

Palaeo Planting
at Crystal Palace Park

The famous Victorian Geological Court by the lower lakes in Crystal Palace Park is the world's first large-scale science 'edu-tainment'. Life-sized reconstructions of extinct creatures and geological rock outcrops were placed in chronological order to showcase the emerging Victorian understanding of palaeontology and geological changes through deep time.

However, the landscape is missing the plants that tell the full story of past worlds. Despite the Victorian enthusiasm for fern collecting and the many remarkable discoveries of plant fossils, it's unclear what living plants were included during the site's construction in 1853-55.

The Palaeo Planting Project at Crystal Palace Park aims to bring the story of the evolution of plants back to life. We are mapping the various palaeo-plants that already exist in the park. With the help of volunteers, we are planting relatives of extinct plants around the sculptures that would have shared their environment. As well as giving some context to the Dinosaurs, the palaeo-planting at Crystal Palace is a great way to highlight the significance of plants and environmental change through time.

Read on to discover interesting facts about fossil plants and go on a plant-finding tour of the Geological Court. Enjoy!

Bryophytes

Palaeozoic: 400 million years ago

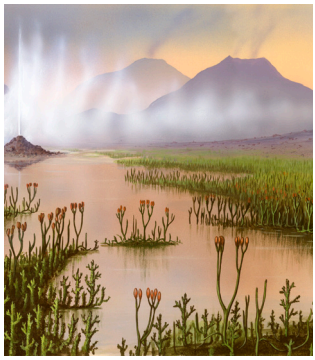
In damp, shady corners and between stones in the park, you will find plant survivors from the earliest groups to conquer the land: the bryophytes.
The first land plants evolved from freshwater algae in the Palaeozoic, around 400 mya (million years ago). They had to overcome some major challenges in an environment where temperatures fluctuated rapidly. Some developed a waterproof outer layer to prevent drying out and protect against ultraviolet radiation. They built new root-like structures to anchor themselves to the surface and find water and nutrients. With no vascular system to transport water from the soil to the plant they were limited in size.



Cooksonia - one of the first landplants (NHM, London)

The bryophytes in the park today are mosses and liverworts commonly found in the UK, and show many of the features of the earliest land plants.

Mosses are small, simple plants that have leaf-like structures only one cell layer thick. You may also find small, projecting stalks topped by a capsule where spores are produced and released, dispersed by wind and allowing a new plant to grow away from its parent.



Reconstruction of a Devonian landscape (Richard Bizley)



Living bryophyte: *Marchantia* with spore-producing structures

Marchantia is a very common liverwort in the UK. It has a flat body that bears little cups in which it produces discs of tissue. These discs get splashed out by rain and can then grow into a whole new plant – a plant cloning factory! *Marchantia* produces distinctive male and female umbrella-like structures for the sexual reproduction phase of their lifecycle. If you can't find any in the park, then look out for them in greenhouses and in the flowerpots of plants from a garden centre.

Spore-producers: Ferns

Palaeozoic: 320 million years ago

Once plants had evolved vascular systems and were able to grow tall, the race for light began and the first forests soon followed. The Coal Measures (which fuelled the Victorian world) are the remains of enormous, hugely productive swamp forests dominated by giant tree forms of clubmosses and horsetails that covered much of the Northern hemisphere around 320 - 300 million years ago.

Look for modern horsetails at Crystal Palace site: plants with jointed stems and whorls of greatly reduced leaves. The species that commonly grows in water, *Equisetum hyemale*, has a stem that has lots of silica in the tissues which makes it rough to the touch.



The most diverse spore-producing vascular plants today are the ferns, characterised by their unfurling fronds. *Osmunda regalis*, the royal fern, is a UK native species which can grow to up to 180cm. Fossils of *Osmunda* from 180 million years ago have been found with exceptional preservation that even reveals chromosomes inside their cells.



Carboniferous fern *Pecopteris* (James St John)

Other native ferns at Crystal Palace include hart's tongue fern *Asplenium scolopendrium* forming clumps with broad, undivided fronds, and the feathery, delicate lady fern *Athyrium filix-femina*. Tree ferns such as *Dicksonia antarctica* serve as a reminder that tree-like species of different ferns are common throughout the fossil record from the ancient coal swamp forests through to present day.

Seed plants

Mesozoic: 250 million years ago



The Mesozoic Era, 250 to 65 million years ago, is often described as the Age of Reptiles, but could equally be described as the Age of Seed Plants. With the evolution of seeds, plants became less reliant on water in their environment for reproduction, and could ride out unfavourable environmental conditions, with seeds remaining dormant until conditions improved.

Flowering plants aside, the most common seed plants today are conifers: woody trees with needle-like or scale-like leaves that bear their seeds in cones. Many examples of conifers can be seen at Crystal Palace including the distinctive monkey puzzle tree *Araucaria araucana* and the 'living fossil' Dawn Redwood *Metasequoia glyptostroboides*, known only from fossils before being discovered in the wild in the 1940s. The yew tree *Taxus baccata* and Japanese nutmeg *Torreya nucifera,* which bear their seeds in fruit-like fleshy structures, diverged from other conifers early in the Mesozoic. Finally, two early fossil tree trunks from an extinct family of conifers were brought from Purbeck, Dorset and installed behind the *Megalosaurus*.



Fossilised Ginkgo leaves



Other important seed plants include cycads such as *Cycas revoluta*, previously widespread but now limited to the tropics and subtropics, and the maidenhair tree *Ginkgo biloba*, the sole surviving species of a once diverse and widespread group.

Not all of the original Victorian sculptures at Crystal Palace were animals. The sprawling *Iguanodon* is leaning on a model trunk of a bennettite, a now-extinct group of seed plants. Six more line the lakeshore. Like cycads, they had stout trunks and tough, fern-like leaves (see left), but differed in having unique, flower-like reproductive structures, possibly developed in partnership with pollinating insects, suggesting co-evolution before the angiosperms.

Flowering plants: Angiosperms

Cenozoic: 130 million years ago



This site is dominated by flowering plants like most of our planet! These appeared and rapidly diversified from about 130 million years ago. Everything from daisies to oak trees, grasses to palm trees, belongs in this hugely diverse plant group today. This group of seed plants fully enclosed its female reproductive structure in an ovary, and developed an elaborate structure - the flower - to attract animal pollinators.

The first angiosperms appeared around the same time as iguanodons, probably as water-plants (similar to the water lily *Nymphaea alba*), while others were small, understory plants, perhaps resembling marsh marigolds *Caltha palustris* (a member of the buttercup family). The rapid, weedy growth of flowering plants probably allowed them to outcompete other slower-growing seed plants and to eventually displace them in most modern environments.



NHM, London

Woody shrub and tree angiosperms rapidly evolved. Plants like *Magnolia* (left) and the closely-related Tulip Tree *Liriodendron* (below) were some of the first to appear from around 95 million years ago. Many groups of flowers co-evolved and diversified in partnerships with pollinator insects such as butterflies, flies, beetles and bees. By about 70 million years ago the world was very much as it is today for plant diversity.



If we were able to plant the Crystal Palace site in full accord with plants' evolutionary timeline, there would be no flowering plants on the island except around *Iguanodon* at the far end of the island. However flowering plants dominate modern landscapes so are impossible to fully remove.

Why not create your own palaeo-garden?

You can have fun creating your own mini prehistoric environment by planting modern relatives of ancient plants in pots, on windowsills or in your own garden.

Palaeozoic plants (540-250 mya): tree ferns and herbaceous ferns such as the Hard Fern and Male Fern will provide structure, then add horsetails, such as *Equisetum hyemale* or *Equisetum fluviatale*. Clubmosses like *Selaginella kraussiana* are easy to grow and if you have more space you can include gymnosperms like yew, monkey puzzle, cedar and pine.



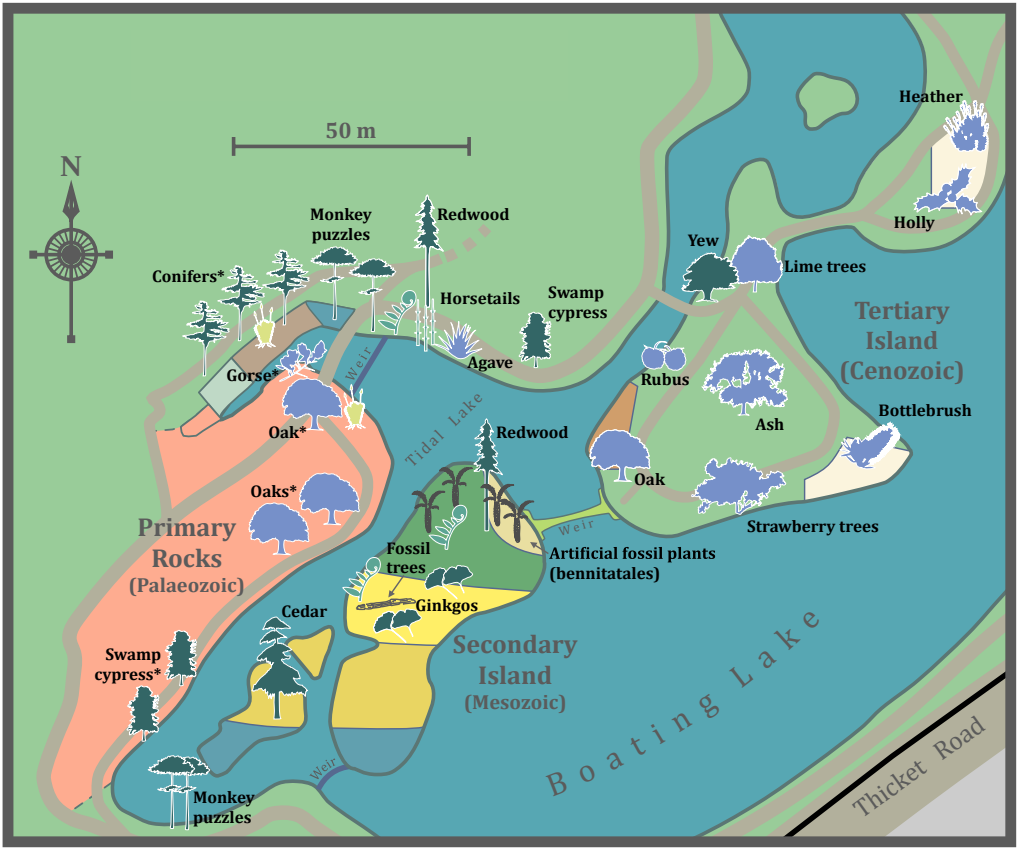


Mesozoic plants (250-75 mya): All of the Palaeozoic plant groups survived into the Mesozoic, but now you can add Marsh Marigold and water lily as water plants or *Gunnera* to add a dramatic touch to damp places near ponds or streams. You could include heather and myrtle as heathland plants or evening primrose and *Clarkia* to give some colour. For trees, swamp cypress and *Ginkgo* will give you that Mesozoic atmosphere.

Cenozoic plants (75 mya to the present): Again, all of the groups above survived but now you can add more flowering plants such as maple and oak trees, shrubs like *Camellia* or *Forsythia*, climbers such as honeysuckle, and herbs like grasses, sedges and daisies. At Crystal Palace, South American plants such as the Chilean Firebush and Chilean bamboo have been added to give context to the *Megatherium* sculpture.



Botany of the Geological Court and surrounding parkgrounds



LEGEND

Crystal Palace Park land

Tertiary (Cenozoic) Epoch

- *Quaternary*
- *Tertiary*

66 million years ago

Secondary (Mesozoic) Epoch

- Upper Secondary (Cretaceous)
  - *Chalk*
  - *Greensand & Gault*
  - *Wealden*
- Middle Secondary (Jurassic)
  - *Oolite*
  - *Lias*
- Lower Secondary (Triassic)
  - *New Red Sandstone*

245 million years ago

Palæozoic Epoch

- Carboniferous
  - *Coal Formation*
  - *Mountain Limestone*
- Devonian
  - *Old Red Sandstone*

Plant colour guide

Flowering plants (blue)

Seed plants (blue green)

Ferns (light green)

Mosses (yellow)

Plants with asterisks (*) are not in their appropriate place in the geological timeline. They were placed for their landscape value, not as part of the scientific narrative

How do we know about plants in the past?

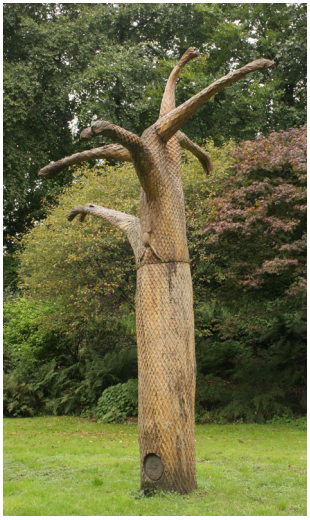
Plants get preserved as fossils in a similar way to animals. However, because plant parts such as leaves, flowers and fruit are usually each preserved separately, plants can be harder to reconstruct from the fossil record than animals. Plant fossils are found in terrestrial rocks from the whole Phanerozoic (540 mya - present), and so record all the environmental changes that have happened through time. This makes them incredibly important for understanding the past and predicting the future. For example, the number of stomata (pores for gas exchange) on preserved leaves can tell us about atmospheric carbon dioxide levels through deep time. This allows us to understand how carbon dioxide levels have affected the global climate in the past.

How does palaeo-planting work?

Most of the plants that lived in the past are not around today, and those that survive often look very different. However, by looking at plant fossils, we can choose modern plants that look like them and create an impression of how the landscape might have appeared in the past. Plants that can thrive in the UK climate were chosen and wild plants were transported to appropriate time periods on the Dinosaur Island.



Reconstruction of an early Cretaceous environment (Karen Carr)



Visit other evolution gardens in the UK:

- **Sheffield Botanical Gardens**
- **Kew Gardens, London**
- **Horniman Museum, London**
- **Fossil Grove, Glasgow**
- **Pannett Park, Whitby**
- **Natural History Museum, London**

This guide sheet is a collaborative project between the King's College London **Beyond the Dinosaurs** project and Friends of Crystal Palace Dinosaurs.
Project members by Jennifer Crees, Adrian Lister, Susannah Lydon, Chris Manias, Ellinor Michel, Ruth Siddall, Lil Stevens, Jon Todd, Mark Witton, Jeremy Young.

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CRYSTAL PALACE DINOSAURS

PALAEO PLANTING PROJECT