

## 4. CASE STUDIES IN MEISE

We present here some activities designed by the guides themselves: most of them are passionate people, and their experiences with public or their lifelong studying processes allow them to develop new proposals for the garden. These proposals present 3 different sorts of activities that can be adapted for many Botanic Gardens.

The two first activities are «storytelling» style: they are collections of stories to save in the guide's backpack. A guide might use the stories now and then in his tours.

The first guide uses her experiences in capturing public's attention with the stories she tells about plants and animals relationships. She noticed that most of the public is mainly interested in animals. In order to drive their attention to plants, she uses stories which connect them with plants. (by Marianne De Cock)

The second guide gathered information for his own sake about plants related to technology. He then started to tell some stories to his public and noticed people's interest : he decided to become more and more documented on the subject. (by Frank van der Hertten)

The third activity is a workshop, designed by two guides working since a long time in the garden. Both are fond of medicinal plants, and both have studied herbalism. One has worked with plants a great part of her life, and the other used to teach biology in schools... (by Martine Van Den Broeck and Martine Van De Vijver)

The fourth activity is a new guided tour intended for visually impaired visitors. The guide developed the tour from her own researches with specialists working with this public. (by Danielle Benit)

### *About Plants and Critters*

*For everyone who enjoys nature these are some fascinating stories of the complex relationships that have evolved between animals, insects, and plants.*

#### **Target**

- Approach the concept of biodiversity as a «circle of life»
- Respect for all living things and the environment.
- Focus on adaptation of plants and animals, the inseparable and complex relationships they have with each other resulting in a fragile ecosystem: one living being cannot exist without the other.
- Focus on the importance of biodiversity and focus on how its loss affects nature.
- Stimulate the respect for nature on this planet and looking at it as a whole.
- Stimulate observation and conservation of plants.
- Stimulate awareness on the role played by plants in ecosystems.

#### **Aims of the stories**

This information is for all kind of public, children, students, and adults.

Guides can use the stories in almost any garden, providing some additional information to the public during the greenhouses/garden tour.

Everybody knows the story of bees and flowers and its importance for nature, but often they don't realize that there is much more to discover.

With these stories of interactions, you can show that plants are «smart» and that all living beings are connected to one another.

Generally, people are far more attracted to animals than plants. Using and telling these fascinating stories during guided tours will charm the participants and keep them focusing on plants and the habitats where they grow and survive, while telling them stories on strategies, adaptations, and propagation.

### How to use the stories

You can use these stories on special occasions like the International Day of Biodiversity, or it is possible to make a complete tour only telling the stories and showing the plants that are involved.

As indicated before, one, some or all stories can be used as complementary information during your usual garden/greenhouse tour.

### Materials

- The living plants in the garden/greenhouses related to the stories.
- Photos or drawings of animals, birds, amphibians, insects that have relations, or/and interactions with the plants involved in the stories.

### The stories

1. Acacias, ants and other companions in a Savannah story
2. Stapelias and their flies, a smelly relationship
3. Yuccas and their moths, united forever
4. Hummingbirds and flowers, about colors and beauty
5. Heliconia flowers and white tent bats, a rainforest alliance
6. Saguaro cactus, friend to many animals in the desert
7. The orchid and its bee, a perfumed story
8. The bromeliad and the poison-arrow frog, a canopy relationship
9. Passionflowers and butterflies, a special battle relationship
10. The fig and the wasp, a weird and wonderful relationship
11. The giant waterlily in a nocturnal relationship with beetles

### 1. WHISTLING ACACIA (*Acacia drepanolobium*) in a mutualistic relationship with ants and companions

This tree, native to East Africa, produces leaves containing tannins, which serve as a deterrent to herbivores. In addition, they have formed a mutualistic relationship with ant species. In exchange for shelter in the bulbous thorns and nectar secretions, the ants defend the tree against herbivores such as elephants and giraffes.

Ants make their nests in the thorns of the tree. The ant queen lays her eggs, and the workers take shelter in it. Herbivores like to feed on the acacia leaves.

Elephants abhor these ants because they bite their trunks and creep inside. So, when this happens, the elephants stop feeding on the leaves. Good for the tree!

Giraffes can close their nostrils while eating and so they can continue for a longer time, but eventually they quit eating too.

Other invaders that want to take advantage from this tree are monkeys. They don't harm the tree itself, but they want the ants! They have sharp teeth and can bite through the nests in the thorns so that they can eat the ants. In that way they can obtain 1/3 of their protein diet. They cannot continue feasting on the ants for a very long period because they too are molested and

bitten by the ants. In that way the ants survive and can continue to protect the tree. In their turn, the broken nests serve as nesting holes for a species of geckos, very small ones so they have many enemies. The female lays 2 eggs inside the nest, and in this way the babies, when they hatch, are protected by the thorns of the tree and the ants that defend it. As they are really very tiny, they mean no threat for the ants so the latter leave them be. As you can see this tree constitutes a whole universe of life and a real chain of biodiversity. The common name of the tree is derived from the observation that when wind blows over the bulbous thorns in which ants have made their entry/exit holes they create a whistling noise.

## 2. STAPELIA in a commensalistic relationship with flies

Stapelias (40 species) are succulents that grow in southern Africa.

In their natural habitat, there are few pollinating insects such as bees and butterflies. So these plants, instead of investing in flowers abundant with nectar, produce «carrion» hairy flowers that generate a smell of rotten flesh attracting flies.

The hairs on the petals give the fly the impression it is a dead animal and the red, yellow striped colors make them look like meat. Therefore, they are irresistible to flies. They land on the flower in search of food and to lay their eggs on it. As they do so the flower's pollen is dispersed on their bodies and flown to other flowers, thereby ensuring the formation of seeds. Unfortunately, the maggots that hatch from the eggs laid on the flower will die from starvation as they cannot find any meat to eat.

Commensalism : good for the flower, no benefit for the fly but doesn't bother it either

## 3. YUCCA AN THEIR MOTHS... a mutualistic relationship

Yuccas are found in arid and desert regions and have an old and intimate relationship with moths.

These specific, light-colored moths are genetically programmed for the yucca's pollination. They stuff a little ball of pollen into the cup-shaped stigma of each flower.

The moth's larvae grow up in the flowers and feed exclusively on the seeds but only in a very small quantity, so it doesn't harm the plant.

This relation is mutual and beneficial to both partners and is vital for survival of both species. When yucca-moths are absent, yucca plants will not produce seeds, and without the plants the moths cannot survive.

## 4. HUMMINGBIRDS AND FLOWERS - mutualistic relationship

Flower attributes have adapted with hummingbirds in ways that not only benefit but also guarantee the survival of both. The birds seek out trumpet-shaped flowers (ex: salvia, columbine, penstemon, agave, cacti), often hanging pendant from stems and with large amounts of nectar but little scent. Reservoirs of nectar reside deep in the flower tube, inaccessible to bees and other insects but available to a hummingbird's long bill, like a lock to a key.

In exchange for nectar, hummingbirds perform important pollination services for plants. When a hummingbird dips into a flower, pollen collects on his head, throat, bill, and stomach. On a visit to another flower of the same species, the bird deposits that pollen onto the female part of the flower, providing material for possible fertilization of the plant. Because they fly long distances, their pollination services also foster gene exchange between plants. Some hummingbirds follow “nectar corridors” where they find food to keep them fueled.

The flowers hummingbirds feed on are frequently red in color. Red colors have advantages: it stands out against a background and it is a heat-absorbing color, the nectar is warmed and is more available to the birds. Bees don't see red, eliminating them as competitors for nectar. However, hummingbirds do feed on other colored flowers too, because what they are really after is

abundant nectar so they will return to that resource no matter the color of the flower that offers it. Insects, especially hummingbird-moths (sphinx), hovers in front of flowers as hummingbirds do. But in other ways they are different. The moths are drawn to pale or white flowers as *Brugmansia* and evening primrose (*Oenothera*) that are sweetly scented by night. Moths feed mostly at night so they are no competitors for nectar.

#### Hummingbirds:

- attracted by abundance of nectar
- the vivid color of the flowers.
- they feed during the day

#### Moths:

- attracted by sweet smell of flowers
- visiting pale, white colored flowers
- feeding at night

### **5. WHITE TENT BATS AND HELICONIA FLOWERS: a rainforest alliance in a commensalistic way (good for me, doesn't bother you!)**

White tent bats are small bats with white fluffy coats and bright yellow ears and noses. They live in rainforests that have *Heliconia* plants. They make daytime shelters for themselves underneath their leaves. With their sharp teeth, they gnaw along the length of the leaf on either side of the midrib and force the leaf to collapse into upside-down V shaped "tents". Small groups of individuals snuggle together to help conserve body heat. The leaf tent helps them to protect from rain, sun, and predators while they are sleeping. When the sunlight shines through the leaves, the green reflection on their white coats makes them invisible.

The stems of *Heliconia* plants are not strong, so any predator brushing along the leaf causes the bats' tent to shake and alerts them to danger so they can quickly fly away.

Each group has more than one leaf tent prepared in its territory. If disturbed at one, all the members of the group fly away to another.

Heliconias are almost exclusively pollinated by hummingbirds (bright colors!)

However, there is a heliconia species which flowers open only at night therefore it is pollinated by bats. In warm regions, bats are important pollinators of plants and trees. Flowers that are pollinated by bats have usually light colors (*Brugmansia*) so they lighten up in the dark and can be spotted. They often have strong scents and are sturdy because when feeding the bats move a lot.

### **6. SAGUARO CACTUS, a friend to many animals in the desert (mutualism)**

Deserts are dry, arid, and hot places. Animals and plants rely on each other for food, water, shelter and protection from the sun.

Woodpeckers depend for survival on the saguaro. It picks holes in the saguaro's body and makes its nest in it. The woodpecker benefits from the cactus by making its home inside the cacti's thick walls which insulate the bird's nest from the hot sun. It feeds on the insects and parasites that could carry and transmit harmful diseases to the cactus. Spreading the pollen from the plant's blossom helps to pollinate other cacti.

Other animals benefit also from the nest holes when abandoned by the woodpeckers as big trees are scarce in the desert. Small owls, small bird species and even squirrels use these nests. Many other animals are drawn to saguaro flowers for nectar including bats, honeybee and various native bees, sphinx moths, doves, hummingbirds.

Birds and bats plunge their heads deeply into the blossoms when foraging for nectar. Thickly

dusted with pollen on their head and shoulders, they then visit other flowers on neighboring plants, depositing some of the pollen and picking up more.  
Bees pollinate many blossoms as well.

### **7. THE ORCHID (*Mormodes*) AND ITS BEE (genus *Euglossa*) - mutualistic relationship**

When bees visit flowers they usually are gathering nectar. But these special bees visit flowers for a very different reason! Even Charles Darwin was puzzled by their behavior as he studied orchids intensively.

Only recently have researchers begun to understand what is actually happening here.

Orchids display an incredible variety in shapes and colors. Features that are common in all orchids are: the labellum as an enticing landing strip for insects, and the column that contains the reproductive organs. The pollen has a sticky pad that plays a role in insect pollination.

When landing on the labellum the bee causes an injection of the pollen which is fixed to its body and is thus transported to another flower or plant.

But why do these bees visit this orchid as it doesn't produce nectar? Darwin thought they were looking for food. Observing the bees you can see they use their front legs to scrub the orchid.

Their front legs appear to have tiny brushes. After scrubbing for a while, they take flight and hover in front of the flower scrubbing their hind legs together. Bees normally do this to

transport the collected pollen into baskets on their hind legs. But these bees do not collect pollen and they are exclusively males! Actually, they are collecting a fragrance of the orchid.

Why do they do that? They serve as perfume factories creating a pheromone that is attractive to female bees, luring them close to the males so that mating can happen.

Mission completed! The bees transport the pollen for the orchid and reproduction of the bees is guaranteed!

### **8. THE POISON-ARROW FROG AND THE BROMELIAD - mutualistic relationship**

Bromeliads can be found at altitudes from sea level to 4200m and from rainforests to deserts. Halves of the species are epiphytes, and some terrestrial (pineapple!)

A wide variety of animals takes advantage of the pools of water trapped by bromeliads. In a large bromeliad it can be up to 50 liters! This water is for the use of the bromeliad, because as an epiphyte it has no roots in the soil, but it is used by many other animals as well. Many of these species are only found on bromeliads. A good example is the unusual life cycle of the poison arrow frog. They use the water pools for a nursery for their developing offspring. Most frogs lay their eggs in water, but this frog starts laying its eggs on land. The female deposits a few eggs in a cluster of jelly under a leaf or in a small burrow under the ground. When the tiny tadpoles hatch they wiggle onto their mother's back, so that she can carry them to a water-filled bromeliad that she has chosen for their home. The journey may take several days if she climbs high into the forest canopy. The poison-arrow frog drops the tadpoles into the rainwater in the bromeliad, each tadpole in a separate tiny pool that has collected between the leaves of the plant. The tadpoles feed on algae and mosquito larvae, but to be sure they have enough food, the female frog returns again and again to deposit a single unfertilized egg in the water for each tadpole. After 6-8 weeks, the tadpoles emerge as frogs and return to the forest floor. Therefore, water-storage in bromeliads forms important habitats for frogs and without these plants they would not be able to survive.

At first glance, it may seem that the bromeliad would not benefit from this relationship, but the waste products of the animals living in the water are a necessary source of nutrients for the epiphytes.

## 9. PASSIONFLOWERS AND HELICONIUS BUTTERFLIES - an extraordinary special battle relationship

Passionflowers have several different defenses to try to prevent butterflies laying their eggs on them. The eggs hatch out into voracious caterpillars which can severely damage or even kill the plants.

Here are some sophisticated defenses of the plant:

### - mimicry :

some passionflower species produce yellow egg-like structures on the leaves or stems. Any butterfly that sees eggs from another butterfly on a plant will not lay its own eggs as they would hatch after the ones already there and would have little food. More importantly *Heliconius* caterpillars are aggressively cannibalistic.

### - drooping growing tips :

a drooping growing tip may suggest to butterflies that the plant is in poor condition and is less appealing either as a snack or as a future food source for caterpillars.

### - changing leaf shapes

butterflies have very sharp eyesight and look for leaf shapes that match a suitable plant for egg laying. Several *Passiflora* plants change their leaf shape to try to throw them off the track.

### - nectar

many *Passiflora* plants produce extra floral nectaries. These are very attractive to ants, and the presence of them increases the caterpillar mortality.

### - poison

the vines produce a poisonous substance to deter leaf predation, but this particular caterpillar is capable of incorporating the poison. So the butterfly could still lay an egg on it but in that case the plant will drop the tendril like a lizard drops its tail, leaving the hatched caterpillar with very little to eat.

## 10. THE FIG AND THE WASP - a weird and wonderful symbiotic relationship!

Did you know that figs you buy in the supermarket have digested wasps in them!?

Figs are technically inverted flowers that store their pollen inside the fruits. In order to get their female fruits pollinated, the trees have developed a specialized relationship with a type of wasp which burrows inside figs to lay its eggs.

After hatching, the baby wasps mate, and the males, who are born sharp-toothed but wingless, chew holes through the fig's skin for winged females to escape. Parenting duties fulfilled, the males die.

The females, pregnant and loaded with pollen, fly to other fig trees and crawl into the fruits to lay their eggs, beginning the cycle anew.

The male fig is the only place where the female wasp can lay her eggs, and it releases a chemical sign when receptive for pollination.

But flying off in search of new male figs to lay her eggs in, some of the females land on female figs instead that don't have the special egg receptacle but they trick the females into the figs anyway.

It is a test of endurance for these tiny wasps to slide through the narrow passage (ostiole=very small opening in the crown) and while doing so, her wings are ripped off (egg-laying is a one-way mission) and while she is unsuccessful in laying her eggs, she successfully pollinates the female flower.

The now wingless wasp is trapped inside the ripening fruit, where it is digested by special enzymes within the fig.

According to fossil records this process has been going on unchanged for millions of years!

## 11. VICTORIA REGIA, QUEEN OF THE AMAZON IN A SPECIAL RELATION WITH SCARAB BEETLES

The genus name was given in honor of Queen Victoria of the UK. The giant waterlily is native to the Amazon river basin. Flowers are up to 40cm in diameter and pollinated by scarab beetles.

The nocturnal impressive flowers are a pure white on their first night when they open and emanate a strong pineapple like scent. This attracts the scarab beetle pollinator to the flower which is functionally female that evening and receptive to pollen brought by the beetle. The beetles will crawl inside the flower lapping the nectar it produces. As daybreak approaches, the flower begins to close, trapping the beetle inside. During the day the flower becomes functionally male, indicated by the maturation of the anthers and the release of pollen. The beetle becomes coated with this pollen, but it cannot fertilize the flower because it is now functionally male! The flower opens the second evening, having changed color from white to pink, which does not tempt the beetle to return. The beetle is released and seeks out another white, fragrant, receptive flower where it will deposit pollen to allow seed set.

## Plants & new technology

### Target

Getting people interested in plants, this is surely the main objective of any guided tour in a botanical garden. Of course, most people visiting a botanical garden are already interested somehow in plants, or find plants just beautiful. Otherwise, they wouldn't visit a botanical garden and pay for a guided tour, wouldn't they? The challenge then for any guide must be to maximize this positive attitude towards plants, and to upgrade it onto a more conscious level.

An interesting strategy for making a group of visitors more enthusiastic about plants is to focus on plants which draw the attention of scientists and industry in order to create new technologies. People are roughly familiar with plants being useful for food or beverage, clothes, building activities, and so on, but most of the time these merits are associated with old technology or less developed countries. What a surprise then to discover that plants are subject to brand-new and top-level scientific research and modern technology.

Plants may even offer an answer to the two major problems of our planet today: the shortage of petroleum and climate changes. This is a bonus people are glad to hear. So, plants are not only problematic and in need of protection (against human beings, climate change, etc.) but may also offer an adequate answer - if not *the* answer - to the apparently unsolvable problems of today. Is there a better thought to leave a botanical garden bearing this in mind?

### How I worked

Let's turn now to some of the plants I want to discuss. Most of these plants, together with their significance for scientists and industry, were brought to my attention by non-specialized magazines or newspapers. Sometimes the plants' comments were very short, nevertheless, their presence in those media demonstrates the virtual relevance for all of us. Anyhow, *I* was interested, so I gathered these articles and started to read more about it on Internet websites. Gradually, I began to integrate this knowledge in my guided tours and I noticed that my public was often astonished by the technological qualities of plants.

## How to use the stories

Of course, in a general guided tour it is not recommended to talk all the time about plants and new technology. Many other things are indeed to be said. But mentioning the issue now and then will not miss its effect. And, as you will realize, the link with the natural process of photosynthesis - the essence of all life on earth - is often easy to make.

### 1. DIESEL OIL FROM LIVING PLANTS

The need for alternative - read sustainable - sources of energy is well known. The stocks of petroleum are not inexhaustible and their combustion constitutes a major cause for the global warming (by replacing oxygen by carbon dioxide (CO<sub>2</sub>) in the atmosphere). Saving energy may be helpful on both areas, but probably cannot be the only answer. The replacement of petroleum (and nuclear energy) by bio-energy (i.e. energy based on living plants) is considered to be a necessary step to solve our problems of energy and climate change.

The seeds of the purging nut (*Jatropha curcas*) contain a high percentage of oil (47% of its weight). Given some supplementary treatments, the oil is perfectly suitable to make diesel engines run. This fuel does not affect the percentage of greenhouse gasses in the atmosphere. Indeed, the amount of CO<sub>2</sub> released during combustion, equals to the amount of CO<sub>2</sub> withdrawn from the air during the process of growth of the tree. In other words, the net CO<sub>2</sub>-production is zero.

Tests have already been undertaken by aircraft building companies with good result. Oil from the purging nut even seems to be better - technically spoken - than kerosene. It delivers more energy and resists better to low temperatures. In addition, *Jatropha* oil may be more profitable to aircraft companies than traditional oil.

The purging nut is growing mainly in Africa and South-America, but it can be cultivated on all continents. The cultivation is even feasible on infertile soils, for instance along railways. In other words, plants for food are not forced to retreat because of the rise of plants for energy. The cultivation of the purging nut is therefore less controversial than the cultivation of other plants meant for bio-energy, such as cabbage, sunflower, palm (for diesel-oil) or sugar beet, sugar cane, maize and grains (for bio-ethanol).

Other promising plants for bio-oil are the Ethiopian or Abyssinian mustard (*Brassica carinata*), which even may turn poor soils into fertile soils, camelina (*Camelina sativa*), which is cultivated in Japan on soils polluted by the Fukushima-accident, halophytes (which grow on salt soils), and *Euphorbia tirucalli* (which may grow on extremely dry soils).

However, most promising seems to be the cultivation of algae. The return of 1 hectare of algae is estimated between 20 000 and 80 000 liters of oil (compared to 6000 liters per hectare produced by *Brassica carinata*). But the production-cost of algae is still too high and the oil from algae still contains too much water.

### 2. FERTILIZATION OF THE OCEANS

Regarding algae, some scientists have a more daring plan in mind. Indeed, they want to cultivate algae just for the purpose of reducing CO<sub>2</sub> only. Cultivating algae means in their view: fertilizing the oceans with iron in order to produce algae (*Diatomeae*). The algae are expected to store massively CO<sub>2</sub>, and after dying, to take this CO<sub>2</sub> right to the bottom of the ocean where it will be kept for centuries.

Futuristic? Without any doubt, but scientific experiments are already ongoing. At least, this example demonstrates clearly the importance of plants today for both scientists and industrial innovators.

### 3. TRANSPORTATION BY PLANTS

Airplanes, ships and motor cars made of plants? Yes, it is possible. These means of transportation are to some extent made of composite, a strong and light material. Because of its lightness, composite material reduces the consumption of energy.

Composite material consists of fibers, which give it its strength. Thus far, these fibers are made of synthetic material (such as glass). But, research has shown that fibers can also be supplied by plants (such as bamboo).

Bamboo belongs to the family of the grasses and counts for 1200 species. It grows mainly in Asia and South-America. Bamboo is known for its solidity. The strength of the bamboo indeed comes from its fibers, which lie lengthwise and form nodes at regular distance that strengthen the plant even more.

Until now, research has demonstrated that bamboo fibers offer the same qualities (of strength and lightness) as synthetic fibers. Furthermore, the use of bamboo fibers is most energy-saving:

- to produce bamboo fibers five times less fossil energy is needed
- bamboo fibers are even lighter than synthetic fibers, which means less consumption of energy when incorporated in means of transportation (and thus less production of CO<sub>2</sub>)
- finally, fibers of bamboo can more easily be burned, composted, or recycled.

Bamboo is also very effective in producing oxygen and eliminating CO<sub>2</sub>. Compared with a new forest, bamboo produces 35% more oxygen and withdraws 4 times as much CO<sub>2</sub> from the atmosphere. And bamboo offers protection against the erosion of the soil and against drastic changes of the water level as well. Hopefully, bamboo fibers can also compete with synthetic fibers when it comes to the commercialization of it.

Some electronic devices such as computers and tablets are bamboo encased.

Other plants that provide for natural fibers are the coconut palm (*Cocos nucifera*), jute (*Corchorus*) and flax (*Linum usitatissimum*).

### 4. CAN WE DO IT WITHOUT THE RUBBER TREE ?

Synthetic rubber - i.e., rubber made of petroleum - is good enough for diving suits, garden hoses, tires for motor cars (to a certain extent), but not good enough for gloves used by dentists or in hospitals. Indeed, synthetic rubber can cause irritation. Rubber from the rubber tree is then the solution. Natural rubber offers also a greater density (useful for condoms) and a greater durability and safety (required when making tires for airplanes for example).

So yes, we cannot go without the rubber tree. The rubber tree (*Hevea brasiliensis*) is cultivated in Brazil (its natural habitat), Malaysia and in African countries. Unfortunately, a soil fungus has reduced the Brazilian rubber production to just 1 percent of the world production.

Malaysia now produces the bulk of the natural rubber (about 9 million tons per year), but it is feared that the soil fungus will be imported from Brazil. If this happens, a real shortage of natural rubber would occur (because no remedy for the disease has been found until now).

Luckily, scientists have found that other plants can produce rubber as well. Among others, scientists are interested in the Guayule (*Parthenium argentatum*), a shrub growing in the deserts of northern Mexico and of the southwest of the USA (Arizona, New Mexico, Texas). But this plant could also be cultivated in countries with a Mediterranean climate.

However, some production problems still need to be solved. The method for extracting the rubber out of the Guayule is labor-intensive and is also harmful for the environment.

But science does not stand still. Other plants containing rubber are dandelion and sunflower. These plants do not yet deliver the required quality and return.

## 5. PLANTS LIKE HEAVY METAL

Some plants can be used to clean soils, contaminated by metals (zinc, cadmium, lead, copper). By doing so, soils no longer need to be excavated and chemically cleaned. Examples of such “metallicolous plants” are: mustard plants, *Alyssum* and *Thlaspi*. Some willow trees also belong to this category of plants.

But soil remediation by plants (“phytoremediation”) is a very slow process. Therefore, scientists look for the possibility to speed up the cleaning process, and they also try to link the cleaning of soils to the production of energy and chemicals. If they succeed, plants may be the ideal soil cleaner.

## 6. PLANTS SHOW HOW TO DO IT

When raindrops are falling on the foliage of an Indian lotus (*Nelumbo nucifera*), they immediately roll off. This phenomenon is mainly due to the structure of the leaf surface. Indeed, the cells of the foliage exhibit bulges, which are standing very close to each other. In addition, the falling raindrops take a lot of dust and dirt with it. The foliage of the Indian lotus is therefore self-cleaning (i.e. the “lotus effect”). Scientists try to imitate this “lotus-effect” throughout industrial applications. What to think about self-cleaning windows, car paint, roof tiles, solar cells, or clothing?

Another example of industrial products imitating plants (a process called “bionics”) is Velcro. Velcro is inspired by the adhesive properties of the prickly heads (burrs) of the burdock plant (*Arctium*), a plant living in the wild in Europe and Asia. In the early 1940’s, after taking his dog for a walk one day, a Swiss man called George de Mestral became curious about the seeds of the burdock plant that had attached themselves to his clothes and to the dog’s fur. Under a microscope, he looked closely at the hook system that the seeds use to hitchhike on passing animals aiding seed dispersal, and he realized that the same approach could be used to join other things together. As a result, Velcro was invented (and our Swiss man probably became rich after he patented his invention in 1955). The name Velcro is a portmanteau word of the two French words “velours” and “crochet”, respectively velvet and hook.

## CONCLUSION

As the examples above demonstrate, the industrial world is also fascinated by plants. Sometimes plants are imitated; sometimes plants are used to create new products or techniques. In addition, plants are expected to save our planet, by keeping the CO<sub>2</sub>-balance under control and by delivering alternative energy.

Is this a surprise? Not really, finally plants are the source of all (other) life on earth, isn’t it?

## **Workshop: Medicinal plants as healing heritage**

### PURPOSE:

- Let know and recognize medicinal plants for using and processing them as support in diet and care.
- In addition, emphasis is placed on teamwork, respectful treatment of wild plants and insight that “weeds” do not really exist!

## CONTENTS:

The workshop consists of 2 parts, a tour and a workshop.

The workshop starts with a guided tour in the medicinal garden with a subsequent workshop in a nearby room, where some of the studied herbs can be processed.

The processed products can be taken home by the participants!

## GENERAL METHOD:

A guide takes a group of about 15 participants across the medicinal garden and afterwards accompanies the workshop. For the workshop, the participants are divided into small groups of about 3 people per group. Material is available for them to process the herbs!

## DURATION:

The whole is estimated for 2h30 where both parts of the workshop are evenly distributed.

## METHOD IN THE MEDICINAL GARDEN:

Giving a brief historical overview of the evolution of the use of herbs, beginning from the ancient Greek philosophers and their view of the medicine. Skip to the development of medicinal gardens and plant gardens, with emphasis on the comparative research of the 17<sup>th</sup> century. So further to contemporary phytotherapy.

The difference between homeopathy and phytotherapy is briefly explained with a concise overview of the main components. This theoretical introduction should not be longer than 10 minutes.

Afterwards there will be a meeting with about twenty species of medicinal herbs, each with information on their ingredients, uses, cultivation, and their value!

A certain number of plants gets more emphasis because they will be later on processed in the workshop!

### *Botanic gardens and medicinal gardens*

Medicinal gardens = Reference Collection and teaching materials for medical students.

Oldest: University of Pisa in Italy in 1543.

Collection of living medicinal plants as a starting point, for making a medicine from any form of the plant.

They went through mutations to evolve into Botanic Gardens, with the mission to establish, maintain, and manage scientifically documented collections, where conservation, research and education are central. Very special role in the conservation of biodiversity!

The scale of collection development is unique and always framed within scientific insights!

### *Theophrastus of Eresos (371-287 BC)*

One of the disciples of Aristotle,

A collection of 500 species of plants.

The plant kingdom divided into three groups: trees, shrubs, and herbs, considered as true layout until the Renaissance!



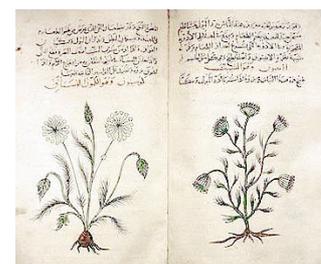
### *Dioscorides (40-90 AD)*

Greek doctor in Rome of Emperor Nero.

Collected herbs together with the Roman armies.

A comprehensive book, consisting of five parts, with 600 plants: description and medical use.

Still considered a standard of herbal medicine in the 16th century!



## ***Galenus (131–201 AD)***

City Doctor of Rome.

A pharmacy with more than 300 plant and 100 animal substances.  
The *simplicibus*, work with 540 plant, 180 animal, and 100 mineral medicines.

Dominated the medicine almost 1500 years.

Thinking: The human body consists of four bodily fluids or humors associated with a particular temperament: phlegm, blood, yellow bile and black bile.

Connected to the four elements: hot, cold, moist and dry



## ***Roman period and the Middle Ages***

Herbs were taboo because many superstitions. lots of empirical knowledge.

Idea of a «botanic garden» disappeared almost completely.

Monks were cultivating enclosed gardens, only the study on practical properties such as healing and nutrition.

Under Charlemagne: list of some 100 plants in "Royal Gardens" and abbey gardens with utility plants, bean, pea, chives, garlic, lettuce, sage, fruit trees...

Great importance to remove waste that means disease.

Explains the frequent use of bloodletting, purging and sweat cures!

Plants with the same properties restore balance.

## ***The Renaissance (16<sup>th</sup> century)***

The rebirth of the culture of antiquity.

Scientific research, observation, and experiment are the key to knowledge!

The botanical garden arises with research and collection!

## ***The medicinal botanical garden: 16<sup>th</sup> century***

Arise in connection with medical or pharmaceutical research.

Associated with the medical faculty of a university.

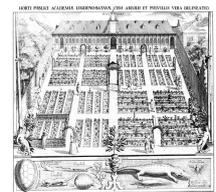
The oldest: Pisa, Firenze, Padua, and Leiden.

Simple in design: planted beds around a central point = A new look at the world!

Leiden 1587: Carolus Clusius (1526-1603) as Director.

Garden with over 1100 species in cultivation in 1600 with many exotics, half of the then known biodiversity!

Not only medicinal herbs: many exotics which became naturalized in Europe: tulips, hyacinths, imperial crowns, anemones, horse chestnut, potato, tomato, ginger, okra, sugarcane and elephant ear. The basic = botanical science!



## ***The botanical Curiosity: 16<sup>th</sup> - 17<sup>th</sup> century***

A broader approach to the plant kingdom

Explorers bring new plants to Europe.

Specialization: Plant systematics arise besides the medicinal properties and the cultivation!

Botanical Gardens arise where the rich people marvel at bizarre plants such as pineapples, cactus, dragon trees or the odd double coconut!

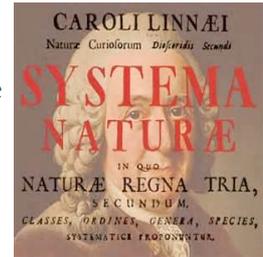


## ***The Economic botanical: 17<sup>th</sup> - 18<sup>th</sup> century***

A botanical world power. European colonies. Botanical Gardens play a major role in the distribution, introduction and cultivation of various tropical plants; spice plants, the rubber tree, the cotton plant, the coffee bush, the bush tea, or sugar cane.

### ***The classifying botanical: 18<sup>th</sup> - 19<sup>th</sup> century***

Descriptive botany with indispensable beautiful botanical illustrations. The Swede Carolus Linnaeus (1707-1778): The binomial nomenclature (1753): a two-part name. The still current terminology rather cumbersome descriptions of plant parts. Genius systematic insight into a fantastic classification schemes based on inheritable characteristics. He created order in the confusion which then prevailed in the nomenclature.



### ***The public botanical garden: 19<sup>th</sup> - 20<sup>th</sup> century botanical gardens are not parks!***

Botanical Gardens attract public to the «green», but there is a risk of loss of unique plant collections!

### ***The protective botanical garden: late 20<sup>th</sup> century***

A new role in the conservation, development of nature conservation actions and creation of seed and gene banks. One of the old core gets much value: study and preservation of biodiversity!

### ***The visible botanical garden: early 21<sup>st</sup> century***

Additional important task: give information about the plant kingdom, the essential usefulness, the threats, the beauty, the fascination of biodiversity!  
Spread the importance of maintaining as much as possible!

### **Medicinal plants in the Botanic Garden**

To accomplish the current basic tasks of conservation, research and education, a medicinal garden is essential. The global interest in natural and healthier lifestyle, gives these medicinal gardens more attention!

### **Some definitions :**

#### **Phytotherapy**

Derived from the Greek *phytos* (plant) and *therapeia* (care) = use of plants as medicine = herbal medicine. The forerunner of the modern medicine: use of effect of the raw material of the plant. It is a scientifically recognized treatment for complaints and diseases.

#### **Homeopathy**

Derived from the Greek *homoios* (similar) and *pathos* (suffering or disease).

Similarity Principle or *similia similibus curentur*: a substance that can induce symptoms, is also able to cure the same symptoms; late 18<sup>th</sup> century.

Founder Samuel Hahnemann (1755-1843), a German doctor and chemist.

Holistic vision: not just the symptom, but the patient as a whole.

Dilution: To deprive the harmfulness of toxics, substances are diluted.

Potentiate: by shaking the medicine become stronger.

Homeopathy uses plants, animals, and minerals substances in its preparation.

#### **Allopathy**

Derived from the Greek *allos* (opposite) and *pathos* (suffering or disease).

A term from Hahnemann for the then conventional medicine: "the doctrine of the four humors". Illness is an imbalance in these humors and healing means restoring the balance using the «opposite». *Ex: feverish (wet and hot) is cured by plants associated with dry and cold.* The modern conventional medicine doesn't recognize these concepts anymore.

## **The comparative research**

1700: from Galenic conceptions, diseases are described rather than the symptomatic treatment. Diseases are investigated and described, the functioning of the organs studied, the first use of instruments as a stethoscope, a sphygmomanometer and a laboratory.

The effect of herbs are investigated in laboratories, and the active working substances detected, isolated, and purified. Then, the substances are chemically improved or synthetically replicated (ex: aspirin).

## **Herbs in medicine and their effect**

Herbs: All plants contain active substances in any of their parts!

Ingredients = the main active components, ancillary materials, and bulking materials.

Main components: active substances.

Ancillary Substances: influencing the active main components; strengthen, weaken, or modify. Bitter substances, tannins, essential oils, glycosides, alkaloids, saponins, mucilage, coumarins, flavone derivatives, resinous substances...

Synergistic effect: the natural composition of all substances = the overall operation.

Important: the habitat of the plant, harvest, processing (drying, tincture, infusion, macerate...), dosage, duration of use...

## **PROCESS FOR THE WORKSHOP:**

*The 3 Botanic Gardens involved in this project are not responsible for consequences from the use of these recipes. They are given merely as an illustration of practices in Botanic Gardens.*

There are 5 different product applications offered. (These were chosen in function of the simplest possible application, low cost and applicability to the layman, other products such as creams, syrups, ointments, lotions needs additional equipment such as a heater.)

Depending on the time of the year (the availability of herbs) and the choice of the group, we choose 2 of the 5 applications for the workshop. All participants will process 2 products which may be taken home after the workshop.

These 5 product applications are: Massage, Bodyshrub, Tincture, Tooth Powder, and Hair Gel.

## **Tincture of yarrow - celandine**

### **Ingredients:**

1l alcohol vodka 40°

herbs 20 g yarrow (dried)

200g celandine (fresh)

### **Preparation:**

Fill a jar with celandine or yarrow and pour the vodka 40° until everything is submerged.

Close the jar and let macerate 3 weeks to one month away from the sunlight at room temperature. Shake every day making sure that the plant material stays submerged. Filter the maceration through a muslin and store in dark bottles. Apply a label with name, ingredients, expiration date and application.

### **Use:**

Internal use 10 to 20 drops 3 times a day in a half glass of water.

external use directly onto the wart. Make sure you shield the healthy skin.

Tinctures work fast because they are quickly absorbed into the bloodstream.

### **Product information:**

Vodka is a colorless and nearly tasteless alcohol of 40°

Yarrow (*Achillea millefolium*) improves digestion.

Celandine (*Chelidonium majus*) internally used by gallstones and liver disorders, externally for warts.

With dried herbs work with a ratio 1/5 (20g herbs on 100 ml alcohol) and with fresh herbs use ratio 1/2.

### **Soothing massage oil**

#### **Ingredients:**

90% almond oil (90 cc)

5% wheat germ oil (5 cc)

5% essential oil (5 cc)

1cc = 1 cubic cm = 1g

Appropriate soothing Essential Oils: Basil, Bergamot, Chamomile (expensive), Lavender all types, Marjoram, Hawthorn, Melissa, Tangerine, Orange-blossom Neroli (very expensive), Orange skin and flower, St John's wort, Valerian.

#### **Preparation:**

A massage oil is composed of a carrier oil, essential oil (E.O.) and an antioxidant product in order to prevent rancidity, for example wheat germ oil which contains a high amount of vitamin E.

The E.O. quantity varies from 1% to 5%. Add wheat germ oil 5% to 10% to keep the mixture for more than one month.

1 ml E.O. = slightly less than 1g and 1 ml = +/- 20 drops

Put a bit of base oil and antioxidant product in a bottle and add drops of E.O.

Shake long and thoroughly and add the rest of the oil and shake again.

Apply a label with name, ingredients, expiration date and application.

#### **Use:**

After a hot shower apply 20 to 30 drops of the soothing oil on the chest, neck, spine, soles, arms and legs, solar plexus and rub soft and gently in a clockwise way.

#### **Product information:**

Almond oil (*Prunus amygdalus*) is a high and stable fine oil with a pale yellow color and a nice smell. The oil is also rich in omega 6 fatty acids. While it contains unsaturated fatty acids this oil rancid after a while, so one can add an antioxidant like vitamin E. The oil has skin smoothing, moisturizing, and soothing properties. It can be used for baby care, for irritated, oily or dry skin, and is pleasant for massages.

Wheat germ oil (*Triticum aestivum*) has a high content of poly saturated fatty oil, linoleic and is rich in vitamin E. It's an orange-yellow oil pleasant in taste and smell. It is mixed with other oils to counteract rancidity. (5% to 10%).

## Bodyscrub with Himalaya-salt

### Ingredients:

155 g Himalaya-salt or dead sea-salt  
45 ml almond oil  
5 dr. E.O. Ylang Ylang  
5 dr. E.O. Rosemary  
2 dr. pigment for example E124 ponceau 4R (red dye)

### Preparation:

Mix the almond oil, pigment, and essential oil in a measuring cup. Put the Himalaya-salt (or dead sea-salt) in a jar. Mix the previous mixture with the salt. Apply a label with name, ingredients, expiration date and application.

### Use:

Use the bodyscrub after a hot shower or sauna when the pores are open. Rub the scrubsalt in with massaging, circular motions. Avoid face, armpits and genitals. Soak for 30 minutes and rinse with hot water and dry.

### Product information

Himalaya-salt: is a pure rock salt. The pink color results from the iron oxide. It contains 84 different minerals with a detoxifying effect.

Dead sea-salt: contains many minerals and is widely used as bath-salt. It stimulates the metabolism of the skin and has a detoxifying effect. It contains a high level of magnesium and a low level of sodium (sea-salt has a high level of sodium and a low level of magnesium while table-salt contains only sodium and very little or even no magnesium.)

Almond oil (*Prunus amygdalus*) is a high and stable oil which is very rich in vitamins A, B, E, and unsaturated fatty acids. The oil activates the metabolism and supports the cell renewal. It's suitable for all skin types but especially for a dry and mature skin it works as a moisturizer. It is mostly used in creams, lotions, herbal oils, and as a carrier for E.O. Because of it's high content of unsaturated fatty acids this oil rancid after a while.

E124 ponceau 4R is a red synthetic azo dye. Azo dyes are not allergenic and do not cause allergic reactions. But they may cause side effects to asthma sufferers and may enhance reactions in people who are intolerant to salicylates.

E.O. ylang ylang (*Cananga odorata*) is an incentive to massage.

E.O. rosemary (*Rosmarinus officinalis*) stimulates the blood circulation in the skin.



## Alcohol-free and translucent hair gel

### Ingredients:

100 ml mineral or demineralized water  
4 dr. heliozint  
15dr. LV41 dissolution enhancer  
1,5 g xanthan gel former  
5 dr. E.O. rosemary  
eventual 2 dr. pigment

### Preparation:

Bring water, heliozint, dissolution enhancer and E.O. in a recipient together. You can warm up the dissolution enhancer so it becomes easier to handle. Than add the xanthan and shake well or stir for a while. After 1 hour to 1.30 hours the gel will reach his firmness.

**Use:**

Use to reinforce the hair-dress.

**Product information:**

Heliozimt is a compound of heliotropine, a natural substance with a chemical compound, hydrozimalcohol. Use 2 drops per 10 g. This product extends the storage time to 2 month and replaces parabens.

LV41 is an emulsifier which ensures the essential oil to dissolve in water.

Xanthan E415 is a natural thickener derived from fermentation of glucose or sucrose by a bacterium the *Xanthomonas campestris* under controlled conditions whereby the quality is more efficient than Arabic gum. Xanthan gum is frequently used in food as a tickening agent and as a stabilizer in cosmetic products. Xanthan dissolves very slowly in water and may not be heated above 40°C else it loses its thickening ability. Already 1% gives a high viscosity to the compound.

E.O. rosemary (*Rosmarinus officinalis*): ct cineol, ct camphor, ct verbenon (ct = chemotype) stimulates the scalp and hair growth, cleans the scalp, removes dandruff, and makes the hair soft and shiny. With dark hair one can use the E.O. of sage as well, to conceal graying hair.

### **Tooth powder with sage and sea-salt**

**Ingredients:**

350 g sea-salt

100 g dried sage leaves

**Preparation:**

Crush the sea-salt and sage leaves with a mortar and poulder. Afterwards grind once more in a grinder to a fine powder. Put the powder in a shallow sterilized jar and close airtight. Apply a label with name, ingredients, expiration date and application.

**Use:**

Use as an ordinary toothpaste every morning and evening to remove dental plaque and cure gingivitis.

You can keep it for a long time if stored in an airtight packing. Use until sage has lost his smell.

**Product information:**

Sea-salt contains a high level of sodium and low level of magnesium

Sage (*Salvia officinalis*) has an astringent, anti-inflammatory and soothing effect. Can be applied to obtain whiter teeth, and to soothe bleeding gums and loose teeth.

Products	Container
Almond oil	Bottle 50 ml
Wheat germ oil	
E.O. Lavender ( <i>Lavendula angustifolium</i> )	
Himalaya-salt	Weck jar 200ml
Almond oil	
E.O. Ylang ylang ( <i>Canaga odorata</i> )	
E.O. Rosemary ( <i>Rosmarinus officinalis</i> )	
E124 ponceau 4R	
Vodka 40° 100ml	Jar 100ml
Dried yarrow	
Sea-salt	Shallow jar
Dried sage	
Demineralized water 100ml	Jar 100ml
Heliozimt	
LV	
Xanthan	
E.O. Rosemary ( <i>Rosmarinus officinalis</i> )	

## ***A tour in the Botanic Garden for visually impaired visitors***

**Kind of activity:** Existing tour adapted for blind and visually impaired people (B&VI)

**Duration:** 1h30 or 2h00

**Required guides:** 1 for a group of 8, max 9 B&VI and their accompanying person.

**Where:** In the Greenhouses

### **Aims of the tour:**

Give the same satisfaction and knowledge to the B&VI visitors as to the seeing people when they visit our garden. Try to give them the impression that they are really in another place or in another country with the help of feeling, handling, smelling, and listening.

### **The tour:**

The first meeting with the group : acquaintance, also with the diseases

Introduction to the Botanic Garden

The walk to the Greenhouses

Description of the greenhouses and an explanation about the building with a 3D model or relief drawings

Inside the greenhouses: Presentation of the biomes with a relief map

In each greenhouse, a first walk through the place with a description of the space and the building

Back in front, the same story as for the seeing people but kept short and in different sequences

Handling and smelling the chosen plant-parts to experience the climate adaptations

A full description about max 2 plants in each greenhouse

### **Material:**

A white stick of 1 meter, to show something and also to show a length

A relief world map, if possible with details; ex: a different one for each biome

A pair of scissors or shears (for Nepenthes or other plants)

A few products; ex: cotton, cork, an olive, a leave or two, to compare etc.

Wet tissues to use after plant handling

A model or relief drawing of the Greenhouses

A few folding chairs

A children trolley to keep everything

### **Guided tour:**

I have chosen to speak about the different climate areas. In our Botanic Garden we have several greenhouses, each of them presenting a biome, a climate area. Each climate gives some different smells and a different atmosphere. The plants have different adaptations that you can perfectly illustrate in a tour where feeling and smell are the guidelines. The proceedings remain the same as in every kind of tour.

The B&VI organizations recommend to work with maximum 8 B&VI in 1 group.

If possible, wait outside in front of the Garden to meet the group. Present you and take them to a safe place for a first contact.

Try to wear some clothes with bright colors; it helps visually impaired people to locate you easily.

Start the conversation in a very open and friendly manner. The first thing to know is what kind of disability they have: if they are blind or visually impaired – born blind or became blind – what kind of disability the visually impaired people have. Each different disability needs to be handled in a different way. Don't be afraid to talk with them and to ask about it in a friendly way. They know very well that the best way to enjoy their trip is to give you all the information, so you can help them to "see" the plants.

Try to create a bond, it is very important that they trust you. Be as friendly as possible. Many B&VI don't feel safe, certainly not new B&VI, when they come to new places. That's also the reason why in some places (we do it) there is a possibility to take some folding chairs with you. A lot of new B&VI feel safer when they can sit down (65% are elder people).

Of course, to start with, you have to explain where they are; the Botanical Garden (history – science institution), don't forget to explain the buildings and the surrounding too (be their eyes). Also, present the activity: but keep it short, sometimes it is better you don't do it at once, walk a little bit first and make another stop.

It is really very difficult for B&VI to follow a verbal description. Everything the guide tells them, they have to remember without sight-references, they have to put it all together to

reassemble the puzzle. They cannot look around to remember the start of the description and if they don't dare to ask (disturbing other people) they cannot follow anymore. It is sometimes very intensive and needs a lot of concentration. SO NEVER TALK MORE THAN 5 – 7 MINUTES AT ONCE

If there is more than one way to reach the greenhouses, take the safest way, even if it's a bit longer (think on: trees with low branches, muddy places, puddles, uneven ground, etc.).

The plants you want to show them have to be chosen very carefully because they are very limited. In our Garden, I show 4-5 greenhouses: 2 whole plants and some parts of a few other plants in each room are more than enough. Just before you start your tour you should have a look to know if the plants are still pleasant enough to be used with blind people. Never change your mind or add plants while you are busy, there is so much to do: it could disturb the tour and you will not have enough time anymore to finish the whole tour.

When you arrive in front of the greenhouses, make another stop for a few minutes, and explain again the surroundings and the greenhouses, how big, high, what kind of materials and glass they used, how heated. But again very short. You have to talk loudly, speak slowly, and don't use unnecessary words.

You can use a model of the greenhouses and/or the botanical garden. If it's too difficult to get one, a relief map could be used instead.

When you enter the first greenhouse, give the B&VI some time to experience their environment. Because they have failing sight, their other senses are much more developed than ours. Leave them time to feel, smell the climate (temperature, odors, humidity). Ask them after a few minutes what they think about it, where they think they are. Pay attention so that your visitors don't talk all at once.

Explain in the same way as for seeing people where they are, but with the help of a relief map. A walk through the room can help them to understand the size of the greenhouse, how it is organized. Don't talk while you are walking, but make one or two stops to explain how the plants are arranged, what kind of ground, how high they are, but don't speak about one particular plant at that moment, your visitors have first to make an idea about their environment, see the room through your eyes.

On the other side of the room finish the explanation about the greenhouse and take the way back to go where you have chosen the plants you want to explain. In this case (climate tour) I show the adaptations to different weather conditions: cold, rain, humidity, dryness, aridity, heat, etc.

With the help of their accompanying person, let them touch and smell some parts of the plants to feel the adaptations.

In some case, you may ask them before if they want to experience it and explain very well what exactly they are going to touch. Ex: the cactus: you have to choose one with big needles, and compare them with the euphorbia. Most of the B&VI will first approach it with the back of the hand. That is the way they approach something that frightens them a little bit. Never push people to touch something they don't like!

Never take a plant out of its environment before they experienced the plant in its environment. They first have to know where and how the plant lives. Ex: The water hyacinth: it is very interesting to show the whole plant, with the roots, but don't take it out of the water before they touched it in the water.

To explain a whole plant, example the olive tree, start with a full image: form, size, color, what it looks like. After that, you can focus on details; you can start with the roots, the stem (can be touched), the branches and leaves (can be touched too) the olives (if there are none bring some).

But, you have to always stay on your subject. First a general image, after that the details so they can really “see the tree” and only after that, have a small talk about the products! So never start an explanation about the oil while you explain the tree, otherwise, it would become too difficult to get a good image of the tree.

You can start again in the same way in the next greenhouse. Some food plants can be very interesting too, and can even be tasted, but never forget to show or speak about the whole plant and not only the fruit or other product.

It is always very interesting to speak about all this with the gardeners : when they must cut a part of a plant, you can ask them to cut it the same day or the day before your tour and leave the cut parts for you (they could be used to touch). Ex: the Nepenthes.

Every Botanic Garden and every guide have to find out with which plants they want to work. It will be adapted to every place. It is only the general concept I wanted to explain here.

## **Background information:**

### **Who are the blind and visually impaired visitors**

At first, you have to know that about 2% of the population, from the industrial countries, is blind or visually impaired, and there is not a typical person who is B&VI. There are many different groups with very different, sometimes conflicting, needs and interests that may depend on what point in life a person became blind or visually impaired and how complete the vision loss is.

Blind means having a maximal visual acuity of the better eye, after correction by refractive lenses, of 1/10 normal vision or less (20/200 or less on the Snellen test). Blindness encompasses a narrower population than legally blind or visually impaired.

Legally Blind is a term used if both eyes have a visual acuity of 20/200 or worse according to a Snellen chart examination. This term is primarily used for legal and official purposes. This term encompasses a broader population than blindness but a narrower population than visually impaired.

Visually Impaired means: having a visual acuity of less than 3/10 and (US: 20/40) vision field or less than 40°.

Severely Visual impaired is a term applied to the approximately  $\frac{3}{4}$  of those considered blind that have some useful vision; typically means a person cannot read newsprint.

Low vision is the level of best corrected visual acuity at which a person is said to have “low vision”. Measured levels of 20/60 or 20/70 are commonly used and correspond roughly to the more qualitative definition of inability to read regular newsprint

As the geriatric population grows, the number of people with low vision and other age-related disabilities will increase. The first thing you have to learn is the most common handicaps, to be able to help the person and use the most appropriate way to guide his sight: is the person blind or partially sighted? Is it since birth or did it happen later in life? If partially sighted, what is the nature of the disability? Peripheral, tunnel, light and dark, spots or marks, color etc. ?

I think it is very important that if you want to help, or guide the B&VI you first experience it too and that you learn the most important diseases. Because there are a lot of different problems and each different situation requires a different way to handle it.

I attended a workshop where I had to wear 4 different diving goggles that illustrated different diseases. I had to walk wearing the goggles, find some things, and places, read and write.

I found this workshop indispensable, thus I made the same diving goggles for myself because I think that one can forget very soon how these goggles make you experience your environment. For me, it is really necessary to know how the B&VI people «see» their environment and the plants you want to show them.

## **How to handle with B&VI: some suggestions**

Speak slowly and clearly, with different intonations: It needs a lot of concentration to follow a verbal, description. The intonations have to replace the face-language and eye-contact. Your voice has to captivate them. Otherwise, the explanation could become boring.

You always have to talk in a calm way, even if something happens, they don't see what happens and could get afraid for nothing

Never touch a B&VI without telling him first (to help him touching plants or to give him something etc.)

Do not use body language, blind people don't see it, but could disturb visual impaired people.

Do not speak about plants they can't touch (or very short) it doesn't bring them enough and there is not much time. It is much more interesting to have a whole idea about a plant.

Don't speak while you are walking, 1st reason, they have to pay attention where they walk, and 2nd reason, your voice is not so clear because you are not in front of them.

Pay only attention to the B&VI: of course, the accompanying persons have to enjoy it too (most of them are volunteers) but don't let them disturb you. They have to stay discreet.

Try to stay at a distance from other noisy groups, or ask them gently to be quieter. For a B&VI person, it is really very disturbing when there is much noise (I experienced it). Without sight, the noises are much louder.

## **How I worked on that tour**

There are a lot of different ways to enhance the B&VI visitors' experience in Botanic Gardens. As a guide, I preferred to work out a guided tour. I wanted to give the opportunity to enjoy nature and plants to a larger part of the population.

The B&VI organizations made a study about what the visitors preferred, and they have a preference for audio features supplemented by features stimulating the other senses of smell, touch, and taste: all these things can be perfectly incorporated in a guided tour in a Botanic Garden.

Guided tours offer the audio stimulation that seems to be desired. Guided tours promote interacting and learning. Being able to handle plants enhance the experience. The tour can be adjusted for a particular group or for a particular person's interest.

Our Botanic Garden in Meise is located out of town and is not so easy to reach: for B&VI visitors it is very difficult to visit us on their own, this is a supplementary reason for my choice.

When I started I didn't know anything about blind people; I had never met some and didn't know where to go. After searching a while I found a very good book in the library of our Botanic Garden "Art in the Dark", a Flemish book written by guides and organization actors. They talk about blind people and art & museums. Many museums worked out a tour for B&VI. I got a first idea about the kind of people, kind of disease, and how to act and handle. There were many addresses of organizations, blind people, guides who could help.

After learning about the different diseases, I started to learn (only in books in the beginning) the way to handle this public: how to act, how to talk, how to guide in normal life, how to guide a tour, what you can and can't do.

Later on, I attended workshops provided by Blind & Visually Impaired organizations. In Belgium, there are a lot of these organizations and all of them produce workshops, some you have to pay for (sometimes very expensive), and some are free.

## **Meeting blind people**

In the book I got, I found addresses from guides (some of them are blind) who work with B&VI people. One of them invited me on an “Info-afternoon” in a museum in Leuven. There, I met a very sweet blind person. It was the first time I really had some contact with a visually impaired person. One of the activities I followed with her (I was her accompaniment for the afternoon) was a guided tour given by two guides, one of them blind.

It was very interesting for me to notice that it is really difficult to follow a verbal description while wearing a blindfold.

The guides started with the explanation of a statue and after that of a painting, both with a lot of details. Very soon I didn't know what she was talking about anymore. So I now know what you can and can't do when you give a verbal description. I learned to use short sentences, to speak very clearly and pay attention to my voice. I also understood that you cannot speak for too long (not more than 5 to 7 min) and that you cannot speak while doing something else (for ex. handling plants). The words you choose are important, and because you cannot have eye-contact and they cannot see your face, the intonation is very important.