

Please follow the black and white number and arrow signs for this tour. Also take along a copy of the geologic time chart provided separately.

To begin the tour, walk down the ramp, turn left and follow the path along the lake. You will see on both sides of the path several (1) *Ginkgo biloba* trees. *Ginkgo* is considered a “living fossil”, because fossil records indicate the species has remained virtually unchanged for over 250 million years. (See the geologic time chart on a separate sheet.) The species name “*biloba*” refers to the double-lobed leaves. Ginkgos are dioecious, meaning they have separate male and female trees. Males produce pollen cones, while the females produce seeds. The seeds have a rather unpleasant odour making female trees unpopular in public places. However we grow both male and female trees at VanDusen. As its long history attests, this is a very resistant tree. Disease, pollution, cold weather and even radioactivity do not kill it - a *Ginkgo biloba* growing about a kilometer from the epicentre, survived the atomic bombing of Hiroshima!

Further along the path is a trail off to the right (follow the arrow) into the Woodland Garden. Follow the path for a few feet and turn right at the next arrow onto the side path leading to a large (2) coast redwood (*Sequoia sempervirens*). This species boasts the tallest tree in the world at 379.7 feet. It was found in Northern California in 2006 and was named ‘Hyperion’ by the team that discovered it. Coast redwoods can live for 2000 years, with trunks up to 21 feet in diameter. This one is just a baby! Its prehistoric ancestors thrived with the dinosaurs during the Jurassic Era, ~160 mya (million years ago).

Return to the path and turn right. On your right you will come to a large (3) southern magnolia tree (*Magnolia grandiflora*), native to southeastern USA. Magnolias exhibit what is called a disjunct distribution. They were once widespread throughout the world but, due to climate change, are now restricted to two widely separated regions - southeast Asia and from southeastern North America to adjacent Central America. Magnolias evolved 60 million years ago, before bees evolved and are pollinated by beetles, which accounts for their very tough petals, resistant to crawling and chewing! Southern magnolias are evergreen and produce large scented white flowers in spring. Beneath the magnolia, and in many other areas of the garden, are various kinds of ferns. (4) is our native deer fern (*Blechnum spicant*). Ferns are amongst the oldest land plants, arising ~360 million years ago in the Carboniferous period. They are widespread and range in height from a few centimetres to tree ferns, several meters tall.

Continue along the woodland path towards Cypress Pond and turn right to number (5). Look across the pond. On the other side you can see a grove of deciduous bald cypress (*Taxodium distichum*) trees, with feathery pale green foliage. These beautiful conifers were widespread on earth as far back as the Jurassic period ~150 mya. Turn back along the main path and across the little stone bridge. Ahead on your right are (6) the true cedars (*Cedrus species*), not to be confused with western red cedar, which isn’t a cedar at all but a species of *Thuja*. True cedars have needles in whorls of ~15 to 20. Three of the four species of *Cedrus* are represented at VanDusen. A useful way to distinguish them is to remember that *Cedrus atlantica* has ascending branches, cedar of Lebanon (*Cedrus libanii*) has level branches, and *Cedrus deodara* has descending branches. True cedars belong to the pine family (Pinaceae) and arose in the Tertiary period.

Continue along the path and turn left into the southern hemisphere garden. At the turn on your left is a somewhat scraggly tree, (7) Antarctic beech (or ñire in Spanish) *Nothofagus antarctica*. Members of the genus *Nothofagus* have provided evidence to help prove the theory of continental drift. Today species of *Nothofagus* are found in South America, New Guinea, New Zealand and Australia. Pollen fossils have been found in Antarctica, indicating it must have existed on the super continent, Gondwana, between 180 and 510 mya. Continue left along the path. Notice on your left, just off the path, an enormous, beautiful, evergreen (8) coigüe (*Nothofagus dombeyi*) from Chile and Argentina.

Ahead, on the peninsula and to your right, you will see several **(9) monkey puzzle trees, (*Araucaria araucana*)** native to Chile and Argentina. The spiny leaves are extremely sharp! Ancestors of these trees lived 160 mya and, as with ginkgos, the male and female reproductive structures are on separate trees. At VanDusen we grow both sexes, distinguishable by the size and shape of their cones - the female cones are large and rounded, the size of small footballs, while the male cones are smaller and more elongated.

Proceed down the path and across the little zig-zag bridge. In Livingstone Lake there are many water lilies. Most of these are the yellow-blossomed ***Nuphar lutea***, found throughout the northern hemisphere. Their ancestors date back about 60 million years. Frogs and insects love them - humans not so much. Invasive, they clog the lake and must be removed regularly. On your right as you step off the bridge is a **(10) Japanese umbrella pine (*Sciadopitys verticillata*)**. It is not a pine at all and has no close relatives amongst present-day plants. It branched off from the other conifers ~250 mya, spreading throughout Eurasia, northern Europe and northern North America. Today it is restricted to a small area in Japan. (Healthier specimens of this species can be found in other parts of the garden.)

Keep left and walk up the curving incline past the pines. At the top of the incline turn left and proceed along the path beside the lake. On your left by the water's edge are several spectacular **(11) giant rhubarb plants (*Gunnera species*)**. These have one of the largest leaves of any plant in the world! Be careful if you touch them as the leaves are very rough. The flower stalks are enormous (you will find them underneath the leaves) bearing hundreds of tiny red inconspicuous flowers. *Gunnera* dates back nearly 100 million years to the middle of the Cretaceous period. A fascinating feature of these plants is that symbiotic **cyanobacteria** live **inside** their leaf cells. These single-celled organisms carry out photosynthesis and "fix" nitrogen, converting it from an inert gas to nitrate or ammonia, forms of nitrogen which plants can use. Because of this 'in house' nitrogen supply, *Gunnera* can grow in nitrogen-poor swampy areas. In turn, the cyanobacteria have a sheltered place to live. This is a nice example of symbiosis and is similar to the way legumes obtain nitrogen from nitrogen-fixing bacteria that live within their root nodules. Ancestors of cyanobacteria were among the first living things on Earth, dating back ~3.4 billion years! These ancient ancestors later colonized the leaf cells of early plants and evolved into chloroplasts, the organelles which carry out photosynthesis in plants today. Meanwhile, non-photosynthesizing bacteria colonized both plant and animal cells and evolved into mitochondria, the organelles which convert food into energy and sustain life. Without these, the advanced forms of life on Earth as we know them could not exist.

Proceed along the path beside the lake and watch for turtles sunning themselves on the rocks. At the end of the path turn right, walk past the jade fountain and turn into the Phyllis Bentall Garden surrounding a rectangular pool. In this garden on your right are pots containing various kinds of **(12) carnivorous plants**. These plants obtain nitrogen by trapping and digesting insects, and can therefore grow in nitrogen-poor soils. Also growing in these pots are **miniature horsetail (*Equisetum scirpoides*)**, another living fossil. The genus *Equisetum* is even older than *Ginkgo*, dating back to the Devonian period ~400 mya. During the Carboniferous period some horsetail relatives were 65 feet tall, but they became extinct. Today horsetails are widespread throughout the world, except for Australasia and Antarctica. Some are invasive and difficult to manage. Gardeners consider them to be nuisance weeds, beautiful though they are.

This is the end of the tour. We hope you enjoyed your trip into the geologic past! To return to the garden entrance go back towards the path beside the lake and over the wooden bridge.

GEOLOGIC TIME PERIODS - not to scale -	MILLIONS OF YEARS AGO (mya)	ORGANISMS:
Quaternary		
-----	1.6	Humans (□4 mya)
Tertiary		Magnolia, Cedrus, Nuphar, Veronica, Gunnera
-----	66	Equisetum (□65mya)
Cretaceous		Nothofagus (□80 mya),
-----	138	Gunnera (□95 mya)
		First flowering plants
Jurassic		Taxodium (Bald Cypress), Monkey puzzle tree
-----	205	Ginkgo biloba (□200 mya, living fossil)
Triassic		First dinosaurs (□230 mya)
-----	240	
Permian		Sciadopitys (□250 mya)
-----	290	First conifers
Carboniferous		
-----	360	First ferns
Devonian		
-----	410	Early horsetails (□400 mya) (Coelacanth fishes □390 mya - living fossils)
Silurian		
-----	435	
Ordovician		First land plants (□470 mya) - mosses, liverworts
-----	500	
Cambrian		First marine animals - e.g. sponges, earliest fishes
-----	545	
Pre-Cambrian		
		First fungi (□1300 mya)
		Cyanobacteria - among first living things (□3400 mya) - photosynthesizers and nitrogen fixers
-----	3800	
Hadean		
Formation of earth	-----	4600