooth of an extinct elephant.



Expansion of phosphate mining activities in the 1960s led to the uncovering of more 5 million year old plant and animal fossils. The South African Museum, under the leadership of Dr Brett Hendey, then became involved in collecting and preserving fossils as the mining progressed. It was soon evident that 'E' quarry, the name of the area from which the fossils were recovered, would yield fossils of unprecedented quality and quantity enabling Dr Hendey to assemble one of the largest collections of terrestrial fossils dating to around 5 million years in the world.



In 1993, mining operations stopped and a 14 ha fossil-rich area within the mine property was declared a National Monument Site. In 1996 the West Coast Fossil Park project started, as a

joint venture between the mining company Samancor (the holding company for Chemfos, and now a subsidiary of BHP Billiton) and the South African Museum (now part of Iziko Museums of Cape Town). The West Coast Fossil Park was opened on the 22nd September 1998 to bring palaeontology to the public. Today you can visit the fossil dig site that has been opened up by Dr Roger Smith and his team over the past 12 years. Here you can see hundreds of bones of extinct animals lying in the ancient river bed just as they were buried, over 5 million years ago.



Some 230 animal species, of which about 80 are mammals, have been recovered since the mining operations first began. Many of them represent new fossil species, and many of these are the earliest representatives of the taxa (groups) to which they belong. The remains of many sivatheres were found in one of the river channel deposits. It is believed that these animals were drowned in catastrophic flood events, resulting in a "catastrophic mortality" profile type accumulation.



Hundreds of thousands of mammal bones and teeth have been collected. Only a small portion of these have been cleaned, repaired, sorted and studied.

Fossils have attracted leading overseas scientists

Langebaanweg is scientifically important nationally and internationally for a number of reasons. The Langebaanweg fossil site is extremely rich in well preserved specimens, and in the diversity of species represented. These fossils have attracted the interest of leading overseas scientists and local researchers.

The many different animal groups represented have provided significant scientific data relevant to understanding their evolution and biogeography. Langebaanweg is the richest pre-Pleistocene site in Southern Africa. It records an era otherwise unknown in this region and thus provides a reference for comparison with other important sites in East Africa and Europe.

Langebaanweg is probably the richest fossil bird site in the world older than 2 million years. Of the more than 10,000 specimens which have been preliminarily studied, around 80 species are represented from a wide spectrum of families and orders, and ranging from tiny seed eaters to an ostrich which was slightly larger than the modern species. For some of the bird groups Langebaanweg represents their only appearance in the fossil record older than the Pleistocene.

Both local and foreign palaeontologists and geologists have studied the fossils, and the deposits in which they occur, and this has made it possible to reconstruct a reasonably detailed picture of the West Coast palaeo-habitat. This information is useful when comparing the past with the present and when tackling questions relating to ecological constraints on how plants and fauna operate, evolutionary-pathways, and exactly what impact climate change and humans have had on biodiversity.

The fossil site today

The West Coast Fossil Park offers students and eco-tourists, an on-site fossil experience, providing opportunities to learn about ancient environments and the climatic changes that have occurred in this region since 5 million years ago. A simple structure covers the excavation site and visitors may view in situ fossils, lying where they were buried 5 million years ago.

The West Coast Fossil Park is open to the public seven days a week for guided tours and school programmes. The Fossil Park is located 110kms north of Cape Town, only one and a half hour's drive along the R27. Turn off on the R45 towards Hopefield. The Fossil Park has a coffee shop that serves light lunches, snacks and teas.

Please visit the Park's Official Website for all relevant visitor information (www.fossilpark.org.za). Alternately you can phone the park on: 022 7661606 for more information, or to arrange school tours or group bookings.

Sources:

Langebaanweg - A Record of Past Life by Dr Q B Hendey
The Cape Odyssey Article, June/July 2002 Media releases by Pippa Haarhoff
Illustrations by Cedric Hunter © South African Museum



QUESTIONS

1. Where is the West Coast Fossil Park situated?
2. When was this area a wildlife paradise?
3. Describe how the vegetation of that time differs from the West Coast today.
4. Look at the picture of the wildlife paradise and identify the two herbivores shown. Give both their common and scientific names.
5. Identify three herbivores and carnivores from the West Coast Fossil Park.
6. Draw a food chain using the examples from the West Coast Fossil Park.
7. What family do sivatheres belong to? Describe what the sivathere looked like.
8. Draw a flow chart showing the chain of events that led to the establishment of the West Coast Fossil Park in 1998.
9. Why is the West Coast Fossil Park such a leading attraction to scientists from all over the world?
10. Explain the following words: extinct, indigenous, terrestrial and 'in situ'.
11. Explain, using an example from the passage, what a "catastrophic mortality" profile is.
12. What work do a palaeontologist and a geologist do?
13. What kind of experience does the West Coast Fossil Park offer to learners and the public?



Activity 2: Creating a poster

Imagine you are a zoologist or palaeontologist who is preparing an A4 information poster on an extinct ancient animal mentioned in the passage "Past Life at Langebaan" for a wildlife magazine. You can use the internet, encyclopaedias and books to research your topic. Best of all, use the West Coast Fossil Park website (www.fossilpark.org.za) which will have up to date information on all the animals.

Requirements for assessment:

1. Your poster must be neat and to the point.
2. Layout must resemble a poster.
3. Check for any spelling and punctuation errors.
4. Your poster must include the following details:
 - The animal's name
 - The classification of the animal according to the Linnaeus system
 - Appearance: size, weight, shape of body, fur, scales
 - Means of locomotion: flying, jumping etc
 - Diet: carnivorous, omnivorous etc
 - Habitat: estuary, islands, etc
 - What kind of predators would it have had to defend itself against, and how did it protect itself against these predators?
5. Bibliography - Indicate the reference material used.



Teacher notes

Activity 1: Reading and comprehension

1. West Coast of South Africa
2. 5 to 5.2 million years ago
3. The kind of vegetation found on the west coast today is a scrubby fynbos, which has adapted to the relatively dry conditions in which it grows. The climate was warmer and wetter than today, and the area was a lush subtropical paradise which contained areas of open grassland, woodland and riverine forest.
4. Sivathere (*Sivatherium hendeyi*) and the gomphothere (*Anancus capensis*).
5. **Herbivores** – hippopotamus, giant pig, sivathere (long-necked giraffe), elephant-like gomphothere, rhinoceros, and a variety of antelopes, three-toed horses, dassies

Carnivores - true seals, penguin, giant wolverine, sabre-toothed cats, foxes, mongooses, shark species

6. Learners own answer – ensure that a producer, herbivore and carnivore is included.
7. Giraffidae - looked similar to an okapi
8. Draw a flow chart showing the chain of events that led to the establishment of the West Coast Fossil Park in 1998.

5 million years ago a herd of sivathere drowned trying to cross the river in flood.

Their bodies floated downstream and many got trapped on an outcrop of phosphate rock jutting out from the north bank of the estuary about 1 km from the sea.

During the following months, the sivathere carcasses were scavenged by hyenas and vultures. As the flesh rotted the skeletons fell apart and bones fell into the pool next to the rock.

Larger animals, like sivatheres and elephants that came to drink at the pool, accidentally trampled on some of the bones, pushing them down into the waterlogged sand and breaking them.

Thousands of tiny bones of shrews, mice and moles came from pellets regurgitated by owls that regularly roosted in the surrounding trees and on the rock.

Over subsequent years, summer dry periods caused the larger animals to congregate around the pool. Some may have got stuck in the quicksand, others got killed by predators. Frogs and small freshwater fishes lived and died in the pool.



Some years, winter storms caused strong south westerly winds resulting in tidal surges that carried whale, dolphin and seal carcasses into the river estuary. One or two carcasses came to rest against the phosphate rock, and as they rotted, their bones too collected in the pool.

Over the next century or so, the sea level gradually rose to flood the area and submerge both the pool and the rock under salt water. The bones then became buried deeper, under layer upon layer of phosphate rich sand (the phosphate being generated by organisms in the upwelling cold currents offshore).

Over the next million years or so, underground water gradually dissolved the deeply buried bones and replaced them, molecule by molecule, with silica and other minerals in the ground, to become fully mineralized fossils.

The fossil bones lay undisturbed 20m underground for another 4 million years until one day in 1976, whilst mining the phosphate sand that buried the bones, the excavator operator accidentally uncovered them.

Fortunately, palaeontologist Dr Brett Hendey of the South African Museum was allowed to rescue the bones. He collected over 1 million specimens and found this ancient bone-bed to be the richest and most diverse accumulation of land animals of early Pliocene age ever found.

The excavations you see today were done by Dr Roger Smith of the Iziko South African Museum, helped by staff from the West Coast Fossil Park. The larger bones were left in place for visitors to view.

9. The Langebaanweg fossil site is extremely rich in well preserved specimens and can provide unique information on the environment and climate in the west coast area 5 million years ago - a particularly interesting period as modern genera were emerging. The many different animal groups represented have provided significant scientific data relevant to understanding their evolution and biogeography. Langebaanweg is the richest pre-Pleistocene site in Southern Africa. It records an era otherwise unknown in this region and thus provides a reference for comparison with other important sites in East Africa and Europe. Langebaanweg is probably the richest fossil bird site in the world older than 2 million years.

10. extinct = the end of an organism or group of taxa. The moment of extinction is generally considered to be the death of the last individual of that species

indigenous = In biogeography, a species is defined as indigenous or native to a given region or ecosystem if its presence in that region is the result of only natural processes

terrestrial = land living

'in situ' = being in the original position; not having been moved

11. The death of many animals at one time during a flood, drought or earthquake.



12. **Palaeontologist** = A palaeontologist studies the history of life on Earth, mainly through the examination and study of fossils, which are evidence of ancient life, most often found in sedimentary rock. Palaeontologists can do a number of things depending on their interests. They may do lab work - cleaning, identifying, and sorting fossil bones; chemically analyzing material, re-assembling fossil structures, preparing exhibits. They can also do field work involving the discovery of new fossils. They may also prepare scientific papers and come up with new scientific theories based on new, or previously published, information. Finally, some palaeontologists can make a living with a career in teaching.

A **geologist** is someone who studies the Earth and the processes which shape it. This field, as one might imagine, is incredibly varied, and geologists can be found working in a large number of subsets within the larger field of geology. People who like the sciences and enjoy being outdoors may find geology an interesting and rewarding career, especially if they are willing to apply themselves to a sometimes extensive field of study.

13. The West Coast Fossil Park offers students and eco-tourists an on-site fossil experience, providing opportunities to learn about ancient environments and the climatic changes that have occurred in this region since 5 million years ago. A simple structure covers the excavation site and visitors may view in situ fossils, lying where they were buried 5 million years ago.

Activity 2: Creating a poster

Use the rubric on the next page to assess the poster.



POSTER COMMUNICATION SKILL ASSESSMENT

Assessment Criteria	Performance Indicator Levels				Comments	
	0	1	2			
Title	No title	Title present but incomplete	Complete title			
Aim of poster	Not clear	Partially clear	Very clear			
Main points	Not relevant	Some points relevant	All points relevant			
Facts / concepts	Mainly incorrect	Some correct with limited detail	Correct with interesting detail			
Language / spelling	Many language and spelling errors	Some language and spelling errors	No language and spelling errors			
Organisation / layout	Organisation / layout muddling	Organisation partially clear and logical	Organisation clear and logical			
Use of colour	No colour / all one colour	Some use of colour	Effective use of colour			
Letter size	Letters very small	Some letters larger	Most letters large			
Diagram / picture appeal / attractiveness	Not appealing / not attractive	Has some appeal / attractiveness	Appealing / attractive			
Diagram / picture relevance	Not relevant	Partially relevant	Totally relevant			
Diagram / picture accuracy (scientifically correct)	Not accurate	Partially accurate	Totally accurate			
Impact of poster	Does not make an impact	Makes an impact				
Impact of poster	No new ideas	Some signs of creativity / new ideas	Very creative and original			
Total = 25 marks						
7	6	5	4	3	2	1
Outstanding	Meritorious	Substantial	Adequate	Moderate	Elementary	Not achieved
80-100%	70-79%	60-69%	50-59%	40-49%	30-39%	0-29%

Review and recommendations

