Exhibition for all senses

Never Alone: The Secrets of Symbiosis

The exhibition was created as a part of the Erasmus+ project Botanical Garden: COME IN!

Funded by the Erasmus+ Programme of the European Union

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Botanická zahrada Praha

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Photos

- the gardener illustrations can be found here: https://mega.nz/#!8MMTRCYA!qOCOyKVti0OLwQD6RsNZfqH258kMNqQcGRKvicX-FVI
- the photos are available here: https://mega.nz/#F!5Ukk0aBR!fPD05IxY8XbpOZ9jnwaJCA, except for a photo of an ant and a photo of *Kerivoula hardwickii*, which we had to buy

Sources/citations of the photos

- introductory banner with the garden motive: Hellen Ekvall
- lichens: Helen Ekvall

- root nodules: Ninjatacoshell, https://commons.wikimedia.org/wiki/File:Medicago_italica_root_nodules_2.JPG, CC-BY-SA-3.0
- alder trees: Petr Kinšt, https://commons.wikimedia.org/wiki/File:Ostroveck%C3%A1_ol%C5%A1ina_2015-06-16_1.jpg, CC-BY-SA-3.0
- alder root nodules: Cwmhiraeth, https://commons.wikimedia.org/wiki/File:Alder_nodules2.JPG, CC-BY-SA-3.0
- rice paddy: Klára Lorencová
- water buffalo on a rice paddy: Laurent Bélanger, https://commons.wikimedia.org/wiki/File:Plowing_paddy_field_with_a_water_buffalo.jpg, CC-BY-SA-4.0
- *Lodoicea maldivica* palm: Ji-Elle, https://commons.wikimedia.org/wiki/File:Lodoicea_maldivica-Jardin_botanique_de_Kandy_(3).jpg, CC-BY-SA-3.0
- *Boletus edulis*: Jörg Hempel, https://commons.wikimedia.org/wiki/File:Boletus_edulis_LC0371.jpg, CC-BY-SA-3.0-DE
- *Santalum album*: Saga70, https://commons.wikimedia.org/wiki/File:Santalum_album1.jpg, CC-BY-SA-4.0
- *Viscum album*: Schnobby, https://commons.wikimedia.org/wiki/File:Mistletoe_with_berries.jpg, CC-BY-SA-3.0
- cemetery at Malá strana (Prague) with ivy: Petr Horáček
- fig tree – detail of a leaf: 4028mdk09, https://commons.wikimedia.org/wiki/File:Ficus_carica_mit_Fruchtansatz.JPG, CC-BY-SA-3.0
- main banner with the rainforest motif: Romana Rybková, Vlastik Rybka
- mycotrophic orchid: Jan Ponert
- *Tristerix* in bloom: Nickrent, D.L., Costea, M., Barcelona, J.F., Pelser, P.B. & Nixon, K. (2006) PhytoImages. Available from: http://www.phytoimages.siu.edu
- broomrape: Björn S., https://commons.wikimedia.org/wiki/File:Broomrape_-_panoramio_(2).jpg, CC-BY-SA-3.0
- *Nepenthes* trap with a bat: https://chienclee.photoshelter.com
- tropical ant: http://www.myrmecos.net
- acacia: Romana Rybková

Labels and list of exhibits

Labels	Exhibits

Table 0

EN/EN BRAILLE: gardening tools	various gardening tools, pay attention to safety (the first table is specific, the visitors stop there for a longer time, listen to general instructions about moving in the exhibition space and the instroduction for the exhibition – it is a place to employ their hands)

Table 1 – Fungus + alga/cyanobacteria = lichen

EN/EN BRAILLE: various types of lichens	lichens on stones, various lichens that can be easily distinguished by touch
EN/EN BRAILLE: lichen microstructure model	model of the lichen microstructure – a model of a cross-section of a heteromeric thallus; the cortex and hyphae made from hemp fabric and wooden beads, the photobiont cells represented by larger green glass beads
EN/EN BRAILLE: lichen tea – to taste	the tea was bought in a pharmacy

Model of the lichen microstructure.

Table 2 and 3 – Plants and bacteria

EN/EN BRAILLE: various legume species	pour larger amount of seeds to bowls or cloth bags; e.g. beans, lentils and peas are easily distinguishable by touch
EN/EN BRAILLE: peanut – plant	(additional leguminous plants can be in the background without label)
EN/EN BRAILLE: alder root nodules	alder roots with tubers, in a strap bowl
EN/EN BRAILLE: rice and *Azolla* in water	the rice plant and the fern share the same pot
EN/EN BRAILLE: rice yields comparison	two containers with different amounts of rice (showing the crop when grown with and without *Azolla*)

The Azolla fern can be seen on the water surface.

Table 4 and 5 – Symbiosis of plants and fungi

EN: orchid seeds – tiny as specks of dust EN BRAILLE: orchid seeds	seeds of available orchid species on a Petri dish
EN: the biggest seed in the world – *Lodoicea* EN BRAILLE: biggest seed	seed or its model
EN: model of bolete in a wood EN BRAILLE: mushroom model	models of selected local mushrooms (e.g. Boletus edulis models placed on a tray with forest soil for the specific aroma, include oak leaves and acorns for additional tactile experience)

Seed of Lodoicea maldivica.

Table 6 and 7 – Partial parasites

EN/EN BRAILLE: cross-section of a branch with mistletoe	
EN: mistletoe seed attached to a branch EN BRAILLE: mistletoe seed on a branch	model of a branch with an attached seed (an enlarged model of a mistletoe seed attached to a branch – place model of the seed (e.g. from plastic) on a real branch, use suitable glue)
EN/EN BRAILLE: sandalwood EN/EN BRAILLE: sandalwood bracelet EN/EN BRAILLE: sandalwood perfume	things made from the wood of the hemiparasitic tree
EN: ivy branch with roots EN BRAILLE: ivy branch	an example of plant which is not a parasite, but is often thought to be

Table 8 and 9 – Who helps with pollination?

EN: fig syconium model EN BRAILLE: syconium model	model of a fig syconium (profesionally made, can be also made from ceramic clay)
EN: dried figs – to taste EN BRAILLE: dried figs	it is good to include toothpicks
EN: *Rafflesia* – the biggest flower in the world EN BRAILLE: biggest flower in the world	model of a *Rafflesia* flower (profesionally made, can be also made from paper mash with wire construction)
EN: bottle with *Rafflesia* scent – please be careful!	a flask with small piece of decaying meat

Table 10 – Sneaky orchids

EN/EN BRAILLE: mycotrophic orchid model EN/EN BRAILLE: epiphytic orchid	mycotrophic orchid model (can be substituted with aerial roots of some *Araceae* species, e.g. *Monstera deliciosa*)

Model of the mycotrophic orchid.

Table 11 – Parasitism has many faces

EN: model of parasitic *Tristerix* in a cactus
EN BRAILLE: model of parasite in a cactus

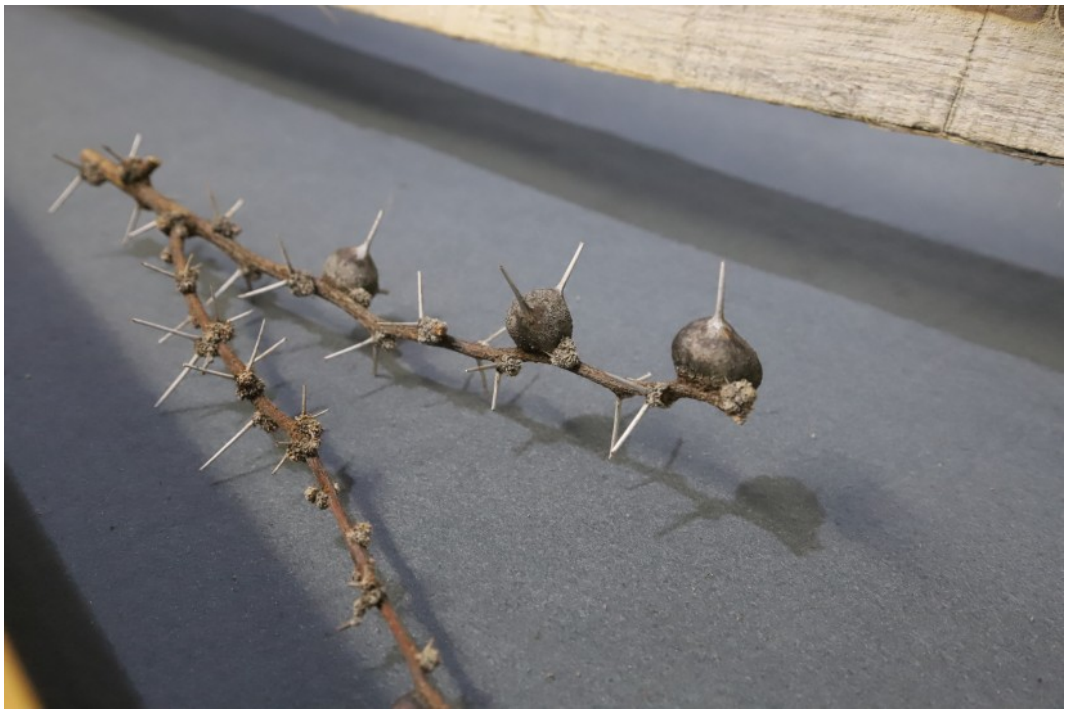
model of a cactus with parasite fruits (the cactus can be made from felt or other thick cloth pierced by thorns from a fine wire safe for the visitors; the fruiting *Tristerix* can be resembled by coated wires, the fruits being individual beads)

Table 12 – Bed and breakfast

EN/EN BRAILLE: model of pitcher and bat	model of *Nepenthes hemsleyana* trap (profesionally made, can be also made from ceramic clay) + bat plush toy

Table 13 – Plants and ants

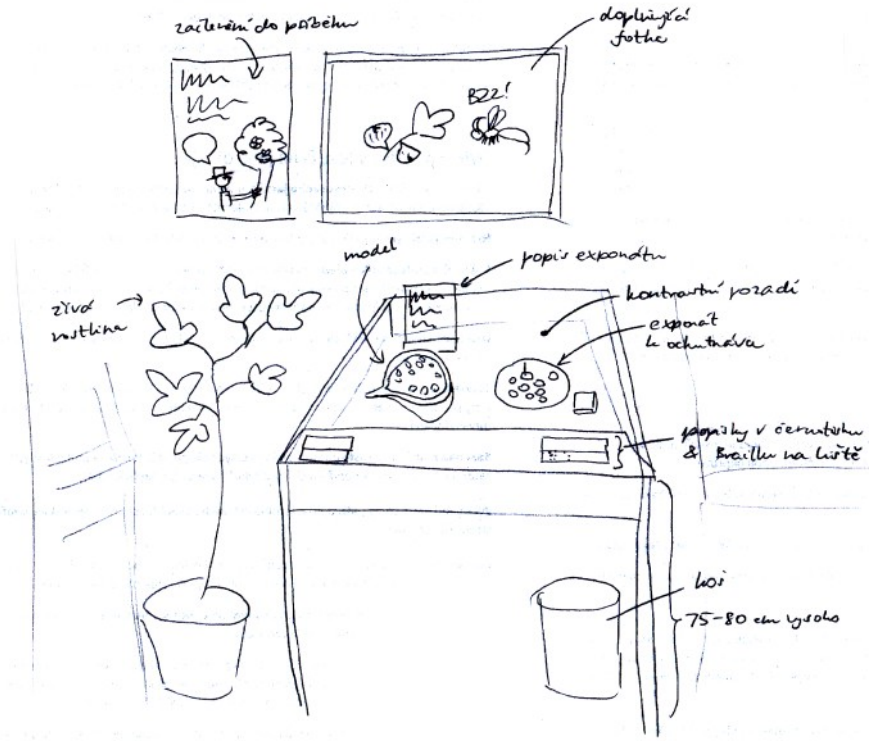
EN/EN BRAILLE: model of *Myrmecodia* with ants	*Myrmecodia* model with ants (profesionally made)
EN: hollow *Cecropia* branch EN BRAILLE: *Cecropia* branch	hollow branch of *Cecropia*
EN: acacia twig with thorns – please be careful! EN BRAILLE: *Acacia* branch – be careful!	ideally a species having visible “shelters” for the ants



Acacia branch.

General info

- Several levels of information are part of the exhibition. There are large texts on the walls giving a general description of the table (including hand drawn pictures of a gardener with comic bubbles), photos, smaller stands with information about the exhibits and the exhibit labels.



- Tips for the exhibition:
  - A wheelchair must fit under the table.
  - Beware of falling exhibits while handling them.
  - We do not count the supplementary exhibits among the main thirty, they do not have Braille descriptions.
  - The audio guide is tied to the order of the exhibits.
  - Size of the font: 50–60 pt on the wall, 33 pt near exhibits, 26 pt on descriptions.
  - The visitors must have free hands for viewing!
  - Care about visitor feedback.
  - Invitation card: use different materials, cutting, 3D elements.
  - Take pictures during the whole exhibition, document it!

Text in the comic bubbles (gardener)

The gardener drawing can be found in the photo folder (see above).

0 – Watering, hoeing, replanting – there is a lot of work in the garden, but I'm looking forward to the harvest.

1 – The lichen is actually like me! It also prepares the ground for other plants.

2/3 – Without fertilizing my crop I'd get less harvest. Nature has its own way of doing this.

4/5 – I will meet you behind the oak!

6/7 – It looks beautiful, but the tree probably doesn't like it much.

8/9 – If bees did not pollinate, we would hardly have anything to harvest…

10 – Such a beautiful orchid. So odd roots! What does this plant need to survive?

11 – I try so hard and then someone comes and exploits my work…

12 – You help me with the harvest and I will give you bed and breakfast.

13 – So even you are gardeners!

Exhibit descriptions

The texts in boxes are to be placed on the walls.

All the effort that you invest into your garden will return to you. Without your help, the plants in the bed, potted on the window sill, in the greenhouse or in the field would have little chance of surviving. However, when you water them, remove the weeds, hoe and fertilize them, they will thrive and will give you many things in return. Similar systems of exchange are found between different living organisms who are connected in various ways. Their close and long-time connection is called symbiosis, which we will talk about here.

Fungus + alga/cyanobacteria = lichen

Lichens can be found all over the world, even in the least imaginable places. They grow where many plants can't – on rocks, on tree bark, in −40 °C freezing temperatures or in areas where the temperature is almost 80 °C. The only thing that does not suit them is polluted air. They represent a well-known example of symbiosis. In most cases it is beneficial for both the alga/cyanobacteria and fungus. Such a relationship can be called mutualism.

Benefit for the alga/cyanobacteria – they live in a dry place, the fungus provides water

Benefit for the fungus – the alga/cyanobacteria supplies the fungus with sugars needed for life

Plants and bacteria

This relationship is advantageous for both the bacteria and plants. The plants get nitrogen fixed from the air. Thanks to the bacteria in their root nodules, they grow faster, have more extensive roots and thus get more water and nutrients from the soil. The bacteria get various organic substances in return.

The connection between the plant and bacteria is beneficial for both partners – just like in the case of lichens.

Peas, beans, lentils or soy are legumes rich in proteins. These plants live in symbiosis with so-called tuberous bacteria that fix nitrogen from the air. Nitrogen is an integral part of proteins.

When walking along streams or rivers, you may notice strange spherical formations on the roots of alders. These are tubers that host cyanobacteria which fix nitrogen from the air. Thanks to these, the alders can grow well on poor waterlogged land.

Rice is grown on paddy fields flooded by water. The water surface can be covered by a miniature fern of the genus Azolla which lives in symbiosis with nitrogen fixing cyanobacteria. As a result, the rice is naturally fertilised which produces a better crop. This way of green fertilizing was known to farmers 1500 years ago.

Symbiosis of plants and fungi

The majority of plants live in a close, mutually beneficial relationship with fungi. This relationship is called mycorrhiza. The fungus supplies the plant with water and minerals which the fungus obtains thanks to the large area of its mycelium. The plant provides the fungus with organic substances rich in energy that were created during photosynthesis.

Orchids create very small seeds that don't have enough nutrients for germinating. The seeds thus have to fall close to the right fungus that will give them what they need. Due to this, orchids are dependent on fungi at the start of life.

For comparison: the largest seeds in the world come from the *Lodoicea maldivica* palm. The palm certainly doesn't have to fear that the seed lacks nutrients for the young plant.

Partial parasites

Thanks to photosynthesis, green plants can create their own organic substances rich in energy. They also need water and minerals which are transported from the soil by their roots. However, there are also plants called hemiparasites. They get water and minerals from other plants. This type of symbiosis is beneficial for one of the participants but harmful to the other. In this case, however, the „abused" plants life is not at risk.

Birds take part in the dispersion of mistletoe. Its white, sticky fruits serve as food. For example, the bohemian waxwing or song thrush enjoy the fruit pulp and swallow it with the seeds. The seeds leave the animal with the faeces, which may fall on a branch where the young plant can come to life.

Even organisms as large as trees can be hemiparasitic. An example is the sandalwood tree, a plant from the tropics of south and Southeast Asia. Its wood is soft and has a pleasant scent. It is used for making jewellery, perfumes and decorative and religious objects.

And how about ivy? Common ivy is an evergreen vine found across Europe. To obtain more light, it climbs up to 30 m high. It clings onto trees, rocks and walls with its aerial rootlets. It competes with other plants for nutrients, space and light. However, it is not a parasite.

Who helps with pollination?

A gust of wind and the air is full of yellow dust – this way the wind transfers pollen between plants. The pollen can also be transported by animals. In Europe they are usually different insects, in the tropics pollinators can be birds, small mammals and even reptiles or molluscs.

In most cases, pollination is beneficial for both the plant and the pollinator (thus we can call it mutualism). The plant can reproduce, the pollinator gets a sweet reward in the form of nectar or pollen. The way to pollination is however not always that simple...

The inflorescence of the common fig, syconium, have a very unusual structure and therefore need a specific pollinator. The flowers are enclosed in a fleshy stem and are accessible only through a small

opening. The plant can be pollinated only by so-called fig wasps who can squeeze through the opening.

Figs found on the market develop thanks to the fig wasp. The wasp with the pollen on its body enters the syconium, pollinates the flowers and dies there. When we enjoy the fig, we also consume the fig wasp. However, some cultivars of these plants do not need the wasp to create the figs.

When travelling through a rainforest, you can be surprised by the smell of rotting flesh. It may not be a dead animal. You are lucky, you have just encountered the largest flower in the world – rafflesia. The odour of its flower attracts pollinators – flies and beetles.

Rafflesia is a parasite. To survive, it needs a liana of genus *Tetrastigma*. When not in bloom, it virtually can't be found. On the other hand, its flowers are unmistakable and impressive.

Sneaky orchids

Many tropical plants and more than half of all tropical orchids grow as epiphytes. Epiphytes are attached to other plants without harming them – they are not parasitic. Orchids need just a handful of nutrients, which are transported with water from rain or fog. Among the epiphytic orchids there are even sneaky species that feed on fungi which parasitize the tree where the orchid lives.

Parasitism has many faces

Hemiparasitic plants like mistletoe or the sandalwood tree are green, they can photosynthesize on their own but receive water and minerals from their host.

When a plant fully exploits other plants and harms them, we can consider them true parasites. Parasitic plants are not green. Apart from water and nutrients they get organic compounds rich in energy from their host plant. Such plants can even be found in our environment, for example the common toothwort or broomrape.

Although the plant *Tristerix* is a parasite, some of its cells contain chlorophyll. *Tristerix* can only be found in Chile, where it lives inside a cactus called *Eulychnia*. The only part of the parasite that can be seen are the flowers and fruits when they emerge from the cactus.

Bed and breakfast

When plants and animals cooperate, they mutually provide each other with food or services. Plants offer animals nutritious pollen, nectar or tasty fruits, refuge, protection from predators or bad weather. In return, animals pollinate the plants, they spread their seeds, supply them with nutrients and protect them.

Plants and animals can live in symbiosis from time to time, or they can be so dependent on each other that one partner cannot live without the other.

The carnivorous monkey cup *Nepenthes hemsleyana* creates large and long traps. Inside them the humidity level and temperature is pleasant, making a perfect sleeping quarter for bats – *Kerivoula hardwickii*. The residing bats are even beneficial for the plant. The animals excrete inside the traps, so the plant receives nitrogen. It has been found that bat guano provides the plant with more than 30 % of the required nitrogen.

Plants and ants

On Earth, there are more than 13 000 species of ants. Not all of them build the typical anthills known from mild climate forests. More than 100 ant species have a closer relationship with plants by protecting the plants from herbivores, insects, fungi and plant rivals. The ants also aid the dispersion of seeds.

The ant's faeces provide the plant with nutrients. The plant protects the ants from predators, offers them shelter for undisturbed development of their eggs and larvae and even supplies them with food.

The plants of the genus *Myrmecodia* can be found from southeast Asia to Australia. They usually grow on tree trunks or rocks. Their stems are enlarged and look like a ball. In the stem, the ants can find shelter in the form of a maze of corridors. Just move in!

An example of close cooperation is the relationship between trees of the genus *Cecropia* and ants of the genus *Azteca*. Cecropias have straight, hollow trunks, which are divided inside. The ants bite through the divisions and thus create a kind of tower with many different rooms. The plant rewards the ants with small edible treats placed at the base of the leaf. The ants get a home and furiously protect the plant against herbivores, sometimes even destroying neighbouring plants.

Acacias live in symbiosis with tuberous bacteria that fix nitrogen from the air – like legumes. Their leaves contain a lot of proteins and are thus attractive to herbivores. An effective defence is cooperating with ants. Some acacia species from Central America have hollow thorns serving as a shelter for ants who protect the plant.

A similar principle of cooperation can be found in acacias from Africa. Their hollow thorns even softly whistle in the wind.

This year's exhibition was created thanks to "symbiosis" with colleagues from Gothenburg Botanical Garden Sweden, from Botanical Garden of the Adam Mickiewicz University in Poznań and from the Hungarian Association of Arboreta and Botanic Gardens. The project was funded by the Erasmus+ programme. We are happy to say that the cooperation was an example of universally beneficial symbiosis and that luckily there are no parasites on our team. Thank you!

Audio Guide

Dear visitors,

we would like to welcome you to the 22nd exhibition for all senses called Never Alone – Secrets of Symbiosis. This year's exhibition is a result of an international cooperation and is funded by the Erasmus+ programme. You will be guided by – who other than the gardener.

sounds – melody or song "Šel zahradník do zahrady…" fading out, transition to direct speech of the gardener

"Watering, hoeing, replanting – there is a lot of work in the garden, but I'm looking forward to the harvest."

melody of the song

There are various gardening tools in front of you. Do you recognise them and use them?

sounds from the garden – noises of the tools, watering from a hoe or can, buzzing bees, melody of the song…

All the effort that you invest into your garden will return to you. Without your help, the plants in the bed would have little chance of surviving. However, when you care for them, they will thrive and give you many things in return. Not only plants and people, but even other organisms on the Earth are connected in various ways. Their close and long-time connection is called symbiosis, which we will talk about here.

short melody of the song

All the exhibits are placed on tables around the edge of the room, the exhibition goes from left to right. Each item has a label in Braille and in latin. Each station is separated by the sound of a bell. When you hear the bell, press the STOP button and after viewing the exhibit press play again. In the introduction to each station there will be illustrative sounds or melodies. We hope that you enjoy the exhibition. Please proceed to the next table on the right.

bell

steps on dry lichens, walking on stones in nature, wind…

“The lichen is actually like me! It also prepares the ground for other plants.”

Lichens grow where many plants can’t – on rocks, on tree bark, in −40 °C freezing temperatures or in areas where the temperature is almost 80 °C.

And what exactly is a lichen? It is a partnership of a fungus and an alga or cyanobacteria. Lichens are well-known examples of symbiosis. The fungus gets sugars needed for life from the alga, the alga can live in a dry place thanks to the fungus.

On the left side of the table there are a few examples of lichens of different sizes and shapes. To the right of the lichens you can see a model of a microstructure of a lichen. The spheres represent the alga, the threads are the fungus.

On the right end of the table you will find tea from a lichen called iceland moss (3), ask the guide to give you a tasting sample. When you have finished viewing the table, step to the right.

bell

the melody again

atmospheric music in the background

“Without fertilizing my crop I’d get less harvest. Nature has its own way of doing this.”

…sounds of gardening work (fertilizing)

An example of natural “fertilizing” is the symbiosis between plants and tuberous bacteria, this relationship is beneficial for both partners. The plants get nitrogen fixed from the air thanks to the bacteria, so they grow faster. The bacteria get various substances in return.

on the left part of the table there are three bags with well-known legumes – can you recognize them? To the right of them there is a live legume/ bean? plant.

water splashing, rustling tree on the brooks bank

From gardens and fields we will move into the countryside. When walking along streams or rivers, you may notice strange spherical formations on the roots of alders. These are tubers that host cyanobacteria which fix nitrogen from the air. Thanks to these, the alders can grow well on poor

waterlogged land. On the right part of the table you can see dry tubers with root remains. After viewing all the exhibits, go to the next table on the right.

bell

squelching of mud, cow sounds (sounds on the paddy, asian melody)

Rice is grown on paddy fields flooded in water. The water surface can be covered by a miniature fern of the genus *Azolla* who lives in symbiosis with nitrogen fixing cyanobacteria. As a result, the rice produces a better crop. This relationship was known to farmers 1500 years ago. On the left part of the table there is a vessel with rice growing together with Azolla, to the right there are two glasses with different amounts of rice. Compare the crops - one has grown together with Azolla the other without. Then step to the next table on the right.

bell

sounds of forest, cracking branches, forest birds (woodpecker), insect noises; summer forest, mushroom hunting

“I search for porcini under oaks, orange birch boletes under birches, larch boletes under larches – I learnt this by foraging in the forest. But I didn’t know that almost all plants live in a close, mutually beneficial relationship with fungi.”

This relationship is called mycorrhiza. For example orchids have very small seeds that do not contain nutrients, they need a specific fungus to germinate. Thanks to the fungus, the seeds get the nutrients needed for growing. On the left part of the table there are small orchid seeds, you can compare them to the largest seed in the world from the palm *Lodoicea maldivica*. The seed can be found on the right handside of the table. See both exhibits.

sounds of the forest, cracking branches

On the right part of the table there is a model of a mushroom. Look at it and try to figure out which tree it can be found under. Then proceed to the next table.

bell

atmospheric music, Christmas sounds

“The mistletoe looks beautiful, but the tree probably doesn’t like it much.”

atmospheric music

On the left part of the table there is the well-known mistletoe. Mistletoe is a hemiparasite. Hemiparasitic plants are green, and thus can create organic substances rich in energy by themselves. However, they need to get water and minerals from the host plant. This type of symbiosis is beneficial for one of the participants but harmful to the other. In this case, however, the “abused” plants life is not at risk.

christmas music

It is not widely known how mistletoe reproduces. Birds eat the tasty, sticky berries. The seeds cannot be digested and pass through the bird’s gut. The seed may fall on a branch where the young plant can come to life. Next to the mistletoe you can see a model of a branch with an attached seed.

Southeast Asia music (India)

Even organisms as large as trees can be hemiparasitic. An example is the sandalwood tree, a plant from the tropics of south and Southeast Asia. Its wood has a pleasant scent. On the left part of the table you can smell not only the wood, but also a sandalwood perfume. The wood of the tree is soft and good for carving. To the right of the perfume there is a carved bracelet. When you are finished viewing the exhibits, go to the next table.

bell

short sounds of forest and other nature sounds

People sometimes think that ivy is a parasite. Is this true? To obtain more light, ivy clings onto trees, rocks and walls with its aerial rootlets. In front of you there is a branch covered in ivy, here you can see the rootlets. Ivy can climb up to 30 meters. It competes with other plants for nutrients, space and light. However, it is not really a parasite. You can proceed to the next table.

bell

insect noises, spring sounds, skylark…

"If bees and other insects did not pollinate plants, we would hardly have anything to harvest…"

wind blowing

A gust of wind and the air is full of yellow dust – this way the wind transfers pollen between plants. The pollen can also be transported by animals, which are usually different insects in Europe, in the tropics pollinators cannot only be insects but also birds, small mammals and even reptiles or molluscs.

In most cases, pollination is beneficial for both parties (thus we can call it mutualism). The plant can reproduce, the pollinator gets a reward in the form of nectar or pollen. The way to pollination is however not always that simple…

buzzing, sea, mediterranean melodies

The pollination of fig trees is very special. The inflorescence of the common fig, syconium, has a very unusual structure. The flowers are enclosed in a fleshy stem and are accessible only through a small opening. The plant can be pollinated only by so-called fig wasps who can squeeze through the opening. See the model of a syconium, taste a piece of fig and proceed to the next table.

bell

sounds of rainforest, flies, steps in the leaves

When travelling through a rainforest, you can be surprised by the smell of rotting flesh. It may not be a dead animal. You are lucky, you have just encountered the largest flower in the world – rafflesia. The odour of its flower attracts pollinators – flies and beetles. In the middle of the table there is a model of the flower. Feel free to inspect it. But the next exhibit – a jar with rotting meat – should be opened with great caution.

flies

Rafflesia is a parasite. To survive, it needs a liana of the genus *Tetrastigma*. When not in bloom, it virtually can't be found. After seeing both exhibits, step to the right.

bell

sounds of rainforest (wet, tropical), dripping water, sometimes a bird… fading out

“Such a beautiful orchid. So odd roots! What does this plant need to survive?”

Many tropical plants and more than half of all tropical orchids grow as epiphytes. Epiphytes are plants that attach to other plants without harming them – they are not parasitic. Epiphytes need just a handful of nutrients, which are transported with water from rain or fog.

Among the epiphytic orchids there are even sneaky species that feed on wood-decaying fungi which parasitize the tree where the orchid lives. In front of you there is a tree trunk with a model of such an orchid and an example of a living epiphytic orchid. Touch them carefully and step to the next table.

bell

sounds from the garden

“I try so hard and then someone comes and exploits my work…”

neutral music fading out

Such situations occur even in nature. We have already seen some hemiparasites – mistletoe or the tropical sandalwood. True parasites are plants that are not green, they cannot photosynthesize on their own. Apart from water and nutrients they get organic compounds rich in energy from their host plant. This way the host plant is harmed.

Such plants can even be found in our environment, for example the common toothwort or broomrape. An exotic parasite is *Tristerix*, a plant which grows only in Chile. It lives inside a cactus called *Eulychnia*. The only part of the parasite that can be seen are the flowers and fruits when they emerge from the cactus. In front of you there is a model of the cactus with fruits belonging to the parasite. Take a look and step to the next table on your right.

bell

agriculture works with people talking

“John, help me with the harvest and I will give you bed and breakfast.”

This kind of collaboration can also be found in nature. When plants and animals cooperate, they mutually provide each other with food or services. Plants offer animals nutritious pollen, nectar or tasty fruits, refuge or protection from predators or bad weather. In return, animals pollinate the plants, they spread their seeds, supply them with nutrients and protect them.

An interesting example is the symbiotic relationship of the carnivorous monkey cup *Nepenthes hemsleyana* and bats – *Kerivoula hardwickii*. In front of you there is a model of the nepenthes pitcher, next to it there is a soft bat toy. In nature, the pitchers of the plants are used as a sleeping quarter by the bats. Inside them the humidity level and temperature is pleasant. In exchange for refuge, the bat fertilizes the plant. Help the bat into into the pitcher! When you´ve succeeded, go on to the last table.

bell

a song about ants, sounds of the forest, woodpecker…

Did you know there are more than 13 000 species of ants on Earth? Not all of them build the typical anthills known from mild climate forests. Some of them live in a close relationship with plants. They protect the plants from herbivores, insects, fungi and plant rivals. The ant’s faeces and body remains provide the plant with nutrients. The plant protects the ants from predators, offers them shelter for undisturbed development of their eggs and larvae and even supplies them with food.

An example of such symbiosis is the plant genus *Myrmecodia*. The stems of the plants are enlarged to provide shelter for the ants. See the intricate maze of corridors. Just move in!

Another example of close cooperation is the relationship between trees of the genus *Cecropia* and ants of the genus Azteca. Cecropias have straight, hollow trunks, which are divided inside. The ants bite through the divisions and thus create a kind of tower inside with many different rooms. In the middle of the table you will find a hollow branch of *Cecropia*.

sounds of African savanna, wind whistling in the thorns

Leaves of acacias contain a lot of proteins and are thus attractive to herbivores. Some acacia species have hollow thorns serving as a shelter for ants who protect them. Their thorns have small openings and can softly whistle in the wind. On the right handside of the table there is an acacia branch. Touch it carefully.

wind whistling in the thorns

In exchange for a home, the ants furiously protect their plant against herbivores, sometimes even destroying neighbouring plants... like a gardener removing weeds.

garden sounds in the background

“So ants are really gardeners like me!”

bell

neutral music fading out

You viewed the last stop of this year’s exhibition. The exhibition was created thanks to “symbiosis” with colleagues from Gothenburg Botanical Garden Sweden, from Botanical Garden of the Adam Mickiewicz University in Poznań and from the Hungarian Association of Arboreta and Botanic Gardens. The project was funded by the Erasmus+ programme.

We hope that you enjoyed it. If you have some time, feel free to write your thoughts using the Braille typewriter or in the visitor’s book. Thank you for your visit and we are looking forward to see you again next time.

Riddles for social media

- Do you know which organism is created by a symbiosis of fungus and alga/cyanobacteria? Thanks to this cooperation, it can live even in very hostile places. It can release mineral substances from rocks and thus create environment for other plants. What is the name of this organism?
- This crop grown on paddies prospers when it is togehter with a small fern of the genus Azolla. Thanks to symbiosis with cyanobacteria, the fern fertilizes the crop with nitrogen fixed from air. What side dish is made from the crop?
- The orchid seeds are small and look like dust. On the other hand, this palm has the largest seed in the world that stores a lot of supplies. Where does it come from?
- Fragrant tropical wood which can be used for making various jewelry or perfumes. And also a plant which is hemiparasitic – it takes water and mineral substances from other plants. What is its name?

- The largest flower in the world that smells like rotting flesh and attracts flies. After pollination, it becomes a mash which is spread by animals across the rainforest. To which plant does the flower belong to?
- Parasitic *Tristerix* lives inside cacti. Only its fruits and flowers emerge from it. In which country could we find this parasite growing naturally?
- Some (tropical) plants give home to ants, which in return get them nutrients and protect them. How do we call plants that live in this close relationship with ants?
- The bat just found his bed. In which plant? Does it harm the plant or is it beneficial? Why?