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Montréal Botanical Garden Arboretum walking trails

Get to know the tree

It will soon be 40 years that the trees of the Montréal Botanical Garden collection took root in a place that did not always attract people. First, it was a quarry exploited for its limestone, then a huge hole filled with waste, and finally a vast empty space. Slowly but surely, the trees found their place and the collections took shape. The time and continuous work of horticulturists and botanists took care of the rest.

Montréalers now enjoy an Arboretum worthy of this name, where there are close to 900 different tree species to discover! Imagine: A natural forest in Southern Québec has about fifteen…

This richness is now highlighted by an amazing walking trail. Along the trails are impressive steel and wood structures whose shapes evoke an aspect of the tree's life: stairs going up and down like sap; a South-facing chair in full sunlight, like leaves at work; two walls that open like seeds taking root and where a large tree grows; a coat surrounding the tree and protecting it like bark. Here and there, at the heart of each collection, a steel structure consisting of two steel legs held together by an interpretive panel seems to move. They are used to present a specific type of tree—pines, maples, oaks—with illustrations and short texts.

Visitors can take in this unique space at their own pace. They will meet exceptional living beings whose calm, determined, quiet and indispensable presence has been enriching our planet Earth for 380 million years.

Andrée Hallé
June 7, 2013

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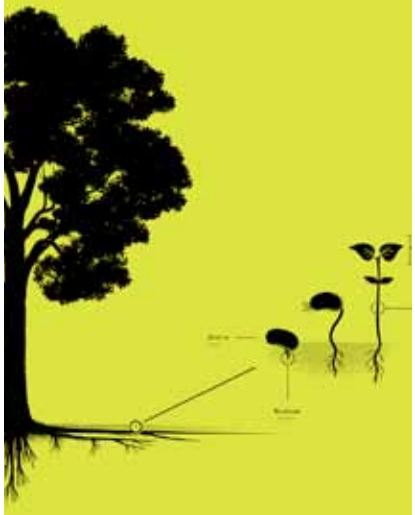
Trees as living beings

Arboretum interpretation trail at the Montréal Botanical Garden

The best time to plant a tree was twenty years ago. The second best time is now.

Chinese proverb

Honey-locust collection



GERMINATING

It all starts with a seed – dropped in a spot where the future tree will always remain, no matter how hostile or hospitable that site may be. The seed has no choice. All it can do is wait. The embryo inside will remain in suspended animation, safe and dry within its envelope, until conditions are just right. Most seeds are able to wait like this for a long, long time.

The seeds of most deciduous trees are contained in a fruit: an acorn, an apple or a key, for instance. But the seeds of conifers are completely exposed.

The seed contains all the nutrients the plant needs to get started. If conditions – water, oxygen and temperature – are right, the radicle will appear and extend down into the soil. Next the stem will form, along with the first leaves. From that point on, the leaves and roots will be responsible for the plant's vital functions.

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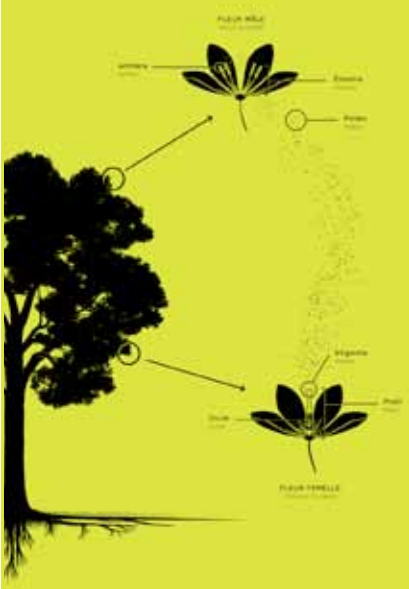
I want to do with you what spring does with the cherry trees.

Pablo Neruda, 1924

Honey-locust collection



REPRODUCING

It takes two sexual partners to start a new life. Animals and humans don't have too much trouble finding each other – usually, that is! Trees, on the other hand, can't move and may actually be standing very far apart. They have to rely on other things that move, like the wind and animals, to transfer the pollen produced by male flowers to female flowers. The wind carries small seeds, which are very light and produced in huge quantities because so many of them will never reach their destination. Animals do a more accurate job of transferring pollen, but sometimes have to be rewarded with nectar.

Tree sexuality is pretty complicated. While conifers always bear both male and female cones on the same tree, deciduous trees come in every combination imaginable!

Dioecious species (meaning "two houses"):
male and female flowers on different trees (willow, poplar, ash)

Monoecious species (meaning "one house"):

- bisexual flowers on the same tree (serviceberry, apple, cherry, plum, elm)
- unisexual flowers on the same tree (oak, walnut, hickory, linden, birch, hackberry, beech)

A single maple or locust tree can have three different types of flowers!

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A tree's future lies in its roots.

Christophe Drénou

Taking root is something that all plants do. Although you might think it pretty obvious, the consequences of this behaviour are enormous! It means that the plant is stuck in one place and must have everything it needs to survive within reach: food, shelter and even a sexual partner.

Drawing a tree is easy. But could you hazard a guess as to what its roots look like? While it's difficult to imagine their shape or extent, we do know what their role is: they anchor the tree to the ground, store nutrients and carry water and minerals.

- The main roots – including the taproot – don't go very deep into the soil (only about 1.5 metres).
- The lateral roots are finer and extend in all directions in search of water and nutrients. They are found in the top 30 cm of soil and cover an area 2 to 3 times as wide as the crown.
- These fine roots associate with microscopic fungi to form mycorrhizae in a mutually dependent relationship. The fungi need the sugars produced by the tree's leaves and the tree needs the water and minerals extracted from the soil by the fungi.

Linden
collection

TAKING ROOT

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Poplar
collection

ABSORBING NUTRIENTS

Plants, algae and a few kinds of bacteria are entirely responsible for all the oxygen found on planet Earth.

Unlike animals, plants have dietary needs that are very easily satisfied – just water, a few dissolved minerals, sunlight and carbon dioxide. These ingredients are transformed into sugars in the leaves, and then directed to all the living parts of the tree. And yet, with just that simple diet, trees beat all growth records among living creatures. All of which means that the parts that capture these ingredients – the leaves and fine roots – have to be both very numerous and exceptionally effective.

Photosynthesis is the process by which water and carbon dioxide are turned into sugars in the presence of sunlight, a chemical reaction that releases oxygen. These sugars are then used by the plant in various ways:

- as a source of instant energy for respiration
- to produce plant tissues by turning into proteins, lipids or complex sugars and forming leaves, wood, flowers, etc.
- to store nutrients by turning into starch

Chemically speaking, respiration is the opposite of photosynthesis. This simple form of combustion uses sugars and oxygen and releases carbon dioxide, water and energy. This is the only function shared by plants and animals.

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General principles … are to the facts as the root and sap of a tree are to its leaves.

Samuel Taylor Coleridge

Maple
collection

CIRCULATING SAP

While it may not look as though anything is happening, a tree is very much alive. The sap is circulating in a system of two channels separated by the cambium, just a few millimetres under the bark. Within the cambium, toward the centre of the tree, the crude sap made of water and minerals is carried in the xylem from the roots all the way to the leaves. When the xylem is young, it forms the sapwood, the living part of the trunk. Between the cambium and the bark, a thin layer of cells called the phloem transports the elaborated sap, which is less abundant, from the leaves to the roots.

TRANSPIRATION

A tree may not have a heart to act as a pump, but it still manages to circulate tonnes of sap in an open circuit many metres high running between the soil, the tree and the air. How is that possible? There are a number of phenomena at work, but it is essentially transpiration through the leaves that causes the water to rise. This transpiration creates suction within the tree's cells. The strong cohesion of the water molecules maintains this tension as the water rises up the tree.

If this transpiration weren't regulated, though, the tree would become dehydrated and die. That's where the stomata – tiny openings on the leaves – come in, opening and closing to control gas exchanges between the tree and the air.

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Trees are poems
The Earth
Writes upon the sky

Khalil Gibran

Oak
collection

STANDING TALL

It's amazing that a tree many metres tall with relatively shallow "foundations" can remain standing in all kinds of weather. No manmade structure is capable of such a feat.

Can you feel the forces at work when you move around on the platform? A tree also reacts to outside movements and can sometimes resist them for centuries, come what may. What gives it such flexibility?

The centre of the trunk and branches contains dead wood, the duramen (or heartwood), the tree's real skeleton. This is the xylem, which dries up after conveying sap for a number of years. At that point, the cell walls thicken and become lignified and solid. Even so, the tree can actually survive without the duramen. Some trees that have been attacked by fungi are completely hollow, in fact. The sapwood, made up of xylem cells that still carry the sap, is strong enough to keep the tree standing.

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The act of planting a tree is, yes, a simple one. But rich. Rich in symbolism, rich in personal satisfaction, rich in the exercise of responsibility.

Michael Fisher, Sierra Club

A tree's growth is dictated primarily by its quest for sunlight. In a dense forest, a tree will grow tall to rise above its competitors, stretching its crown toward the sun. In an open site, its branches will remain low, its crown will spread and it will produce lots of leaves.

Trees continue to grow throughout their lives. Their height and diameter keep increasing, except in winter, when no water is available. In spring, a new growth ring starts to form as growth resumes. Some species may keep growing for hundreds if not thousands of years.

- The trunk and branches lengthen by means of the terminal buds, which contain cells that can divide.
- Growth in diameter comes from the cambium that produces wood cells, which grow inward (the xylem), and phloem cells, which grow outward. The phellogen, or cork cambium, produces phelloderm on the inside and cork on the outside to form the bark. A new layer is added to the entire tree every year.

Pine
collection

GROWING

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A very old tree is a collection of wounds, more or less serious, more or less deep, but ones it has always survived, for it is still standing.

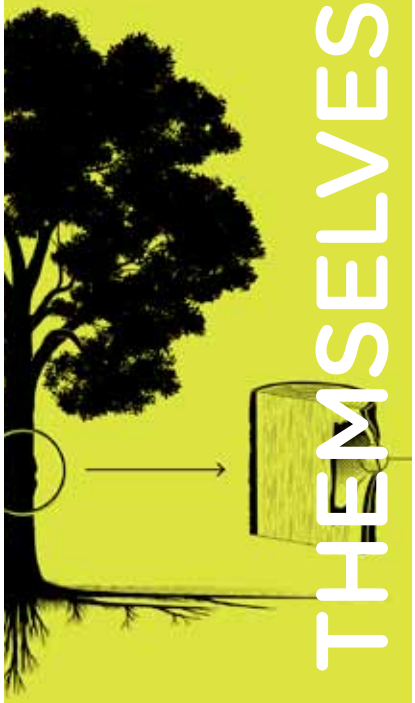
Robert Bourdu

Because they are immobile and contain edible tissues, trees need to protect themselves. Their bark is their first line of defence. It may be as thin as a sheet of paper or thick enough to withstand flames, but it forms an important physical barrier. As does the waxy coating on the leaves.

Chemical defences come into play when a tree is injured and the living tissues become vulnerable to the many insect pests and diseases present in its habitat. Depending on its species, a tree reacts by producing tannins, phenols, resin or latex to limit such outside attacks.

Once injured, a tree's tissues do not heal. Instead, the tree isolates them to prevent the disease from spreading. The tree responds with both physical (new layers of wood) and chemical changes, containing the affected parts in a process called compartmentalization.

Ginkgo
collection



PROTECTING THEMSELVES

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The tree is more than first a seed, then a stem,
then a living trunk, and then dead timber.
The tree is a slow, enduring force straining to win the sky.

Antoine de Saint-Exupéry

Death is probably the function that most distinguishes trees from all other life forms. They aren't genetically programmed to die at a certain age. Few trees ever survive into old age, but their end is usually brought about by forest fires, the cold or lumberjacks' axes.

If time is on their side, they die slowly, bit by bit. They lose their main branches, grow a little more slowly each year and become more vulnerable to disease. This process can last hundreds of years until one spring the sap fails to rise, because the tree is dead.

Some trees can live forever – no other living organism can say as much! Some genera, like spruces, have low branches that may form roots where they touch the ground. This process is called layering. The tree that grows from one of these branches will be genetically identical to the original plant.

Other tree genera form shoots from their roots. In fact, there are a few known instances of entire forests composed of a single individual divided into thousands of clones.

Spruce
collection

LIVING FOREVER?

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